CITY OF Grand Junction COLORADO

Purchasing Division

ADDENDUM NO. 1

DATE: **March 6, 2019**
FROM: **City of Grand Junction Purchasing Division**
TO: **All Offerors**
RE: **Raw Water Irrigation Supply and Waterline Replacement IFB-4611-19-DH**

Offerors responding to the above referenced solicitation are hereby instructed that the requirements have been clarified, modified, superseded and supplemented as to this date as hereinafter described.

Please make note of the following clarifications:

1. The Mandatory Pre-Bid Meeting has been updated/modified as follows:

   Mandatory Pre-Bid Meeting: Prospective bidders are required to attend a mandatory pre-bid meeting on March 12, 2019 at 11:00am. Meeting location shall be in the City Hall Auditorium, located at 250 N. 5th Street, Grand Junction, CO 81501. The purpose of this visit will be to inspect and to clarify the contents of this Invitation for Bids (IFB).

2. Q. Regarding the current referenced bid, wanted to ask if we can use Swagelining to replace the existing 24" pipeline. The new HDPE pipe would be a tight compression fit within the host pipe.

   A. This product will not be accepted for this project.

3. See attached updated Project Manual.

The original solicitation for the project noted above is amended as noted.

All other conditions of subject remain the same.

Respectfully,

Duane Hoff Jr., Senior Buyer
City of Grand Junction, Colorado

CONSULTING ENGINEERS

SET NO. _____

PROJECT MANUAL

BID SET

CITY OF GRAND JUNCTION

PARKS RAW WATER IRRIGATION SUPPLY

FEBRUARY 2019

PROJECT MANUAL

BID SET

CITY OF GRAND JUNCTION

PARKS RAW WATER IRRIGATION SUPPLY

JVA, Inc.
817 Colorado Ave, Suite 301
Glenwood Springs, CO 81601

JVA Job No. 2538.3c

February 2019

PROJECT MANUAL

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CITY OF GRAND JUNCTION
PARKS RAW WATER IRRIGATION SUPPLY

SECTION 01010

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C. Contractor use of site and premises

D. Work sequence

E. Easements and right-of-way

F. Protection of public and private property

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I. Lines and grades

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1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. This project consists of installing new potable and nonpotable waterlines from the City of Grand Junction Water treatment plant to the Las Colonias development project. The project is generally comprised of the following components:
   1. 24-inch, 16-inch, 12-inch and 10-inch PVC pipe
   2. Connection to Reservoir 3 and 4 at the water treatment plant
   3. Removal of solids from Reservoir 3 and 4
   4. Lining of Reservoir 3

B. Furnish and pay for all materials, equipment, supplies, appurtenances; provide all construction equipment and tools; and perform all necessary labor and supervision

C. Coordinate the progress of the Work including coordination between trades, subcontractors, suppliers, public utilities, and Owner to insure the progress of Work

D. It is the intent of this contract that Work proceed in the most expeditious manner possible

E. Construct the Work under contract indicated in the Bid Form

1.3 WORK BY OTHERS

A. City manned plant operating times:
   1. 6:00 am to 5:00 pm, Monday thru Sunday

1.4 CONTRACTOR USE OF SITE AND PREMISES

A. Contractor shall limit use of the premises for Work and will use the designated staging area for field offices, equipment, and material storage. Areas have been designated for contractor's use.

B. Coordinate use of premises under direction of Owner

C. Assume full responsibility for the protection and safekeeping of equipment and products stored on site under this Contract

D. Contractor may use only those areas indicated on the Drawings for storage and such additional areas as Engineer may designate

E. Contractor should plan for normal work days, Monday through Friday, within the hours of 7:00 am to 5:00 pm. Other work hours and days will be allowed by City and Engineer upon 48 hours written notice.

1.5 WORK SEQUENCE

A. Provide open access for Owner to property at all times during construction. Maintain minimum width clearance for access of City and Contractor personnel and emergency vehicles at all times

B. Existing water treatment plant is an operating treatment plant and must remain in operation during the contract period.

C. The Contractor shall develop its own sequence of work to minimize construction time, site disturbances and interruptions of existing plant operations. Testing and Startup schedule and sequence shall be thoroughly discussed and coordinated with Engineer and Owner. Sequences other than those specified will be considered by Engineer, provided they afford equivalent continuity of operations. A suggested general work sequence is outlined as follows:

   1. Install pipe to Reservoir 3
   2. Install Reservoir 3 liner
   3. Construct 24-inch potable waterline, test and connect to existing potable waterline
   4. Construct raw waterline including slip lining and bridge crossing.
   5. Clean up the site and return all disturbed areas to their present condition if required. This includes all grading, seeding and mulching as weather permits and during the first growing season.

6. Achieve Substantial Completion and commissioning of all improvements. Confirm they are fully functional.
7. Achieve Final Completion.

D. Power outages of up to 4 hours duration is allowed.
   1. Schedule each outage with Engineer and Owner 48 hours in advance
      a. Number of outages to be kept to a minimum

1.6 EASEMENTS AND RIGHT-OF-WAY

A. All of the Work will be performed on the City of Grand Junction's property.

B. Confine construction operations to the immediate vicinity of the location indicated on drawings and use due care in placing construction tools, equipment, excavated materials, and pipeline materials and supplies, so as to cause the least possible damage to property

C. On Private Property
   1. Do not enter for material delivery or occupy for any purpose with personnel, tools, equipment, construction materials, or excavated materials, any private property outside the designated construction easement without written permission of the owner.

1.7 PROTECTION OF PUBLIC AND PRIVATE PROPERTY

A. Protect, shore, brace, support, and maintain underground conduits, drains, and other underground construction uncovered or otherwise affected by construction operations

B. Contractor shall be responsible for all damage to streets, roads, highways, shoulders, street lighting and/or signage, embankments, culverts, location or character, which may be caused by transporting equipment, materials, or personnel to or from the Work or any part or site thereof, whether by him or his subcontractors

C. Make satisfactory and acceptable arrangements with the Owner of, or the agency or authority having jurisdiction over, any damaged property concerning its repair or replacement or payment of costs incurred in connection with the damage

1.8 MAINTENANCE OF TRAFFIC

A. Conduct Work to interfere as little as possible with City and public travel, whether vehicular or pedestrian
   1. Whenever it is necessary to cross, close, or obstruct private roads, driveways and walks, provide and maintain suitable and safe detours, or other temporary expedients for accommodation of private travel

1.9 BARRICADES AND LIGHTS

A. Protect streets, roads, highways, and other public thorough fares which are closed to traffic by effective barricades with acceptable warning and directional signs

B. Locate barricades at the street intersecting public thoroughfare on each side of the blocked section

C. Provide suitable barriers, signs, and lights to the extent required to adequately protect the public

D. Provide similar warning signs and lights at obstructions such as material piles and equipment

E. Illuminate barricades and obstructions with warning lights from sunset to sunrise

F. Store materials and conduct work to cause the minimum obstruction to the other contracts

1.10 LINES, GRADES AND SURVEY

A. Construct all Work to the lines, grades, and elevations indicated on the Drawings
   1. Contractor is responsible for correcting all incorrect grades or grades not meeting specified tolerances

B. Engineer has established basic vertical control in the Drawings
   1. Use these points as datum for the Work
   2. Provide such competent personnel and tool, stakes, and other materials as Engineer may require in establishing or designating control points, in establishing construction easement boundaries, or in checking layout survey, and measurement work performed by Contractor

C. Provide all additional survey, layout, and measurement work required
   1. Work performed by a qualified professional engineer or registered land surveyor acceptable to Engineer
   2. Preserve all permanent reference points during construction
      a. Make no changes or relocations without prior written notice to Engineer
      b. Report to Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations
   3. Establish lines and levels, locate and lay out, by instrumentation and similar appropriate means
      a. Temporary project benchmark
      b. Stakes for grading, fill and topsoil placement
      c. Utility slopes and invert elevations
   4. From time to time, verify layouts by the same methods
   5. Maintain a complete, accurate log of all control and survey work as it progresses
   6. On request of Engineer, submit documentation to verify accuracy or field engineering work

1.11 REGULATORY REQUIREMENTS

A. Comply with all federal, state, and local laws, regulations, codes, and ordinances applicable to the Work

B. Other standards and codes which apply to the Work are designated in the specific technical specifications

1.12 CUTTING AND PATCHING

A. Contractor shall be responsible for all cutting, and patching, including attendant excavation and backfill, required to complete the Work or to
   1. Uncover portions of the Work to provide for installation of ill-timed work
   2. Remove and replace defective work
   3. Remove and replace work not conforming to requirements of Contract Documents
   4. Remove samples of installed work as specified for testing

B. Provide products as specified or as required to complete cutting and patching operations

C. Inspection
   1. Inspect existing conditions of the Project, including elements subject to damage or to movement during cutting and patching
   2. After uncovering work, inspect the conditions affecting the installation of products, or performance of the work
   3. Report unsatisfactory or questionable conditions to the Engineer in writing; do not proceed with the work until the Engineer has provided further instructions

D. Preparation
   1. Provide devices and methods to protect other portions of the Project from damage
   2. Provide protection from the elements for that portion of the Project which may be exposed by cutting and patching work, and maintain excavations free from water
   3. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes
   4. Restore work which has been cut or removed; install new products to provide completed Work in accord with requirements of Contract Documents

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01020

GEOTECHNICAL REPORT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reports of explorations and tests of subsurface conditions at the project site.

1.2 RELATED SECTIONS

A. Section 01010 – Summary of Work

B. Section 02300 – Earthwork

1.3 INVESTIGATION

A. Soil and subsurface investigations were conducted at the site, the results of which are to be found in the report issued by Huddleston-Berry Engineering, Geotechnical Investigation Grand Junction Raw Waterline, December 19, 2018.

B. A reference copy of the report is included herein, Supplement A (01020)

C. Bidders are expected to examine soils investigation data and to make their own investigation of the site on or prior to the bid date.

1.4 INTERPRETATION

A. Soil investigation data is provided only for information and the convenience of bidders. Owner and Engineer disclaim any responsibility for the accuracy, true location, and extent of the soils investigation that has been prepared by others. They further disclaim responsibility for interpretations of that data by bidders, as in projecting soil-bearing values, rock profiles, soil stability and the presence, and level and extent of underground water.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

Huddleston-Berry
Engineering & Testing, LLC

640 White Avenue
Grand Junction, Colorado 81501
Phone: 970-255-8005
Fax: 970-255-6818
Info@huddlestonberry.com

December 19, 2018
Project#00877-0002

JVA, Inc.
817 Colorado Avenue, Suite 301
Glenwood Springs, Colorado 81601

Attention: Mr. Cooper Best

Subject: Geotechnical Investigation
Grand Junction Raw Water Irrigation Supply
Grand Junction, Colorado

Dear Mr. Best,

This letter presents the results of a geotechnical investigation conducted by Huddleston-Berry Engineering & Testing, LLC (HBET) for a proposed installation of a raw water irrigation supply line in Grand Junction, Colorado. The site location is shown on Figure 1 – Site Location Map. The scope of our investigation included evaluating the subsurface conditions along the proposed alignment.

Subsurface Investigation

The subsurface investigation included three borings as shown on Figures 2 and 3. The borings were drilled to depths between 8.0 and 11.0 feet below the existing ground surface. Typed boring logs are included in Appendix A. Samples of the native soils and bedrock were collected during Standard Penetration Testing (SPT) and using bulk sampling methods at the locations shown on the logs.

As indicated in the logs, the subsurface conditions along the alignment were variable. Boring B-1, conducted at the south end of the project, encountered 0.5 feet of brown, moist, loose clayey sand soils underlain by tan to grey, soft to medium hard, highly weathered sandstone and claystone bedrock to the bottom of the boring. Auger refusal was encountered in B-1 at a depth of 8.0 feet. Groundwater was not encountered in B-1 at the time of the investigation.

Boring B-2, conducted along 26¼ Road, encountered 1.5 feet of granular base course above brown to tan, moist to wet, soft to very stiff sandy lean clay soils to the bottom of the boring. Auger refusal was encountered in B-2 at a depth of 11.0 feet. Groundwater was encountered in B-2 at a depth of 7.0 feet at the time of the investigation.

Boring B-3, conducted at the northern end of the project, encountered 1.0 foot of topsoil above brown, moist to wet, medium stiff sandy lean clay to a depth of 7.0 feet. Below the clay, brown, wet, dense sandy gravel and cobbles extended to a depth of 13.0 feet. The gravel and cobbles were underlain by gray, soft, highly weathered shale bedrock to the bottom of the boring. Groundwater was encountered in B-3 at a depth of 6.0 feet at the time of the investigation.

Laboratory Testing

Laboratory testing was conducted on samples of the soils encountered in the borings. The testing included grain size analysis, Atterberg limits determination, and natural moisture content determination. The laboratory testing results are included in Appendix B and indicate that the claystone bedrock in B-1 is moderately plastic and that the clay soils in B-2 and B-3 are slightly plastic.

General Recommendations

Bearing Capacity
In general, for well compacted native clay soils, HBET recommends a maximum net allowable bearing capacity of 1,250 psf. For the sandstone and claystone bedrock, a maximum net allowable bearing capacity of 5,500 psf is recommended.

Subgrade Strength
In general, based upon our experience with the native clay soils in the vicinity of the subject site, HBET recommends that a Resilient Modulus of 3,000 psi be utilized for these materials. This corresponds to a CBR of 2.0 or R-value of less than 5.

Corrosion of Steel and Concrete
Based upon our experience in the Grand Valley, the native soils are anticipated to be moderately corrosive to concrete and steel. As a result, steel and concrete used in the construction should consider corrosion in their design, as appropriate.

Lateral Earth Pressures
For backfill consisting of the native soils, weathered bedrock, or imported granular, ***non-free draining***, non-expansive materials, we recommend that any walls be designed for an active equivalent fluid unit weight of 45 pcf in areas where no surcharge loads are present. An at-rest equivalent fluid unit weight of 65 pcf is recommended for braced walls. Lateral earth pressures should be increased as necessary to reflect any surcharge loading behind the walls.

Excavations
Excavations in the soils at the site may stand for short periods of time but should not be considered to be stable. In general, the site soils classify as Type C soil with regard to OSHA's *Construction Standards for Excavations*. For Type C soils, the maximum allowable slope in temporary cuts is 1.5H:1V. For the bedrock at the south end of the project, the materials may classify as Bedrock in accordance with OSHA standards. However, HBET should be provided the opportunity to observe the bedrock exposed in the excavations to determine the proper classification of the materials.

Based upon the results of the subsurface investigation, unstable subgrade conditions may exist in some areas. It may be necessary to utilize geotextile and/or geogrid in conjunction with granular fill to stabilize the subgrade. HBET should be contacted to provide specific recommendations for subgrade stabilization based upon the actual conditions encountered during construction.

General Notes

The recommendations included above are based upon the results of the subsurface investigation and on our local experience. These conclusions and recommendations are valid only for the proposed construction.

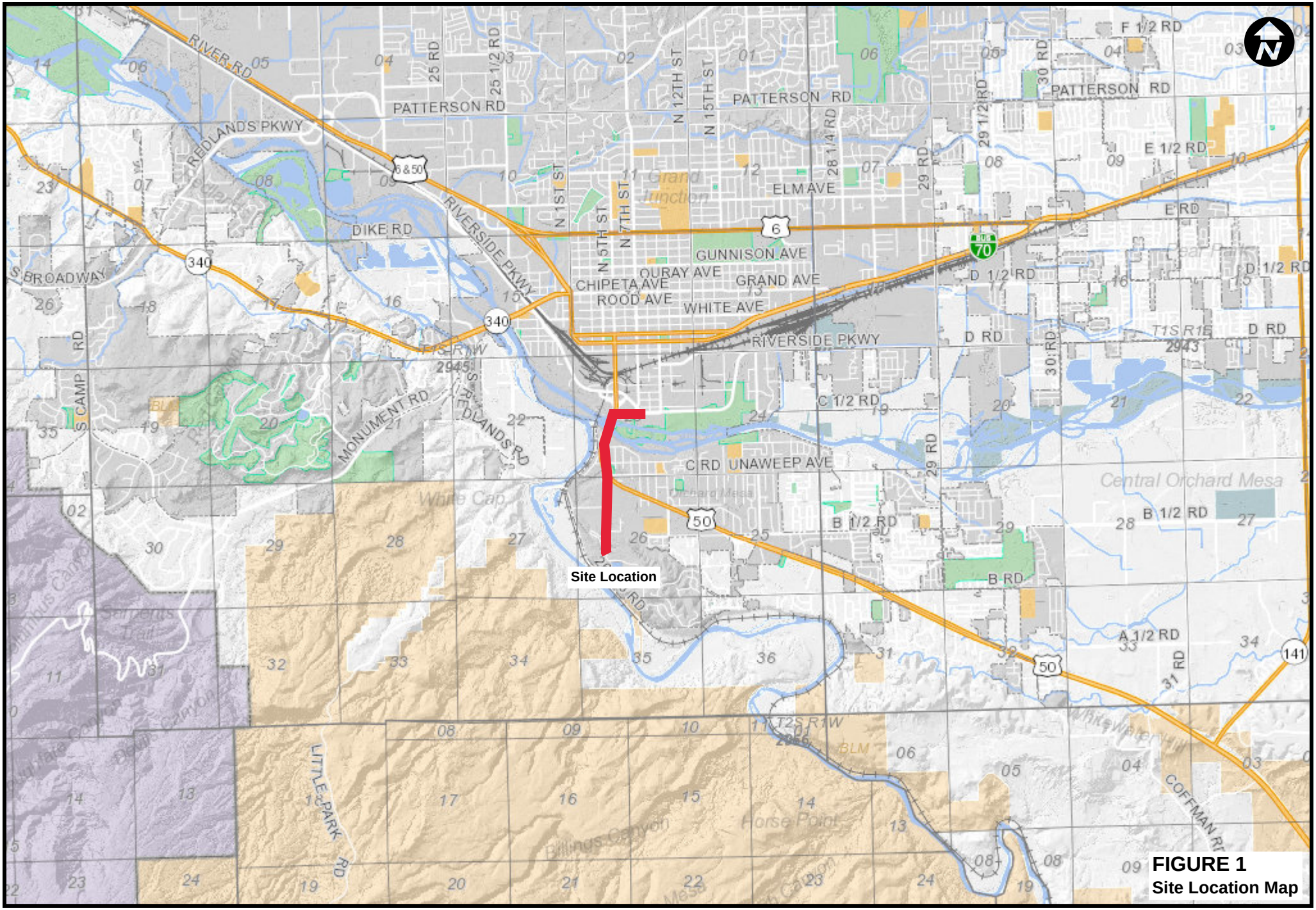
As discussed previously, the subsurface conditions at the site were slightly variable. However, the precise nature and extent of subsurface variability may not become evident until construction. Therefore, it is recommended that a representative of HBET be retained to provide engineering oversight during the construction. This is to verify compliance with the recommendations included in this report or permit identification of significant variations in the subsurface conditions which may require modification of the recommendations.

We are pleased to be of service to your project. Please contact us if you have any questions or comments regarding the contents of this report.

Respectfully Submitted:
Huddleston-Berry Engineering and Testing, LLC

Michael A. Berry, P.E.
Vice President of Engineering

FIGURES



Mesa County Map

0 0.5 1 2 mi
0 0.5 1 2 km

Print Date: December 13, 2018

Mesa County, Colorado
GIS/IT Department
gis.mesacounty.us

FIGURE 2
Site Plan

FIGURE 3
Site Plan

APPENDIX A
Typed Boring Logs

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-1

CLIENT JVA, Inc.
PROJECT NAME GJ Raw Water Irrigation Supply
PROJECT NUMBER 00877-0002
PROJECT LOCATION Grand Junction, CO
DATE STARTED 10/25/18 **COMPLETED** 10/25/18
GROUND ELEVATION _____ **HOLE SIZE** 4-inch
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
AT TIME OF DRILLING dry
LOGGED BY SD **CHECKED BY** MAB
AT END OF DRILLING dry
NOTES _____
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		Clayey SAND with Organics (sc), brown, moist, loose										
		SANDSTONE and CLAYSTONE, tan to gray, soft to medium hard, highly weathered										
2.5			SS 1	94	18-17-20 (37)				34	16	18	
5.0												
			SS 2	0	50/1"							
7.5		**Auger refusal at 8 ft**										
		Bottom of hole at 8.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-2

CLIENT JVA, Inc.
PROJECT NAME GJ Raw Water Irrigation Supply
PROJECT NUMBER 00877-0002
PROJECT LOCATION Grand Junction, CO
DATE STARTED 10/25/18 **COMPLETED** 10/25/18
GROUND ELEVATION _____ **HOLE SIZE** 4-inch
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
AT TIME OF DRILLING 7.0 ft
LOGGED BY SD **CHECKED BY** MAB
AT END OF DRILLING 7.0 ft
NOTES _____
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		Granular BASE COURSE										
		Sandy Lean CLAY (cl), brown to tan, moist to wet, soft to very stiff										
2.5			SS 1	67	3-2-3 (5)							
5.0												
		***Lab Classified SS2										
7.5			SS 2	39	9-9-14 (23)			14	24	14	10	53
10.0												
		Auger refusal at 11 ft										
		Bottom of hole at 11.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-3

CLIENT JVA, Inc. **PROJECT NAME** GJ Raw Water Irrigation Supply

PROJECT NUMBER 00877-0002 **PROJECT LOCATION** Grand Junction, CO

DATE STARTED 10/25/18 **COMPLETED** 10/25/18 **GROUND ELEVATION** _____ **HOLE SIZE** 4-inch

DRILLING CONTRACTOR S. McKracken **GROUND WATER LEVELS:**

DRILLING METHOD Simco 2000 Track Rig **AT TIME OF DRILLING** 6.0 ft

LOGGED BY SD **CHECKED BY** MAB **AT END OF DRILLING** 6.0 ft

NOTES _____ **AFTER DRILLING** ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		Sandy Lean CLAY with Gravel and Organics (TOPSOIL)										
		Sandy Lean CLAY with Gravel (cl), brown, moist to wet, medium stiff										
2.5			SS 1	44	1-1-2 (3)							
5.0												
7.5		Sandy GRAVEL and COBBLES (gw), brown, wet, dense										
10.0												
12.5												
		SHALE, gray, soft, highly weathered										
15.0		Bottom of hole at 15.0 feet.										

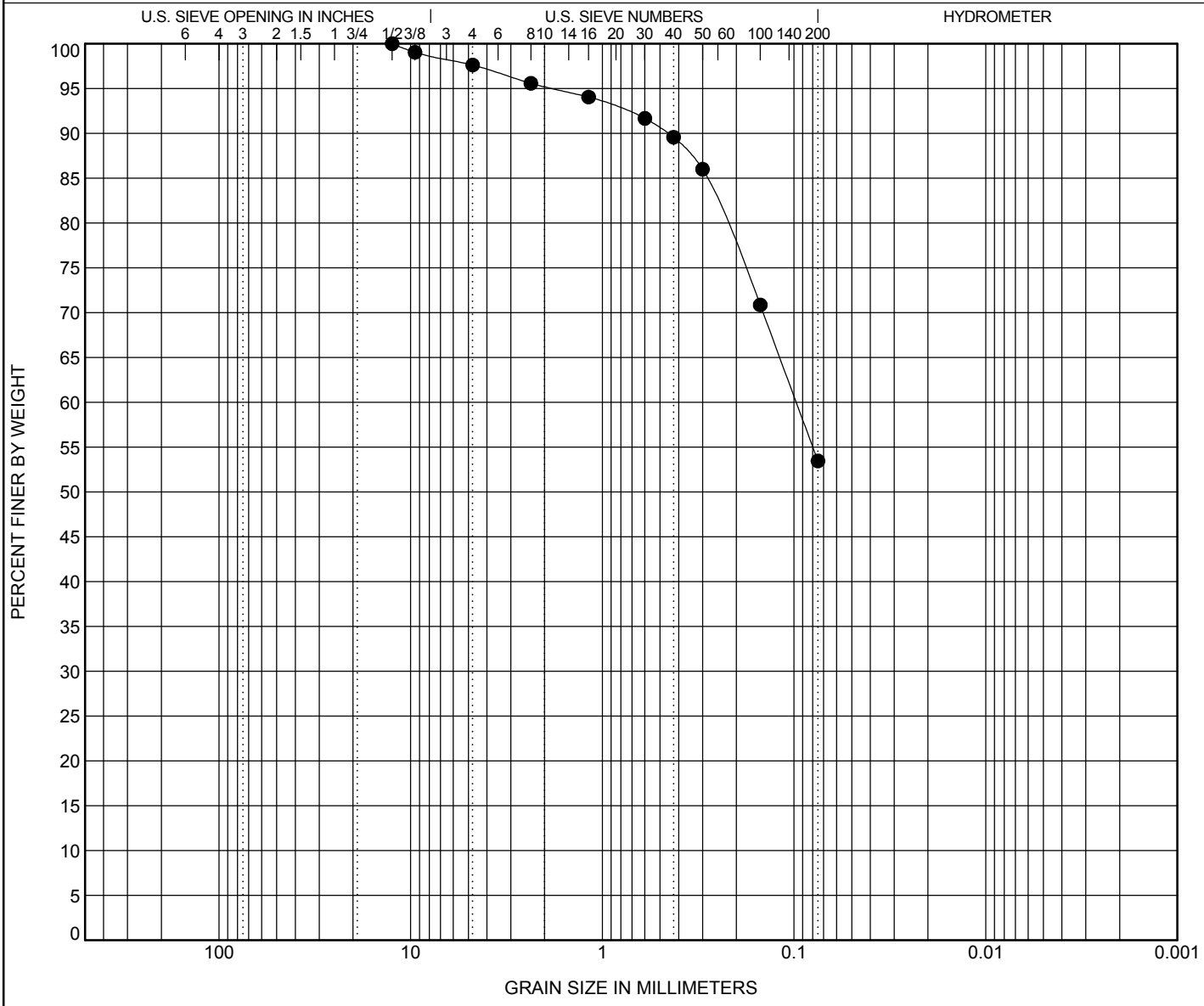
APPENDIX B
Laboratory Testing Results

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

GRAIN SIZE DISTRIBUTION

CLIENT JVA, Inc. **PROJECT NAME** GJ Raw Water Irrigation Supply

PROJECT NUMBER 00877-0002 **PROJECT LOCATION** Grand Junction, CO



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-2, SS1 10/2018**	**SANDY LEAN CLAY(CL)**	**24**	**14**	**10**		

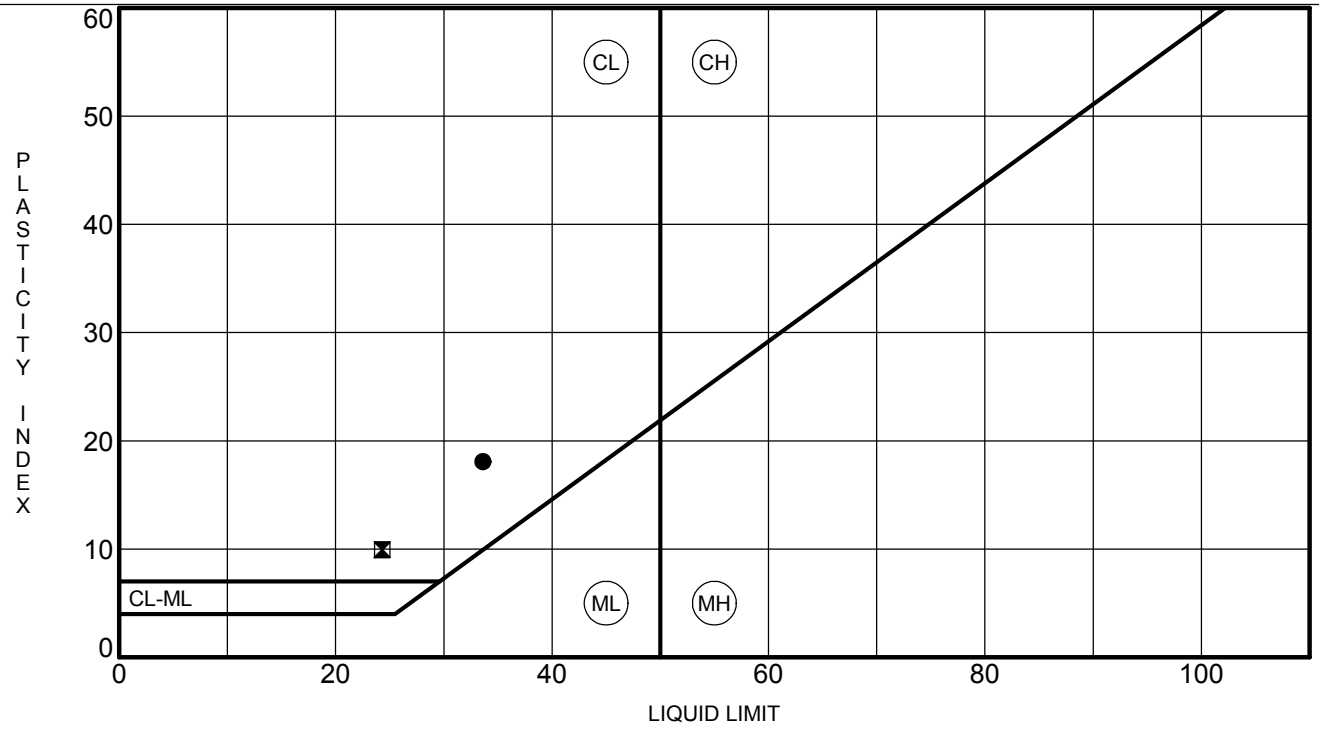
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-2, SS2 10/2018**	**12.5**	**0.097**			**2.4**	**44.2**	**53.5**	

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

ATTERBERG LIMITS' RESULTS

CLIENT JVA, Inc. **PROJECT NAME** GJ Raw Water Irrigation Supply

PROJECT NUMBER 00877-0002 **PROJECT LOCATION** Grand Junction, CO



	Specimen Identification		LL	PL	PI	#200	Classification
●	**B-1, SS1**	**10/2018**	**34**	**16**	**18**		
⧓	**B-2, SS1**	**10/2018**	**24**	**14**	**10**	**53**	**SANDY LEAN CLAY(CL)**

ATTERBERG LIMITS 00877-0002 GJ RAW WATER.GPJ GINT US LAB.GDT 12/10/18

SECTION 01035

MODIFICATION PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing contract modifications.

1.2 MINOR CHANGES IN THE WORK

A. The Engineer will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or Contract Time, on a JVA Field Order Form.

B. The Contractor may request additional information or clarification by using and submitting a “Request for Information” (RFI).

1.3 PROPOSAL REQUEST (PR) OR QUOTATION REQUEST (QR)

A. Owner-Initiated Quotation Request: The Engineer will issue a detailed Quotation Request Form indicating any changes in the Work that will require adjustment to the Contract Sum or Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
   1. The Quotation Request Form issued by the Engineer is for information only. Do not consider them as an instruction either to stop work in progress or to execute the proposed change.
   2. Within 7 days of receipt of a Quotation Request Form, submit an estimate of cost necessary to execute the change to the Engineer for the Owner's review.
      a. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
      b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
      c. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time.

B. Contractor-Initiated Proposals: When latent or unforeseen conditions require modifications to the Contract, the Contractor may propose changes by submitting a Contractor request for a change form to the Engineer,
   1. Include a statement outlining the reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Contract Time.

2. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Comply with requirements under General Conditions in Section 6.05 Substitutes and "Or-Equals" if the proposed change requires substitution of one product or system for a product or system specified.

C. There will be no Contractor initiated Change Orders, the Contractor may only request additional information or clarification by using and submitting a "Request for Information" (RFI), on the Contractor's RFI form. Additional forms may be obtained from the Engineer, and Contractor-Initiated Proposals may also be provided.

1.4 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: When the Owner and the Contractor disagree on the terms of a Change Order, the Engineer may issue a Construction Change. The Construction Change Directive instructs the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. The Construction Change Directive contains a complete description of the change in the Work. It also designates the method to be followed to determine change in the Contract Sum or Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
1. After completion of the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.5 CHANGE ORDER PROCEDURES

A. Upon the Owner's and the Engineer's approval and signature from the Contractor the Change Order Form becomes valid

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01039

COORDINATION AND MEETINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General requirements

B. Coordination

C. Field engineering

D. Alteration project procedures

E. Preconstruction conference

F. Progress meetings

G. Requests for information

1.2 RELATED SECTIONS

A. Section 01010 - Summary of Work

B. Section 01340 - Shop Drawings and Product Data

C. Section 01700 - Contract Closeout

1.3 GENERAL REQUIREMENTS

A. Refer to General Conditions for Owner meetings and other requirements

B. Engineer will schedule and administer pre-construction meeting according to agenda
   1. Prepare agenda for meetings including items required by Owner and Contractor
   2. Notify Contractor and Owner 4 days in advance of meeting date
   3. Preside at meeting

C. Contractor will schedule and administer site mobilization and weekly progress meetings. Contractor will also be responsible for coordination, field engineering, alteration, project procedures, cutting and patching procedures outlined herein. If work progress does not warrant a meeting, all parties can mutually agree to postpone meeting.
   1. Arrange for the attendance of Contractor's agents, employees, subcontractors, and suppliers as appropriate to the agenda
   2. Record the minutes; include all significant proceedings and decisions
   3. Reproduce and distribute copies of minutes within one week after each meeting
      a. To all participants in the meetings

b. To Engineer
c. To Owner

4. Owner and other inspecting parties such as the geotechnical engineer/technician as well as plant operators may attend meetings
5. Engineer will attend weekly meetings either via phone or on site

D. Representatives of contractors, subcontractors, and suppliers attending the meetings shall be qualified and authorized to act on behalf of the entity each represents

1.4 COORDINATION

A. Coordinate scheduling, submittals, and Work of the various Sections of specifications to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later by others.

B. Verify that utility requirement characteristics of operating equipment are compatible with available utilities. Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment, and coordinate preparation of grading and other requirements for installation utility work by others.

C. Coordinate completion and clean-up of Work of separate Sections in preparation for final completion and for portions of Work designated for Owner’s use

D. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities

1.5 FIELD ENGINEERING

A. Employ a Land Surveyor registered in the State of Colorado and acceptable to the Engineer and Owner

B. Contractor will locate and protect survey control and reference points

C. Control datum for survey is that established by Owner provided survey and shown on Drawings

D. Provide field engineering services. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.

1.6 ALTERATION PROJECT PROCEDURES

A. Materials: As specified in product Sections; match existing products and work for patching and extending work

B. Where new work abuts or aligns with existing, perform a smooth and even transition. Patched work to match existing adjacent work in texture and appearance.

C. When finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Engineer

D. Where a change of plane of 1/4 inch or more occurs, submit recommendation for providing a smooth transition for Engineer review

E. Patch or replace portions of existing surfaces, which are damaged, lifted, or showing other imperfections

F. Finish surfaces as specified in individual product sections

1.7 PRECONSTRUCTION CONFERENCE

A. Engineer will schedule a conference after Notice of Award

B. Location: On site

C. Attendance
1. Owner's Representative
2. Engineer and his professional consultants
3. Geotechnical Engineer
4. Contractor's Project Manager
5. Contractor's Superintendent
6. Major Subcontractors
7. Others as Appropriate

D. Agenda:
1. Execution of Owner Contractor Agreement
2. Submission of executed bonds and insurance certificates
3. Distribution of Contract Documents
4. Submission of list of subcontractors and suppliers, list of products, Schedule of Values, and Construction Project Schedule in critical path format
5. Designation of personnel representing the parties in Contractor, Owner, and the Engineer
6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, cost proposal requests, Change Orders and Contract closeout procedures
7. Construction scheduling and updates
8. Scheduling activities of Geotechnical Engineer, equipment manufacturers representatives, and other field tests
9. Critical work sequencing
10. Major equipment deliveries and priorities
11. Procedures for maintaining Record Documents
12. Construction facilities, controls and construction aids
13. Temporary utilities provided by Owner
14. Safety and first-aid procedures
15. Security and housekeeping procedures

16. Procedures for testing

1.8 PROGRESS MEETINGS

A. Contractor will schedule and administer meetings throughout progress of the Work at weekly intervals. If work progress does not warrant meeting, all parties can mutually agree to postpone the weekly meeting.

B. Location of the Meetings: The project field office of the Contractor, or other locations arranged for by Contractor, convenient to all parties. Owner will allow for construction progress meetings to be held in the conference room at the City of Grand Junction Water Treatment Plant

C. Contractor will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings, record minutes, and distribute copies within one week to Contractor, Owner, participants, and those affected by decisions made

D. Attendance
1. Owner's Representative
2. Engineer, and his professional consultants as needed
3. Contractor's Superintendent
4. Subcontractors as appropriate to the agenda
5. Suppliers as appropriate to the agenda
6. Others, as appropriate

E. Suggested Agenda
1. Review Minutes of Previous meetings
2. Review unresolved issues from Last Meeting
3. Review of Work Progress
4. Field Observations, Problems, Conflicts and Decisions
5. RFI Review
6. Review of Submittals Schedule and Status of Submittals
7. Schedule
    a. General Schedule Issues
    b. Review of off-site fabrication and delivery schedules
    c. Planned progress during succeeding work period (3-week “Look ahead”)
    d. Maintenance of construction project schedule
    e. Corrective measures to regain project schedules
8. Maintenance of Quality and Work Standards
9. Change Orders
10. New PR’s or CCR’s
11. Accepted Change Orders
12. Pay Requests
13. Other Business

1.9 REQUESTS FOR INFORMATION (RFI)

A. The Contractor shall prepare and submit an RFI upon the discovery of the need for interpretation of the Contract Documents or additional information
   1. Only the Contractor shall submit RFIs to the Engineer
   2. RFIs shall be submitted on Engineer's RFI form. Engineer will provide a template for the Contractor upon request.

B. RFI shall include:
   1. Project Name
   2. Engineer Job Number
   3. Date
   4. Name of Contractor
   5. Name of Engineer
   6. RFI number, numbered sequentially
   7. Related specification section number, title, and related paragraphs, as needed
   8. Drawing number and detail references, as needed
   9. Field conditions
   10. Contractor's proposed solution. If the Contractor's solution(s) affect contract times or contract price, Contractor shall state the effects on the RFI.
   11. Contractor's signature
   12. Relevant attachments including but not limited to drawings, descriptions, measurements, photos, product data, and shop drawings

C. Electronically Submitted RFIs
   1. Contractor shall submit one (1) complete RFI file in Adobe Acrobat PDF format

D. Engineer's Response
   1. Engineer will review each RFI, determine action required, and respond
   2. Engineer will review and respond to each RFI within seven (7) working days
   3. If Engineer receives an RFI after 1:00 P.M. local time, the RFI will be considered as received the following working day
   4. Engineer will not respond to RFIs requesting approval of submittals, approval of substitutions, coordination and information already indicated in Contract Documents, adjustment in contract time or contract amount, or erroneous RFIs
   5. Engineer may respond to RFIs on related issues with a single response
   6. If Engineer requests additional information as a result of the RFI, any further action or RFIs submitted by the Contractor will restart a new seven (7) day review period
   7. Contractor shall submit any request for change of contract time or contract price utilizing proper Change Order forms

E. Contractor shall log and track all RFIs submitted organized by RFI number
   1. RFI log shall be submitted at each progress meeting
   2. RFI log shall include:
      a. Project name
      b. Name, address, and phone number of Contractor
      c. Contractor representative name

d. RFI number
e. RFI description
f. RFI submittal date
g. RFI response date
h. Related Change Order number, as needed

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01200

PAYMENT PROCEDURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.

B. This information is supplemental to the requirements as stated in the General Conditions.

1.2 SUMMARY

A. This Section includes additional administrative and procedural requirements necessary to prepare and process Applications for Payment. Refer to General Conditions for most requirements of the Owner.
   1. Unit Prices for administrative requirements governing use of unit prices
   2. Construction Progress Schedules

1.3 DEFINITIONS

A. Unit Price: An amount proposed by bidders, stated on the Bid Form, as a price per unit of measurement for materials or services.

1.4 PROCEDURES FOR UNIT PRICES

A. Unit bid prices, as quoted in the Bid Form, shall be in full compensation for labor, materials, equipment, rentals, freight, applicable taxes, overhead, profit and incidentals to complete all work for each pay item; and for all risk, loss, damage, or expense of whatever nature arising from the nature of the work or the prosecution thereof.

B. Work or materials that are essential to the work, but for which there are no pay items, will not be measured and paid for separately, but shall be included in other items of work.

C. Prices include all necessary material, for a complete installation, insurance, applicable taxes, overhead, and profit
   1. Bid Item No. 1: Mobilization/Demobilization
      a. Description: No separate measurement for payment will be made for any labor, equipment, materials, and incidental work required for this item. The lump sum price will include all of Contractor’s costs. This bid item includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: preparing and installing temporary fencing around project work and staging areas, and any other fencing/security items as deemed necessary by Contractor and not covered by another bid item; establishing Contractor’s staging area, construction trailers,

offices, buildings, other necessary facilities, and temporary power and communications; obtaining permits; providing required bonds and insurance; preparing the project schedule. Item also includes demobilization at the completion of the project including the removal of the Contractor's equipment, supplies, temporary facilities, excess materials, and cleaning up the site; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.

b. Unit of Measurement: The total bid amount for mobilization and demobilization shall not exceed eight percent (8%) of the total bid price. Bids received that exceed this amount may be grounds for rejection of the total bid. No measurement for payment will be made for this work. It shall be paid for at the Contract Lump Sum Price based upon the percentage completed and accepted of the work required by this bid item. Fifty percent (50%) of the lump sum price will be paid at the time of the first monthly progress payment; an additional thirty percent (30%) will be paid when one-half of the original Contract amount is earned. The remaining twenty percent (20%) will be paid upon final acceptance of the Project.

2. Bid Item No. 2: Construction Surveying
   a. Description: No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The lump sum price will include all of Contractor's costs. This bid item includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: all construction surveying, locating, referencing, calculating, and staking necessary for the construction of the Work record drawings in accordance with the Drawings and Specifications and in conformance with the CDOT Survey Manual.
   b. Unit of Measurement: No measurement for payment will be made for this work. It shall be paid for at the Contract Lump Sum Price based upon the percentage completed and accepted of the work required by this bid item. One-third of the lump sum price for this item will be paid after twenty-five percent (25%) of the original contract amount has been earned; the second third will be paid after fifty percent (50%) of the original contract amount has been earned; and the final third upon final acceptance of the project.

3. Bid Item No. 3: Demolish Existing Sidewalk
   a. Description: No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The measurement for payment for this item will be the total number listed in the bid schedule and will include all of Contractor's costs. This bid item includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: protecting all existing items, materials, and surfaces not to be demolished; demolishing, hauling, and disposing of existing asphalt and concrete materials to be demolished as required; clean up; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.
   b. Unit of Measurement: Per square feet (surface area) of actual sidewalk removed. Length of sidewalk area will be measured parallel to the alignment of the

sidewalk and width of sidewalk area will be measured perpendicular to the alignment of the sidewalk. Payment will be based on units completed and accepted of the Work required by this bid item.

4. Bid Item No. 4: Demolish Existing Asphalt
    a. Description: No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The measurement for payment for this item will be the total number listed in the bid schedule and will include all of Contractor's costs. This bid item includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: protecting all existing items, materials, and surfaces not to be demolished; demolishing, hauling, and disposing of existing asphalt materials to be demolished as required; clean up; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.
    b. Unit of Measurement: Per square yard (surface area) of actual asphalt removed. Payment will be based on units completed and accepted of the Work required by this bid item.
5. Bid Item No. 5: Maintenance of Traffic
    a. Description: No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The lump sum price will include all of Contractor's costs. This bid item includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: preparing, implementing, adjusting as necessary, and maintaining the approved Traffic Control Plan in accordance with the Drawings and Specifications and accepted Traffic Control Plan; temporary traffic lights; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.
    b. Unit of Measurement: No measurement for payment will be made for this work. It shall be paid for at the Contract Lump Sum Price based upon the percentage completed and accepted of the work required by this bid item. One-third of the lump sum price for this item will be paid after twenty-five percent (25%) of the original Contract amount has been earned; the second third will be paid after fifty percent (50%) of the original Contract amount has been earned; and the final third upon final acceptance of the Project.
6. Bid Item No. 6: Road Base
    a. Description: No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The measurement for payment for this item will be the total number listed in the bid schedule and will include all of Contractor's costs. This bid item includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: furnishing and installing Class II aggregate base with CDOT Class VI gradation; site grading to establish grade prior to placement of Road Base; subgrade preparation; removing debris and excess materials; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.

b. Unit of Measurement: Per actual number of tons of road base installed. Payment will be based on units completed and accepted of the Work required by this bid item.

7. Bid Item No. 7: Asphalt Paving
   a. Description: No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The measurement for payment for this item will be the total number listed in the bid schedule and will include all of Contractor's costs. This bid item includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: saw cutting and patching or repairing existing asphalt and concrete as required to install improvements; furnishing all new materials and labor required to install improvements; installation of all materials as indicated, including all required surface and subgrade preparation; tack coat; clean up; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.
   b. Unit of Measurement: Per actual number of tons of asphalt road surface paved. Payment will be based on units completed and accepted of the Work required by this bid item.
8. Bid Item No. 8: Concrete – 4-inch (flatwork, fiber reinforced)
   a. Description: No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The measurement for payment for this item will be the total number listed in the bid schedule and will include all of Contractor's costs. This bid item includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: saw cutting and patching or repairing existing asphalt and concrete as required to install improvements; furnishing all new materials and labor required to install improvements; installation of all materials as indicated, including all required surface and subgrade preparation; clean up; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.
   b. Unit of Measurement: Per actual number of square feet (surface area) of concrete walk installed. Payment will be based on units completed and accepted of the Work required by this bid item.
9. Bid Item No. 9: Concrete – Curb and Gutter (6-inch Vertical, 1-foot Pan)
   a. Description: No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The measurement for payment for this item will be the total number listed in the bid schedule and will include all of Contractor's costs. This bid item includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: saw cutting existing asphalt and concrete as required to install improvements; furnishing all new materials and labor required to install improvements; installation of all materials as indicated, including all required surface and subgrade preparation; clean up; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.

b. Unit of Measurement: Per actual number of linear feet of concrete curb and gutter installed. Payment will be based on units completed and accepted of the Work required by this bid item.

10. Bid Item No. 10: Painted Striping
    a. Description: No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The measurement for payment for this item will be the total number listed in the bid schedule and will include all of Contractor's costs. This bid item includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: furnishing all new materials and labor required to install improvements; installation of all materials as indicated, including all required surface preparation; installing striping in accordance with the Drawings and Specifications and any applicable local, state or federal requirements; clean up; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.
    b. Unit of Measurement: Per actual number of linear feet of Striping installed. Payment will be based on units completed and accepted of the Work required by this bid item.
11. Bid Item No. 11: Thermoplastic Striping
    a. Description: No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The measurement for payment for this item will be the total number listed in the bid schedule and will include all of Contractor's costs. This bid item includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: furnishing all new materials and labor required to install improvements; installation of all materials as indicated, including all required surface preparation; installing Thermoplastic Striping in accordance with the Drawings and Specifications and any applicable local, state or federal requirements; clean up; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.
    b. Unit of Measurement: Per actual number of square feet (surface area) of Thermoplastic Striping installed. Payment will be based on units completed and accepted of the Work required by this bid item.
12. Bid Item No. 12: Water Pipe – 10-inch PVC C900
    a. No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The measurement for payment for this item will be the number of linear feet of pipe as listed in the bid schedule. The unit price will include all of Contractor's costs which are not specifically measured and paid for under other bid items. This bid item includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: locating and protecting all existing above and below ground utilities and connections along and around the item; topsoil removal, stockpiling, and replacement; excavating, backfilling, and compaction of excavations with suitable material(s); rock and muck excavation and backfill with suitable material(s); furnishing, transporting, and installing all

pipe and materials as indicated; adjusting location of existing small utilities and valves; tapping and/or connecting to pipes or structures and repairing all structures as necessary; furnishing, transporting, and installing special fittings or items not otherwise provided for elsewhere in the Drawings and Specifications; furnishing, transporting, and installing joining materials including O-rings, gaskets, bolts, joint restraints, connecting bands, and other miscellaneous items; removing and replacing surfacing materials, as required; excavating, including exploratory excavation; constructing the specific bedding including the furnishing, placing, and compacting of flowfill, sand, gravel, and rock; supporting trenches as required; disposing of debris, pipe, excess excavated material, and damaged materials; testing; inspecting; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.

b. Unit of Measurement: Per actual number of linear feet of pipe installed. Payment will be based on the units completed and accepted of the Work required by this bid item.

13. Bid Item No. 13: Water Pipe – 12-inch PVC C900
    a. No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The measurement for payment for this item will be the number of linear feet of pipe as listed in the bid schedule. The unit price will include all of Contractor's costs which are not specifically measured and paid for under other bid items. This bid item includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: locating and protecting all existing above and below ground utilities and connections along and around the item; topsoil removal, stockpiling, and replacement; excavating, backfilling, and compaction of excavations with suitable material(s); rock and muck excavation and backfill with suitable material(s); furnishing, transporting, and installing all pipe and materials as indicated; adjusting location of existing small utilities and valves; tapping and/or connecting to pipes or structures and repairing all structures as necessary; furnishing, transporting, and installing special fittings or items not otherwise provided for elsewhere in the Drawings and Specifications; furnishing, transporting, and installing joining materials including O-rings, gaskets, bolts, joint restraints, connecting bands, and other miscellaneous items; removing and replacing surfacing materials, as required; excavating, including exploratory excavation; constructing the specific bedding including the furnishing, placing, and compacting of flowfill, sand, gravel, and rock; supporting trenches as required; disposing of debris, pipe, excess excavated material, and damaged materials; testing; inspecting; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.
    b. Unit of Measurement: Per actual number of linear feet of pipe installed. Payment will be based on the units completed and accepted of the Work required by this bid item.
14. Bid Item No. 14: Water Pipe – 16-inch PVC C900

a. No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The measurement for payment for this item will be the number of linear feet of pipe as listed in the bid schedule. The unit price will include all of Contractor's costs which are not specifically measured and paid for under other bid items. This bid item includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: locating and protecting all existing above and below ground utilities and connections along and around the item; topsoil removal, stockpiling, and replacement; excavating, backfilling, and compaction of excavations with suitable material(s); rock and muck excavation and backfill with suitable material(s); furnishing, transporting, and installing all pipe and materials as indicated; adjusting location of existing small utilities and valves; tapping and/or connecting to pipes or structures and repairing all structures as necessary; furnishing, transporting, and installing special fittings or items not otherwise provided for elsewhere in the Drawings and Specifications; furnishing, transporting, and installing joining materials including O-rings, gaskets, bolts, joint restraints, connecting bands, and other miscellaneous items; removing and replacing surfacing materials, as required; excavating, including exploratory excavation; constructing the specific bedding including the furnishing, placing, and compacting of flowfill, sand, gravel, and rock; supporting trenches as required; disposing of debris, pipe, excess excavated material, and damaged materials; testing; inspecting; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.

b. Unit of Measurement: Per actual number of linear feet of pipe installed. Payment will be based on the units completed and accepted of the Work required by this bid item.

15. Bid Item No. 15: Water Pipe – 24-inch PVC C900

a. No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The measurement for payment for this item will be the number of linear feet of pipe as listed in the bid schedule. The unit price will include all of Contractor's costs which are not specifically measured and paid for under other bid items. This bid item includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: locating and protecting all existing above and below ground utilities and connections along and around the item; topsoil removal, stockpiling, and replacement; excavating, backfilling, and compaction of excavations with suitable material(s); rock and muck excavation and backfill with suitable material(s); furnishing, transporting, and installing all pipe and materials as indicated; adjusting location of existing small utilities and valves; tapping and/or connecting to pipes or structures and repairing all structures as necessary; furnishing, transporting, and installing special fittings or items not otherwise provided for elsewhere in the Drawings and Specifications; furnishing, transporting, and installing joining materials including O-rings, gaskets, bolts, joint restraints, connecting bands, and other miscellaneous items; removing and replacing surfacing materials, as required; excavating, including

exploratory excavation; constructing the specific bedding including the furnishing, placing, and compacting of flowfill, sand, gravel, and rock; supporting trenches as required; disposing of debris, pipe, excess excavated material, and damaged materials; testing; inspecting; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.

b. Unit of Measurement: Per actual number of linear feet of pipe installed. Payment will be based on the units completed and accepted of the Work required by this bid item.

16. Bid Item No. 16: Water Pipe – 12-inch fusable PVC C900
    a. No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The measurement for payment for this item will be the number of linear feet of pipe as listed in the bid schedule. The unit price will include all of Contractor's costs which are not specifically measured and paid for under other bid items. This bid item includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: locating and protecting all existing above and below ground utilities and connections along and around the item; topsoil removal, stockpiling, and replacement; excavating, backfilling, and compaction of excavations with suitable material(s); rock and muck excavation and backfill with suitable material(s); furnishing, transporting, and installing all pipe and materials as indicated; adjusting location of existing small utilities and valves; tapping and/or connecting to pipes or structures and repairing all structures as necessary; furnishing, transporting, and installing special fittings or items not otherwise provided for elsewhere in the Drawings and Specifications; furnishing, transporting, and installing joining materials; removing and replacing surfacing materials, as required; excavating, including exploratory excavation; constructing the specific bedding including the furnishing, placing, and compacting of flowfill, sand, gravel, and rock; supporting trenches as required; disposing of debris, pipe, excess excavated material, and damaged materials; rollers and hangers; testing; inspecting; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.
    b. Unit of Measurement: Per actual number of linear feet of pipe installed. Payment will be based on the units completed and accepted of the Work required by this bid item.
17. Bid Item No. 17-19: Gate Valve 4-, 6-, and 8-inch With Box
    a. Description: The measurement for payment for this item will be on a per-each basis, complete in place, in accordance with the Drawings or Specifications or as otherwise directed by Engineer. The unit price will include all of Contractor's costs. This bid item includes but is not limited to the following items: locating and protecting all existing utilities along and around the item; adjusting location of any existing small utilities and valves; furnishing, transporting, and installing all materials including any sheeting and/or bracing required for support trenches; constructing required connections to existing and new pipes; excavating, backfilling, and compacting, including imported backfill material and flowfill;

removing pavement, base course, subbase material, sod, and other surfacing material outside of the prescribed trench width which is not paid for under another section of this Specification; protecting aboveground and underground utilities and service connections; disposing of debris, pipe, excess excavated material, and damaged materials; testing; inspecting; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.

b. Unit of Measurement: Per actual number of gate valves installed. Payment will be based on units completed and accepted of the Work required by this bid item.

18. Bid Item No. 20-23: Butterfly Valve 10-, 12-, 16-, 24- With Box
    a. Description: The measurement for payment for this item will be on a per-each basis, complete in place, in accordance with the Drawings or Specifications or as otherwise directed by Engineer. The unit price will include all of Contractor's costs. This bid item includes but is not limited to the following items: locating and protecting all existing utilities along and around the item; adjusting location of any existing small utilities and valves; furnishing, transporting, and installing all materials including any sheeting and/or bracing required for support trenches; constructing required connections to existing and new pipes; excavating, backfilling, and compacting, including imported backfill material and flowfill; removing pavement, base course, subbase material, sod, and other surfacing material outside of the prescribed trench width which is not paid for under another section of this Specification; protecting aboveground and underground utilities and service connections; disposing of debris, pipe, excess excavated material, and damaged materials; testing; inspecting; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.
    b. Unit of Measurement: Per actual number of butterfly valves installed. Payment will be based on units completed and accepted of the Work required by this bid item.
19. Bid Item No. 24: Fire Hydrant Assembly
    a. Description: The measurement for payment for this item will be on a per-each basis, complete in place, in accordance with the Drawings or Specifications or as otherwise directed by Engineer. The unit price will include all of Contractor's costs. This bid item includes but is not limited to the following items: locating and protecting all existing utilities along and around the item; adjusting location of any existing small utilities and valves; furnishing, transporting, and installing all materials including any sheeting and/or bracing required for support trenches; installing fire hydrant assembly including gate valve, hydrant lateral pipe line, and mechanical joint restraint in accordance with the Drawings and Specifications and any applicable local, state or federal requirements; constructing required connections to existing and new pipes; excavating, backfilling, and compacting, including imported backfill material and flowfill; removing pavement, base course, subbase material, sod, and other surfacing material outside of the prescribed trench width which is not paid for under another section of this Specification; protecting aboveground and underground utilities and service connections; disposing of debris, pipe, excess excavated material, and damaged

materials; testing; inspecting; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.

b. Unit of Measurement: Per actual number of Fire Hydrant Assemblies installed. Payment will be based on units completed and accepted of the Work required by this bid item.

20. Bid Item No. 25: Connect to Existing Water Services
    a. Description: The measurement for payment for this item will be on a per-each basis, complete in place, in accordance with the Drawings or Specifications or as otherwise directed by Engineer. The unit price will include all of Contractor's costs. This bid item includes but is not limited to the following items: locating and protecting all existing utilities along and around the item; adjusting location of any existing small utilities and valves; furnishing, transporting, and installing all materials including any sheeting and/or bracing required for support trenches; tapping connection to new pipes with brass tapping saddle; new corp stops; new copper pipe service from main to curb stops; curb stop replacement and relocation to as near to edge of right-of-way as practical; excavating, including exploratory excavation; backfilling, and compacting, including imported backfill material and flowfill; removing pavement, base course, subbase material, sod, and other surfacing material outside of the prescribed trench width which is not paid for under another section of this Specification; protecting aboveground and underground utilities and service connections; disposing of debris, pipe, excess excavated material, and damaged materials; testing; inspecting; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.
    b. Unit of Measurement: Per actual number of water service connections installed. Payment will be based on units completed and accepted of the Work required by this bid item.
21. Bid Item No. 26: Erosion and Sediment Control
    a. Description: No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The measurement for payment will be the total number listed in the bid schedule and will include all of Contractor's costs. This bid item includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: furnishing and installing all materials including concrete washout areas, inlet protection, outlet protection, silt fence, curb socks, sediment control logs, vehicle tracking control, and any other materials required to complete the Work; providing all materials, fabricating, and installing erosion and sediment control measures; excavation and backfill, as required for installation; providing and installing all ancillary erosion control items specified in the Drawings, and all other means and methods specified in the erosion control drawings; obtaining required permits; inspecting; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.
    b. Unit of Measurement: No measurement for payment will be made for this work. It shall be paid for at the Contract Lump Sum Price based upon the percentage

completed and accepted of the work required by this bid item. One-third of the lump sum price for this item will be paid after twenty-five percent (25%) of the original Contract amount has been earned; the second third will be paid after fifty percent (50%) of the original Contract amount has been earned; and the final third upon final acceptance of the Project.

22. Bid Item No. 27: Fiber Optic Pull Boxes
    a. Description: No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The measurement for payment for this item will be on a per-each basis, complete in place, in accordance with the Drawings or Specifications or as otherwise directed by Engineer. The unit price will include all of Contractor's costs. This bid item includes but is not limited to the following items: furnishing, transporting, and installing all materials including sheeting and/or bracing, concrete, reinforcing steel, precast or premanufactured manholes, brick, mortar, plastic joint sealant, grout, and manhole steps where required; constructing required connections including any conduit required; rock and muck excavation and backfill with suitable material(s); excavating, backfilling, and compacting, including imported backfill material if no suitable on-site material is available; removing pavement, base course, subbase material, sod, and other surfacing material outside of the prescribed trench width which is not paid for under another section of this Specification; furnishing and installing protective coatings; protecting aboveground and underground utilities; disposing of debris, concrete, excess excavating material, and damaged materials; testing; inspecting; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.
    b. Unit of Measurement: Per actual number of fiber optic pull boxes installed. Payment will be based on units completed and accepted of the Work required by this bid item.
23. Bid Item No. 28: 3-inch Fiber Optic Conduit
    a. No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The measurement for payment for this item will be the number of linear feet of pipe as listed in the bid schedule. The unit price will include all of Contractor's costs which are not specifically measured and paid for under other bid items. This bid item includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: locating and protecting all existing above and below ground utilities and connections along and around the item; topsoil removal, stockpiling, and replacement; excavating, backfilling, and compaction of excavations with suitable material(s); furnishing, transporting, and installing all conduit and materials as indicated; adjusting location of existing small utilities; connecting to structures and repairing all structures as necessary; furnishing, transporting, and installing special fittings or items not otherwise provided for elsewhere in the Drawings and Specifications; furnishing, transporting, and installing joining materials including joint restraints, connecting bands, and other miscellaneous items; removing and replacing surfacing materials, as required; excavating, including exploratory excavation; constructing the specific bedding including the furnishing, placing, and compacting of sand,

gravel, and rock; supporting trenches as required; disposing of debris, conduit, excess excavated material, and damaged materials; testing; inspecting; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.

b. Unit of Measurement: Per actual number of linear feet of 3" Fiber Optic Conduit installed. Payment will be based on the units completed and accepted of the Work required by this bid item.

24. Bid Item No. 29: Water Control and Dewatering
    a. No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The measurement for payment for this item will be lump sum. As specified and approved by the Engineer. Includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: implementing measures to control surface water and groundwater; providing temporary power, if necessary; evaluating, designing, constructing, maintaining, and monitoring dewatering measures; obtaining a dewatering permit and following associated quality discharge requirements; and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.
    b. Unit of Measurement: Lump Sum Price based upon the percentage completed and accepted of the work required by this bid item. One-third of the lump sum price for this item will be paid after twenty-five percent (25%) of the original Contract amount has been earned; the second third will be paid after fifty percent (50%) of the original contract amount has been earned; and the final third amount upon final acceptance of the Project.
25. Bid Item No. 3: Reservoir 3 Liner
    a. No separate measurement for payment will be made for any labor, equipment, and materials required for this item. The measurement for payment for this item will be lump sum. As specified and approved by the Engineer. Includes but is not limited to the following items installed or conducted in accordance with the Drawings and Specifications or as otherwise directed by Engineer: concrete repair, concrete leveling, removal of existing structures, pipe modifications, liner installation, ballasting, water site gauge, pipe modifications, leak testing and providing all other related and necessary labor, equipment, and materials to complete the Work not covered by other items in this section.
    b. Unit of Measurement: Lump Sum Price based upon the percentage completed and accepted of the work required by this bid item. One-third of the lump sum price for this item will be paid after twenty-five percent (25%) of the original Contract amount has been earned; the second third will be paid after fifty percent (50%) of the original contract amount has been earned; and the final third amount upon final acceptance of the Project.

D. Measurement and Payment: Refer to bid form and 1.5 (A) of this Section for establishment of unit prices

E. Owner reserves the right to reject Contractor’s measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor.

1.5 APPLICATION FOR PAYMENTS

A. General
   1. Submit itemized payment request as required in General Conditions together with Schedule of Values and other submittals as specified herein
   2. Contractor shall not "project" work completed beyond the date of Application for Payment submittal for the purpose of payment request

B. Each Application for Payment shall be consistent with previous applications and payments as certified by the Engineer and paid for by the Owner.
   1. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application for Payment involve additional requirements

C. Payment Application Times: Each progress payment date is as indicated in the Agreement. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement

D. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the Owner. Incomplete applications will be returned without action.
   1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions have been made.
   2. Include amounts of Change Orders issued prior to the last day of the construction period covered by the application

E. Transmittal
   1. Submit copy of each Application for Payment to the Engineer by means ensuring receipt within 24 hours
   2. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to the Engineer

F. Initial Application for Payment
   1. Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include the following:
      a. List of subcontractors
      b. List of principal suppliers and fabricators
      c. Schedule of Values
      d. Contractor's Construction Schedule (preliminary if not final)
      e. Schedule of principal products
      f. List of Contractor's staff assignments
      g. Copies of building permits

h. Copies of authorizations and licenses from governing authorities for performance of the Work
i. Certificates of insurance and insurance policies
j. Performance and payment bonds, if required

G. Application for Payment at Substantial Completion
1. Following issuance of the Certificate of Substantial Completion, submit an Application for Payment. This application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of Work
a. Administrative actions and submittals that shall precede or coincide with this application include:
i) Occupancy permits and similar approvals
ii) Warranties (guarantees) and maintenance agreements
iii) Test/adjust/balance records
iv) Maintenance instructions
v) Meter readings
vi) Start-up performance reports
vii) Change-over information related to Owner's occupancy, use, operation and maintenance
viii) Final cleaning
ix) Application for reduction of retainage, and consent of surety
x) Advice on shifting insurance coverages
b. List of incomplete Work, recognized as exceptions to Engineer’s Certificate of Substantial Completion

H. Application for Final Payment
1. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Price, previous payments, and sum remaining due.
2. Application for Final Payment will not be considered until the following have been accomplished:
a. Completion of Project closeout requirements
b. Completion of items specified for completion after Substantial Completion
c. Assurance that unsettled claims will be settled
d. Assurance that Work not complete and accepted will be completed without undue delay
e. Transmittal of required Project construction records to Owner
f. Proof that taxes, fees and similar obligations have been paid
g. Removal of temporary facilities and services
h. Removal of surplus materials, rubbish and similar elements

1.6 PROCEDURES FOR THE CONSTRUCTION PROGRESS SCHEDULE

A. Coordination: coordinate preparation and updates of Contractor’s Construction Schedule with the preparation of Schedule of Values.
1. Correlate line items in the Construction Schedule with required project tasks, including the following:

a. Mobilization/demobilization
b. Permits and regulatory requirements
c. Submittals
d. Equipment
e. O&M Manuals
f. Work breakdown of major project work
g. Major subcontractors work
h. Startup and commissioning
i. Training
j. Substantial completion
k. Final completion
l. Milestones and operational shutdown requirements

B. Utilize the Critical Path Method (CPM) type construction schedule to establish preliminary progress schedule and track Work progress
   1. After acceptance by Engineer of preliminary Progress Schedule submitted per requirements of General Conditions, set preliminary Progress Schedule as the Construction Baseline Schedule
   2. Update and submit the construction progress schedule on a monthly basis with the pay application
      a. Monthly submittal should indicate progress of tasks, changes to baseline schedule logic, work additions such as change orders, milestone and contract date changes
      b. Submit two (2) color print copies, 11” x 17” size, and one Adobe pdf copy
      c. Upon request provide copy of project schedule CPM data file

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

A. Provide a list of unit prices as indicated in Section 00310 – Bid Form

END OF SECTION

SECTION 01340

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submission of all shop drawings and product data as required by the Contract Documents for all equipment and materials to be furnished under this contract unless specifically indicated otherwise

1.2 RELATED SECTIONS

A. Section 01600 – Materials and Equipment

B. Specification Divisions 2 through 16

1.3 SUBMITTALS

A. Definitions
   1. Technical submittals: Shop drawings, product data and samples prepared by Contractor, subcontractors, suppliers, or manufacturers
      a. Shall be submitted by the Contractor to Engineer for approval for the use of Equipment and Materials to complete the Work or as needed to describe the following:
         i) Operation and maintenance
         ii) Technical properties
         iii) Installation
      b. Shop drawings: Custom prepared data for the Project and Work including performance and capacity curves, diagrams, bills of material, instructions, and other information
      c. Product data: Non-custom prepared printed information for the Project and Work on materials and products
      d. Samples: Fabricated and non-fabricated tangible samples of products and material
         i) Used for visual inspection and testing and analysis
   2. Informational submittals: Reports, administrative informational submittals, certification and guarantees not including and defined as shop drawings, samples and product data
      a. Reports: Include laboratory reports and tests, technical procedures and records and design analysis
      b. Administrative informational submittals: Submittals necessary for administrative records such as construction photographs, work records, schedules, standards, record project data, safety data, and similar information submittals
      c. Certification: Includes manufacturer or supplier certificates and guarantees

B. General Requirements

1. Quality
    a. Shall be of suitable quality for legibility and reproduction purposes
    b. Shall be useable for reproduction yielding legible hard copy
    c. Submittals not conforming to specified requirements herein and as specified in Divisions 2 through 16 shall be subject to rejection by Engineer and upon Engineer request, Contractor shall resubmit documents that are in conformance
2. Dimensions
    a. English units shall be provided on submittals
    b. Metric units are acceptable in addition to English units
    c. English units shall govern
3. Form of submittals
    a. Submittals shall be transmitted in electronic format as specified herein
    b. Scanned submittals are acceptable
    c. Electronic project documents and submittals shall be transmitted in the following format:
        i) Native electronic format, nonproprietary
        ii) Adobe PDF produced from native electronic format
    d. Filename:
        i) Shall be consistent for the initial and any subsequent submission revisions for a single submittal
        ii) Contractor shall use a consistent naming convention for all submittals
            a) Use number of original submittal followed directly by a capital letter corresponding to the number of times a submittal is resubmitted (i.e., #001, #001A, #001B, etc.)
4. Non-conforming submittals shall be subject to rejection by Owner and/or Engineer
5. Submittal completion requirements
    a. Submittals shall include design criteria, dimensions, construction materials and all other information specified for a complete submittal to facilitate Engineer review of the submittal information adequately
    b. In the event various drawings are included a submittal for a class of Equipment, Contractor shall annotate clearly which parts apply to furnished Equipment
        i) Information not pertaining to the submittal shall be clearly annotated. Highlighting of such information will cause rejection of the submittal by the Engineer
    c. Contract Drawings
        i) Copies or portions thereof will not be allowed as acceptable fabrication or erection drawings
        ii) In the event Contract Drawings are used by the Engineer for erection drawings to annotate information on erection or identify reference details, Engineer title block and professional seal shall be removed and replaced with the Contractor's title block on the Contract Drawing(s). Contractor shall revise such erection drawings for subsequent revisions by the Engineer to Contract Drawings

C. Preparation
1. Shop Drawings
    a. Drawings shall be presented in a clear and thorough manner:

b. Identify details by reference to sheet and detail, schedule or room numbers shown on Contract Drawings
c. Identify equipment by reference to equipment name and tag number shown on Contract Drawings
d. Scale and Measurements: Make drawings accurate to a scale with sufficient detail to show the kind, size, arrangement and function of component materials and devices
e. Minimum sheet size: 8.5" by 11"
f. Fabrication drawing size: 11" by 17" or 24" by 36"

2. Product Data
a. Clearly mark each copy to identify pertinent products or models submitted for review
b. Identify equipment by reference to equipment name and P&ID number
c. Catalog cut sheets: Cross-out or hatch irrelevant data

D. Technical Submittals: Shop Drawings and Product Data Submittal Requirements
1. Shop Drawings and Product Data shall include the following, at a minimum:
a. Specifications of manufacturer(s)
b. Equipment parts and catalogs
c. Bills of materials, material lists, and schedules
d. Shop erection and fabrication drawings
e. Drawings shall include equipment dimensions, weights, installation location requirements, plates required, main components, support details, anchor bolt details/sizes/locations, support base sizes, baseplate sizes, spacing and clearance requirements for installation, erection, operation and maintenance disassembly
f. Electrical requirements:
i) Shall include schematic diagrams including one-line diagrams, terminal block numbers, internal wiring diagrams, external connections, controls, and any other information as requested in individual specification sections
g. List of spare parts
h. Instruction and Operation and Maintenance (O&M) manuals
i) As specified herein and in Specification Section 01730
i. Manufacturer's performance testing of equipment
j. Concrete mix design data and information
k. Performance characteristics and capacities
l. External connections, anchorages, and supports required
m. Other drawings, parts, catalogs, specifications, samples, or data necessary for the Engineer to determine conformance with Contract Documents

2. Samples – Office samples shall be of sufficient size and quantity to clearly illustrate:
a. Functional characteristics of the product, with integrally related parts and attachment devices
b. Full range of color, texture and pattern
c. Comply with requirements identified in individual specification sections

E. Construction Schedule: Designate in the construction schedule, or in a separate coordinated shop drawing schedule, the dates for submission and the dates that reviewed Shop Drawings and Product Data will be needed, if accelerated review is requested

F. Field samples and Mock-ups:
   1. Contractor shall erect, at the Project Site, at a location acceptable to the Engineer and Owner
   2. Size or area: as specified in the respective specification section
   3. Fabricate each sample and mock-up complete and finished
   4. Remove mock-ups at conclusion of Work or when acceptable to Engineer

1.4 CONTRACTOR RESPONSIBILITIES

A. Review shop drawings and product data prior to submission for accuracy and completeness of each submission

B. Approve and stamp each submission before submitting to Engineer

C. Determine and verify:
   1. Field measurements
   2. Field construction criteria
   3. Catalog numbers and similar data
   4. Conformance with specifications and identification of all deviations
   5. Confirm assignment of unit responsibility

D. Prior to each submission, carefully review and coordinate all aspects of each item being submitted

E. Verify that each item and the corresponding submittal conform in all respects with specified requirements of the Work and of the Contract Documents with respect to means, methods, techniques, sequences, and operations of construction, and safety precautions and programs incidental thereto

F. Make submissions promptly in accordance with Construction Schedule, and in such sequence as to cause no delay in the Work or in the work of any other Contractor

G. Limit requirement for accelerated submittal review by Engineer to no more than 10% percent of total number of submittals
   1. Accelerated submittal review period: less than 14 calendar days

H. Notify Engineer in writing, at time of submission, of any deviations in the submittals from Contract Document requirements:
   1. Identify and tabulate all deviations in transmittal letter
   2. Indicate essential details of all changes proposed, including modifications to other facilities that may be a result of the deviation
   3. Include required piping and wiring diagrams

1.5 SUBMISSION REQUIREMENTS

A. Make submissions far enough in advance of scheduled dates for installation to provide time required for reviews, for securing necessary approvals, for possible revisions and resubmissions, and for placing orders and securing delivery

B. In scheduling, allow fourteen (14) calendar days for review by Engineer following receipt of submission in Engineer's office:
   1. Time required to mail submissions or resubmissions is not considered a part of review period

C. Submittal Naming and Numbering
   1. Assign a unique number to include all shop drawings, product data and other information required for individual specification sections, beginning with #001.
   2. Resubmissions shall have the original number with a letter, starting with "A". If the first submittal required resubmission, it would be labeled #001A.
   3. Each specification section may still have more than one submittal number for later submissions (i.e., Preliminary O&M Manuals, Final O&M Manuals, etc.)
   4. Contractor shall use a consistent naming convention for all submittals

D. Quantity of Submittals Required
   1. Shop Drawings and Product Data:
      a. Initial submittal:
         i) Electronic – One (1) copy to Engineer
      b. Resubmittal:
         i) Electronic – One (1) copy to Engineer
      c. Final Submittal for Distribution
         i) Paper hard copy - Maximum of two (2) copies for Contractor's use, plus a maximum of three (3) copies which will be distributed by Engineer when approved. Do not submit more than five (5) copies
         ii) One (1) electronic copy to Engineer
      d. As –constructed document submittals
         i) Paper hard copy – Maximum of two (2) copies for Contractor's use, plus a maximum of three (3) copies which will be distributed by Engineer when approved. Do not submit more than five (5) copies
         ii) Electronic – One (1) copy to Engineer and one (1) copy to Owner
   2. Samples
      a. Initial submittal:
         i) Submit three (3) of each sample unless specified otherwise in individual specification section
      b. Resubmittal:
         i) Submit three (3) to Engineer
      c. One (1) sample of approved sample submittal will be returned to Contractor
   3. Informational submittals
      a. Technical reports and administrative submittals
         i) Electronic – One (1) copy to Engineer
         ii) Paper: Three (3) copies to Engineer
      b. Certificates and guarantees:
         i) Electronic – One (1) copy to Engineer
         ii) Paper: Three (3) copies to Engineer
      c. Test reports
         i) Paper
            a) Owner: Two (2) copies

b) Engineer: One (1) copy
c) Contractor: Two (2) copies
d) Manufacturer/supplier: One (1) copy

4. Instruction and O&M manuals
   a. In accordance to Specification Section 01730
5. At no additional cost to the Owner and whether or not submittals are copyrighted, the Owner may copy and use for staff training and/or internal operations any submittals approved for final distribution as well as required by this Contract

E. Submittal Transmittal Requirements
1. Accompany each submittal with a letter of transmittal showing all information required for identification and checking
2. Shall include:
   a. Drawing numbers and titles
   b. Revision number
   c. Electronic filename
   d. Deviations from Contract Documents: As specified herein
   e. Submittals unidentifiable will be returned for proper identification
   f. Date

F. Submittals Requirements
1. Submittal number
2. Date of submission and dates of any previous submissions
3. Project title and number
4. Owner Contract identification number if applicable
5. Names of:
   a. Contractor
   b. Supplier
   c. Manufacturer
6. Identification of the product, with the specification section number
7. Field dimensions, clearly identified as such
8. Relation to adjacent or critical features of the Work or materials
9. Applicable standards, such as ASTM or Federal Specification numbers
10. Identification of deviations from Contract Documents:
    a. If Contractor proposes to provide material or equipment of Work which deviates from the Project Manual, Contractor shall indicate so under “deviations” on the transmittal form accompanying the submittal copies
    b. Identify all requested deviations as specified and on the copies of Specifications and Drawings required by paragraph below.
11. Confirmation of compliance with Contract Documents and, if applicable, identification of deviations from Contract Documents:
    a. Provide the following documents to demonstrate compliance with the contract specifications:
       i) A copy of the relevant Drawing(s) with all addendum updates that apply to the equipment in various Divisions marked to show specific changes necessary for the equipment proposed in the Contractor’s submittal

a) If no changes are required, the Drawing(s) shall be clearly marked "No Changes Required"
b) Failure to include copies of relevant Drawing(s) with the submittal, whether changes are required or not, shall be cause for rejection of the entire submittal with no further review by Engineer
c) Relevant Drawing(s) include as a minimum the control diagrams, process and instrumentation diagrams (P&IDs), and Process (P) drawings.

ii) A copy of each pertinent specification section with all addendum updates included, all referenced and applicable specifications sections, with their respective addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate the requested deviations from the specification requirements:
a) If deviations from the specifications are indicated and, therefore requested, by the Contractor, the submittal shall be accompanied by a detailed, written justification for each deviation
b) Failure to include a copy of the marked up specification sections, along with justification for any requested deviations to the specification requirements, with the submittal shall be cause for rejection of the entire submittal with no further review by Engineer

12. Identification of revisions on resubmissions
13. An 8" by 4" blank space for Contractor's and Engineer's stamps
14. Stamp cover sheet of each submittal as identified in letter of transmittal
15. Contractor's stamp: Initialed or signed, certifying review and approval of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the Work and of Contract Documents. Use stamp to include wording similar to the following:

This submittal has been reviewed by [*Name of Contractor*] and approved with respect to the means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incidental thereto. [*Name of Contractor*] also warrants that this submittal complies with contract documents and comprises no deviations thereto: Section No:_____ Submittal No: Date:_____ By:

G. For equipment that is provided directly by manufacturer without specification provide:
1. Shop drawings: Illustrate complete assembly of products; foundation, installation and anchor requirements; dimensions and total weights of each, electrical wiring diagrams
2. Product data: Provide manufacturer's literature including general assembly, materials of construction, model and type, detailed data describing parts and accessories, sufficient data to verify compliance with specifications
3. Manufacturer's installation instructions: Provide detailed connection requirements and startup instructions

4. Manufacturer’s field report: Indicate personnel present and actual start-up procedures that were performed by manufacturer’s representative
5. Field report and test results shall be submitted to the Engineer by the Contractor

H. Submittal Log:
1. Maintain an accurate submittal log for duration of the Work showing current status of all submissions
2. Show submittal number, section number, section title, submittal description, dates and disposition of submittal
3. Make submittal log available to Engineer for Engineer's review upon request

I. Unless specified otherwise, make submissions in groups to facilitate efficient review and approval:
1. Include all associated items from individual specification sections to assure that all information is available for checking each item when it is received
2. Submit a complete initial submittal including all components when an item consists of components from several sources
3. Partial submittals may be rejected as not complying with provisions of the Contract
4. Engineer will not be held liable for delays due to poorly organized or incomplete submissions
5. Do not include items from more than one specification section for any one submittal number

J. Contractor may require subcontractors to provide drawings, setting diagrams and similar information to help coordinate the Work, but such data shall remain between Contractor and his subcontractors and will not be reviewed by Engineer unless specifically called for within the Contract Documents

K. All submittals for each component of multi-component systems shall be compiled and submitted through the Contractor to the Engineer by the manufacturer having System Responsibility

1.6 DISPOSITION OF SHOP DRAWINGS, PRODUCT DATA, AND INFORMATION SUBMITTALS

A. "No Exceptions Taken": Approved with No Corrections Noted
1. One copy sent to Owner
2. One copy sent to Resident Project Representative
3. One copy retained in Engineer's file
4. Remaining copies returned to Contractor for his use
   a. One copy to be kept on file at Contractor's office at job site
   b. Remaining copies for Contractor's office file, suppliers, or subcontractors
5. No corrections or comments noted on the submittal or on a Submittal Response Summary Sheet
6. Issues or miscellaneous comments pertaining to other related items of the Work may be included in transmittal letter
7. Resubmission not required

B. "Exceptions Noted": Approved with Corrections Noted
   1. One copy sent to Owner
   2. One copy sent to Resident Project Representative
   3. One copy retained in Engineer's file
   4. Remaining copies returned to Contractor for his use
      a. One copy to be kept on file at Contractor's office at job site
      b. Remaining copies for Contractor's office file, suppliers or subcontractors
      c. Copies of submittal data in operation and maintenance manuals to be revised according to corrections
   5. Comply with corrections or comments as noted on the submittal or on a Submittal Response Summary Sheet
   6. Resubmission not required

C. "Revise And Resubmit": Incorrect information provided or Significant Information Still Required
   1. One copy sent to Resident Project Representative
   2. One copy retained in Engineer's file
   3. All remaining copies returned to Contractor for revision and re-submittal
   4. Copy of transmittal letter and/or Submittal Response Summary Sheet sent to Owner. A "No Exceptions Taken" or "Exceptions Noted" submittal it will be forwarded to Owner after review per above disposition requirements
   5. Submittal is either: incorrectly annotated; specific comments need to be addressed and incorporated in re-submittal; and/or additional information may be required as noted on the submittal or on a Submittal Response Summary Sheet
   6. Submitted information may not include or address specific item required per the specification as identified on the submittal or on a Submittal Response Summary Sheet
   7. Specific information related to identified item may be required for final approval of submittal
   8. Resubmission of entire submittal may be required or resubmission of specific item may be required as identified on the submittal or on a Submittal Response Summary Sheet

D. "Rejected": Returned for Correction
   1. One copy sent to Resident Project Representative
   2. One copy retained in Engineer's file
   3. All remaining copies returned to Contractor
   4. Copy of transmittal letter and/or Submittal Response sent to Owner
   5. Contractor required to resubmit complete submittal package in accordance with Contract Documents
   6. Submittal does not comply with provisions of Contract Documents as noted on the submittal or on a Submittal Response Summary Sheet
   7. Resubmission required

E. “Receipt Acknowledged”: For Reference Purposes Only, or for Record Copy:
   1. Applicable to manufacturer or Contractor provided calculations and other miscellaneous documentation no subject to Engineer review and approval
   2. One copy sent to Resident Project Representative

3. One copy retained in Engineer's file
4. One copy returned to Contractor
5. Copy of transmittal letter sent to Owner
6. Remaining submittal copies destroyed
7. Detailed review and comment by Engineer not required
8. Resubmission not required

1.7 DISPOSITION OF SAMPLES

A. "No Exceptions Taken": Approved with No Corrections Noted
1. One sample sent to Owner
2. One sample sent to Resident Project Representative
3. One sample retained in Engineer's file
4. Acknowledgement: Copy of transmittal letter sent to Contractor
5. Resubmission not required

B. "Exceptions Noted": Approved with Corrections Noted
1. One sample sent to Owner
2. One sample sent to Resident Project Representative
3. One sample retained in Engineer's file
4. Acknowledgement: Copy of transmittal letter sent to Contractor
5. Work performed or products furnished to comply with exceptions noted in acknowledgement
6. Resubmission not required

C. "Rejected": Returned for Correction
1. One sample retained in Engineer's file
2. Remaining samples sent to Contractor for resubmittal and compliance with the Contract Documents as noted in transmittal letter
3. Copy of transmittal letter sent to Owner
4. Resubmission required

1.8 RESUBMISSION REQUIREMENTS

A. Make any corrections or changes in submittals required by Engineer and resubmit until approved

B. Transmit each resubmission under new letter of transmittal. Use number of original submittal followed directly by a capital letter corresponding to the number of times a submittal is resubmitted (i.e., #001, #001A, #001B, etc.)

C. Shop Drawings and Product Data
1. Revise initial drawings or data and resubmit as specified for the initial submittal
2. Indicate any changes which have been made other than those requested by Engineer

D. Samples: Submit new samples as required for initial submittal

E. Reimbursement of Resubmission Review Costs:

1. Review of first submittal and one resubmittal will be performed by Engineer at no cost to Contractor
2. Cost for review of subsequent resubmissions will be directly paid by Contractor
3. Engineer will document work-hours required for review and costs for Engineer review will be deducted from payments due Contractor as Change Order deducts
4. Charges for review of resubmissions will include Engineer at maximum rate of $150 per hour and administrative staff at maximum rate of $75 per hour

1.9 PROJECT RECORD SUBMITTALS

A. After completion of the Work and prior to final payment, Contractor shall furnish record documents and final approved shop drawings and samples (as-constructed shop drawings and samples) in the number of copies specified herein.
   1. Contractor shall provide additional copies of final approved shop drawings and samples for insertion in Equipment instruction and O&M manuals as required
   2. All copies shall be clearly marked “Project Record”

1.10 ENGINEER'S DUTIES

A. Review submittals with reasonable promptness and in accordance with approved submission schedule provided that each submittal has been called for by the Contract Documents and is stamped by Contractor as indicated above
   1. No extensions of time are allowed due to Engineer’s delay in reviewing submittals unless all the following criteria are met:
      a. Contractor has notified Engineer in writing that timely review of particular submittal in question is critical to the progress of the Work and Contractor has identified the requested submittal return date.
      b. Engineer has failed to return submittal within 21 days of receipt of the submittal or receipt of said notice, whichever is later
      c. Contractor demonstrates that delay in progress of the Work was directly attributable to Engineer’s failure to return submittal within 21 days
   2. No extensions of time are allowed due to delays in progress of the Work caused by rejection and subsequent resubmission of data, including multiple resubmissions
   3. Engineer’s review shall not extend to means, methods, techniques, sequences, construction operations, and safety precautions and programs incidental thereto. No information regarding these items will be reviewed whether or not included in submittals
   4. In the event that Engineer will require more than 21 calendar days to perform review, Engineer shall so notify Contractor

B. Review drawings and data submitted only for general conformity with Contract Documents
   1. Engineer’s review of drawings and data returned marked No Exceptions Taken or Exceptions Noted does not indicate a thorough review of all dimensions, quantities, and details of material, equipment device or items shown
   2. Engineer’s review does not relieve Contractor of responsibility for errors, omissions or deviations nor responsibility for compliance with the Contract Documents

C. Assume that no shop drawing or related submittal comprises a deviation to the Contract Documents unless Contractor advises Engineer otherwise in writing which is acknowledged by Engineer in writing:
   1. Consider and review only those deviations from the Contract Documents clearly identified as such on the submittal and tabulated on the Contractor's transmittal sheet.

D. Review informational submittals for indications of Work or Material deficiencies and will respond to Contractor regarding such deficiencies

E. Return submittals to Contractor for distribution or for resubmission

F. Transmit, unreviewed, to Contractor all copies of submittals received directly from suppliers, manufacturers and subcontractors

G. Transmit, unreviewed, to Contractor all copies of submittals not called for by the Contract Documents or which have not been approved by Contractor

H. Engineer will not review uncalled-for shop drawings or product data except by special arrangement

I. Affix stamp and indicate approval for submittal or resubmission requirements with the following stamp:

☐ NO EXCEPTIONS TAKEN ☐ EXCEPTIONS NOTED
☐ REVISE & RESUBMIT ☐ REJECTED
This review was performed only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Modifications or comments made on the shop drawings and product data during this review do not relieve Contractor from responsibility for compliance with the requirements of the plans and specifications. Contractor is responsible for: dimensions and quantities; information that pertains solely to the fabrication processes or to the means, methods, of construction; coordination of the work of all trades.

JVA, Inc.

Date_____ By_____

1.11 SUBMITTAL SCHEDULE

A. Unless indicated otherwise, provide all submittals required by individual sections of the Contract Documents to establish compliance with the specified requirements.

B. Contractor to produce schedule of submittals for Engineer review

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01380

CONSTRUCTION PHOTOGRAPHS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Construction record photographs prior to commencing and during the course of the Work

1.2 RELATED SECTIONS

A. Section 01010 – Summary of Work

B. Section 01700 – Contract Closeout: Project Record Documents

1.3 PHOTOGRAPHY REQUIRED

A. Take photographs of the existing conditions prior to commencing work to document existing conditions

B. Take photographs on the date on which each scheduled Application for Payment is due. Intent is for digital photos to be kept as project record

C. CD of Digital photos become the property of Owner

1.4 COSTS OF PHOTOGRAPHY

A. Pay all costs for specified photography and printing
   1. Parties requiring additional photography or prints will pay for them directly

1.5 DELIVERY OF PHOTOS

A. Submit digital photos to the Engineer with monthly pay requests or within 20 days of photo date

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 TECHNIQUE

A. Factual Presentation

B. Correct Exposure and Focus
   1. High resolution and sharpness
   2. Maximum depth-of-field

3. Minimum distortion

3.2 VIEWS REQUIRED

A. Photograph from locations to adequately illustrate the condition of construction and the state of the Project
   1. Photographic survey of the existing site
      a. Show all areas to be modified
      b. Show all areas in which Contractor will conduct operations or store equipment
   2. Weekly photographs
      a. Minimum of eight (8) views weekly until final acceptance
      b. Views as designated by the Engineer or Owner

3.3 PHOTOGRAPH REQUIREMENTS FOR PROGRESS SITE PHOTOGRAPHS

A. Responsibility
   1. Site photographs for Owner record of construction progress shall be the responsibility of the Contractor
   2. Contractor shall be responsible for site photographs including the existing and progress of Work

B. Photographs shall include, but not limited to, the following:
   1. Existing site: Photographs of existing site conditions before site work commences
      a. Number of views shall be sufficient to cover the existing site conditions
   2. Progress of work: Shall include photographs from clearing throughout construction
      a. Number of views shall be sufficient to cover progress in Work and shall include a minimum of eight (8) different views
   3. After completion of Work: Shall be sufficient to show completed and finished Work

C. Digital images
   1. Provide images in uncompressed JPEG format
   2. Minimum resolution: 1500 x 2200
   3. Submitted digital images shall not be cropped

D. Identify each digital image file
   1. Name of project
   2. Orientation and description of view
   3. Date and time of exposure

3.4 ADDITIONAL PHOTOGRAPHS

A. Contractor shall provide additional photographs upon the request of the Engineer

B. Additional photographs may include, but not limited to, the following:
   1. Publicity photographs
   2. Special events at Project site
   3. Major phase of Work
   4. Substantial Completion
   5. Follow-up investigations for on-site events such as construction damage or losses

6. Additional record photographs during final acceptance

3.5 PROJECT RECORD

A. Submit CD of all photos, grouped by date

B. Engineer will distribute, after review
   1. One copy of each view to Owner
   2. One copy of each view to Engineer's file
   3. One copy of each view returned to Contractor for inclusion in Project Record Document

END OF SECTION

SECTION 01400

QUALITY CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Quality assurance/Control of installation

B. Inspection and testing laboratory services

C. Qualification of laboratory

D. Laboratory duties

E. Limitations of authority of testing laboratory

F. Contractor's responsibilities

G. Field testing

H. Testing and services schedule

1.2 RELATED SECTIONS

A. Section 01010 - Summary of Work

B. Section 01340 - Shop Drawings, Product Data, and Samples

1.3 REFERENCES

A. Conform to reference standard by date of issue current on date of Contract Documents

B. Obtain copies of standards when required by Contract Documents

C. Where specified reference standards conflict with Contract Documents, request clarification for Engineer before proceeding

D. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document

1.4 SUBMITTALS

A. Submit under provisions of Section 01340

B. Provide copies of written reports for materials, equipment or systems as scheduled at the end of this section. Reference each report by respective section number.

C. Laboratory Test Reports: Provide written reports of each test and inspection to Engineer. Each report shall include:
   1. Date issued
   2. Project title and number
   3. Testing laboratory name, address and telephone number
   4. Name and signature of laboratory inspector
   5. Date and time of sampling or inspection
   6. Record of temperature and weather conditions
   7. Date of test
   8. Identification of product and specification section
   9. Location of sample or test in the Project
   10. Type of inspection or test
   11. Results of tests and compliance with Contract Documents
   12. Interpretation of test results when requested by Engineer

D. Shop Test Reports: Provide reports detailing results of tests and certification from manufacturer to verify compliance with specifications

E. Field Test Reports: Provide reports detailing results of the tests. Indicate compliance or non-compliance with Contract Documents. Identify corrective action for materials and equipment which fails to pass field tests.

1.5 QUALITY ASSURANCE/CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship to produce Work of specified quality

B. Comply fully with manufacturer's instructions, including each step in sequence

C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Engineer before proceeding

D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship

E. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement

F. Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals of public authorities: Conditions of the Contract

G. Certification of products: Respective sections of specifications

H. Laboratory tests required and standards for testing: Respective sections of specifications

1.6 INSPECTION AND TESTING LABORATORY SERVICES

A. Owner will employ and pay for the services of an independent testing laboratory to perform specified laboratory testing of materials where the technical specifications specifically obligate the Owner to provide the services
   1. Contractor shall cooperate with the laboratory to facilitate the execution of its required services
   2. Employment of the laboratory shall in no way relieve Contractor's obligations to perform the Work of the Contract
   3. Contractor shall employ and pay for the services of an independent testing laboratory to perform all specified services and testing not specifically identified in the technical specifications to be provided by Owner related to the design of mixes, products and equipment, to Engineer's review of proposed materials and equipment before, during and after incorporation in the Work and to retest materials and equipment which fail original tests

B. Retesting required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Engineer. Payment for retesting will be charged to the Contractor by deducting inspection or testing charges from the Contract Sum/Price

1.7 QUALIFICATION OF LABORATORY

A. Meet "Recommended Requirements for Independent Laboratory Qualification", published by American Council of Independent Laboratories

B. Meet basic requirements of ASTM E 329, "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction" as applicable

C. Authorized to operate in the State in which the Project is located

1.8 LABORATORY DUTIES

A. Cooperate with Engineer and Contractor; provide qualified personnel after due notice

B. Perform specified inspections, sampling, and testing of materials and methods of construction
   1. Comply with specified standards
   2. Ascertain compliance of materials with requirements of Contract Documents

C. Promptly notify Engineer and Contractor of observed irregularities or deficiencies of work or products

1.9 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

A. Laboratory Is Not Authorized To
   1. Release, revoke, alter or enlarge on requirements of Contract Documents

2. Approve or accept any portion of the Work
3. Owner employed laboratory shall not perform any duties of the Contractor

1.10 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with laboratory and testing personnel and provide access to Work

B. Secure and deliver to the laboratory adequate quantities of representative samples of materials proposed to be used and which require testing

C. Provide to the laboratory the preliminary design mix proposed to be used for concrete and other material mixes which require control by the testing laboratory

D. Furnish copies of product test reports as required

E. Furnish Incidental Labor and Facilities
1. To provide access to Work to be tested
2. To obtain and handle samples at the project site or at the source of the product to be tested
3. To facilitate inspections and tests
4. For storage and curing of test samples

F. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage and assistance as requested
1. Notify Engineer and independent firm 24 hours prior to expected time for operations requiring services to allow for scheduling of tests and laboratory assignment of personnel
2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use

1.11 FIELD TESTING

A. Owner shall pay all costs associated with standard field testing of materials as detailed in these specifications. Contractor shall pay all costs for testing of piping and equipment as detailed in these specifications. Owner's independent firm will take concrete samples, cure and break samples and report results. Owner's independent firm will also provide compaction testing and proctors for backfill operations. Contractor shall pay for all retesting due to tests indicating failed conditions.

B. Provide all required materials, labor, equipment, water, and power required for testing

C. Perform all tests in presence of Engineer and provide one copy of field test results to Engineer same day of tests

D. Repair with no additional compensation all materials and equipment which fail during testing

1.12 LABORATORY TESTING AND SERVICES SCHEDULE

A. Testing laboratory services shall be provided for, but shall not be limited to, the following:

Specification Section	Type of Material, Equipment, or System	Owner (O) or Contractor (C) Provided
02300	Earthwork	C
02740	Asphalt Mixes	C
03000	Concrete Mixes	C

1.13 FIELD TESTING AND SERVICES SCHEDULE

A. Field testing shall be provided for, but shall not be limited to, the following:

Specification Section	Type of Material, Equipment, or System	Owner (O) or Contractor (C) Provided
02300	Earthwork	O
02510	Water Distribution System	C
02676	Disinfection of Water System	C
02740	Asphalt	O
03300	Cast-In-Place Concrete	O

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary Utilities: Electricity, lighting, heating, ventilating, telephone service, water and sanitary facilities

B. Temporary Controls: Barriers, enclosures and fencing, protection of the Work, and water control.

C. Construction Staging Facilities: Access roads, parking areas, progress cleaning, project signage, storage and temporary buildings.

1.2 RELATED SECTIONS

A. Section 01010 – Summary of Work

B. Section 01600 – Materials and Equipment

C. Section 01700 – Contract Closeout

D. Section 16050 – Basic Electrical Material and Methods

1.3 GENERAL REQUIREMENTS

A. Furnish, install and maintain all temporary utilities to assure continuous service required for the Work, except as allowed herein, and remove on completion of Work. Modify and extend systems, as work progress requires.

B. Furnish, install and maintain all construction aids required for the Work, except as allowed herein, and remove on completion of the Work

C. Furnish, install and maintain fences and barriers as required for protection of the public, property and the Work

D. Contractor may use existing roadways for access and parking only where designated by Owner.

E. Provide a field office for the use of the Contractor's Superintendent, Owner’s Representatives, and Engineer in the designated staging area.

F. Products may be new or used, but must be serviceable, adequate for the intended purpose, and must not violate the requirements of any applicable codes or standards

G. Clean and repair damage caused by temporary installations or use of temporary facilities. Grade and seed all disturbed areas not detailed on the drawings for other treatment

H. Provide contractor information sign posted at accessible location with contractor name and emergency phone contact information. Provide and post necessary information related to SRLF requirements.

1.4 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies
   1. Comply with applicable Federal and State rules and regulations, local codes and ordinances
   2. Comply with utility company requirements

1.5 TEMPORARY ELECTRICITY

A. Arrange for and pay all costs associated with temporary power service either from the local utility or a portable engine-generator

B. Provide power outlets for construction operations, with branch wiring and distribution boxes located at the site. Provide flexible power cords as required.

C. Provide main service disconnect and over current protection at convenient location

D. Pay all costs for installation and removal of temporary electrical service

1.6 TEMPORARY LIGHTING

A. Provide and maintain lighting to exterior staging and storage areas after dark for security purposes as required

B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required

C. Maintain lighting and provide routine repairs

1.7 TELEPHONE CELLULAR PHONE SERVICE

A. Provide, maintain and pay for all cellular telephone service for Contractor personnel at time of project mobilization

1.8 TEMPORARY WATER SERVICE

A. Potable water does exist on the site and will be provided by the City. Contractor shall coordinate all work with the City.

B. Provide all drinking water required by construction personnel and Owner's representatives. Pay all costs for temporary water service.

1.9 TEMPORARY SANITARY FACILITIES

A. Contractor shall furnish, install, and maintain sanitary facilities at staging area for use through construction and shall remove upon completion of Work
   1. Temporary sanitary facilities shall be as required by laws and regulations
   2. Not less than one (1) facility

B. Service, clean and maintain facilities and enclosures

1.10 TEMPORARY SAFETY AND HEALTH

A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety and health precautions and programs in connection with the Work

B. Contractor shall provide protections necessary in order to prevent injury or loss to Contractor’s employees

1.11 TEMPORARY FIRE PROTECTION

A. Install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers," and NFPA 241 "Standard for Safeguarding Construction, Alterations and Demolition Operations"
   1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.
   2. Store combustible materials in containers in fire safe locations
   3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas
   4. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition
   5. Contractor shall instruct Contractor’s personnel on proper use of extinguishers
   6. Warning signs and instructions shall be posted at each extinguisher location
   7. Contractor shall post local Fire Department telephone number

1.12 CONSTRUCTION AIDS

A. Provide construction aids and equipment required by personnel and to facilitate the execution of the Work, including but not limited to: scaffolds staging, ladders, stairs, ramps, runways, platforms, railways, hoists, cranes, chutes and other such facilities and equipment

B. Relocate construction aids as required by progress of construction, by storage or work requirements, and to accommodate legitimate requirements by Owner

C. Completely remove temporary materials, equipment, and services at completion of the Project

D. Clean, repair damage caused by installation or by use of temporary facilities
   1. Remove foundations and underground installations for construction aids
   2. Grade the areas for the site affected by temporary installations to required elevations and slopes and clean the area and seed unless specified as shown on the drawings to be different

1.13 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations and demolition

B. Provide suitable barriers as required for public protection of Owner's employees

C. Protect non-owned vehicular traffic, stored materials, site and structures from damage

D. Install facilities of a neat and reasonable uniform appearance, structurally adequate for the required purposes

E. Relocate barriers as required by progress of construction

F. Completely remove barriers, including foundations, when construction has progressed to the point that they are no longer needed

G. Clean and repair damage caused by installation, fill and grade the areas of the site to required elevations and slopes and clean the area

1.14 TEMPORARY FENCING

A. Construction: Commercial grade chain link fence

B. Provide additional fencing to protect stored materials & products or to insure public safety and the safety of Owner's employees

C. Provide Owner two (2) keys to lock(s)

D. The site of the work is fenced

1.15 FUGITIVE DUST PERMIT

A. Comply with all conditions of CDPHE Fugitive Dust Permit. Contractor responsible for both permit filing and any required reporting.

B. Contractor to pay for all metered water used in dust abatement

1.16 PROTECTION OF INSTALLED WORK

A. Protect installed Work and provide special protection where specified in individual specification Sections

B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.

C. Protect finished driving surfaces, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects

D. Prohibit construction traffic from entering future landscaped areas after grades have been established and topsoil restored

1.17 SECURITY

A. Provide security and facilities to protect Work from unauthorized entry, vandalism, or theft

B. Coordinate with Owner's security program

1.18 ACCESS ROADS

A. Maintain existing roads accessing public thoroughfares to construction staging area

B. Extend and relocate as Work progress requires. Provide detours necessary for unimpeded traffic flow.

C. Provide and maintain access to existing fire hydrants free of obstructions

D. Provide means of removing mud from vehicle wheels before entering public paved streets as required by SWMP and Owner

1.19 PARKING

A. Paved and unpaved surfaces adjacent to the staging area can accommodate construction personnel until the designated building staging area has been established

B. If staging area space is not adequate, provide additional off-site parking at location designated by Owner

1.20 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove waste materials, debris, and rubbish from site periodically and dispose off-site in accordance with local and state regulations. If high winds are experienced at the site, waste removal must be done immediately after it is generated.

1.21 SEPTIC SYSTEM

A. The existing water treatment plant is served by an existing septic system. The Contractor shall protect this system and is responsible for all costs and damage that occur to the system from their work operations.

1.22 STAGING AREA

A. The City will provide a staging area for the Contractor's trailer, equipment and material storage onsite. If additional storage area is required it shall be located offsite and at the cost of the Contractor.

B. The Contractor is responsible for returning the staging area to the pre-existing condition at the completion of all work.

1.23 FIELD OFFICES AND SHEDS

A. Construction
   1. Structurally sound, weather-tight, with floors raised above ground
   2. Temperature transmission resistance: Compatible with occupancy and storage requirements
   3. At Contractor's option, portable or mobile buildings modified for office use may be used
   4. Fill and grade sites for temporary structures to provide surface drainage
   5. Construct temporary storage sheds on proper foundations
      a. Secure portable or mobile buildings for winds to 90 mph, exp C, per Section 01600
      b. Provide steps and landings at entrance door
   6. Provide periodic maintenance and cleaning for temporary structures, furnishings, equipment and services
   7. Remove storage sheds when they are no longer needed
   8. Remove foundations and debris; grade the site to required elevations and clean the areas

B. Contractor's Office and Facilities (Contractor's option)
   1. Size: As required for general use and to provide space for project meetings
   2. Internet: Internet access and email capabilities
   3. Telephone: Wireless phone capabilities
   4. Other furnishings: Contractor's option
   5. One 10-inch outdoor-type thermometer

C. Existing facilities at the site shall not be utilized for field offices or storage, except the Owner will allow for construction progress meetings to be held in the conference room at the City of Grand Junction Water Treatment Plant.

D. Fire protection equipment. Contractor shall provide and maintain fire extinguishers and active fire hydrants where indicated, maintain fire lanes to hydrants, and provide other equipment as necessary for proper fire protection during construction. Such equipment shall be for fire protection only.

1.24 REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary above grade or buried utilities, equipment, facilities, materials, prior to Final Application for Payment

B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.

C. Clean and repair damage caused by installation or use of temporary work

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01550

CUTTING AND PATCHING

PART 1 GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for cutting and patching

B. Work included in this Section
   1. Cutting and patching not required to be performed as part of the work of other sections
   2. Cutting and patching existing work altered or disturbed to accommodate new construction
   3. Cutting and patching existing work damaged or defaced during new construction as required to restore to existing or better condition at the time of award of Contract
   4. Cutting and patching required to
      a. Install or correct non-coordinated work
      b. Remove and replace defective and non-conforming work
      c. Remove samples of installed work for testing

C. Contractor shall be responsible for all cutting, and patching, including attendant excavation and backfill, required to complete the Work or to:
   1. Uncover portions of the Work to provide for installation of ill-timed work
   2. Remove and replace defective work
   3. Remove and replace work not conforming to requirements of Contract Documents
   4. Remove samples of installed work as specified for testing

1.2 DEFINITIONS

A. Cutting includes cutting into nominally completed or existing construction including, but not limited to, the following, in order to provide for the coordination of Work, installation of Work, uncovering of other facilities and structures for access or inspection, or obtaining samples for testing or other similar purposes
   1. Concrete
   2. Masonry
   3. Steel
   4. Wood
   5. Miscellaneous metal structures
   6. Piping and pavement

B. Patching includes the repair required to restore cut materials to original or better condition

C. Submittals

1. Submit a proposal describing procedures in advance of the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
    a. Extent: For each occurrence, describe the cutting and patching required, show how it will be performed and indicate the reason(s) it cannot be avoided
    b. In-place construction changes: Describe anticipated results and include changes to structural elements and operating components in addition to changes in building's appearance and other significant visual elements
    c. Products: List products to be used and firms or entities that will perform the Work
    d. Dates: Indicate when cutting and patching will be performed
    e. Utility services and mechanical and electrical systems:
        i) List services and systems that cutting and patching procedures will disturb or affect
        ii) List services and systems that will be relocated and that will be temporarily out of service
        iii) Indicate how long services and systems will be disrupted
    f. Structural elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with the original structure
    g. Approval by Engineer:
        i) Obtain approval of cutting and patching proposal before cutting and patching
        ii) Approval does not waive right to later require removal and replacement of unsatisfactory work

D. Quality Assurance
1. Structural work requirements: Do not cut and patch structural elements in a manner that would reduce their load-carrying or load-deflection ratio
    a. Obtain Engineer approval of cutting and patching proposal before cutting and patching the following structural elements:
        i) Bearing and retaining walls, foundation construction, and structural concrete and structural steel
        ii) Lintels
        iii) Timber and primary wood framing
        iv) Structural decking and stair systems
        v) Equipment supports, piping, ductwork, vessels, and equipment
        vi) Miscellaneous structural metals
2. Operational limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance or decreased operational life or safety
    a. Obtain Engineer approval of cutting and patching proposal before cutting and patching the following operating elements or safety related systems:
        i) Primary operational systems and equipment
        ii) Air, smoke, water, moisture, or vapor barriers
        iii) Membrane and flashings
        iv) Fire protection, control, communication, or electrical wiring systems
        v) Noise and vibration control elements and systems

3. Visual requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Engineer's opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching
    a. Retain the original installer or fabricator throughout construction phases to cut and patch the following categories of exposed work, if possible, or if it is not possible to engage the original installer or fabricator, engage another recognized experienced and specialized firm:
        i) Concrete finishes
        ii) Pre-formed metal panels
        iii) Painting
        iv) Wall covering
        v) HVAC enclosures, cabinets, or covers
        vi) Firestopping

E. Warranty
1. For existing warranties, Contractor shall replace, patch, and repair material and/or surfaces cut and/or damaged by methods and with materials in order to not void any warranties required or existing

PART 2 PRODUCTS

A. Materials
1. Use materials identical to existing materials unless not available
    a. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials matching existing adjacent surfaces to the fullest extent possible with regard to visual effect
    b. Before proceeding, Contractor shall obtain approval of the Engineer
    c. Use materials whose installed performance will equal or surpass that of existing materials

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect existing conditions of the Project, including elements subject to damage or to movement during cutting and patching. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered

B. After uncovering work, inspect the conditions affecting the installation of products, or performance of the work

C. Report unsatisfactory or questionable conditions to the Engineer in writing; do not proceed with the work until the Engineer has provided further instructions

3.2 PREPARATION

A. Provide devices and methods to protect other portions of the Project from damage

B. Provide temporary support of Work to be cut where required

C. Provide protection from the elements for that portion of the Project which may be exposed by cutting and patching work, and maintain excavations free from water
   1. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations

D. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas

E. Take all precautions necessary to avoid cutting existing pipe, conduit or ductwork serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them

F. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes

G. Restore work which has been cut or removed; install new products to provide completed Work in accordance with requirements of Contract Documents

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay

B. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition
   1. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations
      a. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use
      b. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces
      c. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill
      d. By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting
      e. Provide fire-safe seals to maintain fire rating at all penetrations
   2. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances

a. Where feasible, inspect and test patched areas to demonstrate integrity of the installation
b. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing
c. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance
d. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken containing the patch, after the patched area has received primer and second coat
e. Patch, repair or re-hang existing ceilings as necessary to provide an even plane surface of uniform appearance
f. Replace concrete walkways to nearest construction joint

3. Plaster Installation: Comply with manufacturer's instructions and install thickness and coats as indicated

3.4 CLEANING

A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Remove completely paint, mortar, oils, putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied. Restore damaged pipe covering to its original condition

END OF SECTION

SECTION 01600

MATERIALS AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Administrative and procedural requirements governing Contractor's selection of products for use in Project and for Work including, but not limited to, the following
   1. Definitions
   2. General Requirements for Materials and Equipment
   3. Environmental Conditions
   4. Submittals
   5. Quality Assurance and Qualifications
   6. System Responsibility
   7. Transportation and Shipment
   8. Delivery, Storage and Handling
   9. Maintenance Materials
   10. Warranty
   11. Product Selection
   12. Preparation and Installation
   13. Examination, Installation, Adjusting and Cleaning

1.2 RELATED SECTIONS

A. Section 01010 – Summary of Work

B. Section 01340 – Shop Drawings, Product Data, and Samples

C. Section 01400 – Quality Control

1.3 REFERENCES

A. American National Standards Institute – ANSI
   1. B1.1-89-Unified Screw Threads
   2. B18.2.1-81-Square and Hex Bolts and Screws, Including Askew Head Bolts, Hex Cap Screws, and Log Screws
   3. B18.2.2-87-Square and Hex Nuts

B. Hazardous (Classified) Locations: Conform to requirements of NFPA70 Articles 500 through 504

1.4 DEFINITIONS

A. Definitions used in this specification section are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finished," "accessories," and similar terms. Such terms are self-explanatory

and have well-recognized meanings in the construction industry

B. Products: Items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term “product” includes the terms “material”, “equipment”, “system”, and terms of similar intent

C. Named products: Items identified by manufacturer’s product name, including make or model number of other designation, shown or listed in the manufacturer’s published product literature that is current as of date of Contract Documents

D. Foreign products: Distinguished from “domestic products” are items substantially manufactured (50 percent or more of value) outside of the United States and its possessions. Products produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens or, nor living within, the United States and its possessions are also considered to be foreign products

E. Materials: Products substantially shaped, cut, worked, mixed, finished, refined, or otherwise fabricated, processed, or installed to form a part of the Work

F. Equipment: Product with operational parts, whether motorized or manually operated, that requires service connections, such as wiring or piping

G. Special tools, instruments, devices, or accessories: Any tools, instruments, devices or accessories required for repair, adjustment or maintenance of equipment which are designed especially for the equipment in question or which are not normally kept in stock by local tool suppliers

H. Responsible manufacturer: Unless otherwise specified, responsible manufacturer shall be manufacturer of driven equipment. Agents, representatives or other entities who are not a direct component of manufacturing corporation will not be acceptable as a substitute for manufacturer's corporation in meeting this requirement

1.5 GENERAL REQUIREMENTS

A. The section applies to all equipment provided under this contract

B. The requirements of detailed specifications take precedence over this section in the event of an apparent conflict

C. Provide all new Equipment and Materials, except as specified or required by testing

D. Equipment and Materials removed from existing structure: Do not use in completed Work except where specifically indicated or specified

E. Contractor to coordinate equipment with other parts of the Work, including verification or compatibility of structures, piping, wiring and equipment components

F. Do not use any material or equipment for any purpose other than that for which is designed or specified

1.6 ENVIRONMENTAL CONDITIONS

A. Project is a municipal wastewater treatment facility where dilute concentrations of corrosive or explosive chemicals and gasses may be expected to be present

B. Various corrosive or explosive mixtures of liquids including; solvents, grease, gasoline and other hazardous materials may be present

C. Minimum Design Criteria:
   1. Altitude: 4,520 feet above mean sea level
   2. Outdoor air temperature:
      a. Summer Time (Low, High): 65,99 °F
      b. Winter Time (Low, High): 17,47 °F
   3. Relative Humidity:
      a. Summer time (Low, High): 14,47 percent
      b. Winter time (Low, High): 53,88 percent

1.7 SUBMITTALS

A. Provide submittals in accordance with Section 01340

B. Submittals for products are specified in Section 01340 and in Divisions 2 through 9

C. All submittals for each component of multi-component systems shall be compiled and submitted through the Contractor to the Engineer by the manufacturer having System Responsibility

D. Provide a copy of this specification section with all addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate the requested deviations from the specification requirements.

E. Provide Certificate of System Responsibility

1.8 QUALITY ASSURANCE AND QUALIFICATIONS

A. Source limitations and interchangeability: To the fullest extent possible, provide products of the same kind from a single source

B. Compatibility of options: When Contractor is given the option of selection between two or more products for use on Project, product selected shall be compatible with produces previously selected, even if previously selected products were also options

C. Installers Qualifications:
   1. Equipment and material: Installed and placed in service by or under guidance of qualified personnel having knowledge and experience necessary for proper results
   2. Where Contractor's or subcontractor's employees are not properly qualified, use personnel such as factory authorized field representative of equipment supplier

1.9 SYSTEM RESPONSIBILITY

A. Nothing in this provision shall be construed as relieving the Contractor of overall responsibility for the Work of this Contract and the performance of all systems as required under General Conditions

1.10 TRANSPORTATION AND SHIPMENT

A. Shipment preparation: Contractor shall require manufacturers and suppliers to prepare Equipment and Materials for shipment in a manner to facilitate unloading and handling, and to protect against damage or unnecessary exposure in transit and storage, for contractor supplied equipment. Provisions for protection shall include the following:
   1. Crates or other suitable packaging materials

B. Marking
   1. Each item of Material shall be tagged or marked as identified in the delivery schedule or on Submittals
   2. Complete packing lists and bills of material shall be included with each shipment.
   3. Each piece of every item need not be marked separately, provided that all pieces of each item are packed or bundled together and the packages or bundles are properly tagged or marked

1.11 DELIVERY, STORAGE, AND HANDLING

A. Delivery
   1. Arrange deliveries of Equipment and Materials in accordance with construction schedules, in ample time to facilitate inspection prior to installation and to avoid delay of Work. Coordinate to avoid conflict with work and conditions at the site
   2. Deliver products in undamaged condition, in manufacturer's sealed or covered, weather tight, original container or packaging, with identifying labels intact and legible, all in accordance with manufacturer's instructions and recommendations using means and methods that will prevent damage, deterioration, and loss, including theft
   3. Control delivery schedules to minimize long-term storage at the Site and to prevent overcrowding of construction spaces. Coordinate delivery and installation to ensure minimum holding or storage times for items known or recognized to be flammable hazardous, easily damaged, or sensitive to deterioration, theft, and other sources of loss
   4. Products delivered to Work site shall be in undamaged condition, in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing
   5. Mark deliveries of component parts of equipment to identify the equipment, to permit easy accumulation of parts, and to facilitate inspection and measurement of quantity or counting of units
   6. Immediately on delivery, inspect shipment to ensure:
      a. Product complies with requirements of Contract Documents and reviewed Submittals
      b. Quantities are correct
      c. Containers and packages are intact and labels are legible
      d. Equipment and Materials are properly protected and undamaged

7. Include complete packing lists and bills of material with each shipment including Equipment Identification number assigned by Drawings and Specifications of this Contract
8. Deliver anchor bolts together with templates sufficiently early to permit setting when structural concrete is placed

B. Storage
1. Minimal interior space is available from the Owner for storage on a case-by-case basis and must be approved by Owner prior to use.
   a. Provide adequate facilities for storage in accordance with Section 01500
   b. Provide off-site storage and protection when site does not permit on-site storage or protection and if acceptable to Owner in accordance with the General Conditions
2. Submit and maintain insurance for Equipment and Materials at off-site storage
3. Requests for payment of stored Equipment and Materials by the Contractor may be rejected if storage facilities do not conform to these specifications or manufacturer's written recommendations.
4. Store Equipment and Materials immediately on delivery, and protect until completion of the Work. Store in accordance with manufacturer's instructions with seals and labels intact and legible
5. Store Equipment and Materials in a manner that will not endanger the supporting construction
6. Store Equipment and Materials that are subject to damage by elements in weathertight enclosures
7. Maintain temperature and humidity within ranges required by manufacturer
8. Exterior storage:
   a. Provide substantial platforms, blocking, or skids to support fabricated products aboveground and to prevent soiling or staining. Cover products subject to discoloration or deterioration from exposure to elements, with impervious sheet coverings. Provide adequate ventilation to avoid condensation
   b. Store loose granular materials on solid surface areas to prevent mixing with foreign matter
   c. Provide surface drainage to prevent flow or ponding of rainwater
9. Equipment and Materials shall not show any pitting, rust, decay or other deleterious effects of storage prior to final acceptance of Work
10. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to ensure products are maintained under specified conditions and free from damage or deterioration
    a. Prepare stored materials lists with schedules of maintenance activities and frequency of activities required to maintain the quality of the equipment and the warranty from the manufacturer
    b. List dates and activities of storage requirements such as rotating moveable parts
    c. Update lists weekly and include in progress meeting agenda
11. Protect painted surfaces against impact, abrasion, discoloration or other damage:
    a. Repaint any damaged areas with manufacturer provided touch-up paint
12. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation
13. Installed products stored prior to start-up:

a. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations, dust, dirt, water and paint. Remove when no longer needed

C. Handling
1. Provide equipment and personnel necessary to unload and handle Equipment and Materials, by methods to prevent damage or soiling to Equipment and Materials or packaging
2. Handle by methods to prevent bending or overstressing. Where lifting points are designated, lift components only at those points
3. Provide additional protection to surrounding surfaces as necessary to prevent damage

D. Maintenance of storage
1. Inspect stored Equipment and Materials on a scheduled basis
2. Verify that storage facilities comply with manufacturer's product storage requirements, including environmental conditions continually maintained
3. Verify that surfaces of products exposed to elements are not adversely affected; that any weathering of finishes is acceptable under requirements of Contract Documents

E. Protection after installation
1. Provide substantial coverings as necessary to protect installed Equipment and Materials from damage from subsequent construction operations.
2. Remove when no longer needed or as specified

1.12 WARRANTY

A. Warranty all Equipment and Materials against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, leakage, breakage, delamination or other failure for a period of two (2) years from the date of Substantial Completion

B. Unless otherwise specified, for all Equipment and Materials provide manufacturer's warranty for a period of two (2) years from the date of Substantial Completion

C. Warranties that begin at the time of shipment, delivery or within a limited time period from date of shipment or delivery or any other qualification that does not conform to the definition of Substantial Completion are not acceptable

D. Cost of all manufacturer warranties are considered as part of the Bid price

PART 2 PRODUCTS

2.1 MATERIALS

A. Suitable for the intended service conditions

2.2 EQUIPMENT AND PRODUCT SELECTION

A. General product requirements: Provide products that comply with the Contract Document, are undamaged, and unless otherwise indicated or specified, are new at time of installation
   1. Standard products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects
   2. Continued availability: Where, because of the nature of its application, the Owner is likely to need additional amounts of a product at a later date, either for maintenance and repair or replacement, provide standard, domestically produced product for which the manufacturer has published assurances that the product and its parts shall be available to the Owner at a later date. A reasonable doubt regarding such future availability will be grounds for rejection of products other than named products
   3. As specified in each applicable Specification Sections, Drawings, codes, standards, and regulatory agencies
   4. Do not use products for any purpose other than that for which designed
   5. Provide products of the same kind from a single source to the fullest extent possible

PART 3 EXECUTION

3.1 EXAMINATION

A. Inspect all products for deleterious effects of storage. Do not install any equipment showing such effects. Replace damaged equipment with identical new equipment

3.2 INSTALLATION

A. Install all materials in accordance with the manufacturer's written recommendations unless otherwise specified in the individual equipment detailed technical specifications

B. Each product shall be located and aligned with other Work

C. Manufacturer’s Instructions
   1. Contractor shall obtain and distribute hard copies and electronic copies of manufacturer’s instructions and recommendations to parties involved in installation including a copy to Engineer
   2. Maintain one (1) set of complete instructions at job site during installation and until completion
   3. Handle, install, connect, clean, conditions, and adjust products in accordance with such instructions and in conformity with specified requirements

3.3 CLEANING

A. Perform under provisions of Section 01700

B. Repaint all painted surfaces which are damaged prior to final equipment acceptance to Owner's satisfaction

C. Clean exposed surfaces and protect as necessary and required to prevent any damage or deterioration at the time Substantial Completion

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Substantial completion

B. Final acceptance

C. Project record documents

D. Closeout procedures

E. Final cleaning

F. Final adjustment of accounts

G. Final application for payment

1.2 RELATED SECTIONS

A. Section 00700 – General Conditions

B. Section 01500 – Construction Facilities and Temporary Controls

C. Section 01340 – Shop Drawings and Product Data

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Prior to requesting inspection for certification of Substantial Completion, complete the following and list exceptions in the request:
   1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100% completion for the portion of the Work claimed as Substantially Complete
      a. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Price
      b. If 100% completion cannot be shown, include a list of incomplete items, the value of incomplete Work, and reasons the Work is not complete. All items remaining outstanding on the Contractor's punch list shall include a projected date of completion and/or correction with an explanation of why such item is not presently completed
   2. Advise Owner of pending insurance changeover requirements
   3. Submit specific warranties, workmanship Bonds, maintenance agreements, final certifications, and similar documents

4. Obtain and submit releases enabling Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases
5. Submit record drawings, instruction books and operating manuals, final project photographs, damage or settlement surveys, property surveys, and similar final record information
6. Deliver tools, spare parts, extra stock, and similar items
7. Make final changeover of permanent locks and transmit keys to Owner. Advise Owner's personnel of changeover in security provisions
8. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.

B. Inspection Procedures: On receipt of a request for inspection, Engineer will either proceed with inspection or advise Contractor of unfilled requirements. Engineer will prepare the Certificate of Substantial Completion following inspection or advise Contractor of construction that must be completed or corrected before the certificate will be issued
   1. Engineering will repeat inspection when requested and assured by Contractor that the Work is Substantially Complete.
   2. Results of the completed inspection will form the basis of requirements for final acceptance

1.4 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.
   1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required
   2. Submit an updated final statement, accounting for final additional changes to the Contract Price
   3. Submit a certified copy of Engineer’s final inspection list of items to be completed or corrected, endorsed and dated by Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by Engineer.
   4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the Date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work
   5. Submit consent of surety to final payment
   6. Submit evidence of final, continuing insurance coverage complying with insurance requirements

B. Reinspection Procedure: Engineer will reinspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to Engineer.
   1. Upon completion of reinspection, Engineer will prepare a certificate of final acceptance. If the Work is incomplete, Engineer will advise Contractor of Work that

is incomplete or of obligations that have not been fulfilled but are required for final acceptance
2. If necessary, reinspection will be repeated, but at the expense of the Contractor who will reimburse the Owner for these services by the Engineer

1.5 PROJECT RECORD DOCUMENTS

A. General
1. Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Engineer's reference during normal working hours.
2. Maintain on site, one set of the following record documents; record actual revisions to the Work:
   a. Contract Drawings
   b. Specifications
   c. Addenda
   d. Change Orders and other Modifications to the Contract
   e. Reviewed shop drawings, product data, and samples
   f. Field test reports
   g. Construction photographs
3. Store Record Documents and samples separate from documents used for construction
   a. Provide files and racks for storage of documents
   b. Provide locked cabinet or secure storage space for samples

B. Record Drawings
1. Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings
2. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown
3. Mark which drawing is most capable of showing conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings
4. Give particular attention to concealed elements that would be difficult to measure and record at a later date
   a. Record information concurrently with construction progress
   b. Mark record sets with red erasable pencil. Use other colors to distinguish between variations in separate categories of the Work. Mark each document "Project Record" in neat, large, printed letters.
   c. Mark new information that is important to Owner but was not shown on Contract Drawings or Shop Drawings
   d. Note related Change Order numbers where applicable
   e. Organize record drawing sheets into manageable sets. Bind sets with durable-paper cover sheets; print suitable titles, dates, and other identification on the cover of each set.
   f. Upon completion of the Work, submit record drawings to Engineer for Owner's records
5. Contract Drawings and approved Shop Drawings: Legibly mark each item to record actual construction, including:

a. Measured depths of elements of foundation in relation to finish grade or first floor datum
b. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvement
c. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of construction.
d. Field changes of dimensions and details
e. Changes made by Addenda or Change Order(s), if any
f. Details not on original Contract Drawings
g. References to related Shop Drawings and Modifications

C. Record Specifications: Maintain one complete copy of the Project Manual including addenda. Include with the Project Manual one copy of other written construction documents, such as Change Orders and Modifications issued in printed form during construction
1. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications.
2. Give particular attention to substitutions and selection of options and information on concealed construction that cannot otherwise be readily discerned later by direct observation.
3. Note related record drawing information and product data
4. Upon completion of the Work, submit record Specifications to Engineer for Owner's records

D. Record Product Data: Maintain one copy of each product data Submittal. Note related Change Orders and markup of record drawings and specifications.
1. Mark record documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the Site and from the manufacturer's installation instructions and recommendations.
2. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily discerned later by direct observation
3. Upon completion of markup, submit complete set of record product data to Engineer for Owner's records
4. Legibly mark and record at each Product section description of actual Products installed, including the following:
a. Manufacturer's name, product model, number, trade name and supplies
b. Product substitutions or alternates utilized
c. Changes made by Addenda, field order or change order

E. Record Samples Submitted: Immediately prior to Substantial Completion, Contractor shall meet with Engineer and Owner's personnel at the Project Site to determine which Samples are to be transmitted to Owner for record purposes. Comply with Owner's instructions regarding packaging, identification, and delivery to Owner.

F. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record keeping and Submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records, and place in good order. Identify miscellaneous records properly

and bind or file, ready for continued use and reference. Submit to Engineer for Owner's records.

1. For electrical refer to Section 16900

G. Maintenance Manuals: Contractor shall organize operation and maintenance data as specified in Section 01730

H. Submit documents to Engineer with claim for final Application for Payment

I. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.

J. Make documents and samples available at all times for inspection by Engineer

K. Label each document "Project Record" in neat, large printed letters

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 CLOSEOUT PROCEDURES

A. General
   1. Comply with requirements stated in the Owner's General Conditions of the Contract and in these specifications for administrative procedures in closing out the Work
   2. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's inspection
   3. Provide submittals to Engineer/Owner that are required by governing or other authorities
   4. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due

B. Operation and Maintenance Instructions: Arrange for each installer of Equipment that requires regular maintenance to meet with Owner's personnel at Project Site to provide instruction in proper operation and maintenance. Provide instruction by manufacturer's representatives if installers are not experienced in operation and maintenance procedures. Include a detailed review of the following items:
   1. Maintenance manuals
   2. Record documents
   3. Spare parts, materials and tools
   4. Lubricants and fuels
   5. Identification systems
   6. Control sequences
   7. Hazards, hazardous chemicals data sheets
   8. Cleaning
   9. Warranties and bonds

10. Maintenance agreements and similar continuing commitments

C. As part of instruction for operating Equipment, demonstrate the following procedures:
   1. Startup
   2. Shutdown
   3. Emergency operations
   4. Noise and vibration adjustments
   5. Safety procedures
   6. Economy and efficiency adjustments
   7. Effective energy utilization

3.2 FINAL CLEANING

A. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
   1. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion
      a. Remove labels that are not permanent labels
      b. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition.
      c. Wipe surfaces of mechanical and electrical Equipment. Remove excess lubrication and other substances.
   2. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction
   3. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the Site and dispose of lawfully.
      a. Extra materials of value remaining after completion of associated Work become Owner's property. Dispose of these materials as directed by Owner.

3.3 CONTRACTOR'S CLOSEOUT SUBMITTALS

A. Evidence of Payment and Release of Liens: As specified in the General Conditions

B. Final inspection reports by all regulatory agencies demonstrating the agencies' final approval

C. At Contract close-out, deliver Record Documents to Engineer for the Owner

D. Accompany Submittal with Transmittal Letter in Duplicate, Containing
   1. Date
   2. Project title and number
   3. Contractor's name and address
   4. Title and number of each Record Document

5. Signature of Contractor or his authorized representative

3.4 FINAL ADJUSTMENTS OF ACCOUNTS

A. Submit a Final Statement of Accounting to Engineer

B. Statement Shall Reflect All Adjustments to the Contract Sum
   1. The original Contract Sum
   2. Additions and deductions resulting from
      a. Previous Change Orders
      b. Deductions for uncorrected Work
      c. Deductions for liquidated damages
      d. Deductions for reinspection payments
      e. Other adjustments
   3. Total Contract Sum, as adjusted
   4. Previous payments
   5. Sum remaining due

3.5 FINAL APPLICATION FOR PAYMENT

A. Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the General Conditions of the Contract

END OF SECTION

SECTION 02220

DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Demolition, removal, salvage and disposal of existing site features, piping, structures and materials where indicated on the drawings and as specified in this section

B. Demolition and removal of concrete sidewalks, concrete and asphaltic paving

1.2 RELATED SECTIONS

A. Section 01500 – Construction Facilities and Temporary Controls

B. Section 02300 – Earthwork

C. Section 02950 - Seeding

1.3 SUBMITTALS

A. Permits and Certificates.
   1. Permits and notices authorizing demolition
   2. Certificates of severance of utility service
   3. Permit for transport and disposal of debris

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1 specifications

B. Accurately record actual locations of capped utilities and subsurface obstructions

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable State and local codes for demolition of structures, safety of adjacent structures, dust control, and disposal

B. Obtain required permits from authorities

C. Notify affected utility companies before starting work and comply with their requirements

D. Do not close or obstruct roadways, sidewalks, or hydrants without written permission from Owner

E. Conform to applicable regulatory procedures when discovering hazardous or contaminated materials

1.6 SCHEDULING

A. Schedule and submit under provisions of Division 1 specifications

B. Provide detailed descriptions for demolition and removal procedures

C. Notify Engineer and Owner of any demolition work one (1) week prior to commencement

D. Coordinate all demolition work with Engineer and Owner

PART 2 PRODUCTS

2.1 SALVAGE OF MATERIALS

A. All existing construction and items not salvaged to Owner shall be considered waste and shall become the property of Contractor for off-site disposal

B. Remove and reinstall as indicated on Drawings and herein the following Equipment and Materials:
1. Meter

2.2 HANDLING AND STORAGE

A. Contractor shall carefully disassemble Equipment and Materials that are to be reused and returned to Owner in such a way to avoid any damage. Contractor shall store such Equipment and Materials in such a way to avoid any damage, corrosion, or staining

2.3 FILL MATERIALS

A. Fill Material: Use on site fill material under provisions of Section 02300 and in accordance with Geotechnical recommendation

PART 3 EXECUTION

3.1 INSPECTION

A. Verify areas to be demolished are unoccupied and discontinued in use

B. Do not commence work until conditions are acceptable to Engineer and Owner

C. Existing conditions of Equipment and Materials, structures, surfaces, or properties that could be misinterpreted as damaged as a result of demolition work shall be photographed and filed with Owner and Engineer prior to commencement of Work

3.2 PREPARATION

A. Provide, erect, and maintain temporary barriers, enclosures, security fences and shoring at demolition locations in accordance with Division 1 and other related specifications to protect personnel

B. Protect existing structures and utilities which are not to be demolished

C. Provide temporary wiring and connections to maintain existing telephone, electrical, instrumentation and control systems in service during construction

D. Mark location of existing utilities

3.3 GENERAL REQUIREMENTS

A. Sprinkle Work with water to minimize dust where applicable. Provide hoses and water connections for this purpose.

B. Do not use water to extent causing flooding, contaminated runoff, or icing

C. Remove demolished material from the site

D. Repair damage to adjacent structures

E. Remove existing exposed piping and electrical wiring and conduit to be abandoned to structural surface, cut flush, and finish to match existing surfaces

F. Remove buried piping, wiring, and conduit to be abandoned as required for the Work. Plug the remainder flush.

3.4 DISPOSAL

A. Do not store or burn waste materials on-site

B. Transport demolition debris to designated off-site disposal area

C. If hazardous materials are encountered during demolition work, Contractor shall comply with applicable regulations and laws regarding the removal, handling, and protection of environment and human health

3.5 CONNECTION TO EXISTING CONSTRUCTION

A. Cut and remove portions of existing construction as necessary to allow for proper installation of new construction Equipment and Materials

B. Shore and brace existing structures to maintain safe structure conditions and until permanent structures and supports are completed
   1. Contractor shall repair all damage in result of installation of shoring and bracing

C. Cap, seal or abandon pipe and cable as indicated on Drawings and specified herein

3.6 CLEANUP AND REPAIR

A. Contractor shall remove tools, equipment and demolished materials from Site upon completion of demolition work
   1. Remove protections

B. Contractor shall repair demolition performed in excess of that required or indicated
   1. Surfaces and structures to remain shall be repaired to the existing conditions prior to commencement of demolition work

3.7 SITE DEMOLITION

A. Disconnect, remove, cap and identify designated utilities within demolition area

B. Remove asphalt paving, parkway, and other concrete work to facilitate construction. Remove concrete to nearest joint beyond demolition area.

C. Remove storm sewer items where shown on the Drawings.

D. Backfill areas excavated caused as a result of demolition, in accordance with Section 02300

E. Rough grade and compact areas affected by demolition to maintain site grades and contours as shown on drawings

F. Remove demolished materials from site

G. Do not burn or bury materials on site, unless otherwise directed by Owner. Leave site in clean condition.

END OF SECTION

SECTION 02300

EARTHWORK

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, and Division One and other related specification sections apply to work of this section.

1.2 SECTION INCLUDES

A. Clearing, grubbing and site preparation

B. Removal and disposal of debris

C. Handling, storage, transportation, and disposal of excavated material

D. Sheeting, shoring, bracing and protection work

E. Pumping and dewatering as required or necessary

F. Backfilling

G. Pipe embedment

H. Construction of fills and embankments

I. Excavation for buildings & structures

J. Pavement Subgrade preparation

K. Trench Stabilization

L. Final grading

M. Slope Stabilization

N. Appurtenant work

1.3 RELATED SECTIONS

A. Section 01020 – Geotechnical Report [verify numbering w/ architect]

B. Section 02740 – Flexible Paving

C. Section 02750 – Rigid Paving

D. Section 02930 – Sod

E. Section 02950 – Seeding

1.4 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO)

B. American Society for Testing and Materials (ASTM):
   1. C33 – Concrete Aggregates
   2. C136 – Sieve Analysis of Fine and Coarse Aggregates
   3. D698 – Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb. Rammer and 12-Inch Drop
   4. D1241 – Material for Soil Aggregate Subbase, Base and Surface Courses
   5. D1557 – Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
   6. D4253 – Test Methods for Maximum Index Density of Soils and Unit Weight of Soils Using a Vibratory Table
   7. D4254 – Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
   8. D4318 – Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
   9. D6938 – Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth)

C. American Concrete Institute (ACI):
   1. 229 – Controlled Low-Strength Materials

D. Council of American Building Officials/American National Standards Institute (CABO/ANSI):
   1. A117.1 – Accessible and Useable Buildings and Facilities Standards

E. Colorado Department of Transportation (CDOT)

F. Occupational Safety and Health Administration (OSHA):
   1. Part 1926 – Safety and Health Regulations for Construction

1.5 SUBMITTALS

A. Submit under provisions of Division One specifications.

B. Product Data: Submit on all products or materials supplied herein

C. Test Reports: Indicate supplier, sieve analysis, optimum moisture content and density in accordance with ASTM D698 if appropriate for crushed rock or gravel, pipe embedment and material for fills and embankment

1.6 REGULATORY REQUIREMENTS

A. Burning will not be allowed on-site. Comply with all applicable codes, regulations, and laws.

B. Comply with applicable requirements of CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.

C. Obtain and comply with all requirements of City of Grand Junction and CDPHE Stormwater and/or Groundwater Discharge Permits, as required.

D. For public improvements only, in the event of a conflict between municipal standards and this specification, municipal standards for products and installation will govern.

E. Excavation work will be performed in compliance with City of Grand Junction and current OSHA requirements.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Protect adjacent structures and surrounding areas from damage during excavation, filling, and backfilling

B. Protect work from erosion or other similar types of damage until the project has been accepted. Leave protection in place for subsequent contractors' use.

C. Do not backfill or construct fills during freezing weather. Backfill or construct fills only when temperature is 35°F and rising

D. Do not use frozen materials, snow, or ice in any backfill or fill area

E. Do not backfill or construct fill on frozen surfaces

F. Protect excavated material from becoming frozen

G. Do not backfill or construct fills or embankments during periods of heavy rainfall or precipitation when soil moisture conditions will not allow proper compaction to be achieved

H. Do not remove trees from outside excavation or fill areas unless authorized by the Owner; protect from permanent damage by construction activities

I. Provide temporary bridges for roadways, walkways, driveways, etc.

1.8 QUALITY ASSURANCE

A. All imported material to be free of hazardous and organic wastes, "clean" as defined by EPA, and approved for its intended use by the Owner or project Geotechnical Engineer.

PART 2 PRODUCTS

2.1 MATERIALS

A. General - Soil materials, whether from sources on or off the site must be approved by the Geotechnical Engineer as suitable for intended use and specifically for required location or purpose.

B. Classification of Excavated Materials:
   1. No classification applies. Remove and handle all excavated materials regardless of its type, character, composition, condition, or depth. This includes all material that is not classified as rock excavation as described in Paragraph 2.1.B.2 Rock Excavation is included herein.
   2. Waste Materials:
      a. Waste materials are considered unacceptable materials for compaction or placement fill. Site fills will not include environmental pollutants, hazardous substances or waste, hazardous products or by-products.
      b. Transport and properly dispose of any rubble and waste materials found in excavation off the Owner's property
      c. If hazardous, transite or asbestos containing materials are found in excavation, stop work immediately and notify the Owner within one hour of discovery. Comply with special handling requirements.

C. Topsoil
   1. Topsoil is defined as fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of rocks, stumps, stones larger than 2 inches in any dimension, and other extraneous or toxic matter harmful to plant growth for areas to be seeded or planted. Coordinate testing requirements with Owner.
   2. Clean topsoil free of plants and seeds will be spread to 4-inch minimum depth or as specified by Drawings, whichever is greater.

D. Grubbings
   1. Grubbings are defined as the first 1 inch of surface vegetation and topsoil consisting of primarily existing grass groundcover free of roots, brush, and other objectionable material and debris.
   2. Reuse grubbing and surface topsoil containing plants and seeds in designated revegetation areas only.

E. Pipe Embedment: Graded gravel
   1. Comply with City of Grand Junction requirements for pipe embedment for public utilities.

   2. 1-1/2" Washed rock

Sieve Size (Inch)	Percent Passing by Weight
2"	100

1-1/2”	95-100
1”	80-95
3/4”	30-45
1/2”	10-25
3/8”	<1

3. 3/4” – 1” Crushed rock – AASHTO 57/67

Sieve Size (Inch)	Percent Passing by Weight
1	100
3/4”	90-100
1/2”	25-60
3/8”	20-55
NO. 4	0-10
NO. 8	0-5
NO. 200	0-2

4. Well-Graded Sand

Sieve Size	Percent Passing by Weight
3/8”	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	10-30
No. 200	2-10

5. Drain Gravel
   a. Crushed rock, granular material with a maximum size of 1-1/2 inch.
   b. Minimum 50% passing No. 4 sieve, maximum 5% retained on No. 200 sieve

F. Compacted Trench Backfill
1. Job excavated material finely divided, free of debris, organic material, and stones larger than 6 inches in greatest dimension without masses of moist, stiff clay, or topsoil
2. In upper 18 inches, no rock or rock excavated detritus, larger than 6 inches except with specific approval from Geotechnical Engineer.
3. No rock greater than 3 inches in greatest dimension within 3 feet of top of pipe
4. Graded gravel: as specified or shown on Drawings for pipe embedment

G. Coarse Base Rock
1. Granular material, maximum 3 inches, less than 10% passing 1-inch sieve.
2. Free of trash, clay and dust

3. Compaction as specified by Geotechnical Engineer

H. Road Base
1. Will meet ASTM specification for Class II aggregate base and CDOT Class 6 gradation

Sieve Size	Percent Passing by Weight
1”	100
3/4"	90-100
No. 4	35-55
No. 30	10-30
No. 200	2-9

2.2 ACCESSORIES

A. Controlled Low Strength Material (Flow Fill)
1. Comply with City of Grand Junction requirements and ACI 229 for the use of flowable fill within the right-of-way or for public utility trench backfill.
2. Product will be a lean, sand-cement slurry, “flowable fill” or similar material with a 28-day unconfined compressive strength between 50 and 200 psi.

B. Non-woven geotextile fabric
1. Needle-punched nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. Product must be inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids. Product must meet AASHTO M288-06 Class 3 for elongation > 50%.
a. Mirafi 140N or accepted substitution

PART 3 EXECUTION

3.1 EXAMINATION

A. Field verify the location of all underground utilities, pipelines and structures prior to excavation

3.2 PERFORMANCE — GENERAL

A. Contractor to verify quantities of cuts and fills and perform all earthwork required to meet the grades as shown on the Drawings, including but not limited to, additional import or export required to handle compaction, building and pavement subgrade preparation, and pipe bedding.

B. Perform work in a safe and proper manner with appropriate precautions against hazard

C. Provide adequate working space and clearances for work performed within excavations and for installation and removal of utilities

D. Contain all construction activity on the designated site and within the limits of work. Cost of restoration offsite will be the responsibility of the Contractor

E. Maintain service to pipelines and utilities indicated on Drawings during construction

3.3 PREPARATION

A. Clearing and Grubbing
   1. Clear all site areas within the limits of work of grasses, roots, brush, and other objectionable material and debris.
   2. Strip subgrade for fills and embankments of surface vegetation, sod, tree stumps and organic topsoil. Strip and stockpile all on-site material meeting the topsoil definition for all areas receiving grading where shown on Drawings
   3. Remove all waste materials from site and dispose. Stockpile all acceptable grubbings for reuse in revegetation areas.
   4. Remove and dispose of tree stumps and roots over 3 inches in diameter to a minimum depth of 18 inches below the natural surface or 5 feet below finished surface level, whichever is lower.
   5. Remove debris including all demolished trees, underbrush, stumps, roots and other combustible materials from site and dispose of off-site; on-site burning is not permitted
   6. Backfill all excavated depression include grub holes with approved material

B. Preservation of Trees
   1. Do not remove trees outside fill or excavated areas, except as authorized by Engineer
   2. Protect trees and their roots within the drip line that are to remain from permanent damage by construction operation
   3. Trim standing trees in conflict with construction operations as directed by Owner and Engineer

C. Topsoil Stripping
   1. Strip onsite material meeting the topsoil definition to minimum depth of 4 inches from areas to receive grading as shown on Drawings.
   2. Stockpile topsoil in areas designated by Owner and indicated on Drawings where it will not interfere with construction operations and activities and existing facilities
   3. At the completion of work in each area, place and grade topsoil to maintain gradient as indicated and required. Roughen surface as required for erosion control.

D. Waste and Debris
   1. Stockpile all acceptable grubbing for reuse in native revegetation areas
   2. Remove and dispose of all waste materials and debris from clearing, grubbing, stripping and demolition off site

E. Stockpiles
   1. Segregate materials suitable for the following:
      a. Topsoil
      b. Embankments and fills

c. Backfill
d. Spoils and waste only

2. No excavation will be deposited or stockpiled at any time so as to endanger stability of banks or structures, health of trees and shrubs to be protected, or portions of the Work, either by direct pressure or indirectly by overloading banks contiguous to the operation
3. Stockpile soil materials away from edge of excavations
4. Do not obstruct or prevent access to roads, driveways, ditches, natural drainage channels, and utility control devices
5. If in result of adjacent structures, easement limitations, or other restrictions sufficient storage is not available within Project limits, Contractor will arrange for off-site areas for stockpiling and for moving material to and from the storage area at no additional cost to the Owner

3.4 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

A. Excavation and backfill operations will be performed in such a manner to prevent cave-ins of excavations or the undermining, damage or disturbing of existing utilities and structures or of new work.

B. Backfill will be placed and compacted so as to prevent future settlement or damage to existing utilities and structures and new work

C. Any excavations improperly backfilled or where settlement occurs will be reopened to the depth required then refilled with approved materials and compacted, and the surface restored to the required grade and condition, at no additional costs to the Owner

D. Any damage due to excavation, backfilling, or settlement of the backfill, or injury to persons or damage to property occurring as a result of such damage will be the responsibility of the Contractor. All costs to repair such damage, in a manner satisfactory to the Engineer, will be borne by the Contractor at no additional expense to the Owner

3.5 DEWATERING

A. General
1. All dewatering activities in accordance with all federal, state, and local regulations regarding site drainage, dewatering, and erosion and sediment control including permitting requirements
2. Design and provide dewatering system using accepted and professional methods consistent with current industry practice to eliminate water entering the excavation under hydrostatic head from the bottom and/or sides. Design system to prevent differential hydrostatic head, which would result in floating out soil particles in a manner, termed as a “quick” or “boiling” condition. System will not be dependent solely upon sumps and/or pumping water from within the excavation where differential head would result in a quick condition, which would continue to worsen the integrity of the excavation’s stability

3. Provide and maintain adequate dewatering equipment including power supply, if necessary, to remove and dispose of surface and groundwater entering excavations, trenches, and other parts of the Work
4. Provide dewatering system of sufficient size and capacity to prevent ground and surface water flow into the excavation and to allow all Work to be installed in a dry condition
5. Control groundwater in a manner that preserves strength of foundation soils, does not cause instability or raveling of excavation slopes, and does not result in damage to existing structures. Where necessary to these purposes, lower water level in advance of excavation, utilizing wells, wellpoints, jet educators, or similar positive methods
6. Keep each excavation dry during subgrade preparation and continually thereafter until the structure to be built or the pipe to be installed is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result
7. Dewater excavations which extend to or below groundwater by lowering and keeping the groundwater level beneath such excavation at least 12 inches below the bottom of the excavation
8. Design, furnish, install, test, operate, monitor and maintain dewatering system of sufficient scope, size and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of groundwater and permit excavation and construction to proceed on dry, stable subgrades
9. Divert surface water or otherwise prevent it from entering excavated areas or trenches to the extent practical without damaging adjacent property
10. Maintain all drainage pipes, keep clean and free of sediment during construction and final cleanup
11. Open pumping with sumps and ditches will be allowed, provided it does not result in boils, loss of fines, softening of the ground, or instability of slopes
12. No additional payment will be made for any supplemental measures to control seepage, groundwater, or artesian head
13. Dewatering to surface waterways requires Colorado Department of Public Health and Environment dewatering permit. Contractor must obtain dewatering permit and comply with discharge requirements therein, including water treatment prior to discharge, if necessary

B. Design
1. Contractor will be responsible for the accuracy of the Drawings, design data, and operational records required
2. Contractor will be solely responsible for the design, installation, operation, maintenance, and any failure of any component of the system

C. Damages
1. Contractor will be responsible for and will repair without cost to the Owner any damage to work in place, or other contractor's equipment, utilities, residences, highways, roads, railroads, private and municipal well systems, adjacent structures, natural resources, habitat, existing wells, and the excavation including, damage to the bottom due to heave and including but not limited to, removal and pumping out of the excavated area that may result from Contractor's negligence, inadequate or improper

design and operation of the dewatering system, and any mechanical or electrical failure of the dewatering system
2. Remove sub grade materials rendered unsuitable by excessive wetting and replace with approved backfill material at no additional cost to the Owner

D. Maintaining Excavation in Dewatered Condition
1. Dewatering will be a continuous operation. Interruptions due to power outages, or any other reason will not be permitted
2. Continuously maintain excavation in a dry condition with positive dewatering methods during preparation of subgrade, installation of pipe, and construction of structures until the critical period of construction and/or backfill is completed to prevent damage of subgrade support, piping, structure, side slopes, or adjacent facilities from flotation or other hydrostatic pressure imbalance
3. Provide standby equipment on site, installed, wired, and available for immediate operation if required to maintain dewatering on a continuous basis in the event any part of the system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, perform such work as may be required to restore damaged structures and foundation soils at no additional cost to Owner
4. System maintenance will include supervision by personnel skilled in the operation, maintenance, and replacement of system components, and any other work required to maintain excavation in dewatered condition

E. System Removal
1. Remove dewatering equipment from the site, including related temporary electrical service
2. Wells will be removed or cut off a minimum of 3 feet below final ground surface, capped, and abandoned in accordance with regulations by agencies having jurisdiction

3.6 SHEETING, SHORING AND BRACING

A. All sheeting, shoring and bracing in accordance with OSHA and IBC requirements

B. Prevent undermining and damage to all structures, buildings, underground facilities, pavements and slabs

C. Contractor will responsible for obtaining all required permits or easements for encroachments into the public right-of-way and for coordinating any encroachments onto adjacent properties.

D. If sheet pile cut off walls are required, submit design calculations, stamped by a Colorado licensed Professional Engineer

E. Contractor will be solely responsible for proper design, installation, operation, maintenance, and any failure of any system component
1. Engineer review of Contractor’s design and data does not relieve the Contractor from full responsibility for errors or from the entire responsibility for complete and adequate design and performance of the sheeting, shoring and bracing system

F. Provide proper and substantial sheeting, shoring, and bracing, in accordance with OSHA Standards as required, to prevent caving or sliding, to protect workmen and the Work, and to protect existing structures and facilities

G. Design, furnish, build, maintain and subsequently remove, to extent required a system of temporary supports for cut and cover, open cut, temporary bypass road, or trench excavations, including bracing, dewatering, and all associated items to support the sides and ends of excavations where excavation slopes may endanger in-place or proposed improvements, extend beyond construction right-of-ways or as otherwise specified or indicated in the Drawings
   1. Design and build sheeting, shoring, and bracing to withstand all loads that might be caused by earth movement or pressure
   2. Design and build sheeting, shoring and bracing to be rigid, maintain shape and position under all circumstances.

H. Design excavation support system and components for the following to allow safe and expeditious construction of permanent structures without movement/settlement of the ground and to prevent damage to or movement of adjacent buildings, structures, other improvements and underground facilities
   1. To support lateral earth pressures
   2. Loads from utilities, traffic, construction, buildings and surcharge loads

I. Provide sheeting, shoring and bracing equipment and materials onsite prior to start of excavation in each section, making adjustments as required to meet unexpected conditions

J. Contractor will make his own assessment of existing conditions including adjacent property, the possible effects of his proposed temporary works and construction methods, and will select and design support systems, methods, and details as will assure safety to the public, adjacent property, and the completed Work.

K. Employ caution in areas of underground facilities, which will be exposed by hand or other excavation methods acceptable to Owner or Engineer.

L. Space and arrange sheeting and bracing as required to exclude adjacent material and according to the stability of excavation slopes

M. Do not pull trench sheeting before backfilling

N. Do not brace sheeting left in place against the pipe, but support it in a manner that precludes concentrated loads or horizontal thrusts on pipe

O. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment is completed

P. Damages
   1. Contractor will document and all existing damage to adjacent facilities and submit written documentation to Owner and Engineer prior to performing any excavation.

Documentation will include written description of existing damages, measurements, diagrams, maps and associated photographs

2. Repair all damage resulting from excavation and remove and place any existing structure or underground facility damaged during shoring and sheeting and all undermined pavements with Owner-approved equal, concrete or asphalt, at no cost to the Owner.

3.7 TRENCH STABILIZATION

A. Thoroughly compact and consolidate subgrades for concrete structures, precast structures, and utility trench bottoms so they remain firm, dense and intact during required construction activities

B. Remove all mud and muck during excavation

C. Reinforce subgrades with crushed rock or gravel if they become mucky during construction activities

D. Finished elevation of stabilized subgrades are to be at or below subgrade elevations indicated on Drawings

E. Allow no more than ½ inch depth of mud or muck to remain on trench bottoms when pipe bedding material is placed thereon

F. Scarify trench subgrade to a depth of 6 to 8 inches before compaction

3.8 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 0.10 foot

B. Remove existing unsuitable/uncompacted fill, old foundations, rubble/debris, soft or otherwise unsuitable material, and replace with suitable material in excavation

C. Extend excavations to a sufficient distance from structures for placing and removing concrete formwork, installing services and other construction and inspections

D. Trim to neat lines where details call for concrete to be deposited against earth

E. Excavate by hand in areas where space and access will not permit use of machines

F. Provide dewatering and temporary drainage as required to keep excavations dry.

G. Reshape subgrade and wet as required

H. Notify Geotechnical Engineer when structure excavation has reached designated depth. Do not proceed with structure construction until excavation is approved by Geotechnical Engineer.

I. Proof roll at a maximum of 24 hours prior to paving or concrete placement to locate any soft spots in grade. Contractor to stabilize any soft areas with aggregate base course and compact to 95% of maximum density at optimum moisture content, per ASTM D1557, to a minimum depth of 6 inches. Reshape subgrade and wet as required.

3.9 PAVEMENT OVEREXCAVATION AND SUBGRADE PREPARATION

A. Excavate subgrade for asphalt pavement areas per the lines, grades, and dimensions indicated on Drawings within a tolerance of plus or minus 0.10 foot. Excavate subgrade for concrete pavement areas per the lines, grades, and dimensions indicated on Drawings within a tolerance of plus or minus 0.05 foot.

B. Overexcavate and scarify existing soil as required under pavement areas, slabs, curbs and walks to meet the moisture and compaction specifications herein to depth shown on Drawings.

C. Extend subgrade preparation a minimum of one foot beyond back of proposed pavement, slabs, curbs and walks.

D. Extend subgrade preparation a minimum of two feet beyond back of proposed structure foundation limit.

E. Proof roll with a pneumatic tire equipment with a minimum axle load of 18 kips per axle a maximum of 24 hours prior to paving to locate any soft spots that exhibit instability and deflection beyond subgrade tolerances listed above. Areas that are observed to have soft spots in the subgrade, where deflection is not uniform or is excessive as determined by the Geotechnical Engineer, will be ripped, scarified, dried or wetted as necessary and recompacted to the requirements for density and moisture at the Contractor's expense. After recompaction, these areas will be proof rolled again and all failures again corrected at the Contractor's expense.

F. If the Contractor fails to place the sub base, base course, or initial pavement course within 24 hours or the condition of the subgrade changes due to weather or other conditions, proof rolling and correction will be performed again at the Contractor's expense.

3.10 FILLS AND EMBANKMENTS

A. Using suitable approved materials, shape, trim, and finish cut slopes to conform with contours and elevations indicated on Drawings

B. Suitable materials will consist of excavations or borrow areas
   1. Borrow
      a. Borrow areas will be arranged by Contractor at no additional cost to Owner and will be subject to approval by Geotechnical Engineer
      b. Includes all topsoils and fill materials from approved offsite locations

C. Place in layers from 4 to 8 inches where high degree of compaction is required. Otherwise, place in 8 to 12 inch layers. Will be placed on subgrades approved by Geotechnical Engineer

D. Will not be placed on frozen surface. Do not place snow, ice or frozen materials in fill

E. Level and roll subgrade so surface materials will be compact and bond with the first layer of fill or embankment
   1. Plow and scarify subgrade to a minimum depth of 6 inches until uniform and free of large clods

F. Place in horizontal layers at maximum uncompacted depth per compaction specifications herein.

G. Spread and level material deposited in piles and windrows before compacting

H. Thoroughly compact each layer by rolling or other means acceptable to Geotechnical Engineer to meet the moisture and compaction specifications herein.

I. Alter compaction methods if material fails to meet specified density

J. Where a trench passes through a fill or embankment, place and compact fill or embankment to 12 inch above the top of the pipe before excavating the trench

K. Add water and harrow, disc, blade, or otherwise work each layer to obtain the uniform moisture content and adequate compaction

L. Refer to geotechnical report for additional requirements for fill and embankment preparation requirements.

3.11 COMPACTION

A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure as described herein.

C. Refer to geotechnical report for additional requirements for site development material, subexcavation, compaction and related earthwork operations.

D. Percentage of Maximum Dry Density Requirements: Moisture treat and compact soil to not less than the following percentages of maximum dry density and to within the specified moisture content range of optimum moisture content according to ASTM D698 as follows:

Surface Improvement	Compaction %	Moisture Content

Structures	98%	-2 to +2
Paved Areas	95%	-2 to +2
Utility Trenches	95%	-2 to +2
Lawns or Unpaved Areas	90%	-2 to +2
Public Right-of-way	Per municipal standards	

1. Do not deposit or compact tamped or otherwise mechanically compacted backfill if frozen or if in water.
2. Take particular care to compact backfill which will be beneath slabs, pipes, drives, roads, parking areas, curb, gutters, or other surface construction.

3.12 DISPOSAL OF EXCESS EXCAVATED MATERIALS

A. Use excess excavated materials in fills and embankments as indicated on the Drawings to the extent needed. Coordinate with Owner and Engineer on locations for excess material placement.

B. The Contractor is responsible for disposing of all excess excavated materials from the site to a location approved by the Owner or Engineer and permitted with the local authorities.

C. Remove debris, junk, broken concrete, broken asphalt, rock, stones, stumps, logs, roots, and other unsuitable material from the site and dispose of it.

3.13 BLASTING

A. Blasting or other use of explosives is not permitted without City of Grand Junction approval

3.14 TRENCH EXCAVATION

A. Establish alignment and grade or elevation from offset stakes provided by the Contractor's surveyor.

B. Excavate trenches so pipes can be laid straight at uniform grade without dips or bumps, between the terminal elevations indicated on the Drawings

C. Comply with pipe specification sections regarding vertical and horizontal alignment and maximum joint deflection

D. Where grades or elevations are not fixed on the Drawings, excavate trenches to provide a minimum depth of backfill cover over the top of pipe as follows. Coordinate depth of cover with utility owners. Increase depth as required by utility owner and at crossings. Minimum depths are:
   1. 3.0 feet for water piping
   2. Increase depth as required at vertical curves and for clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades

E. Measure pipe cover depth vertically from top of pipe to finished ground or surface elevation

F. Do not open more trench in advance of pipe laying than is necessary to expedite the work; not more than 200 feet

G. Total length of open trench will be limited to 200 feet unless otherwise approved by the Engineer

H. Except where tunneling or boring is indicated on the Drawings, specified, required by jurisdictional agency or permitted by Engineer, excavate trenches by open cut from the surface

I. Limiting trench widths
   1. Excavate to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing, embedment
   2. If needed to reduce earth loads to prevent sliding, cut banks back on slopes which extend not lower than 1 foot above the top of the pipe
   3. Stipulated minimum clearances are minimum clear distances, not minimum average distances
   4. Maximum trench width from six inches above the top of pipe to trench bottom is the pipe outside diameter plus 24 inches
   5. Limiting trench widths and permissible clearances from 6 inches above top of pipe to trench bottom for installed pressure and non-pressure piping

Pipe Size (inch)	Minimum Trench Width	Maximum Trench Width
3	1’ 6”	2’ 6”
4	1’ 6”	2’ 6”
6	1’ 6”	2’ 6”
8	1’ 8”	2” 8”
10	2’ 0”	3’ 0”
12	2’ 0”	3’ 0”
16	2’ 8”	3’ 8”
18	3’ 0”	4’ 0”
24	3’ 6”	4’ 6”
36	4’ 6”	5’ 0”

   6. If the width of the lower portion of the trench exceeds the maximum permitted, provide special pipe embedment, or concrete encasement as required by loading conditions
   7. No excessive trench widths will be allowed to avoid the use of sheeting or shoring and bracing

J. Trench Side Walls
   1. Will be sloped, shored, sheeted, braced, or otherwise supported by means of sufficient strength to protect workmen in accordance with applicable rules and regulations established for construction by the federal, state, and local ordinances and regulations

2. Sheet and brace where necessary and as specified herein
3. Excavate without undercutting

K. Trench Bottom
1. Will be thoroughly protected and maintained when suitable natural materials are encountered
2. Will be thoroughly compacted and in approved condition prior to placing gravel bedding, if required
3. Where in earth, trench bottoms for 6 inches and smaller pipe may be excavated below pipe subgrade and granular embedment provided or the trench may be graded to provide uniform and continuous support between bell holes or end joints of the installed pipe at the Contractor's option
4. Whenever so directed by Engineer, excavate to such depth below grade as Engineer directs and bring the trench bottom to grade with such material approved by Engineer
5. Do not allow any part of bells or couplings to contact the trench bottom, walls, or granular embedment when pipe is joined
6. PVC pipe will not be laid directly on trench bottom

L. Mechanical excavation
1. Do not use where its operation would damage buildings, culverts, or other existing property, structures, or utilities above or below ground; hand excavate only in such areas
2. Use mechanical equipment of a type and design which can be operated to provide the following:
   a. Rough trench bottom to a controlled elevation
   b. Uniform trench widths and vertical sidewalls are obtained from 1 foot above the top of the installed pipe to the bottom of the trench
   c. Trench alignment is such that pipe is accurately laid to specified alignment and is centered in the trench with adequate clearance between pipe and trench sidewalls
3. Do not undercut trench sidewalls
4. Recompact trench bottom disturbed by bucket teeth prior to placement of embedment material

M. Except as otherwise required, excavate trenches below the underside of pipes as indicated in the Drawings to provide for installation of granular embedment pipe foundation material

N. Whenever so directed by Engineer, excavate to such depth below grade as Engineer directs and bring the trench bottom to grade with such material as Engineer may direct

O. For unstable soils, provide concrete or other bedding as directed by Engineer

P. Do not allow any part of bells or couplings to contact the trench bottom, walls, or granular embedment when pipe is joined

Q. Cuts in existing surface construction
1. No larger than necessary to provide adequate working space

2. Cut a clean groove not less than 1½ inch deep along each side of trench or around perimeter of excavation area
3. Remove pavement and base pavement to provide shoulder not less than 6 feet wide between cut edge and top edge of trench
4. Do not undercut trenches, resulting in bottom trench width greater than top widths
5. Make pavement cuts to and between straight or accurately marked curved lines parallel to trench centerline or limits of excavation
6. Remove pavement for connections to existing lines or structures only to the extent required for the installation
7. Replace the pavements between saw cuts to match original surface construction

3.15 PIPE EMBEDMENT

A. Embed pipes above and below the bottom of pipe as indicated on the Drawings and as specified herein

B. Granular embedment
   1. Spread and surface grade granular embedment to provide continuous and uniform support beneath pipe at all points between pipe joints.
      a. Level bottom layer at proper grade to receive and uniformly support pipe barrel throughout length
      b. Barrel of pipe will have a bearing for its full length
   2. Form depressions under each joint to permit the proper jointing. No part of joint will be in contact with trench when pipe is placed in position
   3. After grading, aligning, and placing pipe in final position, and shoring home, deposit and compact sufficient embedment under and around each side of the pipe to hold the pipe in proper position and alignment during subsequent operations
   4. Place and compact embedment material uniformly and simultaneously on both sides of pipe to prevent displacement
   5. Complete embedment promptly after jointing operations and approval to proceed by Engineer
   6. Granular embedment compaction by slicing with shovel or vibrating
      a. Maximum uncompacted thickness of layers: 6 inch
   7. Compacted embedment will be compacted to 90 percent maximum density per ASTM D1557
      a. Maximum uncompacted depth thickness of horizontal layers: 8 inch

C. Arch and concrete encasement
   1. Include in locations indicated on Drawings or where over-width trench conditions need correction as approved by Engineer
   2. Install and form as indicated on Drawings or as specified
   3. Concrete will have a 28-day minimum 3,000 psi compressive strength

D. Do not backfill until tests and inspections have been made and backfilling is authorized by Engineer. Use care in backfilling to avoid damage or displacement of pipe systems

3.16 TRENCH BACKFILL

A. Backfilling will be conducted in a continuous manner to prevent damage to the pipe and its coating and kept as close to the pipe laying operation as possible. Backfilling procedures will be in accordance with additional requirements, if any, of local authorities or private right-of-way agreements.

B. Compacted backfill
   1. Provide full depth of trench above embedment at all locations
   2. Beneath pavements, surfacing, driveways, curbs, gutters, walks or other surface construction or structures
   3. In street or highway shoulders
   4. Beneath fills and embankments

C. Where the trench for one pipe passes beneath the trench of another pipe, compact the backfill for the lower trench to the bottom of the upper trench

D. Site excavated materials
   1. Place job excavated materials in 8 inches maximum uncompacted thickness, uniform layers
   2. Increased layer thickness may be permitted for incohesive material if Contractor demonstrates to Engineer's satisfaction that specified compacted density will be achieved
   3. Use methods and equipment appropriate to the material to be compacted to prevent transmission of damaging shocks to pipe
   4. Thoroughly compact each layer to meet the moisture and compaction specifications herein.

E. Graded gravel
   1. Deposit in uniform layers of 9 inches maximum uncompacted thickness
   2. Compact with suitable vibrating roller or platform vibrator to not less than 70 percent relative density per ASTM D4253/D4254

F. Uncompacted backfill
   1. Compaction of backfill above pipe embedment in locations other than those specified, is required only to prevent future settlement
   2. May be placed by any method acceptable to Engineer which will not impose excessive concentrated or unbalanced loads, shock, or impact on, and will not result in displacement of installed pipe
   3. Until compacted depth over conduit exceeds 3 feet, do not drop fill material over 5 feet. Distance may be increased 2 feet for each additional 1 foot of cover

G. Finish the top portion of backfill with at least 4 inches of topsoil or as specified by landscaping specifications, whichever is greater, corresponding to, or better than, that underlying adjoining turf areas.

H. Trench backfill within the public right-of-way will conform to municipal street and utility standards.

I. Trench backfills through unimproved areas should be restored to previous conditions and left 3” above adjacent grades to allow for settlement. Seed all disturbed areas according to erosion control and landscape specifications.

J. Protection of trench backfill
   1. Where trenches are constructed in ditches or other water courses, protect backfill from erosion
   2. Install ditch checks where the ditch grade exceeds 1 percent
      a. Minimum depth: 2 feet below the original ditch or water course bottom for the full bottom width
      b. Minimum width: 18 inches into the side slopes
      c. Minimum thickness: 12 inches

3.17 DRAINAGE MAINTENANCE

A. Do not backfill trenches across roadways, drives, walks or other trafficways adjacent to drainage ditches or water courses prior to backfilling the trench on the upstream side of the trafficway to prevent impounding water after pipe is laid

B. Backfill so that water does not accumulate in unfilled or partially filled trenches

C. Remove materials deposited in roadway ditches or other water courses crossed by the trench line immediately after backfilling is completed and restore ditches and water courses to original section, grade, and contours

D. Do not obstruct surface drainage any longer than necessary

E. Provide and maintain temporary bridges and other structures across unfilled trenches as required to maintain traffic

F. Provide adequate storm flow conveyance through the site at all times during construction to avoid flooding of any buildings or adjacent property. Provide overland drainage routing when storm sewer inlets are not fully functioning due to erosion and sediment control measures.

3.18 FINAL GRADING

A. After completion of all other outside work and after backfilling is completed and settled, bring to grade at the indicated elevations, slopes and contours, all areas being graded on site

B. Graders and other power equipment may be used for final grading and slope dressing if the result is uniform and equivalent to hand work

C. Grade all surfaces for effective drainage, provide a 2 percent minimum slope except as otherwise shown on the Drawings

D. Provide a smooth transition between adjacent existing grades and new grades

E. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances

F. Slope grades to direct water away from buildings and prevent ponds from forming where not intended

G. Finish subgrades at lawns and unpaved areas to required elevations within a tolerance of plus or minus one (1) inch

H. Finish grades will be no more than 0.1 foot above or below those indicated

I. Finish all ditches, swales and gutters to drain readily

J. Coordinate final subgrade depth with finish landscape treatment and required topsoil depths

K. Topsoil
   1. Clean topsoil, free of plants and seed will be spread to 4-inch minimum depth, or as specified by landscaping specifications.
   2. Reuse grubbings and surface topsoil containing plants and seeds in designated revegetation areas only.

3.19 SLOPE AND CHANNEL STABILIZATION

A. Cover channel banks, slopes, bottom and thalweg (water flowline at lowest point in channel) with erosion control fabric mat where grade is steeper than 4H to 1V and where indicated on the Drawings

B. Lay fabric smoothly on surface, bury top end of each section in 6-inch deep excavated topsoil trench. Provide 6-inch overlap minimum of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil

C. Secure outside edges and overlaps at 48 inch intervals with 4-inch to 6-inch U-shaped type pins or wooden stakes depending on ground condition

D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil

E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches

F. Maintain integrity of erosion control fabric

G. Prior to laying fabric, seed disturbed areas under provisions of related seeding and landscaping specification sections.

3.20 SETTLEMENT

A. Warranty for settlement of all fills, embankments, and backfills is stipulated in the General Conditions from final completion of Contract under which Work is performed

B. Repair or replace within 30 days after notice by Engineer or Owner

3.21 FIELD QUALITY CONTROL

A. Provide under provisions of General Conditions and Division One Specifications

B. Coordinate testing with Owner. Owner will employ testing agency for field testing to determine compliance of in-place and backfill materials and compaction in accordance with the specifications, and to verify design bearing capacities.

C. It is the Contractor's responsibility to initiate, coordinate and accommodate all required tests and inspections including conformance with requirements of all applicable public agencies and authorities. Contractor will be responsible for coordinating the testing requirement with testing agency and provide the testing agency 48 hour, two business day advance notification to schedule tests.

D. Fills and Embankment Testing
   1. Two moisture-density relationship tests, ASTM D698, on each type of fill material
   2. One in-place compaction test for each 5,000 square feet every 1.5 feet of vertical lift of material placed
   3. Additional in-place compaction tests at the discretion of the Owner

E. Pipe Embedment and Backfill Testing
   1. Two moisture-density relationship tests, ASTM D698, or two relative density tests, ASTM D4253/D4254, as appropriate for each type of embedment on backfill material proposed, except granular embedment material
   2. One in-place compaction test every 200 lineal feet of trench in the compacted embedment zone and at every 1.5 feet of vertical lift of backfill materials, per ASTM D6938
   3. One in-place compaction test near top of trench for trench depth of 2 feet or less, per ASTM D6938
   4. Additional in-place compaction tests at the discretion of the Owner

F. Pavement and Structural Subgrade Testing
   1. At a minimum, two moisture-density relationship tests, ASTM D698, or two relative density tests, ASTM D4253/D4254, as appropriate and adequate for each type backfill material proposed.
   2. Perform tests for each footing, concrete site feature, and drainage structure subgrade. Perform tests at every 100 linear feet of subgrade of foundation walls, retaining walls, and every 150 feet for curbing, pans, drainage features, walks, etc. (or portions thereof). Perform tests every 2,000 square feet required of building slab area, exterior slabs and pavement/flatwork areas (with no less than 3 tests). Test at subgrade and at every vertical lift of backfill materials placed.
   3. Additional in-place compaction tests at the discretion of the Owner

G. Inspection and approval
   1. A qualified Geotechnical Engineer will inspect the natural soil at bottom of excavations for structures

2. Do not prepare subgrade or place concrete until Geotechnical Engineer's inspection has taken place and any resulting recommendations of the Geotechnical Engineer have been fulfilled or until the inspection has been waived by the Geotechnical Engineer
3. Prior to placement of structural fill, overexcavated foundations subgrades will be observed and tested by a qualified Geotechnical Engineer to ensure suitable bearing materials exist
4. Geotechnical Engineer will provide a letter to Engineer to confirm the presence of suitable subgrade material and properly placed fill materials by Contractor in accordance with Drawings and geotechnical report.

H. Retesting of flailed compaction will be performed by Geotechnical Engineer for Owner, but paid for the Contractor

END OF SECTION

SECTION 02430

CONCRETE RAISING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provisions to raise and support the existing slab to level by drilling and injecting grout under the sagged areas of the slab.

1.2 MEASUREMENT AND PAYMENT

A. Measurement
   1. The method of measurement for slab jacking is the number of cubic yards of slurry grout mixture completed and accepted in the work

B. Basis of Payment
   1. Portland Cement: The accepted quantities, as determined above, will be paid for at the contract price per unit of measurement. The unit price for Portland cement will include full compensation for furnishing labor, grout materials, and tools and equipment; for furnishing, loading and unloading, storing, hauling and handling grout ingredients; for mixing and pumping grout; and for the drilling and patching of holes used to inject grout. All of the above will be considered in the unit price of Portland cement.

C. Exclusions
   1. Repair or replacement of concrete slabs broken due to jacking shall not be measured for payment. Furnish all labor, equipment, tools, and materials necessary to repair or replace broken concrete slab sections at no cost to the Owner.

1.3 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 01340
   1. Mix proportions for grout mixture

PART 2 PRODUCTS

2.1 SLAB JACKING MATERIALS

A. Grout mixture
   1. Provide portand cement grout mixture, used for slabjacking, consisting of Portland cement, pozzolan or fly ash, limestone dust, sand, and water. The use of accelerators, high range water reducers and fluidifiers are subject to the approval of the Engineer.
   2. Portland Cement: Conform to ASTM C150
   3. Pozzolans and fly ash: Meet the requirements of ASTM C618

4. Chemical admixtures: Provide Chemical admixtures that are proosed to be used to assist in pumping grouts, or to compensate for climatic conditions, conforming to ASTM C494 and ASTM C937.
5. Use water that is fresh, clean, and free from deleterious quantities of oil, acid, alkali, salts, organic matter, or similar substances.
6. Aggregate to be used for slabjacking may consist of natural sand, manufactured sand, or a combination of natural and manufactured sand and limestone dust. If the aggregate is a combination of separately processed sizes from the same or different sources, or a blend of different materials, batch the different components separately or blended under approved conditions prior to delivery.

PART 3 EXECUTION

3.1 INSPECTION

A. Prior to jacking and pavement, closely examine the slabs for any existing cracks or depressions. Perform this investigation with the Engineer. Both parties shall agree regarding the existing condition of the pavement, and existing cracks and depressions shall be noted or marked.

3.2 DRILLING HOLES FOR GROUT INJECTION

A. Drill grout injection holes in a pattern as directed by the Engineer. Holes shall not be larger than 2” in diameter, drilled vertically to a depth sufficient to penetrate through the slab , but not more than 3 inches into the subgrade. Drill holes so that breakout does not occur at the bottom of the slab.

B. Holes may be briefly washed to a create a small cavity underneath the slab allowing initial spread of the grout.

3.3 JACKING

A. Prior to jacking operation erect string lines that will be blocked up from the pavement high points to monitor movement.

B. Lower into holes an expanding rubber packer or other approved device providing a positive seal and connected to the discharge hose. Do not extend the discharge end of the packer or hose below the lower surface of the concrete slab. When jacking the reinforced concrete slab, perform the pumping in a pattern and in the amount required to raise the concrete slab to within 0.05 foot of level. Do not allow loss of grout through cracks, joints, edges of foundation or losses from back pressure.

C. Grout held in the mixer or in the injection pump or hose for more than one hour shall not be used for jacking.

D. Do not raise the slabs more than ¼ inch when pumping in any one hole at any time. No part of the slab shall lead any other part of the slab or any adjacent slab more than ¼” at any

time. Keep the entire slab and all adjacent slabs on the same plane at all times, within the ¼ inch tolerance.

E. Make observations to ensure that when puming from one hole, the grout flows to adjacent holes filling all voids. The Contractor may cut a slab to prevent breakage when it is bound against an adjoining slab. If the temperature is 80 degrees or higher during the jacking operation, moisten the sabs sufficiently to prevent expansion of the slabs.

F. After jacking has been completed at any one hole, immediately remove the packer and plug the hole temporarily with a tapered wooden plug. The temporary wooden plugs shal not be removed until the grout has set sufficiently so that back pressure will not force it through the hole. Permanently seal each hole flush with the pavement surface with a fast setting sand/cement r other patching material approved by the Engineer. The patch material shall have a minimum thickness of 3 inches.

3.4 REPLACING AND REPAIR OF DAMAGED PAVEMENT

A. Replace or repair any sabs broken due to jacking as determined by the Engineer. Cracks emanating radially from the grout injection holes will be presumed to be caused by improper injection techniques by the Contractor. For each 5 feet of such crack measure, the Contractor's pay quantity will be reduced by 1 cubic foot of grout. In the event that transverse cracks develop between adjacent grout injection holes, the Contractor will be required to repair these cracks by an epoxy injection method to the satisfaction of the Engineer. The Engineer may require the removal and replacement of the entire slab or a portion of the slab damaged by radial or transverse cracks at no cost to the Owner.

B. Replace pavement to match the original slab thickness. Concrete mix used shall be 4500 psi concrete with an air content of 6 ± 1.5%.

END OF SECTION

SECTION 02445

SLIP LINING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping for slip lining the raw water irrigation pipeline between the water treatment plant (WTP) and the Las Colonias development.

1.2 RELATED SECTIONS

A. Division 1

B. Section 02300 – Earthwork

C. Section 03604 – Cellular Grout

1.3 DESCRIPTION

A. It is the intent of this specification

B. This section consists of the requirements and work needed to rehabilitate existing pipes by furnishing and installing pipe liners by the method of slip lining. Use pipes and pipe liners of the sizes, types, design, and dimensions shown on the plans, and include all connections, joints, and other appurtenances as required to complete the work. Specified in this section are requirements of slip lining of existing pipelines, including but is not limited to the following:
   1. Pipe Lining fabrication, storage and placement
   2. Grouting
   3. Other specific structural works
   4. Testing
   5. Reinstatement

1.4 REFERENCES

A. ANSI B16.1/ANSI B16.5 – Pipe Flanges and Fittings

B. ASTM C138/C138M – Standard Test Method for Density, Yield, and Air Content of Concrete

C. ASTM C150 – Standard Specifications for Portland Cement

D. ASTM C403/C403M – Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance

E. ASTM C495 – Compressive Strength of Lightweight Insulating Concrete

F. ASTM C796 – Foaming Agents for Use in Producing Cellular Concrete Using Preformed Foam

G. ASTM C869/869M – Foaming Agents Used in making Preformed Foam for Cellular Concrete

H. ASTM C939 – Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)

I. ASTM D1248 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials

J. ASTM D1330 – Standard Specification for Rubber Sheet Gaskets

K. ASTM D2657 – Heat Fusion Joining Polyolefin Pipe and Fittings

L. ASTM D2837 – Standard Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products

M. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR.) Based on Controlled Outside Diameter.

N. ASTM D3139 - Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals

O. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

P. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

Q. ASTM F477 – Standard Specification for Elastomeric Seals for Joining Plastic Pipe

R. ASTM F714 Standard Specification for Polyethylene Plastic Pipe (SDR-PR). Based on outside diameter.

S. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings

T. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch, for water

U. AWWA C906 - American Water Works Association standard for Polyethylene pressure pipe in sizes 4”-63” for water distribution. Testing done per C-906 guidelines.

1.5 SUBMITTALS

A. Submit under provisions of Division 1 Specifications

B. Shop Drawings: Submit manufacturer's detailed product data with complete information on pipeline materials, physical properties, dimensions, maximum recommended external

grout pressure, and minimum bending radius or maximum joint angular deflection. Include a manufacturer's certificate of compliance with specifications for proposed materials.

C. Product Data: Provide sufficient data on features, pipe, joints, gasket material, lubricant and accessories to verify compliance with specification. Certify that pipe, meets or exceeds specified requirements. Confirm all materials comply with applicable standards. Manufacturer's recommendations for shipping, handling, erection procedures, and care and maintenance upon completion of installation.

D. Test Reports: After liner installation, perform a low-pressure air test in accordance with ASTM D2837 before the liner has been completely sealed into place. Check integrity of joints and verify that liner has not been damaged during installation. Repair if needed using liner manufacturer's recommended procedure and retest for leaks.

E. Provide sufficient data to verify compliance with these specifications

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1 Specifications

B. Accurately record actual length of pipe used, volume of grout pumped and pipe elevations

1.7 REGULATORY REQUIREMENTS

A. Conform to all state and local municipal codes and ordinances, laws and regulations

B. In case of apparent conflict, state and local requirements govern over these specifications

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1 Specifications

B. Prevent injury or abrasion to pipe during loading, transportation, and unloading. Do not drop pipe from cars or trucks, nor allow pipe to roll down skids without proper restraining ropes. Use suitable pads, strips, skids, or blocks for each pipe during transportation and while awaiting installation in the field.

C. Remove pipe with cuts, gashes, nicks, abrasions, or any such physical damage which is deeper than 10 percent of the wall thickness from the Site and replace with undamaged pipe at no additional cost to the Owner.

D. Storage
   1. Store pipe, fittings and gaskets in clean locations protected from environmental conditions such as: (direct sunlight, mud. etc)

2. Store pipe on a flat surface which provides even support for the barrel with bell ends overhanging
    a. Do not stack pipe higher than 5 feet

E. Handling
1. Handle so as to insure installation in sound undamaged condition
2. Use equipment, tools and methods for unloading, reloading, hauling and laying that do not damage pipe or cause an impact. Damaged pipe will be cause for rejection
3. Use hooks or straps with broad, well padded contact surfaces for lifting sections of pipe

F. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation

PART 2 PRODUCTS

2.1 PIPE, GROUT, AND ACCESSORIES

A. Comply with City of Grand Junction Standard Specifications for the Construction of Underground Utilities

2.2 FUSIBLE PVC PIPING (PRESSURE)

A. The raw water carrier pipe shall be fusible PVC pipe as indicated on the drawings and as specified herein

B. Manufacturers:
1. Underground Solutions Inc.
2. IPEX
3. Or accepted substitution

C. Material:
1. All piping shall be made from PVC compound conforming to cell classification 12454 per ASTM D1784
2. Fusible PVC pipe shall conform to AWWA C900 for standard dimensionality. Testing shall be in accordance with the referenced AWWA standard.
3. Fusible PVC pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.
4. Fusible PVC pipe shall be manufactured in a standard 40’ nominal length, or custom lengths as specified.
5. Fusible PVC pipe shall be purple in color for reclaim, reuse, or other non-potable water distribution or conveyance.
6. Pipe shall be marked as follows:
    a. Nominal pipe size
    b. PVC
    c. Dimension Ratio, Standard Dimension Ratio, or Schedule

d. AWWA pressure class, or standard pressure rating for non-AWWA pipe, as applicable
e. AWWA standard designation number, or pipe type for non-AWWA pipe, as applicable
f. Extrusion production-record code
g. Trademark or trade name
h. Cell classification 12454 and/or PVC material code 1120 may also be included
i. For raw water service, the wording: "Raw Water, NOT for Potable Use"

7. Pipe shall be homogenous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

D. Fusion Joints:
1. Unless otherwise specified, fusible PVC pipe lengths shall be assembled in the field with butt-fused joints. The Contractor shall follow the pipe supplier's written guidelines for this procedure. All fusion joints shall be completed as described in this specification.

E. Connections and fittings for pressure applications
1. Connections shall be defined in conjunction with the coupling of project piping, as well as the tie-ins to other piping systems.
2. Ductile Iron Mechanical and Flanged Fittings
   a. Acceptable fittings for use with fusible PVC pipe shall include standard ductile iron fittings conforming to AWWA C110/ANSI A21.10, or AWWA C153/ANSI A21.53 and AWWA C111/ANSI A21.11
   b. Connections to fusible PVC pipe may be made using a restrained or non-restrained retainer gland product for PVC pipe, as well as for MJ and flanged fittings.
   c. Bends, tees, and other ductile iron fittings shall be restrained with the use of thrust blocking or other means as indicated in the construction documents.
   d. Ductile iron fittings and glands must be installed per the manufacturer's guidelines.
3. PVC gasketed, push-on fittings
   a. Acceptable fittings for use joining fusible PVC pipe shall include standard PVC pressure fittings conforming to AWWA C900
   b. Acceptable fittings for use joining fusible PVC pipe to other sections of fusible PVC pipe or other sections of PVC pipe shall include gasketed PVC, push-on type coupling and fittings, including bends, tees, and couplings as shown in the drawings.
   c. Bends, tees, and other PVC fittings shall be restrained with the use of thrust blocking or other restraint products as indicated in the construction documents.
   d. PVC gasketed, push-on fittings, and mechanical restraints, if used, must be installed per the manufacturer's guidelines.
4. Fusible PVC sweeps or bends
   a. Fusible PVC sweeps or bends shall conform to the same sizing convention, diameter, dimensional tolerances, and pressure class of the pipe being joined using the sweep or bend.

b. Fusible PVC sweeps or bends shall be manufactured from the same fusible PVC pipe being used for the installation, and shall have at least 2 feet of straight section on either end of the sweep or bend to allow for fusion of the sweep to the pipe installation. There shall be no gasketed connections utilized with a fusible PVC sweep.
c. Standard fusible PVC sweep or bend angles shall not be greater than 22.5 degrees, and shall be used in nominal diameters ranging from 4 inch through 16 inch.

5. Sleeve-type couplings
   a. Sleeve-type mechanical couplings shall be manufactured for use with PVC pressure pipe, and may be restrained or unrestrained as indicated in the construction documents.
   b. Sleeve-type couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.
6. Expansion and flexible couplings
   a. Expansion-type mechanical couplings shall be manufactured for use with PVC pipe, and may be restrained or unrestrained as indicated in the construction documents.
   b. Expansion-type mechanical couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.
7. Connection hardware
   a. Bolts and nuts for buried service shall be made of non-corrosive, high-strength, low-alloy steel having the characteristics specified in AWWA C111/ANSI A21.11, regardless of any other protective coating

2.3 HDPE PIPING (PRESSURE)

A. The raw water carrier pipe may alternately be HDPE pipe as indicated on the drawings and as specified herein

B. Manufacturers:
   1. High Country Fusion
   2. JM Eagle
   3. Performance Pipe
   4. WL Plastics
   5. ISCO Pipe
   6. Or accepted substitution

C. Material:
   1. The pipe shall be manufactured from a PE 4710 resin compound listed with the Plastic Pipe Institute (PPI) as TR-4
   2. The resin material shall be in accordance with ASTM D3350 with a minimum cell classification of 445574C/E
   3. This resin material shall have a Long Term Hydrostatic Strength of 1600 PSI when tested in accordance to ASTM D2837.
   4. Pipe dimensions shall be in accordance with ASTM D3035 as a minimum.
   5. The final compounded material shall contain a minimum of 2% carbon black

6. The pipe shall contain no recycled material except that generated by the pipe manufacturer in their own plant from resin compound of the same specification and raw material supplier. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.
7. Pipe shall have a manufacturing standard of ASTM F714 and be manufactured by an ISO 9001 certified manufacturer.
8. All pipes and fittings shall be suitable for use as pressure conduits, Pressure Class (PC) 100 have a nominal burst value of three and one-half times the Working Pressure Rating (WPR) of the pipe and/or fitting
9. The pipe shall be DR11 unless noted otherwise on the Drawings

D. Fittings:
   1. All fittings shall be PE 4710 HDPE, minimum Cell Classification of 445574C/E as determined by ASTM D3350
   2. All fittings shall be of the same base resin as the pipe.
   3. All fittings shall have a working pressure rating equal to the pipe unless otherwise specified in the plans.
   4. All fittings shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.
   5. Butt Fusion Fittings
      a. Molded butt fusion fittings shall be in accordance with ASTM D3261 and shall be manufactured by injection molding, a combination of extrusion and machining, or fabricated from HDPE pipe conforming to this specification.
   6. Compression Type Mechanical Coupling
      a. Suitable for joining HDPE to HDPE, HDPE to PVC, or HDPE to DIP
      b. Factory coat coupling internally and externally with a fusion bonded epoxy
      c. Reinforce HDPE pipe with a split ring type stiffener in pipe bore
         i) Size stiffeners for size of HDPE pipe being joined
         ii) Supply feature that prevents stiffener from sliding completely into pipe
         iii) Size stiffeners for length of mechanical coupling and not to extend outside of body of mechanical coupling
         iv) Mark stiffener with pipe diameter
         v) Factory coat stiffeners internally and externally with fusion bonded epoxy
      d. Use seal and restraint type coupling. Requirements for type of couplings are specified herein or shown on Drawings
         i) Approved Manufacturers:
            a) JCM, Industries
            b) Sur-Grip
            c) Romac
            d) Or accepted substitution

E. Transition Couplings: One-piece assembly
   1. One end being HDPE pipe with butt fusion joining technique
   2. Other end being either steel or brass pipe threaded suitable for connecting ductile iron, threaded fittings, or threaded valves
      a. Approved Manufacturers:
         i) Central Plastics Company

ii) Industrial Pipe Fittings, Inc.
iii) Or accepted substitution

F. Pipe fittings and flanged connections, to be joined by thermal butt-fusion, shall be of the same type, grade, and class of polyethylene compound and supplied from the same raw material supplier

G. Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer's specifications. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE pipe being fused. The size of the heating iron shall be ¼ inch larger than the size of the outlet branch being fused.

H. Socket fusion, hot gas fusion, threading, solvents, and epoxies will not be used to join HDPE pipe

I. Flange Gaskets
1. Flange gaskets shall be full-faced and shall be in accordance with ASTM D1330
2. Flange gasket drilling pattern shall conform to ANSI B16.1/B16.5
3. Flange gaskets shall be 1/16" thick for flanges up to 14" diameter. 1/8" thick gaskets shall be provided for flanges over 14" diameter
4. Gasket material shall be EPDM

2.4 FUSIBLE PVC AND HDPE PIPE JOINTS

A. Make pipe joints carefully and neatly

B. Connect piping in accordance with manufacturer's recommendations

C. Butt Fusion Joints
1. Thermal Fusion Only
2. Use equipment and procedure recommended by pipe manufacturer

2.5 POLYVINYL CHLORIDE (PVC) PRESSURE PIPING

A. The following piping shall be pressure PVC pipe as indicated on the drawings and as specified herein:
1. Electrical conduit

B. Manufacturers:
1. Cresline Plastic Pipe Co.
2. North American Pipe Corp.
3. Spears Manufacturing Co.
4. Or accepted substitution

C. Pipe and fittings:
1. 2 inch, ASTM D1785
2. Schedule 80

3. Fittings: Comply with ASTM D2466 (Schedule 40) or ASTM D2467 (Schedule 80)

D. Joints:
   1. Shall be bell and spigot, push-on type suitable for solvent welding, threading, or flanging
   2. Designed to hold pipe in alignment, provide flexibility, separate the ends of pipe lengths, resist applied earth pressures, and provide fluid tightness
   3. Solvent welding: ASTM D2672
      a. Use recommended solvent primer and cement for the application of fluid to be conveyed in pipeline
   4. Provide for sleeves or couplings where indicated.
      a. Furnish pipe ends suitable for receiving style of sleeve or coupling indicated or specified.
         i) Provide anchoring where restraint is required to withstand specified operating or hydrostatic test pressure and where indicated

PART 3 EXECUTION

3.1 PREPARATION

A. Qualifications
   1. Submit Contractor Qualifications for slip lining piping, proving its engagement in the successful installation of similar slip lining systems for at least 3 years.

B. Pre-Installation Conference
   1. Within 15 calendar days of Notice to Proceed, submit, for approval, the following:
      a. Detail drawings in an approved form, for each slip lining system
      b. List of proposed products showing existing pipe diameters
      c. New diameters of slip lining installed
      d. Dates of pipe placement and grouting operation
      e. Joints, gaskets, proposed resins, and other pertinent information.
      f. Proposed Construction Progress Schedule
      g. List of proposed subcontractors

C. Complete the following preparations, unless approved otherwise by the Engineer. The Engineer makes no guarantee regarding the information, data, and physical condition of underground facilities or existing pipe lines. Before commencing with any work, or ordering any materials, physically measure and review the CCTV inspection of the existing pipe line to verify that the rehabilitation specified herein is appropriate.

D. Ream pipe and tube ends and remove burrs

E. Remove scale and dirt, on inside and outside, before assembly

3.2 PRE-LINING VIDEO REVIEW

A. It is the Contractor's responsibility to review video of existing pipe before lining and perform additional video inspections, if necessary. Plan work after review of CCTV inspection video and CCTV reports.

3.3 INSERTION AND PULLING OF MANDREL

A. It is the responsibility of the Contractor to pull a mandrel with a minimum length of one joint of pipe completely through each proposed rehabilitated pipe line. Use a mandrel of the same outside diameter as the sliplining pipe.

3.4 PIPE LINE OBSTRUCTIONS

A. If a pre-installation inspection with a mandrel reveals an obstruction (such as heavy solids, dropped joints, or collapsed pipe) in the existing pipe that cannot be removed by pipe cleaning equipment, perform a point repair prior to slip lining as approved by the Engineer. Complete all point repairs, mobilize equipment and material, and inform the Engineer of the impending work schedules for liner installations.

3.5 FIELD QUALITY CONTROL

A. General
   1. Utilize pressures, media and pressure test durations as specified on Piping Schedules
   2. Isolate equipment which may be damaged by the specified pressure test conditions
   3. Perform pressure test using calibrated pressure gauges and calibrated volumetric measuring equipment to determine leakage rates. Select each gauge so that the specified test pressure falls within the upper half of the gauge's range. Notify Engineer 24 hours prior to each test
   4. Completely assemble and test new piping systems prior to connection to existing pipe systems
   5. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance
   6. Provide all necessary equipment and perform all work required in connection with the tests and inspections
   7. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination

B. Testing Methods and Criteria

3.6 DELIVERY AND OFF-LOADING

A. All pipe shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced as directed by the owner or engineer.

B. Each pipe shipment should be inspected prior to unloading to see if the load has shifted or otherwise been damaged. Notify owner or engineer immediately if more than immaterial

damage is found. Each pipe shipment should be checked for quantity and proper pipe size, color, and type.

C. Pipe should be loaded, off-loaded, and otherwise handled in accordance with AWWA M23, and all of the pipe supplier's guidelines shall be followed.

D. Off-loading devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe are strictly prohibited.

E. During removal and handling, be sure that the pipe does not strike anything. Significant impact could cause damage, particularly during cold weather.

F. If appropriate unloading equipment is not available, pipe may be unloaded by removing individual pieces. Care should be taken to ensure that pipe is not dropped or damaged. Pipe should be carefully lowered, not dropped, from trucks.

3.7 HANDLING AND STORAGE

A. Any length of pipe showing a crack or which has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work. Damaged areas, or possible areas of damage may be removed by cutting out and removing the suspected incident fracture area. Limits of the acceptable length of pipe shall be determined by the Owner or Engineer.

B. Any scratch or gouge greater than 10% of the wall thickness will be considered significant and can be rejected unless determined acceptable by the Owner or Engineer.

C. Pipe lengths should be stored and placed on level ground. Pipe should be stored at the job site in the unit packaging provided by the manufacturer. Caution should be exercised to avoid compression, damage, or deformation to the ends of the pipe. The interior of the pipe, as well as all end surfaces, should be kept free from dirt and foreign matter.

D. Pipe shall be handled and supported with the use of woven fiber pipe slings or approved equal. Care shall be exercised when handling the pipe to not cut, gouge, scratch or otherwise abrade the piping in any way.

E. If pipe is to be stored for periods of 1 year or longer, the pipe should be shaded or otherwise shielded from direct sunlight. Covering of the pipe which allows for temperature build-up is strictly prohibited. Pipe should be covered with an opaque material while permitting adequate air circulation above and around the pipe as required to prevent excess heat accumulation.

F. Pipe shall be stored and stacked per the pipe supplier's guidelines.

3.8 FUSION PROCESS FOR FUSIBLE PVC

A. General

1. Fusible polyvinylchloride pipe shall be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this specification and pipe supplier's guidelines.
2. Fusible polyvinylchloride pipe shall be fused by qualified fusion technicians, as documented by the pipe supplier.
3. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine.
4. Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. Fusion machines must incorporate the following elements:
    a. HEAT PLATE - Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly; cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's guidelines.
    b. CARRIAGE – Carriage shall travel smoothly with no binding at less than 50 psi. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.
    c. GENERAL MACHINE - Overview of machine body shall yield no obvious defects, missing parts, or potential safety issues during fusion.
    d. DATA LOGGING DEVICE – An approved datalogging device with the current version of the pipe supplier's recommended and compatible software shall be used. Datalogging device operations and maintenance manual shall be with the unit at all times. If fusing for extended periods of time, an independent 110V power source shall be available to extend battery life.
5. Other equipment specifically required for the fusion process shall include the following:
    a. Pipe rollers shall be used for support of pipe to either side of the machine.
    b. A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement, extreme temperatures, and /or windy weather, per the pipe supplier's recommendations.
    c. An infrared (IR) pyrometer for checking pipe and heat plate temperatures.
    d. Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.
    e. Facing blades specifically designed for cutting fusible PVC pipe shall be used.

B. Joint Recording
1. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of fusible polyvinyl chloride pipe. The software shall register and/or record the parameters required by the pipe supplier and these specifications. Data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.

3.9 INSTALLATION OF FUSIBLE PVC PIPE

A. Installation guidelines from the pipe supplier shall be followed for all installations.

B. The fusible PVC pipe shall be installed in a manner so as not to exceed the recommended bending radius.

C. Where fusible PVC is installed by pulling in tension, the recommended Safe Pulling Force established by the pipe supplier shall not be exceeded.

D. Adhere to the following installation procedures using ASTM F585 unless otherwise specified by the Engineer:
   1. The Contractor is responsible for any existing pipe flow control or backups during slip lining operations.
   2. If the slip line pipe is HDPE, allow the installed pipe to relax and cool following installation in accordance with manufacturer's recommended time, but not less than 8 hours, prior to any reconnection of service lines, grouting of the annulus, or backfilling of the insertion pit.
   3. Prior to the introduction of grout and backfilling of re-established service connections, perform a dye water test on the liner pipe to test the bulkheads at each end for leaks. Place grout within 24 hours of slip lining. After all work is completed, provide the Engineer with DVD showing both pre- and post-installation conditions. Correct all defects discovered during the post-installation television inspection, at no cost to the Government, before the work under the Contract will be considered for substantial completion.

E. After liner is in place, the area between the original pipe and the liner shall be completely filled with a low density, flowable fill of cellular grout.

3.10 INSTALLATION OF HDPE PRESSURE PIPE

A. Pipe and Fittings
   1. Follow pipe manufacturers installation instructions for field cutting and fusion joining techniques for HDPE pipe
      a. Include acceptable size and shape of fusion bead; and minimum radius of curvature of various sizes of pipe for installing curved sections of pipe
   2. Carefully lower pipe, fittings, valves, and accessories into the trench with derricks, ropes, and other suitable equipment to prevent damage
   3. Do not dump or drop pipe or accessories into trench
   4. Lay to lines and grades indicated on drawings or as specified
      a. Lay piping beginning at a low point of system, true to line and grade with unbroken continuity of invert.
      b. Join to form a smooth flow line
   5. Do not install flanges, fittings, or valves in curved sections of pipe
   6. Keep pipe clean during and after laying
   7. Close all open ends with watertight expandable type sewer plugs or test plugs
   8. Do not lay pipe when

a. There is water in the trench
b. Trench conditions are unsuitable
c. Weather conditions are unsuitable

9. Use acceptable adaptors at manhole and structure connections to provide a watertight seal and flexibility; provide a short length of pipe outside each connection
10. Protect from lateral displacement by placing and compacting bedding material under provisions of Section 02300
11. Protect pipe from hot and cold thermal expansion using manufacturer and other recommended techniques
12. HDPE pipe by Horizontal Directional Drilling (HDD): Refer to Section 02446

B. Joining
1. Use butt fusion joining technique for connections between pipe sections or fittings unless otherwise noted herein.
2. Butt Fusion
   a. Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground.
   b. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations.
   c. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer.
   d. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself.
3. Sidewall Fusion
   a. Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer's specifications.
   b. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE pipe being fused.
   c. The size of the heating iron shall be ¼ inch larger than the size of the outlet branch being fused.
4. Mechanical
   a. Bolted joining may be used where the butt fusion method cannot be used.
   b. Flange joining will be accomplished by using a HDPE flange adapter with a ductile iron back-up ring.
   c. Mechanical joint joining will be accomplished using either a molded mechanical joint adapter or the combination of a Sur-Grip Restrainer and Pipe Stiffener as manufactured by JCM Industries, Inc.
   d. Either mechanical joint joining method will have a ductile iron mechanical joint gland.
5. Other
   a. Socket fusion, hot gas fusion, threading, solvents, and epoxies may not be used to join HDPE pipe.

3.11 PREPARATION PRIOR TO MAKING CONNECTIONS INTO EXISTING PIPING SYSTEMS

A. Approximate locations for existing piping systems are shown in the construction documents. Prior to making connections into the existing piping systems, the Contractor shall:
   1. Field verify location, size, piping material, and piping system of the existing pipe.
   2. Obtain all required fittings, which may include saddles, sleeve type couplings, flanges, tees, or others as shown in the construction documents.
   3. Have installed all temporary pumps and/or pipes in accordance with established connection plans.

B. Unless otherwise approved, new piping systems shall be completely assembled and successfully tested prior to making connections into existing pipe systems.

3.12 PIPE SYSTEM CONNECTIONS

A. Pipe connections shall be installed per applicable standards and regulations, as well as per connection manufacturer's guidelines and as indicated in the construction documents. Pipe connections to structures shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines.

3.13 TAPPING FOR NON-POTABLE WATER APPLICATIONS

A. Tapping shall be performed using standard tapping saddles designed for use on PVC piping in accordance with AWWA C605. Tapping shall be performed only with use of tap saddles or sleeves. NO DIRECT TAPPING WILL BE PERMITTED.

B. All connections requiring a larger diameter than that recommended by the pipe supplier, shall be made with a pipe connection as specified and indicated on the drawings.

C. Equipment used for tapping shall be made specifically for tapping PVC pipe:
   1. Tapping bits shall be slotted "shell" style cutters, specifically made for PVC pipe. 'Hole saws' made for cutting wood, steel, ductile iron, or other materials are strictly prohibited.
   2. Manually operated or power operated drilling machines may be used.

D. Taps may be performed while the pipeline is filled with water and under pressure ('wet' tap), or when the pipeline is not filled with water and not under pressure ('dry' tap).

3.14 TESTING

A. Testing shall comply with all applicable jurisdictional building codes, statutes, standards, regulations, and laws

B. Hydrostatic testing and leakage testing for fusible PVC pressure piping
   1. Hydrostatic and leakage testing for piping systems that contain mechanical jointing as well as fused PVC jointing shall comply with AWWA C605.

2. Unless agreed to or otherwise designated by the owner or engineer, for a simultaneous hydrostatic and leakage test following installation, a pressure equal to 150% of working pressure at point of test, but not less than 125% of normal working pressure at highest elevation shall be applied. The duration of the pressure test shall be for two (2) hours.
3. If hydrostatic testing and leakage testing are performed at separate times, follow procedures as outlined in AWWA C605.
4. In preparation for pressure testing the following parameters must be followed:
    a. All air must be vented from the pipeline prior to pressurization. This may be accomplished with the use of the air relief valves or corporation stop valves, vent piping in the testing hardware or end caps, or any other method which adequately allows air to escape the pipeline at all high points. Venting may also be accomplished by 'flushing' the pipeline in accordance with the parameters and procedures as described in AWWA C605.
    b. The pipeline must be fully restrained prior to pressurization. This includes complete installation of all mechanical restraints per the restraint manufacturer's guidelines, whether permanent or temporary to the final installation. This also includes the installation and curing of any and all required thrust blocking. All appurtenances included in the pressure test, including valves, blow-offs, and air-relief valves shall be checked for proper installation and restraint prior to beginning the test.
    c. Temporary pipeline alignments that are being tested, such as those that are partially installed in their permanent location shall be configured to minimize the amount of potentially trapped air in the pipeline.

C. Polyethylene (PE) pressure pipe systems: Test PE pressure pipe in accordance with the latest version of ASTM F2164. For PE pipe, pressurize the test section to the system test pressure and maintain this pressure for four hours by adding make-up water. After this initial expansion phase, reduce the test pressure by 10 PSI and stop adding make-up water. If the test pressure remains steady (within 5% of the target value) for one hour, no leakage is indicated

D. Unless otherwise specified, the allowable leakage in gallons per hour from other buried liquid piping systems shall be less than the length of pipeline tested in feet, times the nominal diameter of the pipe in inches, times the square root of the average test pressure during the leakage test in pounds per square inch (gauge), divided by 133,200. The duration of each leakage test shall be two hours. The equation for computing the allowable leakage is:

$$L = (SDP0.5)/133{,}200$$

Where:
L = allowable leakage, in gallons per hour
S = length of the pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in psi

E. Partial testing

1. Segments of the pipe may be tested separately in accordance with standard testing procedure, as approved by the Owner and Engineer.

3.15 INSTALLATION CERTIFICATE

A. Submit a signed copy of the Manufacturer's Certification of Installation to the Engineer upon completion of final inspection.

3.16 WARRANTY

A. Warranty shall be provided for a minimum of 2 years from the date of Certification of Installation -OR- Final Completion and Acceptance for work related to slip lining. If Manufacturer’s warranty does not cover a 2-year period, Contractor shall warrant the work beyond the manufacturer’s warranty period to provide a minimum 2-year warranty from the date of Certification of Installation -OR- Final Completion and Acceptance.

B. Submit 4 copies of the signed Manufacturer's Warranty to the Engineer within 30 calendar days of Certification of Installation -OR- Final Completion.

END OF SECTION

SECTION 02510

WATER DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Buried and above ground pipe, fittings, hydrants, valves, appurtenances, and associated accessories for water distribution and transmission lines

PART 2 RELATED SECTIONS

A. Section 01730 – Operation and Maintenance Data

B. Section 02300 – Earthwork

C. Section 02676 – Disinfection of Water Systems

2.2 REFERENCES

A. American Society for Testing and Materials (ASTM)
   1. A36 – Standard Specification for Carbon Structural Steel
   2. A48 – Standard Specification for Gray Iron Castings
   3. A53 – Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless
   4. A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
   5. A185 – Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement
   6. A242 – Standard Specification for High-Strength Low-Allow Structural Steel
   7. A276 – Standard Specification for Stainless Steel Bars and Shapes
   8. A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
   9. A449 – Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
   10. A536 – Standard Specification for Ductile Iron Castings
   11. A674 – Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids
   12. A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
   13. A1011 – Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
   14. B62 – Standard Specification for Composition Bronze or Ounce Metal Castings

15. B88 – Standard Specification for Seamless Copper Water Tube
16. B96 – Standard Specification for Copper-Silicon Alloy Plate, Sheet, Strip, and Rolled Bar for General Purposes and Pressure Vessels
17. B763 – Standard Specification for Copper Alloy Sand Castings for Valve Applications
18. B843 – Magnesium Alloy Anodes for Cathodic Protection
19. C33 – Standard Specification for Concrete Aggregates
20. C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
21. C150 – Standard Specification for Portland Cement
22. C913 – Standard Specification for Precast Concrete Water and Wastewater Structures
23. C1227 – Standard Specification for Precast Concrete Septic Tanks
24. D429 – Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates
25. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kn-m/m3))
26. D1241 – Standard Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses
27. D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
28. D1330 – Standard Specification for Rubber Sheet Gaskets
29. D1351 – Standard Specification for Thermoplastic Polyethylene Insulation for Electrical Wire and Cable
30. D1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
31. D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
32. D2000 – Standard Classification System for Rubber Products in Automotive Applications
33. D2239 – Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
34. D2241 – Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
35. D2467 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
36. D2454 – Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
37. D2737 – Standard Specification for Polyethylene (PE) Plastic Tubing
38. D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping
39. D2837 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
40. D3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
41. D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

42. D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
43. D3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
44. D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
45. D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
46. D3950 – Standard Specification for Strapping, Nonmetallic (and Joining Methods)
47. D4253 – Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
48. D4254 – Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
49. D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
50. E8 – Standard Test Methods for Tension Testing of Metallic Materials
51. F412 – Standard Terminology Relating to Plastic Piping Systems
52. F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
53. F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
54. G97 – Standard Test Method for Laboratory Evaluation of Magnesium Sacrificial Anode Test Specimens for Underground Applications

B. American Water Works Association (AWWA)
1. B300 – Standard for Hypochlorites
2. B301 – Standard for Liquid Chlorine
3. B302 – Standard for Ammonium Sulfate
4. B303 – Standard for Sodium Chlorite
5. C104 – Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
6. C105 – Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
7. C110 – Standard for Ductile-Iron and Gray-Iron Fittings
8. C111 – Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
9. C115 – Flanged Ductile-Iron Pipe with Ductile-Iron or Grey-Iron Threaded Flanges
10. C116 – Standard for Protective Fusion-Bonded Epoxy Coatings for Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
11. C150 – Standard for Thickness Design of Ductile-Iron Pipe
12. C151 – Standard for Ductile-Iron Pipe, Centrifugally Cast
13. C153 – Standard for Ductile-Iron Compact Fittings
14. C200 – Standard for Steel Water Pipe 6 In. (150 mm) and Larger
15. C203 – Standard for Coal-Tar Protective Coatings & Linings for Steel Water Pipes
16. C206 – Standard for Field Welding of Steel Water Pipe
17. C207 – Standard for Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)
18. C213 – Standard for Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings
19. C214 – Standard for Tape Coatings for Steel Water Pipelines
20. C219 – Standard for Bolted, Sleeve-Type Couplings for Plain-End Pipe

21. C500 – Standard for Metal-Seated Gate Valves for Water Supply Service
22. C502 – Standard for Dry-Barrel Fire Hydrants
23. C504 – Standard for Rubber-Seated Butterfly Valves
24. C509 – Standard for Resilient-Seated Gate Valves for Water Supply Service
25. C515 – Standard for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
26. C550 – Standard for Protective Epoxy Interior Coatings for Valves and Hydrants
27. C600 – Standard for Installation of Ductile Iron Mains and Their Appurtenances
28. C604 – Standard for Installation of Buried Steel Water Pipe – 4 In. (100 mm) and Larger
29. C605 – Standard for Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
30. C651 – Disinfecting Water Mains
31. C700 – Standard for Cold-Water Meters – Displacement Type, Metal Alloy Main Case
32. C800 – Standard for Underground Service Line Valves and Fittings
33. C900 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm) for Water Transmission and Distribution
34. C901 – Standard for Polyethylene (PE) Pressure Pipe and Tubing 1/2 In. (13 mm) Through 3 In. (76 mm) for Water Service
35. C905 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm) for Water Transmission and Distribution
36. C906 – Polyethylene (PE) Pressure Pipe and Fittings 4 in. (100 mm) Through 63 In. (1,600 mm) for Water Distribution and Transmission
37. M11 – Steel Pipe: A Guide for Design and Installation
38. M17 – Standard for Installation, Field Testing, and Maintenance of Fire Hydrants
39. M23 – Standard for PVC Pipe Design and Installation
40. M41 – Standard for Ductile-Iron Pipe and Fittings

C. Colorado Department of Transportation (CDOT)

D. Occupational Safety and Health Administration (OSHA)

E. NSF International:
   1. Standard 60 – Drinking Water Treatment Chemicals – Health Effects
   2. Standard 61 – Drinking Water System Components – Health Effects

F. Surface Preparation Standards (SSPC)

G. National Association of Corrosion Engineers (NACE):
   1. SP0169 – Control of External Corrosion on Underground or Submerged Metallic Piping Systems
   2. SP0286 – Electrical Isolation of Cathodically Protected Pipelines

H. Uni-Bell PVC Pipe Association:

1. Uni-Pub-8: Tapping Guide for PVC Pressure Pipe

I. Plastics Pipe Institute (PPI):
   1. TR-4 – HDB / HDS / SDB / PDB / MRS Ratings for Thermoplastic Piping Materials or Pipe
   2. TR-33 – Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe
   3. Handbook of Polyethylene Pipe
   4. Material Handling Guide

J. Ductile Iron Pipe Research Association (DIPRA):
   1. Thrust Restraint Design for Ductile Iron Pipe

K. International Plumbing Code (IPC)

L. International Code Council (ICC)

M. Underwriters' Laboratories (UL)

2.3 SUBMITTALS

A. Submit under provisions of Division 1 Specifications

B. Shop Drawings: Provide piping layout and assembly drawings with fitting dimensions. Provide sufficient information to verify compliance with specifications

C. Shop Drawings: Provide sufficient data to verify compliance with the specifications and to illustrate construction and assembly of precast vault

D. Product Data: Provide manufacturer's catalog information with dimensions, material and assembled weight. Indicate pressure ratings for pipe, fittings, valves
   1. Pipe materials
   2. Special, fitting, and coupling details
   3. Joint restraint system
   4. Valves
   5. Laying and installation schedule
   6. Specifications and data sheets
   7. Affidavits of compliance for protective shop coatings and linings

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements and applicable standards. Provide prior to shipment.

2.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1 Specifications

B. Accurately record actual locations of piping mains, valves, connections, top of pipe elevations, and any mapped or unmapped utilities

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities

2.5 QUALITY ASSURANCE

A. Manufacturers shall be experienced in the design and manufacturing of materials specified herein for a minimum period of 5 years

B. All pipe, regardless of diameter, shall be supplied by a single manufacturer

C. Perform Work in accordance with AWWA C651, and the Colorado Department of Public Health and Environment (CDPHE), Mesa County, and City

D. Contractor shall conduct visual inspection before installation

E. Provide manufacturer's name and pressure rating marked on piping and valves

F. Provide piping complete with all fittings, jointing materials, supports, joint restraint system, and necessary appurtenances for watertight, fully operational water lines

2.6 REGULATORY REQUIREMENTS

A. Conform to all municipal codes and ordinances, laws and regulations of Mesa County, City, CDPHE, the notes and details on the drawings and as specified herein, and CDPHE Stormwater Management and/or Construction Dewatering Permit

B. Conform to AWWA C651, as appropriate, and CDPHE Design Criteria for Potable Water Systems for performing the work of this Section

C. In case of apparent conflict, CDPHE requirements govern over these specifications

D. In absence of State and local regulations, International Plumbing Code applies

E. NFPA Compliance: Install fire water systems in accordance with NFPA 24 “Standard for the Installation of Private Fire Service Mains and Their Appurtenances”

F. UL Compliance: Provide fire hydrants that comply with UL 246 “Hydrants for Fire-Protection Service,” and are listed by UL.

G. Contractor, not Owner, shall prepare, submit, pay, and otherwise obtain all necessary permits from all appropriate entities

2.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1 specifications

B. Delivery

1. Ship rubber gaskets in cartons and store in a clean area away from grease, oil, ozone producing electric motors, heat and the direct sunlight

C. Storage
   1. Store pipe, fittings and gaskets in clean locations protected from environmental conditions such as: direct sunlight, mud, etc.
   2. Do not use pipe and fittings stored in direct sunlight for periods in excess of 18 months
   3. Store pipe on a flat surface which provides even support for the barrel with bell ends overhanging
      a. Do not stack pipe higher than 5 feet

D. Storage: Use the following precautions for valves, during storage:
   1. Do not remove end protectors unless necessary for inspection; then reinstall for storage
      a. Protect valves from weather by storing indoors or support valves off ground or pavement in watertight enclosures when outdoor storage is necessary

E. Handling
   1. Handle so as to insure installation in sound undamaged condition
   2. Use equipment, tools and methods for unloading, reloading, hauling and laying that do not damage pipe or cause an impact. Damaged pipe will be cause for rejection.
   3. Use hooks or straps with broad, well-padded contact surfaces for lifting sections of pipe

F. Preparation for Transport: Prepare valves, for shipping as follows: Ensure that valves are dry and internally protected against rust and corrosion. Protect valves against damage to threaded ends, flange faces, and weld ends. Set valves in best position for handling. Set valves closed to prevent rattling

G. Deliver and store valves and accessories in shipping containers with labeling in place in accordance with AWWA C500

H. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation

I. Seal valve ends to prevent entry of foreign materials into valve body

J. During loading, transporting and unloading, exercise care to prevent damage to material
   1. Use nylon slings only
   2. Do not drop pipe or fittings
   3. Do not roll or skid against pipe already on ground
   4. Repair any damage done to coating or lining
   5. Handle per manufacturer's recommendations
   6. Store rubber gaskets in cool dark location
   7. Store all material on wood pallets or timbers

K. Adequately tag or otherwise mark all piping, fittings, and valves as to size per AWWA C509, C900, and C905

L. Shop coated materials shall be handled, transported, stored and shipped in a manner that will prevent damage to the coating and lining. Coating or lining damaged in handling or other operations shall be repaired to the approval of and at no additional cost to the Owner

M. Any damage to the pipe or the protective coating from any cause during the installation of the pipeline and before final acceptance by the Engineer shall be repaired in accordance with these Specifications and at no additional cost to the Owner

2.8 JOB CONDITIONS

A. Underground Obstructions
   1. Underground Obstructions known to Engineer are shown on Drawings
      a. Locations shown may prove inaccurate and other obstructions not known to Engineer may be encountered
      b. Contractor shall field locate and verify all obstructions where or not shown on the Drawings
   2. Notify each utility owner and request utility be field located by surface reference at least 48 hours prior to trenching or excavation
   3. Expose and verify size, location and elevation of underground utilities and other obstructions where conflicts might exist sufficiently in advance to permit changes in the event of a conflict
      a. Notify Engineer and Owner in case of a conflict
      b. In case of a conflict, the proposed work may be changed by Engineer
   4. Maintain, protect, and support by shoring, bracing or other means existing utilities and appurtenances

B. Verify existing system operation, pressures, and valve settings (open or closed) prior to construction

PART 3 PRODUCTS

3.1 PVC PIPE – 4" TO 12" DIAMETER

A. Manufacturers:
   1. JM Eagle
   2. Georg Fischer Piping Systems
   3. North American Pipe Corporation
   4. Diamond Plastics Corporation
   5. Vinyltech Corporation
   6. Or accepted substitution

B. The following piping shall be small diameter PVC pipe as indicated on Drawings and as specified herein:

1. Water distribution mains: 6", 8" and 12" diameter
2. Fire hydrant laterals and blow off drain lines: 6" diameter
3. Diameters: Cast iron pipe equivalent outside diameters

C. Pipe: AWWA C900, DR 18 except as otherwise specified or indicated on the Drawings

D. Marking: Identification markings on pipe shall conform to AWWA C900

E. Fittings: Ductile iron compact fittings: ANSI A 21.53/AWWA C153
   1. Working pressure rating: 350 psi rating
   2. Joint: Mechanical joints with restraints
   3. Coating:
      a. Exterior: AWWA C111, Asphalt coated
      b. Interior: AWWA C104 and C111, lined with double thickness cement seal coated
      c. Or interior and exterior: AWWA C116, fusion bonded epoxy coating

F. Joints: ASTM D3139, integral bell or mechanical joint
   1. Push-on joints: pipe to pipe joints, except as otherwise specified or indicated on Drawings. Push on joints are not permitted on fittings or valves
      a. Integral bell type with elastomeric gaskets, ASTM F477 factory installed
      b. Suitable for buried service
      c. Gaskets:
         i) Material: Virgin SBR rubber suitable for potable water conforming to AWWA C111
         ii) Lubricant shall be suitable for potable water contact
   2. Restraint device for PVC push on joint
      a. Restraint material: ASTM A536 , ductile iron
      b. A split ring shall be used behind the pipe bell. A serrated ring shall be used to grip the pipe, and a sufficient number of bolts shall be used to connect the bell ring and the gripping ring
      c. Nuts and bolts torqued to requirements of manufacturer
      d. Pressure rating consistent with pipe pressure rating
      e. Restraint coatings shall be consistent with manufacturer's standard
      f. Manufacturers:
         i) EBAA Iron Inc. "Series 1600"
         ii) Romac Industries "Series 611"
         iii) Or accepted substitution
   3. Mechanical joint restraint
      a. Provide mechanical joint restraint for all ductile iron fittings connecting to PVC pipe
      b. Restraint devices for shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA A21.10/C110
      c. Pressure rating consistent with pipe pressure rating
      d. Restraint coatings shall be consistent with manufacturer's standard
      e. Manufacturer:
         i) EBAA Iron "MEGALUG 2000 PV"

ii) Romac Industries "Roma-Grip"
iii) Or accepted substitution

G. Couplings
1. Mechanical couplings:
a. Dresser Style 38
b. Rockwell 411
c. Or accepted substitution
2. Insulated Mechanical Couplings:
a. Dresser Style 39
b. Or accepted substitution
3. Transition Couplings:
a. Rockwell 415
b. Dresser Style 39
c. Or accepted substitution
4. Solid Sleeve Coupling:
5. Glands color coded: Black

H. Couplings
1. Provide for connection between PVC and Asbestos Cement water distribution pipe
2. Material: Ductile Iron, ASTM A536 Grade 65-45-12
3. End Rings: Ductile Iron, ASTM A536
4. Gaskets: Virgin SBR rubber suitable for potable conforming to AWWA C111
5. Bolts and Heavy Hex Nuts: UNC 5/8" rolled threads with black finish.
6. Manufacturer:
a. JCM
b. EJ Prescott
c. Or accepted substitution

3.2 PVC PIPE – 14” TO 48” DIAMETER

A. Manufacturers
1. JM Eagle
2. North American Pipe Corporation
3. Diamond Plastic Industries
4. Vinyltech Corporation
5. Or accepted substitution

B. The following piping shall be large diameter PVC pipe as indicated on Drawings and as specified herein:
1. Water transmission mains: 18", 24" and 36" diameter
2. Diameters: Cast iron pipe equivalent outside diameters

C. Pipe: AWWA C905, DR 21 except as otherwise specified or indicated on the Drawings

D. Marking: Identification markings on pipe shall conform to AWWA C905

E. Fittings: Ductile iron fittings, ANSI A 21.53/AWWA C153 or ANSI A21.10/AWWA C110
   1. Working pressure rating: 250 psi rating
   2. Joint: mechanical joints with restraints
   3. Coating:
      a. Exterior: AWWA C111
      b. Asphalt coated interior: AWWA C104 and C111, lined with double thickness cement and seal coated
      c. Or interior and exterior: AWWA C116, fusion bonded epoxy coating

F. Joints: ASTM D3139, integral bell or mechanical joint
   1. Push-on joints: pipe to pipe joints, except as otherwise specified or indicated on Drawings. Push on joints are not permitted on fittings or valves
      a. Integral bell type with elastomeric gaskets, ASTM F477 factory installed
      b. Suitable for buried service
      c. Gaskets:
         i) Material: Virgin SBR rubber suitable for potable conforming to AWWA C111
         ii) Lubricant shall be suitable for potable water contact
   2. Restraint device for PVC push on joint
      a. Restraint material: ASTM A536, ductile iron
      b. A backup ring shall be used behind the PVC bell. A restraint ring, incorporating a plurality of individually-actuating gripping surfaces, shall be used to grip the pipe, and a sufficient number of bolts shall be used to connect the bell ring and the gripping ring
      c. Pressure rating consistent with pipe pressure rating
      d. Restraint coatings shall be consistent with manufacturer's standard
      e. Manufacturers:
         i) EBAA Iron Inc. "Series 2800"
         ii) Romac Industries "Series 470"
         iii) Or accepted substitution
   3. Mechanical joint restraint
      a. Provide mechanical joint restraint for all ductile iron fittings connecting to PVC pipe
      b. Restraint devices for shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA A21.10/ C110
      c. Pressure rating consistent with pipe pressure rating
      d. Restraint coatings shall be consistent with manufacturer's standard
      e. Manufacturer:
         i) EBAA Iron "MEGALUG 2000 PV"
         ii) Romac Industries "Roma-Grip"
         iii) Or accepted substitution

G. Couplings
   1. Mechanical couplings:
      a. Dresser Style 38
      b. Rockwell 411

c. Or accepted substitution
2. Insulated Mechanical Couplings:
   a. Dresser Style 39
   b. Or accepted substitution
3. Transition Couplings:
   a. Rockwell 415
   b. Dresser Style 39
   c. Or accepted substitution
4. Glands color coded: Black

3.3 PVC SADDLE TAP

A. Provide saddle tap for connection to air release/vacuum breaker combination valves as shown on the Drawings

B. Use tapping saddle manufactured specifically for C900 and C905 PVC pipe with stainless steel wide band straps, nuts and washers

C. Manufacturer:
   1. Mueller
   2. Or accepted substitution

3.4 SERVICE LINE ACCESSORIES

A. Corporation Stops: AWWA C800, Bronze body and ground key plug. Threaded inlet and outlet matching service piping material
   1. Bronze body and ground key plug. Threaded inlet and outlet matching service piping material.
   2. Manufacturers:
      a. Mueller, H-15013
      b. Ford, FB1000G
      c. A.Y. McDonald, 4701BQ or 4701BT
      d. Or accepted substitution

B. Curb Stops: 2" bronze body and ground key plug. Threaded inlet and outlet matching service piping material.
   1. Manufacturers:
      a. Mueller
      b. Ford
      c. Or accepted substitution

C. Curb box: Arch pattern base, coal tar coated extensions. Include 1 inch tapped hole with a centered plug having a 5/8-inch hexagon nut. Include cover with lettering “WATER.”
   1. Manufacturers:
      a. A.Y. McDonald, 5607 with 5601-1 lid
      b. Or accepted substitution

D. Service Clamps: Complete assembly, including double strap service clamp, corporation stop, and bolts and nuts. Use service clamp and stop compatible with drilling machine.
   1. Cast iron or ductile iron with gasket and AWWA C800 threaded outlet for corporation stop, and threaded end straps.
   2. Manufacturers:
      a. Mueller Co.
      b. Romac Industries, Inc.
      c. Or accepted substitution

E. Meter box: Provide at existing meter locations as indicated on drawings
   1. 18-inch diameter meter box with minimum 0.30-inch thick PVC shell for 3/4" or 1" meter
   2. Lid: cast-iron with closed cell insulating pad
   3. Provide with shell extensions as required to satisfy bury depth requirements
   4. Manufacturers:
      a. Mueller Co.
      b. Hunt
      c. Ford
      d. Or accepted substitution

3.5 PIPE ACCESSORIES

A. Identification Marker Tape: Provide metallic core tape, blue with black letters “CAUTION – WATER LINE BELOW” continuously printed plastic tape with metallic core, intended for direct-burial service; not less than 6-inch wide x 4 mils thick. Provide identification markers of one of the following:
   1. Allen Systems, Inc.
   2. Emed Co., Inc.
   3. Seton Name Plate Corp.
   4. Or accepted substitution

B. Tracer Wire
   1. Provide tracer wire for all PVC and HDPE pipe
   2. All tracer wire shall be 12 AWG solid copper wire coated with 45 mil Type HMW - PE blue insulation compliant with ASTM D1351 specifically designed for direct burial in corrosive soil or water
   3. UL listed

C. Tracer Wire Test Stations
   1. 4-inch with locking lid
   2. Manufacturers:
      a. CP Test Services
      b. Glenn Series "Glenn-4"
      c. Or accepted substitution

D. Corrosion Control
   1. Rust inhibitive primer:

a. Tnemec "Series 77H Chem-Prime"
b. Or accepted substitution
2. Rust preventative compound:
a. Houghton "Rust Veto 344"
b. Rust-Oleum "R-9"
c. Or accepted substitution

E. Pipe Spacers
1. Pipe bands shall be fabricated of a minimum of 14 gauge 304 stainless steel
a. Steel strapping shall be in accordance with ASTM A36
2. Hardware:
a. Bolts: 5/16-inch stainless-steel flange bolts

F. Insulators
1. Polyethylene casing insulator band and skids with stainless-steel bolts

G. End Seals
1. Fabricated of EPDM or neoprene
2. Durometer hardness: 60
3. Minimum thickness: 1/8 inch
4. Hardware: 304 stainless steel with worm screws
5. Manufacturers
a. Advance Products & Systems, Inc.
b. Pipeline Seal & Insulator, Inc.
c. Or accepted substitution

3.6 GATE VALVES – 3" TO 12" AND ACCESSORIES

A. Manufacturers:
1. Mueller
2. American AVK
3. American Flow Control
4. Clow
5. Kennedy
6. Or accepted substitution

B. AWWA C509, Iron body, bronze trim, two O-ring stem seals, non-rising stem with square nut, single wedge, resilient seat, mechanical joint ends, extension stem, and extension valve box, pressure rating of 250 psi. For installation in horizontal or near horizontal pipe lines
1. Non-adjustable elastomeric stem seals
a. Adjustable packing glands are not permitted
2. Direct operation of stem from above via 2-inch square nut
a. No gear box provided
3. Rotation: Counterclockwise to open with the word "OPEN" and an arrow indicating the direction to open cast on valve body or operating nut

C. Rotation: Contractor to verify the operating direction with the City water department
   1. Provide the word "OPEN" and an arrow indicating the direction to open cast on valve body or operating nut.
   2. Contractor to confirm nut size with the City water department

D. Valve stem material: ASTM B763, UNS alloy C99500 minimum yield strength of 40,000 psi
   1. Valve stem extensions: Provide valve stem extensions as necessary for proper valve operation with a 7 foot key with tee handle
   2. Provide one (1) key to Owner prior to project closeout

E. Extension stems
   1. Provide for buried valves with operating nuts more than 4.5 feet below grade
   2. Non-rising stems
      a. Solid steel shafting with O.D. not less than O.D. of valve stem or galvanized steel pipe with I.D. not less than O.D. of valve stem
      b. Connected to the valve by a flexible socket coupling
      c. All other connections pinned
      d. Extend stem to within 6-inch of grade
      e. Provide spacers to center stem in valve box
      f. Provide wrench nut

F. Coating
   1. AWWA C550 and NSF 61 certified
   2. Minimum 8 mils dry film thickness
   3. Fusion bonded epoxy applied to all ferrous metal surfaces after cleaning surfaces of grease, dirt and moisture, and performing near-white blast cleaning following SSPC-SP10
   4. Do not coat fasteners or machined surfaces subject to contact and relative movement against other surfaces during operation of valve or other surfaces where such coating would compromise proper installation or functionality of valve

G. Valve boxes, depth as required for valve
   1. Three piece cast iron (complying with ASTM A48, Class 20A) adjustable screw type, 5.25-inch diameter, minimum thickness of 3/16 inch
   2. Box, cover, and base coated by dipping in asphalt varnish.
   3. Cover marked with word, “WATER.”
   4. Provide extension piece to permit 6-inch adjustment above finish grade
   5. Manufacturers:
      a. Tyler Pipe Company "Series 6860 with #160 oval base"
      b. East Jordan Iron Works "8560 Series"
      c. Tyler Union "6860 Series"
      d. Or accepted substitution

3.7 BUTTERFLY VALVES – 16" TO 36" (DIRECT BURY) AND ACCESSORIES

A. Manufacturers:

1. Pratt
2. Milliken
3. Or accepted substitution.

B. AWWA C504 Class 150B for direct bury service
   1. Valve body shall be constructed of cast iron ASTM A126 Class B and conform to AWWA C504 in terms of laying lengths and minimum body shell thickness
   2. Mechanical joint ends following AWWA C111
   3. Valve disc shall be cast iron or ductile iron furnished with Type 316 stainless steel seating edge to mate with rubber seat on body
      a. Valve disc shall seat in position at 90 degrees to pipe axis and shall rotate 90 degrees between full-open and tight-closed position. Install valves with valve shafts horizontal and convex side of disc facing anticipated direction of flow
      b. Disc shall not creep or flutter under service conditions
   4. Seat: Buna-N-Rubber
      a. 16-inch to 18-inch: Bonded seats that meet ASTM D429 Method B
      b. 24-inch and larger: Seats retained in the valve body by mechanical means without metal retainers or other devices located in the flow stream
      c. Retaining hardware for seats: type 304 or 316 stainless steel. Nuts and screws used with clamps and discs for rubber seats shall be held securely with locktight, or other approved method, to prevent loosening by vibration or cavitation effects
   5. Valve Shaft: type 304 SS, ASTM A276
      a. Shaft bearings: stainless steel in accordance with AWWA C504. Design valve shaft to withstand 3 times amount of torque necessary to open valve
      b. Packing: Standard self adjusting and wear compensating, split-V type, and replaceable without removing actuator assembly
   6. Actuators:
      a. Provide manual actuators for single project, from same manufacturer
      b. Shaft connecting actuator to valve body must be fully enclosed. Bonnet and extension to be fully enclosed and water tight
      c. Provide bonnet extensions, as required, between valve body and actuator. Space between actuator housing and valve body shall be completely enclosed so that no moving parts are exposed to soil or elements
      d. Provide actuators for valves with size based on line velocity of 12 feet per second and unidirectional service.
         i) Equip with gear manual actuator
         ii) Fully enclosed, traveling-nut type. Traveling nut shall engage alignment grooves in the housing
         iii) Traveling nut actuator shall be self-locking and designed to transmit twice the required actuator torque without damages to faces of gear teeth or contact faces of nut
      e. Oil-tight and watertight actuator housing for valves, specifically designed for buried service and factory packed with suitable grease
      f. Equipped with 2-inch actuator nut
      g. Rotation: Counterclockwise to open with the word "OPEN" and an arrow indicating the direction to open cast on valve body or operating nut
      h. Valve operating key: Provide one (1) for project, 7 foot length with tee handle

7. Coating
    a. Follow AWWA C550 and NSF 61
    b. Coat interior and exterior ferrous surfaces of valve with epoxy suitable for potable water conditions: in accordance with AWWA C550 and coating manufacturer's recommendations
    c. Provide three coats of two component, high-build epoxy with minimum dry film thickness of 12 mils

C. Extension stems
1. Provide as specified for buried valves with operating nuts more than 4.5 feet below grade
2. Non-rising stems
    a. Solid steel shafting with O.D. not less than O.D. of valve stem or galvanized steel pipe with I.D. not less than O.D. of valve stem
    b. Connected to the valve by a flexible socket coupling
    c. All other connections pinned
    d. Extend stem to within 6-inch of grade
    e. Provide spacers to center stem in valve box
    f. Provide wrench nut

D. Valve boxes, depth as required for valve
1. Three piece cast iron (complying with ASTM A48, Class 20A) adjustable screw type, 5.25-inch diameter, minimum thickness of 3/16 inch
2. Box, cover, and base coated by dipping in asphalt varnish.
3. Cover marked with word, “WATER.”
4. Provide extension piece to permit 6-inch adjustment above finish grade
5. Manufacturers:
    a. Tyler Pipe Company "Series 6860 with #160 oval base"
    b. East Jordan Iron Works "8560 Series"
    c. Tyler Union "6860 Series"
    d. Or accepted substitution

3.8 FIRE HYDRANT

A. Fire hydrants to be provided for installation where indicated on the Drawings and be in accordance with City standards.

B. Manufacturers:
1. American AVK
2. Kennedy Valve
3. Or accepted substitution

C. General
1. Fire hydrants shall meet or exceed AWWA C502; latest revision
2. Hydrants shall be manufactured and tested in ISO 9001 certified facility
3. Fire hydrants shall be rated for a working pressure of 250 psi

4. A Higbee cut (blunt start) will be provided on the lead thread of the outlet nozzles, nozzle caps, seat ring, drain ring, and thrust nut.
5. Fire hydrants shall be of the compression type, opening against system pressure and closing with system pressure

D. Main Valves and Drain
1. The main valve and drain shall be of one piece construction and completely encapsulated with EPDM.
2. Fire hydrants shall have a minimum 5-1/4 main valve opening.
3. Fire hydrants shall open left and be clearly marked.
4. The EPDM shall be permanently vulcanized to the main valve.
5. The main valve shall provide complete closing of the drains after 4 to 5 turns.
6. During initial stages of opening, the drains shall momentarily flush outward to remove any debris in the drain ports, in order to provide complete draining upon closing of the hydrant main valve.
7. The drain ring assembly shall be replaceable without removing the hydrant from the connecting pipe or having to dig.
8. Valve facings shall be of nontoxic materials suitable for potable water service.

E. Stems
1. Upper hydrant stems shall be made of stainless steel
2. Hydrant shall have one breakaway flange and stem coupling located 3-inches above finished grade.

F. Operating Nut
1. Operating nuts shall be one-piece bronze design with upper and lower anti-friction washers for ease of operation.
2. A protective weather shield shall be installed over the operating nut.
3. Operating nut shall be 1-1/2 inch and pentagon shape

G. Nozzles
1. Pumper nozzles shall be 4-1/2 inch NH / NST threaded.
2. Fire hydrants shall have two 2-1/2 inch hose connection outlets NH/NST threaded.
3. Nozzles shall be of the 1/4 turn bayonet lug style, secured with a stainless steel locking screw.
4. Caps shall have 1-1/2 inch pentagon shape nuts.
5. Nozzle caps shall be chained to hydrant.

H. Lubrication
1. A lubrication port shall be provided for application of lubricant without disassembly of the bonnet section.
2. The reservoir shall be filled with NSF/FDA approved food grade grease or oil at the manufacture’s facility.
3. Valve stem seals shall be an o-ring type with not less than two o-rings below the thrust nut and two o-rings above the thrust nut.
4. O-ring and gaskets shall be made of an NBR rubber to help prevent the effects of permeation.

I. Protective Coatings
   1. All ferrous parts except the lower barrel and those parts made of stainless steel shall be fusion bonded epoxy coated yellow
   2. All epoxy coatings shall meet the requirements of ANSI/AWWA C550 (latest edition).
   3. The lower barrel shall be bitumen coated both internally and externally.
   4. A bury line shall be marked on the lower barrel below the break flange to indicate proper installation depth. Bury depth will be clearly stenciled on the standpipe section.
   5. Shop paint exterior of hydrants red

J. Shoe
   1. End connections shall be 6 inch mechanical joint unless specified
   2. Mechanical joints shall comply with AWWA C111

K. Break Flange and Couplings
   1. All fire hydrants shall be of the traffic Breakaway type and allow 360-degree rotation of the fire hydrant to position the pumper nozzle in the desired direction
   2. The break flange segments shall be located under the upper barrel flange to prevent the segments from falling into the lower barrel when the hydrant is struck

L. Warranty
   1. All fire hydrants shall be covered by a manufactured warranty for a minimum of 10 years for defects

M. Hydrant Gravel: Hydrant gravel shall be well graded crushed stone or gravel, conforming to AASHTO #67 gradation as listed below:

Sieve Size	Percent Passing
1”	100
3/4”	90-100
3/8”	20-55
No. 4	0-10
No. 8	0-5

3.9 CORROSION CONTROL

A. Shop paint all ferrous metal surfaces of valves and accessories, both interior and exterior for corrosion protection, epoxy interior coating for potable water contact.

B. Manufacturer's standard paint will be acceptable if it is functionally equivalent and compatible with specified field coatings

C. Exterior bituminous coating or asphalt varnish: Manufacturer's Standard epoxy coal tar

D. Ductile-iron Pipe and Fittings Shop lining: Cement-lined, AWWA C104/C205

E. Rust inhibitive primer: Tnemec "Series 77H Chem-Prime" or accepted substitution

F. Rust preventative compound: Houghton "Rust Veto 344", Rust-Oleum "R-9", or accepted substitution

3.10 BEDDING

A. Bedding: As specified in Section 02300

3.11 ACCESSORIES – MISCELLANEOUS

A. Extension stems
   1. For valve installations with operating nuts over 5 five below grade, extend stem to 4.5 feet of final grade. Provide spacers to center stem in valve box.

B. Valve boxes for all buried valves, depth as required for valve
   1. Three piece cast iron (complying with ASTM A48, Class 20A) adjustable screw type, 5.25-inch diameter, minimum thickness of 3/16 inch.
   2. Box, cover, and base coated by dipping in asphalt varnish.
   3. Cover marked with word, “WATER.”
   4. Provide threaded top section to permit 6-inch adjustment above finish grade.
   5. Series 6860 with #160 oval base as manufactured by Tyler Pipe Company or accepted substitution.

C. Concrete for Thrust Blocks: constructed of “Class B” Concrete as defined by CDOT Construction Specifications with maximum water to cement ratio of 0.63 by weight and 28-day compressive strength of 3,000 psi

D. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, caps, bends, valves and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages.
   1. Clamps, straps and washers: Steel, ASTM A506
   2. Rods: Steel, ASTM A575
   3. Rod Couplings: Malleable-iron, ASTM A197
   4. Bolts: Steel, ASTM A307
   5. Cast-Iron Washers: Gray-iron, ASTM A126

3.12 DISINFECTION CHEMICALS

A. Calcium and sodium hypochlorite shall conform to AWWA B300 and B301

B. Store hypochlorite in a cool, dark place away from flammable materials

PART 4 EXECUTION

4.1 EXAMINATION

A. Verify existing conditions under provisions of Division 1 Specifications

B. Verify locations and inverts or tops of pipe for connections to existing system as well as crossings with other utilities as indicated on the drawings. Report any discrepancies to Engineer

C. Carefully examine pipe and fittings for cracks, damage to linings, and other defects prior to installation

D. Remove all defective piping from site and replace

E. Examine areas for weak or structural defects or deviations beyond allowable tolerances for piping clearances that adversely affect excavation and quality of Work

F. Start installation only when conditions are satisfactory

4.2 PERFORMANCE - GENERAL

A. Perform work in a safe and proper manner with appropriate precautions against hazard

B. Provide adequate working space and clearances for work performed within excavations and for installation and removal of utilities

C. Contain all construction activity on the designated site and within the limits of work. Cost of restoration of site will be the responsibility of the Contractor

D. Contractor to verify quantities to perform all earthwork required according to Drawings, including but not limited to, additional import or export required to handle compaction, pavement subgrade preparation, and pipe bedding

E. Contractor shall take precautions to limit the removal of or damage to existing pavements, multi-use paths sidewalks, curbs, lawns, shrubbery, trees, hedges, walls, fences, buildings, or other existing improvements to the least practicable amounts and shall replace or restore such improvements to their original location and condition after the excavation has been backfilled and compacted

4.3 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

A. Excavation and backfill operations shall be performed in such a manner to prevent cave-ins of excavations or the undermining, damage or disturbing of existing utilities and structures or of new work

B. Backfill shall be placed and compacted so as to prevent future settlement or damage to existing utilities and structures and new work

C. Any excavations improperly backfilled or where settlement occurs shall be reopened to the depth required then refilled with approved materials and compacted, and the surface restored to the required grade and condition, at no additional costs to the Owner

D. Any damage due to excavation, backfilling, or settlement of the backfill, or injury to persons or damage to property occurring as a result of such damage shall be the responsibility of the Contractor. All costs to repair such damage, in a manner satisfactory to the Engineer, shall be borne by the Contractor at no additional expense to the Owner

4.4 SITE PREPARATION

A. Clear all site areas within the limits of work of grasses, roots, brush, and other objectionable material and debris

B. Remove all waste materials from site and dispose. Stockpile all acceptable grubbings for reuse in revegetation areas.

C. Remove debris including all demolished trees, underbrush, stumps, roots and other combustible materials from site and dispose of off-site; on-site burning is not permitted

4.5 DEWATERING

A. Comply with CDPHE Dewatering Requirements

B. Dewatering discharge to surface waterways requires CDPHE dewatering permit. Contractor must obtain dewatering permit and comply with discharge requirements therein, if necessary

4.6 PIPE PREPARATION

A. Ream pipe and tube ends and remove burrs

B. Remove scale and dirt, on inside and outside, before assembly

C. Cut ends of metallic pipe, recoat with coating approved for potable water service and compatible with manufacturer's coatings.

4.7 BEDDING

A. Comply with City standards and specifications

B. Excavate pipe trench in accordance with Section 02300 for work of this Section. Do not disturb trench bottom during excavation. Hand trim excavation for accurate placement of pipe to elevations indicated.

C. Place bedding material in accordance with Section 02300 at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth, compact to 95 percent. Protect from lateral displacement by placing embedment evenly on both sides of pipe

D. Provide dewatering and backfill trench in accordance with Section 02300

4.8 PIPE INSTALLATION

A. Comply with City standards and specifications. Use the manufacturer's recommendations if the City standards do not specifically apply.

B. Install PVC Pipe in accordance with AWWA M23 and AWWA C605

C. Install Ductile Iron Pipe in accordance with AWWA C600

D. Install Ductile Iron Fittings in accordance with AWWA M41

E. Route pipe as indicated on the Drawings

F. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, and dirt when connected

G. Install as specified or in accordance with the manufacturer's recommendations

H. Cutting Pipe
   1. Cut pipe to measurement taken at the site, not from the drawings
   2. Cut pipe neatly without damage to pipe
   3. Cut smooth, straight, and at right angles to pipe axis
   4. Dress and bevel end of cut pipe to remove roughness and sharp corners
   5. Cut pipe with saw or abrasive wheel
   6. Follow state and federal safety regulations pertaining to cutting asbestos concrete pipe as necessary

I. Provide an isolation or shutoff valve and union at the water connections to each fixture and unit of equipment, whether shown on the drawings or not

J. Install pipe to indicated elevations. Maintain minimum 3.0 feet depth of ground cover and maintain minimum grade for drainage. Establish elevations of buried piping to ensure minimum cover is achieved. Maximum depth of 7.0 feet is allowed to avoid a local high point unless shown otherwise on the plans. Add additional soil in areas of future fill to provide minimal cover at all times. Report any variations from plan to Owner and Engineer
   1. Provide air release valve at all high points and blow-offs or hydrant at all low points. Coordinate locations and details with Engineer.
   2. Where minimum depth cannot be maintained, provide a minimum of 2 inch of specified insulation board per 1 foot of cover not provided. Contractor must have Owner and Engineer approval prior to installation.
      a. Place insulation board over bedding material for the width of the trench

K. Install pipe to allow for expansion and contraction without stressing pipe or joints

L. Protect from lateral displacement by placing embedment evenly on both sides of pipe

M. Do not lay pipe in water. Maintain groundwater level a minimum of 12 inches below pipe to be installed. Do not lay pipe under unsuitable weather or trench conditions

N. Make changes in horizontal, vertical, and curved alignment shown on drawings by using joint deflections in the amount permissible by manufacturer and shown on drawings

O. Do not bend pipe

P. Deflect pipe at joints

Q. Do not deflect PVC pipe at connection to ductile iron fittings

R. Form and place concrete for thrust blocks at each elbow or change of direction of pipe main as indicated on Drawings

S. Utility crossings
   1. Whenever possible, lay water mains over sanitary and storm sewers to provide vertical separation of at least 18-inch between invert of water main and crown of sewer
   2. If standard crossing detail is not available and above separation cannot be met, provide one continuous length of watertight sewer pipe 20' long centered on water main with joints between different pipes encased in 6-inch minimum of concrete and extending 6-inch either side of joint or encase sewer pipe in 6-inch of concrete completely around pipe, for not less than 10' either side of water main
   3. Water Mains Passing Under Sanitary Sewers: If vertical separation is less than 18-inch, provide structural support for sewer. Provide concrete encasement where water lines pass under sanitary sewer line. Reference detail shown on Drawings

T. Maintain a minimum 10 feet of horizontal separation and 18 inches of vertical separation between water main and storm or sanitary sewer lines in accordance with the CDPHE
   1. Provide concrete encasement if these clearances cannot be achieved and when water line is below sanitary sewer line

U. Tracer wire and marker tape
   1. Install tracer wire continuous over top of pipe
   2. Install tracer wire test stations at maximum 500 LF of water line per City requirements. Locate test station at fire hydrants, gate valves, or special test station locations in a valve box
   3. Terminate tracer wire following drawing details
   4. Tape tracer wire to top of pipe using PVC tape every 4 feet along the pipe, and on each side of fitting
      a. Tape: minimum 2 inches wide and wrapping full circumference of pipe
   5. Install identification /warning marker tape in fill area of trench above all water lines

V. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system

W. Install access fittings to permit disinfection of water system, subject to approval by Engineer

X. Backfill trench in accordance to specifications herein

Y. Protect pipe from floatation or movement until completely backfilled and put into service

4.9 WATER MAIN CONNECTIONS

A. Comply with City standards and specifications. Coordinate with City and fire department representatives for any impacts to the existing water system and provide advanced notice to impacted properties if applicable.

B. Connect to water main per plans and referenced standards or details.

4.10 JOINTS

A. Make pipe joints carefully and neatly

B. Connect piping in accordance with manufacturer's recommendations

C. Push-on joints
   1. Lay pipe with bell ends facing the direction of laying except when Engineer authorizes reverse laying
   2. Assembly of PVC plain end into bell: follow PVC pipe manufacturer's recommendation
   3. For PVC pipe, Contractor to ensure that pipe is not inserted into the bell ends beyond the push line
      a. Utilize EBAA Mega-Stop bell protection, or approved substitution, if necessary, to ensure previously laid pipe joints are not impacted by ongoing installation
   4. Lubricate joint surfaces immediately before completing the joint
   5. Bevel spigot ends of field cut piping
   6. Groove spigot ends of field cut restrained joint piping if required by joint system
   7. Install restrained joints following manufacturer's recommendations

D. Mechanical joints
   1. Before assembling joint, clean both bell and plain end of rust and foreign matter
   2. Assemble joint following AWWA C111, C600, C605 and as specified
   3. Lubricate gasket and install in accordance with manufacturer's instructions
   4. If an effective seal is not obtained, disassemble joint, clean thoroughly, and reassemble
   5. Do not over tighten bolts to compensate for poor installation
   6. Carefully align holes in mechanical joints with restraint device to permit installation of the harness bolts
   7. Install mechanical joint pieces so the mechanical joint holes straddle the top centerline for horizontal piping, or the side centerline for vertical piping

4.11 PROTECTIVE COATING

A. Provide polyethylene tube encasement on all buried ductile iron fittings, valves, and fire hydrant extensions
   1. Encase ductile iron fittings and valves in polyethylene per AWWA C105, Method A, secured with polyethylene compatible adhesive tape. Overlap polyethylene onto PVC pipe a minimum of 6 inches
   2. Before backfilling, inspect polyethylene for rips, punctures and other damage and repair following AWWA C105

B. Coat exposed ferrous metal surfaces of joints, couplings, and uncoated steel with primer and tape coating system after installation. Do not coat stainless steel or high strength low alloy steel nuts and bolts
   1. Surface Preparation: Clean surfaces of rust, scale, soil, mud, oil, grease, and other contaminants by hand or power tool following SSPC-SP2 or SP3 and other appropriate means as recommended by coating manufacturer Remove excess moisture and provide surface dryness as recommended by coating manufacturer
   2. Application: Apply primer in uniform manner to clean and dry surfaces following coating manufacturer's recommendations
      a. Fill complex and irregular surfaces with appropriate mastic or filler tape to eliminate bridging; then apply tape/wrap to primed and filled surfaces following coating manufacturer's recommendations.
      b. When coating restraining rods or strapping, apply tape wrap longitudinally
      c. Where metal being coated enters concrete, overlap coating onto concrete by minimum of 2 inches after placement of concrete
   3. Inspection: After field coating of specified items, conduct visual inspection to verify complete coverage has been accomplished.
      a. Repair damaged or incompletely coated surfaces following coating manufacturer's recommendations

C. Metal Surfaces not Protected by Poly Wrap
   1. Coat all steel clamp rods, bolts, and other metal accessories used in tapping saddles, anchorages, cut ends of pipe, follower rings and bolts or joint harnesses subject to submergence or contract with the earth and not concrete encased, but including pipe fittings and bolts in polyethylene tube protection
   2. Apply 2 coats of coal tar paint to clean, dry metal surfaces, allow first coat to dry before applying second coat

D. Metal Harness Rods
   1. Provide field applied primer and Polyken tape wrap

4.12 CONCRETE ENCASEMENT

A. Provide where indicated on the Drawings

B. Comply with City standards and specifications.

C. Suitably support and block pipe and anchor against flotation

4.13 VALVES AND HYDRANTS INSTALLATION

A. Carefully inspect valve before installation. Clean interior. Operate valve to determine parts in proper working order, with valves seating and drain valve operating properly. Set plumb and center stem in valve box and securely brace into place. Comply with AWWA C600 and referenced standards

B. Center and plumb valve box over valve. Set box cover flush with finished grade.
   1. Backfill and compact under and around valve boxes to ensure no vertical loads are transmitted to valve operators or bonnets

C. Comply with AWWA M17 for fire hydrant installation. Install with gate valve and provisions for drainage

D. Install valves, hydrants, and accessories in accordance with the manufacturer's recommendations and in accordance with referenced standards and specifications.

E. Hydrants and valves to be set plumb on solid bearing surface

F. Locate hydrant flange a minimum of 3” and maximum 6” above adjacent finished grade or flush with the adjacent top of curb. Contractor to verify final grade or adjust flange height upon the completion of final grading

G. Drainage shall be provided at the base of the hydrant by placing rock from the bottom of the trench to at least 12 inches above the barrel flange of the hydrant and to a distance of 12 inches around the elbow. The minimum distance from the bottom of the trench to the bottom of the hydrant elbow shall be 6 inches. The minimum amount of rock placed shall be 1/3 cubic yard

4.14 VALVE INSTALLATION

A. Comply with City standards and specifications

B. Carefully inspect valve before installation. Clean interior. Operate valve to determine parts in proper working order, with valves seating and drain valve operating properly. Set plumb and center stem in valve box and securely brace into place. Comply with AWWA C600 and referenced standards.

C. Provide concrete collar for installations within landscaped areas

D. Protect valve box and cover during paving operations and clean any excess concrete, or asphalt, or road base from valve box and cover to ensure visibility and proper operation

4.15 TAPPING

A. Tapping shall be performed using standard tapping saddles designed for use on PVC piping in accordance with AWWA C605. Tapping shall be performed only with use of tap saddles or sleeves. NO DIRECT TAPPING WILL BE PERMITTED. Tapping shall

be performed in accordance with the applicable sections for saddle tapping as per “Uni-Pub-8: Tapping Guide for PVC Pressure Pipe by Uni-Bell PVC Pipe Association"

B. All connections requiring a larger diameter than that recommended by the pipe supplier, should be made with a pipe connection as specified and indicated on the drawings.

C. Equipment used for tapping shall be made specifically for tapping PVC pipe:
   1. Tapping bits shall be slotted “shell” style cutters, specifically made for PVC pipe. ‘Hole saws’ made for cutting wood, steel, ductile iron, or other materials are strictly prohibited

4.16 WATER SERVICES

A. Water services are to be connected to the new water main per the Contract Drawings and City Standards

B. Water services are to be tapped per the Contract Drawings. Direct taps are not permitted.

4.17 ABANDONMENT

A. Cap ends of main as shown. Place required concrete blocking as shown on drawing details

B. Where mains are to be abandoned and removed to a fitting or valve, cut and plug main at fitting or valve
   1. When shown on drawings, remove fire hydrants and valves, including lead joint tees when encountered; salvage and deliver removed fire hydrants and valves to the City.
   2. Pipe, fittings, and other appurtenances that are removed, but are not required to be salvaged become property of Contractor
      a. Remove and dispose of offsite

4.18 ERECTION TOLERANCES

A. Establish invert elevations as shown on the drawings

B. Construct pipe within manufacturer’s tolerances of horizontal and vertical deflection. Refer to City for allowable deflections at joints and fittings.

4.19 FIELD QUALITY CONTROL

A. Comply with City standards and specifications. Test each line at the Contractor's expense in the presence and to the satisfaction of City inspectors.

B. Field inspection and testing will be performed under provisions set forth by the referenced standards

C. Test each line at the Contractor's expense in the presence and to the satisfaction of Owner or Engineer at a maximum of 1,000 foot intervals

D. Water Line Disinfection
   1. Comply with AWWA C651 and provide Engineer and Owner with results.
   2. Flush water lines prior to disinfection, except when tablet method is used. Acceptable chlorine disinfectants are calcium hypochlorite granules, sodium hypochlorite solutions, and calcium hypochlorite solutions, and calcium hypochlorite tablets.
   3. After the pipe is filled with water and chlorine, the chlorinated water shall be held in contact with the pipe for 24 hours. At the end of the 24 hour period, the water in the pipeline shall be tested by the local health authority having jurisdiction, or their designated representative, to ensure a residual chlorine content in compliance with City requirements. The pipeline shall then be thoroughly flushed to remove the heavily chlorinated water. This activity requires a permit from the CDPHE WQCD prior to flushing. Comply with all provisions of the permit. Care shall be taken in flushing the pipeline to prevent property damage and danger to the public. Discharges of water from blowoff assemblies or other appurtenances shall be contained or discharged in a manner approved by City and the CDPHE.
   4. For fire lines, flush piping complying with NFPA 24
   5. If water in pipe does not meet the governing agency requirements, repeat disinfection procedure until acceptable. Furnish copies of acceptance forms from governing agency to Owner and Engineer.

E. Valve Testing
   1. Conduct pressure and leakage tests on all newly installed valves
   2. Furnish all necessary equipment and material and make all connections to the pipe, as required. The Engineer shall monitor the tests.

F. Hydrostatic Pressure Tests
   1. Provide all necessary pumping equipment, piping connections, pressure gauges with maximum of 5 psi increments, and other required equipment, facilities, and materials
   2. All water used for pressure testing must be potable and delivered in acceptable containers
   3. Immediately locate and replace all pipe fittings, valves, pipe joints, and other materials found to be defective with new and acceptable material
   4. If tests indicate work does not meet specified requirements, remove work, replace, and retest at no cost to Owner
   5. Procedure
      a. Disconnect all fixture devices and other accessories which may be damaged by the specified test pressure
      b. Plug or cap ends as required
      c. Bleed system to eliminate all air from system
      d. No pressure testing shall be permitted until all concrete thrust blocks have adequate curing time to reach design strength, 7 day minimum
      e. Notify Owner and Engineer 48 hours prior to testing
      f. Test for 2 hours with no more than 5 psi pressure loss
      g. Leakage is the quantity of water added to a test section to maintain test pressure ±5 psi:

$$L = \frac{S \times D \times (P)^{0.5}}{}$$

133,200

Where:

L = allowable leakage in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of pipe, in inches

P = average test pressure during test, psig

6. Hydrostatic Test Conditions: At lowest point in the line or section under test pressure or operating pressure, whichever is greater, as scheduled below

Pipe	Test Pressure	Operating Pressure	Test Medium	System
24-inch PVC	150 psi	100 psi	Water	Distribution
16-inch PVC	150 psi	100 psi	Water	Distribution
12-inch PVC	150 psi	100 psi	Water	Distribution
10-inch PVC	150 psi	100 psi	Water	Distribution

7. While the test pressure is maintained, an examination shall be made of the pipeline and any leaks located and repaired. Pipe or fittings found to be faulty shall be removed and replaced. Leakage is not allowed through the bonnet of the line valve. A valve leaking through the bonnet may be repaired in place or removed and replaced. Cutting and replacement of pavement as well as excavation and backfilling may be necessary when locating and repairing leaks discovered during pressure testing.
8. After visible leaks are stopped, repeat procedure beginning at 3.13.D.5 of this section

G. PVC Water Pipe Continuity Testing
1. Test tracer wire for continuity, in the presence of Owner and Engineer, after backfill is complete and before Substantial Completion
2. Notify Owner and Engineer five working days in advance to schedule testing
3. Continuity test to consist of locating the PVC water pipe with an electronic-type pipe locator
4. If test is negative for continuity, repair or replace as necessary to achieve continuity

H. Bac-T Testing
1. After completion of water line disinfection as specified in Section 02676, Contractor shall take Bac-T samples to ensure pipe has been properly disinfected and submit results to Engineer
2. If water line fails Bac-T sampling, any repeat disinfection and Bac-T testing will be at the Contractor's expense
3. The Contractor shall receive City approval before placing a water line in service

4.20 CLEANING

A. Verify that piping has been cleaned and inspected

B. Verify that piping has been successfully pressure tested and flushed

C. Perform scheduling and disinfection activity with start-up, testing, adjusting, demonstration procedures, including coordination with related systems

4.21 DISINFECTION

A. Provide and attach required equipment to perform the work of this Section

B. Tablet, continuous, or slug disinfection may be followed in accordance with AWWA C651

C. The preferred method is continuous disinfection, summarized as follows:
   1. Inject treatment disinfectant, free chlorine in liquid form into piping system to obtain 50 to 80 ppm residual
   2. Bleed water from outlets to ensure distribution and test for disinfectant residual
   3. Maintain disinfectant in system for 24 hours
   4. If final disinfectant residual tests less than 25 ppm, repeat treatment
   5. Flush, circulate and clean until residual equal to that of incoming potable water or 1.0 mg/L is achieved

D. Replace permanent system devices removed for disinfection

4.22 FINAL FLUSHING

A. Maintain a flushing velocity of 2.5 feet per second in piping

B. Collect chlorinated water for proper disposal and/or dechlorinate to less than 0.1 ppm free chlorine prior to discharge in accordance with State, County, and local regulations

4.23 DISINFECTION FIELD QUALITY CONTROL

A. After final flush, and before main or equipment is placed in service, collect water samples from representative points along the main and field test for chlorine residual

B. Chlorine residual shall be within 50 percent of the chlorine residual prevailing in the source

C. If initial disinfection fails to provide satisfactory samples, repeat disinfection until satisfactory samples have been obtained

4.24 DISINFECTION TESTING AND ACCEPTANCE

A. The Contractor will perform Bacteriological (Bac-T) sampling and testing after pipes have been disinfected and flushed as specified herein

B. If any portion of the piping or equipment or tanks fails Bac-T testing, the Contractor is responsible for repeating disinfection procedures until passing Bac-T test is obtained

4.25 FINAL ACCEPTANCE

A. Comply with City standards and specifications for placing water line in service

B. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, and dirt when connected.
   1. Wire brush, if necessary, wipe clean and keep joint contact surfaces clean until connection is complete

C. Drain all test water from the new pipe system prior to placing in service

D. Provide water tap locations (x, y, z) on the Drawings

E. Provide operation and maintenance manuals for air and line valves and fire hydrants

F. Provide final reports to Engineer for:
   1. Bac-T results
   2. Residual chlorine tests
   3. Hydrostatic tests for each section or pipe
   4. Tracer wire continuity test

END OF SECTION

SECTION 02676

DISINFECTION OF WATER SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Disinfection of potable water piping, potable water storage facilities, treatment unit equipment and piping, pumping equipment and piping; testing and reporting results

1.2 RELATED SECTIONS

A. Section 02510 – Water Distribution System

1.3 REFERENCES

A. American Water Works Association (AWWA):
   1. B300 – Standard for Hypochlorites
   2. B301 – Standard for Liquid Chlorine
   3. C651 – Disinfecting Water Mains
   4. C652 – Disinfection of Water Storage Facilities
   5. C653 – Disinfection of Water Treatment Plants

B. National Sanitation Foundation (NSF):
   1. Standard 60 – Drinking Water Treatment Chemicals – Health Effects

1.4 SUBMITTALS

A. Test Reports: Indicate results comparative to specified requirements

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01700

B. Disinfection report; record:
   1. Type and form of disinfectant used
   2. Date and time of disinfectant injection start and time of completion
   3. Test locations
   4. Initial and 24 hour disinfectant residuals (quantity in treated water) in parts per million (ppm) or milligram per liter (mg/L) for each outlet tested
   5. Date and time of flushing start and completion
   6. Disinfectant residual after flushing in ppm for each outlet tested

C. Bacteriological (Bac-T) report; record:
   1. Date issued, project name, and testing laboratory name, address, and telephone number
   2. Time and date of water sample collection

3. Name of person collecting samples
4. Test locations
5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested
6. Coliform bacteria test results for each outlet tested
7. Bacteriologist's signature and authority

1.6 QUALITY ASSURANCE

A. Perform work in accordance with AWWA C651, C652, C653, and the Colorado Department of Public Health and Environment (CDPHE)

1.7 REGULATORY REQUIREMENTS

A. Conform to AWWA C651, C652, C653, as appropriate, and CDPHE regulations for performing the work of this Section

PART 2 PRODUCTS

2.1 DISINFECTION CHEMICALS

A. Calcium and sodium hypochlorite shall conform to AWWA B300 and B301

B. Store hypochlorite in a cool, dark place away from flammable materials

PART 3 EXECUTION

3.1 CLEANING

A. Verify that piping has been cleaned and inspected

B. Verify that piping has been successfully pressure tested and flushed

C. Perform scheduling and disinfection activity with start-up, testing, adjusting, demonstration procedures, including coordination with related systems

3.2 DISINFECTION

A. Provide and attach required equipment to perform the work of this Section

B. Tablet, continuous, or slug disinfection may be followed in accordance with AWWA C651

C. The preferred method is continuous disinfection, summarized as follows:
1. Inject treatment disinfectant, free chlorine in liquid form into piping system to obtain 50 to 80 ppm residual
2. Bleed water from outlets to ensure distribution and test for disinfectant residual
3. Maintain disinfectant in system for 24 hours

4. If final disinfectant residual tests less than 25 ppm, repeat treatment
5. Flush, circulate and clean until residual equal to that of incoming potable water or 1.0 mg/L is achieved

D. Replace permanent system devices removed for disinfection

3.3 FINAL FLUSHING

A. Maintain a flushing velocity of 2.5 feet per second in piping

B. Collect chlorinated water for proper disposal and/or dechlorinate to less than 0.1 ppm free chlorine prior to discharge in accordance with State, County, and local regulations

C. City to provide and pay for flushing water

3.4 FIELD QUALITY CONTROL

A. After final flush, and before main or equipment is placed in service, collect water samples from representative points along the main and field test for chlorine residual

B. Chlorine residual shall be within 50 percent of the chlorine residual prevailing in the source

C. If initial disinfection fails to provide satisfactory samples, repeat disinfection until satisfactory samples have been obtained

3.5 TESTING AND ACCEPTANCE

A. The Contractor will perform Bac-T sampling and testing after pipes have been disinfected and flushed as specified in Section 02510

B. If any portion of the piping fails Bacteriological testing, the Contractor is responsible for repeating disinfection procedures until passing Bac-T test is obtained

C. City shall provide and pay for services of a certified laboratory to complete Bac-T testing

D. Submit test reports per Section 01700

END OF SECTION

SECTION 02715

BASIN LINER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Description of requirements for the manufacture, supply and installation of reinforced polypropylene (RPP) impermeable geomembrane. All procedures, operations and methods shall be in strict accordance with specifications, plans and engineering drawings

B. Quality Control for all geomembrane and extrusion materials supplied to the job site and all aspects of the installation including attachments to structures and penetrations

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. D412 – Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers Tension
   2. D413 – Standard Test Methods for Rubber Property-Adhesion to Flexible Substrate
   3. D471 – Standard Test Method for Rubber Property-Effect of Liquids
   4. D573 – Standard Test Method for Rubber – Deterioration in an Air Oven
   5. D638 – Standard Test Methods for Tensile Properties of Plastics
   6. D624 – Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
   7. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
   8. D751 – Standard Test Methods for Coated Fabrics
   9. D792 – Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
   10. D882 – Standard Test Method for Tensile Properties of Thin Plastic Sheeting
   11. D1004 – Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting
   12. D1149 – Standard Test Methods for Rubber Deterioration – Cracking in an Ozone Controlled Environment
   13. D1203 – Standard Test Methods for Volatile Loss from Plastics Using Activated Carbon Methods
   14. D1204 – Standard Test Methods for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
   15. D1238 – Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
   16. D1505 – Standard Test Method for Density of Plastics by the Density-Gradient Technique
   17. D1693 – Standard Test Methods for Environmental Stress Cracking of Ethylene Plastics

18. D1790 – Standard Test Method for Brittleness Temperature of Plastic Sheeting by Impact
19. D2136 – Standard Test Method for Coated Fabrics – Low-Temperature Bend Test
20. D2137 – Standard Test Methods for Rubber Property – Brittleness Point of Flexible Polymers and Coated Fabrics
21. D2240 – Standard Test Method for Rubber Property – Durometer Hardness
22. D3015 – Standard Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds
23. D3895 – Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
24. D4218 – Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
25. D4437 – Standard Practice for Non-Destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes
26. D4833 – Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
27. D5199 – Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
28. D5397 – Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
29. D5596 – Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
30. D5617 – Standard Test Method for Multi-Axial Tension Test for Geosynthetics
31. D5641 – Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber
32. D5721 – Standard Practice for Air-Oven Aging of Polyolefin Geomembranes
33. D5820 – Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes
34. D5884 – Standard Test Method for Determining Tearing Strength of Internally Reinforced Geomembranes
35. D5885 – Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry
36. D6365 – Standard Practice for the Nondestructive Testing of Geomembrane Seams Using the Spark Test
37. D6392 – Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes
38. D6693 – Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
39. D7176 – Standard Specification for Non-Reinforced Polyvinyl Chloride (PVC) Geomembranes Used in Buried Applications
40. D7465 – Standard Specification for Ethylene Propylene Diene Terpolymer (EPDM) Sheet Used in Geomembrane Applications
41. E96 – Standard Test Methods for Water Vapor Transmission of Materials
42. G151 – Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources
43. G155 – Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

44. G160 – Standard Practice for Evaluating Microbial Susceptibility of Nonmetallic Materials by Laboratory Soil Burial

B. South Coast Air Quality Management District (SCAQMD):
   1. Rule 1168 – Adhesive and Sealant Applications

1.3 DEFINITIONS

A. Geomembrane Manufacturer: Party responsible for compounding the geomembrane and production of sheet or geomembrane

B. Geomembrane Fabricator: Party who receives the sheet from the Manufacturer and who is responsible for welding the sheets, through factory fabrication using controlled welding methods, into geomembrane panels

C. Geomembrane Installer: Party responsible for placing and/or joining geomembrane panels in the field or on the job site

D. Sheet: Product of manufacturer, typically 10 feet in width provided on rolls to the fabricator

E. Geomembrane or panels or Geomembrane panels: Term applied to multiple sheets that have been welded together, through factory fabrication, under controlled conditions. Actual size of panels will depend upon weight, mil thickness, and design configurations

F. Sample: Piece of liner taken for testing or archival material. Shall be large enough to contain specimens for a series of tests

G. Seam: Completed process of welding

H. Specimen: Term applied to an individual part of a sample. Shall be a specific piece of sample upon which 10 specimens can be taken and tested

I. Welding: Process whereby two sheets are joined together

1.4 SUBMITTALS

A. Submit under provisions of Section 01340

B. Resin Manufacturer's Certificates
   1. Written certification that the product delivered was extruded from the specified resin including the following information:
      a. The origin of the resin: Resin Supplier's name, resin production plant, brand name, number and production date of the resin
      b. A copy of the quality control certificate issued by the Resin Supplier
   2. Geomembrane Manufacturer's Certificates

a. Geomembrane manufacturer's certificates for production of geomembrane Quality control certificates shall be signed by responsible parties employed by the Manufacturer. Submit the following information:
b. Roll numbers and identification
c. Sampling procedures and results to quality control tests
d. Extrusion pellets or rod shall be certified by the Manufacturer that it is made of the same resin as the parent geomembrane supplied as in Section 2.2.A
e. Installation and erection data and schedule
f. Manufacturer's standard warranty

C. Shop drawings showing the following
1. Proposed Panel Layout
a. Product roll goods shall be factory fabricated into large panels
b. Installer shall produce drawings showing proposed placement of panels and both factory and field seams prior to fabrication and field installation, and their proposed numbered sequence, as well as areas for adding material for proposed thermal compensation
c. Included shall be drawings and detailed description of all methods of welding and patching the membrane, anchoring details, sealing at all penetrations and ballast systems shown on the Drawings.
d. Shall be provided to Owner and Engineer by Installer prior to material being delivered to job site. Proposed panel placement should show seam direction and panel sizes drawn to scale
e. Placement of liner shall not begin until proposed panel layout diagram has been approved by Owner and Engineer including changes made at the job site
2. Record Drawings
a. Installer shall provide final "as recorded" layout drawings to scale to reflect any changes from the proposed panel layout and details
b. As-built drawings shall include the numbered identification and location of all seams, panel, and patches

1.5 QUALIFICATIONS

A. Manufacturer
1. Company shall have at least five (5) years continuous experience specializing in manufacturing products specified in this Section

B. Installer
1. Shall have at least five (5) years continuous experience in the installation of RPP geomembrane and experience totaling 500,000 m^2 of installed geomembrane for at least 10 completed projects

1.6 QUALITY CONTROL

A. Quality Control shall be defined as a planned system of inspection and tests to directly monitor and control the quality of the work. Contractor shall employ a quality control inspector, who may be the same person as the installation supervisor

1. All seams shall be non-destructively tested by the installer over their full length to verify the integrity of the seam. Non-destructive testing shall be performed concurrently with field seaming. All non-destructive testing shall be observed and documented by the Inspector
2. Approved non-destructive testing procedure is as above. Alternate procedures shall be submitted for approval to the Owner and Engineer prior to the commencement of non-destructive testing

B. Inspection and Acceptance
1. As the work progresses, the Inspector shall document all locations requiring repair work and shall verify and document that all repairs have been successfully made by the Installer. No work on the liner shall be allowed if the inspector is not present. This is to include start-up tests, general seaming and patching, and any work at penetrations or structures
2. Seams are only considered to be accepted after they have passed the specified non-destructive and destructive tests, and the equipment used to produce the seams have passed the required start-up tests. If a seam fails the above criteria, the Installer must reconstruct the seam
3. Entire geomembrane surface shall be examined by the Inspector to confirm that it is free of any defects, pinholes, blisters, undispersed raw materials, or contamination by foreign matter. Sheet material produced must be uniform in color, thickness, and surface texture.
4. Geomembrane surface shall be cleaned by the Installer, if required, so that it is free of dust, mud, debris, or any other material which may inhibit a thorough examination of the surface. Any suspect areas shall be clearly marked by the Inspector and non-destructively tested according to the appropriate specified testing procedure
5. Material must have uniform edges
6. Use of water-soluble compound ingredients is not allowed
7. Manufacturer shall produce geomembranes to meet the manufacturer's specifications
8. Overburden shall not be applied to any portion of the liner system until that portion system is inspected by the contractor and the Owner and Engineer and all documents affecting that portion have been approved

C. Sheet material shall have minimum property values. The following are tests that shall be conducted on the finished lining materials. Testing shall be performed at standard temperature and humidity conditions. Testing shall be conducted after the material has been allowed to age for 24 to 48 hours allowing samples to obtain at least 95 percent of full physical properties

1.7 QUALITY ASSURANCE

A. Quality assurance is defined as a planned system of activities carried out by the Owner or his Representative that provides assurance that the geomembrane liner was constructed/installed as specified

B. Quality assurance program may include tests similar to those carried out for quality control

C. Contractor shall assist and cooperate with the Owner and Engineer in the execution of the quality assurance program

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle product to site under provisions of Section 01600

B. During delivery and storage, protect geomembranes from mechanical damage, excessive mud and debris

C. Accept materials on site in manufacturer's original packaging and inspect for damage

D. Transport and handle liner with equipment designed to protect liner from damage

E. Storage:
   1. Store materials according to manufacturer instructions
   2. Adhesives: Store adhesives between 60 and 80 degrees F (15 and 26 degrees C)

F. Protection:
   1. Protect materials from moisture and dust by storing in a clean, dry location remote from construction operation areas
   2. Provide additional protection according to manufacturer instructions

1.9 EXISTING CONDITIONS

A. Field Measurements:
   1. Verify field measurements prior to fabrication
   2. Indicate field measurements on Shop Drawings

1.10 SCHEDULE OF WORK

A. Submit schedule of expected work for approval by the Owner and Engineer including means and methods of installation

PART 2 MATERIALS

2.1 PROPERTIES OF RPP GEOMEMBRANES

A. MANUFACTURERS
   1. Colorado Lining International, Inc.
   2. The COOLEY Group
   3. Or accepted substitution

B. Geomembrane shall be manufactured from new first quality polypropylene resin, 45 mil thick, scrim reinforced

C. Geomembrane shall be manufactured by the extrusion/calendaring process, consisting of first quality ingredients, suitably compounded of which polypropylene (PP) is the

principal resin. Finished compound shall be uniform in color, thickness, size and surface texture.

D. Finished membrane shall consist of two (2) plies of laminated PP over one (1) ply of reinforcing scrim. The reinforcing scrim shall be a 9 X 9 - 1000 denier polyester fabric to create an open-type weave that permits strike-through of the PP.
   1. The PP shall fully encapsulate the scrim and shall extend a minimum of 1/8" beyond the reinforcing scrim roll edges. Exposed fabric along the longitudinal edges of the roll stock shall not be permitted. The finished membrane shall meet or exceed the "physical properties" values as shown on the following page.

E. Sheet geomembrane shall demonstrate the typical properties shown on the manufacturers specification sheet

F. Material properties of the RPP geomembrane shall meet the following design criteria at a minimum:

Table 1: RPP Geomembrane Properties:

Property	Test Method	Test Result
Gage, nominal, +/-10%	N/A	45
Plies, Reinforcing	N/A	1
Minimum Thickness, mils (mm) Overall Over Scrim	ASTM D751	45 (1.143) 11 (0.28)
Minimum Breaking Strength-Fabric, lbf (N)	ASTM D751 Procedure A	225 (1,000)
Minimum Tear Strength, lbf (N)	ASTM D5884	55 (244)
Low Temperature, degrees F (degrees C)	ASTM D2136, 1/8 inch (3 mm) Mandrel, 4 hours, Pass	minus 40 (minus 40)
Dimensional Stability, Maximum Percent Change	ASTM D1204 180 degrees F (82 degrees C), 1 hour	1.0
Water Absorption, Maximum Percent Weight Change	ASTM D471, 30 days at 122 degrees F (50 degrees C)	less than 1.0
Minimum Hydrostatic Resistance, psi (kPa)	ASTM D751 Procedure A, Procedure 1	350 (2,413)
Minimum Puncture Resistance, lb (kg)	ATSM D4833	300 (136)
Minimum Ply Adhesion, lbf/in (N/m)	ASTM D413 Machine Method	20 (3,500)
Environmental Stress Crack Resistance	ASTM D1693 minimum 3,000 hours without failure	unaffected by ESC
UV Resistance	ASTM G155 Xenon 10,080 kJ/m2 total radiant exposure,0.70 W/m2 irradiance,80ºC black panel thermometer	no cracks or loss of breaking or tearing strength
Minimum Bonded Seam Strength lbf (N)	ASTM D751, Modified	175 (780)
Minimum Peel Adhesion, lbf/in (N/m)	ASTM D413, Modified	20 (3,500)

2.2 DOCUMENTATION

A. Prior to delivery of the geomembrane to the job site, the Installer shall be required to provide the Owner and Engineer with a written certification that the product delivered was extruded from a resin that meets minimum properties listed on the manufacturer's quality control certificates. The manufacturer of the geomembrane shall provide quality control certificates and follow the quality control testing program as described in Section 1.6

B. Fabricator, within the reasonable period of time, will provide copies for the Factory Seaming Test Logs that are appropriate to the panels being shipped to the job site

C. Testing of lining materials prior to delivery. Lining materials proposed to be used on the project shall be set aside by the manufacturer, complete with certificates. Each roll of geomembrane and extrusion rod shall be marked as specified in Part 2.

D. Roll Identification: Each roll shall have permanently affixed and accessible inside the core the following information: name of manufacturer; date of manufacture, thickness of the material; roll number; roll length; and roll width

E. Transportation: Transportation shall be the responsibility of the Installer. Any damaged or unacceptable material shall be replaced by the Installer at no cost to the Owner

F. Storage: Once on site, storage of the geomembrane shall be the responsibility of the Contractor. The geomembrane shall be stored to avoid deformation of rolled goods from one place to another, and to avoid damage by any other means, including weather

2.3 ACCESSORIES

A. Adhesives and Solvents: Do not use unless approved by Engineer. All seams shall be heat welded.

B. Penetration Assemblies: Manufacturer's standard factory-fabricated assemblies for sealing penetrations for utilities and structures

C. Ballast System: Manufacturer's standard ballast system designed to resist wind uplift pressures when basin is empty. Ballast system shall not impede flow to and from inlet and outlet piping. Do dot use ballast system with sharp edges or corners or materials that would otherwise risk damage to the liner.

D. Staff Gage: Liner manufacturer shall provide staff gage in location indicated on the Drawings, mounted to liner along slope of basin to indicate level of water in basin. Staff gage material shall be suitable for continuous exterior exposure and mounting to liner shall not compromise liner material.

PART 3 EXECUTION

3.1 HANDLING AND STORAGE REQUIREMENTS

A. The panels that are delivered to the job site shall be off loaded from the trailer by either forklift or cradle style using slings/chains and a handling bar.

B. If the panels are not to be deployed immediately, the Owner will be responsible for providing storage and on-site security. The geomembrane must be stored so it is protected from puncture, moisture, mechanical abrasions, or other conditions, which may cause damage.

C. The panels must remain in their original, unopened containers

3.2 MEETINGS

A. A Preconstruction Meeting should be held prior to liner placement. Purpose of this meeting is to identify the responsibility and authority of the various parties involved. Additionally, any changes in the procedures that may be necessary should be discussed at this time.

B. Meeting should be attended by Owner and Engineer, General Contractor, and the liner installer's Project Manager

3.3 SEAMING METHODS – EQUIPMENT

A. Approval processes for seaming are double wedge fusion welding for general seaming and extrusion welding for patching. Proposed alternatives must be submitted for approval to the Owner and Engineer.

B. Fusion Welding
   1. The seam shall be produced by self-propelled wedge welding apparatus. The apparatus shall be equipped with gauges to monitor weld temperature. Weld temperature and machine speed shall be varied according to ambient conditions in order to maintain and demonstrate a consistent acceptable weld. All welding surfaces shall be kept clean and dry.

C. Extrusion Welding
   1. The seam shall be produced by extruding molten resin at the edge of two overlapped sheets of geomembrane to effect a homogeneous bond. The extrusion apparatus shall be equipped with gauges to monitor extrudate temperature. Temperature and flow rate shall be varied according to ambient conditions to maintain and demonstrate a consistent acceptable weld. The extruder shall be purged of all heat degraded or cooled extrudate prior to the commencement of each seaming sequence

3.4 FACTORY SEAMS

A. Prior to factory seaming, all roll goods shall be inspected. All factory seams shall be made by thermal fusion methods. All factory seams shall have a minimum scrim-to-scrim overlap of one and one-fourth inches (1-1/4") when fabricated. All seams shall be made so that thermal fusion bond extends fully to the top edge of the sheet so that no loose edges are present on the top side of the panel.

B. All sheets and seams shall be 100% visually inspected during fabrication. No defective seams or exposed scrim will be allowed. All exposed scrim edges shall be sealed with an approved PP edge caulk or capped with a strip of PP. All indicated repairs shall be made by the geomembrane Fabricator before the panels are packaged for shipment.

C. In addition to visual inspection, a 48 inch (1.2M) sample shall be taken from each factory seam welding unit used in this work at the beginning of every work shift and every four hours of production thereafter. Samples shall be non-destructive, not requiring patching of fabricated panels. Test specimens shall be cut at quarter points from each 48-inch seam sample (a total of three places) and tested for seam strength and peel adhesion. The shear seam strength shall be tested in accordance with ASTM D751 modified method and peel adhesion will be tested in accordance with ASTM D413, Machine Method, Type A. A log shall be maintained showing the date, time, panel number and test results. Failure of the material and/or seams to meet all the requirements of these specifications may be cause for rejection of the PP material and/or seams as appropriate. The Fabricator shall provide the test results to the Owner and Engineer upon request.

3.5 EXAMINIATION

A. Verify that anchor trench excavation, where liner is to be secured, is in correct location and configuration

B. Verify that subgrade and anchor trench excavation is free from angular rocks, rubble, roots, vegetation, debris, voids, protrusions, groundwater, and other conditions that may affect liner performance

3.6 SUBGRADE PREPARATION

A. Contractor shall be responsible for preparing concrete substrate in a condition suitable for installation of liner. Concrete patching shall be complete and reviewed for acceptance by the liner installer prior placement of any liner materials.

B. Special care must be taken to maintain the prepared substrate surfaces. Any damage to the surface caused by weather conditions or other conditions must be repaired by the Contractor.

C. The installer will submit to the Owner and Engineer, prior to installing the geomembrane material, written approval of the subgrade surface on which the liner will be installed

D. Surface Conditions

1. Surfaces on which the lining is to be placed shall be maintained in a firm, clean, dry and smooth condition during the lining installation
2. All surfaces shall be smooth with anchor trenches provided as required and detailed
3. All surfaces in contact with the liner must be free of sharp edges and corners, sticks, vegetation, and other debris that can puncture or tear the liner
4. No standing water, mud, snow or excessive moisture should be on the substrate surface when the liner is deployed
5. Geotextiles may be used as a cushioning agent if approved by the Owner or Engineer

E. Immediately prior to installation of the designated geomembrane, substrate surface will be noted by the installer. No geomembrane material shall be placed on a substrate that has imperfections that may be detrimental to the liner material.

3.7 PANEL DEPLOYMENT

A. Surface of the existing excavation shall be prepared in accordance with the requirements as specified in the drawings or specified herein. Surface must be acceptable to the installation contractor and the recommendations of the liner manufacturer.

B. Geomembrane shall be placed over the prepared surfaces in such a manner as to insure minimum handling and in accordance with the approved shop drawings. Liner shall be placed in a relaxed condition and shall be free of tension or stress upon completion of installation. Minimum wrinkles will be allowed to insure the liner is installed in a relaxed condition. Excessive wrinkles which overlap themselves will not be allowed. Liner is not to be stretched.

C. Geomembrane lining shall be closely fitted and sealed around all inlets, outlets and other projections through the lining, using prefabricated fittings where possible as shown in the construction details. Liner sheets, damaged from any cause, shall be repaired or covered with additional sheeting. Only those sheets of lining material which can be anchored and seamed together the same day shall be unpackaged and placed into position. In areas that high wind is prevalent, the lining installation should begin on the upwind side of the project and proceed downwind. The leading edge of the liner shall be secured at all times with sandbags sufficient to hold it down during high winds. The leading edges of the liner material left exposed after the day's work shall be anchored to prevent damage or displacement due to wind.

D. Materials, equipment or other items shall not be dragged across the surface of the PP liner or be allowed to slide down slopes on the lining. All parties walking or working on the PP lining material shall wear soft-sole shoes. Compensation for thermal contraction of the geomembranes shall be provided as necessary during the liner installation as determined by the onsite supervisor

E. Only those panels which can be seamed together in the same day should be deployed. The soil covering operation can begin as soon as the seams have been approved

3.8 TEMPERATURE CONDITIONS

A. The liner is generally deployed when the ambient temperature is above 0°C (32°F) or below 50°C (122°F). If the material is deployed at temperatures outside this range, it can be done with the permission of the Owner and Engineer

B. If the material will be installed at temperatures outside of this range, special installation considerations should be agreed upon in advance between Liner Installer and Owner and Engineer. Special installation procedures for cold weather must be approved by Owner and Engineer

3.9 LINER TRAFFIC

A. Materials or equipment shall not be dragged across the surface of the liner. Any portion of the liner damaged during installation, by any cause, shall be repaired by using an additional piece of lining. All parties walking or working on the liner shall wear shoes that will not damage the liner.

B. No vehicles, other than those approved by the installer, are allowed directly on the geomembrane. Only equipment required during installation and for testing should be allowed on the liner.

3.10 FIELD SEAMING PROCEDURES

A. Seaming shall be a continuous process with a minimum of interruptions along any given seam

B. Prior to seaming, the geomembrane shall be overlapped a minimum of 3 inches for extrusion welding and 4 to 6 inches for fusion welding

C. Any geomembrane area showing injury due to excessive scuffing, puncture, or distress from any cause shall, at the discretion of the installer's onsite supervisor, owner, and Engineer, be repaired or replaced with an additional piece of geomembrane

D. Fusion Welding
   1. The membrane shall have an overlap of approximately 6 inches. The area shall be prepared by wiping the area with a clean dry cloth to remove any foreign matter. The welder shall be inserted at one end of the seam, then the pressure rollers are to be clamped down and the wedge engaged and drive motor turned on. If the welder is interrupted during the seaming process, the area affected shall be marked and repaired

E. Extrusion Welding
   1. The weld area shall be prepared by sanding or grinding to a depth of less than 0.02 mm in the sheet surface to be in contact with the extrudate. Grinding required along a seam shall be done concurrent with or within twenty minutes of the seaming operation and shall not damage the geomembrane. Membrane shall be overlapped a minimum of 3 inches prior to seaming. The weld area shall be kept clean and dry during this process

2. Installer, Owner, and Engineer shall determine when preheating of the area to be seamed is required.
3. Artificially induced cooling of extrusion welds, by water or any other means, shall not be allowed. Care shall be taken during vacuum testing that extrusion welds being vacuum tested are at ambient temperatures

F. Cross-seams
1. The top and bottom excess overlap shall be removed and the top and bottom edge of the cross seam shall be ground to a smooth transition prior to seaming. If the cross seam is welded by means of fusion apparatus, the cross seams shall still be cut back to the edge of the fusion weld and have a bead of extrusion applied 4 inches in all directions from the confluence of the two seams to form a "T"

G. Seams shall run parallel to the slope

3.11 SEAMING AROUND PENETRATIONS

A. The membrane shall be sealed to all concrete structures and other openings through the lining as indicated on Drawings and according to liner manufacturer instructions

B. Factory and/or fabricated pipe boots shall be used to seal all pipes penetrating the liner. All joints shall be tightly bonded.

3.12 ANCHOR TRENCHES

A. Shall be excavated by the Contractor prior to geomembrane placement

B. Anchor trenches excavated in clay soils susceptible to desiccation cracks should be excavated only the distance required for that day's liner placement to minimize the potential desiccation cracking of the clay soils

3.13 PATCHES AND REPAIRS

A. Place a patch of the same material with a minimum of 6 inches overlap over the damaged area. Patch should have rounded corners. Apply heat to damaged membrane. Place the patch over the damaged area and apply pressure to the two surfaces in order to achieve intimate contact between the liners. Bonded area of the patch perimeter should be a nominal 4 inches.

B. Cap stripping is the method of bonding a separate strip of the parent material over the seamed edge. Cap stripping may be used to repair an extended length of seam. Caps shall extend a minimum of 6 inches beyond the limits of the nonconforming seam and all corners shall be rounded. Bonded area of the cap-strip perimeter should be a nominal 4 inches. A cap-stripped section must be nondestructively tested. This method can be achieved by using a hand held heat gun and thermally welding the patch or cap-strip.

C. If reinforced patches are used, the cut edges of the patch should be sealed with approved welding rod

D. Any repairs made to the liner shall be made with PP lining material. Patches shall be cut with rounded corners and shall extend a minimum of four (4) inches in each direction from the damaged area. The entire surface of the patch shall be bonded to the PP lining material. If reinforced patches are used, the cut edges of the patch should be coated with an approved PP edge sealant.

3.14 FIELD TESTING

A. Upon completion of the liner installation, all seams shall be visually inspected for compliance with these specifications. In addition to visual inspection, all field seams shall be checked using an air lance nozzle directed on the upper edge and surface to detect any loose edges or riffles indicating unbonded areas within the seam per air lance method ASTM D4437.

B. All field seams, on completion of the work shall be tightly bonded. Any geomembrane surface showing injury due to scuffing, penetration by foreign object, or distress from other causes shall be replaced or repaired. All exposed scrim edges shall be sealed with an approved Polypropylene edge sealant or capped with a strip of polypropylene.

C. Destructive test seams are to be made by each seaming crew, at the beginning of the seaming process, and every four (4) hours thereafter, or every time equipment is changed. These seams are to be made of like materials provided for the purpose of testing and not cut from the seamed panels. Each seaming crew and the materials they are using must be traceable and identifiable to their test seams. The samples shall be numbered, dated and identified as to the personnel making the seam, and location made by appropriate notes on a print of panel layout for the project. The completed field seam sample shall measure not less than 14 inches in width and 24 inches in length.
   1. The field test seams are to be tested for seam strength and peel adhesion. Seam shear and peel adhesion strength shall be tested in accordance with ASTM D751 modified method (Shear) and ASTM D413, Machine Method, Type A (Peel). If a test seam fails to meet the field seam design specification, then additional test seam samples will have to be made by the same seaming crew, using the same tools, equipment and seaming materials and retested.

3.15 FIELD QUALITY CONTROL

A. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than two (2) eight (8) hour days on Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of liner.

B. Equipment Acceptance:
   1. Before initial filling of pond, or placement of earth or other cover, inspect seams and repaired areas to ensure tight and continuously bonded installation.
   2. Repair damaged liner and seams and reinspect repaired Work.
   3. Make final adjustments to liners under direction of manufacturer's representative and Engineer

3.16 COMPLETION OF WORK

A. Requirements
   1. The installation of the geomembrane shall be considered complete when all required deployment, seaming, repairs, testing, and site clean-up, including sand bags have been completed by the Installer; the Installer has submitted all the required certifications to the Owner and Engineer; and the Owner and Engineer is satisfied that the geomembrane has been installed in accordance with the above Specifications

B. Installation Warranty
   1. The Installer shall guarantee the membrane against defects in installation and workmanship for the period of 10 years commencing with the date of final acceptance of the liner system

C. Material Warranty
   1. The membrane manufacturer shall warranty the membrane against manufacturing defects for a period of 10 years from the date of installation. The manufacturer shall furnish the Owner and Engineer with a written warranty covering the requirements of this paragraph.
   2. The membrane manufacturer shall warranty the membrane against UV degradation for a period of 20 years.

END OF SECTION

SECTION 02740

FLEXIBLE PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Full depth and/or composite hot bituminous pavement (asphalt) over prepared subgrade

B. Overlay, patch and/or pavement rehabilitation applications for streets, parking lots and other miscellaneous asphalt pavement

1.2 RELATED SECTIONS

A. Section 01020 – Geotechnical Report

B. Section 02300 – Earthwork

C. Section 02750 – Rigid Paving

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. T 230: Standard Method of Test of Determining Degree of Pavement Compaction of Bituminous Aggregate Mixtures

B. American Society for Testing and Materials (ASTM):
   1. C29: Unit Weight and Voids in Aggregate
   2. C88: Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
   3. C117: Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing
   4. C128: Specific Gravity Test and Absorption of Fine Aggregate
   5. C131: Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
   6. C136: Sieve or Screen Analysis of Fine and Coarse Aggregates
   7. D70: Specific Gravity of Semi-Solid Bituminous Materials
   8. D2726: Bulk Specific Gravity of Compacted Bituminous Mixtures
   9. D2041: Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures
   10. D4462: Viscosity of Asphalts (Bitumens)
   11. D2172: Quantities Extraction of Bitumens from Bituminous Paving Mixtures
   12. D2419: Sand Equivalent Value of Soils and Fine Aggregate
   13. D290: Bituminous Mixing Plant Inspection
   14. D6373: Performance Graded Asphalt Binder
   15. D692: Course Aggregate for Bituminous Paving
   16. D1073: Fine Aggregate for Bituminous Paving Mixtures
   17. D1241: Materials for Soil-Aggregate Subbase, Base and Surface Courses

18. D2026: Cutback Asphalt (Slow-Curing Type)
19. D2027: Cutback Asphalt (Medium-Curing Type)
20. D2028: Cutback Asphalt (Rapid-Curing Type)
21. D2950: Density of Bituminous Concrete in Place by Nuclear Methods

C. Surface Preparation Standards (SSPC):
   1. SP-2: Superior Performing Asphalt Pavement System (Superpave) Level 1 Mix Design

D. Colorado Department of Transportation

E. Colorado Asphalt Pavement Association

F. City of Grand Junction construction specifications, standards and details.

1.4 SUBMITTALS

A. Submit under provisions of Division One Specifications

B. Record of Work: Maintain record of time and date of placement, temperature, and weather conditions, retain until completion and furnish copy to engineer.

C. Proposed Design Job Mix Formula for each mixture required by the contract. The mixture design shall be determined using AASHTO T-312 or Colorado Procedure CP-L 5115 for the Superpave Method of Mixture Design.

D. Test Reports: Proposed Design Job Mix testing shall be performed in a materials laboratory under the direct supervision of; and shall be stamped and signed by a Professional Engineer licensed in the State of Colorado practicing in this field. In addition, the General Contractor shall submit as part of the Proposed Design Job Mix, documents to verify the following:
   1. Source of materials
   2. Gradation, specific gravity, source and description of individual aggregates and the final blend
   3. Aggregate physical properties
   4. Source and Grade of the Performance Graded Binder (PG Binder)
   5. Proposed Design Job Mix – aggregate and additive blending, final gradation shown on 0.45 power graph, optimum asphalt content
   6. Required mixing and compaction temperatures
   7. Mixture properties determined at a minimum of four asphalt contents and interpolated at optimum and graphs showing mixture properties versus asphalt content.
   8. Sampling and testing of asphalt concrete mixtures for quality control during paving operations
      a. Uncompacted asphalt concrete mix
         i) Asphalt cement content: ASTM D2172 (AASHTO T164)
         ii) Maximum Specific Gravity: ASTM D2041 (AASHTO T209)
      b. Compacted asphalt concrete mix
         i) Bulk density: ASTM D1188 (AASHTO T166)

c. Perform at least one test for each day's paving but not less than one test per each 4000 sf of each lift.

1.5 QUALITY ASSURANCE

A. Materials and installation shall conform to applicable portions of Colorado Department of Transportation (CDOT) and City of Grand Junction construction specifications, standards and details.

1.6 REGULATORY REQUIREMENTS

A. For work on public streets or rights-of-way conform to the requirements of City of Grand Junction construction specifications, standards and details for the construction of concrete, curbs, gutters, sidewalks, driveways, roadways, street paving, and other public right-of-way Improvements.

B. Comply with applicable requirements of CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle materials under provisions of Division One Specifications

B. Transport mixture from mix plant in trucks with tight, clean, smooth, non-sticking compartments. Thinly coat hauling compartments with lime-water mixture, paraffin oil or other approved release agent to prevent sticking. Petroleum distillates such as kerosene or fuel oil are not approved release agents. Elevate and drain compartment of excess solution before loading mix.

C. Cover to protect from weather and prevent loss of heat

D. Provide insulated truck beds during temperature below 50 degrees F on long distance deliveries

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not apply when underlying surface is muddy, frozen or wet

B. Weather conditions permit pavement to be properly placed and compacted

C. The hot mix asphalt will be placed only when both the air and surface temperatures are equal to or exceed the temperatures specified in the table below:

CDOT Table 401-3: Placement Temperature Limitations in F

Compacted Layer Thickness (Inches)	Minimum Air and Surface Temp. (Degrees F and rising)	
	Top Layer	Other Layers
1½ or less	60	50
>1½ to 3	50	40
3 to 4	45	35

Note: Air temperature shall be taken in the shade. Surface is defined as the existing base on which the new pavement is to be placed.

PART 2 PRODUCTS

2.1 MATERIALS

A. General: Pavement shall be asphalt of the plant hot mix type. Materials and construction shall comply with Section 403 and 702 of the CDOT Standards and Specifications for Road and Bridge Construction.

B. Tack Coat:
   1. SS-1 or CSS-1h
   2. AASHTO M208 or M140

C. Asphaltic Cement:
   1. Superpave Performance Graded (PG) binder of PG64-22 or PG58-28 Table 702-1 of CDOT standard section 702
   2. Will not be acidic modified or alkaline modified
   3. Will not contain any used oils that have not been refined
   4. Modifiers will not be carcinogenic

D. Aggregate for Asphaltic Concrete, General
   1. Sound, angular crushed stone, crushed gravel, or crushed slag: ASTM D692
   2. Sand, stone, or slag screening: ASTM D1073
   3. Percent wear: ASTM C131, less than 45 for aggregates retained in #10 sieve

E. Base Course Aggregates for Asphaltic Concrete
   1. Uncrushed gravel may be used in mixture if it meets design criteria specified
   2. Provide uniform quality combined aggregates with a minimum sand equivalent value of 40
   3. Provide aggregate in gradations for courses to comply with Class S and SG, Colorado Department of Transportation, ASTM C136
   4. A maximum of 20% Reclaimed Asphalt Pavement (RAP) will be allowed in (non-polymer or non-rubberized) mixes, provided that all the requirements for hot bituminous pavement are met.
      a. RAP shall not be allowed in polymer modified mixes or in the permanent final lift of asphalt.

F. Surface Course Aggregates for Asphaltic Concrete

1. Provide natural sand, unless sand prepared from stone, slag, or gravel or combinations are required to suit local conditions
2. Provide uniform quality combined aggregate with a minimum sand equivalent value of 50
3. Provide aggregate in gradations for courses to comply with Class SX, Colorado Department of Transportation, ASTM C136.

G. Hydrated Lime for Aggregate:
1. May be added at the rate of 1% by dry weight of the aggregate and shall be included in the amount of material passing the No. 200 sieve. Hydrated lime for aggregate pretreatment will conform to ASTM C207, Type N. Residue retained on a No. 200 sieve will not exceed 10% when determined in accordance with ASTM C110. Drying of the residue in an atmosphere free from carbon dioxide will not be required.

H. Weed Control: First application, “Roundup.” Second application, Casoron “W-50" or “G-10” with colored marker dye, manufactured by Pacific Coast Borax Company or an accepted substitute of non-flammable type.

2.2 ACCESSORIES

A. Traffic Control Devices
1. Signs.
   a. Comply with City of Grand Junction standards and specifications for signs within the public right-of-way.
   b. Sign faces, posts and bases shall be in conformance with the following materials specifications. All nonstandard sign faces, posts and bases must be approved by City of Grand Junction. Private property or nonstandard signs will be maintained by the owner. Submit shop drawings for approval prior to fabrication. All signs shall conform to current M.U.T.C.D. Standards and Colorado Supplements. All signs shall be 3M-engineer grade reflective sheeting or accepted substitute.
   c. Traffic/Parking Signs: Sign blanks shall be 6061 or 5052-H38 aluminum alloy .080 inches thick. Facing shall be specified reflective sheeting with standard sign colors based on standard graphics and as shown on the plans.
2. Sign Posts.
   a. For large signs greater than 12”W x 18”H and for multiple signs of any size mounted on the same post: sign posts shall be two (2) inch by two (2) inch galvanized telespar tube.
   b. For regular single signs 12”W x 18”H or smaller: sign posts shall be one and one-half (1-1/2) inch by one and one-half (1-1/2) inch galvanized telespar tube.
   c. Galvanized telespar tube shall have 0.120-inch wall thickness, and three-eighths (3/8) inch holes drilled on one (1) inch centers, all sides over full length, ten (10) feet in length (min).
3. Sign Post Anchor Bases (Stubs). All sign post anchor bases shall be twist resistant square galvanized telespar tube post with thickness and hole pattern the same as sign posts. Use 2-1/4” by 2-1/4” anchor for large posts and 1-3/4” by 1-3/4” anchor for regular posts. Bases shall be embedded a minimum of 36” below finished grade and shall extend 3” above finished grade.

4. Signs Post Anchor Bases with concrete footing: Sign, post, base and compacted soil shall be rigid and able to withstand wind loads. Where predominantly clay soils are present which will not properly compact at sign base, install a 6" diameter by 36" deep concrete footing around signs post anchor base for all signs in landscaped areas.
5. All signs and posts shall be mounted and secured with municipal-approved vandal-proof type TL-3896 drive rivets with washers, or accepted substitute.

B. Pavement Marking. Specified pavement marking materials shall be used at locations as identified below.
1. Comply with City of Grand Junction and Colorado Department of Transportation standards and specifications for pavement marking within the public right-of-way.
2. FS TT-P-1952, Type I Alkyd, white, blue, yellow and red color paint meeting requirements of CDOT Standard Specification 708. Verify colors and extent of painting prior to painting. Unless noted on plans, evident at existing striping or instructed, provide white in color for traffic striping, parking stalls, and other control markings on internal pavement, yellow in color for traffic control markings or restricted parking or where indicated, blue in color for accessible parking stalls, and red in color for curbs where no parking is indicated. Reflectorized paint required for traffic stripes and control markings on internal drive, road or street pavements.
3. Furnish paint with a no-pick-up maximum drying time of 20 minutes, when tested according to ASTM D711 using a wet film thickness of 0.015-inch when tested and applied at 77 degrees F.
4. 3M Stamark 5730 preformed plastic marking material or an accepted substitute shall be used for crosswalks, stop bars, symbols (i.e. turn arrows) and striping for separation of turn and through lanes in right-of-way. Use of thermoplastic pavement marking is not permitted.

2.3 MIXES/SOURCE QUALITY CONTROL

A. Determine full depth design mix based upon aggregates furnished
1. Test mix by independent laboratory at Contractor's expense
2. Grade dependent on temperature during placement
3. Submit mix designs under provisions of Division One specifications for review and acceptance by Engineer

B. Submit mix design giving unit weight and to meet following requirements prior to placement of asphalt:

Property	S(75)	SX(75)
Air Voids in Mix, % (N Design)	3.5-4.5	3.5-4.5
Initial Gyrations	7	7
Design Gyrations	75	75
Hveem Stability	28 min	28 min
Voids Filled w/ Asphalt	65-80	65-80

Establish a single percentage passing each sieve size, a single percent of asphalt and a mix temperature. Maintain job mixes within following percentages of design mix:

Aggregates:	
¾" and larger	± 6%
#4 to #8	± 5%
#30	± 4%
#200	± 2%
Asphalt Content Tolerance	± 0.3%
Discharge Mix temp	± 20˚ F

PART 3 EXECUTION

3.1 EXAMINATION

A. Establish and maintain required lines and elevations. Provide grade and location stakes under this section as required for asphaltic concrete paving work.

B. Operate heavy, rubber-tired front loader over subgrade of paved areas. Where soft spots occur, remove loose materials and replace with Class 6 road base aggregate complying with CDOT standards compacted to level of subgrade.

3.2 PREPARATION

A. Prepare subgrade under provisions of Section 02300

B. Loose and Foreign Material
   1. Remove loose and foreign material from compacted subgrade surface immediately before application of paving. Clean surface with mechanical sweeper, blowers, or hand brooms, until surfaces are free from dust

C. Weed Control
   1. If weeds or vegetation exist at or on the subgrade, apply "Round-up" at rates following manufacturer's instructions. Apply "Round-up" three days prior to removal of vegetation, subgrade preparation and application of Casoron as described below to allow "Round-up" to kill all vegetation. Remove all living and dead weeds, root balls, tree/shrub roots, vegetation, and/or any organic matter from on or in the subgrade per applicable earthwork specifications prior to subgrade preparation and paving at all areas to be paved.
   2. After all fine grading, checking, shaping, and compacting of the subgrade has been completed, and just prior to placing asphalt or aggregate base course, all subgrade soil in the area to receive asphalt pavement shall be thoroughly treated with Casoron soil sterilant (in addition to "Round-up" and regardless of presence of existing weeds or vegetation). Casoron shall be thoroughly sprinkled to distribute the chemical through

the first two or three inches of the subgrade. For all areas to be paved, apply Casoron weed control at a minimum rate per 100 square yards of 2.4 pounds for G-10 or 4.0 pounds for 50w at rates and methods recommended by manufacturer within one day of paving.

3. The Contractor shall provide all necessary protection to prevent injury to animal, fish, or plant life and property occasioned by the application of the soil sterilant. Apply on a calm, wind-free day. The Contractor will be held responsible for all application of soil sterilant or the storage of same. Protect existing and new trees and shrubs beyond the limit of paving from damage due to weed killer or soil sterilant overspray or root contact. Extra caution is required to prevent over-application of products in areas to be paved under tree canopies. Trees and shrubs damaged or killed by weed killer or sterilant application shall be replaced by the contractor at contractor's expense.
4. Do not apply within 20 feet of trees or shrubs

D. Tack Coat
1. Apply in similar manner as prime coat, except as modified
2. Dilute material with equal parts of water and apply to contact surfaces of previously constructed asphaltic concrete or portland cement concrete and surfaces
3. Apply at rate of 0.05 to 0.15 gallons per square yard of surface
4. Apply tack coat by brush to contact surfaces of curbs, gutters, catch basins, and other structures projecting into or abutting asphaltic concrete pavement
5. Allow surfaces to dry until material is at condition of tackiness to receive pavement
6. Where asphaltic concrete will adhere to surface, tack coat may be eliminated by Engineer

3.3 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
1. Mill to minimum depth of 1 ½-inches, or as indicated on the plans.
2. Mill to a uniform finished surface free of gouges, grooves, and ridges of more than ¼ inch depth.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Transport milled hot-mix asphalt to asphalt recycling facility.
7. Keep milled pavement surface free of loose material and dust.

3.4 RING/FRAME ADJUSTMENTS

A. Set ring/frames of subsurface structures to final grade as a part of this work.

B. Placing Ring/Frames

1. Surround ring/frames set to elevation with a ring of compacted asphalt concrete base prior to paving
2. Place asphalt concrete mixture up to 1-inch below top of ring/frame, slope to grade, and compact by hand tamping

C. Adjust frames to proper position to meet paving

D. If permanent covers are not in place, provide temporary covers over openings until completion of rolling operations

E. Set ring/frames to grade, flush with surface of adjacent pavement

3.5 PREPARING THE MIXTURE

A. Comply with ASTM D995 for material storage, control, and mixing and for plant equipment and operation

B. Stockpile
1. Keep each component of the various sized combined aggregates in separate stockpiles
2. Maintain stockpiles so that separate aggregate sizes will not be intermixed and to prevent segregation

C. Heating
1. Heat the asphalt cement at the mixing plant to viscosity at which it can be uniformly distributed throughout mixture
2. Use lowest possible temperature to suite temperature viscosity characteristics of asphalt
3. Do not exceed 350 degrees F

D. Aggregate
1. Heat-dry aggregates to acceptable moisture content
2. Deliver to mixer at recommended temperature to suite penetration grade and viscosity characteristics of asphalt cement, ambient temperature, and workability of mixture
3. Accurately weigh or measure dry aggregates and weigh or meter asphalt cement to comply with job-mix formula requirements

E. Mix aggregate and asphalt cement to achieve 90-95 percent coated particles for base mixtures and 85-90 percent coated particles for surface mixture, per ASTM D2489

3.6 EQUIPMENT

A. Bituminous Pavers:
1. Self-propelled, spreads without tearing surfaces, equipped with an activated screed assembly, heated if necessary, controls pavement edges to true lines without use of stationary forms and capable of spreading and finishing the asphalt plant mix material in widths applicable to the typical sections and thicknesses shown in the contract documents.

2. Pavers used for roadway shoulders, recreational paths and similar construction will be capable of spreading and finishing the courses of asphalt plant mix material in width shown in the contract documents.
3. Pavers will be equipped with automatic screed controls with sensors capable of sensing grade from an outside reference line, and maintaining the screed at the specified longitudinal grade and transverse slope. The sensor will be constructed to operate from either or both sides of the paver and will be capable of working with the following devices:
    a. Ski-type device at least 30 feet in length
    b. Short ski or short shoe
    c. At least 5,000 feet of control line and stakes
4. The controls will be capable of maintaining the screed at the specified transverse slope within plus or minus 0.1 percent.
5. Manual operation will be permitted:
    a. For constructing irregularly shaped or minor areas
    b. If the automatic controls fail or malfunction the equipment may be operated manually for the remainder of the normal working day, provided specified results are obtained. However, if specified surface tolerances cannot be achieved, paving operations will be suspended until satisfactory correction, repairs of equipment replacements are made.

B. Rolling Equipment
1. Steel-wheel roller: Self-propelled, contact pressure of 250 to 350 psi per inch of width of roller wheel, equipped with adjustable scrapers and means for keeping wheel wet to prevent mix from sticking
2. Pneumatic-tired rollers: Self-propelled, contact pressure under each tire of 85 to 110 psi, wheels spaced so that one pass will accomplish one complete coverage equal to rolling width of machine, oscillating wheels. Remove and replace immediately tires picking up fines

C. Hand Tools: Provide rakes, lutes, shovels, tampers, smoothing irons, pavement cutters, portable heaters, and other miscellaneous small tools

3.7 PLACING THE MIX

A. Place asphalt concrete mixture on prepared surface, spread and strike-off using paving machine

B. Complete placement over full width of section on each day's run

C. Spread mixture at minimum temperature specified by CDOT Table 401-5 for the specific binder used in the asphalt mix:
1. PG 64-22: 320 F minimum mix discharge temperature, 235 F minimum delivered mix temperature
2. PG 58-28: 275 F minimum mix discharge temperature, 235 F minimum delivered mix temperature

3. The maximum mix discharge temperature will not exceed the minimum discharge temperature by more than 30 F.
4. Delivered mix temperature will be measured behind the paver screed
5. Hot asphalt mixture will be produced at the lowest temperature with the specified temperature range:
   a. producing a workable mix and provides for uniform coating of aggregates, in accordance with AASHTO T195
   b. allowing the required compaction to be achieved

D. Inaccessible and small areas may be placed by hand

E. Conform to the grade, cross section, finish thickness, and density indicated.

F. Lift Thickness
1. Place in multiple lifts. Place asphalt in lifts such that each compacted lift thickness is no less than 2.0" thick and no greater than 3.0" thick. Top lift to be 2" thick.
2. Typical Lift Thickness Sequencing:

Final Asphalt Section Required (inches)	No. of Lifts	Thickness of each Lift (inches) from bottom to top lift
2"	1	2
3"	1	3
4"	2	2-2
5"	2	3-2
6"	3	2-2-2
7"	3	3-2-2
8"	3	3-3-2
9"	4	3-2-2-2
10"	4	3-3-2-2
>10	Review with Engineer	

G. Paver Placing
1. Unless otherwise directed, being placing along centerline of areas in crowned section and at high side on one-way slope and in direction of traffic flow
2. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips
3. Complete base courses before placing surface courses
4. Place mixture in continuous operation as practicable

H. Hand Placing
1. Spread, tamp, and finish mixing using hand tools in areas where machine spreading is not possible as acceptable to Engineer
2. Place mixture at a rate that will insure handling and compaction before mixture becomes cooler than acceptable working temperature

I. Joints

1. Construct transverse joint at right angles to centerline when operations are suspended long enough for mixture to chill
2. Construct joints to have same texture, density, and smoothness as adjacent sections of asphalt concrete course
3. Clean contact surfaces free of sand, dirt, or other objectionable material and apply tack coat
4. Offset transverse joints in succeeding courses not less than 24 inches
5. Cut back edge of existing pavement or previously placed course to expose an even, vertical surface for full course thickness
6. Offset longitudinal joints in succeeding courses not less than 6 inches
7. When the edges of longitudinal joints are irregular, honeycombed or inadequately compacted, cut back unsatisfactory sections to expose an even, vertical surface for full course thickness
8. Wearing course constructed in even number of strips; place 1 longitudinal joint on centerline of road
9. Wearing course constructed in odd number of strips; place the centerline of 1 strip on centerline of road

J. Gutter: Finish surface high adjacent to concrete gutter so when compacted surface is slightly higher than edge of curb and flashing

3.8 COMPACTING THE MIX

A. All paving will be compacted to 94 +/- 2% of Maximum Theoretical (RICE) density, CP-51 or AASHTO T209: Maximum Specific Gravity of Bituminous Paving Mixtures, as determined by ASTM D 2950. RICE values will be used in calculating Relative Compaction according to CP-44 or AASHTO T166.

B. Provide pneumatic and steel-wheel type rollers to obtain the required pavement density, surface texture and rideability

C. Begin rolling operations when the mixture will bear weight of roller without excessive displacement and complete as quickly as possible after placement occurs.

D. Compaction operations will be continuous until the required density is achieved or the density requirements are not met and the mix temperature falls below 185˚ F or there is obvious surface distress or breakage. Minimum compaction temperatures may be adjusted according to the asphalt binder supplier recommendations. Adjusted minimum compaction temperatures must be shown on the approved mix design or on the asphalt binder supplier documentation kept on file at the jobsite.

E. Do not permit heavy equipment, including rollers to stand on finished surface before it has thoroughly cooled or set

F. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers

G. Start rolling longitudinally at extreme lower side of sections and proceed toward center of pavement. Roll to slightly different lengths on alternate roller runs

H. Do not roll centers of sections first under any circumstances

I. Breakdown Rolling
   1. Accomplish breakdown or initial rolling immediately following rolling of transverse and longitudinal joints and outside edge
   2. Operate rollers as close as possible to paver without causing pavement displacement
   3. Check crown, grade, and smoothness after breakdown rolling
   4. Repair displaced areas by loosening at once with lutes or rakes and filling, if required, with hot loose material before continuing rolling

J. Second Rolling
   1. Follow breakdown rolling as soon as possible, while mixture is hot and in condition for compaction
   2. Continue second rolling until mixture has been thoroughly compacted

K. Finish Rolling
   1. Perform finish rolling while mixture is still warm enough for removal of roller marks by combination of steel and pneumatic rollers
   2. Continue rolling until roller marks are eliminated and course has attained specified density, and required surface texture and surface tolerances
   3. After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled and attained its maximum degree of hardness

L. Patching
   1. Remove and replace defective areas
   2. Cut-out and fill with fresh, hot asphaltic concrete
   3. Remove deficient areas for full depth of course
   4. Cut sides perpendicular and parallel to direction of traffic with edges vertical
   5. Apply tack coat to exposed surfaces before placing new asphaltic concrete mixture
   6. Compact by rolling to specified surface density and smoothness

3.9 JOINING TO EXISTING WORK

A. Cut sides vertically and apply tack coat to exposed asphalt surfaces before placing new pavement. Meet existing thickness of surface and base courses, but not less than specified for new work.

B. All joins shall be compacted to 92.0% +/- 2.0% of RICE, taken fully on each side of joint, every 200 lineal feet. RICE values shall be used in calculating Relative Compaction according to AASHTO T166.

3.10 FIELD QUALITY CONTROL

A. The City of Grand Junction will engage a certified testing agency to perform field testing to determine compliance of in-place asphaltic concrete paving materials and compaction in accordance with Division One Specifications.

B. It is the Contractor's responsibility to initiate, coordinate and accommodate all required tests and inspections including conformance with requirements of all applicable public agencies and authorities. Contractor will be responsible for coordinating the testing requirement with testing agency and provide the testing agency 48 hour advance notification to schedule tests.

C. Testing Agency will test in-place pavement for density and thickness.

D. Asphalt density testing:
   1. Every one-hundred fifty (150) lineal feet per driving lane.
   2. Every 2,000 square feet of parking lot
   3. Densities shall be between ninety-two percent (92%) and ninety-six percent (96%) of the RICE unit weight

E. Contractor to verify final surfaces are of uniform texture, conforming to required grades and cross sections

F. The Contractor will core the pavement as required by the testing agency for field density tests in accordance with AASHTO T 230, Method B, or for field calibration of nuclear density equipment in accordance with ASTM D 2950.
   1. Testing agency will take not less than 4-inch diameter pavement specimens
   2. At the testing agency's discretion, cores may be required at the beginning of placement of each pavement layer or change of mixture materials or gradation.
   3. Untested areas during placement will require cores to be taken to verify compaction
   4. Contractor to repair holes from test specimens

G. For each completed course or from locations directed by the testing agency, and at a minimum, a representative asphalt pavement sample shall be taken from the first one thousand (1,000) tons, and all mix properties shall be verified. The percent voids filled with asphalt cement, Hveem stability, and Lottman shall be verified at a minimum of every ten-thousand (10,000) tons. Asphalt testing shall comply with ASTM D1559. Two copies of all test reports shall be submitted directly to the Engineer.

H. Acceptable density of in-place course materials is between 92 and 96 percent of the recorded laboratory RICE unit weight. Immediately re-compact asphaltic concrete not conforming to acceptable density. Remove and replace all sections not in conformance density requirements

I. Thickness: Variations from drawings
   1. Base course: 1/4-inch +
   2. Remove and replace paving less than minimum thickness

J. Grade Tolerance: ±0.1 feet

K. Surface Smoothness
   1. Test using a 10-foot straight edge applied parallel to direction of drainage
   2. Advance straight edge five feet, maximum 1/4-inch per foot from nearest point of contact
   3. Do not permit pockets or depressions where water may pool
   4. Remove and replace areas, deficient in smoothness. Overlay corrections may be permitted only if acceptable to Engineer

L. Inspection: The work of this section is subject to the inspection and approval of the engineer and/or owner. The following inspections are required:
   1. Protection of adjacent property
   2. Staking and establishment of elevations
   3. Establishment and compaction of subgrade
   4. Placement and compaction of bituminous base course and wearing surface
   5. Final inspection
   6. Obtain approval of each element of work listed above in sequence of its completion before proceeding with the next item

3.11 CLEANING

A. After completion of paving operations, clean surfaces of excess or spilled asphalt materials to the satisfaction of Engineer

3.12 PROTECTION OF FINISHED WORK

A. After final rolling, do not permit vehicular traffic on asphalt concrete pavement until it has cooled and hardened and in no case sooner than 6 hours

B. Provide barricades and warning devices as required to protect pavement and the general public

3.13 WARRANTY

A. Provide installer's 2-year written warranty endorsed by the contractor warranting the pavement from creeping, shoring, cracking, softening, settling, ponding and other defects due to improper placing or defective materials. Replace defective materials upon notification by the owner in accordance with the requirements of the original work.

3.14 SCHEDULE OF MIX PLACEMENT:

A. Refer to Drawings for asphalt thickness and subgrade requirements.

END OF SECTION

SECTION 02750

RIGID PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Forming, jointing, placing and curing of concrete pavements, curbs, gutters, cross pans, islands and sidewalks.

1.2 RELATED SECTIONS

A. Section 01020 – Geotechnical Report

B. Section 02300 – Earthwork

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. M171 – Sheet Materials for Curing Concrete

B. American Concrete Institute (ACI):
   1. 214 – Recommended Practice for Evaluating Compression Test Results of Field Concrete
   2. 301 – Specifications for Structural Concrete for buildings
   3. 304 – Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
   4. 305/305R – Hot Weather Concreting
   5. 306/306R – Cold Weather Concreting
   6. 308 – Standard Practice for Curing Concrete

C. American Society for Testing and Materials (ASTM):
   1. A1064 – Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed for Concrete
   2. A615 – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
   3. C31 – Making and Curing Concrete Test Specimens in the Field
   4. C33 – Concrete Aggregates
   5. C39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens
   6. C94 – Ready Mix Concrete
   7. C143 – Test Method of Slump of Hydraulic Cement Concrete
   8. C150 – Portland Cement
   9. C260 – Air-Entraining Admixtures for Concrete
   10. C309/AASHTO M148 – Liquid Membrane-Forming Compounds for Curing Concrete
   11. C494 – Chemical Admixtures for Concrete

12. C618 – Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
13. C979 – Pigments for Integrally Colored Concrete
14. C1116 – Fiber Reinforced Concrete
15. D994 – Preformed Expansion Joint Filler for Concrete (Bituminous Type)
16. D1751 – Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction
17. D1752 – Preformed Sponge Rubber Cork Expansion and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
18. D6690 – Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

D. CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.

E. City of Grand Junction construction specifications, standards and details.

1.4 SUBMITTALS

A. Provide under provisions of Division One Specifications

B. Product Data: Provide sufficient information on mix design and products specified to verify compliance with specifications. Provide data on joint filler admixtures and curing compounds
1. Existing data on proposed design mixes, certified and complete
2. Submit reports of field quality control testing

1.5 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301, Conform materials and installation to applicable portions of Colorado Department of Transportation, and the City of Grand Junction construction specifications, standards and details.

1.6 REGULATORY REQUIREMENTS

A. For work on public streets or rights-of-way conform to the requirements of City of Grand Junction construction specifications, standards and details for the Construction of Curbs, Gutters, Sidewalks, Driveways, Street Paving, and other public right-of-way Improvements.

B. Comply with applicable requirements of CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.

C. Obtain cementitious materials and aggregate from same source for all work

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle materials under provisions of Division One Specifications

B. Reinforcing steel: Store on supports which will keep materials from contact with the ground and cover

C. Rubber and plastic materials: Store in a cool place, do not expose to direct sunlight

D. Prepare a delivery ticket for each load of ready-mixed concrete

E. Contractor shall submit tickets for all concrete delivered to site:
   1. Quantity delivered
   2. Actual quantity of each material in batch
   3. Outdoor temp in the shade
   4. Time at which cement was added
   5. Numerical sequence of the delivery
   6. Quantity of water that can be added in the field based on mix design
   7. Free moisture in fine and coarse aggregate in percent by weight
   8. Temperature of batch

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen

B. Protect concrete from rapid loss of moisture during hot water placement

PART 2 PRODUCTS

2.1 MATERIALS

A. Form Materials
   1. Form Materials: Plywood: PS 1, waterproof resin-bonded, exterior type Douglas Fir; face adjacent to concrete Grade B or better
   2. Fiberboard: FS LL-B-810, Type IX, tempered, waterproof, screen back, concrete form hardboard
   3. Capable of supporting loads imposed by construction equipment, straight and free from warp. Clean and strong enough to resist pressure of concrete when placed and retain horizontal and vertical alignment. Coat forms with a non-staining form release agent that will not discolor or deface the surface of the concrete
   4. Joint filler: ASTM D1751 or D1752 type; 3/4-inch thick unless indicated otherwise

B. Reinforcement
   1. Where reinforcement is specified herein or indicated on the plans:
      a. Bars: ASTM A615, Grade 60
      b. Reinforcing Welded Wire Fabric (WWF): ASTM A1064, steel, 16 gage minimum
         i) Furnish in flat sheets
      c. Dowels: ASTM A615; 40 ksi yield, Grade 60, plain steel, unfinished finish
      d. Fibrous reinforcement: Collated, fibrillated, polypropelyne fibers, tensile strength 70,000 psi

i) ASTM C1116
ii) Use 1.5 lbs. Per cubic yard minimum
iii) Fibermesh or accepted substitution

C. Weed Control: First application, “Roundup.” Second application, Casoron “W-50" or “G-10” with colored marker dye, manufactured by Pacific Coast Borax Company or an accepted substitute of non-flammable type.

2.2 ACCESSORIES

A. Curing Compound: ASTM C309, AASHTO M-148, white pigmented liquid membrane

B. Joint Sealers: Polyurethane base, elastomeric, self leveling, chemical cure, handling 50% joint movement; Sikaflex-2C-SL or accepted substitutions

C. Sheet Materials: AASHTO M171, 4 mil

D. Expansion Joint Material: 0.5-inch thick, ASTM D1751, asphalt impregnated fiber board, glass fiber or sponge, or closed cell polyethelene foam; Texmastic “vinylex 3600,” Sonneborn “Sonoflex F,” or accepted substitutions

2.3 CONCRETE MIX

A. Comply with ASTM C94

B. Maximum Coarse Aggregate Size: 1-inch

C. Portland Cement: ASTM C150, Type II; 555 pounds minimum per cubic yard of concrete

D. Water/Cementitious Material (Cement and Fly Ash) Ratio: Less than or equal to 0.44

E. Slump: 4-inch maximum
1. May be increased to 4.5 inches for hand work, acceptable to Engineer
2. As low as possible consistent with proper handling and thorough compaction

F. Volumetric Air Content: 4.5%±1% after placement for 1-inch aggregate
1. Vary air content with maximum size aggregate, ASTM C94, Table 3.

G. Strength: Compressive strength as determined by ASTM C39, 4,500 psi minimum at 28 days

H. Consistency: Uniform slump, suitable for the placement conditions with aggregate floating uniformly throughout the concrete mass, flowing sluggishly when vibrated or spaded

I. Adjust mix as required to meet specifications

J. Approved fly ash may be substituted for ASTM C150 cement up to a maximum of 25 percent Class C or Class F by weight of the cementitious material content. Fly ash for concrete shall conform to the requirements of ASTM C618 with the following exceptions:

1. The loss on ignition shall not exceed 3.0 percent
2. The CaO in Class F fly ash shall not exceed 18 percent

K. Admixtures: Content, batching method, and time of introduction in accordance with the manufacturer's recommendations for compliance with this specification
   1. Include a water reducing admixture
   2. Calcium chloride content shall not exceed 0.05% of the cement content by weight

2.4 SOURCE QUALITY CONTROL AND TESTS

A. Provide under provisions of Division One Specifications

B. Submit proposed mix design to Engineer for review prior to commencement of work

C. Tests on cement and aggregates will be performed to ensure conformance with specified requirements

D. Test samples in accordance with ACI 301.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads

B. Verify gradients and elevations of base are correct

C. Check completed formwork for grade and alignment to the following tolerances:
   1. Top of forms not more than 1/8-inch in 10 feet
   2. Vertical face on longitudinal axis, not more than 1/4-inch in 10 feet

3.2 PREPARATION

A. Subgrade
   1. Prepare subgrade in accordance with Section 02300
   2. Moisten subgrade to depth of 6 inches at optimal moisture not more than 12 hours prior to placement to minimize absorption of water from fresh concrete
   3. Check for soft spots by proof-rolling or other means prior to setting forms. Remove soft yielding material and replace. Compact to specifications under provisions of Section 02300
   4. Check crown and/or elevation of subgrade to assure specified thickness. Compact to specification additional material used to bring to correct elevation. Remove excess material where subgrade is too high
   5. Clean subgrade of all loose materials before placement of concrete. Do not disturb area inside forms after fine grading is complete
   6. Weed Control

a. If weeds or vegetation exist at or on the subgrade, apply "Round-up" at rates following manufacturer's instructions. Apply "Round-up" three days prior to removal of vegetation, subgrade preparation and application of Casoron as described below to allow "Round-up" to kill all vegetation. Remove all living and dead weeds, root balls, tree/shrub roots, vegetation, and/or any organic matter from on or in the subgrade per applicable earthwork specifications prior to subgrade preparation and paving at all areas to be paved.
b. After all fine grading, checking, shaping, and compacting of the subgrade has been completed, and just prior to placing asphalt or aggregate base course, all subgrade soil in the area to receive asphalt pavement shall be thoroughly treated with Casoron soil sterilant (in addition to "Round-up" and regardless of presence of existing weeds or vegetation). Casoron shall be thoroughly sprinkled to distribute the chemical through the first two or three inches of the subgrade. For all areas to be paved, apply Casoron weed control at a minimum rate per 100 square yards of 2.4 pounds for G-10 or 4.0 pounds for 50w at rates and methods recommended by manufacturer within one day of paving.
c. The Contractor shall provide all necessary protection to prevent injury to animal, fish, or plant life and property occasioned by the application of the soil sterilant. Apply on a calm, wind-free day. The Contractor will be held responsible for all application of soil sterilant or the storage of same. Protect existing and new trees and shrubs beyond the limit of paving from damage due to weed killer or soil sterilant overspray or root contact. Extra caution is required to prevent over-application of products in areas to be paved under tree canopies. Trees and shrubs damaged or killed by weed killer or sterilant application shall be replaced by the contractor at contractor's expense.
d. Do not apply within 20 feet of trees or shrubs

B. Frame Adjustment
1. Coat surfaces of manhole and catch basin frames with oil to prevent bond with concrete pavement for concrete collars
2. Set frames of structures in full grout bed to provide bearing. Set to final grade
3. Form construction joints and blockouts as indicated on drawings

3.3 PERFORMANCE AND INSTALLATION

A. Transporting mixed concrete
1. Transporting of mixed concrete shall conform to ACI 305R
2. Do not exceed manufacturer's guaranteed capacity of truck agitators. Maintain the mixed concrete in a thoroughly mixed and uniform mass during handling
3. Do not incorporate additional mixing water into the concrete during hauling or after arrival at the delivery point, unless ordered by the Engineer. If additional water is to be incorporated into the concrete, revolve the drum not less than 30 revolutions at mixing speed after the water is added and before placing concrete.
4. Furnish a water measuring device in good working condition, mounted on each transit mix truck, for measuring the water added to the mix on the site by the Engineer
5. Provide delivery ticket and comply with delivery requirements of this section

B. Forming
   1. Place and secure forms to correct location, dimension, profile, and gradient
   2. Install sufficient quantity of forms to allow continuous progress of work so that forms can remain in place at least 24 hours after concrete placement
   3. Join neatly and mechanically tamp to assure firm placement. Assemble formwork to permit easy stripping and dismantling without damaging concrete
   4. Oil forms prior to concrete placement
   5. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement
   6. Set dowels, expansion joints, preformed construction joints and header boards as specified or indicated on the drawings
   7. Low roll or mountable curbs may be formed without the use of face form by using a straight edge and template to form curb face
   8. Backfill behind forms as required to prevent water from entering subgrade

C. Reinforcement
   1. Add fiber reinforcement to mix at plant prior to delivery to jobsite
   2. Place bar or WWF reinforcement at mid-height of slabs-on-grade or as shown on the drawings
      a. Install in as long lengths as possible. Lap adjoining pieces at least one full mesh and lace with wire
      b. Support with metal chairs, brick or stone is unacceptable
   3. Hold all tie and marginal dowels in proper position by sufficient supports or pins
   4. Mechanically install dowels or place on supports if center longitudinal joint is sawed in lieu of placing plastic strip
   5. Interrupt reinforcement at expansion joints
   6. Place dowels to achieve pavement and curb alignment as detailed.
   7. Provide doweled joints inch at interruptions of concrete with one end of dowel set in capped sleeve to allow longitudinal movement
   8. Grease dowels on one side of joints with caps on greased end

D. Placing concrete
   1. Place concrete in accordance with ACI 301
   2. Lightly moisten subgrade or base course immediately before placing concrete.
   3. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed
   4. during concrete placement
   5. Deposit concrete near final position. Minimize segregation and damage to subgrade
   6. Place concrete continuously over the full width of the panel and between predetermined construction joints. Spread mechanically to prevent segregation and separation of materials
   7. Consolidate concrete with vibrators and spade next to forms to remove air spaces or honeycombs
   8. Do not place concrete in forms that has begun to set
   9. Do not place more concrete in one day than can be finished before dark the same day
   10. Curbs and Gutters: Automatic machine may be used for curb and gutter placement at Contractor's option. If machine placement is to be used, submit revised mix design and laboratory test results which meet or exceed minimums specified. Machine placement

must produce curbs and gutters to required cross-section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified

11. Walks: Construct sidewalks with a minimum thickness of 4-inch. Tool edges to rounded profile and finish as specified or as shown on the drawings. Pitch walks 1/4-inch per foot for cross drainage unless otherwise indicated

E. Cold weather concreting
   1. Conform to ACI 306/306R, except as modified herein
   2. Minimum concrete temp at the time of mixing

Outdoor Temp at Placement (in shade)	Concrete Temp at Mixing
Below 30°F	70°F
Between 30°F & 45°F	60°F
Above 45°F	45°F

   3. Do not place heated concrete which is warmer than 80 degrees F
   4. If freezing temp are expected during curing, maintain the concrete temp at or above 50 deg F for 5 days or 70 deg F for 3 days with forms in place
   5. Do not allow concrete to cool suddenly

F. Hot weather concreting
   1. Conform to ACI 305/305R, except as modified herein
   2. At air temp of 90 degrees F and above keep concrete as cool as possible during placement and curing. Fog sprayers or special wetting agents may be required for protection
   3. Do not allow concrete temperature to exceed 70 deg F at placement
   4. Prevent plastic shrinkage cracking due to rapid evaporation of moisture
   5. Do not place concrete when the actual or anticipated evaporation rate equals or exceeds 0.2 lbs per sq ft per hr as determined from ACI 305, Fig 2.1.4

G. Joints
   1. Provide concrete joints per CDOT Standard Details
   2. Sidewalk and pavement
      a. Contraction joints: At intervals not to exceed 10 feet and 1 1/2 inches deep, tooled or sawcut
      b. Expansion joints: 1/2-inch premolded joints where sidewalks end at curb returns, against fixed objects, at points of sharp radius, and between sidewalk and driveway slabs. Place expansion joint at minimum of every 100 feet.
      c. Construction joints: At all separate pours, and around all appurtenances such as manholes, utility poles, and other penetrations extending into and through sidewalks. Place backer rod and polyurethane sealant for entire joint length
   3. Curb and Gutter
      a. Contraction joints: At intervals not to exceed 10 feet made by insertion of 1/8-inch template at right angles to curb and 1 1/2-inch deep.

b. Expansion joints: At curb returns, against fixed objects, at points of sharp radius, between adjacent sidewalk and curb at all curb returns, between sidewalk and all driveway slabs, and along straight lengths every 200 linear feet. Install expansion joint filler between concrete sidewalks and any fixed structure. Extend expansion joint material for full depth of concrete, except stop 1/2-inch below finish surface.
c. Construction joints: At all separate pours, place backer rod and polyurethane sealant for entire joint length.

4. Place expansion joint filler between paving components and buildings or other appurtenances at temperatures above 50 deg F. Clean all dust, debris and water from joint. Recess top of filler 1/2-inch for sealant placement.
5. Provide keyed joints as indicated in details.

H. Finishing
1. Run straight-edge over forms with sawing motion to fill all holes and depressions.
2. After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.
3. After floating, test surface for trueness with a 10' straightedge. Distribute concrete as required to remove surface irregularities, and re-float repaired areas to provide a continuous smooth finish
4. Finish surfaces with a wooden or magnesium float. Plastering of surfaces is not permitted
5. Immediately after float finishing, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Use fine hair fiber-bristle broom unless otherwise directed. Coordinate the required final finish with the Engineer before application.
6. On inclined slab surfaces and steps, provide a coarse, non-slip finish by scoring surface with a stiff-bristled broom, perpendicular to line of traffic
7. Edge all outside edges of the slab and all joints with a 0.25-inch radius edging tool.
8. Work edges of gutters, back top edge of curb, and formed joints with an edging tool, and round to 0.5-inch radius, unless otherwise indicated. Eliminate tool marks on concrete surface
9. Brush with soft bristle brush to remove trowel marks and leave a uniform appearance just before concrete takes initial set.
10. Direction of Texturing:
    a. Curb and Gutter: At right angles to the curb line
    b. Sidewalk: At right angles to centerline of sidewalk.
11. Place curing compound on exposed concrete surfaces immediately after finishing. Apply under pressure at the rate of one gallon to not more than 135 square feet by mechanical sprayers in accordance with manufacturer's instructions acceptable to Engineer.

I. Joint sealing
1. Seal joints and clean concrete prior to opening to traffic.
2. Seal all expansion joints.
3. Separate concrete from other structures with 3/4-inch thick joint filler.

4. Place joint filler in concrete pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
5. Extend joint filler from bottom of pavement to within 1/4-inch of finished surface.

J. Curing and protection
1. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury
2. Have plastic sheeting, straw, burlap and/or canvas materials available at all times to protect fresh uncured surfaces from adverse weather conditions
3. Do not permit pedestrian traffic over sidewalks for 7 days minimum after finishing. Do not permit vehicular traffic over pavement for 14 days minimum after finishing or until 75 percent design strength of concrete has been achieved

3.4 FIELD QUALITY CONTROL

A. Comply with Division One Specifications - Quality Assurance: Field inspections and testing

B. It is the Contractor's responsibility to initiate, coordinate and accommodate all required tests and inspections including conformance with requirements of all applicable public agencies and authorities. Contractor will be responsible for coordinating the testing requirement with testing agency and provide testing agency 48 hour advance notification to schedule tests.

C. Tolerances
1. Division One Specifications - Quality Assurance: Tolerances
2. Maximum Variation of Surface Grade: 1/4- inch in 10 ft
3. Maximum Variation from True Alignment: 3/8-inch in 10 ft

D. Take cylinders and perform slump and air entrainment tests as required by Division One Specifications in accordance with ACI 301. Unit weight and mix temperature will also be taken

E. The first three loads will be tested for slump and air content. If any one test fails to meet requirements, that load will be rejected and tests will continue on each load until three consecutive loads meet requirements. Thereafter, five concrete test cylinders will be taken for every 75 cu yds or less cu yds of concrete placed each day

F. One additional test cylinder will be taken during cold weather and cured on site under same conditions as concrete it represents

G. One slump and air entrainment test will be taken for each set of test cylinders taken

H. Cylinders will be tested as follows: 2 at 7 days, 2 at 28 days and one at a later date, if necessary, as directed by the Engineer

I. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken

J. Thickness of fresh concrete may be checked by Owner at random. Coring will be conducted in accordance with City of Grand Junction requirements. Where average thickness of concrete is deficient in thickness by more than 0.20-inch, but not more than 1.0-inch, payment to Contractor will be adjusted based on amount indicated in schedule of values for portland cement concrete paving as specified in the following table.

CONCRETE PAVEMENT DEFICIENCY	
Deficiency in Thickness (Determined by Cores) INCHES	**Proportional Part of Contract Price Allowed**
0.00 to 0.20	100%
0.21 to 0.30	80%
0.31 to 0.40	72%
0.41 to 0.50	68%
0.51 to 0.75	57%
0.76 to 1.00	50%
Over 1.00	NONE

Note: When thickness of pavement is deficient by more than one inch, and judgment of the Engineer is that area of such deficiency should not be removed and replaced, there will be no payment for the area retained.

K. Failure of Test Cylinders or Coring Results: Engineer may order removal and replacement of concrete as required upon failure of 28-day tests or if thickness of pavement is less than 95% of specified thickness

3.5 SCHEDULE OF CONCRETE

A. See plans for concrete thicknesses and subgrade preparation.

3.6 SCHEDULE OF CONCRETE REINFORCEMENT

A. Fiber reinforcement required for all concrete flatwork, including curb and gutter, sidewalk and pavement

END OF SECTION

SECTION 02920

SEEDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Soil preparation

B. Fertilization

C. Seeding methods

D. Areas to be reseeded

E. Seed Mix

F. Maintenance

G. Seed protection and slope stabilization

1.2 RELATED SECTIONS

A. Section 01500 – Construction Facilities and Temporary Controls

B. Section 02300 – Earthwork

1.3 REFERENCES

A. Federal Specification (FS) O-F-241 - Fertilizers, Mixed, Commercial

B. American Association of Nurserymen - Standardized Plant Names

C. Association of Official Seed Analysts (AOSA)

D. Colorado Department of Agriculture (CDA) Seed Act

E. Colorado Department of Transportation (CDOT) Construction Specifications

1.4 SUBMITTALS

A. Submit under Division One Specifications for products related to seeding work including but not limited to seed mixes, mulches, composts, tackifiers, fertilizers and herbicides.

B. Product Data:

1. Certified Live Seed analyses not more than 6 months old by a recognized laboratory of seed testing for grass mixtures including percent of live seed (PLS), germination, all crop seeds in excess of 1 percent, inerts and weeds
2. Manufactures guaranteed chemical analysis, name, trade name, trademark and conformance to state and local laws of all fertilizers and herbicides

1.5 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging

B. Provide a certificate of the PLS test of the grass seed intended for the project, certifying that the seed furnished is from a lot that has been tested by a recognized laboratory within the last 6 months

C. All brands furnished shall be free from such noxious seeds as Russian or Canadian Thistle, Coarse Fescue, European Birdweed, Johnson Grass, Leafy Spurge, field bindweed, kochia, or any state-listed or City listed noxious weed species

D. Any materials that have become wet, moldy or otherwise damaged in transit or in storage will not be used

1.6 QUALIFICATIONS

A. Applicator: Company specializing in performing work of this section with landscaping license from State of Colorado
   1. Experienced with type, elevation, topography and scale of work specified
   2. Adequate equipment and personnel to perform work

1.7 REGULATORY REQUIREMENTS

A. Comply with codes and ordinances of local regulatory agencies for fertilizer and herbicide composition and regulations.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of seed mixture

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division One specifications

B. All materials and products will remain in original manufacturers shipping bags or containers until they are used. All material or products will be stored in a manner to prevent them from coming into contact with water or other contaminating substance and in a manner that product effectiveness will not be impaired

C. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable

D. Commercial fertilizer or commercial herbicide: mixed in original bags or containers of the manufacturer, showing weight, chemical analysis and manufacturer name. Store in such a manner such that product effectiveness will not be impaired

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not prepare or seed frozen soils

B. Perform seeding and planting only after preceding work establishing final ground surface is completed

C. Conduct minimum of two (2) soil tests to confirm fertilizer type and application rates

1.10 MAINTENANCE SERVICE

A. Maintain seeded areas immediately after placement until grass is well established and exhibits vigorous growing condition

1.11 WARRANTY

A. All plant material and work accomplished under this section shall be guaranteed to provide a uniform stand of grass acceptable to the Owner at the end of a one (1) year time period from the completion of the Seeding and Erosion Control work

PART 2 PRODUCTS

2.1 SEED

A. In conformance with State and Federal regulations and subject to the testing provisions of the Associate of Official Seed Analysts (AOSA)

B. Seed Suppliers: Licensed Seed Dealer with Colorado Department of Agriculture

C. Provide the latest crop available in accordance with Colorado Department of Agriculture Seed Laws, Chapter 35, Article 27

D. Compensate for percentage of purity and germination by furnishing sufficient additional seed to equal the specified pure live seed product. The formula for determining the quantity of pure live seed (PLS) is as follows:

Pounds of Seed (Bulk) x Purity x Germination = Pounds of Pure Live Seed (PLS)

2.2 SEED MIX

A. Permanent seed mixes per tables below:

1. Permanent Upland Area Seed Mix (UDFCD Table A-1. Recommended for loamy to clay soils)

Common Name	Scientific Name	Growth Season	Growth Form	% Mix	Lbs/Ac (PLS[1])
Grasses					
Blue grama	*Bouteloua gracilis*	Warm	Sod	25	1.8
Sand dropseed	*Sporobolus cryptandrus*	Warm	Bunch	20	0.2
Sideoats grama	*Bouteloua curtipendula*	Warm	Sod	20	6.3
Western wheatgrass	*Pascopyrum smithii*	Cool	Sod	15	8.2
Buffalograss	*Bouteloua dactyloides*	Warm	Sod	10	10.7
Inland saltgrass	*Distichlis spicata*	Warm	Sod	5	0.6
Herbaceous/Wildflowers					
Pasture sage	*Artemisia frigida*			1	0.01
Blanket flower	*Gaillardia aristata*			1	0.5
Prairie coneflower	*Ratibida columnifera*			1	0.1
Purple prairieclover	*Dalea (Petalostemum) purpurea*			1	0.3
Blue flax	*Linum lewisii*			1	0.4
TOTAL PLS POUNDS/ACRE				**100**	**29.11**

[1]PLS = Pure Live Seed – If broadcast seeding, double the rate

2. Permanent Upland Area Seed Mix (UDFCD Table A-2. recommended for sandy soil)

Common Name	Scientific Name	Growth Season	Growth Form	% Mix	Lbs/Ac (PLS[1])
Grasses					
Switchgrass	*Panicum virgatum*	Warm	Sod/Bunch	15	2.3
Prairie sandreed	*Calamovilfa longifolia*	Warm	Sod	10	2.2
Sideoats grama	*Bouteloua curtipendula*	Warm	Sod	10	3.1
Blue grama	*Bouteloua gracilis*	Warm	Sod	10	0.7
Indian ricegrass	*Oryzopsis hymenoides*	Cool	Bunch	10	4.3
Western wheatgrass	*Pascopyrum smithii*	Cool	Sod	10	5.5
Little bluestem	*Schizachyrium scoparium*	Warm	Bunch	10	2.3
Sand dropseed	*Sporobolus cryptandrus*	Warm	Bunch	10	0.1
Green needlegrass	*Stipa viridula*	Cool	Bunch	10	3.3
Herbaceous/Wildflowers					
Pasture sage	*Artemisia frigida*			1	0.1
Blanket flower	*Gaillardia aristata*			2	0.9
Tansy aster	*Maceranthera tanacetifolia*			2	0.2
TOTAL PLS POUNDS/ACRE				**100**	**25**

[1]PLS = Pure Live Seed – If broadcast seeding, double the rate

3. Permanent Upland/Transitional Seed Mix (UDFCD in Table A-3 recommended for alkali soil)

Common Name	Scientific Name	Growth Season	Growth Form	% Mix	Lbs/Ac (PLS[1])
Blue grama	*Bouteloua gracilis*	Warm	Sod	20	1.5
Sideoats grama	*Bouteloua curtipendula*	Warm	Sod	15	4.7
Slender wheatgrass	*Elymus trachycaulus*	Cool	Bunch	15	5.7
Alkali sacaton	*Sporobolus airoides*	Warm	Sod/Bunch	15	0.5
Inland saltgrass	*Distichlis spicata*	Warm	Sod	15	1.7
Western wheatgrass	*Pascopyrum smithii*	Cool	Sod	10	5.5
Sand dropseed	*Sporobolus cryptandrus*	Warm	Bunch	10	0.1
TOTAL PLS POUNDS/ACRE				**100**	**19.7**

[1]PLS = Pure Live Seed – If broadcast seeding, double the rate

4. Permanent Riparian Native Seed Mixes (UDFCD Table A-4. Recommended for loamy to clay soils and for middle to upper terraces and slopes above the 5-year flood elevations.)

Common Name	Scientific Name	Growth Season	Growth Form	% Mix	Lbs/Ac (PLS[1])
Grasses					
Blue grama	*Bouteloua gracilis*	Warm	Sod	20	1.5
Sand dropseed	*Sporobolus cryptandrus*	Warm	Bunch	20	0.2
Switchgrass	*Panicum virgatum*	Warm	Sod/Bunch	20	3.2
Sideoats grama	*Bouteloua curtipendula*	Warm	Sod	15	4.7
Western wheatgrass	*Pascopyrum smithii*	Cool	Sod	10	5.5
Green needlegrass	*Nasella viridula*	Cool	Bunch	10	3.3
Wildflowers					
Smooth aster	*Aster laevis*			1	0.1
Louisiana sage	*Artemisia ludovisciana*			1	0.1
Showy goldeneye	*Heliomeris multiflora (aka*			1	0.1
Blanket flower	*Gaillardia aristata*			1	0.5
Prairie coneflower	*Ratibida columnifera*			1	0.1
TOTAL POUNDS PLS/ACRE				**100**	**19.3**

[1]PLS = Pure Live Seed – If broadcast seeding, double the rate

5. Permanent Riparian Area Seed Mix (UDFCD Table A-5. Recommended for sandy soil and for middle to upper terraces and slopes above 5-year flood elevations.)

Common Name	Scientific Name	Growth Season	Growth Form	% Mix	Lb/ac (PLS[1])
Grasses					
Sand dropseed	*Sporobolus*	Warm	Bunch	20	0.2
Switchgrass	*Panicum virgatum*	Warm	Sod/Bunch	20	3.1
Blue grama	*Bouteloua gracilis*	Warm	Sod	15	1.1
Canada wildrye	*Elymus canadensis*	Cool	Bunch	10	5.2
Sand bluestem	*Andropogon hallii*	Warm	Bunch	10	5.3
Western wheatgrass	*Pascopyrum smithii*	Cool	Sod	10	5.5
Yellow Indiangrass	*Sorghastrum nutans*	Warm	Sod	10	3.5
Wildflowers					
Blanket flower	*Gaillardia aristata*			1	0.5
Rocky Mountain	*Penstemon strictus*			1	0.1
Purple prairie clover	*Dalea purpurea*			1	0.3
Mexican hat	*Ratibida columnifera*			1	0.1
Western yarrow	*Achillea millefolium*			1	0.02
TOTAL PLS POUNDS/ACRE				**100**	**24.92**

[1]PLS = Pure Live Seed – If broadcast seeding, double the rate

6. Permanent Riparian Area Seed Mix (UDFCD Table A-6 recommended for alkali soil and for middle to upper terraces and slopes above the 5-year flood elevations.)

Common Name	Scientific Name	Growth Season	Growth Form	% Mix	Lbs/Ac (PLS[1])
Alkali sacaton	*Sporobolus airoides*	Warm	Bunch	25	0.9
Blue grama	*Bouteloua gracilis*	Warm	Sod	25	1.8
Inland saltgrass	*Distichlis spicata*	Warm	Sod	25	2.9
Streambank wheatgrass	*Elymus lanceolatus*	Cool	Sod	10	3.9
Western wheatgrass	*Pascopyrum smithii*	Cool	Sod	10	5.5
Buffalograss	*Bouteloua dactyloides*	Warm	Sod	5	5.4
TOTAL PLS POUNDS/ACRE				**100**	**20.4**

[1]PLS = Pure Live Seed – If broadcast seeding, double the rate

7. Riparian/Creek Edge Seed Mix (UDFCD Table A-7 recommended for moist to wet soils and for riparian streambank/low terraces below the 5-year flood elevation.)

Common Name	Scientific Name	Growth Season	Growth Form	% Mix	Lbs/Ac (PLS[1])
Grasses					
Inland saltgrass	*Distichlis stricta*	Cool	Sod	15	1.7
Creeping spikerush	*Eleocharis palustris*	Cool	Sod	15	1.5
Baltic rush	*Juncus balticus*	Cool	Sod	15	0.1
Switchgrass	*Panicum virgatum*	Warm	Sod	12	1.9
Western wheatgrass	*Pascopyrum smithii*	Cool	Sod	8	4.4
Green needlegrass	*Nasella viridula*	Cool	Bunch	10	3.3
Prairie cordgrass	*Spartina pectinata*	Warm	Sod	10	3.1
Wooly sedge	*Carex lanuginosa*	Cool	Sod	5	1.0
Nebraska sedge	*Carex nebrascensis*	Cool	Sod	5	0.6
Wildflowers					
Wild Bergamot	*Monarda fistulosa*			1	0.1
Yarrow	*Achillea millefolium*			1	0.02
Blue vervain	*Verbena hastata*			2	0.1
Nuttall's sunflower	*Helianthus nuttallii*			1	0.2
TOTAL PLS POUNDS/ACRE					**18.02**

[1]PLS = Pure Live Seed – If broadcast seeding, double the rate

8. Permanent Wetland Native Seed Mix (UDFCD Table A-8. Recommended for loamy to sandy soils and for detention ponds and less eroding wetland areas.)

Common Name	Scientific Name	Growth Season	Growth Form	% Mix	Wetland Indicator*	Lbs/Ac (PLS[1])
Grasses and Herbaceous Species						
American Sloughgrass	*Beckmannia syzigachne*	Cool	Sod	15	OBL	0.8
Prairie cordgrass	*Spartina pectinata*	Warm	Sod	15	FACW	4.6
Switchgrass	*Panicum virgatum*	Warm	Sod/Bunch	15	FAC	2.3
Western wheatgrass	*Pascopyrum smithii*	Cool	Sod	10	FACU	5.5
Fowl mannagrass	*Glyceria striata*	Cool	Sod	10	OBL	3.3
Hardstem bulrush	*Scirpus acutus*			10	OBL	1.6
Baltic rush	*Juncus balticus*			10	OBL	0.1
Creeping spikerush	*Eleocharis palustris*			10	OBL	1.0
Wildflowers						
Blue vervain	*Verbena hastata*			2.5	FACW	0.1
Nuttall's sunflower	*Helianthus nuttallii*			2.5	FAC	0.5
TOTAL PLS POUNDS/ACRE				**100**		**19.8**

[1]PLS = Pure Live Seed – If broadcast seeding, double the rate

9. Wetland Seed Mix (UDFCD Table A-9 recommended for clay and alkali soils and for detention ponds and wetland areas.)

Common Name	Scientific Name	Growth Season	Growth Form	% Mix	Wetland Indicator*	Lbs/Ac (PLS[1])
Grasses and Herbaceous Species						
Alkali sacaton	*Sporobolus airoides*	Warm	Bunch	10	FAC	0.4
Inland saltgrass	*Distichlis spicata*	Warm	Sod	10	FACW	1.2
Nuttall's alkaligrass	*Puccinellia nuttalliana*	Cool	Bunch	10	OBL	0.2
Prairie cordgrass	*Spartina pectinata*	Warm	Sod	10	FACW	3.0
Slender wheatgrass	*Elymus trachycaulus spp.*	Cool	Bunch	10	FACU	3.8
Western wheatgrass	*Pascopyrum smithii*	Cool	Sod	10	FACU	5.5
Fowl mannagrass	*Glyceria striata*	Cool	Sod	10	OBL	3.3
Hardstem bulrush	*Scirpus acutus*			10	OBL	1.6
Baltic rush	*Juncus balticus*			10	OBL	0.1
Creeping spikerush	*Eleocharis palustris*			10	OBL	1.0
TOTAL PLS POUNDS/ACRE						**20.1**

[1]PLS = Pure Live Seed – If broadcast seeding, double the rate

B. Temporary native seed mixes per tables below:

1. Upland Area Temporary Seed Mix [UDFCD Table A-10 recommended for loamy to clay soils]

Common Name	Scientific Name	Growth Season	Growth Form	% Mix	Lbs/Ac (PLS[1])
Slender wheatgrass	*Elymus trachycaulus spp.*	Cool	Bunch	20	5
Green needlegrass	*Nasella viridula*	Cool	Bunch	20	4.4
Western wheatgrass	*Pascopyrum smithii*	Cool	Sod	20	7.3

Arizona fescue	*Festuca arizonica*	Cool	Bunch	20	1.5
Sideoats grama	*Bouteloua curtipendula*	Warm	Bunch/Sod	20	4.2
TOTAL PLS POUNDS/ACRE				**100**	**22.4**

[1]PLS = Pure Live Seed – If broadcast seeding, double the rate

2. Upland Area Temporary Seed Mix [UDFCD Table A-11 recommended for sandy soil

Common Name	Scientific Name	Growth Season	Growth Form	% Mix	Lbs/Ac (PLS[1])
Sand lovegrass	*Eragrostis trichodes*	Warm	Bunch	20	0.5
Sand bluestem	*Andropogon hallii*	Warm	Sod	20	7.1
Prairie sandreed	*Calamovilfa longifolia*	Warm	Sod	15	2.2
Sand dropseed	*Sporobolus cryptandrus*	Warm	Bunch	15	0.1
Needle and Thread	*Hesperostipa comata spp. comata*	Cool	Bunch	15	5.2
Red three-awn	*Aristida purpurea var. longiseta*	Warm	Bunch	15	2
TOTAL PLS POUNDS/ACRE				**100**	**17.1**

[1]PLS = Pure Live Seed – If broadcast seeding, double the rate

3. Upland Area Temporary Seed Mix [UDFCD Table A-12 recommended for combination of soil types]

Common Name	Scientific Name	Growth Season	Growth Form	% of Seed Mix	Lbs/Ac (PLS[1])
Slender wheatgrass	*Elymus trachycaulus spp.*	Cool	Bunch	25	6.3
Canada wildrye	*Elymus canadensis*	Cool	Bunch	15	5.2
Little bluestem	*Schizachyrium scoparium*	Warm	Bunch	15	2.3
Thickspike wheatgrass	*Elymus lanceolatus ssp. lanceolatus*	Cool	Sod	15	3.9
Sixweeks fescue	*Vulpia octoflora*	Cool	Annual/	15	0.6
Bottlebrush squirreltail	*Elymus elymoides*	Cool	Bunch	15	3.1
TOTAL PLS POUNDS/ACRE				**100**	**21.4**

[1]PLS = Pure Live Seed – If broadcast seeding, double the rate

4. Moist to West Area Temporary Seed Mix [UDFCD Table A-13 recommended for combination of soil types]

Common Name	Scientific Name	Growth Season	Growth Form	% of Seed Mix	Lbs/Ac (PLS[1])
Streambank wheatgrass	*Elymus lanceolatus ssp. psammophilus*	Cool	Sod	20	5.1
Slender wheatgrass	*Elymus trachycaulus spp.*	Cool	Bunch	15	3.8
Switchgrass	*Panicum virgatum*	Warm	Sod/Bunch	15	1.5
American	*Beckmannia syzigachne*	Cool	Sod	15	0.5
Bluejoint reedgrass	*Calamagrostis canadensis*	Cool	Sod	15	0.3
Fowl mannagrass	*Glyceria striata*	Cool	Sod	10	2.2
Inland saltgrass	*Distichlis spicata*	Warm	Sod	10	0.8
TOTAL PLS POUNDS/ACRE				**100**	**14.2**

[1]PLS = Pure Live Seed – If broadcast seeding, double the rate

2.3 SOIL MATERIALS

A. Select onsite topsoil: Earth material of loose friable clay loam reasonably free of admixtures of subsoil, refuse stumps, roots, rocks, brush, weeds or other material which can be detrimental to the proper development of site revegetation

2.4 ACCESSORIES

A. Soil Additives (Fertilizer)
   1. Dry fertilizers: Primary element composition by weight of 6-10-5
      a. Nitrogen (N) six (6%) percent of which fifty (50%) per-cent inorganic, phosphoric acid (P_2O_5) ten (10%) percent, and potash (K_2O) five (5%) percent
   2. Commercial fertilizer: Primary element composition by weight of 18-46-0
      a. Nitrogen, eighteen (18%) percent, of which fifty (50%) percent is organic, and phosphoric acid (P_20_5), forty-six (46%) percent
      b. These elements may be organic, inorganic, or a combination and shall be available according to the methods adopted by the Association of Official Chemists

3. Dry, pelletized or granular, uniform in composition and a free flowing product. Do not use material which has caked, segregated, exceeded the expiration date of application, or be otherwise damaged
4. Thoroughly mixed by the manufacturer. Clearly identify the contents of each container. Do not use materials and containers previously opened, exceeding the expiration date for application or otherwise damaged

B. Erosion Control Fabric: Straw and/or coconut fiber combination blanket for temporary protection of steeply sloped areas
1. Sloped areas 4:1 and steeper
2. SC150 by North American Green, or approved substitution
3. S2 by Bon Terra American, or approved substitution

C. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass

D. Mulching Material: Straw or onsite grasses from grubbing operation, dry, free from foreign matter detrimental to plant life

PART 3 EXECUTION

3.1 GENERAL

A. Seed all areas disturbed by construction, including all areas along the roadside ditches

B. Pattern for seeding and fertilization as required by field conditions. In no case shall revegetation occur within 30 days of the application of any chemical weed control substance

C. Engineer to review grading prior to seeding

3.2 SOIL PREPARATION

A. Uniformly place and spread topsoil removed during grubbing and stored on site. Provide minimum thickness of 4 inches to meet finished grade. Key topsoil to the underlying and surrounding material by the use of harrows, rollers or other equipment suitable for the purpose

B. Apply water to the topsoil for compaction purposes in a fine spray by nozzles in such a manner that it will not wash or erode the newly placed soil

C. Exercise care during soil preparation on all embankments so as not to disturb established ground cover. Areas disturbed during the soil preparation will be fertilized and seeded at the discretion of the Engineer in accordance with these documents

3.3 FERTILIZATION

A. Do not proceed with fertilization in adverse weather and unsuitable ground conditions. Examples of these respective conditions may be wind, precipitation, frozen and untillable ground or conditions detrimental to the effectiveness of the application

B. Apply fertilizer in a manner to assure uniform distribution, light watering is acceptable for dispersion

C. In cases where work progress is stopped due to the above conditions, fertilization will begin again, when appropriate conditions exist. The application will begin again with a reasonable overlapping of the previously applied area

3.4 SEEDING METHODS

A. All seeding shall be installed either by hydroseeding or drilling method. Small areas of restoration may be broadcast seeded if directed by Engineer.

B. Do not proceed with seeding in adverse weather and unsuitable ground conditions. Examples of these respective conditions may be wind, precipitation, frozen or untillable ground or conditions detrimental to the effectiveness of the application. All seeding shall be performed between either March 1st to May 30th of the calendar year of construction unless indicated otherwise by Engineer

C. Hydroseeding:
   1. Apply seeded slurry with hydraulic seed at a rate of //160 lbs// live seed per 1,000 square feet, evenly in two intersecting directions
   2. Do not hydroseed areas in excess of that which can be mulched on same day
   3. Immediately following seeding apply mulch to a thickness of 1/8 inch
   4. Apply water with a fine sprat immediately after each area has been mulched. Saturate to four (4) inches of soil

D. Drilling:
   1. Accomplish seeding by means of an approved power drawn drill, followed by drag chains. The grass drill should be equipped with a satisfactory feeding mechanism, agitation, and double disk furrow openers. Equip drills with depth bands set to maintain a planting depth of approximately 3 to 2 inch and shall be set to space rows not more than 7 inches apart
   2. If inspections indicate that strips wider than the specified space between the rows planted have been left or other areas skipped, the Engineer will require immediate resowing of seed in such areas at the Contractor's expense. The seeding mixture shown in the Materials Section applies at a pure live seed rate per acre
   3. Immediately following seeding apply straw mulch at a rate of one (1) ton per acre
   4. Apply water with a fine spray immediately after each area has been mulched. Saturate to four (4) inches of soil depth
   5. Provide additional watering weekly until revegitation seed has germinated

3.5 AREAS TO BE RESEEDED

A. Seed all disturbed areas that are damaged or disturbed by the Contractor's activities during the entire project scope

B. Additional areas as requested by the Owner and approved by the Engineer

3.6 MAINTENANCE

A. Fertilize the seeded areas once a uniform stand of grass has been established

B. Maintain seeded areas until there is an acceptable uniform plant growth. Reseed areas that are not producing a uniform plant growth within five (5) weeks following seeding. Acceptable uniform plant growth shall be defined as that time when the scattered bare spots, not greater than 1 square foot in area, do not exceed three percent (3%) of the seeded area

C. Maintenance period - 1 year

D. Areas that are seeded late in the fall planting season which are not producing acceptable uniform plant growth, as described above, shall be reseeded during the following spring planting season. If such a condition exists, and the Contractor has diligently, in the opinion of the Engineer, pursued the performance of his work, the Owner at his option, may extend the contract completion date and reduce contract retainage. Retainage may be reduced to less than five percent (5%) of the total contract amount, but shall be at least two (2) times the estimated cost of obtaining the required growth in the indicated areas, plus areas which are susceptible to damage by winter kill, washout or other causes

E. Contractor shall control perennial weeds, thistle, spotted and napweed, spurge and other weeds during the maintenance period

3.7 SEED PROTECTION AND SLOPE STABILIZATION

A. Cover seeded slopes with erosion control fabric where grade is 4 to 1 or greater and where indicated on the Drawings and/or Section 02300. Cover seed with mulch in all other areas

B. Lay fabric smoothly on surface, bury top end of each section in 6-inch deep excavated topsoil trench. Provide 6-inch overlap minimum of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil

C. Secure outside edges and overlaps at 48 inch intervals with 4-inch to 6-inch U-shaped type pins or wooden stakes depending on ground condition

D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil

E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches

F. Maintain integrity of erosion control fabric until seed germination. If seed is washed out before germination, fertilize, reseed and restore affected areas

END OF SECTION

SECTION 03604

CELLULAR GROUT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide grouting of the annular space between the carrier pipe and the casing pipe. The annular space (void between the carrier pipe and the casing pipe) shall be completely grouted to support the carrier pipe and provide long-term stability. The Contractor shall provide testing of materials and methods for compliance with the requirements which follow. All proposals shall be submitted to the Engineer.

1.2 REFERENCES

A. ASTM C109 – Test Method for Compressive Strength of Hydraulic Cement Mortar

B. ASTM C150 – Standard Specification for Portland Cement

C. ASTM C138/C138M – Standard Test Method for Density, Yield, and Air Content of Concrete

D. ASTM C157 – Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete

E. ASTM C403/C403M – Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance

F. ASTM C495 – Standard Specification for Compressive Strength of Lightweight Insulating Concrete

G. ASTM C495 – Compressive Strength of Lightweight Insulating Concrete

H. ASTM C 618 – Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete

I. ASTM C796 – Foaming Agents for Use in Producing Cellular Concrete Using Preformed Foam

J. ASTM C869/869M – Foaming Agents Used in making Preformed Foam for Cellular Concrete

K. CRD C 621 – Non-shrink Grout

1.3 SUBMITTALS

A. The Contractor shall submit the following to the Engineer at least 5 working days prior to the start of the grouting operation:

1. The proposed grouting mix
2. The proposed densities and viscosities
3. Initial set time of the grout
4. The proposed grouting method
5. The maximum injection pressures
6. The 24-hour and 28-day minimum compressive strength
7. Proposed grout volumes
8. Bulkhead designs
9. Flow control
10. Pressure gauge certification
11. Vent location plans

B. Product Data: Provide manufacturer's catalog sheet for material indicating test data and physical properties

1.4 QUALITY ASSURANCE

A. Conform to applicable industry standard, Corps of Engineers, Specification CRD-C 621 - Specification for non-shrink grout

B. Qualification of Installers
1. The Contractor shall provide references of previous projects demonstrating to the Engineer its capabilities of filling the annular space and performing work in conformance with the Plans and the Specifications.
2. Throughout the progress of installation of the work of this Section, provide at least one person who shall be thoroughly familiar with the specified requirements.
3. In actual installation of the work of this Section, use adequate numbers of skilled workmen to ensure installation in strict accordance with the approved design.

C. Quality Control
1. Prior to all work under this Section, make all necessary arrangements with the testing laboratory, as required by the Engineer.
2. Prepare design mixes for each type of flowable backfill or cellular concrete, using previously tested and approved materials. Submit unit weight test results and compressive strength test results developed at seven days from not less than three test cylinders cast for each design mix.
3. At the start of each grout placement, or as directed by the Engineer, the Contractor shall measure the wet unit weight of the mix in accordance with the requirements of ASTM C796. The samples for these tests shall be taken at the point of placement (or injection). The test shall be performed on the site of the Work during the placement operations to check the quality and consistency of the mix relative to the design mix as it is produced. The Contractor shall maintain the wet unit weight within five (5) pcf of the designed target wet unit weight.

PART 2 PRODUCTS

2.1 MATERIALS

A. Water
   1. Clean and free from deleterious substances

B. Cellular Grout
   1. The grout shall consist of portland cement, fly ash and a expanding/fluidifying grouting aid admixture

C. Compressive Strength
   1. The grout shall have a minimum penetration resistance of 100 psi in 24 hours when tested in accordance with ASTM C 403 and a minimum compressive strength of 300 psi in 28 days when tested in accordance with ASTM C 495 or C 109.

D. Performance Requirements
   1. The Contractor shall submit the proposed grout mixes, methods, plans, and criteria of the grouting operations. The grouting system shall have sufficient gauges, monitoring devices, and tests to determine the effectiveness of the grouting operation and to ensure compliance with the pipe specifications and design parameters.

E. Mix Designs
   1. The mix shall be developed to completely fill the annular space based on the following requirements:
      a. Size of the annular void
      b. Sufficient strength and durability to prevent movement of the carrier pipe
      c. Provide adequate retardation
      d. Provide less than 1 percent shrinkage by volume
   2. Recommended Cellular Grout Design Mix:

Component	Amount
Cement (Type I or Type II)	200 lb.
Fly Ash	100 lb.
Water	4-5 gallons
Expanding/Fluidifying Grouting Aid	1% by weight of cementitious material

2.2 MANUFACTURERS

A. Expanding/Fluidifying Admixture
   1. Sika Intraplast-N
   2. Or Engineer Accepted Substitution

PART 3 EXECUTION

3.1 PREPARATION

A. Clean Pipe

1. Clean the existing steel pipe by high-velocity jet method. All high-velocity cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a selection of two or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in the existing 20-inch steel outlet conduit.

3.2 GROUTING

A. Grouting Equipment
   1. The materials shall be mixed in equipment of sufficient size and capacity to provide the desired amount of grout material for each stage in a single operation. The equipment shall be capable of mixing the grout at densities required for the approved procedure and shall also be capable of changing density as dictated by field conditions any time during the grouting operation.

B. Injection Procedure and Pressure
   1. The gauged pumping pressure shall not exceed the liner pipe manufacturer's approved recommendations. Pumping equipment shall be of a size sufficient to inject grout at a velocity and pressure relative to the size of the annular space. Gauges to monitor grout pressure shall be attached immediately adjacent to each injection port. The gauge shall conform to an accuracy of no more than one-half percent error over the full range of the gauge. The range of the gauge shall not be more than 100 percent greater than the design grout pressure. Pressure gauges shall be instrument oil filled and attached to a saddle-type diaphragm seal (gauge saver) to prevent clogging with grout. All gauges shall be certified and calibrated in a accordance with ANSI B40, Grade 2A.
   2. Pressure on the annular space shall be limited to prevent damage to the liner and shall not exceed 5 psi. Regardless of the pressure, the Contractor shall be solely responsible for any damage or distortion to the slipliner pipe due to grouting.
   3. The drilling of access holes from the surface to facilitate backfilling shall not be allowed.
   4. No hardened grout shall be permitted in the slipliner pipe after completion of grouting operations.

C. Venting
   1. Standing or running water in the annular space shall be removed or controlled to maintain the correct water ratio of the grout mixture. The annular space shall be grouted by injecting grout from one end of the pipeline segment, allowing it to flow toward the other end. The annular space shall be vented to assure uniform filling of the void space.

D. Bulkheads
   1. Bulkheads shall be placed at the ends of each pipeline segment to seal the annular space. Bulkheads shall not be removed until after the grout has set.

3.3 TESTING

A. Onsite Test Equipment

1. Density shall be verified by ASTM C 138 or by other methods as approved by the Engineer at a minimum of twice per hour. Viscosities shall be checked with a flowcone provided by the Contractor and tested per ASTM C 939.

B. Sampling
   1. Take four test specimens for each 100 cubic yards of grout or for each four hours of placing.
   2. Test in accordance with ASTM C 495 except:
      a. The specimens shall be 3 inch by 6 inch cylinders covered after casting to prevent damage and loss of moisture. Moist cure specimens for a period up to 7 days prior to a 28-day compressive strength test.
      b. Do not oven dry specimens that are load tested. Specimens may be tested at any age to monitor compressive strength. The material may require special handling and testing techniques.

C. Test Section
   1. The Contractor may be required to perform an above ground test on each type of grout and grout system proposed to be used. The test Section to be grouted and the size of the annular space considered for each type of grout system shall be determined by the Contractor and approved by the Owner and Engineer.

END OF SECTION

SECTION 03610

NON SHRINK GROUT

PART 1 GENERAL

1.1 SUMMARY

A. Cement based grout for setting equipment base plates.

1.2 RFERENCES

A. ASTM: American Society for Testing and Materials

1.3 SUBMITTALS

A. Product Data:
   1. Manufacturer’s literature.

B. Submit in accordance with Section 01330.

PART 2 PART 2 – PRODUCTS

2.1 MATERIALS

A. Manufacturers:
   1. Five Star NBEC by Five Star Products, Inc.
   2. SET Grout by BASF.
   3. Duragrout by L&M Construction Chemicals, Inc.
   4. SikaGrout 212 by Sika Corp.

PART 3 PART 3 – EXECUTION

3.1 PREPARATION

A. Clean grout contact surfaces of oil, grease, scale, and other foreign matter.

B. Chip away unsound concrete leaving surface rough but level.

C. Clean base plates, rails, anchors, bolts, etc. in contact with grout of oil, grease, dirt, and coatings.

3.2 MIXING AND PLACING

A. Mix and place in accordance with manufacturer’s written instructions.

B. Provide forming materials where necessary to retain grout until hardened.

C. Work grout from one side. Avoid trapping air under base plate.

D. Do not load grout until it has reached a minimum of 3000 pounds per square inch compressive strength.

3.3 CURING

A. Cure as recommended by grout manufacturer.

END OF SECTION