JEO CONSULTING GROUP INC
JEO ARCHITECTURE INC

PLANS, SPECIFICATIONS AND CONTRACT DOCUMENTS
FOR
2022 CAMPGROUND IMPROVEMENTS
DAVID CITY, NEBRASKA

Engineering
Architecture
Surveying
Planning
Funding

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FOR
2022 CAMPGROUND IMPROVEMENTS
FOR
DAVID CITY, NEBRASKA

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PLANS AVAILABLE **jeo.com/bidding**

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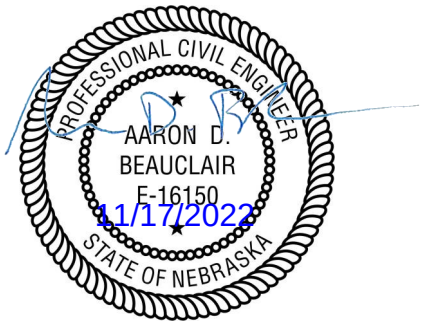
JEO PROJECT NO. 220784.00



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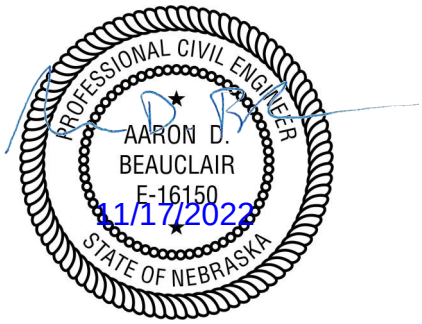

The following Specification Sections have been prepared by myself or under my direct supervision:

Section No.	Title
Division 01 – All Sections Included	General Requirements
Division 03 – All Sections Included	Concrete
Division 09 – All Sections Included	High-Performance Coatings – Water and Wastewater Environments
Division 31 – All Sections Included	Earthwork
Division 32 – All Sections Included	Exterior Improvements
Division 33 – All Sections Included	Utilities

2022 CAMPGROUND IMPROVEMENTS
FOR
DAVID CITY, NEBRASKA
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The following Specification Sections have been prepared by myself or under my direct supervision:

Section No.	Title
Division 26 – All Sections Included	Electrical

SECTION 01 10 00

SPECIAL PROVISIONS

PART 1 - GENERAL

These Special Provisions amend or supplement the following Specifications and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

The terms used in these Special Provisions will have the meanings indicated in the Specifications and Contract Documents. Additional terms used in these Special Provisions have the meanings indicated below, which are applicable to both the singular and plural thereof.

1.01 PROJECT CONTACT

A. Owner's Primary Contact:

1. Name: Tami Comte
2. Address: 490 "E" Street, David City, NE 68632
3. Phone Number: 402.367.3135
4. Email: tcomte@davidcityne.com

B. Engineer's Primary Contact:

1. Name: Dave Henke
2. Address: 1937 N Chestnut St, Wahoo, NE 68066
3. Phone Number: 402.443.7464
4. Cell Number: 402.443.8005
5. Email: dhenke@jeo.com

C. Engineer's Secondary Contact:

1. Name: Aaron Beauclair
2. Address: 2000 Q St Ste 500, Lincoln, NE 68503
3. Phone Number: 402.474.8744
4. Cell Number: 402.413.9813
5. Email: abeauclair@jeo.com

1.02 CONTRACT DESCRIPTION

A. Coordinated by Owner:

1. All Contract Documents shall be prepared and provided by the Owner. Contractor shall pay special attention to the general conditions, special conditions, insurance, bonding, and administrative requirements within those documents.
2. Materials: Any Material Supply Contracts shall be for the furnishing and delivering of materials to a site to be selected by Owner. Contract Documents shall be as provided by the Owner to Material Supplier(s).
3. Construction: Construction shall be coordinated by Owner. Contract Documents shall be as provided by the OWNER to any contractors as necessary. Construction may also be performed directly by the Owner at their discretion.

4. Any references to 'Contractor' or Material Supplier for administrative procedures, not affecting construction methods or quality, are applicable as noted in the Contract Documents supplied by the Owner.

1.03 CONTRACT DRAWINGS AND SPECIFICATIONS

A. The Drawings, Specifications, Proposal, Special Provisions, and all supplementary documents are intended to describe the complete work and are essential parts of the Contract. All requirements occurring in any of them are binding.

B. In cases where there is a discrepancy in the contract documents.

1. Written dimensions take precedence over scaled dimensions on Drawings.
2. Larger scale Drawings take precedence over smaller scale Drawings.
3. Section 01 10 00 – Special Provisions, take precedence over the Drawings.
4. Section 01 10 00 – Special Provisions, take precedence over other Specification Sections.

C. Referenced Sections:

1. Any Specification Section that is referenced by another Specification Section and is not included in the project specifications (see table of contents for complete listing) shall not apply to this project.

D. At least one copy of all Drawings and Specifications shall be maintained by Contractor at the project site and these shall be accessible at all times to Owner and Engineer.

1.04 PERMITS

A. NDEE: A permit is being processed by the Nebraska Department of Environment and Energy (NDEE). A copy of the permit will be presented to the successful bidder, when the approval has been issued. Contractor shall construct the proposed improvements in strict compliance to the instructions and provisions of the permit.

B. NPDES: Due to the nature and area of this construction project, Owner is required to request discharge authorization for the stormwater discharge from the construction site under the General NPDES Permit Number NER210000. Owner has filed a NOI. A Stormwater Pollution Prevention Plan (SWPPP) for this project has been developed. It will be the responsibility of Contractor and all sub-Contractors to maintain the site according to the permit requirements and the SWPPP. A copy of the SWPPP is available from Engineer upon request.

1. During construction, Contractor will be responsible for inspecting the erosion control measures and record keeping per the requirements of the NPDES Permit duration of the project.
2. Contractor shall post the Storm Water Pollution Prevention Plan (SWPPP) in a conspicuous place on the project site. This posting shall be available for public viewing during normal business hours and shall have the contact numbers for Contractor.
3. Contractor shall be responsible for maintaining and controlling all erosion control devices throughout the duration of the project, in strict compliance with the conditions of the permit.
4. Contractor shall conduct weekly reviews of the erosion control measures and make any repairs or adjustments necessary to satisfy the requirements of the permit.

5. Contractor shall complete the required Storm Event Monitoring Reports after each rainfall event during the construction project.

6. Copies of all reports, daily reports and forms recorded by Contractor shall be maintained on the site. A copy of these documents shall be provided to Owner on a monthly basis, along with monthly Partial Pay Request. Pay requests will not be processed by Owner without copies of these documents.

7. Contractor shall be responsible for removal and disposal of all temporary erosion control measures from the site after final stabilization measures are in place and satisfactory vegetation has been established.

1.05 CODE COMPLIANCE

A. All proposed work shall comply with the National Plumbing Code, National Electrical Code, International Building Code and all applicable state and local codes.

1.06 SPECIAL FUNDING

A. There is no special funding for this project.

1.07 INCIDENTAL AND SUBSIDIARY ITEMS OF WORK

A. Any items or materials called for on the Drawings or in these Specifications that are not measured and paid for directly shall be considered incidental and subsidiary to other items of work for which direct payment is made.

1.08 PROJECT CONDITIONS

A. Existing Utilities:

1. There are utilities in the vicinity of the proposed work.

2. Contractor shall notify the respective utility company(s) and/or “one-call notification center” before commencing work.

3. Neither Owner nor Engineer assumes any responsibility for utility locations being accurately shown, or not shown on the Drawings.

4. Any reference to utilities in the Drawings is approximate. Contractor shall verify the location of any existing utilities within the vicinity of the proposed work.

5. Contractor shall provide notification of intent to begin construction in advance to allow utility company(s) sufficient time to locate or relocate their utilities.

6. Once the location of the utility(s) has been staked, located or marked, it shall be Contractor’s responsibility to protect these stakes/markings. Any costs for restaking or remarking shall be Contractor’s expense.

7. Contractor shall avoid damaging any utility(s). Any such damage caused by Contractor, Contractor’s employees, subcontractors, suppliers or agents will be the responsibility of Contractor to repair at Contractor's expense. No additional compensation will be allowed for protecting utility(s) or for repair of any damage caused by Contractor, Contractor’s employees, subcontractors, suppliers or agents.

8. Contractor shall coordinate utility relocation or reconstruction with the appropriate utility company.

B. Maintain Continuous Water Service:

1. Whenever possible, Contractor shall schedule and conduct all work in a sequence, which will provide continuous operation of the water system. Contractor's schedule of planned operations shall outline compliance with this requirement.
2. When it is necessary to temporarily interrupt water service to any user:
    a. Contractor shall limit shutdown to 4 hours maximum time.
    b. Contractor shall make arrangement with Owner at least 48 hours in advance of any shutdown.
    c. Contractor shall get approval of any shutdown from Owner at least 48 hours in advance of the shutdown.
    d. Contractor shall give notification to any effected user at least 48 hours in advance of the shutdown. Such notification shall be closely coordinated with Owner.

C. Maintain Continuous Sanitary Sewer Service:
1. Whenever possible, Contractor shall schedule and conduct all work in a sequence, which will provide continuous operation of the sanitary sewer system. Contractor's schedule of planned operations shall outline compliance with this requirement.
2. When it is necessary to temporarily interrupt sewer service to any user:
    a. Contractor shall limit shutdown to 4 hours maximum time.
    b. Contractor shall make arrangement with Owner at least 48 hours in advance of any shutdown.
    c. Contractor shall get approval of any shutdown from Owner at least 48 hours in advance of the shutdown.
    d. Contractor shall give notification to any effected user at least 48 hours in advance of the shutdown. Such notification shall be closely coordinated with Owner.
3. Contractor shall provide any temporary pumping of sewer flows necessary to provide continuous service to the users. Discharging of untreated wastewater during the construction will not be allowed. Contractor's schedule of planned operations shall outline compliance with this requirement.

1.09 RECORD DRAWINGS

A. Contractor shall provide digital PDF copies of the record drawings/as-builts clearly marking the field adjustments, additions/deletions to the Drawings, and locations of all buried piping/infrastructure and critical elevations of same.

1.10 RIGHT-OF-WAY/EASEMENTS

A. The project shall be constructed within limited easements, right-of-way and property owned by Owner, as shown on the Drawings.

B. Contractor shall confine all operations to areas within the limited easements, right-of-way and property owned by Owner, as shown on the Drawings.

C. Areas outside of the limited easements, right-of-way and existing property owned by Owner, as shown on the Drawings, are not to be disturbed.

D. Contractor shall exercise all reasonable care in any activities that are conducted in the areas of right of way and easement, to minimize damages to the property. Contractor's

attention is specifically called to any buildings, trees, fences, drainage structures and other miscellaneous appurtenances to the property.

E. Contractor shall be solely and completely responsible for any damages caused by Contractor, Contractor's employees, sub-Contractors, suppliers or agents to any areas outside of the limited easements, right-of-way and existing property owned by Owner, as shown on the Drawings.

F. Contractor shall be solely responsible for obtaining and shall pay all costs in connection with any additional work area, storage site, access to the site, or temporary right-of-way, which may be required for proper completion of the work.

G. Staging Area: Contractor is responsible for obtaining a site for storage of materials and equipment.

1.11 OPERATION AND MAINTENANCE MANUALS

A. Contractor shall furnish digital PDF copies of complete manufacturer's operation, maintenance and parts data for all equipment to be installed in the project. All equipment that may require spare parts shall be documented and data furnished as to source of spare parts. The following material shall be submitted:

1. Manufacturer's Operation & Maintenance Manual.
2. Manufacturer's Parts Manual and Specifications.
3. Manufacturer's Service and Repair Manual.
4. Repair Parts Source.
5. Detailed Drawings of Equipment.
6. Detailed Electrical Schematic Drawings, if applicable.

1.12 SITE ADMINISTRATION

A. Contractor shall be responsible for all areas of the site used by him and by all Sub-Contractors in the performance of the work. He will exert full control over the actions of all employees and other persons with respect to the use and preservation of the property and existing facilities, except such controls as may be specifically reserved to Owner or others. Contractor has the right to exclude from the site all persons who have no purpose related to the work or its inspection, and may require all persons on the site (except Owner's employees) to observe the same regulations as he requires of his employees.

B. Contractor may use the area within the limited easements, right-of-way and property owned by Owner, as shown on the Drawings, for storage and staging, but must not interfere with normal operations of Owner, without prior written approval from Owner.

1.13 POWER

A. All power for lighting, construction use, operation of Contractor's plant or equipment, or for any other use by Contractor, shall be provided by Contractor at his sole cost and expense and shall be considered incidental and subsidiary to other items of work for which direct payment is made. No separate payments will be made for this work.

1.14 TEMPORARY FACILITIES

A. Temporary facilities shall be considered incidental and subsidiary to other items of work for which direct payment is made. No separate payments will be made for this work.

1.15 HISTORICAL AND ARCHAEOLOGICAL

A. If, during the course of construction, evidence of deposits of historical or archaeological interest is found, Contractor shall cease operations affecting the find and shall notify Owner. No further disturbance of the deposits shall ensue until Contractor has been notified by Owner that Contractor may proceed. Compensation to Contractor, if any, for lost time or changes in construction resulting from the find shall be determined in accordance with changed or extra work provisions of the Contract Documents.

1.16 DEWATERING OF SITE

A. Work to be performed may require pumping and dewatering to complete the work as specified and as indicated on the Drawings. It is the intent of the specifications that such pumping and dewatering operation shall be the obligation of Contractor.

B. Pumping and dewatering shall be considered incidental and subsidiary to other items of work for which direct payment is made. No separate payments will be made for this work.

C. Contractor will be responsible for design, construction, electrical service and materials, operation, maintenance and permitting of any dewatering system necessary for the successful construction and completion of the project.

D. Contractor shall conduct such investigation as is necessary to satisfy themselves of the groundwater conditions that will be encountered during the construction of the Work.

1.17 SUBSTANTIAL COMPLETION

A. Substantial Completion so that the Work can be utilized requires the following components to be complete, operational and tested:

1. Earthwork, Excluding Final Fine Grading
2. Above Grade and Below Grade Piping and Valves
3. Manholes
4. Aggregate Surfacing
5. Concrete Paving
6. Electrical Work
7. Control System Installation and Alterations
8. Connection to Existing Water Main
9. Connection to Existing Sanitary Manhole
10. Tracer Wire Testing

PART 2 - PRODUCTS

2.01 CONCRETE

A. Compressive Strength When Tested in Accordance with ASTM C39 at 28 Days: Minimum 3,500 psi.

1. Type 47B Traditional Mix per NDOT Standard Specifications.
2. Concrete mix design shall have a minimum of 30% coarse aggregate.
3. Air content shall be 6.5% to 9%.

B. Fiber Reinforcement

1. Shall be added to concrete to reduce plastic shrinkage cracking
2. SINTA F19 by GCP Applied Technologies or equal

3. Addition Rate: 1.5 lbs/cy

2.02 SEEDING

A. Seed Mixture for Rural Areas: 100 lbs/acre (drill seeded) of the following composition:

	Percent of Mix
Tall Fescue	45.00
Perennial Ryegrass	40.00
Cover Crop	15.00

B. Cover Crop for Seed Mixture (to be selected by Contractor based on dates of seeding):

1. Oats:
   a. Seeding: 64 pounds/acre (drill seeded).
   b. Dates: January 1 to August 31.
   c. Minimum Purity: 80 percent.
2. Winter Wheat:
   a. Seeding: 60 pounds/acre (drill seeded).
   b. Dates: September 1 to December 31.
   c. Minimum Purity: 80 percent.
3. Annual Ryegrass:
   a. Seeding: 50 pounds/acre (drill seeded).
   b. Dates: Any
   c. Minimum Purity: 80 percent

2.03 EARTHEN SOILS

A. Borrow/Fill: Contractor shall be responsible for providing the borrow/fill materials on this project

B. The Contractor shall provide earthwork and grading as necessary to meet the site elevations shown on the Drawings. If necessary, the Contractor shall retrieve additional soils from an offsite location of their choosing.

1. Fill material shall be a clean, inorganic silt or lean clay with a liquid limit less than 45 and a plasticity index less than 20. Fill material shall not contain an appreciable amount of roots, rock, or debris, and should not contain any foreign material with a dimension greater than 3 inch.

C. All earthwork and/or off-site borrow material shall be paid for under the lump sum bid price for earthwork and will not be measured separately.

2.04 RIPRAP

A. The riprap shall be sandstone, limestone, quartzite, concrete or other hard stone.

B. The riprap shall be clean and free from earth, clay or refuse.

C. The riprap shall have a density of at least 140 pounds per cubic foot.

D. Each load of riprap shall be reasonably well graded from the largest to the smallest size specified.

E. Control of gradation shall be by visual inspection to verify that the riprap conforms to the required gradation.

F. Riprap shall be angular in shape to permit interlocking between the various riprap pieces.

G. Least dimension of a piece of riprap shall not be less than 1/3 the greatest dimension of the piece.

H. Riprap shall meet NDOT Type A gradations.

2.05 AGGREGATE SURFACING

A. Crushed Rock Surfacing:

1. Crushed rock for surfacing shall consist of clean, hard particles of crushed limestone, quartzite, or dolomite.
2. The crushed rock aggregates for surfacing shall have a Los Angeles Abrasion loss percentage of not more than 45.
3. Crushed rock for surfacing shall have a percent loss of not more than 30 at the end of 16 cycles of the freezing and thawing test.
4. Roadway surface course material shall meet the following gradation limits:

Sieve Size	Percentage Passing
1 inch (25.0 mm)	100
No. 4 (4.75 mm)	20-60
No. 10 (2.00 mm)	0-30
No. 200 (75 µm)	0-5

B. Crushed Rock Roadway Foundation:

1. Material shall be 3” nominal maximum size screened over ¾” screen

2.06 GEOSYNTHETICS

A. Roadway Geotextile:

1. Mirafi HP270 Woven Geotextile or equal
2. Install per manufacturer’s recommendations
   a. Install in direction of travel along roadway
   b. Overlap sides and ends minimum 12”
   c. Follow all other manufacturer’s recommendations

2.07 SANITARY SEWER

A. Ductile Iron Pipe (DIP):

1. Above grade piping: Pressure Class 350 with flanged joints. Pipe must meet all requirements of AWWA C151 and flanged joints must meet all requirements of AWWA C110. All exterior exposed piping shall be insulated as shown on the Drawings and detailed in these specifications.
2. Below grade or buried piping: Pressure Class 350 (3” to 12” diameter) or Pressure Class 250 (14” to 48” diameter) with mechanical joints or push joints as noted on Drawings. Pipe must meet all requirements of AWWA C151 and joints must meet all requirements of AWWA C111. All buried pipe shall be polywrapped.

B. Ductile Iron Fittings:

1. All fittings shall be Tyler, Star, Sigma or approved equivalent and shall meet the requirements of AWWA C 153/111 or C 110/153 and shall be cement lined.
2. All fittings shall minimum pressure rating, 250 psi.
3. Flanged joint for all above grade fittings.

4. Mechanical joint for all buried fittings.
5. All buried fittings shall be polywrapped.

C. PVC Sewer Main:
1. SDR 35 PVC Pipe.

D. Sanitary Sewer Pipe Bedding:
1. Embedment material shall be placed to the top of the sewer main pipe with Class II – GW material as listed in ASTM D2321.
2. Class II – GW material shall be a well graded gravel or gravel-sand mixture with little fines. Gradation shall meet the following:

Size	Percentage Passing
1 ½"	100%
No. 4	<50%
No. 200	<5%

E. PVC Sewer Service:
1. SDR 26 PVC Pipe

F. Sanitary Sewer Manhole:
1. Precast base section shall be furnished and installed.
2. When building a manhole over an existing line, cast-in-place base section shall be furnished and installed.
3. Ring and Cover for both Manholes and Cleanouts shall be Deeter Model 1030 and Deeter Model 1805 respectively or equal.

G. Prepackaged Lift Station
1. Zoeller Shark EX840 packaged lift station with duplex controller
   a. Contact Chris Smith with Mack McClain and Associates (P: 402.938.0271)
2. Fiberglass basin to be 48" diameter and 16' deep
3. Three float system
   a. Off at 12" above lift station bottom
   b. Lead On at 20" above lift station bottom
   c. Lag On and Alarm at 22" above lift station bottom
4. See electrical drawings and specifications for phasing, voltage, and power requirements.
5. Aluminum hatch
6. Install per manufacturer's instructions and include all appurtenances necessary for a fully functioning and performing lift station
7. Duty point: 38 gpm @ 47 ft TDH

H. Forcemain
1. HDPE 4710 Pipe, DR 11, Copper Tube Size (CTS)

I. Manhole Epoxy Topcoat
1. Corrosion resistant, rapid curing epoxy resin that will cure at low temperatures and in the presence of water.

2. This material shall have the following minimum properties:
    a. Minimum Value Color Green or Light Blue
    b. Solids Content: 100%
    c. Solvent Content: 0%
    d. Compressive Strength: ASTM D695 13,500 psi
    e. Tensile Strength ASTM D638 7,500 psi
    f. Tensile Elongation: ASTM D638 1.5%
    g. Flexural Strength ASTM D790 11,500 psi
    h. Shore Hardness, Type D ASTM D2240 80
    i. Bond Strength ASTM D7234 > Tensile Strength of Concrete
    j. Primer Req'd: None – Self-Priming
3. Install per manufacturer's recommendations
    a. Minimum DFT of 100 mils
4. Acceptable Materials:
    a. Raven 405 Epoxy
    b. Neopoxy NPR-5303 Epoxy
    c. Approved Equal
5. To be applied only to Existing Manhole – 1.

2.08 WATER

A. Ductile Iron Fittings:
1. All fittings shall be Tyler, Star, Sigma or approved equivalent and shall meet the requirements of AWWA C 153/111 or C 110/153 and shall be cement lined.
2. All fittings shall have a minimum pressure rating of 250 psi.
3. Flanged joint for all above grade fittings.
4. Mechanical joint for all buried fittings.
5. All buried fittings shall be polywrapped.

B. PVC Water Main: AWWA C900 PVC Pipe, DR 18.

C. Pipe Bedding:
1. Pipe bedding shall be placed to the haunch of the pipe with Class II – GW material as listed in ASTM D2321.
2. Class II – GW material shall be a well graded gravel or gravel-sand mixture with little fines. Gradation shall meet the following:

Size	Percentage Passing
1 ½"	100%
No. 4	<50%
No. 200	<5%

D. Service Line:
1. HDPE 4710 Pipe, DR 7, Copper Tube Size (CTS)

E. Water Service Saddle: The service saddle shall be Ford FC202 with a stainless steel double bolt band.

F. Corporation Stop: The corporation stop shall be a Ford or Mueller taper thread inlet with a swivel eighth bend and a pack joint outlet suitable for service line material.

G. Curb Stop: The curb stop shall be a Ford or Mueller Minneapolis Pattern quarter-turn ball valve with pack joint nuts suitable for service line material.

H. Curb Stop Box: The curb stop box shall be Minneapolis Pattern with a plug style lid, with the word "water" cast on the lid. A 60 inch stationary rod will be included with the curb stop.

I. Connection Stiffeners: Insert stiffeners shall be installed in the PE pipe at all connections to fittings. The insert stiffeners shall be made of solid tubular stainless steel.

J. Gate Valves:

1. Approved Manufacturers:
    a. American Flow Control
    b. Mueller
    c. Or Equal
2. All gate valves by the same manufacturer.
3. The valve box shall be furnished with a valve box adaptor as manufactured by Adaptor, Inc. or equal.

K. Water Meter

1. 4" in line Tru/Flo Neptune Compound Meter or approved equal
2. Shall include Pro-read meter reading system or approved equal

L. Backflow Preventer

1. 4" Watts 709 Double Check Valve Assembly with Strainer or approved equal
2. Gate valves (MJ) shall be installed outside of water meter manhole. See Section 2.07.J.

2.09 STORM DRAINAGE

A. Reinforced Concrete Pipe (RCP): The RCP storm sewer pipe shall be Class III.

B. Storm Sewer Pipe Bedding:

1. Embedment material shall be placed to the top or springline of the storm sewer main pipe as shown on the plans with Class II – GW material as listed in ASTM D2321.
2. Class II – GW material shall be a well graded gravel or gravel-sand mixture with little fines. Gradation shall meet the following:
3.

Size	Percentage Passing
1 ½"	100%
No. 4	<50%
No. 200	<5%

C. Castings:

1. Grate Inlet – See plans
2. Storm Sewer Manhole – Deeter 2000

2.10 THERMAL INSULATION FOAM BOARD

A. Extruded Polystyrene Board Insulation: ASTM C578 Type IV; Extruded polystyrene board with either natural skin or cut cell surfaces; with the following characteristics:

B. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.

C. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.

D. Board Edges: Square.

E. Thermal Conductivity (k factor) at 25 degrees F: 0.18.

F. Compressive Resistance: 25 psi.

G. Board Density: 1.6 lb/cu ft.

H. Water Absorption, maximum: 0.3 percent, volume.

I. Manufacturers:

1. Dow Chemical Co: www.dow.com.
2. Owens Corning Corp: www.owenscorning.com.

PART 3 - EXECUTION

3.01 ACCESS REQUIREMENTS

A. Notices: Contractor shall provide notice to property owners and authorities:

1. Contractor shall notify owners of adjacent property and utilities when proceeding with the work that may affect them.
2. When it is necessary to temporarily deny access by owners or tenants to their property, or when any utility service connection must be interrupted, Contractor shall give notices sufficiently in advance to enable the affected persons to provide for their needs. Notices shall conform to any applicable local ordinance and, whether delivered orally or in writing, will include information concerning the interruption and instructions on how to limit their inconvenience.
3. Utilities and other concerned agencies shall be contacted at least 48 hours prior to cutting or closing streets or other traffic areas or excavating near underground utilities or pole lines.
4. Contractor shall regularly advise the local law enforcement, fire and rescue authorities of the project status and coordinate with them in a manner to maximize access to property in the construction area in event of an emergency.

B. Contractor to maintain access for the residents of the area located within the area of the project, as much as possible. Contractor shall keep driveways and entrances serving adjacent properties clear and available to the property owner or occupant at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site that obstructs access to property.

C. Contractor shall at all times maintain public access to the neighboring buildings in the project area.

D. Contractor shall provide temporary approaches and crossings of streets and sidewalks during construction operations. The temporary approaches and crossings shall be maintained by Contractor in good condition during construction operations.

E. Contractor to arrange site and premises to allow work by others and Owner.

F. Contractor to limit shutdowns of utility services to 4 hours at a time and arrange with Owner 48 hours in advance of any shutdowns.

G. Contractor shall take all precautions not to damage buildings, utilities, sidewalks, drives, trees and property that are to remain in place during and after construction activities. Contractor shall be responsible for any damage and repair at Contractor's expense.

3.02 VERIFY UTILITY LOCATION

A. Contractor to verify depth and location of existing utilities prior to any excavation.

B. Contractor to verify that the existing utilities are of the size and type shown in the Drawings prior to providing any connecting materials.

3.03 UNFAVORABLE CONSTRUCTION CONDITIONS

A. During unfavorable weather, wet ground or other unsuitable construction conditions, Contractor shall confine operations to work, which will not be affected adversely by such conditions. No portion of the work shall be constructed under conditions, which would adversely affect the quality or efficiency thereof, unless special means or precautions are taken by Contractor to perform the work in a proper and satisfactory manner.

3.04 TOPSOIL AND SUBSOIL

A. Contractor shall remove the upper 6 inches (6") of topsoil from the area of trench excavation and store it on site. After the trench has been backfilled, Contractor shall replace the stored topsoil on top of the backfill to provide a suitable seed bed for the area above the trench excavation.

B. Topsoil containing crop residue shall be collected separately and reapplied to agricultural ground to proposed finish grades.

C. Excess topsoil shall be neatly stockpiled at a location determined by the Owner only if requested. If not requested by Owner, any excess topsoil remaining at the conclusion of the project shall be the responsibly of the Contractor to remove from the site.

3.05 SIDEWALK

A. All sidewalk joints shall be hand tooled.

3.06 CONCRETE SAWING

A. Sawing of new concrete for jointing is incidental to the unit price for concrete paving.

3.07 BARRICADES, LIGHTS AND TRAFFIC CONTROL

A. General:

1. All open trenches and other excavations shall have suitable barricades, signs, lights and other safe guards to provide adequate protection to the public. Obstructions such as material piles and equipment shall be provided with similar warning barricades, signs, lights and other safe guards.
2. Contractor shall maintain traffic and shall provide and maintain traffic control devices in accordance with the contract documents.
3. If there is no specific traffic control plan, then Contractor's traffic control devices shall be in accordance with and shall be placed as required in the current edition of the Manual on Uniform Traffic Control Devices for Streets & Highways.
4. Barricades, signs, lights and other safeguards shall be placed and maintained by Contractor during construction activities.

5. Contractor shall provide all necessary devices for traffic control during construction.

B. Traffic control, including barricades, signs, lights and other safe guards shall be considered incidental and subsidiary to other items of work for which direct payment is made. No separate payments will be made for this work.

3.08 REMOVALS

A. Contractor shall use care in removing concrete, asphalt and other permanent surfacing. Additional removals required due to Contractor's negligence will be at Contractor's expense.

B. Contractor shall saw-cut existing concrete, asphalt, etc. to be removed and this sawing shall be considered incidental and subsidiary to the other items of work for which direct payment is made. No separate payments will be made for this work.

C. Where sewer and storm sewer castings are removed by Contractor, care shall be taken when removing castings so they are suitable for future reuse. The castings shall be salvaged to Owner and shall be delivered to a site designated by Owner.

3.09 DISPOSAL OF REMOVALS

A. All disposal of any material that is removed shall be done in strict compliance with all applicable State, Federal and Local laws and rules and regulations.

B. Excavated materials: Excess excavated material that is not suitable for reuse in the project shall be disposed of at Contractor's own disposal site and at Contractor's expense.

C. Trees: All trees and stumps removed shall be disposed of by Contractor at Contractor's own disposal site and at Contractor's expense.

D. Miscellaneous: Contractor shall be responsible for the disposal of any miscellaneous items at Contractor's own disposal site and at Contractor's expense.

E. Drainage Pipe: All drainage pipe removed shall be disposed of by Contractor at Contractor's own disposal site and at Contractor's expense.

F. Sewer manholes and structures: All concrete materials resulting from sewer manhole, storm sewer inlet, junction box or other storm sewer and sewer material removal shall be disposed of by Contractor at Contractor's own disposal site and at Contractor's expense.

3.10 INSTALLATION OF THERMAL INSULATION FOAM BOARD

A. Place insulation as shown on the Drawings after pipe trench has been backfilled and compacted.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

C. Protect insulation from damage prior to concealment.

3.11 CONSTRUCTION STAKING

A. Engineer shall provide engineering surveys to establish reference points and the general layout of the work, which in Engineer's judgment are necessary to enable Contractor to proceed with the work. Contractor shall give Engineer at least 72 hours' notice prior to needing staking.

B. Engineer will set stakes for

1. Centerline alignments for road, storm sewer, sanitary sewer, water main, and sanitary force main

2. RV pad locations

C. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points, construction stakes and property monuments, and shall make no changes or relocations without the prior written approval of the Owner.

D. Contractor shall report to Engineer whenever any reference point, construction stakes, or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the payment to Owner to replace or relocate such reference points, construction stakes, or property monuments. Such payment shall be paid prior to the Contractor's final estimate or shall be deducted from the same.

E. All improvements shall be installed as staked by the Engineer. The locations as shown on the plans should be considered approximate.

3.12 SUBGRADE PREPARATION

A. All concrete paving, sidewalks, ramps, etc. shall include subgrade preparation. Contractor shall include cost of subgrade preparation with the appropriate related bid item.

3.13 TESTING

A. Subgrade: Owner shall arrange and pay for all subgrade testing that meets the required densities. Any re-tests shall be paid for by Contractor.

1. Soil Compaction shall meet the following requirements.

a. In critical areas (driven roadways, driveways, alleys, parking lots, under pavement: 98% of maximum standard proctor density, with moisture content at optimum (-) 2% to (+) 4%.

b. Under Structures: 100% of maximum standard proctor density, with moisture content at optimum (-) 0% to (+) 4%. Compacted embankment shall extend a minimum of 5 feet outside of edge of foundation.

B. Trench: Owner shall arrange and pay for all trench testing that meets the required densities. Any re-tests shall be paid for by Contractor.

1. Soil Compaction shall meet the following requirements.

a. Trench Backfill in critical areas (driven roadways, driveways, alleys, parking lots, under pavement) 98% of maximum standard proctor density, with moisture content at optimum (-) 2% to (+) 4%.

b. Trench Backfill, not in critical areas: 95% of maximum standard proctor density, with moisture content at optimum (-) 2% to (+) 4%.

c. Top 12" of Trench Backfill in lawn and cultivated fields: 90% of maximum standard proctor density, with moisture content at optimum (-) 2% to (+) 4%.

C. Non-structural Fill: Owner shall arrange and pay for all testing of non-structural fill that meets the required densities. Any re-tests shall be paid for by Contractor.

1. Soil Compaction shall meet the following requirements.

a. General Fill: 95% of maximum standard proctor density, with moisture content at optimum (-) 2% to (+) 4%.

b. Top 12" of fill in lawn and cultivated fields: 90% of maximum standard proctor density, with moisture content at optimum (-) 2% to (+) 4%

D. Concrete Testing: An independent testing agency employed by Owner shall perform quality control tests and materials testing.

1. The Owner will perform testing similar to specification Section 03 30 00 – 3.09 Field Quality Control and/or Section 32 13 13 – 3.12 Field Quality Control.

3.14 WATER

A. Contractor shall make arrangements to obtain water from Owner, as necessary for construction of the work.

B. Contractor shall furnish all hose, hose adapters, backflow protection devices, meters and fittings necessary, and shall provide transportation and distribution of the water.

C. Contractor shall exercise care in drawing water from the water system and shall not draw water at a rate (when combined with municipal uses) that will reduce the water system storage level below 75% of the maximum.

D. If water is required to provide the proper moisture content for compaction, the transportation and distribution of water shall be considered incidental and subsidiary to other items of work for which direct payment is made.

E. All work associated with this shall not be measured and paid for directly but shall be considered incidental and subsidiary to other items of work for which direct payment is made. No separate payments will be made for this work.

3.15 OPERATION OF WATER SYSTEM VALVE AND WATER MAIN CONNECTIONS

A. No valve or other control on the existing water system shall be operated for any purpose by Contractor without prior permission of Owner.

B. Connections to existing water mains will be coordinated with Owner.

3.16 CLEANUP

A. Contractor shall return all areas disturbed by construction of the project to the original grade or to the finish grade as shown on Drawings and shall restore the site to as clean and sightly condition as before the work began.

B. Contractor shall keep the cleanup of the project current with the construction and shall not have any more than 300 feet of construction at any time during the project which has not been cleaned up.

C. During construction, areas to be maintained for traffic shall be kept clear of all hazardous materials, including but not limited to construction debris, dust, and mud.

D. The cleaning and sweeping of the streets in the construction area shall be completed prior to the completion of the project. The project cleanup shall be conducted to the satisfaction of Owner and Engineer and shall be completed prior to final acceptance of the project.

E. Contractor shall clean streets in project area whenever mud, dirt or debris is tracked onto to the streets as a result of the activities of Contractor, by his/her employees, sub-Contractors, suppliers or agents.

3.17 STARTUP AND TRAINING

A. Contractor shall provide on-site training and instructions. The scheduling of this training shall be coordinated with Owner.

B. Startup of new equipment shall be conducted only on Monday, Tuesday, Wednesday or Thursday.

END OF SECTION

SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

B. Documentation of changes in contract price and contract time.

C. Change procedures.

D. Correlation of Contractor submittals based on changes.

E. Procedures for preparation and submittal of application for final payment.

1.02 SCHEDULE OF VALUES

A. Submit a printed schedule for projects or items bid as a lump sum.

B. Revise schedule to list approved change orders with each application for payment.

1.03 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the agreement or arranged at preconstruction meeting.

B. Present required information in typewritten form.

C. Form: Provided by Engineer.

D. Execute Contractor's certification by signature of authorized officer.

E. Use data from approved schedule of values. Provide dollar value in each column for each line item for portion of work performed and for stored products.

F. List each authorized change order as a separate line item, listing change order number and dollar amount as for an original item of work.

G. Submit 4 copies of each application for payment to Engineer for review.

H. Include the following with the application:

1. Transmittal letter as specified for submittals in Section 01 30 00 - Administrative Requirements.

2. Construction progress schedule, revised and current as specified in Section 01 30 00 - Administrative Requirements.

3. Affidavits and invoices attesting to on and off-site stored materials.

I. When Engineer requires substantiating information, submit data justifying dollar amounts in question. Provide 1 copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.04 MODIFICATION PROCEDURES

A. Submit name of the individual authorized to receive change documents and who shall be responsible for informing others in Contractor's or subcontractor's employ of changes to the work.

B. Engineer shall advise of minor changes in the work not involving an adjustment to contract price or contract time as authorized by the conditions of the contract by issuing supplemental instructions on letter.

C. Work Directive Change: Engineer may issue a document, signed by Owner, instructing Contractor to proceed with a change in the work for subsequent inclusion in a change order.

1. The document shall describe changes in the work and shall designate method of determining any change in contract price or contract time.

2. Promptly execute the change in work.

D. Notice of Change: Engineer may issue a document which includes a detailed description of a proposed change with supplementary or revised drawings and specifications and a change in contract time for executing the change. Contractor shall prepare and submit an estimated price quotation within 7 days.

E. Contractor may propose a change by submitting a request for change to Engineer, describing the proposed change and its full effect on the work, with a statement describing the reason for the change and the effect on the contract price and contract time with full documentation.

F. Computation of Change in Contract Amount:

1. For change requested by Engineer for work falling under a fixed price contract, the amount shall be based on Contractor's price quotation.

2. For change requested by Contractor, the amount shall be based on Contractor's request for a change order as approved by Engineer.

3. For predetermined unit prices and quantities, the amount shall be based on the fixed unit prices.

G. Substantiation of Costs: Provide full information required for evaluation.

1. On request, provide the following data:

a. Quantities of products, labor and equipment.

b. Taxes, insurance and bonds.

c. Overhead and profit.

d. Justification for any change in contract time.

e. Credit for deletions from contract, similarly documented.

2. Support each claim for additional costs with additional information:

a. Origin and date of claim.

b. Dates and times work was performed and by whom.

c. Time records and wage rates paid.

d. Invoices and receipts for products, equipment and subcontracts, similarly documented.

H. Execution of Change Orders: Engineer shall issue change orders for signatures of parties as provided in the conditions of the contract.

I. After execution of change order, promptly revise schedule of values and application for payment forms to record each authorized change order as a separate line item and adjust the contract price.

J. Promptly revise progress schedules to reflect any change in contract time, revise sub-schedules to adjust times for other items of work affected by the change and resubmit.

K. Promptly enter changes in project record documents.

1.05 APPLICATION FOR FINAL PAYMENT

A. Prepare application for final payment as specified for progress payments, identifying total adjusted contract price, previous payments and sum remaining due.

B. Application for final payment shall not be considered until the following have been accomplished:

1. All closeout procedures specified in Section 01 77 00 - Project Closeout.

2. Walk through with Engineer and Owner.

3. All punch list items completed.

4. Acceptance signed. Full execution of the substantial completion, if not already executed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 22 00

UNIT PRICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Measurement and payment criteria applicable to work performed under a unit price payment method or lump sum.

B. Defect assessment and nonpayment for rejected work.

1.02 COSTS INCLUDED

A. Unit prices and lump sum prices included on the bid form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the work; and overhead and profit.

B. Where a following technical specification attached to this contract document identifies a measurement and payment on a unit price basis or other method and no item is specifically listed on the bid form, such work shall be considered incidental to the contract. Full compensation shall be considered paid in listed bid items and no separate payment shall be made for incidental items of work including items not specifically identified as bid items.

1.03 UNIT QUANTITIES SPECIFIED

A. Quantities indicated in the bid form are for bidding and contract purposes only. Quantities and measurements of actual work shall determine the payment amount.

1.04 MEASUREMENT OF QUANTITIES

A. Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.

B. Take all measurements and compute quantities. Measurements and quantities shall be verified by Engineer.

C. Assist by providing necessary equipment, workers and survey personnel as required.

D. Measurement Devices:

1. Weigh Scales: Inspected, tested and certified by the applicable state weights and measures department within the past year.

2. Platform Scales: Of sufficient size and capacity to accommodate the conveying vehicle.

3. Metering Devices: Inspected, tested and certified by the applicable state department within the past year.

E. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes shall be measured by handbook weights to the nearest pound. Welded assemblies shall be measured by handbook or scale weight.

F. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness to the nearest cubic yard.

G. Measurement by Area: Measured by square dimension using mean length and width or radius measured to the nearest square foot or square yard. Horizontal stationing along the centerline of alignments is based upon level line measurement and is used for measurement and payment.

H. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord measured to the nearest foot. Horizontal stationing along the centerline of alignments is based upon level line measurement and is used for measurement and payment.

I. Lump Sum: For each described item. Includes materials, equipment, labor, products and incidentals to provide for a complete and functional system as described in the specifications.

J. Established Quantity (EQ): Plan quantity not field measured.

1.05 PAYMENT

A. Payment for work governed by unit prices shall be made on the basis of the actual measurements and quantities of work which is incorporated in or made necessary by the work and accepted by Engineer, multiplied by the unit sum/price.

B. Payment shall not be made for any of the following:

1. Products wasted or disposed of in a manner that is not acceptable.
2. Products determined as unacceptable before or after placement.
3. Products not completely unloaded from the transporting vehicle.
4. Products placed beyond the lines and levels of the required work.
5. Products remaining on hand after completion of the work.
6. Loading, hauling and disposing of rejected products.

1.06 DEFECT ASSESSMENT

A. Replace work, or portions of the work, not conforming to specified requirements.

B. If, in the opinion of Engineer, it is not practical to remove and replace the work, Engineer shall direct one of the following remedies:

1. The defective work may remain, but the unit sum/price shall be adjusted to a new sum/price at the discretion of Engineer and accepted by Owner.
2. The defective work shall be partially repaired as per the instructions of Engineer; and the unit sum/price shall be adjusted to a new sum/price at the discretion of Engineer and accepted by Owner.

C. The individual specification sections may modify these options or may identify a specific formula or percentage sum/price reduction.

D. The authority of Engineer to assess the defect and identify payment adjustment is final.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Preconstruction meeting.

B. Progress meetings.

C. Construction progress schedule.

D. Submittal procedures.

E. Submittal schedule.

F. Shop drawings.

G. Project data.

H. Samples.

I. Engineers Action.

J. Manufacturer's instructions.

1.02 PROJECT COORDINATION

A. Project Engineer: JEO Consulting Group, Inc.

B. Cooperate with Owner and Engineer to determine the availability of staging areas for field offices, storage of materials, parking of equipment, etc.

C. During construction, coordinate use of site and facilities through Owner and Engineer.

D. Comply with Engineer's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings and recommendations; and resolution of ambiguities and conflicts.

E. Comply with instructions of Owner and Engineer for use of temporary utilities and construction facilities.

F. Coordinate field engineering and layout work under instructions of the project Engineer.

G. Make the following types of submittals to Engineer:

1. Requests for interpretation.
2. Requests for substitution.
3. Shop drawings, product data and samples.
4. Test and inspection reports.
5. Design data.
6. Manufacturer's instructions and field reports.
7. Applications for payment and change order requests.

8. Progress schedules.

9. Coordination drawings.

10. Closeout submittals.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 PRECONSTRUCTION MEETING

A. Engineer shall schedule a meeting after the contract documents are executed.

B. Attendance Required:

1. Owner.

2. Engineer.

3. Contractor.

4. Subcontractors.

5. Utilities.

C. Agenda:

1. Designation of project representatives for Owner, Engineer and Contractor.

2. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, change orders and contract closeout procedures.

3. Project scheduling.

4. Scheduling activities of subcontractors.

5. Review scope of project and project specific items.

6. Review other miscellaneous items as needed.

D. Record minutes and distribute copies after meeting to participants.

3.02 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the work with a maximum of monthly intervals.

B. Engineer shall make arrangements for meetings, prepare agenda with copies for participants and preside at meetings.

C. Attendance Required: Job superintendent, major subcontractors and suppliers, Owner and Engineer, as appropriate to agenda topics for each meeting.

D. Agenda:

1. Review minutes of previous meetings.

2. Review of work progress.

3. Field observations, problems and decisions.

4. Identification of problems which impede planned progress.

5. Review of submittals schedule and status of submittals.

6. Review of off-site fabrication and delivery schedules.

7. Maintenance of progress schedule.

8. Corrective measures to regain projected schedules.

9. Planned progress during succeeding work period.

10. Coordination of projected progress.

11. Maintenance of quality and work standards.

12. Effect of proposed changes on progress schedule and coordination.

13. Other business relating to work.

E. Engineer shall record minutes and distribute copies within 2 days after meeting to participants, with 1 copy each to Owner, Contractor, participants and those affected by decisions made.

3.03 CONSTRUCTION PROGRESS SCHEDULE

A. Within 10 days after the effective date of the agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.

B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.

1. Include written certification that major contractors have reviewed and accepted proposed schedule.

D. Within 10 days after joint review, submit complete schedule.

E. Submit updated schedule with each application for payment.

3.04 SUBMITTAL PROCEDURES

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.

2. Coordinate transmittal of different types of submittals for related elements of the work so processing will not be delayed by the need to review submittals concurrently for coordination.

a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

3. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.

a. Allow 2 weeks for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Engineer shall promptly advise Contractor when a submittal being processed must be delayed for coordination.

b. If an intermediate submittal is necessary, process the same as the initial submittal.

c. Allow 2 weeks for reprocessing each submittal.

d. No extension of contract time shall be authorized because of failure to transmit submittals to Engineer sufficiently in advance of the work to permit processing.

B. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

1. Provide a space to record Contractor's review and approval markings and the action taken.

2. Include the following information on the label for processing and recording action taken.

a. Project name.

b. Date.

c. Name and address of Engineer.

d. Name and address of Contractor.

e. Name and address of subcontractor.

f. Name and address of supplier.

g. Name of manufacturer.

h. Number and title of appropriate specification section.

i. Drawing number and detail references, as appropriate.

C. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Engineer using a transmittal form. Submittals received from sources other than Contractor shall be returned without action.

D. Copies Required: If submitting hard copies, submit 6 copies for review unless otherwise noted in the Special Provisions. If submitted via electronic submittal, only 1 copy is required.

3.05 SUBMITTAL SCHEDULE

A. After development and acceptance of Contractor's construction schedule, prepare a complete schedule of submittals. Submit the schedule within 10 days of the date required for establishment of Contractor's construction schedule.

1. Coordinate submittal schedule with the list of subcontracts, schedule of values and the list of products, as well as Contractor's construction schedule.

2. Prepare the schedule in chronological order; include submittals required during the first 10 days of construction. Provide the following information:

   a. Scheduled date for the first submittal.

   b. Related section number.

   c. Submittal category.

   d. Name of subcontractor.

   e. Description of the part of the work covered.

   f. Scheduled date for resubmittal.

   g. Scheduled date Engineer's final release or approval.

B. Distribution: Following response to initial submittal, print and distribute copies to Engineer, Owner, subcontractors and other parties required to comply with submittal dates indicated. Post copies in the project meeting room and field office.

   1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the work and are no longer involved in construction activities.

C. Schedule Updating: Revise the schedule after each meeting or activity where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting.

3.06 SHOP DRAWINGS

A. Submit newly prepared information drawn to accurate scale. Highlight, circle or otherwise indicate deviations from the contract documents. Do not reproduce contract documents or copy standard information as the basis of shop drawings. Standard information prepared without specific reference to the project is not considered shop drawings.

B. Shop drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:

   1. Dimensions.

   2. Identification of products and materials included.

   3. Compliance with specified standards.

   4. Notation of coordination requirements.

   5. Notation of dimensions established by field measurement.

   6. Sheet Size: Except for templates, patterns and similar full-size drawings, submit shop drawings on sheets formatted at least 8 1/2 inches x 11 inches but no larger than 24 inches x 36 inches. Electronic submittal is preferred.

7. If submitting hard copies, submit 6 Black Line Prints: For review unless otherwise noted in the Special Provisions.

8. One of the prints returned shall be marked up and maintained as a "record document".

9. Do not use shop drawings without an appropriate final stamp indicating action taken in connection with construction.

C. Coordination drawings are a special type of shop drawings that show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or function as intended.

1. Preparation of coordination drawings may include components previously shown in detail on shop drawings or product data.

2. Submit coordination drawings for integration of different construction elements. Show sequences and relationships of separate components to avoid conflicts in use of space.

3.07 PRODUCT DATA

A. Collect product data into a single submittal for each element of construction or system. Product data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where product data must be specially prepared because standard printed data is not suitable for use, submit as "shop drawings".

1. Mark each copy to show applicable choices and options. Where printed product data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:

a. Manufacturer's printed recommendations.

b. Compliance with recognized trade association standards.

c. Compliance with recognized testing agency standards.

d. Application of testing agency labels and seals.

e. Notation of dimensions verified by field measurement.

f. Notation of coordination requirements.

2. Do not submit product data until compliance with requirements of the contract documents has been confirmed.

3. Submittals: If submitting via hard copies submit 4 copies of each required submittal; submit 4 hard copies where required for maintenance manuals. Engineer shall retain one and shall return the other marked with action taken and corrections or modifications required.

a. Unless noncompliance with contract document provisions is observed, the submittal may serve as the final submittal.

4. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators and others required for performance of construction activities. Show distribution on transmittal forms.

   a. Do not proceed with installation until an applicable copy of product data applicable is in the installer's possession.

   b. Do not permit use of unmarked copies of product data in connection with construction.

3.08 SAMPLES

A. Submit full-size, fully fabricated samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture and pattern.

1. Mount, display, or package samples in the manner specified to facilitate review of qualities indicated. Prepare samples to match Engineer's sample. Include the following:

   a. Generic description of the sample.

   b. Sample source.

   c. Product name or name of manufacturer.

   d. Compliance with recognized standards.

   e. Availability and delivery time.

2. Submit samples for review of kind, color, pattern and texture, for a final check of these characteristics with other elements, and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed.

   a. Where variation in color, pattern, texture or other characteristics are inherent in the material or product represented, submit multiple units (not less than 3) that show approximate limits of the variations.

   b. Refer to other specification sections for requirements for samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation and similar construction characteristics.

3. Preliminary Submittals: Where samples are for selection of color, pattern, texture or similar characteristics from a range of standard choices, submit a full set of choices for the material or product.

   a. Preliminary submittals shall be reviewed and returned with Engineer's mark indicating selection and other action.

4. Submittals: Except for samples illustrating assembly details, workmanship, fabrication techniques, connections, operation and similar characteristics, submit 4 sets; 1 shall be returned marked with the action taken.

5. Maintain sets of samples, as returned, at the project site for quality comparisons throughout the course of construction.

   a. Unless noncompliance with contract document provisions is observed, the submittal may serve as the final submittal.

   b. Sample sets may be used to obtain final acceptance of the construction associated with each set.

B. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, suppliers, installers and others as required for performance of the work. Show distribution on transmittal forms.

1. Field samples specified in individual sections are special types of samples. Field samples are full-size examples erected on-site to illustrate finishes, coatings or finish materials and to establish the standard by which the work will be judged.

   a. Comply with submittal requirements to the fullest extent possible. Process transmittal forms to provide a record of activity.

C. Compliance with specified characteristics is Contractor's responsibility.

3.09 ENGINEER'S ACTION

A. Review required submittals with reasonable promptness and in accordance with schedule, only for general conformance to design concept of project and compliance with information given in plans and specifications. Review shall not extend to means, methods, sequences, techniques, procedures of construction, safety precautions or programs incidental thereof. Review of a separate item as such shall not indicate approval of assembly in which item functions.

B. Affix stamp and initials or signature and indicate requirements for resubmittal or review of submittal. Engineer's action on submittal is classified as follows:

1. No Exceptions Taken: Submittal has been reviewed and appears to be in conformance with design concept of project and plans and specifications.

2. Make Corrections Noted: Submittal has been reviewed and appears to be in conformance with design concept of project and plans and specifications, except as noted by Engineer.

3. Amend and Resubmit: Submittal has been reviewed and appears not to be in conformance with design concept of project and plans and specifications. Contractor shall make corrections as required by Engineer and resubmit for review.

4. Rejected - See Remarks: Submittal has not been reviewed because submittal is otherwise substantially contrary to design concept of project and plans and specifications. Contractor shall revise submittal to correct defects and resubmit for review.

5. No action taken.

C. Return submittals to Contractor.

D. Engineer's review of submittals shall not relieve Contractor from responsibility for any deviations from plans and specifications unless Contractor has, in writing, called Engineer's attention to such deviation at time of submission, and Engineer has given written concurrence pursuant to plans and specifications to specific deviations; nor shall any concurrence by Engineer relieve Contractor from responsibility for errors or omissions in submittals.

E. Installation, manufacture or fabrication of items prior to final approval is at Contractor's own risk.

3.10 MANUFACTURER'S INSTRUCTIONS

A. When required in individual specification section, submit manufacturer's printed instructions for delivery, storage, assembly, installation, start-up, adjusting and operation in quantities specified for product data.

END OF SECTION

Submittals Transmittal Form

TRANSMITTAL NO. | _____
DATE | _____
PROJECT | _____
JEO PROJECT NO. | _____
LOCATION | _____

CONTRACTOR | _____
ADDRESS | _____
CITY, STATE, ZIP | _____
PHONE | _____

☐ **1st Submittal** ☐ **Resubmittal [Previous Submittal No. _____, Date _____]**

Contractor shall fill in columns 1 through 5 for each submittal item. List each drawing, data item, or sample separately.

1. Spec Section & Paragraph No.	2. Item Description	3. Manufacturer or Supplier	4. Drawing or Detail No. *(if appropriate)*	5. Sample Only *(mark X)*	6. Coordinating Professional Action *(ref. A-E below)*

These/this item(s) have been checked for compliance with specification requirements and space limitations and will meet these conditions.

Submitted by (CONTRACTOR): _____ _____

Signature Printed Name and Title

SPACE BELOW FOR JEO USE ONLY

Review is for general compliance with contract documents. No responsibility is assumed for correctness of dimensions or details.

The above data has been reviewed in accordance with the provisions of the project specifications and is returned with action designated above in accordance with the following legend *(circle one of the following)*:

A	B	C	D	E
NO EXCEPTIONS TAKEN	MAKE CORRECTIONS NOTED	AMEND AND RESUBMIT	REJECTED (SEE REMARKS)	NO ACTION TAKEN (SEE REMARKS)

Remarks: _____

_____

_____

Reviewed by (COORDINATING PROFESSIONAL): _____ _____

Signature Date

SECTION 01 40 00

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Submittals - qualifications and reports.

B. References and standards.

C. Testing and inspection agencies.

D. Control of installation.

E. Tolerances.

F. Testing and inspection.

G. Manufacturers field service.

H. Defect assessment.

1.02 SUBMITTALS - QUALIFICATIONS AND REPORTS

A. Testing Agency Qualifications:

1. Prior to start of work, submit testing agency name, address and telephone number, and names of full time registered Engineer and responsible officer.

2. Submit copy of report of testing agency laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.

B. Design Data: Submit for Engineer's knowledge as contract administrator or Owner for the limited purpose of assessing conformance with the design concept expressed in the contract documents.

C. Test Reports: After each test/inspection, promptly submit 2 copies of report to Engineer.

1. Include:

a. Date issued.

b. Project title and number.

c. Name of inspector.

d. Date and time of sampling or inspection.

e. Identification of product and specification section.

f. Location in the project.

g. Type of test/inspection.

h. Date of test/inspection.

i. Results of test/inspection.

j. Conformance with contract documents.

k. When requested by Engineer, provide interpretation of results.

2. Test reports are submitted for Engineer's knowledge as contract administrator for the limited purpose of assessing conformance with the design concept expressed in the contract documents and for Owner's information.

D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Engineer in quantities specified for product data.

1. Indicate that material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits and certifications as appropriate.

2. Certificates may be recent or previous test results on material or product but must be acceptable to Engineer.

E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting and finishing for Owner's information. Indicate special procedures, perimeter conditions requiring special attention and special environmental criteria required for application or installation.

F. Manufacturer's Field Reports: Submit reports for Engineer's benefit as contract administrator and for Owner's information.

1. Submit report in duplicate within 15 days of observation to Engineer for information.

2. Submit information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

G. Erection Drawings: Submit drawings for Engineer's benefit as contract administrator and for Owner's information.

1. Submit for information and for the limited purpose of assessing conformance with the information given and the design concept expressed in the contract documents.

2. Data indicating inappropriate or unacceptable work may be subject to action by Engineer or Owner.

1.03 REFERENCES AND STANDARDS

A. For products and workmanship specified by reference to a document or documents not included in the project manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard of date of issue current on date of contract documents, except where a specific date is established by applicable code.

C. Obtain copies of standards where required by product specification sections.

D. Maintain copy at project site during submittals, planning and progress of the specific work until project acceptance.

E. Should specified reference standards conflict with contract documents, request clarification from Engineer before proceeding.

F. Neither the contractual relationships nor the duties or responsibilities of the parties in contract or those of Engineer shall be altered from the contract documents by mention inference or otherwise in any reference document.

G. Should plans conflict with specifications or other contract documents, request clarification from Engineer before proceeding.

1.04 TESTING AND INSPECTION AGENCIES

A. As indicated in the Section 01 10 00 - Special Provisions or individual specification sections, Owner or Contractor shall employ and pay for services of an independent testing agency to perform specified testing.

B. Employment of an independent testing agency in no way relieves Contractor of obligation to perform work in accordance with requirements of contract documents.

C. Owner Employed Agency:

1. Owner shall employ a certified testing agency to test concrete for air content, slump and make cylinders for and perform compressive strength testing. Test frequency as indicated in Section 32 13 13 – Portland Cement Concrete or Section 03 30 00 – Cast in Place Concrete, as applicable.

2. Owner shall employ a certified testing agency to test the asphalt for uniformity of the mix and conformity to the mix design. Owner shall employ a certified testing agency to collect and test asphalt core samples.

3. Owner shall employ a certified testing agency for trench, fill and subgrade sampling and testing, and as noted in individual specification sections

4. All costs (including testing and other evaluations) related to the determination of defective work shall be the responsibility of the Contractor, if said work is found to be defective.

5. Retesting of failed tests and testing to identify a failed area shall be paid for by Contractor.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 CONTROL OF INSTALLATION

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

B. Comply 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 minimum quality for the work, except where more stringent tolerances, codes and specified requirements indicate higher standards or more precise workmanship.

E. Work shall be performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion and disfigurement.

H. The Contractor shall be responsible for the protection, care, and upkeep of the work, all associated storage sites, and other areas used to execute the contract.

1. The Contractor shall take every precaution against injury or damage to the work due to the weather or from any other cause.

2. The Contractor shall rebuild, repair, restore, and make good all injuries or damages to the work due to any cause before final acceptance at no additional cost.

3.02 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable work. Do not permit tolerances to accumulate.

B. Comply with manufacturer's tolerances. Should manufacturer's tolerances conflict with contract documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions, position before securing products in place.

3.03 TESTING AND INSPECTION

A. See individual specification sections for testing required.

B. Testing Agency Duties:

1. Test samples of materials and mixes submitted by Contractor.

2. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.

3. Perform specified sampling and testing of materials, products and mixes in accordance with specified standards.

4. Ascertain compliance of materials, products and mixes with requirements of contract documents.

5. Promptly notify Engineer and Contractor of observed irregularities or nonconformance of work or products.

6. Perform additional tests and inspections required by Engineer.

7. Attend preconstruction meetings and progress meetings.

8. Submit reports of all tests/inspections specified.

C. Limits on Testing/Inspection Agency Authority:

1. Agency may not release, revoke, alter or enlarge on requirements of contract documents.

2. Agency may not approve or accept any portion of the work.

3. Agency may not assume any duties of Contractor.

4. Agency has no authority to stop the work.

D. Contractor's Responsibilities:

1. Deliver to agency at designated location adequate samples of materials proposed to be used which require testing, along with proposed mix designs.

2. Cooperate with testing agency personnel and provide access to the work.

3. Provide incidental labor and facilities.

a. To provide access to work to be tested/inspected.

b. To obtain and handle samples at the site or at source of products to be tested/inspected.

c. To facilitate tests/inspections.

d. To provide storage and curing of test samples.

4. Notify Engineer and testing agency 48 hours prior to expected time for operations requiring testing/inspection services.

E. Retesting required because of nonconformance to specified requirements shall be performed by the same agency on instructions by Engineer. Payment for retesting shall be paid for by the Contractor.

3.04 MANUFACTURER'S FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions; conditions of surfaces and installation; quality of workmanship; start-up of equipment; test, adjust and balance of equipment as applicable; and to initiate instructions when necessary.

B. Submit qualifications of observer to Engineer 30 days in advance of required observations.

1. Observer subject to approval of Engineer.

2. Observer subject to approval of Owner.

C. Report to Engineer observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.

3.05 DEFECT ASSESSMENT

A. Replace work or portions of the work not conforming to specified requirements.

B. If, in the opinion of Engineer, it is not practical to remove and replace the work, Engineer shall direct an appropriate remedy or adjust payment.

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Temporary utilities.

B. Temporary sanitary facilities.

C. Barriers.

D. Fencing.

E. Security.

F. Vehicular access and parking.

G. Waste removal facilities and services.

H. Project identification.

I. Removal of utilities, facilities and controls.

1.02 TEMPORARY UTILITIES

A. Provide and pay for all electrical power, lighting, water, heating and cooling and ventilation required for construction purposes.

B. Existing facilities may be used subject to the Owner’s approval.

C. New permanent facilities may not be used.

1.03 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

B. Use of existing facilities is not permitted unless approved by Owner.

C. New permanent facilities may not be used during construction operations.

D. Maintain daily in clean and sanitary condition.

E. At end of construction, return facilities to same or better condition as originally found.

1.04 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas to allow for Owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way.

C. Provide protection for plants designated to remain. Replace damaged plants.

D. Protect nonowned vehicular traffic, stored materials, site and structures from damage.

1.05 FENCING

A. Construction: See Section 01 10 00 - Special Provisions.

1.06 SECURITY

A. Provide security and facilities to protect work, existing facilities and Owner's operations from unauthorized entry, vandalism or theft.

1.07 VEHICULAR ACCESS AND PARKING

A. Coordinate access and haul routes with governing authorities and Owner.

B. Provide and maintain access to fire hydrants, free of obstructions.

C. Provide means of removing mud from vehicle wheels before entering public right-of-way.

D. Designated, existing on-site roads may be used for construction traffic.

E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

F. Existing parking areas may be used for construction parking subject to Owner’s approval.

G. Do not allow vehicle parking on existing pavement without Owner’s approval.

1.08 WASTE REMOVAL

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

B. Provide containers with lids. Dispose of waste off-site periodically.

C. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.09 PROJECT IDENTIFICATION

A. Provide project identification sign of design and construction if indicated in the drawings or Section 01 10 00 - Special Provisions.

B. Erect on site at location indicated.

C. No other signs are allowed without Owner's permission, except those required by law.

1.10 REMOVAL OF UTILITIES, FACILITIES AND CONTROLS

A. Remove temporary utilities, equipment, facilities and materials prior to recommendation of acceptance inspection.

B. Remove underground installations to a minimum depth of 3 feet. Grade site as indicated.

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

D. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 55 00

TRAFFIC CONTROL AND BARRICADING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section describes various materials, equipment and procedures involved in traffic control and barricading during construction.

1.02 REFERENCES

A. Manual on Uniform Traffic Control Devices – MUTCD.

B. National Cooperative Highway Research Program.

C. Report 350 – NCHRP Report 350.

D. ASTM D 4956 – Standard Specification for Retroreflective Sheeting for Traffic Control.

E. State Standard Specifications, latest revision.

1.03 RESPONSIBILITIES

A. Contractor and the contracting authority have certain responsibilities whether public traffic is allowed or is prohibited during construction.

B. Contractor shall furnish, erect, operate, maintain, move and remove all traffic control and barricading devices required by the contract documents.

C. All traffic control and barricading shall be in accordance with the current edition of the MUTCD (Manual on Uniform Traffic Control Devices) and latest revisions.

1.04 TRAFFIC CONTROL DEVICES

A. All Category I traffic control and barricading devices used on projects shall meet National Cooperative Highway Research Program (NCHRP) Report 350. Category I devices are defined as low mass, single-piece traffic cones, tubular markers, single-piece drums and delineators. No lights or signs may be attached to these devices in order for them to meet the Category I limitations. Category I devices shall be self-certified by the vendor. It shall be the responsibility of the vendor of the device to determine if the device meets the evaluation criteria of NCHRP Report 350.

B. All Category II traffic control devices purchased for use on projects shall meet NCHRP Report 350. Category II devices are defined as vertical panels, Type II and Type III barricades; moveable skid mounted sign stands and barrels with reflected signs or lights attached. Type III barricades with attached signs used on all projects shall meet NCHRP Report 350. A list of approved Category II traffic control devices is found on the world wide web at the following URL:

http://safety.fhwa.dot.gov/fourthlevel/hardware/wzd.htm.

1.05 MONITORING

A. Contractor shall provide 24 hour per day continuous monitoring of traffic control and barricading devices.

B. Assistance to motorists and involvement with obstructions shall continue until they are no longer an impediment to traffic and further assistance can be provided safely by others.

C. When a vehicle or anything else is obstructing a travel lane or shoulder intended to be clear, the operator shall assist the motorist or remove the obstruction promptly and safely. If further assistance is needed, it is to be summoned.

D. The operator shall keep a report of any events that restrict the normal traffic flow during complex operations.

E. A copy of this report shall be provided to Engineer daily.

F. Contractor shall perform the following quality control work associated with monitoring and documenting traffic control and barricading conditions daily as the project is constructed:

1. Review all traffic control operations and maintain a project traffic control daily diary, which shall be submitted to Engineer and shall become a part of the contracting authority's project records. The diary shall include:

   a. All reviews of traffic control devices and operations.

   b. Approved changes to traffic control.

   c. Incidentals affecting the efficiency and safety of traffic.

   d. Coordinate all traffic control operations, including those of subcontractors and suppliers.

1.06 SIGNS

A. Signs shall utilize retro reflective sheeting. Reflective sheeting shall meet the requirements of ASTM D 4956, including supplementary requirements, except when modified in the contract documents or this specification.

B. Reflective sheeting shall be uniform in color and reflectivity. In a single sign or traffic control device, variations in color or reflectivity noticeable at a distance of 50 feet or more, under daytime or nighttime lighting conditions, shall be cause for rejection of the sign.

C. Signs for traffic control and construction zones in duration for 4 calendar days or more shall be mounted on fixed posts.

D. Signs for traffic control and construction zones in duration for less than 4 calendar days may be mounted on moveable skids or fixed posts.

E. Fixed, post-mounted signs shall have the sign sheeting applied to rigid wood or metal and shall be mounted at a height of at least 7 feet, measured from the bottom of the sign to the near edge of the pavement. A secondary sign on the same post may be mounted 1 foot lower than specified above. Post-mounted signs shall have a clear distance 2 feet behind a curb or beyond the edge of the shoulder.

F. Moveable skid mounted signs shall use flexible roll-up sheeting or other skid mounted sign systems that meet NCHRP 350 requirements. Moveable skid mounted signs shall be mounted at a height of at least 1 foot above the roadway.

G. Mounting devices shall not be so substantial as to be a hazard to vehicles.

1. Wood sign supports are allowed.

2. U-shaped rail steel posts not exceeding 3.0 pounds per foot are allowed.

3. Dual-post and triple-post configurations using these sign supports are acceptable provided that no more than 2 posts occupy any 8-foot wide path. Bracing of these posts shall not be permitted. Posts exceeding these requirements shall have breakaway features approved by Engineer.

H. Signs shall be in a condition so they are effective for the intended purposes when viewed from a vehicle. For nighttime installations, the reflectance shall be adequate so that the message is clearly readable. Signs shall be maintained in a near vertical position.

1.07 CHANNELIZING DEVICES

A. Channelizing devices shall utilize reflective sheeting.

1.08 BARRICADES

A. Type II barricades shall be used for all pavement surfaces on interstate and multilane roadways, which include travel lanes, intersections, ramps, acceleration and deceleration lanes, crossovers and shoulders.

B. At locations other than on interstate and multilane divided roadways, Type II barricades may be used. Type II barricades shall have a minimum length of rail of 2 feet.

C. When Type II barricades are furnished as one of the options for channelizing devices in lieu of vertical panels, cones or drums, a 2 foot minimum length barricade may be used.

D. Type III barricades shall be used where specifically required. They shall have a minimum length of rail of 4 feet. When used as a shoulder barricade, the minimum barricade is acceptable. Unless otherwise shown in the contract documents, other Type III barricades shall have a minimum effective length of rail of 8 feet, including locations where the barricades are staggered to permit construction or local traffic. Barricades of the minimum length may be used, side by side and rigidly fastened together by bolting or other approved methods, to make this effective length.

E. When traffic is permitted in each direction around a Type III barricade, the Type III barricade used shall have fully reflectorized faces on both sides of the rails.

F. Barricades shall be erected in essentially a horizontal position perpendicular to the direction of approaching traffic. When placed on the traveled way or shoulder, they shall be ballasted with sandbags placed so as not to cover any striped rail.

1.09 CONES, VERTICAL PANELS, DRUMS AND TUBULAR MARKERS

A. Cones, vertical panels, drums and tubular markers shall meet the current requirements of the MUTCD, latest revision.

B. When used to separate two-way traffic, temporary no passing lines shall be separated by approximately 16 inches with the marker to be installed between these lines.

C. Tubular markers shall be between 28 inches and 34 inches in height with a diameter facing traffic at least 2 inches in width. Tubular markers shall be completely faced with reflectorized white and orange sheeting. The white reflectorized sheeting shall be in 2 bands 4 inches wide with 6 inches between bands. The top band shall be no more than 2 inches from the top of the tubular marker.

1.10 FLAGGERS

A. Flaggers shall be trained about safe flagging operations that comply with Department of Roads or Transportation Flaggers Handbook, Part VI of the MUTCD and the standard specifications prior to flagging operations. Training of flaggers shall include the following:

1. Issue and review the current Flaggers Handbook.
2. Presentation of the current professional flagging video.
3. Issue flagger training card, which shall include the following:
    a. Employee name.
    b. Date of training.
    c. Name of instructor.
    d. Expiration date of December 31 of the year following the training date.
    e. Flaggers shall carry their flagger training card at all times and show it upon request.
4. Contractor shall maintain a list of flaggers trained and the date of the training.

B. Training shall not be required for short time, emergency or relief assignment of employees to flagging operations.

C. Except in an emergency, flaggers shall use signs as specified in the current edition of the MUTCD, Part VI, except the signs shall be as least 24 inches wide. The sign shall be mounted on a staff with a clear distance of 6 feet above the road surface.

D. To be visible to traffic while flagging, flaggers shall wear a soft cap or a hard hat and a vest, shirt or jacket. The colors of these articles of dress shall be orange or strong yellow-green or fluorescent versions of these colors. Combinations of these colors are acceptable.

1.11 LIMITATIONS

A. All traffic control and barricading devices subject to movement by wind shall be anchored by sandbags.

B. When a two-way road is open to public traffic during contract work, one-way traffic shall not be controlled through the work area by means of a carry through flag or other token, except during equipment failure or emergency. When voice or signal communication between flaggers at control points is difficult or not effective because of distance, sight or noise, other means shall be used. These may be two-way radios, pilot cars or traffic signals. When the normal work area exceeds 1/4 mile on projects, pilot

cars shall be used; however, where necessary for short durations, the distance may be extended to 1/2 mile for better sight distance or to clear intersections or other safety considerations with approval of Engineer, provided a two-way radio is used for communication between flaggers.

C. During nonworking hours, traffic control and barricading devices intended for working hours only shall be removed, covered or turned down. When traffic control devices are no longer needed, they shall be removed.

D. During daylight hours, workers exposed to traffic in or adjacent to traffic lanes should wear a vest, shirt or jacket equal to that required for flaggers.

E. At night, workers shall wear clothing that is similar in color to that required for flaggers and is retro reflective to be highly visible to drivers. The retro reflective clothing shall be designed to identify clearly the wearer as a person and shall be visible through the full ranges of body actions.

F. Engineer may require traffic control and barricading devices to be recleaned by washing. The device shall be washed with a brush and water and with detergent or solvent as necessary. Washing shall include a supplemental or auxiliary sign, if any, the entire target area or sign face, all reflectors, and faces of warning lights which are part of that device.

G. Entry to and exit from work areas shall be in the direction of public traffic and shall not cross open traffic lanes at other than designated locations. During hours of darkness, Contractor shall operate equipment in the traffic control zone facing in the direction of traffic flow unless otherwise specified in the traffic control plan. Darkness shall include the period from sunset to sunrise and other times when conditions such as fog, snow, sleet or rain provide insufficient lighting to clearly identify persons and vehicles on the highway at a distance of 500 feet ahead.

H. Unless otherwise stated in the traffic control plan, Contractor shall provide for a minimum of 2 miles between traffic control zones on rural roadways. Minimum distances between traffic control zones on urban roadways shall be at the direction of Engineer.

1.12 METHOD OF MEASUREMENT

A. When the contract documents include a pay item for traffic control and barricading, Engineer shall measure for payment the following items:

1. Traffic Control/Barricading: This item shall be the lump sum for traffic control and barricading for the project.

1.13 BASIS OF PAYMENT

A. When the following item is required for traffic control and barricading, there shall be items included in the contract documents with payment as follows:

1. Traffic Control/Barricading: When there is a contract item for traffic control, Contractor shall be paid either the lump sum contract price or at the contract unit prices. This payment shall be full compensation for erecting, maintaining, moving and removing all traffic control devices required by the contract

documents, including warning lights and for furnishing all materials, labor and equipment.

B. If traffic control and barricading is not a bid item it shall be incidental to other items on the project.

C. All traffic control and barricading devices furnished by Contractor shall remain Contractor's property at the completion of the work and shall be removed from the site when no longer needed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. General product requirements.

B. Transportation, handling, storage and protection.

C. Product option requirements.

D. Substitution limitations and procedures.

E. Spare parts and maintenance materials.

1.02 SUBMITTALS

A. Proposed Products List: Submit list of major products proposed for use with name of manufacturer, trade name and model number of each product.

1. Submit within 10 days of the effective date of the agreement.

2. For products specified only by reference standards, list applicable reference standards.

B. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options and other data. Supplement manufacturer's standard data to provide information specific to this project.

C. Shop Drawing Submittals: Prepared specifically for this project; marked up drawings will not be acceptable.

D. Sample Submittals: Illustrate functional and aesthetic characteristics of the product with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures and patterns.

E. Indicate utility and electrical characteristics, utility connection requirements and location of utility outlets for service for functional equipment and appliances.

PART 2 - PRODUCTS

2.01 EXISTING PRODUCTS

A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by the contract documents.

B. Existing materials and equipment indicated to be removed, but not to be reused, relocated, reinstalled, delivered to Owner, or otherwise indicated as to remain the property of Owner, become the property of Contractor and shall be removed from project site.

2.02 NEW PRODUCTS

A. Provide interchangeable components of the same manufacturer for components being replaced.

2.03 PRODUCT OPTIONS

A. Products specified by reference standards or by description only. Use any product meeting those standards or description.

B. Products specified by naming one or more manufacturers. Use a product of one of the manufacturers named and meeting specifications; no options or substitutions allowed.

C. Products specified by naming one or more manufacturers with a provision for substitutions. Submit a request for substitution for any manufacturer not named.

2.04 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Provide spare parts, maintenance and extra products of types and in quantities specified in individual specification sections.

B. Deliver to project site; obtain receipt prior to final payment.

PART 3 - EXECUTION

3.01 SUBSTITUTION PROCEDURES

A. No substitutions will be considered prior to receipt of bids unless written request for approval has been received by Engineer at least 10 days prior to the date for receipt of bids. Substitution requests shall be submitted by the bidder or supplier.

B. After an award of a contract, if Contractor chooses to make a substitution for items specified and that are available, Contractor shall identify an amount to be deducted from the bid price. Cost of substitution review shall be reimbursed to Owner and Engineer as per Article 7, Section 7.05.D, of the Standard General Conditions of the Construction Contract.

C. Document each request with complete data substantiating compliance of proposed substitution with contract documents.

D. A request for substitution constitutes a representation that the submitter:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.

2. Will provide the same warranty for the substitution as for the specified product.

3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to Owner.

4. Waives claims for additional costs or time extension which may subsequently become apparent.

5. Will reimburse Owner and Engineer for review or redesign services associated with reapproval by authorities/consultants.

E. Substitutions will not be considered when they are indicated or implied on shop drawings or product data submittals without separate written request or when acceptance will require revision to the contract documents.

F. Substitution Submittal Procedure:

1. Submit to Engineer 3 copies of Form 01 60 00 Material/Equipment Substitution Request Form Prior to Letting or Form 01 60 00-A Material/Equipment Substitution Request Form After Execution of Contract, whichever is applicable, for consideration. Limit each request to one proposed substitution.

2. Submit shop drawings, product data and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.

3. Engineer shall notify Contractor in writing of decision to accept or reject request.

3.02 CONTRACTOR SUBSTITUTIONS FOR APPROVED MAJOR EQUIPMENT

A. Bidder shall indicate all proposed substitutions by listing in writing the substitute equipment or supplier and the addition or deduction to the base bid lump sum price for the proposed substitute item.

B. Contractor may propose only one substitution for each item. No further substitutions will be considered.

C. No proposed substitution for an item of approved major equipment shall be considered unless, in the opinion of Engineer or Owner, it conforms to the requirements of the contract drawings and specifications in all major respects, except for make, manufacturer or other minor details.

D. Proposed Contractor substitutions shall be deemed as equal if the substitute is the same or better quality than the product or equipment specified under the base bid in terms of its function, performance, reliability, quality and general configuration.

E. Required substitution data shall include:

1. Product Identification:

a. Manufacturer's name.

b. Telephone number and representative contact name.

c. Specification section or drawing reference number of originally specified product.

2. Manufacturer's literature clearly marked to show compliance of proposed product with contract documents.

3. Itemized comparison of original and proposed product addressing product characteristics including, but not limited to:

a. Size.

b. Composition or materials of construction.

c. Weight.

d. Electrical or mechanical requirements.

4. Product Experience:

a. Location of past projects utilizing product.

b. Name and telephone number of persons associated with referenced projects concerning proposed product.

c. Available field data and reports associated with proposed product.

5. Data relating to changes in construction schedule.

6. Data relating to changes in cost.

7. Samples:

a. At request of Engineer.

b. Full size if requested by Engineer.

c. Engineer not responsible for loss or damage to samples.

8. Data and drawing information shall be specifically prepared for this project. Sales catalog cuts or marked up drawings from previous projects are not acceptable.

F. The design and preparation of these drawings and specifications are based on products and equipment specified under base bid. Bidder or Contractor shall be responsible for any and all changes necessary to accommodate the substitute items, including the costs for:

1. Redesign.

2. Revision of construction documents.

3. Additional construction administration.

3.03 TRANSPORTATION AND HANDLING

A. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

B. Transport and handle products in accordance with manufacturer's instructions.

C. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

D. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct and products are undamaged.

E. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement or damage.

F. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.

B. Store and protect products in accordance with manufacturer's instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weather tight, climate-controlled enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.

G. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

H. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

I. Prevent contact with material that may cause corrosion, discoloration or staining.

J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement or damage.

K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

ENGINEER USE ONLY

Date Received _____

MATERIAL/EQUIPMENT SUBSTITUTION REQUEST FORM PRIOR TO LETTING

This form to be submitted with supporting data.

Project Description/Title _____ JEO Project No. _____

Date of Letting _____ Date of Submittal _____

Reference Specification and Section _____

Name of Bidder Submitting Substitution Request _____

Reason for Substitution Request _____

_____

Is specified material or equipment available? ☐ Yes ☐ No

Has bidder procured plans and specifications from JEO Consulting Group, Inc.? ☐ Yes ☐ No

Has bidder reviewed instructions to bidders, general conditions and supplemental conditions regarding procedures for substitute or "or-equal" materials and equipment? ☐ Yes ☐ No

The contract, if awarded, will be on the basis of materials and equipment specified or described in the bidding documents, or those substitute or "or-equal" materials and equipment approved by Engineer and identified by addendum. The materials and equipment described in the bidding documents establish a standard of required type, function and quality to be met by any proposed substitute or "or-equal" item. No item of material or equipment shall be considered by Engineer as a substitute or "or-equal" unless written request for approval has been submitted by bidder and has been received by Engineer (submittal time and requirements as specified) prior to the date for receipt of bids. Each such request shall conform to requirements of the general conditions, supplemental conditions and instructions to bidders. The burden of proof of the merit of the proposed item is upon bidder. Engineer's decision of approval or disapproval of a proposed item shall be final. If Engineer approves any proposed item, such approval shall be set forth in an addendum issued to all prospective bidders. Bidders shall not rely upon approvals made in any other manner.

APPROVED: ☐ Yes ☐ No

REVIEWER: _____ DATE: _____

Signature

ENGINEER USE ONLY

Date Received _____

MATERIAL/EQUIPMENT SUBSTITUTION REQUEST FORM AFTER EXECUTION OF CONTRACT

This form to be submitted with Contractor's supporting data.

Project Description/Title _____ JEO Project No. _____

Date of Letting _____ Date of Submittal _____

Reference Specification and Section _____

Contractor Submitting Substitution Request _____

Reason for Substitution Request _____

_____

Is specified material or equipment available? ☐ Yes ☐ No

Has Contractor reviewed general conditions, supplemental conditions and other specified material/equipment submittal requirements regarding procedures for substitute or "equivalent" materials and equipment? ☐ Yes ☐ No

What cost savings will be experienced by Owner with this substitution? $_____

Contractor agrees to reimburse Owner for Engineer's review of substitution request if specified equipment is available? ☐ Yes ☐ No

Substitution requests will not be considered that are submitted by subcontractors or suppliers. The contract was awarded on the basis of materials and equipment specified or described in the contract documents, or those substitute or "or-equal" materials and equipment approved by Engineer and identified by addendum. The materials and equipment described in the contract documents establish a standard of required type, function and quality to be met by any proposed substitute or "or-equal" item. No item of material or equipment shall be considered by Engineer as a substitute or "or-equal" unless written request for approval has been submitted by Contractor and has been received by Engineer (submittal time and requirements as specified). Each such request shall conform to requirements of the general and supplemental conditions and any other material/equipment submittal requirements. The burden of proof of the merit of the proposed item is upon Contractor. Engineer's decision of approval or disapproval of a proposed item shall be final. If Engineer approves any proposed item, such approval shall be set forth in written notification to Contractor. Contractor shall not rely upon approvals made in any other manner.

APPROVED: ☐ Yes ☐ No

REVIEWER: _____ DATE: _____

Signature

SECTION 01 70 00

EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation and general installation procedures.

B. Preinstallation meetings.

C. Surveying for laying out the work.

D. Cleaning and protection.

E. Starting of systems and equipment.

F. Demonstration and instruction of Owner's personnel.

1.02 PROJECT CONDITIONS

A. Grade site to drain. Maintain excavations free of water. Provide, operate and maintain pumping equipment.

B. Protect site from ponding or running water. Provide barriers as required to protect site from soil erosion.

C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity and to prevent accumulation of dust, fumes, vapors or gases.

D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent airborne dust from dispersing into atmosphere.

E. Erosion and Sediment Control: Plan and execute construction by methods to control surface drainage from cuts and fills and from borrow and waste disposal areas. Prevent erosion and sedimentation.

1. Minimize amount of bare soil exposed at one time.

2. Provide temporary measures such as berms, dikes, bale checks, silt fence, etc. to prevent erosion.

3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.

4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

5. Contractor is responsible to furnish and install any and all the measures necessary to control erosion, whether it is a pay item or not.

F. Noise Control: Provide methods, means and facilities to minimize noise produced by construction operations.

G. Pollution Control: Provide methods, means and facilities to prevent contamination of soil, water and atmosphere from discharge of noxious, toxic substances and pollutants produced by construction operations.

H. Pest Control: Provide methods, means and facilities to prevent pest and insects from damaging work.

I. Rodent Control: Provide methods, means and facilities to prevent rodents from accessing or invading premises.

1.04 COORDINATION

A. Coordinate scheduling, submittals and work of the various sections of the project manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Notify affected utility companies about proposed construction and coordinate with their requirements.

C. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to and placing in service such equipment.

D. Coordinate space requirements, supports and installation of mechanical and electrical work which are indicated diagrammatically in the drawings. Follow routing shown for pipes, ducts and conduit as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance and for repairs.

E. Coordinate completion and cleanup of work of separate sections.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Engineer of any discrepancies discovered.

C. Control datum for survey may be indicated in the drawings.

D. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

E. Promptly report to Engineer the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

F. Utilize recognized engineering survey practices.

G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:

1. Site improvements, including pavements; stakes for grading, fill and topsoil placement; and utility locations, slopes and invert elevations.

2. Grid or axis for structures.

H. Periodically verify layouts by same means.

I. Maintain a complete and accurate log of control and survey work as it progresses.

3.02 PROGRESS CLEANING

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

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces and other closed or remote spaces prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris and rubbish from site periodically and dispose off-site.

3.03 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 prevent damage.

C. Prohibit traffic from landscaped areas.

D. Limiting Exposure: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging or otherwise deleterious exposure during the construction period, no matter what the cause. Where applicable, such exposures include, but are not limited to, the following:

1. Excessive static or dynamic loading.
2. Excessively high or low temperatures.
3. Excessively high or low humidity.
4. Water or ice.
5. Heavy traffic.
6. Soiling, staining and corrosion.
7. Unusual wear or other misuse.
8. Excessive weathering.
9. Unprotected storage.
10. Improper shipping or handling.
11. Theft.
12. Vandalism.

3.04 STARTING SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Engineer and Owner 7 days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence and for conditions that may cause damage.

D. Verify tests, meter readings and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturer's instructions.

G. When specified in individual specification sections, require manufacturer to provide authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up and to supervise placing equipment or system in operation.

H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.05 DEMONSTRATION AND INSTRUCTION

A. Demonstrate operation and maintenance of products to Owner's personnel prior to date of final inspection.

B. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance and shutdown of each item of equipment.

C. Provide a qualified manufacturer's representative who is knowledgeable about the project to perform demonstration and instruction of Owner's personnel.

D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

3.06 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.07 FINAL CLEANING

A. Execute final cleaning after items have been completed but before making final application for payment.

1. Clean areas to be occupied by Owner prior to final completion and/or before Owner's occupancy.

B. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned, as recommended by the manufacturer of the equipment and/or fixtures.

C. Clean filters, if reusable, or provide new for operating equipment.

D. Clean site, sweep paved areas and rake clean landscaped surfaces.

E. Remove waste and surplus materials, rubbish and construction facilities from the site.

3.08 MAINTENANCE SERVICE

A. Furnish service and maintenance of components indicated in specification sections during the warranty period.

B. Examine system components at a frequency consistent with reliable operation. Clean, adjust and lubricate as required.

C. Include systematic examination, adjustment and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

D. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of Owner.

END OF SECTION

SECTION 01 71 13

MOBILIZATION AND DEMOBILIZATION

PART 1 - GENERAL

1.01 SCOPE

A. The work shall consist of the mobilization and demobilization of Contractor's forces and equipment necessary for performing the work required under the contract.

B. This work shall not include mobilization and demobilization for specific items of work for which payment is provided elsewhere in the contract.

C. Mobilization shall not be considered as work in fulfilling the contract requirement for commencement of work.

D. The work shall consist of providing all required contract bonding and insurance required under the contract.

1.02 UNIT PRICES - MEASUREMENT AND PAYMENT

A. No measurement will be made.

B. Mobilization: A lump sum amount that includes all items described in this section. The costs for insurance and bonds may be included in Mobilization if a separate bid item for insurance and bonds is not provided.

1. The partial payment for any Mobilization item will be limited to an amount not to exceed 10 percent (10%) of the total amount bid, including mobilization, for the group in which the Mobilization occurs. In the event the lump sum bid for "Mobilization" exceeds 10 percent (10%) of the total group amount; the difference (remainder) will not be paid until Owner has accepted the Project.

2. Subject to the limitations stated in Paragraph 1 of this subsection, when the contract documents provide a separate bid item for Mobilization, progress payments for mobilization shall be made as follows:

a. When 5 percent (5%) of the original contract sum for the contract or a specific Group has been earned, excluding Mobilization, the first 25 percent (25%) of the contract or that Group's Mobilization amount will be paid, subject to the limitations stated in Paragraph 1 of this subsection.

b. When 10 percent (10%) of the original contract sum for the contract or a specific Group has been earned, excluding Mobilization, the second 25 percent 25% (bringing the total payments to 50%) of the contract or that Group's Mobilization amount will be paid, subject to the limitations stated in Paragraph 1 of this subsection.

c. When 50 percent (50%) of the original contract sum for the contractor or a specific Group has been earned, excluding Mobilization, the second 50 percent 50% (bringing the total payments to 100%) of the contract or

that Group's Mobilization amount will be paid, subject to the limitations stated in Paragraph 1 of this subsection.

d. Upon completion of all work on the project required by the contract, and acceptance by Owner, full payment will be made for mobilization, including any amount not paid as a progress payment.

3. When "Mobilization" is not shown as a separate pay item in the bid form, the work described in this section shall be considered incidental and subsidiary to all other items of work within the contract for which direct payment is made and no separate payments will be made for Mobilization.

C. Insurance and Bonds: A lump sum amount that includes the costs of Contract Bond(s) and all insurance premiums.

1. Payment for any Insurance and Bonds bid item will be allowed following contract execution and Owner will pay up to 100 percent (100%) of the bid item for that Group's Insurance and Bonds amount.

2. When "Insurance and Bonds" is not shown as a separate pay item, it shall be included in the "Mobilization" bid item. If neither "Insurance and Bonds" or "Mobilization" are shown as separate bid items, the work described in this section shall be considered subsidiary to other pay items in the contract.

1.03 EQUIPMENT AND MATERIALS

A. Mobilization shall include all activities and costs for transportation of personnel, equipment and operating supplies to the site; establishment of offices, buildings and other necessary facilities for Contractor's operations at the site; and premiums paid for performance and payment bonds, including coinsurance and reinsurance agreements as applicable.

B. Demobilization shall include all activities and costs for transportation of personnel, equipment and supplies not included in the contract from the site, including the disassembly, removal and site cleanup of offices, buildings and other facilities assembled on the site for this contract. No separate payment will be made for demobilization.

C. This work includes mobilization and demobilization required by the contract at the time of award. If additional mobilization and demobilization activities and costs are required during the performance of the contract as a result of changed, deleted or added items of work for which Contractor is entitled to an adjustment in contract price, compensation for such costs shall be included in the price adjustment for the item or items or work changed or added.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 77 00

PROJECT CLOSEOUT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including general and supplementary conditions and other specification sections, apply to this section.

1.02 SUMMARY

A. This section specifies administrative and procedural requirements for project closeout including, but not limited to:

1. Inspection procedures.
2. Project record document submittal.
3. Operation and maintenance manual submittal.
4. Submittal of warranties.
5. Final cleaning.

B. Closeout requirements for specific construction activities are included in the appropriate sections.

1.03 PRIOR TO FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting the substantial completion, complete the following.

1. If 100 percent of project completion has not been achieved, include a list of incomplete items, the value of incomplete construction and reasons the work is not complete.
2. Inform 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 extra stock as specified in individual specification sections.
6. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

B. Inspection Procedures: On receipt of a request for inspection, Engineer shall either proceed with inspection or advise Contractor of unfilled requirements. Engineer shall advise Contractor of construction that must be completed or corrected before the substantial completion will be issued.

1. Engineer shall repeat inspection when requested and assured that the work has been completed.

2. Results of the completed inspection shall form the basis of requirements for final acceptance.

1.04 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for substantial completion and final payment, complete the following. List exceptions in the request.

1. Submit record drawings, maintenance manuals, property survey and similar final record information.

2. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.

3. Submit an updated final statement, accounting for final additional changes to the contract sum.

4. Submit a certified copy of Engineer's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance and the list has been endorsed and dated by Engineer.

5. Submit consent of surety with the application for final payment, if requested by the Owner.

6. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

7. Submit an affidavit stating that, to the best of Contractor's knowledge, asbestos was not used in the manufacture and fabrication of products and materials used in conjunction with the project.

8. Submit signed and completed punch list documents to Engineer.

B. Reinspection Procedure: Engineer shall reinspect the work upon receipt of notice that the work, including inspection list items from earlier inspections, has been completed, except items where completion has been delayed because of circumstances acceptable to Engineer.

1. Upon completion of reinspection, Engineer shall prepare the substantial completion, or advise Contractor of work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance of the project.

1.05 RECORD DOCUMENT SUBMITTALS

A. General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; and provide access to record documents for Engineer's reference during normal working hours.

B. Record Drawings: Maintain a clean, undamaged set of blue or black line white prints of contract drawings and shop drawings. Mark the set to show the actual installation where the installation varies substantially from the work as originally shown. Mark whichever 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. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

1. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the work.
2. Mark new information and/or design changes that were not shown on contract drawings or shop drawings.
3. Note related change order numbers where applicable.
4. Organize record drawing sheets into manageable sets; bind with durable paper cover sheets; and print suitable titles, dates and other identification on the cover of each set.

C. Record Specifications: Maintain 1 complete copy of the project manual, including addenda, and 1 copy of other written construction documents, such as change orders and modifications issued in printed form during construction. Mark these documents to show substantial variations in actual work performed in comparison with the text of the specifications and modifications. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation. Note related record drawing information and product data.

1. Upon completion of the work, submit record specifications to Engineer for Owner's records.

D. Record Product Data: Maintain 1 copy of each product data submittal. Mark these 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. Give particular attention to concealed products and portions of the work which cannot otherwise be readily discerned later by direct observation. Note related change orders and markup of record drawings and specifications.

1. Upon completion of markup, submit complete set of record product data to Engineer for Owner's records.

E. Extra Stock Submitted: Immediately prior to the date or dates of substantial completion, Contractor shall meet at the site with Engineer and Owner's personnel to transmit extra stock to Owner for storage purposes. Comply with delivery of Owner's storage area.

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, properly identified and bound or filed, ready for continued use and reference. Submit to Engineer for Owner's records.

1.06 OPERATION AND MAINTENANCE MANUAL SUBMITTAL

A. Maintenance Manuals: Organize operating and maintenance data into 3 sets of manageable size. Bind properly indexed data in individual heavy-duty, 3-inch, 3-ring

vinyl-covered binders complete with tab sections and table of contents, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder. Include the following types of information:

1. Emergency instructions.
2. Spare parts list.
3. Copies of warranties.
4. Wiring diagrams.
5. Recommend “turn around” cycles.
6. Inspection procedures.
7. Shop drawings and product data.
8. Equipment cards for all equipment furnished on project.
9. List of subcontractors and material suppliers.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.

1. Provide copies to Engineer and Owner.

B. Notify Engineer when work is considered ready for final/partial inspection.

C. 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 review.

D. Owner shall occupy all of the site or facilities as indicated in the plans or as directed by Owner and Engineer.

E. Correct items of work listed in executed punch list documents and comply with requirements for access to Owner occupied areas.

F. Notify Engineer and Owner when work is considered 100 percent complete.

G. Complete items of work determined by Engineer’s final inspection.

H. Operating and Maintenance Instructions: Arrange for each installer of equipment that requires regular maintenance to meet Owner’s personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer’s representatives. Include a detailed review of the following items:

1. Maintenance manuals.
2. Record documents.
3. Spare parts and materials.
4. Tools.

5. Identification systems.

6. Control sequences.

7. Hazards.

8. Cleaning.

9. Warranties and bonds.

10. Maintenance agreements and similar continuing commitments.

11. Equipment cards.

12. Lubricants and fuels.

I. As part of instruction for operating equipment, demonstrate the following procedures:

1. Start-up.

2. Shutdown.

3. Emergency operations.

4. Noise and vibration adjustments.

5. Safety procedures.

6. Economy and efficiency adjustments.

7. Effective energy utilization.

3.02 FINAL CLEANING

A. General: General cleaning during construction is required by the general conditions and included in Section 01 50 00 - Temporary Facilities.

B. 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 substantial completion.

a. Remove labels that are not permanent labels.

b. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.

c. 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 reflective condition. Leave concrete floors broom clean.

d. Clean the site, including landscape development areas, of rubbish, liter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted to a smooth, even-textured surface.

C. Removal of Protection: Remove temporary protection and facilities installed for protection of the work during construction.

D. 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 Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.

1. Wipe surfaces of mechanical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition.

2. Wipe surfaces of electrical equipment. Clean light fixtures and lamps.

3. Where extra materials of value remaining after completion of associated work have become Owner's property, arrange for disposition of these materials as directed by Engineer/Owner.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Concrete formwork

B. Floors and slabs on grade

C. Concrete foundation walls

D. Elevated concrete slabs

E. Concrete reinforcement

F. Joint devices associated with concrete work

G. Miscellaneous concrete elements, including equipment pads, light pole bases, thrust blocks and manholes

H. Concrete curing

1.02 REFERENCES

A. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete

B. ACI 301 – Specifications for Structural Concrete for Buildings

C. ACI 302.1R – Guide for Concrete Floor and Slab Construction

D. ACI 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete

E. ACI 305R – Hot Weather Concreting

F. ACI 306R – Cold Weather Concreting

G. ACI 309R – 05 Guide to Consolidation of Concrete

H. ACI 315 – Standard Practice for Detailing Reinforced Concrete Structures

I. ACI 351 – Grouting Between Foundations and Bases for Support of Equipment and Machinery

J. ASTM C 33 – Standard Specification for Concrete Aggregates

K. ASTM C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

L. ASTM C 94 – Standard Specification for Ready-Mixed Concrete

M. ASTM C 143 – Standard Test Method for Slump of Hydraulic-Cement Concrete

N. ASTM C 150 – Specification for Portland Cement

O. ASTM C 171 – Standard Specification for Sheet Materials for Curing Concrete

P. ASTM C 173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

Q. ASTM A 185 – Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete (Withdrawn 2013)

R. ASTM C 260 – Standard Specification for Air-Entraining Admixtures for Concrete

S. ASTM C 309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

T. ASTM C 311 – Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland - Cement Concrete

U. ASTM C 494 – Standard Specification for Chemical Admixtures for Concrete

V. ASTM A 497 – Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete (Withdrawn 2013)

W. ASTM A 615 – Standard Specification for Deformed and Carbon-Steel Bars for Concrete Reinforcement

X. ASTM C 618 –- Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

Y. ASTM C 920 – Standard Specification for Elastomeric Joint Sealants

Z. ASTM C 1017 – Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete

AA. ASTM C 1074 – Standard Practice for Estimating Concrete Strength by the Maturity Method

BB. ASTM C 1077 – Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation

CC. ASTM C 1116 – Standard Specification for Fiber-Reinforced Concrete

DD. ASTM D 2628 – Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

EE. ASTM D 5893 – Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.

FF. ASTM DD 6690 – Standard Specification for Joint and Crack Sealants, Hot-Applied for Concrete and Asphalt Pavements

GG. ASTM E 329 – Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

HH. ASTM E 548 – Standard Guide for General Criteria Used for Evaluating Laboratory Competence

II. ASTM E 1643 – Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs

JJ. AASHTO M 33 – Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)

KK. AASHTO M 182 – Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

LL. State Standard Specifications for Highway Construction, Latest Addition, including all current supplemental specifications

MM. NSF 61 – Drinking Water System Components - Health Effects

1.03 UNIT PRICES

A. Concrete - Slab on Grade or Vertical in Forms or Miscellaneous Locations:

1. Includes formwork, reinforcement, concrete, placement accessories, consolidating and leveling, troweling and curing.

2. Method of measurement and pay unit by the cubic yard, square yard, as shown on the Bid Form, or as described in the Special Provisions Section 01 10 00.

3. Components and accessories are subsidiary items to placing concrete.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data on manufactured material and products indicated.

B. Design Mixes:

1. Submit the proposed mix design for each class of concrete to Engineer and testing firm for review prior to commencement of concrete operations.

2. Specify amounts of mix water to be withheld for later addition at project site, if any.

3. Provide the source, type, name, and amount of each admixture in the design mix.

C. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Cementitious materials and aggregates.

2. Steel reinforcement and reinforcement accessories.

3. Admixtures.

D. Mockup Panels:

1. Contractor may be required to construct and erect a mockup panel for architectural surfaces, finishes, colors or other treatments.

E. Shop Drawings - Steel Reinforcement: Details of fabrication, bending and placement prepared according to ACI 315.

1. Included material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement and supports of concrete reinforcement.

2. Include special reinforcement required for openings through concrete structures.

F. Project Record Documents: Accurately record locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design and extent to that indicated for this project and whose work has resulted in construction with a record of successful in-service performance.

B. Concrete Supplier's Qualifications: Firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

1. Concrete Supplier's must be certified according to the National Ready Mixed Concrete Association Certification of Ready Mixed Concrete Production Facilities.

C. Testing Agency Qualifications: Independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct testing indicated, as documented according to ASTM E 548.

1. Personnel conducting tests shall be qualified as ACI concrete field testing technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

D. Obtain each type or class of cementitious material of the same brand from the same source, aggregate from same source and each admixture from same source.

PART 2 - PRODUCTS

2.01 FORMWORK

A. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.

1. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true and smooth concrete surfaces. Furnish in largest practical sizes to minimize number of joints.

a. Plywood, metal or other approved panel materials.

b. Use of aluminum forms is prohibited.

2. Rough-Formed Finished Concrete: Plywood, lumber, metal or other approved material. Provide dressed lumber on at least 2 edges and 1 side for tight fit. Use of aluminum forms is prohibited.

3. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber reinforced plastic, paper or fiber tubes that will produce surfaces that meet specified formwork surface class. Use of aluminum forms is prohibited. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

4. Chamfer Strips: Wood, metal, PVC or rubber strips 3/4 inch by 3/4 inch minimum.

5. Form Coating: Commercially formulated release agent that will not bond, stain or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

    a. For steel forms, formulate form-release agent with rust inhibitor.

6. Form Ties: Cone snap type that will leave no metal within 1 1/2 inches of concrete surface. Form ties with a waterstop shall be used for any structure that its intended purpose is to hold a liquid (i.e., water, wastewater, swimming pools, etc.).

2.02 REINFORCEMENT

A. Reinforcing Steel:

1. ASTM A 615 Grade 60

    a. New, deformed billet-steel bars.

    b. Unfinished.

B. Plain-Steel Welded Wire reinforcement:

1. ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

    a. Rolled sheets are not permitted.

C. Deformed-Steel Welded Wire Reinforcement:

1. ASTM A 497, flat sheet

    a. Rolled sheets are not permitted.

D. Dowel Bars:

1. ASTM A 615 Grade 60.

    a. New, smooth round steel bars.

    b. Coated with organic coating AASHTO M 254, corrosion resistant coated dowel bars.

2. Cut bars true to length with ends square and free of burrs.

E. Reinforcement Accessories:

1. Tie Wire: Annealed, minimum 16 gauge.

2. Chairs, Bar Supports, Bolsters, Spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place shall comply with CRSI's "Manual of Standard Practice’.

3. Chairs, Bar Supports, Bolsters, Spacers, and other devices for spacing: Sized and shaped for adequate support of reinforcement during concrete placement.

2.03 CONCRETE MATERIALS

A. Concrete Materials:

1. Concrete shall consist of aggregate, Portland cement, water, approved air-entraining and other admixtures and pozzolans.

B. Cement:

1. Type I, Type II, Type I/II and Type III Portland cement shall conform to the requirements in ASTM C 150 with the following additional requirements:

   a. Portland cement shall not contain more than 0.60 percent equivalent alkali.

   b. Processing additions may be used in the manufacture of the cement, provided such materials have been shown to meet the requirements of ASTM C 465 and the total amount does not exceed 1 percent of the weight of Portland cement clinker.

2. Interground and Blended Cement shall conform to the requirements in ASTM C 595 with the following additional requirements:

   a. Interground/Blended cement Type IP

      (i) Type IP(25) shall be composed of Class F fly ash or Class N pozzolan replacement shall be 25%+/-2%

      (ii) Type IP(20) shall be composed of Class F fly ash or Class N pozzolan replacement shall be 20%+/-2%

   b. Interground/Blended cement Type IT

      (i) For SCMs, slag cement and limestone, the maximum replacement by weight shall be 40%. The manufacturer has a production tolerance of +2% from the proposed replacement.

      (ii) For slag cement, the maximum replacement shall be 20% or less when incorporated into the final Interground/Blended cement.

      (iii) For limestone cement, the replacement range shall be from 5.1% to 10.0% when incorporated into the final Interground/Blended cement.

C. Normal weight Fine and Coarse Mix Aggregate:

1. Mineral aggregates shall be crushed rock, broken stone, gravel, sand-gravel, coarse sand, fine sand, or a mixture of these materials composed of clean, hard, durable, and uncoated particles.

2. Shall meet the requirements in ASTM C 33.

3. Aggregates shall be free from injurious quantities of dust, soft or flaky particles, loams, alkali, organic matter, paper, wood, or other deleterious matter as determined by Engineer.

4. Free of materials with deleterious reactivity to alkali in cement.

D. Fly Ash: Shall meet the requirements in Class F; ASTM C 618 and ASTM C 311.

1. The use of Class C Fly ash is not acceptable in any concrete on this project.

E. Water:

1. Shall meet the requirements in ASTM C 94 and potable.

2. Water shall be free from objectionable quantities of oil, acid, alkali, salt, organic matter, or other deleterious materials.

2.04 ADMIXTURES

A. Contractor shall report the source, type, name, and amount of each admixture.

B. Air-Entrainment Admixture:

1. Shall meet the requirements in ASTM C 260.

2. For concrete that requires shrinkage reducing admixture, ensure that the air entrainment admixture that meets the shrinkage reducing admixture's manufacturer's requirements is utilized.

C. Plasticizing and Retarding Admixture: Shall meet the requirements in ASTM C 1017.

D. Other Chemical Admixtures:

1. Refer to approved products list in the applicable State or Local Standard Specifications or as specified in Section 01 10 00 - Special Provisions.

2. Admixtures shall meet the requirements in ASTM C 494.

3. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of concrete.

4. Admixture shall not contain more than 1 percent of chlorides calculated as calcium chloride.

2.05 CONCRETE ACCESSORIES

A. Vapor Retarder: 10 mil thick nonwoven, polyester-reinforced, polyethylene coated sheet, type recommended for below grade application.

B. Waterstops:

1. Corps of Engineers (COE) CRD-C 572 and ASTM Standards

2. PVC type

3. Factory fabricated corners, intersections and directional changes.

4. Profile: Flat, ribbed with center bulb.

5. Size: 4", unless specified differently on the Plans or Special Provisions.

6. Pre-approved Manufacturers:

a. Greenstreak

b. Progress Unlimited, Inc.

c. Westec Barrier Technologies

d. Williams Products, Inc.

e. Approved Equivalent

C. Joint Filler: Preformed, non-extruding, bituminous type, AASHTO M 33.

D. Joint Sealer:

1. Asphaltic, hot poured, ASTM D 6690, Type II.

a. Application: Use for joints in vehicular traffic areas.

2. Silicone, cold applied, ASTM D 5893.

a. Application: Use for joints in vehicular traffic areas.

3. General Purpose Exterior Sealant: Polyurethane; ASTM C 920, Grade NS, Class 25, Uses T, I, M, A; single component. (Not for use in highway and airfield pavements and bridges.)

a. Applications: Use for:

(i) Control, expansion, and soft joints in masonry.

(ii) Joints between concrete and other materials.

(iii) Joints between metal frames and other materials.

(iv) Other exterior joints for which no other sealant is indicated.

4. Exterior Preformed Expansion Joint Sealer: ASTM D 2628, hollow neoprene (polychloroprene) compression gasket, black in color, supplied in proper size and shape to perform for the finished joint detail on Drawings.

a. Applications: Use for:

(i) Exterior wall expansion joints.

(ii) Parking deck expansion joints.

5. Concrete Paving Joint Sealant: Polyurethane, self-leveling; ASTM C 920, Class 25 100/50, Uses T, I, M and A; single component, color gray.

a. Applications: Use for:

(i) Joints in sidewalks, pedestrian walkways and vehicular paving (other than highway and airfield pavements and bridges) where a self-leveling sealant is appropriate.

2.06 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz/sq yd dry.

C. Moisture-Retaining Cover: ASTM C 171; clear polyethylene or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

F. Liquid Membrane-Forming Compounds for Curing Concrete: White pigmented, AASHTO M 148, Type 2.

2.07 CONCRETE MIX DESIGN

A. Specific mix design criteria for project components as stated in Section 01 10 00 – Special Provisions.

B. For trial mixtures method, employ independent testing agency acceptable to Engineer for preparing and reporting proposed mix designs.

C. Admixtures: Add acceptable admixtures as recommended in ACI 211 and at rates recommended by manufacturer.

1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizers) in concrete, as required, for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity or other adverse placement conditions.

D. Non-Shrink Grout:

1. 6 sack grout, with the following quantities:

a. Cement: Type I, 2.87 cubic feet

b. Sand: Masonry sand, 17.97 cubic feet

c. 6% entrained air

d. Water: 4.54 cubic feet

e. POZZ 900 oz./100 admixture, 12 per mix

f. Water-Cementitious Ratio: 0.502 at SSD aggregate moisture

g. Unit Weight: 140.20 lbs./cf

E. Maximum Water-Cementitious Materials Ratio: As specified by the applicable State or Local Standard Specifications or as specified in Section 01 10 00 - Special Provisions.

F. Air Content: As specified by the applicable State or Local Standard Specifications or as specified in Section 01 10 00 - Special Provisions.

2.08 MIXING

A. Ready-Mixed Concrete: Measure, batch, mix and deliver concrete according to ASTM C 94 and ASTM C 1116 and furnish batch ticket information.

1. When air temperature is between 85- and 90-degrees F, reduce mixing and delivery time from 1 1/2 hours to 75 minutes. When air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify lines, levels and dimensions before proceeding with work of this section.

B. Verify compacted subgrade is acceptable and ready to support footings, slabs and any other imposed loads.

3.02 PREPARATION

A. Notify Engineer a minimum of 48 hours prior to commencement of concreting operations.

B. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured.

1. Set edge forms, bulkheads and intermediate screed strips for slabs to achieve required alignment, elevation and slope in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

2. Chamfer exterior corners and edges of permanently exposed concrete.

3. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt and other debris just before placing concrete.

4. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

5. Verify that forms are clean and free of rust before applying release agent. Coat contact surfaces of forms with form-releasing agent, according to manufacturer's directions, before placing reinforcement.

6. Use of excavated earth back form shall not be permitted unless approved by Engineer. All structural walls shall be formed with form panels.

C. Removing and Reusing Forms:

1. Fabricate and assemble formwork to permit easy stripping and dismantling without damage to concrete. Forms shall be easily removed without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses and the like for easy removal.

2. Formwork for sides of beams, walls, columns and similar parts of the work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 degrees F for 24 hours after placing concrete, provided concrete is hard enough to prevent damage by form removal operations,

concrete has adequate strength to maintain structural integrity of the work and curing and protection operations are maintained.

3. Leave formwork for beam soffits, joists, slabs and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of 28-day design compressive strength.

4. Clean and repair surfaces of forms to be reused in the work. Split, frayed, delaminated or otherwise damaged form-facing material is not acceptable for exposed surfaces. Apply new form-release agent.

5. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms on exposed concrete surfaces unless approved by Engineer.

D. Embedded Items:

1. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions and directions furnished with items to be embedded.

a. Install anchor bolts, accurately located, to elevations required.

E. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

F. Vapor Retarder Under Interior Slabs on Grade:

1. Place, protect and repair vapor-retarder sheets according to ASTM E 1643 and manufacturer's instructions.

3.03 REINFORCEMENT

A. Delivery, Storage and Handling

1. Deliver, store and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

B. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale and accurately position, support and secure in place to achieve not less than minimum concrete coverage required for protection.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

C. Accurately position, support and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

D. Tying Reinforcement:

1. Tie reinforcing bars securely in place at all points where bars cross other reinforcing bars.

2. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practical length on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least 1 mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Splice laps with tie wire.

F. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely and will not interfere with concrete placement.

G. Welding on reinforcing steel is prohibited unless specifically authorized by Engineer.

3.04 JOINT PLACEMENT

A. Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired at locations indicated or as approved by Engineer.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.

2. Form with preformed galvanized steel, plastic keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1 1/2 inches into concrete.

3. Locate joints for beams, slabs, joists and girders in the middle third of span. Offset joints in girders a minimum distance of twice the beam width from beam-girder intersection.

4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, girders and at top of footings or floor slabs.

5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners and in concealed locations where possible.

6. Use bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade. Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least 1/4 of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate tool marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams and other locations as indicated.

1. Extend joint filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are indicated.

3. Install joint-filler strips in lengths as long as practical. Where more than one length is required, lace or clip sections together.

E. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated. Use dowel sleeves or lubricate or asphalt-coat 1/2 of dowel length to prevent concrete bonding to 1 side of joint.

F. Waterstops:

1. Flexible Waterstops: Install in construction joints as indicated to form a continuous diaphragm. Install in longest lengths practical. Support and protect exposed waterstops during progress of work. Field fabricate joints in waterstops according to manufacturer's instructions.

3.05 PLACING CONCRETE

A. Follow recommendations of ACI 306R when concreting during cold weather.

B. Follow recommendations of ACI 305R when concreting during hot weather.

C. Before placing concrete, verify that installation of formwork, reinforcement and embedded items are complete and required inspections have been performed.

D. Repair vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas a minimum of 6 inches and seal watertight.

E. Install joint devices in accordance with manufacturer's instructions.

F. Ensure reinforcement, embedded parts and forms are not disturbed during concrete placement.

G. Do not add water to concrete during delivery, at project site or during placement unless approved by Engineer.

H. Deposit concrete continuously or in layers at such thickness that no concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation. Concrete free fall distance shall not exceed 5 feet. This includes free fall in a discharge pipe. Chutes and tremie pipes may be used for conveying concrete to the forms when authorized by Engineer.

I. Deposit concrete in forms in horizontal layers no deeper than 18 inches and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic to avoid cold joints.

1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.

2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layers and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration as necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.

J. Deposit and consolidate concrete for floors and slabs in continuous operation, within limits of construction joints, until placement of panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Maintain reinforcement in position on chairs during concrete placement.

3. Screed slab surfaces with a straightedge and strike off to correct elevations.

4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-texture surface plane, free of humps or hollows, before excess moisture or bleedwater appears on surface. Do not further disturb slab surfaces before starting finishing operations.

K. Pumping Concrete:

1. Pump concrete into forms in a continuous stream and free of air pockets. Eject concrete in the pipeline in such a manner that there will be no contamination or segregation of the concrete.

2. Use pump discharge pipes designed to maintain a positive pressure head on the concrete. Free fall distance shall not exceed 5 feet at discharge.

3. Perform air test, slump tests and fabrication of concrete test cylinders at the final discharge point.

L. Cold-Weather Placement: Comply with ACI 306.1 and as follows:

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions or low temperatures.

2. When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F and not more than 80 degrees F at point of placement.

3. Do not use frozen materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

4. Do not use calcium chloride, salt or materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.

M. Hot-Weather Placement: Comply with ACI 305R and as follows when hot weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 degrees F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, steel reinforcement and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots or dry areas.

N. Screed floors level, maintaining surface flatness of maximum 1/4 inch in 10 feet.

3.06 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.

C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:

1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive not more than 24 hours after form removal.

2. Grout Cleaned Finish: Wet areas to be cleaned and apply grout mixture by brush or spray; scrub immediately to remove excess grout. After drying, rub vigorously with clean burlap and keep moist for 36 hours.

3. Cork Floated Finish: Immediately after form removal, apply grout with trowel or firm rubber float, compress grout with low-speed grinder and apply final texture with cork float.

D. Concrete Floors and Slabs: Finish to requirements of ACI 302.1R and as follows:

1. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Straighten, cut down high spots and fill low spots. Repeat float passes and straightening until surface is left with a uniform, smooth, granular texture.

a. Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up membrane roofing or sand-bed terrazzo.

2. Trowel Finish: After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and straighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

    a. Apply a trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic, or quarry tile set over a cleavage membrane, paint or another thin-film finish coating system.

    b. Finish and measure surface so gap at any point between concrete surface and an unleveled freestanding 10-foot long straightedge, resting on 2 high spots and placed anywhere on the surface, does not exceed 1/4 inch.

3. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thick-set or thin-set method.

    a. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with fine broom.

4. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps and elsewhere as indicated.

    a. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

5. Burlap Drag Finish: Apply a burlap drag finish to paving, parking areas and elsewhere as indicated.

    a. Immediately after float finishing, texture by dragging a wet burlap, carpet or canvas belt over full width of surface in longitudinal direction.

    b. Suspend drag from mandrel or similar device to ensure uniform texture.

    c. Rinse or wash drags as necessary to obtain uniform texture.

    d. Replace drags which cannot be cleaned.

3.07 CURING AND PROTECTION

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold weather protection and with recommendation in ACI 305R for hot weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry or windy conditions cause moisture loss approaching 0.2 lb/sq ft per hour before and during finishing operations.

1. If the rate of evaporation approaches 0.2 lb/sq ft per hour, Contractor must notify Engineer regarding the additional actions that will be taken to prevent plastic shrinkage cracking.

2. Obtain rate of evaporation from applicable State or local Standard Specification.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days with the following materials:

a. Water.

b. Continuous water-fog spray.

c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining Cover Curing: Cover concrete surfaces and sides with moisture-retaining cover for curing concrete, placed in widest practical width, lapped at least 12 inches and sealed with waterproof tape or adhesive. Cure for not less than 7 days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

c. Cure concrete surfaces to receive floor covering with either a moisture-retaining cover or a manufacturer recommended curing compound for use with floor coverings.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Repeat process 24 hours later and apply second coat. Maintain continuity of coating and repair damage during curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings and other surfaces, by one of the methods listed above in formed surfaces.

3.08 JOINT FILLING

A. Prepare, clean and install joint filler according to manufacturer's directions.

B. Remove dirt, debris, saw cuttings, curing compounds and sealers from joints; leave contact faces of joint clean and dry.

C. Install semi-rigid epoxy joint filler depth in saw-cut joints and at least 2 inches into deep-formed joints. Overfill joint and trim joint filler flush with lip of joint after hardening.

D. Seal joints in conformance with Drawings and according to manufacturer's directions for joint sealer product used.

E. For preformed compression seals install compressed into the joint, with manufacturer-approved equipment and installation method.

F. If adhesion is not satisfactory, the joint sealer material will be removed and the joint cleaned and resealed at no cost to Owner.

3.09 FIELD QUALITY CONTROL

A. An independent testing agency employed by Owner shall perform field quality control tests as specified in Section 01 40 00 - Quality Requirements.

1. Contractor shall provide free access to concrete operations at project site and cooperate with testing agency.

2. Contractor shall submit proposed mix design of each class of concrete to Engineer and testing agency for review prior to commencement of concrete operations.

3. Results of testing shall be furnished in a timely manner to Owner, Engineer and Contractor, in writing.

4. Field testing and laboratory testing of concrete will be performed by testing agency employed by Owner to determine conformance with specified requirements.

5. Strength Testing:

a. Compressive Strength Test Samples: ASTM C 39. For each test, mold and cure 3 concrete test cylinders. A set of 3 test cylinders shall be collected for every 100 cubic yard or fractional part thereof for each class of concrete placed in a day. At least one set of cylinders is required for each day concrete placement takes place.

(i) One additional cylinder may be required for a break prior to 7 days.

(ii) Take 1 additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

b. Maturity Method for Estimating Strength: ASTM C 1074. The Contractor may elect to utilize the maturity curve method to determine concrete strength. The Contractor must notify the Engineer in writing and submit a Plan with any changes applicable with State or local standard specifications.

6. Perform 1 slump test for each set of test cylinders taken.

a. If the concrete mixture is excessively wet causing segregation, excessive bleeding, or any other undesirable condition, the concrete shall be rejected.

b. If the slump is outside the allowable limits specified in Section 01 10 00 - Special Provisions, the load of concrete shall be rejected.

7. Perform 1 air content test for each set of test cylinders taken.

a. If the air content is less than the minimum specified, only one addition of air-entraining admixtures is allowed.

b. If the air content is then outside the allowable limits specified in Section 01 10 00 - Special Provisions, the load of concrete shall be rejected.

B. The independent testing agency employed by Owner will maintain records of placed concrete items and Contractor shall assists testing agency as necessary to accomplish the completion of this record keeping. Records will include type of test samples taken, all test results, date and location of sample collected, concrete test cylinder number, quantity of concrete placed and slump, air content, air temperature test results.

C. Additional Tests: The testing agency employed by Owner shall make additional tests of concrete, as directed by Engineer, when test results indicate that slump, air entrainment, compressive strengths or other requirements have not been met.

1. The cost for this additional testing will be paid for by Contractor.
2. If any additional testing is required to isolate failures, this shall be considered retests and shall be paid for by Contractor.

3.10 DEFECTIVE CONCRETE

A. All materials which Engineer determines to be damaged, defective, or otherwise unsuitable for use will be rejected and shall be removed and replaced at Contractor's expense.

B. Contractor will be required to take corrective measures for high spots or low areas by removal and replacement, or by grinding with a machine equipped with multiple diamond blades with spacers to the required profile. If grinding is used, utilize methods which do not break the cement and aggregate bond. Engineer will determine whether defective concrete will be repaired, or if it will be rejected and removed and replaced. Contractor shall submit the proposed corrective action plan and receive Engineer AND Owner approval prior to performing corrective measures. The approved corrective measure will be done at Contractor's expense.

C. Contractor will be required to take corrective measures for any cracking of concrete no matter what the cause. The corrective measures may include routing and sealing the cracks or removal and replacement. Engineer will determine whether defective concrete will be repaired, or if it will be rejected and removed and replaced. Contractor shall submit the proposed corrective action plan and receive Engineer AND Owner approval prior to performing corrective measures. The approved corrective measures will be done at Contractor's expense.

D. Joints: Contractor will be required to take corrective measures for any joints that in the opinion of Engineer are not constructed per the plans and specifications. Contractor shall submit the proposed corrective action plan and receive Engineer AND Owner approval prior to performing corrective measures. The approved corrective measures will be done at Contractor's expense.

E. Contractor will be required to take corrective measures for any concrete containing excessive honeycombing, spalling, fractures, chips and concrete that does not conform to required lines, details, dimensions, tolerances, specified requirements or other defects at no additional cost to Owner. The corrective measures may include repairing concrete or removal and replacement of concrete. Engineer will determine whether defective concrete will be repaired, or if it will be rejected and removed and replaced. Contractor shall submit the proposed corrective action plan and receive Engineer AND Owner approval prior to performing corrective measures. The approved corrective measures will be done at Contractor's expense.

F. Contractor must protect the concrete from damage due to rain, premature drying, excessive hot or cold temperatures, foot traffic and vehicular traffic. Failure to properly protect concrete may constitute cause for repairing or for removal and replacement of defective concrete. Engineer will determine whether defective concrete shall be repaired, or if it shall be rejected and removed and replaced. Contractor shall submit the proposed corrective action plan to address the defective concrete and receive Engineer AND Owner approval prior to performing corrective measures. The approved corrective measures will be done at Contractor's expense.

G. The cost of any additional testing performed as a result of repairing or removal and replacement of defective concrete shall be borne by Contractor when defective concrete is identified.

3.11 TOLERANCES

A. Maximum Variation of Surface Flatness: 1/8 inch in 10 feet.

B. Maximum Variation from True Position: 1/4 inch.

C. All concrete shall meet or exceed the strength requirement of the specifications.

1. If concrete does not meet the minimum strength requirement, the Contractor may elect to further evaluate the use of the concrete in place. Evaluation shall be performed by the Engineer of record, at the Contractor's expense. .

2. Concrete not approved by the Engineer shall be rejected and shall be removed and replaced at Contractor's expense.

D. All concrete shall meet or exceed the minimum thickness as per the plans and specifications.

1. If concrete does not meet the minimum thickness requirement, the Contractor may elect to further evaluate the use of the concrete in place. Evaluation shall be performed by the Engineer of record, at the Contractor's expense.

2. Concrete not approved by the Engineer shall be rejected and shall be removed and replaced at Contractor's expense.

END OF SECTION

SECTION 09 96 10

HIGH-PERFORMANCE COATINGS WATER AND WASTEWATER ENVIRONMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. General Intention:

1. The work covered under this specification includes applications for high-performance coatings to equipment, piping or other miscellaneous materials typically associated with potable drinking water and wastewater facilities and structures.

2. The types of applications for coating included in this Section generally include, but are not limited to: submerged and non-submerged equipment, ferrous and non-ferrous piping, ferrous mechanical treatment equipment, pumps, steel piping supports and other items as shown in the Drawings or otherwise noted in the Specifications.

B. Section Includes:

1. The work under this section includes furnishing all materials, equipment, tools and labor for surface preparation, priming and painting necessary to complete the application of the high-performance coatings, as shown in the Drawings and Specifications.

C. Contractor Responsibility:

1. The Contractor shall be responsible for performing all the work called for in this specification, in a safe and workmanlike manner.

1.02 REFERENCES

A. ASTM B 117 – Standard Practice for Operating Salt Spray (Fog) Apparatus

B. ASTM D 16 – Standard Terminology for Paint, Related Coatings, Materials, and Applications

C. ASTM D 520 – Standard Specification for Zinc Dust Pigment

D. ASTM D 870 – Standard Practice for Testing Water Resistance of Coatings Using Water Immersion

E. ASTM D 1005 – Test for determining dry film thickness

F. ASTM D 1014 – Standard Practice for Conducting Exterior Exposure Tests of Paints and Coatings on Metal Substrates

G. ASTM D 2370 – Standard Test Method for Tensile Properties of Organic Coatings

H. ASTM D 2794 – Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)

I. ASTM D 3359 – Test Method for Measuring Adhesion by Tape Test

J. ASTM D 4060 – Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser

K. ASTM D 4141 – Standard Practice for Conducting Black Box and Solar Concentrating Exposures of Coatings

L. ASTM D 4263 – Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

M. ASTM D 4417 – Test for determining surface profile

N. ASTM D 4541 – Test Method for Pull Off Strength of Coatings Using Portable Adhesion-Testers

O. ASTM D 4585 – Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation

P. ASTM D 4587 – 11 Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings

Q. ASTM G 8 – Standard Test Methods for Cathodic Disbonding of Pipeline Coatings

R. The Society for Protective Coatings:

1. SSPC-SP1 Specification for Solvent Cleaning
2. SSPC-SP2 Specification for Hand Tool Cleaning
3. SSPC-SP3 Specification for Power Tool Cleaning
4. SSPC-SP5 Specification for White Metal Blast Cleaning
5. SSPC-SP6 Specification for Commercial Blast Cleaning
6. SSPC-SP7 Specification for Brush-Off Blast Cleaning
7. SSPC-SP10 Specification for Near White Metal Blast Cleaning
8. SSPC-SP11 Specification for Power Tool Cleaning to Bare Metal
9. SSPC-PA1 Painting Application Specification
10. SSPC-PA2 Measurement of Dry Paint Thickness with Magnetic Gages
11. SP WJ-1 Waterjet Cleaning of Metals - Clean to Bare Substrate
12. SP WJ-2 Waterjet Cleaning of Metals - Very Thorough Cleaning
13. SP WJ-3 Waterjet Cleaning of Metals - Thorough Cleaning
14. SP-WJ-4 Waterjet Cleaning of Metals – Light Cleaning

S. ASME A13.1 – Scheme for the Identification of Piping Systems

T. AWWA D102 Standard for Coating Steel Water-Storage Tanks

U. NSF/ANSI Standard 61: Drinking Water System Components -- Health Effects

1.03 DEFINITIONS

A. Terms Coating or Paint shall, in a general sense, refer to primers, alkyds, latex, polyurethane, enamels and epoxy type coatings, including emulsions, stains, sealers, fillers and other applied materials, whether used as prime, intermediate or finish coats, and the application of these materials.

B. Dry Film Thickness (DFT): Thickness, measured in mils (1/1000 inch), of a coat of paint in a cured state.

1.04 SUBMITTALS

A. Product Data:

1. Submit manufacturer’s literature describing products to be provided, giving manufacturer’s name, product name, and product line number for each material.

2. Submit technical data sheets for each product, giving descriptive data, including solids content.
3. Submit color charts showing manufacturer's full range of standard colors, for each product.
4. Submit manufacturer's warranty, for each product.
5. Submit a list of similar installations where the product was used.

B. Submit Manufacturer's Application Instructions:
1. Manufacturer's application instructions shall include:
a. Application equipment to be used.
b. Thinning instructions.
c. Mixing instructions.
d. Recommended thickness, dry film thickness, DFT, mils, to be applied, per coat.
e. Curing time for each coat applied.
f. Temperature limitations for storage and application.

C. Certificate:
1. Provide manufacturer's certification that products to be used comply with specified requirements (including Performance Requirements stated) and are suitable for intended application.

1.05 QUALIFICATIONS:

A. Manufacturer shall have specialized in the manufacturing of potable water, sanitary and marine style coatings with a minimum of 10 years experience in that field.

B. Manufacturer and authorized sales representative shall have evidence of 10 years of successful experience in providing coatings of the type, design, function and quality within either the State or 120 miles of the project site.

C. Painter shall be trained in surface preparation and application techniques and procedures for the coating materials used and shall demonstrate a minimum of 2 (two) years experience in application of the coating materials used.

D. Contractor shall maintain, throughout duration of application, a crew of painters who are experienced and fully qualified.

1.06 DELIVERY AND STORAGE

A. Packing and Shipping:
1. Deliver only products in manufacturer's original unopened containers. Each container shall have manufacturer's label, intact and legible.
2. Provide Material Safety Data Sheets (MSDS), for all material provided.
3. Include on label for each container:
a. Manufacturer's name
b. Type of coating material
c. Manufacturer's stock number and lot number
d. Color name and number
e. Instructions for thinning, where applicable

B. Storage and Protection:

1. Store materials in conformity with manufacturer's printed instructions.

PART 2 - PRODUCTS

2.01 COATING MATERIALS

A. Single Source Responsibility:

1. Undercoats shall be produced by same manufacturer as the finish coat(s).

2. Undercoats and finish coat(s) shall be approved by manufacturer as suitable for use with each other, for the surface being painted and the environment outlined in the Drawings and Specifications that will allow the paint system to function properly.

B. Coating materials shall arrive on the job ready-mixed, except for tinting of undercoats, possible thinning, and mixing of multi-component products. Specific product mixing and thinning instructions shall be provided by the manufacturer.

C. Provide secondary materials, which are produced or are specifically recommended by coating system manufacturer to ensure capability of system.

1. Use only thinners approved by coating materials manufacturer, and use only within manufacturer's recommended limits.

D. When applied to potentially immersed Potable Water Equipment, Tanks and Piping, paint/coating materials shall be NSF/ANSI Standard 61 Approved.

E. Coating materials manufacturer shall demonstrate and document compliance with performance requirements for coating materials.

2.02 POLYAMIDOAMINE EPOXY, TWO COMPONENT

A. Acceptable Surface Temperatures:

1. Minimum: 50 degree F

B. Cure Time at 60 degrees F:

1. Handle: 8 hours maximum

C. Performance Requirements:

1. Humidity per ASTM D 4585 Standards: No blistering, cracking, checking, rusting or delamination of film after 10,000 hours exposure.

2. Abrasion per ASTM D 4060 Standards: CS-17 Wheel, 1,000 gram load: 140 mg loss maximum after 1,000 cycles.

3. Adhesion per ASTM D 4541 Standards: Type V Tester: 1,750 psi minimum.

4. Salt Fog Spray per ASTM B 117 Standards: No blistering, cracking or delamination of film. No more than 1% rusting on plane. No more than 1/16" rust creepage at scribe after 6,700 hours exposure.

2.03 POLYFUNCTIONAL ALIPHATIC POLYURETHANE, TWO COMPONENT

A. Acceptable Surface Temperatures:

1. Minimum: 35 degree F

B. Cure Time at 55 degrees F:

1. Handle: 12 hours maximum

C. Performance Requirements:

1. Exterior Exposure per ASTM D 4141 Standards, Method C: No blistering, cracking or chalking. 97% gloss retention and 0.11 DEhunter color change minimum after 500 MJ/m2 EMMAQUA exposure.
2. Abrasion per ASTM D 4060 Standards, CS-17 Wheel, 1,000 gram load: 120 mg loss maximum after 1,000 cycles.
3. QUV Exposure ASTM D 4587 Standards: No Blistering, cracking, chalking, no less than 84% gloss retention; no more than 1.31 DED CIELAB color change after 10,000hrs exposure.
4. Impact Resistance per ASTM D 2794 Standards: No visible cracking or delamination after 16 inch-pounds, minimum, direct impact.

2.04 ZINC EPOXY PRIMER COATING/PAINT:

A. Two component, moisture cured, zinc-rich epoxy primer.

B. When applied to potentially immersed Potable Water Equipment and Piping, shall be NSF/ANSI Standard 61 Approved.

C. Base Materials and Requirements:

1. Can be topcoated with Epoxies, Polyurethanes and Acrylics
2. Zinc Pigment:
   a. ASTM D 520, Type II or Type III
   b. Lead content: 0.002% or less

D. Acceptable Surface Temperatures:

1. Minimum: 35 degree F

E. Cure Time at 55 degrees F:

1. Handle: 5 hours maximum

F. Performance Requirements:

1. Cathodic Disbondment per ASTM G8 Standards, Method A: No blistering, cracking, rusting or delamination and no undercutting at holiday after 30 days exposure.
2. Adhesion per ASTM D 4541 Standards, Method E, Type V Tester: 2,000 psi minimum.
3. Salt Fog Spray per ASTM B 117 Standards: No blistering, cracking or delamination of film. No more than 1% rusting on plane. No more than 1/8" rust creepage at scribe after 50,000 hours exposure.

2.05 HYDROPHOBIC AROMATIC POLYURETHANE, TWO COMPONENT

A. Acceptable Surface Temperatures:

1. Minimum: 35 degree F

B. Cure Time at 60 degrees F:

1. Handle: 10 hours maximum

C. Performance Requirements:

1. Tensile Strength ASTM D 2370 Standards: No less than 2,693 psi (18.6 MPa) tensile strength.

2. Abrasion per ASTM D 4060 Standards, CS-17 Wheel, 1,000 gram load: 114 mg loss maximum after 1,000 cycles.
3. Adhesion per ASTM D 4541 Standards, Type V Tester: 1,300 psi minimum.
4. Impact per ASTM D 2794 Standards: No visible cracking or delamination of film after 48 inch-pounds or less direct impact
5. Severe Wastewater Analysis Testing: Initial impedance of 10.2 (log-Z). No blistering, cracking, checking or loss of adhesion. No more than 0.1 (log-Z) reduction in electrical impedance after 28 days exposure.

2.06 POLYAMIDOAMINE EPOXY: TWO COMPONENT, HIGH-BUILD EPOXY.

A. Base Materials and Requirements:
1. Potable water immersed ferrous materials, equipment and pipe.

B. Acceptable Surface Temperatures:
1. Minimum: 35 degree F

C. Cure Time at 55 degrees F:
1. Handle: 14 hours maximum
2. Topcoat: 24 hours maximum
3. Immersion: 10 days maximum

D. Performance Requirements:
1. Humidity per ASTM D 4585 Standards: No blistering, cracking, checking, rusting or delamination of film after 10,000 hours exposure.
2. Abrasion per ASTM D 4060 Standards, CS-17 Wheel, 1,000 gram load: 140 mg loss maximum after 1,000 cycles.
3. Adhesion per ASTM D 4541 Standards, Type V Tester: 1,750 psi minimum.
4. Salt Fog Spray per ASTM B 117 Standards: No blistering, cracking or delamination of film. No more than 1% rusting on plane. No more than 1/16" rust creepage at scribe after 6,700 hours exposure.

2.07 PIPE BANDING AND LABELS

A. Comply with 2007 ASME A13.1 Standards

B. Shall designate the material conveyed in the piping and the general flow direction.

C. Materials:
1. Coiled Rigid Vinyl or Strap-On Rigid Vinyl with Nylon Ties
a. Engineer approved equal
2. Shall wrap 360 degrees around the pipe.
3. Printed with UV resistant ink
4. Service Temp: -40 to 180 degrees F

D. Colored banding on piping or similar installations shall be placed:
1. 10 feet spacing, maximum.
2. At all changes in direction.
3. Both sides of obstructions

E. Band width:

1. 2 inches for pipes up to 8 inches in diameter.
2. 4 inches for pipes over 8 inches and up to 24 inches in diameter.
3. 8 inches for pipes over 24 inches in diameter

F. Arrow and Letter Heights:

1. Pipes smaller than 4": 1" height lettering, minimum
2. Pipes 4" or larger: 2" height lettering, minimum

2.08 COLOR

A. See Section 01 10 00 – Special Provisions.

B. When the color is not stated elsewhere, the color shall be selected by the Owner from the manufacturer's standard color chart for the product used.

C. The following general colors and schemes shall be utilized when coating materials listed within in this Section. Contractor to coordinate all final color selections with the Engineer prior to application of materials.

D.

	Location/Purpose:	Generic Color(s):
1.	Raw Drinking Water	Olive Green
2.	Settled or Clarified Drinking Water	Aqua
3.	Finished or Potable Water	Dark Blue
4.	Sewage Plant Effluent	Clay
5.	Backwash Waste	Light Brown
6.	Sludge	Dark Brown
7.	Sanitary Sewer	Dark Gray
8.	Alum or Primary Coagulant	Orange
9.	Ammonia	White
10.	Carbon Slurries	Black
11.	Caustic Solutions	Yellow w/ Green Band
12.	Chlorine	Yellow
13.	Fluoride	Light Blue w/ Red Band
14.	Lime Slurries	Light Green
15.	Ozone	Yellow w/ Orange Band
16.	Phosphate	Light Green w/ Red Band
17.	Polymer or Coagulant Aid	Orange w/ Green Band
18.	Permanganates	Violet
19.	Soda Ash	Light Green w/ Orange Band
20.	Sulfuric Acid	Yellow w/ Red Band
21.	Sulfur Dioxide	Light Green w/ Yellow Band
22.	Compressed Air	Dark Green
23.	Gas	Red
24.	Other	Light Gray or Consult Engineer

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verification of Site Conditions:

1. Examine the site and surroundings, and the environment under which the surface preparation and painting will be performed for, conditions that will adversely affect the execution of the work, permanence or quality of the coating.
2. Correct conditions detrimental to timely and proper execution of the work.
3. Do not proceed until unsatisfactory conditions have been corrected.
4. Commencement of surface preparation and painting by Contractor constitutes Contractor acceptance of the site conditions and the responsibility for satisfactorily completing the work.

3.02 PREPARATION

A. Surface Preparation - General Requirements:

1. Prior to application, the surfaces shall be properly prepared to receive the specified coatings in compliance with manufacturer's recommendations.
2. Surfaces to be coated shall be clean, dry and free from dust and any foreign matter which would adversely affect durability, adhesion or appearance of the coating.

B. Protection:

1. Take precautionary measures to prevent fire hazards and spontaneous combustion.
2. Provide drop cloths, shields, and other protective equipment.
3. Protect elements surrounding the work from damage or disfiguration.
4. Protect all of the worksite and surroundings, whether to be painted or not, against damage by the surface preparation, painting, finishing and cleanup work.
5. Protect newly coated areas against damage.
6. Protect the work of other trades, whether to be painted or not, against damage by surface preparation, painting, finishing and cleanup work.
7. Protect all electrical items including controls, switches, outlets, lights, and panels against damage by surface preparation, painting, finishing and cleanup work.

C. Shop and Field Surface Preparation:

1. Remove all oil, grease, soil, dirt and other soluble contaminants in accordance with SSPC-SP1.
2. Repair any damaged or corroded areas and weld where necessary, with inspection by Engineer, following repair. Weld slag, weld spatter, rough edges and sharp edges of weld seams shall be ground smooth.
3. All rusted, abraded and unpainted areas shall be abrasive blast cleaned in accordance with the recommended methods outlined in manufacturer's

preparation requirements for the environment outlined in the Drawings and Specifications.

4. Immediately after blasting and before any rusting occurs, apply one coat of primer to all bare ferrous metal surfaces.

3.03 FACTORY OR SHOP PRIMED MATERIALS

A. Application of the primer coating is permitted to occur away from the project site with proper inspection documentation outlined later in this Section.

B. Field preparation of ferrous components that have a predominant shop primed surface will remain necessary at locations such as welded seams, damaged areas or components that otherwise do not have shop primer applied.

C. Shop primed materials are not required to be further blasted bare nor additionally primed other than for repairs, surface preparation and cleaning purposes or increasing the thicknesses of the material previously applied.

D. At material locations where the primer coating has been damaged or destroyed, it shall be repaired in the field or returned to the factory/shop.

1. The primer located within a 2-inch radius of the damaged area shall be removed using a power tool or blasting.

2. The surface shall be re-prepared for application of the primer coating in accordance with the manufacturer's recommendations and Engineer.

3.04 APPLICATION

A. Environmental Requirements:

1. Do not apply coating when conditions exist that would adversely affect durability, adhesion or appearance of the coating. Do not apply coating materials in snow, rain, fog or mist, or to damp or wet surfaces, unless otherwise permitted by coating materials manufacturer's printed instructions.

2. Provide for proper ventilation, using explosion proof equipment, during the surface preparation, application and curing operations.

3. Provide adequate illumination, using explosion proof lights and equipment, during the surface preparation, application and curing operations.

4. Atmosphere shall be free of airborne dust and any other contaminate or foreign matter, during the application and initial curing operations.

B. General Requirements:

1. Mix and prepare coating in accordance with manufacturer's directions.

2. Apply coating in compliance with manufacturer's instructions, using application method best suited for obtaining a full uniform coverage of surfaces to be coated and providing a uniform finish, color and appearance.

3. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

4. Apply first coat to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

5. Apply primer, intermediate, and finish coats to comply with wet and dry film thickness and spreading rates for each type of coating as recommended by manufacturer and herein specified minimums.

6. Number of coats specified shall be minimum number acceptable.

   a. Apply additional coats as needed to provide a smooth, even application, with a uniform finish, color and appearance.

   b. If two coats of the same material is specified, Contractor may, at own cost, apply one single coat of material at the total thickness required with written approval of coating manufacturer and Engineer.

   c. Closely adhere to re-coat times recommended by manufacturer.

   d. Provide adequate ventilation during curing phase.

7. Use only application equipment that is clean, properly adjusted, in good working order and of type recommended by coating manufacturer.

8. Allow sufficient time between successive coats to permit proper curing.

C. Field Intermediate Coat:

1. After the topcoating time of the primer is completed, apply one coat of epoxy intermediate coating all primed surfaces.

2. If primed areas are exposed for more than 30 days, the primed surface shall be brush blasted to clean.

3. To achieve complete finish coat coverage, the intermediate coat color should be noticeably different than the specified finish coat color. When feasible, the field intermediate coat should be in the same finish coat color family (blue, beige, gray, etc.) with a difference in light reflectance value of approximately 10%.

D. Field Finish Coat:

1. After the topcoating time of the intermediate coat is completed, apply finish coat to surfaces.

2. If areas that have received an intermediate coat are not coated again within 30 days, the surface shall be brush blasted to clean, before the succeeding coat is applied.

E. Coating Application Accessories:

1. Provide application accessories as indicated in coating manufacturer's application instructions, including but not limited to cleaning agents, etching agents, cleaning cloths, sanding materials, and clean-up materials.

2. Material not specifically identified, but necessary for the proper application of the coating system, shall be provided, and are considered incidental and included in the price.

3.05 ABOVE GRADE PVC PIPING, FITTINGS AND VALVES

A. Surface Preparation:

1. Scarify

2. Clean and dry.

B. Prime Coat:

1. Polyamidoamine Epoxy, two component

2. Finish: Satin
3. Thickness: 2.0 to 3.0 mils DFT

C. Field Intermediate Coat:
1. Polyamidoamine Epoxy, two component
2. Finish: Satin
3. Thickness: 2.0 to 3.0 mils DFT

D. Field Finish Coat:
1. This paragraph only applies if pipe is located such to be regularly exposed to outdoor weather conditions.
2. Polyfunctional Aliphatic Polyurethane, two component
3. Finish: High Gloss
4. Thickness: 2.0 to 3.0 mils DFT

E. Total Dry Film Thickness: 4.0 to 6.0 mils, or 6.0 to 9.0 mils in weather conditions

3.06 ABOVE GRADE DUCTILE IRON PIPING, FITTINGS AND VALVES

A. Surface Preparation:
1. SP 6 – Commercial Blast
2. 1.5 mils anchor profile.
3. Clean and dry.

B. Shop and/or Field Prime Coat:
1. Polyamidoamine Epoxy, two component
2. Finish: Satin
3. Thickness: 3.0 to 5.0 mils DFT

C. Onsite Cleaning of Shop Primed Materials:
1. Field preparation with a power wash over the entire surface with a 3,000 psi power washer or equal to remove all loose paint or other surface contaminants.

D. Field Intermediate Coat:
1. Polyamidoamine Epoxy, two component
2. Finish: Satin
3. Thickness: 3.0 to 5.0 mils DFT

E. Field Finish Coat:
1. This paragraph only applies if pipe is located such to be regularly exposed to outdoor weather conditions.
2. Polyfunctional Aliphatic Polyurethane, two component
3. Finish: High Gloss
4. Thickness: 3.0 to 5.0 mils DFT

F. Total Dry Film Thickness: 6.0 to 10.0 mils, or 9.0 to 15.0 mils in sunlight/weather conditions

3.07 EXTERIOR FERROUS EQUIPMENT (NON-IMMERSED)

A. Surface Preparation:
   1. SP 10 – Near White Metal Blast Cleaning
   2. 1.5 mils anchor profile.
   3. Clean and dry.

B. Shop and/or Field Prime Coat:
   1. Zinc epoxy primer coating/paint
   2. Thickness: 2.5 to 3.5 mils DFT

C. Onsite Cleaning of Shop Primed Materials:
   1. Field preparation with a power wash over the entire surface with a 3,000 psi power washer or equal to remove all loose paint or other surface contaminants.

D. Field Intermediate Coat:
   1. Polyamidoamine Epoxy, two component
   2. Finish: Satin
   3. Thickness: 2.0 to 3.0 mils DFT

E. Field Finish Coat:
   1. Polyfunctional Aliphatic Polyurethane, two component
   2. Finish: High Gloss
   3. Thickness: 2.0 to 5.0 mils DFT

F. Total Dry Film Thickness: 6.5 to 11.5 mils

3.08 INTERIOR FERROUS EQUIPMENT (NON-IMMERSED)

A. All rusted, abraded and unpainted areas shall be abrasive blast cleaned in accordance with the recommended methods outlined in The Society for Protective Coatings Specification SSPC-SP6 (NACE No. 3).

B. Surface Preparation:
   1. SP 6 – Commercial Blast
   2. 1.5 mils anchor profile.
   3. Clean and dry.

C. Shop and/or Field Primer Coat:
   1. Zinc epoxy primer coating/paint
   2. Thickness: 2.0 to 3.0 mils DFT

D. Onsite Cleaning of Shop Primed Materials:
   1. Field preparation with a power wash over the entire surface with a 3,000 psi power washer or equal to remove all loose paint or other surface contaminants.

E. Field Finish Coat:
   1. Polyamidoamine Epoxy, two component
   2. Finish: Satin
   3. Thickness: 2.0 to 3.0 mils DFT

F. Total Dry Film Thickness: 4.0 to 6.0 mils

3.09 IMMERSED FERROUS EQUIPMENT AND PIPING

A. Immersed environment shall be considered to be where the material is regularly immersed in, or within six inches of splashing materials, such as; water, chemicals or wastewater sludge.

B. All rusted, abraded and unpainted areas shall be abrasive blast cleaned in accordance with the recommended methods outlined in The Society for Protective Coatings Specification SSPC-SP10 (NACE No. 2).

C. Surface Preparation:

1. SP 10 – Near White Metal Blast Cleaning
2. 1.5 mils anchor profile.
3. Clean and dry.

D. Shop and Field Primer Coat:

1. Hydrophobic Aromatic Polyurethane, two component
2. Finish: Satin
3. Thickness: 7.0 to 10.0 mils DFT

E. Onsite Cleaning of Shop Primed Materials:

1. Field preparation with a power wash over the entire surface with a 3,000 psi power washer or equal to remove all loose paint or other surface contaminants.

F. Field Finish Coat:

1. Hydrophobic Aromatic Polyurethane, two component
2. Finish: Satin
3. Thickness: 7.0 to 10.0 mils DFT

G. Total Dry Film Thickness: 14.0 to 20.0 mils

3.10 POTABLE WATER IMMERSED FERROUS EQUIPMENT AND PIPING

A. Immersed environment shall be considered to be where the material is regularly immersed in, or within six inches of splashing materials, such as; water or chemicals.

B. Meet AWWA D102-06 Standards for Inside Coating System No. 5

C. All rusted, abraded and unpainted areas shall be abrasive blast cleaned to a near white finish in accordance with the recommended methods outlined in The Society for Protective Coatings Specification SSPC-SP10 (NACE No. 2).

D. Surface Preparation:

1. SP 10 – Near White Metal Blast Cleaning
2. Clean and dry.

E. Shop and Field Prime Coat:

1. Zinc epoxy primer coating/paint
2. Thickness: 2.5 to 3.5 mils DFT

F. Onsite Cleaning of Shop Primed Materials:

1. Field preparation with a power wash over the entire surface with a 3,000 psi power washer or equal to remove all loose paint or other surface contaminants.

G. Field Intermediate Coat:

1. Polyamidoamine Epoxy: Two component, HIGH-BUILD EPOXY.

a. NSF/ANSI Standard 61 Approved

2. Thickness: 4.0 to 6.0 mils DFT

H. Field Finish Coat:

1. Polyamidoamine Epoxy: Two component, HIGH-BUILD EPOXY.

a. NSF/ANSI Standard 61 Approved

2. Thickness: 4.0 to 6.0 mils DFT

I. Total Dry Film Thickness: 10.5 to 15.5 mils

3.11 FIELD QUALITY CONTROL

A. Daily Records: The following information shall be recorded for each day of coatings application for each type of material applied.

1. Date, starting and ending times.

2. Atmospheric conditions, including precipitation, temperature and wind.

3. Surface temperature of material that coating is applied to.

B. Measure and document wet film thickness of each coating every 100 feet of piping or 200 square feet of flat surfacing, whichever is less. A minimum of 3 tests per location shall be taken.

C. Provide 'wet paint' signs in areas where coating activity is taking place and/or coating is curing.

D. The Contractor shall prepare and deliver to the Owner an inspection log setting forth the number of tests taken and results of each test. All logs shall note the date of the test and person making the inspection. Any thickness not met, type of failures observed and the percentage of the surface area where failure has occurred shall be included to the extent possible. Color photographs illustrating each type of failure shall be included in the log(s).

3.12 REPAIR/RESTORATION

A. At completion of the work, touch-up and restore finishes where damaged.

1. Touch-up of minor damage shall be acceptable where result is not visibly different from surrounding surfaces.

2. Where result is visibly different; either in color, sheen or texture, recoating of the entire surface shall be done.

B. When stain, dirt, or undercoats show through finish coat, correct defects and cover with additional coats until coating is of uniform finish, color, appearance and coverage.

3.13 CLEANUP

A. Leave storage area neat and clean at all times.

B. As the work proceeds, promptly remove spilled, splashed or splattered materials from surfaces.

C. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

D. Upon completion of the painting work, clean window glass and other paint spattered surfaces.

3.14 WASTE MANAGEMENT

A. General Requirements:

1. During progress of the work, at end of each workday, remove from site discarded paint materials, rubbish, cans and rags.
2. Place materials defined as hazardous or toxic waste in designated containers.
3. Return solvent and oil soaked rags for contaminant recovery and laundering, or for proper disposal.
4. Do not dispose of coating materials or solvents by pouring on ground. Place in designated containers for proper disposal.
5. Contractor shall be responsible for all costs associated with waste disposal that may result from execution of this Project.

END OF SECTION

SECTION 26 00 00

ELECTRICAL WORK

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Extent of electrical work is indicated by drawings and schedules and by requirements of this section. Work includes the following:

B. General Work: The work associated with electrical systems and equipment to be performed as electrical work includes excavating, conduit sleeves, conduit supports, anchors, metering, power, miscellaneous systems, identification, coordination of drawings, record drawings, permits, tests, inspection, utility connection, starting up systems, training of Owner's operating personnel, producing operating and maintenance manuals, and construction permits.

1. Power: The extent of the power work is indicated in the contract documents by E-Series drawings. This work includes conduit, wire, boxes, receptacles, disconnects, panels, and all equipment required for a complete installation. Wiring of equipment furnished by other specification Divisions or by the Owner that requires electrical power connections shall be wired in accordance with manufacturer’s instructions.

C. Refer to Section 31 23 33 for trenching, excavating and backfilling required in connection with the underground telephone, television and electrical service. This work to be performed as part of the electrical contract.

D. Refer to Section 03 30 00 for concrete work associated with the electrical work.

1.02 QUALITY ASSURANCE

A. General: In addition to complying with local codes, ordinances, standards and regulations, comply with:

1. Independent Testing Laboratories (ITL)
2. Electrical Testing Laboratories (ETL)
3. Factory Mutual (FM)
4. Institute of Electrical and Electronic Engineers (IEEE)
5. Underwriters' Laboratories, Inc. (UL)
6. National Fire Protection Association (NFPA)
7. American Society for Testing and Materials (ASTM)
8. American National Standards Institute (ANSI)
9. National Electrical Code (NEC)
10. National Electrical Safety Code (NESC)
11. Insulated Power Cable Engineers Association (IPCEA)
12. American Institute of Steel Construction (AISC)
13. State & Municipal Codes in Force in the Specific Project Area
14. Occupational Safety and Health Association (OSHA)

1.03 SUBSTITUTIONS

A. Pre-Bid Substitution Requests: Unless indicated otherwise, in general, products indicated are a basis of design and pre-bid substitutions are allowed per the requirements of Section 01 10 00 and the Instructions to Bidders.

1. If a specific product is listed without an “or approved equal/equivalent” clause, then the product listed shall be the product provided. This is generally restricted to products in which compatibility with other equipment or existing equipment is necessary.
2. If a specific product is specified without a Basis of Design manufacturer and product catalog number/series, or a list of approved manufacturers then a pre-bid substitution request is not required.

1.04 SUBMITTALS

A. General: The Contractor shall submit to the Engineer, for approval, electronic PDF copies of shop drawings of all major items of equipment and/or systems, giving manufacturer's name, catalog numbers, etc., and shall in particular set forth any variation or substitution from that intended by plans and specifications. Submittals shall consist of a Bill of Materials for major items included in the submittal, manufacturer’s catalog page indicating general features and listings, and shop drawings. Electronic PDF files shall be text searchable and include bookmarks for major sections for ease of navigation.

B. Shop drawings shall be submitted for review for the following:

1. Direct Bury Cables
2. Campsite Pedestals
3. Above Grade Secondary Pedestals
4. Disconnect Switches
5. Panels
6. SPD

C. Operational & Maintenance Manuals: Provide O & M Manuals in accordance with Sections 01 10 00, 01 30 00 and 01 77 00.

1. Provide manufacturer’s O & M or instruction Manuals for panelboards and campsite pedestals.
2. In addition to paper copies, an electronic version shall be provided in PDF format. The PDF file shall be text searchable and organized the same as paper copy complete with bookmarks for each indexed tab section.

1.05 COORDINATION OF ELECTRICAL WORK

A. Coordination of Work: The Contractor shall be responsible for the coordination electrical work with the work all other suppliers and installers for this Project.

B. Coordinate and install wiring for appliances and systems furnished under other specification Divisions, furnished by the Owner, Bid Packages or in some instances furnished under separate Contract. It is the intent of this requirement, that anything with an electrical connection will have power, and be working properly at Substantial Completion unless indicated otherwise. Verify outlet box sizes for various components such as wall switches and indicators. Install electrical wiring in accordance with manufacturer's instructions. Items requiring some installation by the Electrical Contractor that are furnished by others include, but not limited to: prepackaged lift station.

C. For some items that are provided for this Project provided by others, product substitutions may result in changes to the electrical systems indicated. When Contractor initiated product variations result in electrical system changes, coordinate those changes at no additional cost to the Owner.

D. The Electrical Contractor shall be responsible for coordinating the electrical requirements of items provided under Division 26. Make field adjustments as necessary for variations in product requirements provided under Division 26 at no additional cost to the Owner.

E. Coordinate service outages of the service utilities with the Owner and General Contractor for proper sequencing of work and for protection of the Owner's operations.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Handle all electrical equipment carefully to prevent breakage, denting, and scoring finishes.

B. Deliver all electrical equipment in factory fabricated fiberboard type containers.

C. Store all equipment to be installed on the job that is stored on the site for any period of time shall be protected from the weather in a manner acceptable to the Engineer. All conduit shall be stored off the ground to insure that no dirt or debris is allowed to enter them before installation. Failure to store material correctly shall be just cause for the Architect to direct the Contractor to remove the material from the site.

1.07 PERMITS AND FEES

A. The Contractor shall familiarize himself with all requirements as to permits, fees, codes and ordinances, etc., and arrange to comply with them.

B. All permits, licenses, fees, inspections, and arrangements required for the work under this contract shall be obtained by the Contractor at his expense.

C. The Contractor shall field coordinate and provide all temporary power required.

D. Utility Coordination: The Contractor shall coordinate electrical service with the providing electric utility. All utility fees associated with this project shall be billed to the Owner.

1. The electrical utility point of contact is:

   Pat Hoeft

   David City Electrical Department

   402-367-3197

   pat3197@windstream.net

1.08 CODES

A. All work shall be in accordance with applicable State and Local Codes. All work shall comply with the rules and recommendations of the National Fire Protection Association, all requirements of local utility companies, and the State Fire Inspection Bureau. These codes, rules, recommendations, and requirements shall take precedence if the drawings and specifications are not in conformance therewith.

1.09 LABELS AND IDENTIFICATION

A. Equipment Identification: All identification labels shall be installed in a neat and workmanlike manner. Cleans surfaces prior to installation.

1. All Panels shall have identification labels of the equipment neatly stenciled on the equipment. Labels shall be 1 inch wide plastic “black” with 3/8 inch engraved letters “white”. Labels shall be permanently glued to equipment in a neat fashion. Label shall have the complete name of the equipment as well as its mark or number, such as “Panel EL1”.

2. All disconnect switches shall have identification of the equipment being served neatly stenciled on the switch. Labels shall be 1 inch wide plastic “black” with 3/8 inch engraved letters “white”. Labels shall be permanently glued to equipment in a neat fashion. Label shall have the complete name of the equipment as well as its mark or number, such as “Electric Unit Heater EH-1”.

B. Wiring: At each above-grade secondary pedestal, cables shall be labeled by destination and phase. Identification shall be self-adhesive wraparound type labels.

C. Panelboards: All panelboards shall have a machine printed, flexible self-adhesive vinyl label with the following identifications:

1. A label with the available short-circuit current shall be included on each panelboard, switchboard, switchgear, and motor control center per NEC 408.6. Contractor to verify with Engineer to provide the available short-circuit currents which incorporate shop drawing transformer impedances and field installed feeder lengths. For information provided subsequent to bidding, use the date of receipt of information.

2. Ungrounded conductor color coding system per NEC 210.5.

3. Label that identifies the equipment where the power originates per NEC 408.4(B).

4. Arc Flash Hazard Warning per NEC 110.16. The Contractor is responsible for generic arc flash warning labels.

D. Circuit Directories: Provide machine printed circuit directory card for the As-Built conditions for each panelboard. In lieu of a circuit directory card, it is acceptable to utilize machine printed flexible self-adhesive vinyl labels at each circuit breaker.

1. Campsite Feeder Circuits shall be identified by campsite numbers fed.

E. The main disconnect shall have a preprinted, flexible self-adhesive vinyl label that identifies the available fault current per NEC 110.24. If the available fault is not identified on the drawings, verify levels with the Engineer.

F. At each RV Pedestal, provide machine printed flexible, self-adhesive vinyl label identifying campsite number. Label shall be placed inside the cabinet. Label text shall be a minimum of one-inch text height.

PART 2 - PRODUCTS

2.01 ELECTRICAL RACEWAYS

A. General: For each electrical raceway system indicated, provide assembly of conduit, tubing or duct, and fittings, included but not necessarily limited to, connectors, couplings, off sets, elbows, straps, bushings, expansion joints, hangers, and other components and accessories as needed for a complete system. Minimum size of conduit shall be 3/4 inch. All conduit shall be new.

B. RMC: Rigid steel conduit complying with ANSI C80.1 shall be listed to UL 6, standard weight, mild-steel, hot-dipped galvanized or sherardized inside and out.

C. Stainless Steel IMC: Intermediate Metal Conduit, complying with ANSI C80.6 and listed to UL 1242. Stainless steel type 316 with threaded connections.

D. Flexible Couplings for Hazardous Locations: Explosionproof, dust-ignitionproof, watertight listed to UL 886. Stainless steel braid with insulating liner. End fittings made from stainless steel. For corrosive environments, provide PVC outer coating.

E. Nonmetallic: Rigid non-metallic conduit shall be PVC schedule 40 or 80 PVC conduit, NEMA TC 2, listed to UL 651 and listed for direct sunlight. 90° bends shall utilize schedule 80 conduit to prevent burn through during pulling.

1. RTRC: Fiberglass Reinforced Thermosetting Resin Conduit (RTRC), heavy wall Type XW may be used in lieu of PVC. Raceway shall be listed to UL 2525 and UL 94 HB.
2. For horizontal directional boring, HDPE, NEMA TC 7, listed to UL 651A, schedule 80, outside and inside smoothwall, black or red may be used in lieu of PVC.

F. Each length of conduit shall be stamped with the name or trademark of the manufacturer and shall bear the Underwriter's label.

2.02 RACEWAY FITTINGS

A. All raceway fittings shall be listed to UL 514B.

B. Coupling and connections in non-hazardous areas (steel) for thin wall conduit shall be compression type. For outdoor or wet locations couplings shall also be rain tight, and concrete-tight. Indent or set screw type fittings shall not be used. Fittings for rigid conduit shall be threaded. Fittings for liquid tight flexible conduit shall be liquid tight. Fittings for stainless steel raceways shall be stainless steel. Unless noted otherwise, die-cast fittings in whole or part shall not be acceptable.

C. Coupling and connections in hazardous areas for galvanized rigid steel shall be Class 1 Division 1 Appleton Type SFM or approved equal with breathers and drains. Include sealing compound.

D. Seal fittings in hazardous areas for SS-IMC shall be Class 1 Division 1 Type 316 stainless steel Type EYS with breathers and drains for 1” sizes and below. For conduit sizes 1-1/4” and larger, seal fittings made from copper free aluminum or alloys with epoxy coat paint may be used. Include sealing compound.

E. Bushings and lockouts for galvanized steel raceway shall be made of galvanized malleable iron and shall have sharp clean-out threads for rigid conduit. Compression type shall be used for EMT. Bushings and lockouts for stainless steel raceway shall be made of stainless steel.

F. Expansion joint fittings shall be Type XJ/XJG-long or other conduit fittings as manufactured by Crouse-Hinds or equal for RMC and IMC. Use PVC expansion joints with length of travel suitable for 120°F temperature differential and the length of raceway for non-metallic raceways.

2.03 RACEWAY SUPPORT

A. Galvanized Steel Support Systems: Structural-grade, factory formed, galvanized steel channels and angles with 9/16 inch diameter holes at a maximum of 8 inches o.c. in at least 1 surface.

1. Fitting and Accessory materials: Same as channels and angles. Stainless steel may also be used.
2. Rated Strength: Selected to suit applicable load criteria.

2.04 CONDUCTORS

A. Direct Bury Cables: Provide either multi-conductor cable, quadruplex cable or single conductor cables listed for direct burial applications, size as indicated on the plans. Aluminum alloy conductor, compact stranding, rated 600-V, 90˚C, cross-linked polyethylene (XLP or XLPE) insulation. Where connecting to a box or enclosure, watertight connectors intended for the type of conductor shall be used.

B. Circuits not designated direct bury on the plans shall consist of a complete system of copper conductors shall be installed in a raceway system with green ground wire throughout the building for all feeder and branch circuits, etc. Wire shall be copper, 600-V minimum rating, except for special systems. No wire smaller than No. 12 gauge shall be used, except for signal or control systems, or where otherwise indicated.

C. Insulation Types:

1. #10 and smaller shall be Type THWN-2 rated for 90°C.
2. #8 and larger shall be Type THWN-2 or XHHW-2 rated for 90°C.

D. Cables shall conform to the requirements of the Underwriter's Laboratories, Inc and shall be listed by a Nationally Recognized Testing Laboratory. THWN-2 cable shall be listed to UL 83. XHHW-2 cable shall be listed to UL 44.

E. All wire shall be brought to the job in unbroken packages and shall bear the date of manufacture and shall not be older than 12 months.

F. Color Coding: All wiring shall be color-coded throughout its entire length.

1. 1 phase SN 120/240V
    a. Line 1 – Black
    b. Line 2 – Red
    c. Neutrals –White
    d. Ground – Green

G. Conductor Splices and Taps:

1. Interior and Dry Locations:
    a. Splicing of Conductors #10 AWG or smaller shall be by one of the following methods:
        (1) Conductors shall be twisted together and soldered. All uninsulated splices, joints and free ends of conductors shall be covered with heat shrink rubber insulating sleeve or equal.

(2) Preinsulated spring-pressure connectors, such as "Scotch-lok" or equal.

b. Splicing and Termination of Conductors #8 AWG or larger:

(1) Conductors shall be connected using insulated secondary set-screw connectors. Connector Manufacturing Co. Type NACC or approved equal.

(2) Connection to ground conductors No. 1/0 AWG and larger shall be cast by Cadweld, or Burndy "Thermoweld", fusible-metal process.

2. Wet Locations: Unless indicated otherwise, conductor splices and taps in wet locations shall utilize connectors listed to UL 486D for wet locations.

a. Splicing of conductors in ground level pull boxes or above grade secondary pedestals shall be connected using secondary set-screw connectors listed to UL 486D with either “submersible” or “direct burial” listing mark. Connector Manufacturing Co. Type SSBC series or approved equal.

3. Hazardous Location Cable Terminations: Cable termination shall be listed for Class I, Division 1 or 2 as required by the environment, made from nickel plated brass or 316 stainless steel, and equipped with IP68 deluge seal. Crouse-Hinds ADE-1FC series or equal from Killark, or Appleton.

2.05 GROUNDING

A. Ground Rods: UL 467 listed, Copper-clad steel, sectional threadless type. Unless noted otherwise, minimum size shall be ¾”Ø x 10 feet.

B. Clamps and Connectors: Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

1. Bolted Connectors: Clamp type, sized for pipe, copper or copper alloy, bolted pressure type with at least two bolts.
2. Welded Connectors: Exothermic welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
3. Compression Connectors: UL listed, 600 V, and minimum 75°C, dual rated for copper and aluminum, one or two-hole type as applicable, irreversible compression type connectors.

2.06 PANELBOARDS

A. All equipment shall be the product of one manufacturer as manufactured by Square D, General Electric, Cutler Hammer or Siemens.

B. All panelboards shall be listed to UL 67. All panels shall be dead front with circuit breakers and copper buses in accordance with schedule and notations on the electrical drawings.

C. All busses shall be silver-plated copper, or tin-plated copper.

D. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

E. Overcurrent Protective Devices: Unless indicated otherwise, overcurrent protective devices shall be molded case type circuit breakers. Circuit breakers shall comply with and be listed to UL 489. The individual breakers shall be calibrated and sealed to eliminate tampering or unauthorized changes in calibration. Breakers shall be interchangeable and capable of being operated in any position.

1. Individual circuit breakers shall be fully rated for the available short-circuit rating of the panelboard, series ratings are prohibited.
2. Circuit breakers are thermal magnetic trip units unless electronic trip units are indicated by "LSIG" or any combination of those letters. Adjustable trip setting dials shall be accessible from the front.
3. Circuit breakers of frame size of 200 Amperes and greater shall have an adjustable instantaneous trip.
4. Two-pole and three-pole branch breakers shall be single-handle, common trip type. 15 and 20 amp breakers shall be (SWD) switching duty rated. All branch breakers shall be 20 amp one-pole unless indicated otherwise.
5. Tandem or half-sized circuit breakers will not be acceptable.
6. Breakers shall be the bolt-on type.
7. Where circuit breakers are indicated to be GFCI type, they shall be listed to UL 943, Class A, with a trip at 4-6 mA.

F. A suitable directory or card holder shall be mounted on the inside of each cabinet door. Each circuit thereon shall bear a typewritten notation covered with transparent celluloid designated exactly what it controls. These cards shall be made out after the circuits have been connected.

G. Enclosures: Cabinets, wiring gutters, etc., shall be in strict accordance with the standard practice of the NEMA and the National Electric Code. All panels shall be flush or surface mounted as shown on the drawings. Provide the NEMA environmental rating suitable for the environment or as indicated.

1. Doors shall have concealed hinges.
2. Panel and trim shall be factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
3. Back Boxes: Unless indicated otherwise, galvanized steel.

H. Distribution Panelboards:

1. NEMA PB 1, power and feeder distribution type.
2. Distribution panel shall have voltage and wiring configuration indicated, main breaker as indicated, minimum AIC as indicated fully rated and branch breakers as indicated. Square D type I-Line.

2.07 SAFETY AND DISCONNECT SWITCHES

A. Disconnect switches for all equipment and motors indicated on the plans shall be by one Manufacturer Square D, General Electric, Cutler Hammer or Siemens. Square D catalog numbers are specified herein as a basis for quality and type of device to be installed.

B. Disconnect horsepower rating shall be appropriate for the motor(s) served.

C. Disconnects for integral horsepower motors, 3/4 horsepower and larger, and for equipment of similar capacity shall be NEMA KS 1, Type HD, industrial type, 600 V, fused or non-fused as indicated, 3 blades with solid neutrals where required and have provision of padlocking in the "ON" or "OFF" positions. Disconnect switches shall be listed to UL 98.

1. At exterior locations enclosures shall be NEMA Type 3R.

D. Fuses for feeders, branch circuits, motors and other equipment shall be selected in types of ratings in accordance with NEC to provide a coordinated system of overcurrent protection, whereby if a fault or harmful overload should occur, only the fuses nearest the fault or overload will open.

E. Fuses: Provide fuses for safety switches, as recommended by switch manufacturer, of classes, types, and ratings needed to fulfill electrical requirements for service indicated.

1. Fuse Types:

a. Service Entrance: Class RK1, time delay.

F. Provide one spare set of three of each size and type of fuses installed on the project.

2.08 SURGE PROTECTIVE DEVICE (SPD)

A. SPD shall be Component Recognized in accordance with UL 1449 4th Edition, Standard for Safety, Surge Protective Devices, and UL 1283, Electromagnetic Interference Filters.

B. SPD shall be a Type 2 device and shall be installed on the load side of the service disconnect overcurrent device per NEC.

C. SPD shall incorporate thermally protected metal-oxide varistors (MOV's) as the core surge suppression component for the service entrance and all other distribution levels.

D. SPD shall provide suppression for all modes of protection: L-L, L-N, L-G and N-G in WYE systems. For delta configured systems, the SPD shall have components directly connected between each phase conductor and between each phase conductor and ground.

E. SPD shall have a minimum Short Circuit Current Rating (SCCR) of 200kA.

F. SPD shall have a minimum surge current rating of 100 kA per phase (50 kA per mode).

G. SPD shall be capable of protecting against and surviving 20,000 ANSI/IEEE C62.41 Category C3 impulses with less than 10% change in the baseline to final let-through voltage.

H. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

VOLTAGE	L-N	L-G	N-G	L-L
240/120	700V	700V	700V	1200V

I. SPD shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS operating system voltages.

J. SPD shall have a minimum EMI/RFI filtering of -50dB at 100kHz using the MIL STD. 220A insertion loss test method.

K. SPD shall be equipped with onboard visual and audible diagnostic monitoring. Red and green indicator lights shall provide full time visual diagnostic monitoring of the operational status of each phase. The SPD diagnostic monitoring devices shall be mounted on the front of the device. The diagnostic monitoring circuits shall continually monitor the operational status of the surge current diversion modules. No other test equipment shall be required for SPD monitoring or testing before or after installation.

L. SPD shall have a response time no greater than one nanosecond for any of the individual protection modes.

M. SPD manufacturer shall provide a warranty for a period of ten (10) years from the date of shipment against any SPD part failure.

N. SPD shall not be integral to the panelboard. Unit shall be mounted adjacent to panelboard.

O. Provide Square D HWA series, Eaton SPC series, or equal.

2.09 ABOVE GRADE SECONDARY PEDESTALS

A. Pedestal shall house free standing secondary connectors.

B. Pedestal shall be made from fiberglass molded with fire retardant additives, UV additives, and green colored pigment additives. Material shall be comprised so that the fiberglass does not peel over time and shall be resistant to fertilizers, salt, and ultraviolet rays.

C. Pedestal shall have 3” perimeter flange around the base to provide stability when buried.

D. Provide locking assembly with stainless steel or aluminum hardware to prevent rusting or corrosion.

E. Nordic Fiberglass PRMC series or equal, nominal dimensions of 9”W x 14”D x 30”H, with 18” Bottom Base Height. Provide “Electrical” molded labeled in raised lettering on top of pedestal.

2.10 CAMPSITE ELECTRICAL PEDESTALS

A. General: Electrical pedestal specifically designed to comply with Article 551 of NFPA 70-2017. Pedestals shall be UL listed.

B. Features:

1. Enclosure: Galvanized steel construction with factory paint overcoat. NEMA 3R for outdoor installations. Lid covering receptacles shall be weatherproof while in use.
2. Post Installation: Earth burial/embedded post.
3. Unmetered.
4. Short Circuit Rating: 10 kAIC
5. Circuit Breakers and Receptacles: Unless noted otherwise, each pedestal shall have:
    a. (1) 50A/2P circuit breaker
    b. (1) 30A/1P circuit breaker
    c. (1) 20A/1P/GFCI circuit breakers
    d. (1) NEMA 14-50R, 50A, 125/250V, 3P/4W grounding type receptacle
    e. (1) 30A, 125V, 2P/3W, grounding type receptacle

f. (1) Duplex NEMA 5-20R, 20A, 125V, 2P/3W, grounding type receptacle.

6. Terminals: Terminals shall be suitable for copper or aluminum conductors, rated 75°C, and sized to handle the conductors indicated.

2.11 UNDERGROUND UTILITIES MARKER TAPE

A. General: Provide non-detectable marker tape with tracer wire.

B. Marker Tape:Minimum of 4 inch wide by 5 mil thick non-detectable type. APWA approved colors with "Buried (Utility type)" permanently imprinted at intervals not to exceed 36 inches. Maximum elongation of < 50% at Break per ASTM D2578.

C. Tracer Wire: Provide at same height as marker tape for accurate locates and bring up into handholes for connection of signal generator. Flexible copper clad steel tracer wire, #12 AWG with minimum break load of 55 kpsi to meet ASTM B910. Insulation 30 mil, high molecular polyethylene, HMW-HDPE per ASTM D1248. For directional boring utilize 45 mil HMW-HDPE insulation. Use Pro-Trace line from Pro-Line Safety or equal.

D. Colors & Legend:

1. Electrical: Red color with "Buried Electrical" legend.

2. Communications: Orange color with "Buried Communications" legend.

PART 3 - EXECUTION

3.01 ELECTRICAL WORK, GENERAL

A. All electrical work shall be done in a neat and workmanlike manner as defined by NECA 1 "Standard Practices for Good Workmanship in Electrical Contracting".

B. Installation of electrical systems, equipment and raceways shall be done in accordance with the latest version of the appropriate NECA standard.

1. Aluminum wire and conductors (where indicated) shall be installed in accordance with NECA 104.

2. Installation of motors and motor controllers shall be in accordance with NECA 230.

3. Installation of panelboards shall be in accordance with NECA 407.

3.02 ELECTRICAL SERVICE

A. The Contractor shall verify the requirements of the utilities. The locations shown on the plot plan are reasonably accurate but the Contractor shall verify all conditions with each separate utility company. All work must be acceptable to the utilities.

B. Provide electrical service as indicated on the drawings.

C. Provide secondary conduit and wire from serving utility transformer to the main disconnect as indicated on the drawings.

D. Grounding of the electrical service shall be in accordance with the NEC and NECA 331 "Standard for Building and Service Entrance Grounding and Bonding". Provide grounding electrode conductor to each grounding electrode at each structure.

3.03 EQUIPMENT SUPPORT

A. Application of Support Systems: Unless noted otherwise, types of raceway and equipment support systems shall be as follows:

1. Outdoors and Exterior Environment: Galvanized steel strut and raceway support system.

B. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Existing Concrete: Expansion anchor fasteners.
4. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units. In corrosive environments, bolts shall be stainless steel.
5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

C. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

3.04 MINIMUM BRANCH CIRCUITS

A. Power Branch Circuits: Unless indicated otherwise, minimum branch circuits shall consist of #12 ungrounded conductors, #12 grounded conductor, and #12 equipment grounding conductor in ¾" raceway.

1. Where single pole circuit breakers or fuses are used for the branch circuit overcurrent protection, use of common neutrals on multi-wire branch circuits is prohibited.

3.05 CONDUIT

A. Electrical raceways shall be installed in accordance with NECA 101 "Standard for Installing Steel Conduit (Rigid, IMC, EMT)" and NECA 111 "Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC)" and NECA 605 "Installing Underground Nonmetallic Utility Duct".

B. Application of Raceways: Unless noted otherwise, types of raceways shall be applied as follows.

1. Exterior:
    a. Above-grade: RMC.
    b. Corrosive Environment: Stainless Steel IMC.
2. Below Grade: RNC PVC, HDPE, or RTRC-XW.
    a. Below Grade, general: RNC Schedule 40, or RTRC-XW.
    b. Below Grade, Under Roadways, Railroads: HDPE Schedule 80.
    c. Below Grade, Under creeks, lakes, rivers or similar: HDPE Schedule 80.
    d. Embedded in Concrete: RNC-40 or RTRC-XW.

3. Hazardous Locations: All conduit entries and electrical enclosures within a hazardous location shall have seals per Article 501 of the National Electrical Code. A sealing compound recommended by the fitting manufacturer shall be installed in all sealing fittings.

   a. Corrosive Environment: Stainless Steel IMC.

   b. Exterior: Stainless Steel IMC.

   c. Below Grade: Either stainless steel IMC. PVC-80 may be used if encased in 2 inches of concrete with a burial depth of 24 inches or more.

C. RMC: Each joint shall be made up wrench tight at couplings and unions, threaded hubs of junction box, device boxes, conduit bodies, etc. All sealing fittings shall be accessible.

D. Conduit sizes for various numbers and sizes of wire shall be as recommended by the latest edition of the National Electric Code and the latest supplements thereto. Conduit size shall be increased in size when lead-covered cable is required by the National Electric Code or this specification.

E. No conduit shall be used where the required number and sizes of wires cannot be easily "pulled in" and the Contractor shall be responsible for the selection of the conduit sizes. Conduit sizes shown on the drawings are "minimum" sizes in accordance with appropriate tables in the National Electric Code. If because of bends of elbows a larger conduit size is required, the Contractor shall so furnish without further cost to the Owner.

F. The entire conduit system shall be installed complete, thoroughly cleaned and all conduit fished before the wires are pulled in. Conduit shall be continuous from outlet to outlet, cabinet or junction box, and shall be so arranged that wire may be pulled in with the minimum practicable number of junction boxes.

G. The ends of all conduits shall be securely plugged, and all boxes temporarily covered to prevent plaster or dirt from entering the conduits. All conduit shall be thoroughly swabbed out with a dry swab to remove moisture and debris before conductors are drawn into place.

H. The Contractor shall be entirely responsible for the proper protection of this work from the other trades on the job. When conduit becomes bent or holes are punched through same, or outlets moved after being roughed-in, the Contractor shall repair same as directed, without additional cost to the Owner.

I. Changes in direction shall be made by bends in the pipe wherever possible and these shall be made smooth and even without flattening the pipe or flaking the finish. Bends shall be as long radius as possible and in no case smaller than the corresponding trade elbow. Long-radius elbows shall be used where necessary.

J. RNC and RTRC: Nonmetallic raceway bends shall be made with factory fabricated bends whenever possible. Field bends shall be made with a hot-box designed for the purpose. Field bends shall not be made using a torch or flame. Raceways with torch burn marks shall be removed and replaced.

K. Not more than four 90 degree bends will be allowed in one raceway run. Where more bends are necessary, a conduit or pull box shall be installed. All bends in 1 inch and smaller shall be made with a conduit bender and all larger sizes shall have machine bends.

L. Where rigid conduits enter boxes, panels, cabinets, etc., they shall be rigidly clamped to the box by a locknut on the outside, and a bushing on the inside of the box for each conduit.

M. All conduits shall enter the box squarely.

N. Furnish and install insulated bushings as required by NEC Article 300.4(G). The use of insulated bushings does not exclude the use of double locknuts to fasten conduit to the box.

O. For all exterior/outdoor conduit risers from below grade to above grade shall have an expansion fitting.

P. All conduit work installed in concrete slabs resting on earth shall be RNC in ordinary locations, and stainless steel IMC/RMC in hazardous locations and corrosive locations. All conduit laid in earth or under slab shall be RNC in ordinary locations, and stainless steel IMC/RMC in hazardous locations and corrosive locations.

Q. Where conduits are run individually, they shall be supported by approved pipe straps, or beam clamps. Straps shall be secured by means of toggle bolts on hollow masonry; expansion shields and machine screws or standard preset inserts on concrete or solid masonry; machine screws or bolts on metal surfaces; and wood screws on wood construction.

R. No perforated straps or wire hangers of any kind will be permitted.

S. All steel bolts, washers and screws shall be stainless steel, galvanized, or cadmium-plated in ordinary locations and shall be stainless steel in corrosive environments.

3.06 LUBRICANTS

A. Where lubrication is required for pulling conductors or cables it shall be a compound specifically prepared for cable pulling and shall not contain petroleum and other products which will have a deteriorating effect on the cable insulation.

3.07 PULL WIRE

A. A pull wire shall be installed in all empty conduits. In dry locations, pull wire shall be No. 16 gauge galvanized iron.

B. In conduits under slab on fill below grade, or in damp locations pull wire shall be No. 12 AWG copper wire.

C. Both ends of all pull wires shall be identified by means of labels or tags, reading "PULL WIRE" and shall be numbered to refer to the same pull wire.

3.08 EQUIPMENT GROUND

A. Any conductor used solely for grounding purpose, equipment grounding, etc., shall be green unless bare.

B. All wiring throughout the entire project for all of the various systems shall be furnished with a ground wire and color coded in accordance with the needs of the particular system. Wire must be color coded throughout its entire length.

C. The practice of color coding or tagging wire ends will not be acceptable, except for feeders which shall be color coded at both ends.

3.09 INSTALLATIONS IN ABOVE GRADE SECONDARY PEDESTALS / CAMPSITE ELECTRICAL PEDESTALS

A. Install pedestals level and plumb and with the orientation and depth coordinated with connecting raceways to minimize bends and deflections required for proper entrance. Set pedestal depth in accordance with manufacturer's recommendations.

B. Unless otherwise indicated, support pedestal on a level bed of crushed stone or gravel, graded from ½ inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth. Minimum of 4 inches of gravel below box and for 6 inches beyond the outside walls of the box.

C. Provide prefabricated raceway sweep bends to turn raceway up so that the raceway enters the enclosure vertically from the bottom

D. Install all splices and taps, in a neat, professional and workmanlike manner, using insulated, booted, wiring connectors created especially for the intended application. Only wiring connectors with a "submerible" or "Direct Burial (DB)" designation will be accepted. Do not use hand-made squeeze-ons, tape wrapped ball connections, or connectors not suitable for use with conductors utilized.

E. For pedestals with more than one conduit entry and exit, identify each raceway within the pedestal. Identify the destination of each raceway. For raceways containing power circuits, identify the circuit by campsite served and identify the circuit originating panel. Identification may be legibly handwritten with permanent ink (Sharpie) or with permanent pre-printed vinyl adhesive label.

3.10 DIRECT BURIAL CONDUCTOR INSTALLATION

A. Minimum Depth = 24"

B. Bedding: Minimum 3" below conductor shall be required in the bottom of all trenches. Bedding shall consist of finely crushed dirt.

C. Cover: Minimum 3" over condcutors shall be required in all trenched. Cover shall consist of finely crushed dirt.

D. Trench bed, cover, and backfill dirt shall be free of large rocks and any sharp angular material to avoid damage to direct bury condcutors.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. General:

1. Remove surface debris.
2. Removal of vegetation and sod.
3. Remove trees, shrubs and other plants.
4. Remove root system of trees and shrubs.
5. Disposal.

1.02 REFERENCES

A. State Standard Specifications, latest edition, including all current supplemental specifications.

1.03 REGULATORY REQUIREMENTS

A. Conform to local, state, and federal regulations for disposal of debris.

B. Contractor shall obtain, at Contractor's own expense, all permits or licenses for the use and maintaining of dumps and waste areas.

C. Coordinate clearing work with utility Owners.

D. Conform to local, state, and federal regulations for preparation and implementation of erosion control plan.

1.04 UNIT PRICES

A. General Clearing and Grubbing:

1. Includes:

a. Clearing: Removal and disposal of all unwanted material from the surface, such as trees/stumps vegetation, boulders and trash.

b. Grubbing: Removal and disposal of all unwanted materials from underground, such as boulders, stumps, roots or other debris.

c. Backfill: Backfill required to fill cavities as a result of any removal shall be included in the cost of the clearing and grubbing.

2. Method of Measurement and Pay Unit: By the lump sum.

B. Tree and/or Stump Removal:

1. Includes trees and stumps (including root ball) that the circumference exceeds 80 inches at 40 inches above ground level (or the circumference exceeds 80 inches at ground level if stump only). Backfill required to fill cavities as a result of the removals shall be included in the cost of the removal.

2. Method of Measurement and Pay Unit: By each tree/stump removed.

1.05 PROJECT CONDITIONS

A. Conform to applicable regulations relating to environmental requirements, disposal of debris, use of herbicides and hazardous materials.

B. Coordinate clearing work with utility companies.

C. Protect utilities to remain from damage.

D. Protect trees, plants, amenities and other features designated to remain as final landscaping.

E. Protect benchmarks, survey control points and existing structures from damage or displacement.

PART 2 – PRODUCTS

2.01 MATERIALS

A. See Section 31 23 23 – Fill and Backfill for material specifications.

PART 3 - EXECUTION

3.01 PREPARATION

A. Locate and identify utilities to remain. Tag utilities to be removed.

B. Verify that existing plants designated to remain are tagged or identified.

C. Tag existing plants designated to remain.

D. Identify a waste area/salvage area for placing removed materials.

3.02 CLEARING

A. Clear areas required for access to site and execution of work.

B. Remove trees, shrubs and stumps within limits of construction (LOC).

C. Remove roots to a depth of 36 inches.

D. Clear undergrowth and deadwood without disturbing subsoil.

E. Remove existing sod or vegetation without disturbing topsoil.

3.03 REMOVAL

A. Remove surface rock.

B. Remove debris from site.

3.04 SALVAGED MATERIALS

A. Carefully remove, load, transport, unload, and store materials and items designated as salvage.

B. Reinstall salvage material and items as shown in the plans.

3.05 DISPOSAL

A. Remove waste material from project site promptly as it is generated by construction operations; do not permit to accumulate. Unless directed, do not remove topsoil from the site.

B. Remove brush, trees, stumps, roots, rubbish, spoil, excess excavated material and material not suitable for backfill to off-site location of Contractor's choice, cost to be incidental to the removal.

C. Disposal areas shall be Contractor's responsibility unless otherwise indicated in Section 01 10 00 - Special Provisions.

D. Grade final cover to allow for positive surface drainage.

E. Haul Routes:

1. Determine haul roads with approval of agency having jurisdiction over proposed roadway.

2. Make condition survey of haul roads prior to use and document with necessary photographs and written descriptions.

3. Keep reasonably free from dirt, dust, mud and other debris from construction operations.

4. Clean a minimum of twice a week.

5. Repair any damaged haul roads to match existing conditions before use.

6. No extra payment shall be made for removals regardless of disposal locations.

7. Temporary haul routes (roads) developed by the Contractor shall be completely removed at the completion of the project and the area returned to its original condition. The cost of temporary haul routes shall be incidental to the cost of the project.

END OF SECTION

SECTION 31 22 00

GRADING, EXCAVATION AND EMBANKMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Removal, storage, and placement of topsoil.

B. Rough grading for site improvements.

C. Building, Shaping, Excavation and/or Embankment for:

1. Building volume below grade, footings, pile caps, site structures, box culverts, and general grading and fills.

2. Roadbeds, subgrades, shoulders, bridge approaches and private entrances.

3. Slopes, dikes, channels and ditches needed for drainage.

4. Stripping of all unsuitable materials.

5. Obtaining soils from off-site borrow pit.

1.02 REFERENCES

A. State Standard Specifications, latest edition.

B. AASHTO T 180 – Standard Specification for Moisture – Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 inch) Drop: American Association of State Highway and Transportation Officials.

B. ASTM C 136 –Standard Test Method for Sieve Analysis of Fine Coarse Aggregates.

C. ASTM D 698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))

D. ASTM D 1556 – Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.

E. ASTM D 1557 –Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3)).

F. ASTM D 2167 –Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.

G. ASTM D 2487 –Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

H. ASTM D 6938 –Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

J. ASTM D 4318 –Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.03 UNIT PRICES

A. Topsoil:

1. Work may be considered subsidiary to bid item "Earthwork as Excavation" and/ or "Earthwork as Embankment" or work may be paid for as "Topsoiling" per cubic yard. If paid for by unit price, measurement will be in cubic yards of topsoil stripped, salvaged, supplied (if required), and spread, and will be computed on the basis of a uniform 6 inch finished thickness, or as specified.

2. Includes excavating existing topsoil, stockpiling, scarifying substrate surface, supplying, placing topsoil where required and compacting.

3. The loading, hauling and disposal of surplus material at a site of the contractor's choice is considered subsidiary to excavating existing topsoil.

B. Earthwork as Excavation:

1. Payment may be made by Established Quantity OR per Cubic Yard (CY). If paid for per cubic yard, measurement shall be based on a post construction survey or other agreed upon method of measurement between Engineer and Contractor.

2. If paid by Established Quantity, plan quantity(s) not field measured upon completion of project,

3. The loading, hauling and disposal of surplus material at a site of the contractor's choice is considered subsidiary.

4. Includes excavation, placing where required, compacting soils to the elevations shown in the drawings and water applied to obtain compaction.

C. Earthwork as Embankment:

1. Payment may be made by Established Quantity OR per Cubic Yard (CY). If paid for per cubic yard, measurement shall be based on a post construction survey or other agreed upon method of measurement between Engineer and Contractor.

2. If paid by Established Quantity, plan quantity not field measured upon completion of project.

3. Contractor may be required to furnish borrow material – See plans and or Section 01 10 00 – Special Provisions.

4. No Additional Compensation for:

   a. Additional material required to obtain compaction.

   b. Material placed outside of limit of typical cross section.

   c. Material placed to correct settlement of embankment.

   d. Water applied to obtain compaction.

5. Includes excavation, supplying, placing where required, compacting soils to the elevations shown in the drawings and water applied to obtain compaction.

D. Unsuitable Materials:

1. Includes excavating materials which are determined by Engineer to be unsuitable, loading and removal of unsuitable material from site, and furnish and backfill with materials specified by Engineer.

2. Method of Measurement and Pay Unit: By the cubic yard (measured in place).

1.05 SUBMITTALS

A. Project Record Documents: Contractor shall accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

B. Samples: 60-pound samples of each type of fill. Submit in airtight containers to testing laboratory unless samples are to be acquired by the testing agency.

C. Materials Sources: Submit name of imported materials source.

D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

E. Compaction density test reports.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with State Standard Specifications, Section 01 40 00 – Quality Requirements and Section 01 10 00 – Special Provisions.

1.07 PROJECT CONDITIONS

A. Protect above and below-grade utilities that remain.

B. Protect plants, lawns, rock outcroppings, amenities and other features to remain as a portion of final landscaping.

C. Protect benchmarks, survey control points, existing structure, fences, sidewalks, paving, curbs, batter boards and amenities from excavating equipment and vehicular traffic.

PART 2 - PRODUCTS

2.01 MATERIALS

A. See Section 31 23 23 – Fill and Backfill for material specifications.

B. Water required for grading is Contractor's responsibility. The cost of furnishing water will not be a direct pay item, unless specified otherwise, but is to be included in other items for which payment is made.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that survey benchmark and intended elevations for the work are as indicated.

3.02 PREPARATION

A. Identify required lines, levels, contours and datum.

B. Stake and flag locations of known utilities.

C. Locate, identify and protect utilities that remain from damage.

D. Notify utility owner to remove and relocate utilities when relocation is required.

E. Implement erosion control plan.

3.03 EXCAVATING

A. Underpin adjacent structures which may be damaged by excavating work.

B. Excavate to accommodate new structures.

C. Notify Engineer of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.

D. Slope bank of excavations deeper than 3 feet to angle of repose or less until shored.

E. Do not interfere with 45 degree bearing splay of foundations.

F. Cut utility trenches wide enough to allow inspection of installed utilities.

G. Hand trim excavations. Remove loose materials.

H. Remove lumped subsoil, boulders and rock.

I. Correct areas that are over-excavated and load-bearing surfaces that are disturbed.

J. Grade top perimeter of excavation to prevent surface water from draining into excavation.

K. Remove excavated material that is unsuitable for reuse from site.

L. Remove excess excavated material from site.

3.04 ROUGH GRADING

A. Remove topsoil within the limits of construction (LOC) without mixing with foreign materials and stockpile. Minimum depth of topsoil removal shall be 6 inches unless otherwise noted in the drawings.

B. Do not remove topsoil when wet.

C. Remove subsoil from areas to be further excavated, relandscaped or regraded.

D. Do not remove wet subsoil unless it is subsequently processed to obtain optimum moisture content.

E. When excavating through roots, perform work by hand and cut roots with sharp axe.

F. Benching Slopes: Horizontally bench existing slopes greater than 1 foot vertical rise in 4 feet to key fill material to slope for firm bearing.

G. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

H. Employ a compaction method that achieves the specified density requirements.

I. Employ a placement method that does not disturb or damage other work.

J. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

K. Prewatering, if required, shall be defined and paid for within the Section 01 10 00 Special Provisions.

L. Maintain optimum moisture content of fill materials to attain required compaction density. See Geotechnical Report.

M. Granular Fill: Place and compact materials in equal, continuous layers not exceeding 6 inches compacted depth or as indicated in the Geotechnical Report.

N. Maintain Roadbed in Such Condition That:

1. Roadbed drains at all times.

2. Side ditches are constructed to avoid damage to embankments by erosion.

3. Slopes are trimmed accurately.

4. Avoid loosening material below or outside of the required slopes, remove all breakage and slides.

5. Excavate side ditches as shown in the drawings.

6. Finished roadway matches the lines, grades and cross sections shown in the drawings.

3.05 SOIL REMOVAL AND STOCKPILING

A. Stockpile topsoil to be reused on site. Remainder to be removed from site and disposed of at a location of the contractor's choice, unless otherwise stated in Section 01 10 00 – Specials Provisions.

B. Stockpile subsoil to be reused on site. Remainder to be removed from site and disposed of at a location of the contractor's choice, unless otherwise stated in Section 01 10 00 – Specials Provisions.

C. Stockpiles: Use areas designated; protect from erosion.

3.06 FINISH GRADING

A. Before Finish Grading:

1. Verify building and trench backfilling have been inspected.

2. Verify subgrade has been contoured and compacted.

B. Remove debris, roots, branches and stones in excess of 1 inch in size.

C. Where topsoil is to be placed, scarify surface to depth of 6 inches.

D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 6 inches.

E. Place topsoil in areas where seeding, sodding and planting are indicated.

F. Place topsoil to the following compacted thicknesses:

1. Areas to be Seeded with Grass: 6 inches.

2. Areas to be Sodded: 4 inches.

3. Shrub Beds: 8 inches.

4. Flower Beds: 2 inches.

5. Planter Boxes: To within 3 inches of box trim.

G. Place topsoil during dry weather.

H. Remove roots, weeds, rocks and foreign material while spreading.

I. Near trees, shrubs and buildings, spread topsoil manually to prevent damage.

J. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.

3.07 HAUL ROUTES

A. Determine haul roads with approval of agency having jurisdiction over proposed roadway.

B. Make condition survey of haul roads prior to use and document with necessary photographs and written descriptions.

C. Keep reasonably free from dirt, dust, mud and other debris from construction operations.

D. Clean a minimum of twice a week.

E. Repair any damaged haul roads to match existing conditions before use.

F. No extra payment shall be made for removals regardless of disposal locations.

G. Temporary haul routes (roads) developed by the Contractor shall be completely removed at the completion of the project and the area returned to its original condition. The cost of temporary haul routes shall be incidental to the cost of the project.

3.08 TOLERANCES

A. Top Surface of Finish Grade and/or Subgrade: Plus or minus 0.08 feet from required elevation.

3.09 FIELD QUALITY CONTROL

A. Compaction density testing shall be performed on compacted fill in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 6938.

B. Results shall be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 "standard proctor", ASTM D 1557 "modified proctor" or AASHTO T 180.

C. If tests indicate work does not meet specified requirements, remove work, replace and retest.

D. Frequency of Tests:

1. Test randomly.

2. Under Paving, Slabs-on-Grade and Similar Construction, or as directed by Engineer: A minimum of 1 test for each lift of 0 to 2 feet in depth per 100’ x 100’ area or as determined by Engineer.

E. Proof roll compacted fill at surfaces that will be under slabs-on-grade, pavers and paving.

3.10 CLEANING AND PROTECTION

A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

C. Remove unused stockpiled topsoil and subsoil. After removing all stockpiles, grade areas to prevent standing water. Maintain drainage away from buildings and structures at a 2 percent grade or as indicated on the drawings.

D. Leave site clean and raked, ready to seed, sod or landscape.

END OF SECTION

SECTION 31 23 13

SUBGRADE PREPARATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Subgrade preparation of subgrade soils.

1.03 REFERENCES

A. State Standard Specifications, latest edition.

1.04 UNIT PRICES

A. Subgrade Preparation:

1. Pay unit by the square yard (SY).

2. Required subgrade preparation 3 feet, or width as stated on Plans, beyond the edge of the pavement is considered incidental and will not be a pay item.

B. Unsuitable Materials:

1. Includes excavating materials which are determined by Engineer to be unsuitable as subgrade, loading and removal of unsuitable material to a site of the contractor's choice, and furnish and backfill with materials specified by Engineer.

2. Method of Measurement and Pay Unit: By the cubic yard (measured in place).

PART 2 - PRODUCTS

2.01 MATERIALS

A. See Section 31 23 23 – Fill and Backfill for material specifications.

B. Water required for subgrade preparation is Contractor's responsibility. The cost of furnishing water will not be a direct pay item but is to be included in the bid item subgrade preparation.

2.02 CERTIFICATION

A. Borrow material delivered to the project must be approved by Owner's designated geotechnical firm prior to bringing the material on-site. Contractor shall be responsible for any testing costs to confirm that the material is acceptable.

PART 3 - EXECUTION

3.01 CONSTRUCTION METHODS

A. Subgrade preparation shall include the subgrade directly under the proposed pavement and shall extend a minimum of 3 feet, or width stated on Plans, laterally beyond the edge of the pavement. The depth of the subgrade preparation shall be as recommended in the geotechnical report.

B. The subgrade shall be disced or ripped, removed or windrowed to thoroughly mix the soil, then redistributed and compacted in 2 lifts or as otherwise directed in the geotechnical report.

C. The subgrade should be compacted to a maximum dry density and a moisture content as recommended in the geotechnical report.

D. Subgrade testing shall be completed by an approved testing laboratory and shall be at Owner's expense. Any areas that do not meet the compaction requirements shall be reworked and recompacted at Contractor's expense. Any retesting of the subgrade shall be at Contractor's expense.

E. Subgrades shall be profiled with an automated, electronically controlled machine. The machine must provide accurate vertical and horizontal control.

F. The subgrade surface shall be proof rolled to identify any soft spots prior to the placement of any paving. The removal and replacement of the material in any soft spots to a minimum depth of 12 inches shall be at Contractor's expense.

G. Subgrade profiling and other subgrade preparations are subsidiary to subgrade preparation.

H. The material from subgrade profiling shall be removed from the site at the time of profiling operations if it is not suitable for use as final grading material. If this material is not to be used as backfill material, it shall be disposed of at Contractor's own disposal site. Engineer to determine the suitability of the trimmings for use as final grading material.

3.02 FIELD QUALITY CONTROL

A. Compaction density testing shall be performed on compacted fill in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 6938.

B. Results shall be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 "standard proctor", ASTM D 1557 "modified proctor" or AASHTO T 180.

C. If tests indicate work does not meet specified requirements, remove work, replace and retest.

D. Frequency of Tests:

1. 1 test per 100 to 150 linear feet per lane of roadway subgrade or as determined by Engineer.

2. 1 test per 100' X 100' area or as directed by Engineer for irregular areas.

E. Proof roll subgrade that will be under paving.

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Excavation dewatering

1.02 REFERENCES

A. ASTM D 422 – Standard Test Method for Particle Size-Analysis of Soils (Withdrawn 2016)

B. ASTM D 698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))

C. ASTM D 1556 – Standard Test Method for Density and Unit Weight of Soil in place by the Sand-Cone Method

D. ASTM D 1587 – Standard Practice for Thin-Walled Tube Sampling of Fine-Grained Soils for Geotechnical Purposes

E. ASTM D 2216 – Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

F. ASTM D 2488 – Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

G. ASTM D 4220 – Standard Practices for Preserving and Transporting Soil Samples

H. ASTM D 4318 – Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

I. ASTM D 6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.03 SCOPE OF WORK:

A. The work in this Section includes site dewatering necessary to lower and control groundwater level and hydrostatic pressure, and controlling the site drainage and surface water flows, to allow construction to be performed.

1. It is required that the groundwater level be lowered and maintained at the level necessary to provide a substantially dry and stable grade to allow subsequent operations to be performed.
2. The Contractor shall install all such dewatering equipment as may be necessary, throughout the duration of the project, to maintain the groundwater level, as required.
3. Contractor is responsible for controlling discharge rate and the dewatering system’s effect on the groundwater level.
4. The Contractor shall intercept and divert site drainage and surface water flows away from excavations and trenches; using dikes, ditches, pipes, sumps, pumps or other means.
5. The Contractor shall remove standing water from trench or excavation with sumps, pumps and piping or other means.

B. It shall be Contractor's responsibility to select materials, methods, and equipment, and design a dewatering system which will:

1. Provide a substantially dry and stable grade to allow subsequent operations to be performed.
2. Effectively reduce the hydrostatic pressure and lower the groundwater level, as required.
3. Not result in damage to adjacent properties, buildings, structures, utilities, private and public water wells, or other work, as a result of settlement, standing water or other groundwater-related effects.

C. Dewatering operations shall be adequate to assure the integrity of the finished project.

D. The responsibility for conducting the dewatering operation in a manner, which will protect adjacent structures and facilities, rests solely with Contractor.
1. The cost of repairing any damage and/or the restoration or replacement of adjacent structures and facilities that are damaged as a result of the dewatering operations shall be the sole responsibility of Contractor.

E. The Contractor shall be solely responsible for the design, installation, operation, maintenance, monitoring, and removal of the dewatering system.

1.04 POWER

A. All power necessary for dewatering, intercepting and diverting the site drainage and surface water flows away from the excavation, and removing standing water from trench or excavation with a sump and pump shall be provided by Contractor at his sole cost and expense and shall be considered incidental and subsidiary to other items of work for which direct payment is made. No separate payment will be made for this power.

1.05 MEASUREMENT AND PAYMENT (INCIDENTAL)

A. Unless otherwise stated in Section 01 10 00 - Special Provisions, measurement and separate payment for dewatering will not be made.

B. Dewatering, including intercepting and diverting site drainage and surface water flows away from excavations and trenches, and removing standing water from trench or excavation with a sump and pump shall be considered incidental and subsidiary to other items of work for which direct payment is made.

1.06 REGULATORY REQUIREMENTS

A. The Contractor shall be responsible for submitting the applications and securing all permits necessary to complete the requirements of this Section.
1. Owner will support Contractor’s efforts in securing the required permits, as necessary.
2. To support Contractor’s efforts in securing required permits, if required by regulatory authority, Owner will sign the permit application documents that have been prepared by Contractor and reviewed and approved by Owner.
    a. Contractor shall prepare necessary documents, required by regulatory authority to be signed by Owner, and shall provide Owner a minimum of 5 (five) working days for Owner to review and approve documents.
3. Contractor shall provide a copy of all permits that are secured to Owner through Engineer.

4. A copy of all necessary permits shall be maintained by Contractor at the work site at all times during the performance of the work.

B. The Contractor shall comply with requirements of applicable regulatory authorities for the dewatering system, including but not limited to the construction of the dewatering system and the control and discharge of groundwater from dewatering operations.

C. The Contractor shall coordinate dewatering activities with Owner, other Contractors, Sub-contractors and regulatory authorities.

D. The Contractor shall comply with the site-specific requirements included in any permits, including the possible modification of the dewatering system or adjustment of the dewatering operation, if the discharge exceeds limits imposed by a regulatory permit.

1. Obtain regulatory authority's specific discharge requirements prior to commencement of dewatering.
2. The Contractor will be responsible for the costs of flow measurement, sampling, analysis and reporting, required by a regulatory permit.

E. Where applicable, Contractor shall provide a pollution prevention plan and implement any Best Management Practices needed to achieve necessary results.

1.07 SUBMITTALS

A. Prior to commencement of construction, if dewatering to lower the groundwater level is to be performed, submit the detailed dewatering plan for Owner's and Engineer's record. Review and approval of the dewatering plan by Owner and/or Engineer is not required. The detailed dewatering plan shall, at a minimum, include:

1. Complete description of equipment and instrumentation Contractor plans to utilize in dewatering, with the installation, operation, maintenance and monitoring procedures.
2. Dewatering system design, complete with design calculations and shop drawings demonstrating the adequacy of the proposed system and equipment.
3. Arrangement, location and depths of the components of the dewatering system.
4. Estimated pumping rates for dewatering system.
5. Estimated duration of dewatering operations.
6. Method of disposal of groundwater pumped from dewatering system.
7. Method of water quality monitoring, if required by regulatory authority.
8. Method of flow measurement, if required by regulatory authority.
9. Method for monitoring the groundwater level at the construction site.
10. If applicable, the name of subcontractor(s) responsible for dewatering and their contact information.
11. Source of power for dewatering.
12. Description and location of standby equipment and standby power supply.
13. Description of the process to decommission the dewatering system, including the criteria for determining the schedule for ending dewatering system operation.

B. Submit copies of the special permits required for performing the work of this Section.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Contractor shall furnish, install and remove all equipment and materials necessary for dewatering, control of site drainage and surface water flows and removing standing water from excavations or trenches.

B. Equipment and materials may include, but is not limited to, sump pumps, single or multiple stage well point systems, eductor and ejector type systems, deep wells, well pumps, berms, dikes, ditches, sumps, temporary pipelines, treatment systems or any combinations thereof.

C. Contractor shall provide adequate standby equipment and competent personnel; available at all times, to insure continuous and efficient dewatering operations are maintained.

D. Contractor shall furnish and install equipment, as necessary, to comply with flow measurement and water quality monitoring requirements of regulatory authorities or permit requirements.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall furnish, install, and operate pumps, pipes, appliances, and equipment as necessary to maintain the groundwater level as required within the excavation limits, control site drainage and surface water flows, and remove standing water from excavations and trenches.

1. Dewatering system shall be designed, installed, operated and maintained to lower and control the groundwater level to permit excavation, construction and placement of backfill materials to be performed under substantially dry and stable soil conditions.
2. Contractor shall maintain the required groundwater level, until the construction is completed, backfilled and operational.
3. Dewatering shall at all times be conducted in a manner that preserves the undisturbed bearing capacity of subgrade soils.
4. Contractor shall prevent flotation by maintaining a positive and continuous removal of groundwater and control of surface water. Contractor is responsible and liable for all damages that may result from failure to adequately keep excavations and trenches dewatered.
5. Contractor shall locate dewatering facilities where they will not interfere with existing or proposed utilities or structures, or the work to be performed by others.
6. Contractor shall use sand-pack or provide other means to prevent pumping of fine sands or silts from the subsurface.

B. Observation and Operational Control

1. Adequate observation and operational control and routine inspections shall be provided by Contractor at all times to ensure proper operation and compliance with any permits or water quality requirements.

2. Temporary diversions, sumps, channels and flow outlets shall be inspected regularly by Contractor for erosion and accumulated sediment, and repairs and maintenance shall be done, as needed, in a timely manner.
    a. Sediment shall be disposed of in accordance with all applicable laws and regulations.
3. Adequate observation and operational control shall be maintained by Contractor at all times to ensure that the stability of excavated grade and slopes is not adversely affected by dewatering.
4. Adequate observation and operational control shall be maintained by Contractor to ensure that erosion is controlled and that flooding or damage to the excavation, adjacent structures or facilities, and downstream property does not occur.
5. Contractor shall monitor dewatering system to ensure that subsurface soil, sand or fine-sized soil particles are not being removed by the dewatering operation.

C. Dispose of groundwater in a suitable manner.
1. Contractor shall NOT drain groundwater into work built or under construction.
2. Wherever possible, groundwater shall be discharged into a nearby, existing storm sewer or drainage system.
3. Contractor shall obtain all permits required for discharge of groundwater from authorities having jurisdiction.
    a. Any groundwater discharged shall comply with applicable permit requirements.
    b. Methods of groundwater discharge, conveying, and transmission to off-site locations shall meet with the approval of the authorities having jurisdiction.
    c. Treat any groundwater collected by dewatering operations prior to discharge, as required by authorities having jurisdiction.
        (i) Remove solids from groundwater treatment facilities and perform other maintenance of groundwater treatment facilities as necessary to maintain their efficiency.
    d. Discharge groundwater as required by permits and in manner that will not cause erosion or flooding, or otherwise damage existing facilities, facilities under construction or adjacent property.

D. Contractor shall control site drainage and surface water flows at all times and shall remove standing water from trench or excavation.
1. Intercept and divert site drainage and surface water flows away from excavations and trenches, drain standing water to sumps and pump or drain away by gravity to keep the excavation free from standing water.
2. Any water discharged shall comply with regulatory authority requirements and applicable permit conditions.

E. Contractor shall provide any temporary piping necessary to convey dewatering discharge to an acceptable drainage structure with the capacity to convey said discharge.

1. Any temporary piping, necessary to complete the project, shall be provided by Contractor.

F. Contractor shall modify any dewatering procedures, which cause or threaten to cause damage to new or existing facilities, to prevent further damage.

1. The Contractor is responsible for determining the extent of any modifications that are to be made, and shall implement these modifications at no additional cost to the Owner.

G. The dewatering system shall be placed into operation, prior to beginning excavating and shall be operated continuously 24 hours a day, 7 days a week until construction that is subject to effects of groundwater is complete and backfill materials have been placed.

1. Provide back-up equipment as necessary for replacement and for unanticipated emergencies.

2. If the dewatering system fails to operate properly, shuts down or pumping is suspended before scheduled and the groundwater rises above the level required, the groundwater level will need to be lowered to the level required, prior to continuing any construction, including excavation or backfilling.

a. If the excavation or backfill is prematurely subjected to an increase in groundwater level, additional soil testing, as determined necessary by Engineer, will be performed, to verify soils stability and suitability.

b. The additional testing shall be conducted prior to continuing construction and may include compaction test, moisture content test and other soil testing to determine the soil condition.

c. If the soil stability or soil condition is determined to be unacceptable by Engineer, Contractor shall take such corrective action as is necessary to provide acceptable soil conditions, at Contractor's sole cost and expense.

d. The cost of any additional soil testing required as a result of a premature increase in groundwater level shall be borne solely by Contractor.

H. Contractor shall establish, observe, and record reference points to detect any settlement of structures adjacent to areas of proposed dewatering.

1. Take and record elevation measurements not less than once per week and report results to Owner through Engineer weekly during the entire dewatering system operation.

2. Upon completion of dewatering, take weekly measurements for a period of 4 weeks and report results to Owner through Engineer weekly.

3. Notify Owner through Engineer and take immediate remedial action, if movement of the existing structure occurs during the performance of the work.

4. Modify dewatering procedures that cause, or threaten to cause any movement or damage to new or existing facilities, to prevent further movement or damage.

3.02 OPERATIONAL RECORDS

A. Contractor shall submit to Owner, through Engineer, copies of records of:

1. Discharge volume on a periodic basis, as required by regulatory authority.
2. Water quality test results on a periodic basis, as required by regulatory authority.
3. Submit records of elevation readings taken on existing structure in the area that may be affected by dewatering operations, monthly.

3.03 UNSTABLE SOIL CONDITIONS

A. If during or after any excavation, Contractor observes sufficient soil instability present to prevent the proper installation of pipe bedding, pipelines, foundation material, subgrade preparation, structure, backfill and compaction, then Contractor shall call for inspection of conditions by the Engineer.

3.04 RESTORATION

A. Allow groundwater to return to its static level in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted backfill and prevent flotation or movement of structures or pipelines.

B. Provide materials, equipment and labor necessary to remove all temporary dewatering system components and equipment prior to contract closeout.

C. All dewatering wells and well points shall be decommissioned in strict compliance with applicable regulatory requirements.

D. Restore to conditions equivalent to those existing prior to start of work, including repair of any settlement related damage.

END OF SECTION

SECTION 31 23 23

FILL AND BACKFILL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Filling, backfilling and compacting for building volume below grade, footings, slabs-on-grade, paving, site structures and utilities all within the building envelope, and pile caps.

B. Filling holes, pits and excavations generated as a result of removal operation.

C. Backfilling around and outside of structures.

1.02 REFERENCES

A. AASHTO T 180 – Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop; American Association of State Highway and Transportation Officials.

B. ASTM C 136 – Standard Test Method for Sieve Analysis of Fine Coarse Aggregates.

C. ASTM D 698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft3 (600 kN-m/m3)).

D. ASTM D 1556 – Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.

E. ASTM D 1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3).

F. ASTM D 2167 – Standard Test Method for Density and Unit Weight of Soil in Place by Rubber Balloon Method.

G. ASTM D 2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

H. ASTM D 6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

I. ASTM D 4318 – Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

J. State Standard Specifications for Highway Construction, latest edition, including all current supplemental specifications.

1.03 UNIT PRICES

A. Fill and backfill is considered subsidiary to the work included in the project.

1.04 SUBMITTALS

A. Samples: 60-pound sample of each type of fill. Submit airtight containers to testing laboratory.

B. Materials Sources: Submit name of imported materials source.

C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

D. Compaction density test reports.

1.05 PROJECT CONDITIONS

A. Provide sufficient quantities of fill to meet project schedule and requirements. When necessary, store materials on-site in advance of need.

B. When fill materials need to be stored on-site, locate stockpiles where designated.

1. Separate differing materials with dividers or stockpile separately to prevent intermixing.

2. Prevent contamination.

3. Protect stockpiles from erosion and deterioration of materials.

C. Verify that survey benchmarks and intended elevations for work are as indicated.

PART 2 - PRODUCTS

2.01 FILL MATERIALS

A. Fill Materials: All recommendations in the geotechnical report shall be followed. In the absence of a geotechnical report, the fill materials shall meet the criteria stated in this section.

B. Non-structural Fill: Subsoil excavated on-site.

1. Material should not contain an appreciable amount of roots, rock, or debris, and should not contain any foreign material with a dimension greater than 3 inches.

2. ASTM C 2487 classification: GW, GP, GM, GC, SC, SW, SP, SM, ML, CL-ML or CL.

3. Liquid limit: Less than 45.

4. Maximum plasticity index: 20.

5. See Geotechnical Report for additional information, if available.

C. Structural Fill: Subsoil excavated on-site.

1. Low volume change cohesive soils, free of organic matter, rocks or foreign material.

2. ASTM D 2487 classification: CL, ML, or CL-ML.

3. Liquid limit: Less than 45.

4. Maximum plasticity index: 20.

5. See Geotechnical Report for additional information, if available.

D. Flowable Fill:

1. A mixture of cement, fly ash, fine sand, water and air having a consistency which will flow under a very low head.

2. Approximate quantities, per cubic yard:

a. Cement (Type II): 50 Lbs.

b. Fly ash: 200 Lbs.

c. Fine Sand: 2,700 Lbs.

d. Water: 420 Lbs.

e. Air Content: 10 percent

3. Compressive Strength: 85 to 175 psi.

E. Topsoil: Topsoil excavated on-site.

1. Unclassified.

2. Free of roots, rocks, subsoil, debris, large weeds and foreign matter.

I. Water: Water required for fill and backfill is Contractor's responsibility. The cost of furnishing water will not be a direct pay item but is to be included in other items for which payment is made, unless stated otherwise.

2.02 SOURCE QUALITY CONTROL

A. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.

B. If tests indicate materials do not meet specified requirements, change material and retest.

C. Provide materials of each type from same source throughout the work.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Identify required lines, levels, contours and datum locations.

B. Verify subdrainage, dampproofing or waterproofing installation has been inspected.

C. Verify structural ability of unsupported walls to support imposed loads by the fill.

3.02 PREPARATION

A. Scarify and proof roll subgrade surface to a depth of 6 inches to identify soft spots.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with specified fill.

C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING AND BACKFILLING

A. Fill to contours and elevations indicated using unfrozen materials.

B. Employ a placement method that does not disturb or damage other work.

C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

D. Maintain optimum moisture content of fill materials to attain required compaction density.

E. Fill and Backfill: Place and compact materials in equal, continuous layers not exceeding 6 inches compacted depth (as recommended in geotechnical report or Section 01 10 00 – Special Provisions).

F. Slope grade away from building minimum 2 percent or as shown on the plans. Make gradual grade changes. Blend slope into level areas.

G. Correct areas that are over-excavated.

1. Load-Bearing Foundation Surfaces: Use structural fill, flush to required elevation, compacted as per the geotechnical report.

2. Other Areas: Use non-structural fill, flush to required elevation, compacted as per the geotechnical report.

H. Compaction density(s) shall be as recommended in the geotechnical report or Section 01 10 00 – Special Provisions.

I. Reshape and recompact areas subjected to vehicular traffic.

3.04 TOLERANCES

A. Top Surface of Fill: Plus or minus 0.08 foot from required elevations.

3.05 FIELD QUALITY CONTROL

A. Compaction density testing shall be performed on compacted fill in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 6938.

B. Results shall be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 "standard proctor", ASTM D 1557 "modified proctor" or AASHTO T 180.

C. If tests indicate work does not meet specified requirements, remove work, replace and retest.

D. Frequency of Tests:

1. Test randomly.

2. Under Paving, Slabs-on-Grade and Similar Construction: A minimum of 1 test for each lift of 0 to 2 feet in depth per 100’ x 100’ area or as determined by Engineer.

E. Proof roll compacted fill at surfaces that will be under slabs-on-grade, pavers and paving.

3.06 CLEANUP

A. Remove unused stockpiled materials; leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

SECTION 31 23 33

TRENCHING FOR UTILITIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Excavation, backfilling and compacting for utilities.

1.02 REFERENCES

A. AASHTO T 180 - Standard Specification for Moisture - Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials.

B. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine Coarse Aggregates.

C. ASTM D 698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D. ASTM D 1556 – Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.

E. ASTM D 1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

F. ASTM D 2167 – Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.

G. ASTM D 2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

H. ASTM D 6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

I. ASTM D 4318 – Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

J. State Standard Specifications for Highway Construction, latest edition, including all current supplemental specifications.

1.03 METHOD OF PAYMENT

A. Excavation, trenching, backfilling, moisture condition and compaction are subsidiary items that are not measured for payment and for which no direct payment shall be made. Contractor must include the cost of performing this work in a related item that is identified in the plans and specifications which is measured for payment and for which direct payment is made.

1. Includes excavating to required elevations. The loading, hauling and disposal of surplus material at a site of the contractor's choice is considered subsidiary.

B. Unsuitable Materials:

1. Includes excavating materials which are determined by Engineer to be unsuitable as subgrade for pipe and/or structures, loading and removal of

unsuitable material to a site of the contractor's choice, and furnish and backfill with materials specified by Engineer.

2. Method of Measurement and Pay Unit: By the cubic yard (measured in place).

1.04 SUBMITTALS

A. Samples: 60 pound sample of each type of fill. Submit in airtight containers to testing laboratory.

B. Materials Sources: Submit name of imported materials source.

C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

D. Compaction density test reports.

1.05 PROJECT CONDITIONS

A. Provide sufficient quantities of fill to meet project schedule and requirements. When necessary, store materials on-site in advance of need.

B. When fill materials need to be stored on-site, locate stockpiles where designated. See Engineer.

1. Separate differing materials with dividers or stockpile separately to prevent intermixing.

2. Prevent contamination.

3. Protect stockpiles from erosion and deterioration of materials.

C. Verify that survey benchmarks and intended elevations for the work are as indicated. Notify Engineer immediately if a discrepancy is identified.

D. Protect plants, lawns, rock outcroppings, trees, amenities and other features to remain.

E. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, curbs, utility pedestals and amenities from excavating equipment and vehicular traffic.

F. Provide exploratory excavation to determine exact location of existing underground structures or utilities.

PART 2 - PRODUCTS

2.01 FILL MATERIALS

A. See Section 31 23 23 – Fill and Backfill for material specifications.

B. Refer to the Drawing, Section 01 10 00 – Special Provision, and/or geotechnical report for specific bedding material requirements.

2.02 SOURCE QUALITY CONTROL

A. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.

B. If tests indicate materials do not meet specified requirements, change material and retest.

C. Provide materials of each type from same source throughout the work.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Identify required lines, levels, contours and datum locations.

3.02 TRENCHING

A. Notify Engineer of unexpected subsurface conditions and discontinue affected work in areas until notified to resume work.

B. Slope banks of excavation deeper than 3 feet to angle of repose or less until shored.

1. Install shoring to protect pavements and structures or where backsloping is impractical.

2. Pile excavated material beyond edge of trench to prevent slides and cave-in.

C. Stockpile topsoil material for placement in areas disturbed by construction.

D. Do not interfere with 45 degree bearing splay of foundations.

E. Cut trenches wide enough to allow inspection of installed utilities.

F. Bottom width of trench not less than 8 inches nor more than 12 inches on each side of pipe, or as indicated on the Plans.

G. Hand trim excavations. Remove loose material.

H. Remove large stones and other hard matter which could damage piping or impede consistent backfilling or compaction.

I. Remove lumped subsoil, boulders and rock.

J. Remove excavated material that is unsuitable for reuse from site.

K. Stockpile excavated material to be reused in area designated on-site.

L. Remove excess excavated material from site.

3.03 PREPARATION FOR UTILITY PLACEMENT

A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with specified fill.

B. Compact subgrade to density equal to or greater than requirements for subsequent fill material. See Geotechnical Report.

C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

D. Provide uniform bearing for each pipe section.

1. Round bottom of trench to allow at least 1/4 of the circumference to rest firmly on undisturbed earth.

2. Excavate holes for pipe bells.

E. Verify that trace wire has been installed and is unbroken or damaged.

3.04 BEDDING AND BACKFILLING

A. Backfill to contours and elevations indicated using unfrozen materials.

B. Employ a placement method that does not disturb or damage other work.

C. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

D. Adjust and maintain optimum moisture content of fill and backfill materials to attain required compaction density.

E. Fill: Place and compact materials in equal, continuous layers.

F. Place bedding material as indicated on the drawings.

G. Manually backfill under pipe haunches and around bells.

1. Fill in uniform layer on each side of pipe to prevent displacement.

2. Use handheld pneumatic or mechanical compacting equipment.

3. Use manual methods until backfill is a minimum of 12 inches above top of pipe, or as indicated on the Plans.

4. Use caution to prevent damage to trace wire.

H. Leave shoring in place where required to protect structures or pavement.

1. Cut off top of piling a minimum of 36 inches below subgrade elevation.

I. Correct areas that are over-excavated.

1. Thrust Bearing Surfaces: Fill with concrete.

2. Other Areas: Use specified fill, flush to required elevation, compacted as per the geotechnical report.

J. Reshape and recompact areas subjected to vehicular traffic.

K. Slope grade away from building and structures minimum 2 percent unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

3.05 TOLERANCES

A. Top Surface of Backfill: Plus or minus 0.08 feet from required elevations.

3.06 FIELD QUALITY CONTROL

A. Compaction density testing shall be performed on compacted fill in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 6938.

B. Results shall be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 "standard proctor", ASTM D 1557 "modified proctor" or AASHTO T 180.

C. If tests indicate work does not meet specified requirements, remove work, replace and retest.

D. Frequency of Tests:

1. Under Paving, Slabs-on-Grade and Similar Construction:

a. 1 test per 150 linear feet of main line or as determined by Engineer. Test at random depths.

b. 1 test of each service line or as determined by Engineer.

2. Nonpaved Area:

a. 1 test per 300 linear feet of main line or as determined by Engineer. Test at random depths.

b. 1 test of each service line or as determined by Engineer.

E. Proof roll compacted fill at surfaces that will be under slabs-on-grade, pavers and paving.

3.07 CLEANUP

A. Remove unused stockpiled materials; leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

SECTION 31 25 00

EROSION CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Storm water pollution prevention plans – SWPPP.

B. Permits.

C. Erosion control blanket.

D. Silt fence.

E. Straw wattle.

F. Inlet filters.

1.02 UNIT PRICES

A. SWPPP or Storm Water Management Plans, construction of erosion control facilities, maintenance, permit compliance responsibilities, erosion control materials, and installation, payment by lump sum, as shown on the Bid Form, and/or refer to Section 01 10 00 - Special Provisions.

B. Permit Compliance – No separate payment, incidental to project cost.

C. Erosion control blankets (all types):

1. Method of Measurement and Pay Unit: By the square yard per type or as shown on the Bid Form.

2. Includes matting, filter fabric, staples, placement, delivery, installation and maintenance.

D. Silt fence (all types):

1. Method of Measurement and Pay Unit: By the lineal foot per type or as shown on the Bid Form.

2. Includes fence, posts, trenching and backfilling, installation and maintenance.

E. Straw wattles:

1. Method of Measurement and Pay Unit: By the lineal foot per size or as shown on the Bid Form

2. Includes material and installation.

F. Inlet filters:

1. Method of Measurement and Pay Unit: Included in the cost of the inlet, by each or as shown on the Bid Form

2. Includes material, installation, maintenance, and disposal.

1.03 REFERENCES

A. Erosion Control Technology Council.

B. National Pollutant Discharge Elimination System (NPDES) General NPDES Permit Number NER110000.

C. State Standard Specifications, latest revision.

1.04 PERMITS

A. NPDES: The Owner is responsible for submitting the Notice of Intent (NOI) to the permitting authority for this project. Once the project is provided a permit number and the proper forms are received, copies will be provided to the Contractor.

1. Under this permit the Contractor will be responsible for:

a. Filling out and obtaining signatures on the Start Form. This must be turned in prior to work beginning on the project.

b. Installation and removal as called for on plans and in these specifications.

c. Maintain the site according to the permit requirements. Erosion control features will be cleaned when they have been 50 percent filled.

d. Completing a daily record for erosion control measures installed and condition of those installed previously.

e. Maintaining a record of rainfall events and the effects on the erosion control measures.

f. Maintain a record of events when the erosion control measures failed and what corrective measures were taken.

g. Filling out and obtaining signatures on the End form. This must be turned in at the completion of work on the project.

h. Allowing for the inspection of the site by others including; Regulatory Authority, Engineer, Owner or other designated representatives.

i. Providing a copy of all documents to Engineer and Owner at completion of project.

PART 2 - PRODUCTS

2.01 EROSION CONTROL BLANKET

A. The erosion control blanket shall be placed as per the manufacturer's recommendations and the plans. The erosion control blanket shall be placed after the area is seeded and before the area is mulched.

B. Wire staples shall be used for anchoring the erosion control blanket. The staple pattern shall be per the manufacturers recommendations.

C. The seed shall comply with the applicable portions of Section 01 10 00 – Special Provisions and Section 32 92 19 - Seeding. The seed mixture shall be of the types and applied at the rate shown in the special provisions.

D. The fertilizer shall comply with the applicable portion of Section 32 92 19 - Seeding. The fertilizer shall be of the types and applied at the rate shown in the special provisions.

E. All erosion control mats shall be of type specified in the plans.

2.02 SILT FENCE

A. The silt fence material shall be of the type specified in the plans.

B. The stakes shall be as shown in the plans, or as follows:

1. The pins that are required shall be 11 gauge (0.120 inch) steel wire with a 1 inch or larger throat with at least 6-inch legs.

2. Silt fence stakes shall be 5.5 foot studded, steel "T" fence posts.

a. Used posts are acceptable.

C. Stakes for low profile silt fence shall be wood, 1 1/2 inches x 1 1/2 inches x 36 inches.

2.03 STRAW WATTLE

A. The straw wattles (or sediment logs) shall be of the type, size and length specified in the plans.

B. The stakes shall be as shown in the plans.

1. Wood stakes shall be 1-1/8" x 1-1/8" x 30" for 9" and 12" straw wattle.

2. Wood stakes shall be 1-1/8" x 1-1/8" x 48" for 20" straw wattle.

2.04 INLET FILTERS

A. The inlet filters shall be of the type and size as shown on the plans.

PART 3 - EXECUTION

3.01 SWPPP OR STORM WATER MANAGEMENT PLAN

A. These facilities shall be constructed as shown on the plans. The time frame for construction is set forth in Section 01 10 00 – Specials Provisions or as directed by the Engineer. The SWPPP shall be maintained throughout the duration of the project and until the Engineer has deemed the SWPPP may be closed, transferred to another party or as stated in Section 01 10 00 – Special Provisions.

3.02 EROSION CONTROL BLANKETS

A. This work shall be performed as soon as possible after finish grading operations have been completed or as directed.

B. No restrictive seeding time periods shall apply to this work.

C. Contractor shall tamp and shape fill earth to the finish grade as needed to repair erosion to the grades and conditions shown in the plans.

1. If additional fill dirt is required, it will not be paid for as extra work and must be provided and placed at no additional cost.

D. Contractor shall perform all work in the areas to be protected so that the land surface is graded smooth and free of all debris, including roots and stones larger than 1 inch in their largest dimensions.

1. All lumps of soil shall be pulverized, raked out or removed.

2. Vegetation shall be removed from these areas, except for the desirable native vegetation that has been designated by Engineer to remain undisturbed.

3. The soil in the areas to be protected by the soil retention blanket shall be loosened to a depth of not less than 1 inch by discing, harrowing, raking or other approved methods.

E. Contractor shall obtain Engineer's approval of all soil preparation work, fertilizer and seed.

F. Contractor shall place the erosion control blankets immediately following fertilizing and seeding.

1. The blanket shall be laid out flat, parallel to the surface runoff flow direction, and secured as shown in the plans for each specific type of erosion control.

2. Care shall be exercised in placing the blanket so as not to disturb previously seeded areas.

3.03 SILT FENCE

A. The silt fence shall be installed and in good working condition prior to any grading operations taking place.

1. Contractor shall excavate a trench to the depth, width and length shown in the plans.

B. Contractor shall place the silt fence in the trench and pin it as shown in the plans.

1. If the silt fence is installed with mechanical methods, installing pins is not required.

C. Contractor shall backfill the trench, compact the soil and attach the fabric to the posts as shown in the plans.

1. All silt fence splice joints shall be overlapped a minimum of 16 inches (400 mm).

D. Contractor shall remove and dispose of silt that accumulates near the silt fence during construction and at completion of the project. Each time silt is removed, the fence shall be repaired to a good working condition.

E. Contractor shall maintain the silt fence in good working condition at all times.

3.04 STRAW WATTLES

A. Contractor shall place straw wattles immediately after finish grading is complete in areas where straw wattles are to be constructed or as directed.

B. Contractor shall install straw wattles as per the plans.

C. The remainder of the area shall be prepared and the entire area shall be fertilized and seeded in accordance with Standard Specifications or Section 32 92 19 – Seeding.

D. Contractor shall then place the erosion control blanket and staple it as shown in the plans.

1. If the filter fabric is attached to the erosion control blanket, then the seed shall

be broadcast over the blanket and then the blanket shall be soil filled.

E. The limits of the completed straw wattles shall extend up the fore slope and back slope of the swale or channel to effectively contain the runoff and prevent erosion and washout at the edges of the installation.

F. All straw wattles shall be held securely in place.

G. In shale, the 2 reinforcing steel stakes in each barrier shall be wired together to prevent the barrier from floating off the stakes.

H. All stakes shall be driven into the ground a minimum of 16 inches.

I. Contractor shall remove and dispose of silt that accumulates adjacent to the straw wattle.

3.05 INLET FILTERS

A. Contractor shall install inlet filters immediately after the construction of the inlet structure.

B. Contractor shall remove and dispose of silt that accumulates in the inlet filter. If the inlet filter becomes damaged, the Contractor shall replace the inlet filter, the cost of such shall be incidental.

3.06 EROSION CONTROL REMOVAL

A. Contractor shall remove inlet filters, silt fence, straw wattles including stakes and posts, after vegetation has been fully established and as otherwise directed by Engineer (not to exceed 1 year).

B. Contractor to obtain permission from Engineer prior to the removal of any erosion control materials.

3.07 SWPPP FACILITY REMOVAL

A. Contractor may be required to remove facilities that were constructed as part of a SWPPP, such as detention or sedimentation basins, accumulated silt, drainage piping, riprap, etc. Refer to Section 01 10 00 – Special Provisions or the Bid Form.

B. Contractor to obtain permission from the Engineer prior to the removal of any SWPPP Facilities.

C. Contractor may be required to seed the removal areas. Refer to Section 01 10 00 – Special Provisions or the Bid Form.

END OF SECTION

SECTION 31 37 00

RIPRAP

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Rock riprap.

B. Broken concrete riprap.

C. Geotextile or engineering fabric.

1.02 REFERENCES

A. State Standard Specifications, latest revision.

B. ASTM C 150 – Standard Specification for Portland Cement.

C. ASTM C 311 – Standard Test Methods for Sampling and Testing Fly Ash or Natura Pozzolans for Use in Portland-Cement Concrete.

D. ASTM C 618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

E. ASTM D 5313 – Standard Test Method for Evaluation of Durability of Rock for Erosion Control Under Wetting and Drying Conditions.

F. ASTM D 5312 – Standard Test Method for Evaluation of Durability of Rock for Erosion Control Under Freezing and Thawing Conditions.

G. ASTM D 4992 – Standard Practice for Evaluation of Rock to be Used for Erosion Control.

H. ASTM D 5779 – Standard Test Method for Field Determination of Apparent Specific Gravity of Rock and Manmade Materials for Erosion Control.

I. ASTM D 6092 – Standard Practice for Specifying Standard Sizes of Stone for Erosion Contol.

1.03 UNIT PRICES

A. Rock Riprap:

1. Method of Measurement and Pay Unit: By the ton for each respective type of rock riprap shown in the bid form.

2. Includes:

a. Supplying.

b. Weighing.

c. Hauling.

d. Placing where required.

e. Furnish and installation of filter fabric.

3. Furnish load ticket for each load delivered.

4. Load ticket information.
    a. Ticket number.
    b. Project name.
    c. Date.
    d. Truck number.
    e. Empty truck weight.
    f. Gross weight.
    g. Load weight in pound and tons.
5. Use only approved scales.
6. Give to Owner's representative prior to unloading material.
7. Payment based on load tickets.
8. No payment for material not accompanied with ticket.

B. Broken Concrete Riprap:
1. Method of Measurement and Pay Unit: By the ton.
2. Includes:
    a. Supplying.
    b. Weighing.
    c. Hauling.
    d. Placing where required.
    e. Furnish and installation of filter fabric.
3. Furnish load ticket for each load delivered.
4. Load ticket information.
    a. Ticket number.
    b. Project name.
    c. Date.
    d. Truck number.
    e. Empty truck weight.
    f. Gross weight.
    g. Load weight in pounds and tons.
5. Use only approved scales.
6. Give to Owner's representative prior to unloading material.
7. Payment based on load tickets.
8. No payment for material not accompanied with ticket.

C. Riprap Filter Fabric (Geotextile):

1. Method of Measurement and Pay Unit: Shall be considered incidental to the riprap or by the square yard (SY) of area covered, as indicated in the Bid Form or Section 01 10 00 – Special Provisions.

2. No allowance for overlays.

3. Includes:

a. Supplying.

b. Placing where required.

4. Trenching and wire staples or stakes needed to secure fabric are subsidiary items.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with State Standard Specifications.

B. Obtain aggregate materials from same source throughout project.

C. Obtain cementation materials from same source throughout project.

PART 2 - PRODUCTS

2.01 MATERIAL

A. Rock Riprap:

1. State of Nebraska riprap gradations are as follows:

a. Type A:

Size of Rock	% of Total Weight Smaller than Given Size
150 pounds	100
35 pounds	50
2 pounds	Not to Exceed 10

b. Type B:

Size of Rock	% of Total Weight Smaller than Given Size
300 pounds	100
80 pounds	50
5 pounds	Not to Exceed 10

c. Type C:

Size of Rock	% of Total Weight Smaller than Given Size
700 pounds	100
150 pounds	50
10 pounds	Not to Exceed 10

2. State of Iowa riprap gradations area as follows:
    a. Class A:
        i. Nominal top size of 400 pounds.
        ii. At least 75% of the stones are to weigh more than 75 pounds.
        iii. None less than 50 pounds.
        iv. Stones are to have at least one flat face with one dimension at least 15 inches.
    b. Class B:
        i. Nominal top size of 650 pounds.
        ii. At least 20% of the stones are to weigh more than 500 pounds.
        iii. At least 50% of the stones are to weigh more than 275 pounds.
        iv. At least 90% of the stones are to weigh more than 25 pounds.
    c. Class C:
        i. Nominal top size of 450 pounds.
        ii. At least 50% of the stones are to weigh more than 275 pounds.
        iii. At least 90% of the stones are to weigh more than 25 pounds.
    d. Class D and Class E:
        i. Nominal top size of 250 pounds.
        ii. At least 50% of the stones are to weigh more than 90 pounds.
        iii. At least 90% of the stones are to weigh more than 5 pounds.
        iv. Engineer may approve using riprap material larger than 250 pounds.

B. Broken Concrete Riprap:
    1. Reinforcing steel bars shall be cut off and removed.
    2. State Standard Specifications and as shown on the plans.

C. Riprap Filter Fabric (Geotextile):
    1. Shall be a nonwoven geotextile fabric resistant to ultraviolet and biological degradation and resistant to naturally occurring chemical, alkali and acid environments.
    2. Shall be manufactured with fibers consisting of long-chain synthetic polymers composed of at least 95 percent by weight of polyolefins or polyesters. They shall form a stable network such that the filaments or yarns retain their dimensional stability relative to each other, including selvages.
    3. Shall be designed to prevent soil loss resulting in excessive scour and prevent hydraulic uplift pressures causing instability of energy absorbing armor permanent erosion control system.

4. The geotextile fabric shall meet the minimum requirements below. All numeric values below, except Apparent Open Size (AOS) represent Minimum Average Roll Value (MARV) in the weakest principal direction. Values for AOS represent Maximum Average Roll Values.

Property	Test Method	Units	MARV
Grab Tensile Strength	ASTM D 4632	Lbs	200
Trapezoid Tear Elongation	ASTM D 4533	%	50
Trapezoid Tear Strength	ASTM D 4533	Lbs	80
CBR Puncture Strength	ASTM D 6241	Lbs	500
Permittivity	ASTM D 4991	sec-1	1.4
Flow Rate	ASTM D 4991	Gal/Min/Ft2	95
Apparent Opening Size	ASTM D 4751	U.S. Sieve	80 (Max)
Ultraviolet Stability	ASTM D 4355	% Strength @ 500 hr.	70

5. Filter fabric shall be (TenCate Geosynthetics) Mirafi 180N or equal, or as specified in Section 01 10 00 – Special Provisions and/or as shown on the plans.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify earth surface conforms to grades and slopes of the neat lines at the bottom surface of the riprap as shown in the drawings.

B. Do not place over frozen, soft or unstable subgrade surfaces.

C. Surface relatively smooth, free of obstructions.

3.02 PLACEMENT

A. Riprap Filter Fabric (Geotextile):

1. Shape and eliminate erosion features, such as rills and gullies, to produce a relatively smooth surface.

2. Place upstream strip of fabric to overlap the downstream strip. Overlap unstitched seam as recommended by the supplier.

3. Lay geotextile undamaged, smooth, without tension or stress and free of folds, wrinkles or creases.

4. Hold geotextile in place by staples and/or selectively placed riprap.

B. Cover geotextile with riprap to the specified depth within 2 days.

C. Rock Riprap:

1. Place filter fabric on grade prior to installation of rock riprap. Install initial layer of rock riprap to not damage filter fabric. All damaged filter fabric shall be replaced at the Contractor's cost.

2. Place rock riprap to produce solid mass of rock within limits shown in the drawings.

3. Distribute material so there are no large accumulations of either large or small sizes of material.

4. Correct any appreciable variations from specified thickness by redistributing material.

5. Exercise care so as not to displace geotextile fabric.

6. Place riprap such that all positive surface drainage is maintained.

D. Broken Concrete Riprap:

1. Place filter fabric on grade prior to installation of broken concrete riprap. Install initial layer of broken concrete riprap to not damage filter fabric. All damaged filter fabric shall be replaced at the Contractor's cost.

2. Place broken concrete riprap to produce solid mass within limits as shown in the drawings.

3. Distribute material so there are no large accumulations of either large or small sizes of material.

4. Correct any appreciable variations from specified thickness by redistributing material.

5. Cut off any projecting reinforcing steel.

6. Exercise care so as not to displace geotextile fabric.

END OF SECTION

SECTION 32 13 13

PORTLAND CEMENT CONCRETE PAVING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Concrete roads, streets, sidewalks, trails, curb ramps, curb and gutter, driveways, alleys and parking areas.

1.02 REFERENCES

A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete

B. ACI 301 - Specifications for Structural Concrete for Buildings

C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete

D. ACI 305R – Guide for Hot Weather Concreting

E. ACI 306R – Guide to Cold Weather Concreting

F. ASTM A 185 – Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete (Withdrawn 2013).

G. ASTM A 497 – Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete (Withdrawn 2013).

H. ASTM A 615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

I. ASTM C 33 – Standard Specification for Concrete Aggregates.

J. ASTM C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

K. ASTM C 94 – Standard Specification for Ready-Mixed Concrete.

L. ASTM C 150 – Standard Specification for Portland Cement.

M. ASTM C 173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

N. ASTM C 260 – Standard Specification for Air-Entraining Admixtures for Concrete.

O. ASTM C 309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

P. ASTM C 311 – Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete.

Q. ASTM C 494 – Standard Specification for Chemical Admixtures for Concrete.

R. ASTM C 618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

S. ASTM C 685 – Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.

T. ASTM C 1074 – Standard Practice for Estimating Concrete Strength by the Maturity Method.

U. ASTM C 1116 – Standard Specification for Fiber-Reinforced Concrete.

V. ASTM D 1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

W. ASTM D 1752 – Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete paving and Structural Construction.

X. ASTM D2628 – Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.

Y. ASTM D 5893 – Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.

Z. ASTM D 6690 – Standard Specification for Joint and Crack Sealants, Hot-Applied, for Concrete and Asphalt Pavements.

AA. AASHTO M 33 – Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

BB. AASHTO M 148 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

CC. State Standard Specifications for Highway Construction, Latest Addition, including all current supplemental specifications.

1.03 UNIT PRICES

A. Portland Cement Concrete:

1. Paid for by the square yard, square feet or lineal foot for each thickness as shown on the Bid Form, includes placing, floating, finishing, curing, sawing, cold weather protection and incidentals.

B. Detectable Warning Panels:

1. Paid for by the square feet of the detectable warning panel, includes furnishing and installing each unit.

C. Earth Shoulder Construction:

1. Method of Measurement and Pay Unit: By stations of 100 feet. If no bid item is considered incidental to other bid items.

2. Includes shouldering:

a. Furnish and excavate topsoil from sources other than right-of-way.

b. Haul, compact, blade and shape material to conform to typical section shown in the plans and cross sections.

3. Each shoulder will be measured separately along the project centerline regardless of width.

4. Deductions will be made for areas where shoulders are not required.

5. Additional length of shoulder construction due to intersection returns, tapers, curves, tangents, stubs, driveways, sidewalks and other irregular areas are considered to be subsidiary to earth shoulder construction.

6. Water applied to obtain compaction is considered to be subsidiary.

1.04 SUBMITTALS

A. Submit the proposed mix design for each class of concrete to Engineer and testing firm for review prior to commencement of concrete operations.

B. Submit information on any proposed additives for the mix design.

C. Submit information on reinforcement for baskets, special design, etc.

1. Included material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement and supports of concrete reinforcement.

D. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Cementitious materials and aggregates.

2. Steel reinforcement and reinforcement accessories.

3. Admixtures.

1.05 QUALITY ASSURANCE

A. Obtain cementitious materials, aggregate and each admixture from same source throughout.

B. Concrete Supplier Qualifications: Firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

1. Concrete Supplier must be certified according to the National Ready Mixed Concrete Association Certification of Ready Mixed Concrete Production Facilities.

C. Testing Agency Qualifications: Independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct testing indicated, as documented according to ASTM E 548.

D. Follow recommendations of the applicable State or Local Standard Specifications, and ACI 306R, when placing concrete during hot or cold weather.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Reference: Applicable State or Local Standard Specifications.

B. Do not place concrete when base surface temperature is less than 40 degrees F or surface is unstable or frozen.

C. Do not start to place concrete until ascending ambient air temperature reads 41 degrees F.

D. Cease placing operations when descending ambient air temperature reaches 41 degrees F.

E. Protect concrete when the air temperature may be expected to drop below 36 degrees F.

F. Any concrete damaged by freezing will be rejected. Removal and replacement at Contractor's expense.

G. When evaporation rate approaches 0.2 lb./sf/h, Contractor must notify Engineer regarding the actions to be taken to prevent plastic shrinkage cracking. Obtain rate of evaporation using nomograph, applicable State or Local Standard Specifications.

1.07 METHOD OF CONSTRUCTION

A. Full Width, Slip Form Paving Machines:

1. Required method of main line paving.

2. Reference: Applicable State or Local Standard Specifications.

3. Exceptions to Full Width Paving:

a. Intersection returns.

b. Driveways and parking area.

c. Irregular shapes.

d. Sidewalks.

e. Areas designated in the drawings to be constructed in phases in order to provide access to property.

B. Paving Less Than Full Width:

1. Restrictions:

a. No equipment is allowed within 3 feet of the edge of freshly poured concrete paving for a minimum of 3 days.

b. No concrete trucks, pumping machines, paving machines, conveyors or related equipment used to transport or place concrete shall be allowed on new paving for a minimum of 7 days and concrete has developed a compressive strength of 3,500 psi.

2. Additional Costs:

a. If approved by Owner and Engineer, Contractor shall be responsible for additional costs related to paving less than full width on main line paving areas.

b. If approved by Owner and Engineer, Contractor shall make payment to Owner an amount equal to 5.0 percent of the total bid for square yards of concrete paving as submitted to compensate for the additional time involved. This payment shall be made to Owner prior to final payment of the completed project.

c. Additional costs include:

(i) Construction staking.

(ii) Construction observation by resident project representative (RPR) and/or Engineer.

(iii) Construction Administration.

(iv) Additional compaction testing of subgrade.

(v) Additional concrete testing.

PART 2 - PRODUCTS

2.01 FORM MATERIALS

A. Form Materials: Conform to applicable State or Local Standard Specifications.

2.02 REINFORCEMENTS

A. Tie Bars: New, deformed billet-steel bars, Grade 60, ASTM A 615.

B. Dowel Bars: New, smooth, round steel bars, Grade 60, ASTM A 615 coated with organic coating AASHTO M 254, corrosion resistant coated dowel bars.

2.03 CONCRETE MATERIALS

A. Concrete Materials: As specified in applicable State or Local Standard Specifications or as specified in Section 01 10 00 - Special Provisions.

B. Cement:

1. Type I, Type II, Type I/II and Type III Portland cement shall conform to the requirements in ASTM C 150 with the following additional requirements.

a. Portland cement shall not contain more than 0.60 percent equivalent alkali.

b. Processing additions may be used in the manufacture of the cement, provided such materials have been shown to meet the requirements of ASTM C 465 and the total amount does not exceed 1 percent of the weight of Portland cement clinker.

2. Interground and Blended Cement shall conform to the requirements in ASTM C 595 with the following additional requirements:

a. Interground/Blended cement Type IP

(i) Type IP(25) shall be composed of Class F fly ash or Class N pozzolan replacement shall be 25%+/-2%

(ii) Type IP(20) shall be composed of Class F fly ash or Class N pozzolan replacement shall be 20%+/-2%

b. Interground/Blended cement Type IT

(i) For SCMs, slag cement and limestone, the maximum replacement by weight shall be 40%. The manufacturer has a production tolerance of +2% from the proposed replacement.

(ii) For slag cement, the maximum replacement shall be 20% or less when incorporated into the final Interground/Blended cement.

(iii) For limestone cement, the replacement range shall be from 5.1% to 10.0% when incorporated into the final Interground/Blended cement.

C. Fine and Coarse Mix Aggregate:

1. Mineral aggregates shall be crushed rock, broken stone, gravel, sand-gravel, coarse sand, fine sand, or a mixture of these materials composed of clean, hard, durable, and uncoated particle.

2. Shall meet the requirements in ASTM C 33.

3. Aggregates shall be free from injurious quantities of dust, soft or flaky particles, loams, alkali, organic matter, paper, wood, or other deleterious matter as determined by Engineer.

4. Free of materials with deleterious reactivity to alkali in cement.

D. Fly Ash: Class F, ASTM C 618 and ASTM C 311.

1. The use of Class C Fly Ash is not acceptable in any concrete on this project.

E. Water:

1. Shall meet the requirements in ASTM C 94 and potable.

2. Water shall be free from objectionable quantities of oil, acid, alkali, salt, organic matter, or other deleterious materials.

F. Air-Entrainment Admixture: Shall meet the requirements of ASTM C 260.

G. Other Chemical Admixtures:

1. See applicable State or Local Standard Specifications or as specified in Section 01 10 00 - Special Provisions.

2. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of concrete.

3. Admixture shall not contain more than 1 percent of chlorides calculated as calcium chloride.

2.04 ACCESSORIES

A. Joint Filler: Preformed, nonextruding, bituminous type, AASHTO M 33.

B. Joint Sealer: Asphaltic, hot poured, ASTM D 6690, Type II or Silicone, cold applied, ASTM D5893. If required on Drawings, preformed elastomeric compression joint seals shall be ASTM D2628 supplied in proper size and shape to perform for the finished joint detail on Drawings.

C. Liquid Membrane-Forming Compounds for Curing Concrete: White pigmented, AASHTO M 148, Type 2.

D. Reinforcement Accessories:

1. Tie Wire: Annealed, minimum 16 gauge.

2. Chairs, Bar Supports, Bolsters, Spacers, and other devices for spacing: Sized and shaped for adequate support of reinforcement during concrete placement.

2.05 CONCRETE MIX DESIGN

A. Street and roadway paving, alleys, driveways, trails, curb and gutter and parking areas.

1. Proportioning Normal Weight Concrete: As specified in Section 01 10 00 - Special Provisions.

2. Concrete Strength: Minimum compressive strength at 28 days in pounds per square inch (psi) - 3,500 psi. or as specified in Section 01 10 00 - Special Provisions.

3. Admixtures: Add approved admixture at rate recommended by manufacturer.

B. Sidewalks:

1. Proportioning Normal Weight Concrete: As specified in Section 01 10 00 – Special Provisions.

2. Concrete Strength: Minimum compressive strength at 28 days in pounds per square inch (psi) - 3,500 psi. or as specified in Section 01 10 00 - Special Provisions.

3. Admixtures: Add approved admixture at rate recommended by manufacturer.

2.06 MIXING

A. Ready-Mixed Concrete: Measure, batch, mix and deliver according to ASTM C 94 and ASTM C 1116 and furnish batch ticket information.

1. When air temperature is between 85- and 90-degrees F, reduce mixing and delivery time from 1 1/2 hours to 75 minutes. When air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.

B. On Project Site: Mix in drum type batch mixer, complying with ASTM C 685. Mix each batch not less than 1.5 minutes and not more than 5 minutes.

C. Transit Mixers: Comply with ASTM C 94.

2.07 DETECTABLE WARNING PANELS

A. At all curb ramps, detectable warning panels will be required. The panels shall be a color selected by Owner, from the manufacturer's standard color palette. The total area of the panels shall not be less than 4 feet wide by 2 feet deep. Concrete stamping is not allowed.

B. See Section 01 10 00 - Special Provisions for type specified and color. The premade panels will be installed as per the manufacturer's recommendations.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.

B. Verify gradient and elevation of base are correct.

C. Review project site to coordinate construction activities.

3.02 SUBGRADE

A. In compliance with requirements Section 01 10 00 - Special Provisions, subgrade preparation or subgrade stabilization section and the recommendations of the geotechnical report for subgrade preparation requirements.

3.03 PREPARATION

A. Moisten subgrade to minimize absorption of water from fresh concrete.

B. Coat surfaces of manhole frames with oil to prevent bond with concrete.

C. Notify Engineer a minimum of 48 hours prior to commencement of concreting operations.

3.04 FORMING

A. Place and secure forms to correct location, dimension, profile and gradient.

B. Assemble formwork to permit easy stripping and dismantling without damage to concrete.

C. Place vertical joint filler in position and in straight lines. Secure to formwork during concrete placement.

3.05 REINFORCEMENT

A. Place reinforcement as indicated in the plans.

B. Keep reinforcement clean and free from foreign materials.

C. Furnish and install suitable supports for all reinforcing steel and dowel bars.

D. Tying Reinforcement:

1. Tie reinforcing bars securely in place at all points where bars cross other reinforcing bars.

2. Tie epoxy coated reinforcing bars with plastic coated ties.

3. After tying epoxy coated reinforcing, perform holiday test. Repair any damaged epoxy coating. Retest.

E. Lubricate dowel bars as shown in the plans.

1. Lubricate to form a complete and continuous film over portion of bar being coated.

2. Coating to be sufficient to break bond between dowel bars and concrete.

3. Lubricant to have sufficient contrast with bar to be easily seen.

F. Placement of Dowel Bars:

1. Mid-depth of slab.

2. Parallel with finished surface of slab.

3. Parallel with centerline of roadway.

G. Dowel Bar Placement:

1. Baskets, or

2. Approved mechanical inserters, or

3. Free end of dowels supported in a frame to properly maintain alignment.

H. Longitudinal Tie Bar Placement:

1. Support on bar pins, or

2. Approved mechanical inserter.

I. Longitudinal Tie Bar Placement in Key-Type Joint:

1. Bend at 90 degrees at center to facilitate placement.

2. Before placing adjacent slab, bend at 45 degrees to longitudinal joint.

3. Replace bars that crack or break (see applicable State or Local Standard Specifications).

4. Replace cracked or broken bars at no cost to Owner.

3.06 PLACING CONCRETE

A. Construction methods in accordance with applicable State or Local Standard Specifications or as specified in Section 01 10 00 - Special Provisions.

B. Ensure reinforcement, inserts, embedded parts and formed joints are not disturbed during concrete placement.

C. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

D. Keep concrete manipulation to a minimum when bringing concrete to proper line and grade.

E. Adjust forward speed of finishing machines so that operations are continuous and uninterrupted.

F. Addition of water to the surface of the concrete to assist finishing operations is not allowed.

G. Remove laitance and surplus water while concrete is still plastic.

H. Test surface for smoothness and true to line and grade with 10-foot straightedge.

1. Set parallel with centerline.

2. Lap half-length on each successive position.

3. Remove high areas, fill depressions and consolidate concrete with hand floats.

I. Texture concrete over full width of surface in the longitudinal direction.

1. Use wet burlap, carpet or canvas belt.

2. Suspend drags with a mandrel or similar device to insure a uniform texture.

3. Remove drag from surface of concrete when the paving train is not in motion 30 minutes or more.

4. Rinse or wash drags as necessary to obtain a uniform surface.

5. Replace drags which cannot be cleaned.

6. Remove concrete over joints after final drag finish.

J. Use edging tool to round joints and edges of concrete along the side forms.

3.07 JOINTS

A. Align curb, gutter and sidewalk joints.

B. Place preformed expansion joint materials as shown in the plans.

1. Form joints with joint filler extending from the bottom of the concrete to within 1/2 inch of finished surface.

2. Secure to resist movement while placing concrete.

C. Provide keyed joints as shown in the plans.

D. Construction Joints:

1. Begin initial sawing when concrete can support the weight of the saw and sawing does not create raveling. Early entry or soft cut sawing will be allowed.

2. Complete sawing before random cracking occurs.

3. Cut each traverse joint in one continuous pass.

4. Discontinue sawing of joint if a crack occurs at or near the joint location before sawing or a crack develops ahead of the saw. Route these cracks to a depth of 1 1/2 inches and 0.4 to 0.6 inches wide and seal with joint sealers.

5. Any spalling of joints to be repaired in accordance with applicable State or Local Standard Specifications.

3.08 FINISHING

A. Roads, Streets, Alleys and Parking Areas: Use wet burlap, carpet or canvas drag.

B. Driveways and Sidewalks:

1. New Concrete Abutting Existing Concrete: Match existing texture.

2. New Construction: Steel floating with light broom finish.

C. Trails:

1. Use wet burlap, carpet or canvas drag, or float and light broom finish texture perpendicular to direction of travel.

2. 1/4-inch radius edge and transverse cut joints.

D. Curb Ramps:

1. Meet minimum design standard in accordance with requirements of applicable State or Local Standard Specifications, as specified in Section 01 10 00 - Special Provisions and special plan for curb ramps.

2. Float and light broom finish.

3. Truncated Domes - Detectable Warning Panels, See Section 01 10 00 - Special Provisions.

4. Americans with Disabilities Act (ADA) approved detectable warnings.

E. Apply liquid membrane-forming compounds for curing concrete immediately after finishing. Apply in accordance with manufacturer's instructions.

3.09 JOINT SEALING

A. Preparation:

1. Seal joints according to manufacturer's recommendations.

2. Clean joints and ensure they are dry and free of oil residue prior to filling joints with joint sealer.

B. Filling:

1. Top surface of joint material to be approximately 1/4 inch below surface of concrete.

2. Remove overflow material.

3. Repair overfilled joints by reinstalling the joint filler.

4. For preformed compression seals install compressed into the joint, with manufacturer-approved equipment and installation method.

C. If adhesion is not satisfactory, the material will be removed and the joint cleaned and resealed at no cost to Owner.

D. All joints will be sealed including joints between existing and new concrete.

3.10 TOLERANCES

A. Maximum Variation of Surface Flatness: 1/8 inch in 10 feet.

B. Maximum Variation from True Position: 1/4 inch.

C. All concrete shall meet or exceed the strength requirement of the specifications.

1. At Owner’s option, Owner may elect to allow concrete that does not meet the minimum strength requirement to remain in place subject to an adjustment (reduction) in the payment to Contractor. The adjustment in the payment will be according to the following table:

CONCRETE STRENGTH PAY FACTOR TABLE

Payment Deductions Based on Concrete Strength	
Percent of Required Concrete Compressive Strength	**Pay Factor**
Greater than 99.9	1.00
Greater than 98.5 to 99.9	0.9975
Greater than 97.5 to 98.5	0.9950

Greater than 96.0 to 97.5	0.99
Greater than 94.0 to 96.0	0.98
Greater than 92.0 to 94.0	0.97
Greater than 90.0 to 92.0	0.94
Greater than 88.0 to 90.0	0.90
Greater than 86.0 to 88.0	0.86
Greater than 84.0 to 86.0	0.81
Greater than 82.0 to 84.0	0.76
Greater than 80.0 to 82.0	0.70
Less than 80.0	0.40 or Reject

2. If there is no adjustment in the payment to Contractor for concrete that does not meet the minimum strength requirement, the concrete shall be rejected and shall be removed and replaced at Contractor's expense.

D. All concrete shall meet or exceed the minimum thickness as per the plans and specifications.

1. At Owner's option, Owner may elect to allow concrete that does not meet the minimum thickness requirement to remain in place subject to an adjustment (reduction) in the payment to Contractor. The adjustment in the payment will be according to the following table:

THICKNESS PAY FACTOR TABLE

Payment Deductions Based on Deficient Pavement Thickness	
Thickness Deficiency	**Pay Factor**
0 to 0.25 inch	1.00
Greater than 0.25 to 0.30 inch	0.85
Greater than 0.30 to 0.35 inch	0.80
Greater than 0.35 to 0.40 inch	0.75
Greater than 0.40 to 0.45 inch	0.70
Greater than 0.45 to 0.50 inch	0.65

2. If there is no adjustment in the payment to Contractor for concrete that does not meet the minimum thickness requirement, the concrete shall be rejected and shall be removed and replaced at Contractor's expense.

3.11 DEFECTIVE CONCRETE

A. All materials which Engineer determines to be damaged, defective, or otherwise unsuitable for use will be rejected and shall be removed and replaced at Contractor's expense.

B. Contractor will be required to take corrective measures for high spots by removal and replacement, or by grinding with a machine equipped with multiple diamond blades with spacers to the required profile. If grinding is used, utilize methods which do not break the cement and aggregate bond. Engineer will determine whether defective concrete will be repaired, or if it will be rejected and removed and replaced. Contractor shall submit the proposed corrective action plan and receive Engineer AND Owner approval prior to performing corrective measures. The approved corrective measure will be done at Contractor's expense.

C. Contractor will be required to take corrective measures for low areas that pond water by removal and replacement of concrete or by grinding with a machine equipped with multiple diamond blades with spacers to the required profile. If grinding is used, utilize methods which do not break the cement - aggregate bond. Engineer will determine whether defective concrete will be repaired, or if it will be rejected and removed and replaced. Contractor shall submit the proposed corrective action plan and receive Engineer and Owner approval prior to performing corrective measures. The approved corrective measure will be done at Contractor's expense.

D. Contractor will be required to take corrective measures for any cracking of concrete no matter what the cause. The corrective measures may include routing and sealing the cracks or removal and replacement. Engineer will determine whether defective concrete will be repaired, or if it will be rejected and removed and replaced. Contractor shall submit the proposed corrective action plan and receive Engineer AND Owner approval prior to performing corrective measures. The approved corrective measures will be done at Contractor's expense.

E. Joints: Contractor will be required to take corrective measures for any joints that in the opinion of Engineer are not constructed per the plans and specifications. Contractor shall submit the proposed corrective action plan and receive Engineer AND Owner approval prior to performing corrective measures. The approved corrective measures will be done at Contractor's expense.

F. Contractor will be required to take corrective measures for any concrete containing excessive honeycombing, spalling, fractures, chips or other defects at no additional cost to Owner. The corrective measures may include repairing concrete or removal and replacement of concrete. Engineer will determine whether defective concrete will be repaired, or if it will be rejected and removed and replaced. Contractor shall submit the proposed corrective action plan and receive Engineer AND Owner approval prior to performing corrective measures. The approved corrective measures will be done at Contractor's expense.

G. Contractor must protect the concrete from damage due to rain, premature drying, excessive hot or cold temperatures, foot traffic and vehicular traffic. Failure to properly protect concrete may constitute cause for repairing or for removal and replacement of defective concrete. Engineer will determine whether defective concrete shall be repaired, or if it shall be rejected and removed and replaced. Contractor shall submit the proposed corrective action plan to address the defective concrete and receive

Engineer AND Owner approval prior to performing corrective measures. The approved corrective measures will be done at Contractor's expense.

3.12 FIELD QUALITY CONTROL

A. An independent testing agency employed by Owner shall perform field quality control tests as specified in Section 01 40 00 - Quality Requirements.

1. Results of testing will be furnished in a timely manner to Owner, Engineer and Contractor, in writing.

2. Contractor shall provide free access to concrete operations at project site and cooperate with testing agency.

3. Contractor shall submit proposed mix design of each class of concrete to Engineer and testing agency for review at least 10 days prior to commencement of concrete operations.

4. Field testing and laboratory testing of concrete will be performed by testing agency employed by Owner to determine conformance with specified requirements.

5. Strength Testing

   a. Compressive Strength Test Samples: ASTM C 39. For each test, mold and cure 3 concrete test cylinders. A set of 3 test cylinders shall be collected for every 100 cubic yard or fractional part thereof for each class of concrete placed in a day. At least one set of cylinders is required for each day concrete placement takes place.

      (i) One additional cylinder may be required for a break prior to 7 days.

      (ii) Take 1 additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

   b. Maturity Method for Estimating Strength: ASTM C 1074. The Contractor may elect to utilize the maturity curve method to determine concrete strength. The Contractor must notify the Engineer in writing and submit a Plan with any changes applicable with State or local standard specifications.

6. Perform 1 slump test for each set of test cylinders taken.

   a. If the concrete mixture is excessively wet causing segregation, excessive bleeding, or any other undesirable condition, the concrete shall be rejected.

   b. If the slump is outside the allowable limits specified in Section 01 10 00 - Special Provisions, the load of concrete shall be rejected.

7. Perform 1 air content test for each set of test cylinders taken.

   a. If the air content is less than the minimum specified, only one addition of air-entraining admixtures is allowed.

b. If the air content is then outside the allowable limits specified in Section 01 10 00 - Special Provisions, the load of concrete shall be rejected.

B. The independent testing agency employed by Owner will maintain records of placed concrete items and Contractor shall assists testing agency as necessary to accomplish the completion of this record keeping. Records will include type of test samples taken, all test results, date and location of sample collected, concrete test cylinder number, quantity of concrete placed and slump, air content, air temperature test results.

C. Additional Tests: The testing agency employed by Owner shall make additional tests of concrete, as directed by Engineer, when test results indicate that slump, air entrainment, compressive strengths or other requirements have not been met.

1. The cost for this additional testing will be paid for by Contractor.

2. If any additional testing is required to isolate failures, this shall be considered retests and shall be paid for by Contractor.

3.13 PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessive hot or cold temperatures, foot traffic, vehicular traffic and rain events.

B. Do not permit pedestrian traffic over concrete for a minimum of 1 day after finishing.

C. Do not permit vehicular traffic over concrete for a minimum of 7 days and after design strength of concrete has been achieved and joint sealants have properly cured per manufacturers requirements.

END OF SECTION

SECTION 32 15 00

AGGREGATE SURFACING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Aggregate surfacing.

1.02 REFERENCES

A. State Standard Specifications, latest revision.

1.03 UNIT PRICES - MEASUREMENT AND PAYMENT

A. Removing, Salvaging and Reinstalling Existing Gravel/Rock Surfacing: The removing, salvaging and reinstalling of the existing gravel and rock surfacing on existing private driveways, parking lot/areas, streets, roads or alleys will not be measured and paid for separately but shall be considered subsidiary to the cost of those items for which direct measurement and payment are made.

B. New Aggregate Surfacing: The measurement and payment for furnishing and installing aggregate surfacing on existing private driveways, parking lot/areas, streets, roads or alleys, as shown in the plans or as directed by Owner through Engineer, will be made based on the tons of material delivered and placed. Contractor shall provide weigh scale tickets to Owner through Engineer for all aggregate that is delivered and placed to resurface areas as shown in the plans or as directed by Owner through Engineer. Contractor's unit price for aggregate surfacing shall include furnishing, delivering and spreading aggregate on an approved roadbed surface and includes furnishing the necessary material, labor, equipment, tools and incidentals necessary to complete the work.

1.04 QUALITY ASSURANCE

A. Aggregate surfacing shall meet the specifications in the Standard Specifications, for gravel and crushed rock surfacing.

B. Submit a recent analysis from proposed aggregate source showing compliance with the specifications.

PART 2 - PRODUCTS

2.01 ROAD GRAVEL SURFACING

A. State of Nebraska gravel gradations:

Gravel Surfacing Gradation Limits	
Sieve Size	Percent Passing Target Value
1 inch	100
No. 4	78
No. 10	16
No. 200	3

B. State of Iowa gravel gradations:

Class C - Gradation #10 Gravel Surfacing Gradation Limits	
Sieve Size	Percent Passing Target Value
¾”	100
No. 4	50-80
No. 8	25-60

2.02 CRUSHED ROCK SURFACING (ROADS, DRIVEWAYS, PARKING AREAS, TEMPORARY SURFACING)

A. State of Nebraska crushed rock surfacing gradations:

¾” Crushed Rock for Surfacing Gradation Limits	
Sieve Size	Percent Passing
1 inch	100
No. 4	20-60
No. 10	0-30
No. 200	0-10

1-1/2” Crushed Rock for Surfacing Gradation Limits	
Sieve Size	Percent Passing
1”	100
¾”	65-95
3/8”	30-70
No. 10	10-30
No. 200	0-10

B. State of Iowa crushed rock surfacing gradations:

Class A - Gradation #11 Crushed Rock Surfacing Gradation Limits	
Sieve Size	Percent Passing Target Value
1 inch	100
¾”	95-100
½”	70-90
No. 4	30-55
No. 8	15-40
No. 200	6-16

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify compacted subgrade is dry and ready to receive work of this section.

B. Verify gradients and elevations of subgrade are correct.

C. Beginning of installation means acceptance of existing conditions.

3.02 PLACING AGGREGATE SURFACING

A. Spread material over prepared subgrade to a total compacted thickness as shown in the plans or as specified in Section 01 10 00 - Special Provisions.

B. Level surfaces to elevations and gradients indicated.

C. Compact placed aggregate materials by rolling.

D. Perform hand tamping in areas inaccessible to compaction equipment.

E. Add moisture as needed to supplement the compaction process.

END OF SECTION

SECTION 32 92 19

SEEDING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Preparation of seedbed.

B. Placing topsoil.

C. Seeding, mulching and fertilizer.

D. Hydroseeding.

E. Maintenance.

1.02 SUBMITTALS

A. Submit from an established seed dealer or grower the certified "blue tag" for each container of seed. This tag will show percentage by weight, percentage of purity, germination and weed seed for each grass, legume and cereal crop stating botanical and common name of each species as specified.

1.03 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for seed and fertilizer.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable. Deliver seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging and location of packaging.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis and name of manufacturer.

1.05 MAINTENANCE

A. Maintain seeded areas immediately after placement until grass/seed mix is well established and exhibits a vigorous growing condition.

B. Fill washouts and areas of erosion with topsoil. Contractor is responsible for any and all erosion control measures necessary for the establishment of the specified seed material.

C. Maintain erosion control.

1.06 UNIT PRICE - MEASUREMENT AND PAYMENT

A. The work of seeding shall be a per acre, lump sum or as shown on the Bid Form for surfaces seeded in accordance with these specifications. The quantity of completed and accepted work measured as provided herein shall be paid for at the contract price for the item "seeding". This price shall be full compensation for furnishing and applying fertilizer; furnishing and sowing seed; furnishing and applying mulch materials; preparation of the seedbed; and for all materials, labor, equipment, tools and incidentals necessary to complete the work.

PART 2 - PRODUCTS

2.01 FERTILIZER

A. Fertilizer shall be a standard commercial inorganic product containing nitrogen, available phosphoric acid and soluble potash in a recognized plant food form. This fertilizer shall be either suspendable or soluble in water.

B. All fertilizer shall comply with the provisions of the State and Local Regulations, with subsequent amendments or revisions thereto. Under these regulations, each brand and grade of commercial fertilizer must be registered. Each container of commercial fertilizer shall have placed on or affixed to the container, in written or printed form, the new weight and the following additional information:

1. The name and address of the person guaranteeing the fertilizing.
2. The brand and grade.
3. The guaranteed analysis showing the minimum percentage of plant food claimed in the following order and form:
    a. Total nitrogen - percent.
    b. Available phosphoric acid (P_2O_5) - percent.
    c. Soluble potash (K_2O) - percent.
    d. If distributed in bulk, a written or printed statement of the weight and preceding information shall accompany delivery and be supplied to Engineer.

C. Any grade or mixture of grades of nitrogen and phosphoric acid fertilizer may be used providing the proportions of the minimum rate of application per acre in accordance with the specifications or as directed by Engineer are met.

D. Fertilizer shall be furnished and delivered in standard bags or bulk.

E. Rate of application of commercial inorganic fertilizer shall be 200 pounds/acre of 18-46-0, recommended by seed supplier or shown in Section 01 10 00 – Special Provisions.

2.02 SEED MIXTURE

A. All seeds shall comply with applicable state and federal seed laws.

B. The seed shall comply with the specified requirements and shall be applied at the rate shown. All seeds shall be certified blue tag. A certified blue tag and analysis tag shall be on every bag.

C. See Section 01 10 00 – Special Provisions for seed mixture.

2.03 WATER

A. Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that the prepared soil base is ready to receive the work of this section.

B. Contractor shall notify Engineer at least 48 hours in advance of the intended time to begin work and shall not proceed with such work until permission to do so has been granted by Engineer.

3.02 PREPARATION

A. Prepare subgrade and topsoil in accordance with Section 31 22 00 – Grading.

B. Remove foreign materials, plants, roots, stones and debris from site. Do not bury foreign material.

C. Remove contaminated soil.

D. The finish grading must be approved by Engineer before seeding operations begin.

3.03 FERTILIZING

A. Apply fertilizer at the rate specified.

B. Apply after smooth raking of topsoil and prior to roller compaction.

C. Do not apply fertilizer at the same time or with the same machine as will be used to apply seed.

D. Mix thoroughly into upper 2 inches of topsoil.

E. Lightly water to aid the dissipation of fertilizer, if required.

3.04 SEEDING

A. The seedbed shall be prepared by loosening the soil to a depth of not less than 2 inches by discing, harrowing, raking or by other approved means. Several discings, harrowings or similar means may be required to provide a satisfactory seedbed. Discing, harrowing and raking shall be longitudinal on all slopes.

B. Existing weed stubble and small weeds shall be cut and partially incorporated into the soil during the seedbed preparation work. All other growth of vegetation that will interfere with seeding operations shall be removed. Extreme care shall be exercised to avoid injury to trees and shrubs that have not been designated by Engineer to be removed.

C. For seeding, approved mechanical power-drawn drills shall be used. Mechanical power-drawn drills shall have depth bands set to maintain a planting depth of 1/2 to 1 inch.

D. Apply seed at the rate specified evenly in 2 intersecting directions. Rake in lightly.

E. Planting Season: Seeding operations shall be performed only during the periods March 1 to June 30 and August 1 to December 1.

F. Do not sow immediately following rain, when ground is too dry or frozen, or during windy periods.

G. Apply water with fine spray immediately after each area has been sown.

3.05 HYDROSEEDING

A. Apply seeded slurry with a hydraulic seeder, only when specifically stated in the Section 01 10 00 – Special Provisions, evenly in 2 intersecting directions at a rate of 1,500 pounds of mulch/acre.

3.06 MULCHING

A. This work shall consist of placing a mulch on areas seeded. The mulch shall be loose enough to allow sunlight to penetrate and air to slowly circulate, but thick enough to shade the ground, reduce rate of water evaporation and prevent or reduce water or wind erosion.

B. Mulch shall be either dry cured native hay or threshed grain straw. Hay or straw shall be free from seeds of noxious weeds and relatively free from seeds of all other weeds.

C. The mulch shall be applied at the rate of 2 tons per acre.

D. Mulch shall be immediately applied after sowing the seed unless otherwise directed by Engineer. The mulch shall be applied with a mulch blowing machine or other approved methods.

E. Immediately following the spreading of the mulch, the material shall be anchored to the soil by a V-type wheel land packer, a soil erosion mulch tiller or other suitable equipment which will secure the mulch firmly to form a soil-binding mulch.

F. Apply water with a fine spray immediately after each area has been mulched.

3.07 RESEEDING

A. Prior to the expiration of the 1-year warranty, Contractor will be required to reseed any area that has not established a vigorous growth of specified seed mixture. Engineer to determine which areas are to be reseeded.

END OF SECTION

SECTION 33 11 16
WATER DISTRIBUTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pipe and fittings for potable water mains, including domestic waterlines and fire waterlines.

B. Fire hydrant

C. Flush hydrant

D. Hydrostatic testing.

E. Disinfection.

F. Thrust restraints.

G. Water main boring.

H. Casing for water main.

I. Service lines.

1.02 REFERENCES

A. ANSI/AWWA C 104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.

B. ANSI/AWWA C 105 – Polyethylene Encasement for Ductile-Iron Pipe Systems.

C. ANSI/AWWA C 110 – Ductile-Iron and Gray-Iron Fittings.

D. ANSI/AWWA C 111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

E. ANSI/AWWA C 115 – Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.

F. ANSI/AWWA C 116 – Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings.

G. ANSI/AWWA C 150 – Thickness Design of Ductile-Iron Pipe.

H. ANSI/AWWA C 151 – Ductile-Iron Pipe, Centrifugally Cast.

I. ANSI/AWWA C 153 – Ductile-Iron Compact Fittings.

J. ANSI/AWWA C 502 – Dry Barrel Fire Hydrants.

K. ANSI/AWWA C 550 – Protective Interior Coatings for Valves and Hydrants.

L. ANSI/AWWA C 600 – Installation of Ductile Iron Water Mains and Their Appurtenances.

M. ANSI/AWWA C 605 – Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.

N. ANSI/AWWA C 651 – Disinfecting Water Mains.

O. ANSI/AWWA C 655 – Field Dechlorination

P. ANSI/AWWA C 800 – Underground Service Line Valves and Fittings.

Q. ANSI/AWWA C 900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.

R. ANSI/AWWA C 901 – Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) 3 In. Through (76 mm) for Water Service.

S. ANSI/AWWA C 905 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. through 48 In. (350 mm through 1,200 mm).

T. ANSI/AWWA C 906 – Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm), for Waterworks.

U. ANSI/AWWA C 907 – Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water, Wastewater, and Reclaimed Water Service.

V. ANSI/AWWA C 909 – Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. through 24 In. (100 mm through 600 mm) for Water, Wastewater, and Reclaimed Water Service.

W. ASTM A 53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

X. ASTM B 88 – Standard Specification for Seamless Copper Water Tube.

Y. ASTM A 139 – Standard Specification for Electric-Fusion (Arc) - Welded Steel Pipe (NPS 4 and Over).

Z. ASTM F 477 – Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

AA. ASTM D 698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

BB. ASTM D 1556 – Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.

CC. ASTM D 1557 – Standard Test Methods for Laboratory Compaction of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).

DD. ASTM D 1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

EE. ASTM D 2167 – Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.

FF. ASTM D 3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR_PR) Based on Controlled Outside Diameter.

GG. ASTM D 3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

HH. ASTM D 3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

II. ASTM D 6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

JJ. ASTM F 1962 – Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings.

KK. ASTM F 2164 - Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure

LL. ASTM F 2206 - Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE).

MM. ASTM F 2620 - Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

NN. ASTM F 3154 - Standard Practice for Data Recording the Procedure used to Produce Heat Butt Fusion Joints in Plastic Piping Systems or Fittings.

OO. ASTM F 3190 - Standard Practice for Heat Fusion Equipment (HFE) Operator Qualification on Polyethylene (PE) and Polyamide (PA) Pipe and Fittings.

PP. AASHTO T 180 – Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

QQ. Recommended Standards for Water Works, latest edition (aka 10 States Standards) by Great Lakes-Upper Mississippi River Board of State Public Health and Environmental Managers

1.03 UNIT PRICES

A. Pipe:

1. Method of Measurement

a. Measure along centerline of pipe to the nearest foot.

b. No deduction for length of fittings or valves

2. Pay Unit: By the linear foot (LF) for each respective size and type of pipe.

3. Includes excavation, hand trimming excavation, pipe, tracer wire and test stations, bolts, concrete thrust restraints, placement, assembly, bedding, backfilling and compaction of backfill, testing and incidentals thereto.

a. Testing includes:

(1) Hydrostatic testing

(2) Compacted density testing of backfill.

(3) Concrete Compressive Strength testing

(4) Bacteriological / E-Coli testing

(5) Tracer wire testing

B. Fittings:

1. Method of Measurement and Pay Unit: By the unit (Each) for each respective size and type of fitting.

2. Includes excavation, hand trimming excavation, fitting, gland, gasket, polyethylene encasement, eye bolts, concrete thrust restraints, thrust restraint rods if specified, placement, assembly, bedding, backfilling and compaction of backfill, testing and incidentals thereto.

C. Mechanical Joint Restraint Devices:

1. Method of Measurement and Pay Unit: By the unit (Each) for each respective size and type of Mechanical Joint Restraint Device.

2. Includes furnishing the device (gland with restraint wedges), placement, assembly, testing and incidentals thereto.

D. Fire Hydrant Assembly:

1. Method of Measurement and Pay Unit: By the unit (Each) for each respective size and type of fire hydrant.

a. Includes fire hydrant, excavation, hand trimming excavation, bedding, fire hydrant lead pipe (up to 8 feet) from the fitting in the trunk line to the auxiliary valve, auxiliary gate valve and valve box with valve box

adapter and concrete valve box collar, pipe from the auxiliary valve to the foot of the fire hydrant, gravel drain, bolts, concrete thrust restraints, thrust restraint rods, mechanical joint restraint devices, concrete base, backfilling and compaction of backfill, testing and incidentals thereto.

2. Fire hydrant lead pipe from the fitting in the trunk line to the auxiliary valve that is in excess of 8 feet in length will be measured and paid for as pipe.

E. Fire Hydrant Extension:

1. Method of Measurement and Pay Unit: By the unit (Each) for each respective size and length of Fire Hydrant Extension if shown in the bid form and drawings. No payment for Fire Hydrant Extensions shall be made for units not shown in bid form and any units installed without approval of the Engineer will be considered incidental to the Fire Hydrant Assembly bid item.

2. Includes furnishing the device, placement, assembly, testing, and incidentals thereto.

F. Flush Hydrant Assembly:

1. Method of Measurement and Pay Unit: By the unit (Each) for each respective size and type of flush hydrant.

a. Includes flush hydrant, excavation, hand trimming excavation, bedding, flush hydrant lead pipe (up to 8 feet of lead pipe) from the connecting fitting, valve or curb stop to the foot of the flush hydrant, base elbow, gravel drain, concrete thrust restraints, backfilling and compaction of backfill, testing and incidentals thereto.

2. Flush hydrant lead pipe from the connecting fitting, valve or curb stop to the base elbow that is in excess of 8 feet in length will be measured and paid for as pipe.

G. Corporation Stop and Saddle:

1. Method of Measurement and Pay Unit: By the unit (Each) for each respective size and type of corporation stop and saddle.

2. Includes excavation, hand trimming excavation, tapping water main, corporation stop with saddle, backfilling, compaction, testing and incidentals thereto.

H. Curb Stop and Box:

1. Method of Measurement and Pay Unit: By the unit (Each) for each respective size of curb stop.

2. Includes excavation, hand trimming excavation, connections to water service lines, curb stop, curb stop box, stationary rod, backfilling, compaction, testing and incidentals thereto.

I. Polyethylene Encasement:

1. Polyethylene encasement of ductile or gray iron pipe, fitting, fire and flush hydrant is considered to be subsidiary to and included in the cost of the ductile iron, gray iron or other item for which payment is made.

J. Dry Boring and Jacking of Casing Pipe:

1. Method of Measurement: Measured along centerline of casing pipe, within the extents of the casing pipe shown in the Drawings. The length of the casing pipe considered for payment shall not be greater than the length shown in the

Drawings, unless the length of the casing pipe is increased at the direction of Engineer.

2. Pay Unit: By the linear foot (LF) for each respective size and type of casing pipe bored and jacked, within the limits shown in the Drawings or directed by Engineer.

3. Includes excavation of jacking pits, dry bore hole for casing pipe, removal of bored materials, jacking equipment, casing pipe and installation, casing chocks, installation of carrier pipe in casing pipe, casing end seals, backfilling and compaction of backfill, connection to pipe, testing and incidentals thereto.

4. Carrier Pipe: Installed within casing pipe, shall be measured and paid for separately.

K. Dry Boring Without Casing Pipe:

1. Method of Measurement: Measured along centerline of Dry Bore, within the extents of the dry bore shown in the Drawings. The length of the dry bore considered for payment shall not be greater than the length shown in the Drawings, unless the length of the dry bore is increased at the direction of Engineer.

2. Pay Unit: By the linear foot (LF) for each respective size of pipe installed by dry boring.

3. Includes excavation of boring pits, dry bore hole for pipe, removal of bored material, jacking equipment, installation of carrier pipe in bore hole, backfilling and compaction of backfill, connection to pipe, testing and incidentals thereto.

4. Carrier Pipe: Installed within dry bore, shall be measured and paid for separately.

L. Directional Boring Carrier Pipe:

1. Method of Measurement: Measured along centerline of directional boring, within the extents of the directional boring shown in the Drawings. Horizontal stationing along the centerline of alignments is based upon level line measurement and is used for measurement and payment. Actual pipe length is determined by the slope or curve on which the pipe is installed. No additional payment shall be made for variations in actual pipe length due to installation on slopes or curves.

2. The length of the directional boring considered for payment shall not be greater than the length shown in the Drawings, unless the length of the directional boring is increased at the direction of Engineer.

3. Pay Unit: By the linear foot (LF) for each respective size of pipe installed by directional boring.

4. Includes excavation, directional bore hole for pipe, tracer wire and test stations, jacking equipment, carrier pipe and installation of carrier pipe, backfilling and compaction of backfill, connection to pipe, testing and incidentals thereto.

5. Carrier pipe will not be measured and paid for separately, but will be considered a subsidiary item included in the directional boring pay item.

M. Wet boring is not approved for this project.

N. Dewatering of Trench:

1. Dewatering, including intercepting and diverting site drainage and surface water flows away from excavations and trenches, and removing standing water from trench or excavation with a sump and pump shall be considered incidental and subsidiary to other items of work for which direct payment is made
    a. Includes providing all permits required for the dewatering and paying all permit costs, pump, piping, wells and/or well points, dewatering equipment, assembly and disassembly, backfilling and compaction of backfill, energy cost and incidentals thereto.
2. Method of Measurement: (INCIDENTAL)
    a. Unless otherwise specified in Section 01 10 00 – Special Provisions, measurement and separate payment for dewatering will not be made.

O. Connection to Existing Water Main (Dry or Cut-in):

1. Method of Measurement and Pay Unit: By the unit (Each).
2. Includes excavation, hand trimming excavation, bedding, bolts, concrete thrust restraints, backfilling and compaction of backfill, couplings, bolts, sleeves, adapters and incidentals thereto.
3. Washing, cleaning and disinfection of all units prior to installation shall be considered to be a subsidiary to and included in the cost of the item for which payment is made.
4. Mechanical joint fitting(s) at the connection shall be measured and paid for as a separate item (Each).

P. Connection to Existing Water Main (Pressure or Wet Tap):

1. Method of Measurement and Pay Unit: By the unit (Each).
2. Includes excavation, hand trimming excavation, bedding, bolts, concrete thrust restraints, tapping main, backfilling and compaction of backfill, couplings, sleeves, adaptors, and incidental work and materials.
3. Washing, cleaning and disinfection of all units prior to installation shall be considered to be a subsidiary to and included in the cost of the item for which payment is made.
4. Tapping tee and attached valve with appurtenances shall be paid for as a separate item (Each).

Q. Connection to Existing Water Service:

1. Method of Measurement and Pay Unit: By the unit (Each).
2. Includes excavation, hand trimming excavation, bedding, backfilling and compaction of backfill, fittings, and adapters to connect new service line or curb stop to existing service line or existing curb stop and incidental work and materials thereto.
3. Washing, cleaning and disinfection of all units prior to installation shall be considered to be a subsidiary to and included in the cost of the item for which payment is made.

R. Abandon Existing Water Main:

1. Method of Measurement and Pay Unit: By the unit (Each) or by Lump Sum as shown in the bid form.
2. Includes excavation, hand trimming excavation, capping or plugging existing main, concrete, thrust blocking, backfilling and compaction of backfill, adapters, fittings, couplings, sleeves, gaskets and incidentals thereto.
3. Mechanical joint ductile iron - gray iron fitting shall be paid for as a separate item (Each).

S. Abandon Existing Water Service:

1. Method of Measurement and Pay Unit: By the unit (Each) or by Lump Sum as shown in the bid form.
2. Includes excavation, hand trimming excavation, capping or plugging existing main, thrust blocking, backfilling and compaction of backfill, adapters, fittings, couplings, sleeves, gaskets and incidentals thereto.

T. Tracer Wire, Tracer Wire Terminal Access Box, Marker Post and Appurtenances:

1. Tracer wire, tracer wire test stations, tracer wire terminal access boxes, marker posts with test station, mounting stakes, decals and installation and testing are considered to be subsidiary items to and included in the cost of items for which payment is made.

U. Thrust Restraint Rods and Concrete Thrust Restraints:

1. Thrust restraint rods and eye bolts and concrete thrust restraints are considered to be subsidiary items included in the cost of items for which payment is made.

V. Flexible Couplings:

1. Considered to be a subsidiary item included in the cost of items for which payment is made.

W. Pipe Material Adapters:

1. Adapters for transition from one type of material to another are considered a subsidiary item included in the cost of items for which payment is made.

X. Pipe Pressure Testing, Flushing, Cleaning and Disinfection:

1. Considered to be subsidiary items included in the cost of items for which payment is made.

Y. Bacteriological / E-Coli Testing:

1. Considered to be a subsidiary item included in the cost of items for which payment is made.

1.04 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, hydrants, service line materials and accessories and appurtenances.

B. Concrete: Provide concrete design mix data.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer's Installation Instructions: Provide special procedures required to install products.

E. Project Record Documents:

1. Record the location of water main, fittings, and connections and thrust restraints.
    a. Provide Engineer with a minimum of 3 distance ties from the pipe fittings and connections to permanent topographical feature (trees, buildings, fire hydrants, etc.).
    b. Provide Engineer with GPS Coordinates, if required, see Section 01 10 00 – Special Provisions.
    c. Provide Engineer with measure distance to service taps from center curb stop.
    d. For directional bore, submit to Engineer the plot of the actual horizontal and vertical alignment of the pilot bore at intervals not to exceed 30 feet.
2. Identify, describe and record the discovery of variations in subsoil conditions, and provide copy of record to Engineer.
3. Identify, describe and record the discovery of uncharted utilities, and provide copy of record to Engineer.
4. Testing:
    a. See Section 01 40 00 – Quality Requirements for general requirements for field inspection and testing.
    b. See Section 31 23 33 – Trenching for Utilities for compaction testing.
    c. See Section 33 13 00 – Disinfection of Water Distribution System for testing.
    d. Hydrostatic Test of Water Main; provide copy of Test Records to Engineer
    e. HDPE Fusion Reports; provide copy of Reports to Engineer
    f. Tracer Wire Continuity Test; provide copy of Test Records to Engineer
    g. Backfill Compaction Test; provide copy of Test Records to Engineer, see Section 01 10 00 – Special Provisions.
    h. Concrete Strength Test Records; provide copy of Test Records to Engineer, see Section 01 10 00 – Special Provisions.

F. Submit the following as appropriate for each hydrant provided:

1. Outline and installation drawings for equipment and fixtures furnished.
2. Equipment performance data and operating characteristics.
3. Manufacturer's data for hydrants and accessories.
    a. Supply catalog data, including illustrations and a parts list that identifies the materials used for various parts.
    b. The information shall be in sufficient detail to serve as a guide in the assembly and disassembly of the hydrant and for ordering repair parts.
4. Manufacturer's catalog data marked to indicate materials being furnished as standard equipment, fixtures, specialties and accessories.

G. Submit the following for restrained joint ductile iron pipe:

1. Restrained joint style and detailed designs by the pipe manufacturer, including detailed laying schedules.

1.05 QUALITY ASSURANCE

A. All products are required to meet applicable AWWA requirements, NSF 61 and the requirements of the Safe Drinking Water Act.

B. Marking:

1. Pipe: Nominal pipe size, material code designation, standard dimension ratio, pressure rating, manufacturer's name or mark, National Sanitation Foundation seal and appropriate ASTM designation numbers marked on pipe.

2. Fittings: Manufacturer's name or mark and pressure rating marked on body.

3. Fire Hydrant: Manufacturer's name or mark, main valve opening and year of manufacture marked on Hydrant.

C. Bacteriological water quality sampling and testing in accordance with AWWA C600 or C605 and AWWA C651 and in compliance with the rules and regulations of the authority having jurisdiction for potable water system piping.

1. Bacteriological and/or E-Coli testing water quality analysis shall be performed by a laboratory approved by the authority having jurisdiction for potable water system piping.

1.06 REGULATORY REQUIREMENTS

A. Conform to all applicable local, state and federal code for materials and installation of the work of this section. Perform work in accordance with standards of authorities having jurisdiction for potable water system piping. Includes materials, installation, testing and disinfection.

1.07 PROJECT CONDITIONS

A. Verify that survey control points for alignment and elevation are as shown in the Drawings.

B. Research public utility records and verify location of existing utilities.

1. Contact utility locating service for project area.

2. Comply with applicable “ONE CALL” requirements.

C. Provide exploratory excavation to determine exact location of existing underground structures or utilities. Notify Engineer immediately if a discrepancy or conflict is identified.

D. Protect plants, lawns, trees, and other amenities and features; which are to remain, as shown in the Drawings or specified in Section 01 10 00 – Special Provisions, from damage by equipment, vehicular traffic and other construction related activities.

E. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, curbs, utility pedestals and lines and amenities that are to remain from damage by excavating equipment, vehicular traffic and other construction related activities.

F. Verify that water service piping can be installed as shown in the Drawings and to reference standards.

G. Coordinate the connection of water piping to existing water main, water service line and/or other water facilities as shown in the Drawings.

1.08 DELIVERY, STORAGE AND HANDLING

A. Preparation for Transport:

1. Ensure that fittings, hydrants and specialties are dry and internally protected against rust and corrosion.
2. Protect glands, gaskets, threaded ends and flange faces.
3. Set fittings, hydrants and specialties in best position for handling.
4. Do not telescope small diameter pipe inside larger diameter pipe.

B. During Storage:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather:
    a. Protect stored pipe, fittings, hydrants and specialties from moisture and dirt.
    b. Pipe end covers may be required, see Section 01 10 00 – Special Provisions.
    c. Store indoors and maintain temperature higher than ambient dew point temperature, where possible.
    d. When outdoor storage is necessary, support materials off the ground or pavement.
3. Protect PVC pipe from prolonged (more than 1 month) exposure to sunlight.
4. Support flexible pipe to prevent sagging and bending.

C. Handling:

1. Use sling to lift pipe, fittings, hydrants and specialties where size requires handling by crane or other equipment.
    a. Rig pipe, fittings, hydrants and specialties to avoid damage.
2. Protect pipe, fittings, hydrants and specialties from moisture and dirt during handling.
3. Deliver pipe, fittings, hydrants and specialties to trench in sound, undamaged condition.

1.09 SEQUENCING/SCHEDULING

A. Attend preconstruction meeting.

B. Submit plan for construction sequence prior to commencing work.

C. Coordinate the connection of water piping to existing water main, water service line and/or other water system facilities, as shown in the Drawings, with Owner and Engineer.

1. Give Owner and Engineer a minimum 24-hours notice before connection to existing main or other water system facilities.
2. Keep disruption of service to less than 4 hours.

D. Give Engineer, Owner and permitting authority a minimum 48-hours notice prior to commencing any boring activity.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS/PRODUCTS

A. All products furnished shall meet all applicable AWWA requirements and NSF 61 requirements.

B. See Section 01 10 00 – Special Provisions for specific product brand requirements.

2.02 WATER PIPE

A. Ductile Iron Pipe (DIP):

1. Conform to ANSI/AWWA C151.
2. Diameter: As shown in the Drawings.
3. Thickness/Rating:
    a. 3” – 12”: Pressure Class 350, minimum.
    b. 14” – 48”: Pressure Class 250, minimum.
4. Joints: ANSI/AWWA C111, rubber gasket, push-on or mechanical joint.
    a. Restrained Joint DIP:
        (1) Flexible type.
        (2) Boltless, lock ring type.
        (3) Restraining gaskets are not approved.
        (4) Fittings: Ductile iron molded or formed to suit pipe size and joint design.
5. Exterior Coating: Asphaltic, 1 mil thickness, per ANSI/AWWA C104.
6. Interior Coating: Standard cement lining with seal coat, per ANSI/AWWA C104.
7. Buried DIP shall be encased in Polyethylene per ANSI/AWWA C105.

B. Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVOC) Pipe:

1. General:
    a. AWWA C900, 4 inch through 12 inch; AWWA C905, 14 inch through 36 inch, AWWA C909, 4 inch through 24 inch.
    b. DR or Pressure Class as shown on the Bid form and/or specified in Section 01 10 00 – Special Provisions.
    c. Color: Blue
    d. Same outside diameter as ductile iron pipe.
2. Joints:
    a. Conform to AWWA C900 or AWWA C905 or AWWA C909 as applicable to pipe.
    b. Elastomeric gasketed push-on joints.
    c. Solvent cement welded joints are not approved.

C. Restrained Joint PVC Pipe:

1. General:
    a. AWWA C900, for 4 inch through 12 inch.

b. Restrained joint pipe shall be furnished in 4", 6", 8", 10", 12" sizes in DR or Pressure Class as shown on the Bid form, and/or specified in Section 01 10 00 – Special Provisions.

c. The restrained joint pipe system shall meet all short and long term pressure test requirements of AWWA C900.

d. Pipe joints shall be designed for use at or above the pressure class of the pipe with which they are utilized.

2. Materials:

a. The products represented by this specification are made from un-plasticized PVC compounds having a minimum cell classification of 12454 as defined in ASTM D 1784.

b. Gasket shall be elastomeric sealing gaskets meeting the requirements of ASTM F 477.

c. Pipe joints shall be designed for use at or above the pressure class of the pipe with which they are utilized.

d. Joints shall be designed to meet the zero leakage test requirements of ASTM D 3139.

3. Certifications:

a. The products represented by this specification shall additionally conform to NSF 61 Drinking Water System – Health Effects.

4. Dimensions & Color

a. Nominal outside diameters and wall thicknesses of this restrained joint pipe conforming to the requirements of AWWA C900 (Cast Iron pipe OD).

b. Pipe shall be furnished in standard lengths of 20 feet.

c. Color: Blue.

5. Workmanship

a. Pipe and couplings (as applicable) shall be homogeneous throughout and free from voids, cracks, inclusions and other defects and shall be as uniform as commercially practicable in color, density and other physical characteristics.

6. Marking

a. Pipe and couplings (as applicable) are legibly and permanently marked in ink with critical information including nominal size, material type, dimension ratio, pressure class, applicable standards, manufacturer's name or trademark, production record code and seal (mark) of testing agency verifying the suitability of the pipe material for potable water systems.

D. High Density Polyethylene (HDPE) Pipe:

1. AWWA C906: PE 3408 or PE 4710.

2. DR as shown on the Bid Form and/or specified in Section 01 10 00 – Special Provisions.

3. Manufactured with color striping to identify their application. Blue for Water purposes.

4. Same outside diameter size as ductile iron.
5. Furnish manufacturer's inspection certificates.
6. Polyethylene pipe may be joined together by butt fusion using approved heat-fusion joining machine in accordance with ASTM F 2620.
7. Polyethylene pipe may be joined to other materials with fittings with the same or greater pressure rating by means of:
    a. Flanged adapters:
        (1) Shall be manufactured from PE4710 material.
        (2) Fitted with back-up rings that are pressure rated equal to or greater than the mating pipe.
        (3) The back-up ring bore shall be chamfered or radiused to provide clearance to the flange adapter radius.
        (4) Shall meet the requirements of ASTM D3261 for molded butt fusion fittings and mechanical joint adapters or shall comply with AWWA C906 for fabricated butt fusion fittings.
        (5) Shall meet the marking requirements of ASTM D3261 for molded butt fusion fittings and mechanical joint adapters or shall comply with the marking requirements of AWWA C906 for fabricated butt fusion fittings. Marking shall include NSF/ANSI 61 designation.
8. Where shown on the drawings, 4" and larger transitions to mechanical joint fittings and valves shall be accomplished using a MJ Adapter kit:
    a. Molded or Fabricated HDPE mechanical joint transition fitting.
    b. Gasket.
    c. Mechanical joint backup drive ring.
    d. Stainless Steel tee bolts.
9. Mechanical Joint Adapters
    a. Mechanical couplings designed for joining polyethylene pipe to another material and AWWA C111 joints.
    b. A stainless steel stiffener shall be installed in the bore of the polyethylene pipe when an OD compression mechanical coupling is used and when connecting plain end PE pipe to a mechanical joint pipe, fitting or appurtenance.
    c. External clamp and tie rod restraint shall be installed where PE pipe is connected to the socket of a mechanical joint pipe, fitting or appurtenance except where a Mechanical Joint Adapter is used.
10. High density polyethylene (HDPE) molded fittings are not approved.

E. Pressure Water Pipe Restraint:
1. Mechanical Restraint and Concrete Thrust Block at bends, tees and dead ends against undisturbed soil.
2. Location and Size: As shown in the Drawings.

2.03 FITTINGS

A. Conform to ANSI/AWWA C110 or ANSI/AWWA C153

B. Diameter: 2 inch through 64 inch as shown in the Drawings.

C. Material: Ductile Iron

D. Mechanical Joints: Conform to ANSI/AWWA C111.

E. Gaskets: Conform to ANSI/AWWA C111.

F. Exterior Coating: Asphaltic, 1 mil thickness.

G. Interior Coating: Standard cement lining ANSI/AWWA C104 with seal coat.

H. Working Pressure: 350 psi.

I. Buried fittings shall be encased in Polyethylene per ANSI/AWWA C105.

2.04 SPECIAL FITTINGS

A. Ductile Iron Couplings/Flexible Couplings:

1. Ductile iron body.
2. Finish: Epoxy coated per AWWA C213 or equal.
3. Gaskets: Synthetic rubber, Buna-N or equal.
4. Working Pressure: 150 psi, minimum.

B. Mechanical Joint Restraint Devices:

1. Sizes: 3 inch through 48 inch.
2. Specifically designed to be installed on PVC or Ductile Iron pipe.
3. Restraint devices shall consist of multiple gripping wedges incorporated into a follower gland.
   a. Gland shall meet applicable requirements of ANSI/AWWA C110.
   b. Wedges shall impart increasing resistance against the pipe as internal pressure increases.
   c. Actuate the gripping wedges with torque limiting twist off nuts.
4. Gland body, wedges and wedge actuating components: Ductile iron
5. Working Pressure:
   a. Minimum safety factor: 2:1
   b. 3 -16 inch: 350 psi, min.
   c. 18-48 inch: 250 psi, min.

C. Bolt-Through Mechanical Joint Adapter:

1. Adapter shall be a bolt-through positive restraint mechanism that connects valves and/or AWWA C110 fittings together at a linear distance not to exceed three (3) inches and without attachment to pipe.
2. Material: Ductile iron
3. Gaskets: Conform to ANSI/AWWA C111.
4. Exterior Coating: Asphaltic, 1 mil thickness.
5. Interior Coating:
   a. 3-12 inch: Standard cement lining conforming to ANSI/AWWA C104 with seal coat.

b. 14-36 inch: NSF 61, 7-mil. fusion bonded epoxy conforming to AWWA C116 and C550.

6. Working Pressure:

a. 3 -24 inch: 350 psi, min.

b. 30-36 inch: 250 psi, min.

D. Pressure/Wet Tap Tapping Sleeves:

1. 2-section construction.

a. Stainless Steel

b. Ductile/Gray Iron

2. Gaskets: Rubber, Buna-N or equal.

3. Flanged outlet for tapping valve, ANSI B16.1, Class 125.

4. Pressure Rated: 200 psi.

E. Tapping Valve:

1. Resilient seat, non-rising stem gate valves - AWWA C509.

2. Materials for tapping valves in potable water service shall comply with the requirements of the Safe Drinking Water Act and shall be certified as suitable for contact with drinking water by an accredited certification organization in accordance with ANSI/NSF Standard 61.

3. Exposed Bolts and Nuts: Stainless steel.

4. Joints for Tapping Valves.

a. Valve end connecting Valve to tapping sleeve: Flanged, ANSI B16.1, Class 125

b. Valve end connecting Valve to branch pipe: Mechanical Joint.

5. Actuator: 2-inch operating nut.

F. Encased in Polyethylene per ANSI/AWWA C105

2.05 POLYETHYLENE ENCASEMENT FOR IRON PIPE AND FITTINGS

A. Shall meet ANSI/AWWA C105 standards.

B. Flat sheet, split tube or tube.

C. 8 mil (0.20 mm) thickness.

2.06 PIPE LUBRICANT

A. NSF Standard #61 certified for potable water pipe.

B. Non-toxic and non-corrosive. Shall not support bacterial growth.

C. No residue after assembly and flushing of main and appurtenances according to AWWA procedures.

2.07 TRACER WIRE

A. General

1. Wire Size: Minimum size shall be 12 AWG or as shown in the Drawings or specified in Section 01 10 00 – Special Provisions.

2. Jacket color shall meet the APWA color code standard for identification of buried utilities, blue for potable water.

3. Jacket/ coating type shall be High Density Polyethylene (HDPE) or High Molecular Weight Polyethylene (HMWPE) rated for direct burial. Nylon is not allowed.

B. Placement:

1. The tracer wire shall be placed in the same orientation as installed pipe.
2. The tracer wire shall be placed as shown in the Drawings or specified in Section 01 10 00 – Special Provisions.
3. When connecting to an existing main, begin tracer wire system at the connection to the existing main.
    a. If test station is not installed adjacent to the connection to the existing main, install a five foot long by 1/2" diameter or larger copper clad or solid copper ground rod in the trench, next to the connection.
    b. Connect tracer wire to ground rod with corrosion-resistant brass, stainless steel or copper alloy clamp. Steel rebar is not acceptable.

C. Wire Type:

1. Open trench/direct bury: Wire type shall be Solid Copper or Solid Copper Clad Steel (CCS) or as shown in the Drawings or specified in Section 01 10 00 – Special Provisions.
2. Pipe bursting and directional boring: Wire type shall be Solid Copper Clad Steel (CCS) or as shown in the Drawings or specified in Section 01 10 00 – Special Provisions.
3. Stranded wire not required, but may be used at Contractor’s option.

D. Connectors (splice):

1. Shall be Copperhead SnakeBite connector, 3M DBR connector or approved equal and shall be rated for direct bury for the protection of wire from moisture and corrosion.
2. Connector shall be sized appropriate to the number and size of wires connected.

E. Terminal Access Boxes and Marker Posts.

1. General:
    a. Access boxes and/or test stations shall be installed to bring the tracer wire to level for ease of testing.
2. Flush Mount Terminal Access Box:
    a. Tracer wire terminal access box shall be located directly in front of fire hydrant auxiliary valves and water main valve boxes, as shown in the Drawings or specified in Section 01 10 00 – Special Provisions.
    b. Tracer wire shall be terminated at each end in a flush mount terminal access box.
    c. Terminal access box shall have a cast iron lid that can be locked and opened with a standard pentagon head key wrench.
    d. Riser base: 12” minimum depth, PVC or approved equivalent.
    e. Terminal access box shall be installed in a concrete pad, set to finish grade, as shown in the Drawings or specified in Section 01 10 00 – Special Provisions.
    f. Tracer wires shall be attached to integral stainless steel screws.

g. Terminals shall be readily accessible once the lid is removed for use of a locator.

h. Extend tracer wire up inside the terminal access box, leaving minimum of 3 feet of tracer wire inside the terminal access box.

3. Water line marker post with tracer wire test station:

a. Marker post and test station shall be located when shown in the Drawings or specified in Section 01 10 00 – Special Provisions.

b. Six (6) foot minimum length.

c. Shall be designed to bend and rebound when struck by a vehicle.

d. Shall be triangular shape or approved equal.

e. Color shall meet the APWA color code standard for identification of buried utilities, blue for potable water.

f. Shall have decals stating “Warning, Buried Water” or similar.

g. Shall have minimum of two corrosion resistant internal terminals, brass or stainless steel.

h. Shall have removable top cap to access internal terminals.

i. Installation of tracer wire in marker post and test station:

(1) Bury the bottom 18 inches of the marker post and test station, with anchor barbs flared out.

(2) Run the tracer wire up through the marker post and test station, leaving a minimum of 3 feet of tracer wire slack inside the marker post and test station.

(3) Each tracer wire shall be attached to an internal corrosion resistant terminal.

(4) Label the screws with a permanent marker to indicate the direction of the main and tracer wire from the marker post and test station. IE; “Tracer Line North”, “Tracer Line South”, Etc.

2.08 HYDRANTS

A. Fire Hydrants:

1. ANSI/AWWA C502 for dry-barrel fire hydrants.

2. Hydrant shall be UL Listed and FM Approved, in allowable configurations.

3. Type of Shutoff: Compression.

4. Type of Construction: Break flange or break bolt.

5. Main Valve Opening: 5 1/4 inches.

6. Nozzle Arrangement and Size: 3 nozzles - two 2 1/2 inch nozzles and one 4 1/2 inch pumper nozzle.

7. Nozzle Threads: National standard hose threads.

8. Type of Inlet Connection: Mechanical Joint.

9. Size of Inlet Connection: 6 inch.

10. Depth of bury: Distance from ground line to top of connection pipe shall be 5-½ feet minimum, or otherwise as shown in the Drawings.

11. Direction of Opening: Counterclockwise.
12. Packing: Conventional or O-ring.
13. Size and Shape of Operating Nut: 1 1/2 inch, standard pentagon.
14. Working Pressure: 150 psi.
15. Color: Red, or as indicated in Section 01 10 00 – Special Provisions.
16. Thrust Restraint: Mechanical restraints and concrete thrust block, as shown in the Drawings.
    a. Mechanical joint restraint devices shall be installed on the branch of the connecting tee, each side of the auxiliary valve and each side of any fittings.

B. Fire Hydrant Extensions:
1. Fire Hydrant Extension shall meet or exceed ANSI/AWWA C502, latest revision for use in water supply systems.
2. Rated working pressure shall be 250 psig min, test pressure shall be 500 psig.
3. Traffic break feature to be designed for easy 360°rotation of nozzle section and incorporate the use of a 2-piece square rod and single cast-iron rod coupling secured with stainless steel coupling pins.
4. Hydrant extension shall be made of ductile iron.
5. Hydrant extension manufacturer shall match the manufacturer of the hydrant being extended.
6. Hydrant extension to be Certified to NSF/ANSI Standard 61 and NSF/ANSI 372.

C. Flush Hydrants:
1. Style: Above ground, non-freezing, self-draining.
2. Barrel: 2 inch diameter with traffic break-away coupling, horizontal inlet
3. Depth of bury: Distance from ground line to top of connection pipe shall be 5-½ feet minimum, or otherwise as shown in the Drawings.
4. Nozzle(s): arrangement and size:
    a. Nozzle thread: National Standard Hose Threads.
    b. 1 nozzle – 2-½ inch.
    c. Horizontal discharge.
    d. Iron nozzle cap and chain.
5. Operating Parts:
    a. Hydrant shall include a lockable cover to prevent unauthorized use.
    b. Non-turning operating rod.
    c. Operating nut: Slotted corporation style
    d. Direction of opening: Counterclockwise.
    e. Internal working parts shall be bronze, brass, aluminum or approved equivalent.
    f. Internal working part shall be serviceable from above grade with no digging.

6. Coating: AWWA C502
    a. Color: Red, or as indicated in Section 01 10 00 – Special Provisions.
7. Thrust Restraint: Mechanical Restraint and Concrete Thrust Block, as shown in the Drawings.

2.09 NUTS AND BOLTS, EYE BOLTS AND THREADED ROD THRUST RESTRAINTS

A. Nuts and Bolts: Ductile iron, corten or stainless steel.

B. Eye Bolts: 3/4 inch diameter, corten.

C. Threaded Rod: 3/4 inch diameter; stainless steel or corten.

D. Wrapped with polyethylene encasement AWWA C105.

2.10 CONCRETE THRUST BLOCKS

A. As shown in the Drawings.

B. Concrete Mix Design: Compressive strength when tested in accordance with ASTM C 39 at 28 Days: Minimum 3,500 psi.

2.11 WATER SERVICE LINE MATERIALS

A. Conform to the requirements of ANSI/AWWA C800 Underground Service Line Valves and Fittings.

B. Copper Tubing: Type K, ASTM B 88.
1. Flared joint or pack joint fittings.
2. Size: As shown in the Drawings.

C. Polyethylene (PE) plastic pipe (SIDR):
1. ASTM D 2239 and AWWA C901
2. Thickness: SIDR 7.
3. Minimum Pressure Rating: 200 psi.
4. Outer Diameter: Iron Pipe Size.
5. Size: As shown in the Drawings.
6. Install with insert stiffeners.

D. Service Saddles:
1. Brass, bronze, stainless or ductile iron body for use with water pipe.
2. Wide band stainless, bronze, brass straps.
3. O-ring seal.
4. AWWA taper threaded outlet.
5. Minimum Working Pressure: 150 psi.
6. Size: As shown in the Drawings.

E. Corporation Stops:
1. Brass or bronze body for use with copper or PE service pipe.
2. AWWA taper threaded inlet.
3. Minimum Working Pressure: 150 psi.
4. Size: As shown in the Drawings.

F. Curb Stops:

1. Brass or bronze body without drain; ball valve type for use with copper or polyethylene service pipe.
2. Inlet and outlet connection as shown in the Drawings for copper or polyethylene service pipe.
3. Grip joint or pack joint; (See Section 01 10 00 – Special Provisions).
4. Minimum Working Pressure: 150 psi.
5. Size: As shown in the Drawings.

G. Curb Boxes:

1. Extendable type with cast iron base and lid:
2. Steel pipe upper section.
3. Minimum Inside Diameter: 1 1/2 inches.
4. Base Pattern: Minneapolis or Arch; (See Section 01 10 00 – Special Provisions).
5. Lid Pattern: Plug style with pentagon bolt.
6. Rod Type: 42-inch stationary rod.
7. Length: As shown in the Drawings.

H. Couplings:

1. Brass for flared connections for copper service pipe.
2. Compression type for PE service pipe.
3. Minimum Working Pressure: 150 psi.
4. Size: As shown in the Drawings.

2.12 CASING PIPE

A. Steel Pipe:

1. General: Uncoated, smooth wall welded steel pipe; ASTM A 53, Type E or Type S, Grade B black steel; or ASTM A 139, Grade B black steel. Minimum yield strength 35,000 psi.
2. Minimum Wall Thickness: See Drawings and Section 01 10 00 – Special Provisions

B. Casing Chocks:

1. General: Provide casing chocks for carrier pipe 4 inches or greater in diameter.
2. High Density Polyethylene, Stainless Steel body or equal
3. Shall have runners that extend beyond the bell, mechanical joint, or restrainer of the carrier pipe.
4. Shall be designed to grip tightly to the carrier pipe

C. Casing End Seals: Minimum 1/8" thick synthetic rubber end seals with mechanical stainless steel bands or equal:

1. After insertion of the carrier pipe into the casing, the ends of the casing shall be closed by installing wrap-around end seals or equal.
2. Place the end seal around the carrier pipe and casing; then compress the adhesive strips to form a seal.
3. Stainless steel banding installed and mechanically tightened per manufacturer's recommendation.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that trench cut and excavation base are ready to receive work and excavations, dimensions and elevations are as shown in the Drawings.

B. Verify that building service connection and municipal utility water main size, location and invert elevation are as indicated.

C. Verify depth and location of other buried utilities and structures in the area.

3.02 TRENCHING

A. Hand trim excavation for accurate placement of pipe, hydrant, fitting and specialties to elevations shown.

B. Form and place concrete for pipe thrust restraints at each change in pipe direction. Place concrete to permit full access to pipe and pipe accessories. See Drawings for square footage of thrust restraint based on pipe diameter.

C. Place and compact embedment materials for bedding, haunching and initial backfill according to manufacturer's recommendations.

D. Backfill around sides and to top of pipe with cover fill, tamp in place and compact; then complete backfilling and compaction.

E. Protect pipe from damage and displacement while backfilling and compacting.

3.03 PIPE AND FITTING INSTALLATION

A. Install pipe and appurtenances in accordance with manufacturer's recommendations and AWWA C 600 (Ductile Iron) or AWWA C605 (PVC), including but not limited to proper handling and storage, installation, tapping and testing of pipe.

B. Handling Pipe and Appurtenances:

1. Protect pipe, fittings, hydrants and specialties during handling to prevent damage and to prevent entrance of dirt, debris and moisture.
2. Deliver to trench in sound, undamaged condition.
3. Use web slings. End hooks not allowed.

C. Inspect for Defects:

1. Tap DIP pipe with light hammer to detect cracks.
2. Replace defective, damaged or unsound pipe and appurtenances.

D. Protection of Pipe Interior:

1. Clean pipe interior of foreign material before lowering into trench.
2. Keep clean at all times.
3. Securely close open pipe ends and fittings with watertight plugs during nonworking periods including:
    a. When pipe laying is not in progress.
    b. Nights.
    c. Weekends.

E. Cutting Pipe:

1. Use methods recommended by manufacturer.

2. Cut pipe in neat, workmanlike manner without damage to interior lining or exterior coating.
3. Use approved mechanical cutter.
4. Grind smooth and bevel cut ends.

F. Joining Pipe:
1. Use minimum amount of gasket lubricant necessary to allow safe and efficient assembly of pipes and fittings.
2. Use methods recommended by manufacturer to assemble pipes and fittings.

G. Pipe Deflections:
1. Allowed only with permission of Engineer or if shown in the Drawings.
2. Do not exceed manufacturer's recommendations for type and size of pipe and joint being used.
3. Utilize fittings (bends) or shorter lengths of pipe where necessary to achieve desired alignment.

H. Pipe Gradient:
1. Lay pipe to slope gradient shown in the Drawings.

I. Separation Between Water Mains and Sewer Mains:
1. Maintain minimum of 10 feet horizontal separation of water mains from storm sewer and sanitary sewer mains and manholes.
2. Maintain minimum of 18 inches vertical separation where sewer and water mains cross.
    a. Center 1 full length (approximately 20 feet) of water main pipe at sewer line crossing.
    b. Correct any misalignment and/or loosened joints of sewer line prior to backfilling.
    c. Carefully compact backfill beneath sewer line to prevent misalignment.
    d. Repair any damage to sewer line at no cost to Owner. Use Engineer approved method of repair.

J. Polyethylene Encasement:
1. Wrap ductile iron and cast iron pipe, fittings, specialties, and hydrants with polyethylene encasement per ANSI/AWWA C 105.
2. Repair damaged areas of polyethylene encasements with an adhesive PVC, 10 mil minimum thick tape or equal.

K. Tracer Wire, Tracer Wire Terminal Access Box and Marker Posts with Test station:
1. Place tracer wire in trench adjacent to the water main, as shown in the Drawings.
2. Terminate tracer wire in a tracer wire terminal access box or marker posts with test station.
3. Minimum bury of tracer wire from water main to terminal access box or marker post: 36 inches.
4. Boring with Casing Pipe, Dry Boring and Directional Boring:
    a. Attach tracer wire to carrier pipe as required.

b. Install a terminal access box or marker post with test station at each end of the boring or casing pipe.

5. Test tracer wire to ensure continuity.

6. Maximum length between tracer wire terminal access boxes or marker posts: As shown in the Drawings or specified in Section 01 10 00 – Special Provisions.

L. Marker Post with Test Station and Decals:

1. Furnish and install marker posts with test station, as shown in the Drawings or specified in Section 01 10 00 – Special Provisions.

2. Maximum spacing as specified in Section 01 10 00 – Special Provisions or as shown in the Drawings.

3. See Drawings or Section 01 10 00 – Special Provisions for special wording (If Required)

4. Place decal on each marker post.

M. Depth of Cover:

1. Minimum Depth of Cover: 5.5 feet unless shown otherwise in the Drawings or stated on the Plans. (Depth of cover is measured from top of pipe to finish grade elevation.)

3.04 HYDRANT INSTALLATION

A. Set hydrant on concrete pad that is placed on undisturbed soil or other solid bearing approved by Engineer.

B. Fire Hydrants:

1. Set hydrant at location and grade shown in the Drawings.

2. Set plumb.

3. Keep interior clean at all times.

4. Locate pumper nozzle perpendicular to and facing roadway unless directed otherwise.

5. Set hydrant "bury line" at finish grade.

6. Set hydrant on 18 inch square by 4 inch thick concrete foundation.

7. Provide a drainage pit 36 inches square by 24 inches deep filled with washed gravel. Encase elbow of hydrant in gravel to 6 inches above drain opening. Do not connect drain opening to sewer.

a. Gravel shall be a locally available material composed of ¾" or smaller well graded road gravel, free of organic matter, fine sand, loam, clay or other particles that would restrict water flow through the gravel. Crushed concrete materials are not an acceptable substitute.

8. Tie auxiliary gate valve to tee with thrust rods.

9. Position auxiliary valve a minimum of 18 inches from hydrant.

10. Wrap hydrant barrel above gravel pack, up to finish grade, with polyethylene encasement ANSI/AWWA C105.

11. Place a temporary cover over the hydrant until placed in service.

C. Flush Hydrants:

1. Set hydrant at location and grade shown in the Drawings.

2. Set plumb.

3. Keep interior clean at all times.

4. Set hydrant "bury line" at finish grade.

5. Set hydrant on 18 inch square by 4 inch thick concrete foundation.

6. Provide a drainage pit 36 inches square by 24 inches deep filled with washed gravel. Encase elbow of hydrant in gravel to 6 inches above drain opening. Do not connect drain opening to sewer.

   a. Gravel shall be a locally available material composed of ¾" or 1" graded gravel free of organic matter, sand, loam, clay or other particles that would restrict water flow through the gravel. Crushed concrete materials are not an acceptable substitute.

7. Position auxiliary valve a minimum of 18 inches from hydrant.

8. Wrap hydrant barrel above gravel pack, up to finish grade, with polyethylene encasement ANSI/AWWA C105.

3.05 RESTRAINED JOINT PIPE INSTALLATION

A. Restrained Joint Ductile Iron Pipe:

1. Provide restrained joint ductile iron pipe as shown in the Drawings. Include detailed laying schedule.

2. Field cutting of restrained joint pipe not allowed.

   a. Exceptions: Locations that utilize a "field cut" restrained joint end kit as provided and recommended by pipe manufacturer and shown in the Drawings.

3. Protect restraining mechanisms, tie rods, clamps or other components of dissimilar metal against corrosion by hand application of a suitable coating or by encasement of entire assembly with polyethylene film in accordance with ANSI/AWWA C105.

B. Concrete Thrust Blocks:

1. Place concrete thrust blocks at bends, tees and dead ends against undisturbed soil.

2. Location and Size: As shown in the Drawings.

3.06 HDPE PIPE INSTALLATION

A. Location: As shown in the Drawings. Install pipe to the lines and grades shown in the Drawings.

B. The Contractor shall use the proper tools and equipment necessary to safely install the high-density polyethylene (HDPE) pipe and fittings. The installation shall be in conformance with the manufacturer's requirements and instructions.

C. HDPE pipe and fittings shall be assembled in the field with butt fusion joints. ASTM F 2620 and the pipe manufacturer's recommended procedure shall be observed for butt fusion joints.

D. Butt fusion joints shall be made by qualified fusion technicians.

1. Each fusion technician shall be separately qualified to make a butt fusion joint.

E. Butt fusion machines shall incorporate the following properties, including the following elements:

1. Heat Plate:

a. Heat plates and the non-stick coatings on heating surfaces shall be in good condition without gouges or scratches in the heating surfaces.

b. The non-stick coating shall be intact and free of any contamination.

c. Heater controls and temperature indicators shall function properly, and electrical cords and connections shall be in good condition.

d. The heat plate shall maintain a uniform and consistent temperature on all areas of the heating surfaces on both sides of the heat plate.

2. Carriage:

a. Carriage shall travel smoothly with no binding at less than 50 psi for hydraulic fusion machines.

b. Clamps shall be in good condition with proper inserts for the pipe size being fused.

F. If required by the Section 01 10 00 - Special Provisions, a data logger shall be provided on the fusion machine and fusion reports for each butt fusion joint performed on the project, including joints that were rejected shall be provided. The joint technician's joint report shall include:

1. Pipe or fitting size, DR, and pressure rating
2. Fusion equipment size and identification
3. Fusion technician identification
4. Job identification number and fusion number
5. Fusion joining parameters
6. Ambient temperature

G. The following equipment shall be required during fusion:

1. Pipe rollers shall be used to support pipe to either side of the butt fusion machine to provide vertical and lateral pipe alignment through the butt fusions machine.

2. A protective enclosure that provides for full machine motion of the clamps, heat plate, fusion assembly and carriage shall be provided during fusion in inclement and/or windy weather. Pipe ends shall be covered or blocked where open pipe ends could allow prevailing winds to blow through the pipe.

H. Horizontal directional drilling of HDPE pipe shall conform to ASTM D2321 and pipe manufacturer's recommendations.

3.07 BORING WITH CASING PIPE

A. Location: As shown in the Drawings and indicated in any special permit.

B. Refer to permit:

1. Boring under federal and state highways shall be done in strict compliance with all conditions of the permit, including but not limited to:

a. State Department of Roads or Transportation policy for utility crossings of highways and primary road systems.

b. Any other local standards that apply in the project area.

2. Boring under railroad tracks shall be shall be done in strict compliance with all conditions of the railroad permit.

3. Refer to permit provided by governmental (County or Municipal) agency. Boring shall be done in strict compliance with all conditions of the permit.

C. Encase water mains and service lines that cross roadways from toe of fill slope to toe of fill slope or as shown in the Drawings.

D. Pits for boring, tunneling or jacking not permitted closer to roadway than toe of fill slope or toe of foreslope in rural areas or 2 feet back of curb in urban sections or as shown in the Drawings.

E. Installation of casing and pipe accomplished by boring, tunneling or jacking methods.

1. Use of water under pressure (jetting) or puddling not permitted.

2. Water used to lubricate cutter and pipe, with Engineer approval, considered as dry boring.

F. Boring or tunneling operation, including location of bore pit, shall be conducted in a manner which is not detrimental to the roadway being crossed.

G. Take prompt remedial action when excessive voids or oversized bored holes are produced by filling the bore with concrete or pressurized grout and beginning a new bore hole. Obtain approval of Engineer prior to abandoning a completed bored or tunneled hole unless safety is an immediate concern.

H. Bore hole diameter for casing pipe shall not to exceed the casing pipe diameter by more than 1 1/2 inches for casing pipe having inside diameter of 12 inches or less.

I. Bore hole diameter for casing pipe shall not to exceed the casing pipe diameter by more than 2 inches for casing pipe having inside diameter of greater than 12 inches.

J. Install water main 4 inches or greater in diameter through casing pipe using casing chocks strapped to the pipe and large enough to provide clearance between casing and pipe couplings.

1. Follow manufacturer's recommendations, minimum.

2. Spacing of Chocks:

a. Maximum 10-foot centers for ductile iron pipe.

b. Maximum 6-foot centers for PVC pipe.

c. or as shown in the Drawings.

K. Leave space between carrier pipe and casing open.

L. Seal annular space at end of casing with synthetic rubber end seal with stainless bands.

M. Backfill bore pit:

1. See Section 31 23 33 – Trenching for Utilities.

2. Backfill over-excavated areas around the casing with compacted clean aggregate or rock.

3. Backfill Compaction Density for Bore Pit: Per the geotechnical report or at least 95 percent of maximum dry density, Standard Proctor, if geotechnical report unavailable.

3.08 DRY BORING

A. Location: As shown in the Drawings.

B. Use of water under pressure (jetting) or puddling not permitted.

C. Water used to lubricate cutter, with Engineer approval, considered as dry boring.

D. Hole diameter for water main not to exceed outside diameter of bell or coupling plus 2 inches for pipe having inside diameter of 4 inches or less.

E. Hole diameter for water main not to exceed outside diameter of bell or coupling plus 4 inches for pipe having inside diameter of more than 4 inches.

F. Where unstable soil conditions exist, conduct boring operation in a manner which is not detrimental to adjacent features or structures.

G. Take prompt remedial action when excessive voids or oversize bored hole is produced or when abandoning a bored hole. Obtain approval of Engineer prior to taking action.

H. Pressure grout all voids or abandoned holes caused by boring or jacking.

I. Backfill bore pit:

1. See Section 31 23 33 – Trenching for Utilities.
2. Backfill over-excavated areas with compacted clean aggregate or rock.
3. Backfill Compaction Density for Bore Pit: Per the Geotechnical Report or at least 95 percent of maximum dry density, Standard Proctor, if Geotechnical Report is unavailable.

3.09 DIRECTIONAL BORING

A. Location: As shown in the Drawings. Install pipe to the lines and grades shown in the Drawings.

B. In situations that are shown as open-cut in the drawings, deviations from the design profile may be cause for rejection of directional drilling as a proposed method of construction.

C. Examination of Site:

1. Verify horizontal and vertical alignment.
2. Review geotechnical report.
3. Verify depth and location of sewer lines and other utilities.
4. Notify Engineer immediately of any observations affecting the work.

D. Diameter of bore hole only large enough to properly install water pipe without causing excessive stress on pipe.

E. Do not exceed maximum bending radius of pipe as given by manufacturer.

F. If required by the Section 01 10 00 - Special Provisions, Contractor to plot the actual installed horizontal and vertical alignment of the pilot bore at intervals not to exceed 50 feet. Such data shall be provided with the as-built drawings.

3.10 HYDROSTATIC TEST

A. General:

1. Hydrostatic testing of water main(s) shall be conducted prior to disinfection and bacteriological testing of the water main(s).
2. Perform Hydrostatic Pressure Testing of piping and appurtenances in accordance with AWWA C 600 or C 605.
   a. Test against closed hydrant, with hydrant auxiliary valve open.

b. Test performed simultaneously with initial disinfection and flushing.

B. Preparation:

1. Slowly fill pipeline with clean potable water.

2. Water used for filling may be supplied from a direct connection to the existing water distribution system, where only unidirectional flow into the new pipeline is possible, or alternate method approved by the Engineer unless additional measures are required in the Special Provisions.

3. Expel air from system. Extreme care must be taken to ensure that all air is expelled from the pipeline before testing. This may require several cycles of pressurizing and bleeding the trapped air, prior to beginning the test.

a. Open air valve(s) to release air and close air valves prior to testing.

b. Install corporation stops at high points, as necessary, and open to release air. Close corporation stops, prior to beginning the test.

(1) Owner's option after testing completed and accepted: Remove corporation stop and install plug, or leave corporation stop in place and cap.

c. The pipeline should stand full of water for at least 24 hours prior to conducting the hydrostatic test, to allow air to escape.

C. Test:

1. Test Pressure: 150 psi or as directed by Engineer.

a. The pressure applied at the test site shall be the pressure necessary to create the specified test pressure at the lowest point along the section of the pipeline being tested. The pressure applied at the test site shall be determined based on the specified test pressure, and the relative elevation of the lowest point along the section of pipeline being tested and the elevation of the test gage.

b. Test pressure shall not be less than 1.25 times the working pressure at highest point of test section. (Working pressure is the anticipated maximum sustained operating pressure.)

c. Test pressure shall not be less than 1.50 times the working pressure at lowest point of test section. (Working pressure is the anticipated maximum sustained operating pressure.)

d. Test pressure shall not exceed 1.5 times the pressure rating of the pipe (as specified by the manufacturer).

e. Test pressure shall not exceed the rated working pressure of the valves, fittings and appurtenances, or the thrust restraint design pressure.

f. The pipeline shall be allowed to stabilize at the test pressure before conducting the hydrostatic test.

2. Minimum Test Period: 2 hours.

3. Testing Allowance:

a. Testing allowance is the maximum quantity of makeup water that is added into the section of the pipeline undergoing hydrostatic testing, in

order to maintain pressure within +/- 5 psi of specified test pressure throughout the test period.

b. No pipe installation will be accepted, if the quantity of makeup water is greater than that determined by the following formula.

(1) $Q = LD \times \sqrt{P}$ divided by 148,000 where

Q = Quantity of makeup water, in gallons per hour

L = Length of pipe section being tested, in feet

D = Nominal diameter of the pipe, in inches

P = Average test pressure during the hydrostatic test, in pounds per square inch (gauge)

$\sqrt{P}$ means the square root of P

D. Replace damaged or defective pipe, fittings, hydrants, appurtenances or joints that are discovered during or following the test.

E. Completion of Hydrostatic Test:

1. If the quantity of makeup water is less than the testing allowance, as stated above, the Hydrostatic Test for the section of the pipeline being tested passes.

2. If the quantity of makeup water is greater than the testing allowance, as stated above, the Hydrostatic Test for the section of the pipeline being tested fails.

a. Locate and repair all leaks.

b. Repeat Hydrostatic Test, until satisfactory results are obtained.

3.11 CLEANING AND FLUSHING OF PIPING AND APPURTENANCES

A. Cleaning:

1. Prior to assembly and installation, thoroughly clean interior of each piece of pipe, hydrant and fitting.

2. Keep interior clean at all times.

3. If dirt enters the pipe, it shall be removed and the interior of the pipe washed with a 1 percent, minimum, free chlorine residual water.

a. If in the opinion of the Owner and Engineer, the pipe cannot be thoroughly cleaned using flushing operations, the interior of the pipe shall be cleaned using mechanical means (i.e. foam pig) along with a chlorine solution.

4. If the installed pipe is flooded during construction, the floodwater shall be drained and the exposed piping shall be filled with a 25 mg/L, minimum, free chlorine residual water and held for a minimum of 24 hours. The chlorinated water shall be drained or flushed and regular flushing and disinfection practices outlined in these Specifications shall be resumed through the course of construction.

B. Final Filling and Flushing:

1. The Owner will provide sufficient volume of potable water from the active distribution system for the minimum required filling and flushing activities required by these Specifications at no additional cost to the Contractor.

a. Refer to Section 01 10 00 – Special Provisions for any costs to the Contractor for additional water.

2. Obtain approval of Owner and Engineer prior to discharging flushed water into storm sewer or natural waterway.

3. Use flushing methods that prevent damage to private and public property.

4. Hydrants may be used for flushing.

5. Minimum Flushing Velocity: 3.0 feet per second (fps) unless otherwise approved by the Engineer. The following table outlines the minimum flows required for various pipe sizes to achieve the minimum velocity.

Pipe Size	Flow @ 3.0 fps. Velocity
(inches)	(gal/min)
4	120
6	260
8	470
10	730
12	1,060
16	1,880

6. Flush a minimum of 5 times the volume of the applicable water main.

3.12 DISINFECTION

A. Refer to Section 33 13 00 – Disinfection of Water Distribution System.

3.13 CHLORINATED WATER DISCHARGE

A. Refer to Section 33 13 00 – Disinfection of Water Distribution System.

3.14 BACTERIOLOGICAL and/or E-COLI TESTING

A. Refer to Section 33 13 00 – Disinfection of Water Distribution System.

3.15 CONNECTION TO EXISTING WATER MAIN

A. General:

1. Location: As shown in the Drawings.

2. Coordinate connection location with Owner and Engineer.

3. Coordinate time and date for connection with Owner and Engineer.

4. Obtain permission from Owner prior to operating controls and/or valves.

5. All salvaged valves and fittings to be salvaged and delivered to Owner.

6. Minimize shutoff time of existing water distribution system.

7. Disinfect new fittings and piping prior to installation.

B. Water mains and appurtenances shall be completely installed, flushed, disinfected and satisfactory bacteriological samples received prior to permanent connections made to the active distribution system.

C. Connections Equal to or Less Than 20 Feet in Length: New pipe, fittings and valves shall be spray or swab disinfected with a 1 percent, minimum, free chlorine solution immediately before being installed.

D. Connections Greater Than 20 Feet in Length: New pipe, fittings and valves shall be setup, disinfected, and bacteriological samples taken prior to the connection being connected to the active distribution system.

3.16 SERVICE LINES

A. General:

1. Extend new service line from corporation stop on water main to new or existing curb stop or as shown in the Drawings or details.

B. Service Taps:

1. Made in conformance with AWWA C600 or AWWA C605 at location shown in the Drawings.
2. Use service line saddle.
3. Locate 45 degrees to top of pipe.
4. Follow manufacturer's recommendations.
5. Inspected by Owner's representative prior to backfilling.

C. Service Line:

1. Depth of Cover: Minimum 5.5 feet or as specified in Section 01 10 00 – Special Provisions or as shown in the Drawings.
2. Minimum 2-foot separation between structures open to weather and service line (i.e. storm sewer pipe).
3. Deviations in Depth of Cover and/or Minimum Separation: Notify Engineer immediately of any deviation in depth or alignment. Make changes as directed by Engineer.

D. Curb Stops and Boxes:

1. Install at locations shown in the Drawings.
2. Follow manufacturer's recommendations.

E. Leakage:

1. Locate and repair all visible leaks.
2. Replace damaged and defective pipe, fittings, valves or joints.

F. Maintenance of Service to Customers:

1. Keep disruption of service at maximum of 1 hour.
2. Provide temporary connection if necessary.
3. Do not abandon, disconnect or discontinue an existing water service for greater than one hour, until customer is connected to temporary or permanent service line.
4. Provide Owner and Engineer with service connection schedule.
5. Notify service customer 24 hours in advance of making connection to curb stop.

G. Connection of New Water Service Inside of House or Building:

1. Contractor to coordinate this connection with the Owner and property owner.

2. Connection of new service line to existing plumbing inside of the house or building will be done by a Licensed Plumber.

3.17 FIELD QUALITY CONTROL

A. If tests indicate work does not meet specified requirements, remove defective materials/work and replace and retest; and/or take necessary remedial action and retest, all at no cost to Owner.

B. See Geotechnical Report.

C. Compaction density testing shall be performed on compacted fill in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 6938.

1. Results shall be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 "standard proctor", ASTM D 1557 "modified proctor" or AASHTO T 180.

2. Frequency of Backfill Compaction Tests:

a. Under Paving, Slabs-on-Grade and Similar Construction:

(1) 2 tests per 150 linear feet of main line, test lower portion and test upper portion of trench or as determined by Engineer.

(2) 1 test of each service line or as determined by Engineer

b. Nonpaved Area:

(1) 2 tests per 300 linear feet of main line, test lower portion and test upper portion of trench or as determined by Engineer.

(2) 1 test of each service line or as determined by Engineer.

D. Perform hydrostatic test at Contractor's expense.

1. If tests indicate work does not meet specified requirements, remove defective materials/work and replace and retest; and/or take necessary remedial action and retest, all at no cost to Owner.

E. Perform bacteriological and/or E-Coli test at Contractor's expense.

1. See Section 33 13 00 – Disinfection of Water Distribution System.

2. If tests indicate work does not meet specified requirements, remove defective materials/work and replace and retest; and/or take necessary remedial action and retest, all at no cost to Owner.

F. Tracer Wire Test:

1. If tracer wire installed, Contractor shall perform a continuity test on all tracer wire prior to the acceptance of the water system. This test may be performed by either hiring an acceptable underground utility locating firm to physically locate the tracer wire in the presence of a representative of Owner or via low voltage circuit completed with the use of a suitable voltage source and meter to ensure continuity of the tracer wire.

2. In the event that continuity cannot be demonstrated or difficulties with the locating or continuity test arise, the cause shall be isolated and corrected. Thereafter, the section in which the defective test occurred shall be retested as a unit and continuity of that section confirmed.

END OF SECTION

SECTION 33 12 16

BURIED WATER AND SEWER MAIN VALVES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Valves.

B. Air release valves.

C. Disinfection.

D. Thrust restraints.

1.02 REFERENCES

A. ANSI/AWWA C 104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.

B. ANSI/AWWA C 105 – Polyethylene Encasement for Ductile-Iron Pipe Systems.

C. ANSI/AWWA C 110 – Ductile-Iron and Gray-Iron Fittings.

D. ANSI/AWWA C 111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

E. ANSI/AWWA C 504 – Rubber-Seated Butterfly Valves.

F. AWWA C 508 – Swing-Check Valves for Waterworks Service, 2 inch through 24 inch (50-mm Through 600-mm) NPS.

G. ANSI/AWWA C 509 – Resilient-Seated Gate Valves for Water Supply Service.

H. ANSI/AWWA C 512 – Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.

I. ANSI/AWWA C 517 – Resilient-Seated Cast-Iron Eccentric Plug Valves

J. ANSI/AWWA C 550 – Protective Interior Coatings for Valves and Hydrants.

K. ANSI/AWWA C 600 – Installation of Ductile-Iron Water Mains and Their Appurtenances.

L. ANSI/AWWA C 605 – Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings.

M. ANSI/AWWA C 651 – Disinfecting Water Mains.

N. ASTM D 698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))

O. ASTM D 1556 – Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method

P. ASTM D 1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))

Q. ASTM D 2167 – Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method

R. ASTM D 6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

S. AASHTO T 180 – Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

T. Recommended Standards for Water Works, latest edition (aka 10 States Standards) by Great Lakes-Upper Mississippi River Board of State Public Health and Environmental Managers

1.03 UNIT PRICES

A. Valves with Valve Boxes:

1. Method of Measurement and Pay Unit: By the unit (Each) for each respective size and type of valve shown on the bid form.

2. Includes excavation, hand trimming excavation, valve, bedding, thrust restraints, concrete for base and thrust restraints, backfilling and compaction of backfill, valve box, valve box adapter, concrete valve box collar, testing and incidentals thereto.

B. Air-Release, Vacuum and Combination Valves:

1. Method of Measurement and Pay Unit: By the unit (Each) for each respective size and type of air valve.

2. Water Air Valve: Includes excavation, hand trimming excavation, bedding, backfilling and compaction of backfill, connection to pipe, air valve, supply valve and air valve structure or manhole, assembly, testing and incidentals thereto, as shown in the Drawings.

3. Sewer Air Valve: Includes excavation, hand trimming excavation, bedding, backfilling and compaction of backfill, connection to pipe, air valve, inlet and outlet shut off valves, coupling, hose, air valve structure or manhole, assembly, testing and incidentals thereto, as shown in the Drawings.

C. Polyethylene Encasement:

1. Polyethylene encasement of ductile iron valves is considered to be a subsidiary item included in the cost of items for which payment is made.

D. Tracer Wire, Marker Post and Appurtenances:

1. Tracer wire, pedestals, maker posts, mounting stakes, decals and installation and testing are considered to be subsidiary items to and included in the cost of items for which payment is made.

E. Reinforced Concrete Valve Box Collar, as shown in the Drawings:

1. Considered to be a subsidiary item included in the cost of valve for which payment is made.

F. Valve Box Adaptor:

1. Considered to be a subsidiary item included in the cost of valve for which payment is made.

G. Disinfection:

1. Considered to be a subsidiary item included in the cost of valve for which payment is made.

H. Testing and Cleaning:

1. Considered to be a subsidiary item included in the cost of the item for which payment is made.

I. Bacteriological and/or E-Coli Testing:

1. Considered to be a subsidiary item included in the cost of valve for which payment is made.

J. Dewatering:

1. Considered to be a subsidiary item included in the cost of valve for which payment is made.

K. Bedding:

1. Considered to be a subsidiary item included in the cost of the item for which payment is made.

1.04 SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Submit the following as appropriate for each valve and air valve provided:

1. Outline and installation drawings for equipment and fixtures furnished.
2. Equipment performance data and operating characteristics.
3. Manufacturer's data for valve, air valves and accessories.
   a. Supply catalog data, including illustrations and a parts list that identifies the materials used for various parts.
   b. The information shall be in sufficient detail to serve as a guide in the assembly and disassembly of the valve and for ordering repair parts.
4. Manufacturer's catalog data marked to indicate materials being furnished are a standard equipment, fixtures, specialties and accessories.

C. Project Record Documents:

1. Record the location of valves.
   a. Provide Engineer with a minimum of 3 distance ties from the valve to permanent topographical feature (trees, buildings, fire hydrants, etc.).
   b. Provide Engineer with GPS Coordinates, if required, see Section 01 10 00 – Special Provisions.
2. Identify, describe and record the discovery of variations in subsoil conditions, and provide copy of record to Engineer.
3. Identify, describe and record the discovery of uncharted utilities, and provide copy of record to Engineer.
4. Backfill Compaction Test; provide copy of Test Records to Engineer

1.05 QUALITY ASSURANCE

A. All products are required to meet applicable AWWA requirements, ANSI/NSF 61 and the requirements of the Safe Drinking Water Act.

B. Marking: Manufacturer's name or mark, size and pressure class/rating marked on valve body/cover.

1.06 REGULATORY REQUIREMENTS

A. Conform to all applicable local, state and federal code for materials and installation of the work of this section. Perform work in accordance with standards of authorities having jurisdiction over system piping and appurtenances. Includes materials, installation, testing and disinfection, if applicable

B. If installed in a potable water system, bacteriological water quality sampling and testing in accordance with AWWA C 600 or C 605 and AWWA C 651 and in compliance with the rules and regulations of the authority having jurisdiction for potable water system piping.

1. Bacteriological water quality analysis shall be performed by a state approved laboratory.

C. If installed in a wastewater system, conform to all applicable state, federal and local codes of authorities having jurisdiction for wastewater piping. Includes materials, installation and testing.

1.07 PROJECT CONDITIONS

A. Verify that survey control points for alignment and elevation are as indicated in the Drawings.

B. Research public utility records and verify location of existing utilities.

1. Contact utility locating service for project area.

2. Comply with applicable “ONE CALL” requirements.

C. Provide exploratory excavation to determine exact location of existing underground structures or utilities. Notify Engineer immediately if a discrepancy or conflict is identified.

D. Protect plants, lawns, trees, and other amenities and features; which are to remain, as shown in the Drawings, from damage by equipment, vehicular traffic and other construction related activities.

E. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, curbs, utility pedestals and lines and amenities that are to remain from damage by excavating equipment, vehicular traffic and other construction related activities.

F. Verify that valve can be installed as shown in the Drawings and to reference standards.

G. Coordinate with the installation of piping and/or other facilities as shown in the Drawings.

1.08 DELIVERY, STORAGE AND HANDLING

A. Preparation for Storage:

1. Ensure that valves are dry and internally protected against rust and corrosion.

2. Protect actuator and end joints.

3. Set valves in best position for handling.

4. Set valves closed to prevent rattling.

B. During Storage:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.

2. Protect from weather:

a. Protect stored valves and accessories from moisture and dirt.

b. Store indoors and maintain temperature higher than ambient dew point temperature, where possible.

c. When outdoor storage is necessary, support valve off the ground or pavement in watertight enclosures.

C. Handling:

1. Use sling to lift valves where size requires handling by crane or other equipment. End hooks not allowed

a. Rig valves to avoid damage to exposed valve parts.

b. Do not use actuator or stem as lifting or rigging points.

2. Deliver to trench in sound, clean and undamaged condition.
3. Protect valves and appurtenances from moisture and dirt during handling.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS/PRODUCTS

A. All products installed in a potable water system shall meet NSF 61 requirements.

B. All valves and accessories shall meet all applicable AWWA requirements.

2.02 VALVES

A. Gate Valves:

1. Meeting requirements of ANSI/AWWA C509.
2. All valves by same manufacturer.
3. Resilient-seated type
4. Nonrising stem
5. Body: Cast Iron or Ductile Iron meeting ASTM A126 standards.
6. Nuts and Bolts: Type 304 stainless steel meeting ASTM A240 standards.
7. Valve Ends: Mechanical joint meeting ANSI/AWWA C110 and C111.
8. Actuator:
   a. Manually driven 2-inch square nut for buried service.
   b. Valve shall open by turning the operator counter clockwise.
9. Coating: ANSI/AWWA C550 epoxy coating; inside and outside of body, bonnet and stuffing box.
10. Pressure Rating: 200 psi for 3 through 12 inch, 150 psi for 16 through 30 inch.

B. Butterfly Valves:

1. Meeting requirements of ANSI/AWWA C504, sized for bi-directional water service.
2. All valves by same manufacturer.
3. Body: Cast Iron meeting ASTM A126 standards or Ductile Iron meeting ASTM A536 standards.
4. Valve Ends: Mechanical joint meeting ANSI/AWWA C110 and C111.
5. Disc:
   a. Cast Iron meeting ASTM A126 standards or Ductile Iron meeting ASTM A536 standards, with a 316 stainless steel edge.
   b. Discs shall be secured to the shaft by stainless steel pins, which extend through the full diameter of the shaft to withstand the specified line pressure up to valve rating and the torque required to operate the valve.
   c. Disc stops located in the flow stream are not allowed.
6. Seats: Synthetic rubber compound, mechanically retained to the body.
7. Nuts and Bolts: Type 304 stainless steel meeting ASTM A240 standards.
8. Stem: Type 304 stainless steel meeting ASTM A240 standards, turned, ground, and polished.

9. Stem Seals: standard self-adjusting "V" type packing. Packing material shall be suitable for use in high temperature air piping. "O" ring and "U" cup packing is not allowed.

10. Operator:

    a. Manually driven encased worm gear with 2-inch square nut for buried service.

    b. Valve shall open by turning the operator counter clockwise.

11. Coating: ANSI/AWWA C550 epoxy coating; inside and outside of body.

12. Pressure Rating Class: 150 psi, minimum (Class 150B).

C. Plug Valves:

1. Meeting requirements of ANSI/AWWA C517.

2. All valves by same manufacturer.

3. Body:

    a. Cast Iron meeting ASTM A126 standards or Ductile Iron meeting ASTM A536 standards.

    b. Port Size of not less than 100 % of pipe area.

4. Valve Ends: Mechanical joint meeting ANSI/AWWA C110 and C111.

5. Nuts and Bolts: Type 304 stainless steel meeting ASTM A240 standards.

6. Operator:

    a. Manually driven encased worm gear with 2-inch square nut for buried service.

    b. Valve shall open by turning the operator counter clockwise.

7. Coating: ANSI/AWWA C550 epoxy coating; outside of body.

8. Minimum Design Pressure Rating:

    a. 175 psi for valves 12” and smaller.

    b. 150 psi for valves 14” and larger

D. Buried valves shall be encased in Polyethylene per ANSI/AWWA C105.

2.03 VALVE BOXES:

A. Cast iron base, center and top sections; screw type adjustment.

B. Base: Standard or oval as required for valve.

C. Top Section: Drop lid marked "WATER" for water mains or “SEWER” for sewer force main.

2.04 VALVE BOX ADAPTER:

A. The valve box adapter shall permanently align the valve with the valve box assembly preventing shifting and settling of the valve box assembly.

B. The valve box adapter shall center the valve box over the operating nut.

C. The valve box adapter shall be polyester powder coated steel or rubber to provide corrosion protection.

D. The adapter shall be available in various sizes designed to accurately align a valve box assembly.

E. The adapter shall be manufactured to fit the various valve manufacturers’ products.

2.05 COMBINATION AIR VALVES – WATER

A. The Drinking Water Combination Air Valve shall perform the functions of both Air Release and Air/Vacuum Valves and furnished as a single body or dual body type, and be designed for operation in a drinking water system.

1. Valves shall be manufactured and tested in accordance with American Water Works Association (AWWA) Standard C512 certified to NSF/ANSI 61 Drinking Water System Components – Health Effects.

2. The valve shall be an automatic float operated valve designed to exhaust large quantities of air during the filling of a piping system and close upon liquid entry, without spilling.

3. The valve shall open during or if a negative pressure occurs. The valve shall also release accumulated air from a piping system while the system is in operation and under pressure.

4. All valves installed shall include an inflow preventer to prevent the introduction of contaminated water through air valve outlet. The inflow preventer shall allow the admittance and exhausting of air while preventing contaminated water from entering during normal operational conditions. The inflow preventer shall be flow tested by an independent third party to certify performance.

B. The valve body and cover shall be constructed of cast iron, ductile iron or polyethylene.

1. Cast or ductile iron valve interiors and exteriors shall be coated with an NSF/ANSI 61 certified fusion bonded epoxy in accordance with AWWA C550.

C. Valves 3 inch and smaller shall be threaded with NPT inlets and outlets. Larger valves shall be provided with flanged ends.

1. The valve shall be mounted on a vertical riser with ball, plug, or gate isolation valve prior to the inlet as shown on the Drawings.

D. Resilient seats shall be replaceable and provide drip tight shut off to the full valve pressure rating.

E. The float and guide shaft shall be constructed of stainless steel or equal.

1. Floats shall be unconditionally guaranteed against failure, including pressure surges.

F. Pressure Rating: Working pressures up to 250 psig.

G. Polyethylene Encasement: AWWA C105, if buried.

H. Includes fittings, couplings and incidentals thereto.

2.06 COMBINATION AIR VALVES - SEWER

A. The Sewage Combination Air Valve shall perform the functions of both Air Release and Air/Vacuum Valves and furnished as a single body type, and be designed for operation in a sewage system. Dual body types shall only be permitted if shown in the Drawings and/or included in Section 01 10 00 – Special Provisions.

1. Valves shall be manufactured and tested in accordance with American Water Works Association (AWWA) Standard C512 certified to NSF/ANSI 61 Drinking Water System Components – Health Effects.

2. The valve shall be an automatic float operated valve designed to exhaust large quantities of air during the filling of a piping system and close upon liquid entry, without spilling.

3. The valve shall open during or if a negative pressure occurs. The valve shall also release accumulated air from a piping system while the system is in operation and under pressure.

B. The valve body and cover shall be constructed of cast iron, ductile iron or polyethylene.

C. Valves 3 inch and smaller shall be threaded with NPT inlets and outlets. Larger valves shall be provided with flanged ends.

1. The valve shall be mounted on a vertical riser with ball, plug, or gate isolation valve prior to the inlet as shown on the Drawings.

D. Resilient seats shall be replaceable and provide drip tight shut off to the full valve pressure rating.

E. The float and guide shaft shall be constructed of stainless steel or equal.

1. Floats shall be unconditionally guaranteed against failure, including pressure surges.

F. The body shall have 2" NPT cleanout and 1" NPT drain connection for manual drainage outlet on the side of the body.

G. Inlet and blow off valves, quick disconnect couplings and minimum 5' hose for flushing shall be provided.

H. Pressure Rating: Working pressures up to 250 psig.

I. Polyethylene Encasement: AWWA C105, if buried.

J. Includes fittings, couplings and incidentals thereto.

2.07 TRACER WIRE

A. Wire: No. 12 AWG solid copper conductor with type THHN insulation or No. 12 AWG copper clad steel conductor with HDPE jacket.

B. Splices: Splicing shall be made with 3M DB type direct bury wire splice kits, sized appropriate to the number and size of wires connected.

C. Incidentals: Terminal box, pedestal box or duplex box - see detail sheet and Section 01 1000 - Special Provisions.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that trench cut and excavation base are ready to receive work and that the location and elevation is as indicated.

B. Verify that water main size, location and invert are as indicated.

C. Verify depth and location of other buried utilities and structures in the area.

3.02 TRENCHING

A. Hand trim excavation for accurate placement of valves to elevations indicated.

B. Backfill around sides and to the top of valve body and tamp in place; and then backfill around sides and to the top of valve box in layers and compact to meet backfill compaction requirement.

C. Protect valve and appurtenances from damage and displacement while backfilling and compacting.

3.03 VALVE INSTALLATION

A. General:

1. Location: As shown in the Drawings.
2. Inspect valve for defects before completing installation.
3. Prior to assembly and installation, thoroughly clean interior of each valve.
4. Keep interior clean at all times.
5. Set valves on solid bearing.

B. Center and plumb valve box over valve:

1. Install valve box adapter.
2. Set box cover flush with finished grade.

C. Install valve and appurtenances in accordance with manufacturer's recommendations and AWWA C 600 (Ductile Iron) on AWWA C 605 (PVC).

D. Handling Pipe Valves and Appurtenances:

1. Use sling to lift valves where size requires handling by crane or other equipment.
   a. Rig valves to avoid damage to exposed valve parts.
   b. Do not use actuator or stem as lifting or rigging points.
2. Deliver to trench in sound, undamaged condition.
3. Use web slings. End hooks not allowed.

3.04 JOINING TO PIPE

A. Use methods recommended by manufacturer.

B. Use minimum amount of gasket lubricant necessary to allow safe and efficient assembly.

3.05 JOINT DEFLECTIONS

A. Do not exceed manufacturer's recommendations for type and size of valve and joint being used.

3.06 POLYETHYLENE ENCASEMENT

A. Wrap buried ductile iron valves and actuators with polyethylene encasement per ANSI/AWWA C 105.

B. Repair damaged areas of polyethylene encasements.

3.07 TRACER WIRE

A. Place tracer wire in trench adjacent to valve.

B. Terminate trace wire in terminal access boxes and/or pedestals as noted in the Specifications and shown in the Drawings.

3.08 DEPTH OF COVER

A. Minimum Depth of Cover: 5.5 feet unless noted otherwise in the Drawings. (Depth of cover is measured from top of pipe to finish grade elevation.)

3.09 PROTECTION OF VALVE INTERIOR

A. Clean valve interior of foreign material before lowering into trench.

B. Keep clean at all times.

C. Securely close open ends with watertight plugs during nonworking periods including:

1. When pipe laying is not in progress.
2. Nights.
3. Weekends.

3.10 DISINFECTION:

A. See Section 33 13 00 – Disinfection of Water Distribution System.

3.11 RESTRAINT

A. Restrained Joints:

1. Provide restrained joint fittings where indicated in the Drawings.

B. Thrust Restraint:

1. Mechanical Restraint:
   a. Threaded Rod: 3/4 inch diameter; stainless steel or corten.
   b. Nuts: Ductile iron, corten or stainless steel.
   c. Eye Bolts: 3/4 inch diameter, corten.
2. Concrete Thrust Block.

C. Protect restraining devices, threaded rods, clamps or other components of dissimilar metal against corrosion by hand application of a suitable coating or by encasement of entire assembly with polyethylene film in accordance with ANSI/AWWA C 105/A 21.5.

3.12 FIELD QUALITY CONTROL

A. General: If a test indicates that work does not meet specified requirements, remove defective materials/work and replace and retest; and/or take necessary remedial action and retest, all at no cost to Owner.

B. Compaction density testing shall be performed on compacted fill in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 6938.

1. Results shall be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 "standard proctor", ASTM D 1557 "modified proctor" or AASHTO T 180.
2. If tests indicate work does not meet specified requirements, remove defective materials/work and replace and retest; and/or take necessary remedial action and retest, all at no cost to Owner.

C. Perform hydrostatic test at Contractor's expense.

1. If tests indicate work does not meet specified requirements, remove defective materials/work and replace and retest; and/or take necessary remedial action and retest, all at no cost to Owner.

D. Perform disinfection and bacteriological and/or E-Coli tests at Contractor's expense.

1. See Section 33 13 00 – Disinfection of Water Distribution System.
2. If tests indicate work does not meet specified requirements, remove defective materials/work and replace and retest; and/or take necessary remedial action and retest, all at no cost to Owner.

END OF SECTION

SECTION 33 13 00

DISINFECTION OF WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Disinfection of waterline.

B. Testing and reporting.

1.02 REFERENCES

A. AWWA B300 – Hypochlorites.

B. AWWA B301 – Liquid Chlorine.

C. AWWA C651 – Disinfecting Water Mains.

D. Standard Methods for the Examination of Water and Wastewater (AWWA/WEF/APHA)

1.03 UNIT PRICES - MEASUREMENT AND PAYMENT

A. Disinfection of Potable Waterlines:

1. Separate payment for disinfection of potable waterlines and water wells will not be made. Disinfection is considered subsidiary to the work indicated in the project.

B. Bacteriological Testing of Potable Waterlines:

1. Separate payment for bacteriological testing of potable waterlines and water wells will not be made. Biological testing is considered subsidiary to the work included in the project.

1.04 SUBMITTALS

A. Disinfection Report, Record:

1. Type and form of disinfectant used.
2. Type and form of adhesive (if use).
3. Date and time of disinfectant injection start and time of completion.
4. Test locations.
5. Initial and 24-hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
6. Date and time of flushing start and completion.
7. Disinfectant residual after flushing in ppm for each outlet tested.

B. Bacteriological 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. Test results for each outlet tested.

7. Certification that water conforms, or failed to conform, to bacterial standards of State Regulatory Agency.
8. Bacteriologist's signature and authority.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with AWWA C 651.

B. Disinfection: Company with minimum of 3 years documented experience in disinfecting potable water systems.

C. Testing Firm: State Regulatory Agency laboratory or company specializing in testing potable water systems, certified and approved by the State Regulatory Agency for microbiological testing.

1.06 REGULATORY REQUIREMENTS

A. Conform to applicable State Regulatory Agency code or regulation for performing the work of this section.

B. Provide certificate of compliance from authority having jurisdiction, indicating approval of water system.

PART 2 - PRODUCTS

2.01 DISINFECTION CHEMICAL

A. ANSI/AWWA B300 – Hypochlorites:
1. Sodium hypochlorite solution.
2. Calcium hypochlorite granules.
3. Calcium hypochlorite tablets.

B. ANSI/AWWA B301 – Liquid Chlorine.

2.02 FOOD GRADE ADHESIVES

A. NSF/ANSI 61Compliant

B. Silco RTV 4500.

C. Approved equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that piping systems or water well has been cleaned, inspected and pressure tested.

B. Schedule disinfecting activity to coordinate with start-up, testing, adjusting and balancing, and demonstration procedures, including related systems.

3.02 GENERAL

A. Disinfection in accordance with ANSI/AWWA C651, latest edition.

B. Potable water shall be used from the existing distribution system or another source approved by the Engineer for disinfection, flushing and testing activities.

C. Filling and Flushing: Refer to Part 3 of Section 33 11 16 – Water Distribution. Eliminate air pockets and remove particulates from pipe to be disinfected and tested.

3.03 DISINFECTION

A. Continuous-Feed Method:

1. Preparation:

a. Flush line following procedures outlined in Part 3 of Section 33 11 16 – Water Distribution to eliminate air pockets and remove particulates.

2. Application of Chlorine Solution:

a. Fill line with potable water and chlorine solution at constant and measured rate at a tap, with corporation stop, within 10 feet downstream from beginning (upstream side) of the new main.

b. Constantly apply chlorine solution using one of the following methods:

(1) Liquid chlorine solution-feed, vacuum-operated chlorinator and booster pump.

(2) Liquid hypochlorite metered, chemical feed pump.

c. Direct-feed chlorinators which operate solely from gas pressure in chlorine cylinder are not allowed.

d. Chlorine solutions must have a minimum of 1% chlorine concentration prepared with sodium hypochlorite or calcium hypochlorite.

e. Pace the water and chlorine solution flow rates so water entering the new line will not have less than 25 mg/L available chlorine.

f. The amount of chlorine required for each 100 feet of pipe shall be as outlined in the following table.

Chlorine Solution Required to
Produce an Initial 25 mg/L Concentration
(per 100 feet of pipe)

Pipe Diameter (Inches)	100% Chlorine (lbs)	1% Chlorine Solution (gal)
4	0.013	0.16
6	0.030	0.36
8	0.054	0.65
10	0.085	1.02
12	0.120	1.44
16	0.217	2.60

g. Chlorine application shall not cease until the entire main is filled with chlorinated water.

B. Slug Method:

1. Preparation:

a. Flush line following procedures outlined in Part 3 of Section 33 11 16 – Water Distribution to eliminate air pockets and remove particulates.

2. Application of Chlorine Solution:

   a. Fill line with potable water and chlorine solution at constant and measured rate at a tap, with corporation stop, within 10 feet downstream from beginning (upstream side) of the new main.

   b. Constantly apply chlorine solution using the methods outlined for the Continuous Feed Method.

   c. Pace the water and chlorine solution flow rates so water entering the new line will not have less than 100 mg/L available chlorine.

   d. Chlorine shall be applied consistently to develop a solid slug of chlorinated water that will, as it moves through the main, expose all interior surfaces to approximately 100 mg/L concentration for 3 hours, minimum.

   e. The free chlorine concentration shall be measured at regular intervals, as the slug moves through the main, to provide consistent loading of the target chlorine concentration.

   f. If at any time the chlorine concentration drops below 75 mg/L, the flow shall be stopped and chlorination equipment shall be relocated to the head of the slug to restore the concentration of chlorine to a minimum of 100 mg/L.

   g. As the slug passes past fittings, hydrants, branches of the water main, etc.., related valves and hydrants shall be operated to disinfect those locations.

C. Tablet/Granular Method:

1. General:

   a. Need written permission of Engineer.

   b. Do not use on solvent-welded plastic or screwed-joint steel pipe.

   c. Use only if pipe and appurtenances have been kept clean and dry during construction.

   d. Use with calcium hypochlorite granules or tablets to give average chlorine does of 25 mg/L.

2. Placing Calcium Hypochlorite Granules (HTH):

   a. Place at upstream end of first section of pipe and each branch main.

   b. Place at 500-foot intervals thereafter.

c. The quantity of granules to be applied at each location shall be as outlined in the following table.

HTH Granules
(65% Available Chlorine by Weight)

Pipe Diameter (Inches)	(ounces)	(grams)
4	1.7	48
6	3.8	108
8	6.7	190
10	10.5	298
12	15.1	428
14 and larger	D^2 x 15.1	D^2 x 428

D = Inside pipe diameter in feet

3. Placing Calcium Hypochlorite Tablets (HTH):

a. Place 5-gram tablet(s) in the upstream end of each section of pipe.

b. At least one tablet shall be placed in each fire hydrant or flush hydrant lead pipe.

c. The quantity of tablets to be placed at each location shall be as outlined in the following table.

Number of 5 gram HTH Tablets
(65% Available Chlorine by Weight)

	Pipe Size									
Length of Pipe	4”	6”	8”	10”	12”	16”	20”	24”	30”	36”
13’	1	1	1	2	3	4	7	9	15	21
18’	1	1	2	3	4	6	9	13	20	28
20’	1	1	2	3	4	7	10	14	22	32
30’	1	2	3	4	6	10	15	21	33	47
40'	1	2	4	5	7	13	20	28	44	63

(Number of 5g tablets per pipe section = 0.0012 d^2 L rounded up, where d = Inside diameter of pipe in inches and L = length in feet.)

d. Attach tablets to inside, top of pipe of each length of pipe with NSF/ANSI 61 approved adhesive.

4. Filling Pipe:

a. Slowly fill pipe to ensure tablets do not come loose from pipe.

b. Keep the filling velocity to no greater than 1 foot per second. Refer to the following table as reference.

Pipe Size (Inches)	Flow (gpm) < 1 Ft/Sec. Velocity
4	< 40
6	< 85
8	< 155
10	< 245
12	< 350
14	< 480
16	< 625

c. Ensure that air pockets are eliminated.

D. Retention Time:

1. Maintain the chlorinated water in the piping for at least 24 hours.
2. If water temperature is less than 41 degrees F, allow treated water to stand for at least 48 hours.
3. Maintain minimum 10 mg/L free residual chlorine concentration during entire retention time.

E. Post-Disinfection Flushing:

1. Refer to Section 33 11 16 – Water Distribution.
2. Ascertain that heavily chlorinated water has been removed from waterline.
3. Chlorine concentration should be no higher than that generally maintained in the system or less than 1 mg/L.

3.04 CHLORINATED WATER DISCHARGE

A. Refer to ANSI/AWWA C655 – Field Dechlorination.

B. Contractor shall discharge/dispose of the chlorinated water resulting from the disinfection of the water improvements in an appropriate manner and in strict compliance with local, state and federal requirements for discharges to any storm drain, surface water, ditch or other waterway.

C. Do not discharge 'super-chlorinated' (concentration of 4 mg/L or higher) water directly to any storm sewer drain system, surface water or other waterway without permission of the Owner.

1. Super-chlorinated water may only be discharged after dechlorination by aeration, retention, dissipation, or chemical treatment using a portable dechlorinator to "no measurable chlorine" content.
2. Removal of any residual chlorine must be completed before any discharge into an environmentally sensitive area or surface water

D. If the discharge is to a ditch, at a minimum, all regulatory requirements and the following stipulations shall be complied with.

1. The water in the ditch(es) shall not have measurable residual chlorine within 1,000 feet of the point of discharge or at the point of entry into an environmentally sensitive area, surface water or other waterway, whichever distance is less.
2. Discharges shall not be toxic to vegetation or aquatic life in the ditch.

3.05 BACTERIOLOGICAL TESTS

A. Sample Collection Methods:
1. After final flushing and before new waterline is placed in service, fill line with potable water.
2. Install corporation stop on waterline with copper tube gooseneck assembly.
3. Bacteriological samples shall be analyzed for the presence of coliform bacteria.
   a. Samples shall be tested in accordance with Standard Methods for the Examination of Water and Wastewater.
   b. A passing sample is defined as results showing absence (zero presence) of coliform bacteria.
4. Contractor shall conduct bacteriological sample collection and testing in conformance with one of the following options:
   a. Collect 2 consecutive sets of samples at least 16 hours apart
   b. At the conclusion of flushing, allow the main to sit without water use for a minimum of 16 hours. After the minimum of 16 hours, two sets of samples shall be collected a minimum of 15 minutes apart while the sample taps are left running.

B. Location of Samples:
1. 1 set at end of each test section.
2. 1 set for every 1,200 feet.
3. 1 set at the end of each branch.
4. Others as directed by Engineer, as specified in Section 01 10 00 – Special Provisions or shown in the Drawings.

C. Sample Collection:
1. Collect samples in sterile bottles treated with sodium thiosulfate.
2. Do not take samples from hoses or fire hydrant.

D. Submit water samples to state regulatory agency laboratory or certified testing laboratory for bacteriological analysis.

E. Bacteriological Test Failure:
1. Repeat flushing and disinfection procedures.
2. Use continuous-feed method for disinfection.
3. Repeat bacteriological sampling and testing.

END OF SECTION

SECTION 33 31 00

SANITARY SEWER PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Sanitary sewer collection piping, fittings and accessories.

B. Sanitary sewer force main.

C. Sanitary sewer service.

D. Furnishing of material, labor and installation.

E. Testing of sanitary sewer lines.

F. Cleaning of sanitary sewer lines.

1.02 REFERENCES

A. ANSI/AWWA C 104 – Cement – Mortar Lining for Ductile – Iron Pipe and Fittings for Water.

B. ANSI/AWWA C 105 – Polyethylene encasement for Ductile – Iron Pipe Systems.

C. ANSI/AWWA C 110 – Ductile – Iron and Gray – Iron Fittings, for Water.

D. ANSI/AWWA C 111 – Rubber – Gasket Joints for Ductile – Iron Pressure Pipe and Fittings.

E. ANSI/AWWA C 150 – Thickness Design of Ductile – Iron Pipe.

F. ANSI/AWWA C 151 – Ductile – Iron Pipe, Centrifugally Cast, for Water.

G. ANSI/AWWA C 153 – Ductile – Iron Compact Fittings, for Water Service.

H. ANSI/AWWA C 512 – Air Release, Air/Valve and Combination Air Valves for Water Work Service.

I. ANSI/AWWA C 600 – Installation of Ductile – Iron Water Mains and Their Appurtenances.

J. ANSI/AWWA C 605 – Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.

K. ANSI/AWWA C 900 – Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch for Water.

L. ANSI/AWWA C 905 – Polyvinyl Chloride (PVC) for Pressure Pipe, 14 inch through 48 inch for Water for Water Transmission and Distribution.

M. ANSI/AWWA C 906 – Polyethylene (PE) Pressure Pipe and Fittings, 4 inch through 63 inch for Water Distribution and Transmission.

N. ANSI/AWWA C 909 – Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 inch through 24 inch for Water Distribution.

O. ASTM A 53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

P. ASTM A 139 – Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over).

Q. ASTM A 746 – Standard Specification for Ductile Iron Gravity Sewer Pipe.

R. ASTM C 12 – Standard Practice for Installing Vitrified Clay Pipe Lines.

S. ASTM C 425 – Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.

T. ASTM D 698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))

U. ASTM C 700 – Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.

V. ASTM C 1173 - Standard Specification for Flexible Transition Couplings for Underground Piping Systems

W. ASTM D 1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

X. ASTM D 1556 – Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.

Y. ASTM D 1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).

Z. ASTM D 1785 – Standard Specification for Poly(Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120.

AA. ASTM D 2167 – Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.

BB. ASTM D 2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

CC. ASTM D 2680 – Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping.

DD. ASTM D 2729 – Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

EE. ASTM D 6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

FF. ASTM D 3034 – Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

GG. ASTM D 3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR_PR) Based on Controlled Outside Diameter.

HH. ASTM D 3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

II. ASTM D 3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

JJ. ASTM D 6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

KK. ASTM F 477 – Standard Specification for Elastometic Seals (Gaskets) for Joining Plastic Pipe.

LL. ASTM F 679 – Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

MM. ASTM F 1336 – Standard Specification for Poly (Vinyl Chloride) (PVC) Gasketed Sewer Fittings.

NN. ASTM F 1417 – Standard Practice for Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low-Pressure Air.

OO. ASTM F 1962 – Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings.

PP. ASTM F 2164 - Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure

QQ. ASTM F 2206 - Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE).

RR. ASTM F 2620 - Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

SS. ASTM F 3154 - Standard Practice for Data Recording the Procedure used to Produce Heat Butt Fusion Joints in Plastic Piping Systems or Fittings.

TT. ASTM F 3190 - Standard Practice for Heat Fusion Equipment (HFE) Operator Qualification on Polyethylene (PE) and Polyamide (PA) Pipe and Fittings.

UU. UNI-B-06 – Uni-Bell PVC Pipe Association, Recommended Low-Pressure Air Testing of Installed Sewer Pipe

VV. AASHTO T 180 – Standard Method of Test for Moisture Density Relations of Soils Using 10-lb Rammer and an 18-in Drop

WW. Recommended Standards for Water Works, latest edition (aka 10 States Standards) by Great Lakes – Upper Mississippi River Board of State Public Health and Environmental Managers.

1.03 UNIT PRICES

A. Pipe:

1. Method of Measurement:

a. Measured along centerline of pipe, to the nearest foot.

b. No deduction for manhole or fitting installed in the line.

2. Pay Unit: By the linear foot (LF) for each respective size and type of pipe.

3. Includes excavation, hand trimming excavation, pipe, trace wire and test stations, thrust restraint rods and eye bolts, concrete thrust restraints, placement, assembly, bedding, backfilling and compaction of backfill, testing and incidentals thereto.

a. Testing includes:

(1) Deflection testing of flexible gravity sewer main pipe (PVC, PE, Etc.) using rigid ball or mandrel.

(2) Leakage testing, by low pressure air, of gravity sewer main pipe.

(3) Televised inspection of gravity sewer main pipe.

(4) Hydrostatic testing of pressure sewer pipe (Force Main Pipe).

(5) Alignment testing of gravity sewer main pipe.

(6) Compacted density testing of backfill.

(7) Concrete Compressive Strength Testing

(8) Trace Wire Testing

B. Fittings:

1. Method of Measurement and Pay Unit: By the unit (Each) for each respective size and type of fitting.

2. Includes excavation, hand trimming excavation, fitting, polyethylene encasement, thrust restraint rods and eye bolts, concrete thrust restraints, placement, assembly, bedding, backfilling and compaction of backfill, testing and incidentals thereto.

C. Retainer Gland:

1. Method of Measurement and Pay Unit: By the unit (Each) for each respective size and type of Retainer Gland.

2. Includes Retainer Gland placement, assembly, testing and incidentals thereto.

D. Special Pipe Fittings:

1. Method of Measurement and Pay Unit: By the unit (Each) for each respective size and type.

2. Includes excavation, hand trimming excavation, fitting, placement, assembly, bedding, backfilling and compaction of backfill, connection to pipe, testing and incidentals thereto.

E. Service Wye or Saddle:

1. Method of Measurement and Pay Unit: By the unit (Each) for each respective size and type.

2. Includes excavation, hand trimming excavation, wye or saddle, placement, assembly, bedding, backfilling and compaction of backfill, connection to pipe, testing and incidentals thereto.

F. Dry Boring and Jacking of Casing Pipe:

1. Method of Measurement: Measured along centerline of casing pipe, within the extents of the casing pipe shown in the Drawings. The length of the casing pipe considered for payment shall not be greater than the length shown in the

Drawings, unless the length of the casing pipe is increased at the direction of Engineer.

2. Pay Unit: By the linear foot (LF) for each respective size and type of casing pipe bored and jacked within the limits shown in the Drawings or as directed by Engineer.

3. Includes excavation of jacking pits, dry bore hole for casing pipe, removal of bored materials, jacking equipment, casing pipe and installation, chocks, installation of carrier pipe in casing pipe, casing end seal, backfilling and compaction of backfill, connection to pipe, testing and incidentals thereto.

4. Carrier Pipe: Installed within casing pipe, shall be measured and paid for separately.

G. Dry Boring Without Casing Pipe:

1. Method of Measurement: Measured along centerline of Dry Bore, within the extents of the dry bore shown in the Drawings. The length of the dry bore considered for payment shall not be greater than the length shown in the Drawings, unless the length of the dry bore is increased at the direction of Engineer.

2. Pay Unit: By the linear foot (LF) for each respective size of pipe installed by dry boring.

3. Includes excavation of boring pits, dry bore hole for pipe, removal of bored material, jacking equipment, installation of carrier pipe in bore hole, backfilling and compaction of backfill, connection to pipe, testing and incidentals thereto.

4. Carrier Pipe: Installed within dry bore, shall be measured and paid for separately.

H. Directional Boring Carrier Pipe:

1. Method of Measurement: Measured along centerline of directional boring, within the extents of the directional boring shown in the Drawings. Horizontal stationing along the centerline of alignments is based upon level line measurement and is used for measurement and payment. Actual pipe length is determined by the slope or curve on which the pipe is installed. No additional payment shall be made for variations in actual pipe length due to installation on slopes or curves.

2. The length of the directional boring considered for payment shall not be greater than the length shown in the Drawings, unless the length of the directional boring is increased at the direction of Engineer.

3. Pay Unit: By the linear foot (LF) for each respective size of pipe installed by directional boring.

4. Includes excavation, directional bore hole for pipe, trace wire and test stations, jacking equipment, carrier pipe and installation of carrier pipe, backfilling and compaction of backfill, connection to pipe, testing and incidentals thereto.

5. Carrier pipe will not be measured and paid for separately, but will be considered a subsidiary item included in the directional boring pay item.

I. Wet boring is not approved for this project.

J. Dewatering of Trench:

1. Dewatering, including intercepting and diverting site drainage and surface water flows away from excavations and trenches, and removing standing water from trench or excavation with a sump and pump shall be considered incidental and subsidiary to other items of work for which direct payment is made

a. Includes providing all permits required for the dewatering and paying all permit costs, pump, piping, wells and/or well points, dewatering equipment, assembly and disassembly, backfilling and compaction of backfill, energy cost and incidentals thereto.

2. Method of Measurement: (INCIDENTAL)

a. Unless otherwise specified in Section 01 10 00 – Special Provisions, measurement and separate payment for dewatering will not be made.

K. Polyethylene Encasement:

1. Polyethylene encasement of ductile or gray iron pipe and fitting is considered to be subsidiary to and included in the cost of the ductile iron, gray iron or other item for which payment is made.

L. Connection to Existing Sewer Main or Manhole:

1. Method of Measurement and Pay Unit: By the unit (Each).

2. Includes excavation, hand trimming excavation, bedding, backfilling and compaction of backfill, adapters, fittings, thrust restraints, couplings, coring the wall of the structure, sleeves, gaskets and incidentals thereto.

M. Connection to Existing Sewer Service:

1. Method of Measurement and Pay Unit: By the unit (Each).

2. Includes excavation, hand trimming excavation, bedding, backfilling and compaction of backfill, adapters, fittings, couplings, sleeves, gaskets and incidentals thereto.

N. Abandon Existing Sewer Main:

1. Method of Measurement and Pay Unit: By the unit (Each).

2. Includes excavation, hand trimming excavation, capping or plugging the existing main, concrete, fittings, backfilling and compaction of backfill, adapters, fittings, couplings, sleeves, gaskets and incidentals thereto.

O. Abandon Existing Sewer Service:

1. Method of Measurement and Pay Unit: By the unit (Each).

2. Includes excavation, hand trimming excavation, capping or plugging the existing service line, concrete, fittings, backfilling and compaction of backfill, adapters, fittings, couplings, sleeves, gaskets and incidentals thereto.

P. Bedding:

1. Considered to be a subsidiary item included in the cost of the item for which payment is made.

Q. Flexible Coupling:

1. Considered to be a subsidiary item included in the cost of the item for which payment is made.

R. Adapter:

1. Adapters for transition from one type of material to another are considered a subsidiary item included in the cost of the item for which payment is made.

S. Testing and Cleaning:

1. Considered to be a subsidiary item included in the cost of the item for which payment is made.

T. Thrust Restraint:

1. Thrust restraint rods and eye bolts and concrete thrust restraints are considered to be a subsidiary item included in the cost of the item for which payment is made.

U. Trace Wire, Trace Wire Terminal Access Box, Marker Post and Appurtenances:

1. Trace wire, trace wire test stations, trace wire terminal access boxes, marker posts with test station, mounting stakes, decals and installation and testing are considered to be subsidiary items to and included in the cost of the item for which payment is made.

V. TV Inspection:

1. Considered to be a subsidiary item included in the cost of the item for which payment is made.

1.04 DEFINITIONS

A. Bedding: Fill placed under, beside and directly over pipe prior to subsequent backfill operations, as shown in the Drawings.

1.05 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, service line materials, and accessories and appurtenances.

B. Bedding: Provide data on proposed bedding material.

C. Concrete: Provide concrete design mix data.

D. Manufacturer's Installation Instructions: Provide special procedures required to install products.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Project Record Documents:

1. Record location of pipe runs, connections, manholes, cleanouts, pipe fittings and invert elevations.

a. Provide Engineer with a minimum of 3 distance ties from the center of manhole cover, clean out cover and pipe fittings to permanent topographical feature (trees, buildings, fire hydrants, etc.).

b. Provide Engineer with GPS Coordinates, if required, see Section 01 10 00 – Special Provisions.

c. Provide Engineer with distance to service wyes or saddle from center of manhole.

d. For directional bore, submit to Engineer the plot of the actual horizontal and vertical alignment of the pilot bore at intervals not to exceed 30 feet.

2. Identify, describe and record the discovery of variations in subsoil conditions, and provide copy of record to Engineer.

3. Identify, describe and record the discovery of uncharted utilities, and provide copy of record to Engineer.

4. Testing:

a. Low Pressure Air Test of Gravity Flow Sewer Pipe, provide copy of Test Records to Engineer.

b. Hydrostatic Test of Pressure Sewer Pipe, provide copy of Test Records to Engineer.

c. Alignment and Deflection Test of Gravity Flow Sewer Pipe, provide copy of Test Records to Engineer.

d. Televising of Gravity Flow Sewer Pipe, provide copy of Records of Televising to Engineer.

e. HDPE Fusion Reports; provide copy of Reports to Engineer

f. Trace Wire Continuity Testing; provide copy of Test Records to Engineer.

g. Backfill Compaction Testing; provide copy of Test Records to Engineer, see Section 01 10 00 – Special Provisions.

h. Concrete Strength Test Records; provide copy of Test Records to Engineer, see Section 01 10 00 – Special Provisions.

5. Submit the following for restrained joint ductile iron pipe:

a. Restrained joint style and detailed designs by the pipe manufacturer, including detailed laying schedules.

1.06 QUALITY ASSURANCE

A. Pipe: Nominal pipe size, material code designation, standard dimension ratio, pressure rating, manufacturer's name or trademark and appropriate AWWA or ASTM designation numbers marked on pipe.

B. Fittings: Manufacturer's name and pressure rating marked on body.

1.07 REGULATORY REQUIREMENTS

A. Conform to all applicable local, state and federal code for materials and installation of the work of this section. Perform work in accordance with standards of authorities having jurisdiction for sanitary sewer piping. Includes materials, installation and testing.

1.08 PROJECT CONDITIONS

A. Verify that survey control points for alignment and elevation are as shown in the Drawings.

B. Research public utility records and verify location of existing utilities.

1. Contact utility locating service for project area.

2. Comply with applicable “ONE CALL” requirements.

C. Provide exploratory excavation to determine exact location of existing underground structures or utilities. Notify Engineer immediately if a discrepancy or conflict is identified.

D. Verify that sanitary sewer piping and appurtenances can be installed as shown in the Drawings and to reference standards.

E. Protect plants, lawns, trees, and other amenities and features; which are to remain, as shown in the Drawings or specified in Section 01 10 00 – Special Provisions, from damage by equipment, vehicular traffic and other construction related activities.

F. Verify that sewer service piping can be installed as shown in the Drawings and to reference standards.

G. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, curbs, utility pedestals and lines and amenities that are to remain from damage by excavating equipment, vehicular traffic and other construction related activities.

H. Coordinate the connection of sanitary sewer piping to existing sewer main, sewer service line and/or other sewer facilities as shown in the Drawings.

1.09 DELIVERY, STORAGE AND HANDLING

A. Preparation for Transport:

1. Do not telescope small diameter pipe inside larger diameter pipe.

2. Protect fittings, glands, gaskets, threaded ends, flange faces, castings, manholes and specialties.

B. During Storage:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.

2. Protect from weather:

a. Protect stored pipe, fittings, castings, manholes and specialties from moisture and dirt.

b. When outdoor storage is necessary, support materials off the ground or pavement.

3. Protect PVC pipe from prolonged (more than 1 month) exposure to sunlight.

4. Support flexible pipe to prevent sagging and bending.

C. Handling:

1. Use sling to lift pipe, fittings, castings, manholes and specialties where size requires handling by crane or other equipment.

a. Rig pipe, fittings, castings, manholes and specialties to protect and avoid damage during handling.

2. Deliver pipe, fittings, castings, manholes and specialties to trench in sound, undamaged condition.

1.10 SEQUENCING/SCHEDULING

A. Attend preconstruction meeting.

B. Submit plan for construction sequence prior to commencing work.

C. Coordinate the connection of sanitary sewer piping to existing sewer main, sewer service line and/or other sewer system facilities, as shown in the Drawings, with Owner and Engineer.

1. Give Owner and Engineer a minimum 24-hours' notice before connection to existing main or other sewer system facilities.

2. Keep disruption of service less than 4 hours.

D. Give Engineer, Owner and permitting authority a minimum 48-hours notice prior to commencing any boring activity.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS/PRODUCTS

A. All products furnished shall meet all applicable ASTM and AWWA requirements.

B. See Section 01 10 00 – Special Provisions for specific product brand requirements.

2.02 GRAVITY SEWER PIPE

A. Poly (Vinyl Chloride) (PVC) Solid Wall Pipe:

1. General:

a. Diameter: As shown in the Drawings.

b. Conform to ASTM D 3034, or ASTM D 1784 or ASTM F 679, as applicable.

c. Cell Classification: 12454-B.

2. Pipe Class:

a. 8 inch to 15 inch diameter inclusive, ASTM D 3034, SDR 35.

b. 18 inch to 27 inch diameter inclusive, ASTM F 679.

3. Color: Green or White for Sewer purposes.

4. Joints: Bell and spigot type with rubber gasket, ASTM D 3212 and ASTM F 477.

5. Fittings: Same material as pipe, molded or formed to suit pipe size and joint design.

B. Poly(Vinyl Chloride) (PVC) Composite Truss Pipe:

1. General:

a. Diameter: As shown in the Drawings.

b. Conform to ASTM D 2680.

c. Semirigid pipe.

2. Color: Green or White for Sewer purposes.

3. Joints: Bell and spigot type with rubber gasket, ASTM D 3212.

4. Fittings: Gasketed fittings for PVC composite truss pipe, molded or formed to suit pipe size and joint design.

C. Vitrified Clay Pipe and Fittings:

1. General:

a. Diameter: As shown in the Drawings.

b. Conform to ASTM C 700 for Vitrified Clay Pipe (VIP) and fittings, integrally cast bell and spigot type, conforming to extra strength provisions.

c. Vitrified clay pipe bell and spigot joints shall conform to ASTM C 425 for compression joint.

d. Fittings: Vitrified Clay, molded or formed to suit pipe size and joint design.

D. Ductile Iron Pipe (DIP):

1. Conform to ANSI/AWWA C151.

2. Diameter: As shown in the Drawings.

3. Thickness/Rating:

a. 3” – 12”: Pressure Class 350, minimum.

b. 14” – 48”: Pressure Class 250, minimum.

4. Joints: ANSI/AWWA C111, rubber gasket, push-on or mechanical joint.

a. Restrained Joint DIP:

(1) Flexible type.

(2) Boltless, lock ring type.

(3) Restraining gaskets are not approved.

(4) Fittings: Ductile iron molded or formed to suit pipe size and joint design.

5. Exterior Coating: Asphaltic, 1 mil thickness, per ANSI/AWWA C104.

6. Interior Coating: Standard cement lining with seal coat, per ANSI/AWWA C104.

7. Buried DIP shall be encased in Polyethylene per ANSI/AWWA C105.

E. High Density Polyethylene (HDPE) Pipe:

1. AWWA C906: PE 3408 or PE 4710.

2. DR: As shown on the Bid form and/or shown in the Drawings or specified in Section 01 10 00 – Special Provisions.

3. Manufactured with color striping to identify their application.

   a. Green for Sewer purposes.

4. Same outside diameter size as ductile iron.

5. Furnish manufacturer's inspection certificates.

6. Polyethylene pipe may be joined together by butt fusion using approved heat-fusion joining machine in accordance with ASTM F 2620.

7. Polyethylene pipe may be joined to other materials by means of:

   a. Flanged connections (flange adapters and back-up rings). Flange adapters shall be fitted with back-up rings that are pressure rated equal to or greater than the mating pipe. The back-up ring bore shall be chamfered or radiused to provide clearance to the flange adapter radius.

   b. Mechanical Joint Adapters.

   c. Mechanical couplings designed for joining polyethylene pipe to another material.

8. A stainless steel stiffener shall be installed in the bore of the polyethylene pipe when an OD compression mechanical coupling is used and when connecting plain end PE pipe to a mechanical joint pipe, fitting or appurtenance.

9. External clamp and tie rod restraint shall be installed where PE pipe is connected to the socket of a mechanical joint pipe, fitting or appurtenance except where a Mechanical Joint Adapter is used.

10. High density polyethylene (HDPE) molded fittings are not approved.

2.03 PRESSURE SEWER PIPE (FORCE MAINS)

A. Polyvinyl Chloride (PVC) Pipe and Molecularly Oriented Polyvinyl Chloride (PVOC):

1. General:

   a. AWWA C900, 4 inch through 12 inch; AWWA C905, 14 inch through 36 inch, AWWA C909, 4 inch through 24 inch.

   b. DR or Pressure Class: As shown on the Bid form and/or shown in the Drawings or specified in Section 01 10 00 – Special Provisions.

   c. Color: Green or White for Sewer purposes.

   d. Same outside diameter as ductile iron pipe.

2. Joints:

   a. Conform to AWWA C900 or AWWA C905 or AWWA C909 as applicable to pipe.

b. Elastomeric gasketed push-on joints.

c. Solvent cement welded joints are not approved.

3. Fittings: Mechanical Joint Ductile Iron - Gray Iron

B. Ductile Iron Pipe (DIP):

1. Refer to Paragraph 2.02 D of this Section.

C. Restrained Joint PVC Pipe:

1. General:

a. AWWA C900, for 4 inch through 12 inch.

b. Restrained joint pipe shall be furnished in 4", 6", 8", 10", 12" sizes in DR or Pressure Class, as shown on the Bid form and/or shown in the Drawings or specified in Section 01 10 00 – Special Provisions.

c. The restrained joint pipe system shall meet all short and long term pressure test requirements of AWWA C900.

d. Pipe joints shall be designed for use at or above the pressure class of the pipe with which they are utilized.

2. Materials:

a. The products represented by this specification are made from un-plasticized PVC compounds having a minimum cell classification of 12454 as defined in ASTM D 1784.

b. Gasket shall be elastomeric sealing gaskets meeting the requirements of ASTM F 477.

c. Pipe joints shall be designed for use at or above the pressure class of the pipe with which they are utilized.

d. Joints shall be designed to meet the zero leakage test requirements of ASTM D 3139.

3. Dimensions & Color:

a. Nominal outside diameters and wall thicknesses of this restrained joint pipe conforming to the requirements of AWWA C900 (Cast Iron pipe OD).

b. Pipe shall be furnished in standard lengths of 20 feet.

c. Color: Green or White for Sewer purposes.

4. Workmanship:

a. Pipe and couplings (as applicable) shall be homogeneous throughout and free from voids, cracks, inclusions and other defects and shall be as uniform as commercially practicable in color, density and other physical characteristics.

5. Marking:

a. Pipe and couplings (as applicable) are legibly and permanently marked in ink with critical information including nominal size, material type, dimension ratio, pressure class, applicable standards, manufacturer's name or trademark, production record code and seal (mark) of testing agency verifying the suitability of the pipe material for potable water systems.

D. High Density Polyethylene (HDPE) Pipe:

1. General:

a. PE 3408 or PE 4710.

b. DR: As shown on the Bid form and/or shown in the Drawings or specified in Section 01 10 00 – Special Provisions.

c. Manufactured with color striping to identify their application. Green for sewer purposes.

d. Same outside diameter size as ductile iron.

e. Furnish manufacturer's inspection certificates.

f. Polyethylene pipe may be joined together by butt fusion using approved heat-fusion joining machine in accordance with ASTM F 2620.

2. Polyethylene pipe may be joined to other materials with fittings with the same or greater pressure rating by means of:

a. Flanged adapters:

(1) Shall be manufactured from PE4710 material.

(2) Fitted with back-up rings that are pressure rated equal to or greater than the mating pipe.

(3) The back-up ring bore shall be chamfered or radiused to provide clearance to the flange adapter radius.

(4) Shall meet the requirements of ASTM D3261 for molded butt fusion fittings and mechanical joint adapters or shall comply with AWWA C906 for fabricated butt fusion fittings.

(5) Shall meet the marking requirements of ASTM D3261 for molded butt fusion fittings and mechanical joint adapters or shall comply with the marking requirements of AWWA C906 for fabricated butt fusion fittings.

3. Where shown on the drawings, 4" and larger transitions to mechanical joint fittings and valves shall be accomplished using a MJ Adapter kit:

a. Molded or Fabricated HDPE mechanical joint transition fitting.

b. Gasket.

c. Mechanical joint backup drive ring.

d. Stainless Steel tee bolts.

4. Mechanical Joint Adapters:

a. Mechanical couplings designed for joining polyethylene pipe to another material and AWWA C111 joints.

b. A stainless steel stiffener shall be installed in the bore of the polyethylene pipe when an OD compression mechanical coupling is used and when connecting plain end PE pipe to a mechanical joint pipe, fitting or appurtenance.

c. External clamp and tie rod restraint shall be installed where PE pipe is connected to the socket of a mechanical joint pipe, fitting or appurtenance except where a Mechanical Joint Adapter is used.

5. High density polyethylene (HDPE) molded fittings are not approved.

E. Pressure Sewer Pipe Restraint:

1. Mechanical Restraint and Concrete Thrust Block at bends, tees and dead ends against undisturbed soil.

2. Location and Size: As shown in the Drawings.

2.04 FITTINGS

A. Conform to ANSI/AWWA C110 or ANSI/AWWA C153

B. Diameter: 2 inch through 64 inch as shown in the Drawings.

C. Material: Ductile Iron

D. Mechanical Joints: Conform to ANSI/AWWA C111.

E. Gaskets: Conform to ANSI/AWWA C111.

F. Exterior Coating: Asphaltic, 1 mil thickness.

G. Interior Coating: Standard cement lining ANSI/AWWA C104 with seal coat.

H. Working Pressure: 350 psi.

I. Buried fittings shall be encased in Polyethylene per ANSI/AWWA C105.

2.05 SHIELDED FLEXIBLE COUPLINGS

A. Watertight flexible coupling shall provide connection of gravity sewer pipes of same or different materials.

B. Coupling shall meet ASTM C 1173 with maximum test pressure of 4.3 psi.

C. Gasket shall have minimum tensile strength of 1,000 psi and minimum tear strength of 150 lbs/in.

D. Shall include a stainless steel shear ring, minimum 0.012” thick, width according to coupling diameter.

E. Watertight flexible coupling shall provide positive seal against infiltration and exfiltration.

F. Watertight flexible coupling shall be leakproof, root proof and be resistant to chemicals, ultraviolet rays, fungus growth, and normal sewer gases.

G. Stainless steel clamps shall corrosion-resistant and rustproof.

2.06 FLEXIBLE COUPLINGS

A. Install at locations as shown in the Drawings.

B. Ductile Iron Couplings/Flexible Couplings:

1. Ductile iron body.

2. Finish: Epoxy coated per AWWA C213 or equal.

3. Gaskets: Rubber, Buna-N or equal.

4. Working Pressure: 150 psi.

2.07 POLYETHYLENE ENCASEMENT FOR IRON PIPE AND FITTINGS

A. Shall meet ANSI/AWWA C105 standards.

B. Flat sheet, split tube or tube.

C. 8 mil (0.20 mm) thickness.

2.08 NUTS AND BOLTS, EYE BOLTS AND THREADED ROD THRUST RESTRAINTS

A. Nuts and Bolts: Ductile iron, corten or stainless steel.

B. Eye Bolts: 3/4 inch diameter, corten.

C. Threaded Rod: 3/4 inch diameter; stainless steel or corten.

D. Wrapped with polyethylene encasement AWWA C105.

2.09 CONCRETE THRUST BLOCKS

A. As shown in the Drawings.

B. Concrete Mix Design: Compressive strength when tested in accordance with ASTM C 39 at 28 Days: Minimum 3,500 psi.

2.10 TRACE WIRE

A. General:

1. Trace wire shall be installed with pipe when shown in the Drawings or specified in Section 01 10 00 – Special Provisions.

2. Wire Size: Minimum size shall be 12 AWG or as shown in the Drawings or specified in Section 01 10 00 – Special Provisions.

3. Jacket color shall meet the APWA color code standard for identification of buried utilities, green for sewer.

4. Jacket/ coating type shall be High Density Polyethylene (HDPE) or High Molecular Weight Polyethylene (HMWPE) rated for direct burial. Nylon is not allowed.

B. Placement:

1. The tracer wire shall be placed in the same orientation as installed pipe.

2. The tracer wire shall be placed as shown in the Drawings or specified in Section 01 10 00 – Special Provisions.

C. Wire Type:

1. Open trench/direct bury: Wire type shall be Solid Copper or Solid Copper Clad Steel (CCS) or as shown in the Drawings or specified in Section 01 10 00 – Special Provisions.

2. Pipe bursting and directional boring: Wire type shall be Solid Copper Clad Steel (CCS) or as shown in the Drawings or specified in Section 01 10 00 – Special Provisions.

3. Stranded wire not required, but may be used at Contractor's option.

D. Connectors (splice):

1. Shall be Copperhead SnakeBite connector, 3M DBR connector or approved equal and shall be rated for direct bury for the protection of wire from moisture and corrosion.

2. Connector shall be sized appropriate to the number and size of wires connected.

E. Test Stations:

1. General:

a. Test stations shall be installed to bring the tracer wire to level for ease of testing.

2. Flush Mount Terminal Access Box:

a. Tracer wire shall be terminated at each end in a flush mount terminal access box.

b. Terminal access box shall have a cast iron lid that can be locked and opened with a standard pentagon head key wrench.

c. Riser base: 12" minimum depth, PVC or approved equivalent.

d. Terminal access box shall be installed in a concrete pad, set to finish grade, as shown in the Drawings or specified in Section 01 10 00 – Special Provisions.

e. Tracer wires shall be attached to integral stainless steel screws.

f. Terminals shall be readily accessible once the lid is removed for use of a locator.

g. Extend tracer wire up inside terminal access box, leaving minimum of 3 feet of tracer wire inside terminal access box.

h. Tracer wire terminal access box shall be located, as shown in the Drawings or specified in Section 01 10 00 – Special Provisions.

3. Sewer line marker post and tracer wire test station:

a. Six (6) foot minimum length.

b. Shall be designed to bend and rebound when struck by a vehicle.

c. Shall be triangular shape or approved equal.

d. Color shall meet the APWA color code standard for identification of buried utilities, green for sewer.

e. Shall have decals stating “Warning, Buried Sewer” or similar.

f. Shall have minimum of two corrosion resistant internal terminals, brass or stainless steel.

g. Shall have removable top cap to access internal terminals.

h. Installation of trace wire in marker post and test station:

(1) Bury the bottom 18 inches of the marker post and test station, with anchor barbs flared out.

(2) Run the trace wire up through the marker post and test station, leaving a minimum of 3 feet of tracer wire slack inside the marker post and test station.

(3) Each tracer wire shall be attached to an internal corrosion resistant terminal.

(4) Label the screws with a permanent marker to indicate the direction of the main and trace wire from the marker post and test station. IE; “Trace Line North”, “Trace Line South”, Etc.

i. Marker post and test station shall be located as shown in the Drawings or specified in Section 01 10 00 – Special Provisions.

2.11 SERVICES

A. General:

1. Nominal Inside Diameter: 4 inches or as shown in the Drawings.

2. Service Wyes shall be same material as main line pipe and shall have the same type of gasketed connections.

B. Poly(Vinyl Chloride) (PVC) Sewer Service Pipe:

1. PVC - SDR 26 or Schedule 40. See bid form, Section 01 10 00 – Special Provisions and Drawings.

2. Joints: Bell and spigot type with rubber gasket, ASTM D 3212 and ASTM F 477.

3. Service Wye and Bends:

a. PVC, molded or formed to suit pipe size and joint design.

b. Compatible with main line sewer material.

c. Watertight Joints:

(1) Bell and spigot type.

(2) Rubber gasket ASTM D 3212, ASTM F 477 and ASTM F 1336.

C. Vitrified Clay Pipe and Fittings:

1. General:

a. Nominal Inside Diameter: 4 inches or as shown in the Drawings.

b. Conform to ASTM C700 for Vitrified Clay Pipe (VCP) and fittings, integrally cast bell and spigot type, conforming to extra strength provisions.

c. Vitrified clay pipe bell and spigot joints shall conform to ASTM C 425 for compression joint.

d. Fittings: Vitrified Clay, molded or formed to suit pipe size and joint design.

D. Saddles with watertight, rubber gasket joints and stainless steel bands.

2.12 CASING PIPE

A. Steel Pipe:

1. General: Uncoated, smooth wall welded steel pipe; ASTM A 53, Type E or Type S, Grade B black steel; or ASTM A 139, Grade B black steel. Minimum yield strength 35,000 psi.

2. Minimum Wall Thickness: See Drawings and Section 01 10 00 – Special Provisions.

B. Casing Chocks:

1. General: Provide casing chocks for carrier pipe 4 inches or greater in diameter.

2. High Density Polyethylene

3. Shall have runners that extend beyond the bell, mechanical joint, or restrainer of the carrier pipe.

4. Shall be designed to grip tightly to the carrier pipe

C. Casing End Seals: Minimum 1/8" thick synthetic rubber end seals with stainless steel bands:

1. After insertion of the carrier pipe into the casing, the ends of the casing shall be closed by installing wrap-around end seals or equal.

2. Place the end seal around the carrier pipe and casing; then compress the adhesive strips to form a seal.

3. Stainless steel banding installed and tightened per manufacture's recommendation.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that trench excavation is ready to receive work and excavation dimensions and elevations are as shown in the Drawings.

B. Verify that building service connection and utility sanitary service line size, location and invert are as indicated.

C. Verify depth and location of other buried utilities and structures in the area.

3.02 TRENCHING

A. See Section 31 23 33 – Trenching for Utilities and Drawings for additional requirements.

B. Hand trim excavation for accurate placement of pipe and fittings to elevations and alignment shown.

C. Place and compact embedment materials for bedding, haunching and initial backfill according to manufacturer's recommendations.

D. Place and compact embedment materials for bedding, haunching and initial backfill according to ASTM D 2321 for plastic pipe.

E. Backfill around sides and to top of pipe with cover fill, tamp in place and compact; then complete backfilling.

F. Protect pipe from damage and displacement while backfilling and compacting.

3.03 PIPE AND FITTING INSTALLATION

A. Install pressure pipe and appurtenances in accordance with manufacturer's recommendations and applicable AWWA standards, including but not limited to proper handling and storage, installation, and testing of pipe.

1. Form and place concrete for pressure sewer pipe thrust restraints at each change in pipe direction. Place concrete to permit full access to pipe and pipe accessories. See Drawings for square footage of thrust restraint based on pipe diameter.

B. Installation of gravity pipe and appurtenances:

1. In accordance with manufacturer's recommendations and ASTM D 2321 for plastic pipe.

2. Begin at lowest point of section being installed.

3. Lay bell ends pointing upstream.

4. Leakage, exfiltration or infiltration shall not exceed 100 gallons per inch of pipe diameter per mile per day for any section of the gravity sewer main, when tested under minimum positive head of 2 feet of water.

C. Handling Pipe and Appurtenances:

1. Protect pipe, fittings, and specialties during handling to prevent damage.

2. Deliver to trench in sound, undamaged condition.

3. Use web slings. End hooks not allowed.

D. Inspect for Defects:

1. Tap DIP pipe with light hammer to detect cracks.

2. Replace defective, damaged or unsound pipe and appurtenances.

E. Protection of Pipe Interior:

1. Clean pipe interior of foreign material before lowering into trench.

2. Keep clean at all times.

3. Securely close open pipe ends and fittings with watertight plugs during nonworking periods including:

    a. When pipe laying is not in progress.

    b. Nights.

    c. Weekends.

F. Cutting Pipe:

1. Use methods recommended by manufacturer.

2. Cut pipe in neat, workmanlike manner without damage to interior lining or exterior coating.

3. Use approved mechanical cutter.

4. Grind smooth and bevel cut ends.

G. Joining Pipe:

1. Use methods recommended by manufacturer to assemble pipes and fittings.

2. Use minimum amount of gasket lubricant necessary to allow safe and efficient assembly of pipes and fittings.

H. Pipe Deflections:

1. Allowed only with permission of Engineer or if shown in the Drawings.

2. Do not exceed manufacturer's recommendations for type and size of pipe and joint being used.

3. Utilize bend fittings or shorter lengths of pipe where necessary to achieve desired alignment.

I. Pipe Gradient:

1. Lay pipe to slope gradient noted in the Drawings using laser equipment.

J. Separation Between Water Mains and Sewer Lines:

1. Maintain minimum of 10 feet horizontal separation of water mains from sewer lines. Measured from face of pipe to face of pipe.

2. Maintain minimum of 18 inches vertical separation where sewer and waterlines cross. Measured from face of pipe to face of pipe.

    a. Center 1 full length (approximately 20 feet) of water main pipe at sewer line crossing.

    b. Correct any misalignment and/or loosened joints of sewer line prior to backfilling.

    c. Carefully compact backfill beneath sewer line to prevent misalignment.

    d. Repair any damage to sewer line at no cost to Owner. Use Engineer approved method of repair.

K. Polyethylene Encasement:

1. Wrap buried ductile iron and cast iron pipe and fittings with polyethylene encasement per ANSI/AWWA C105.

2. Repair damaged areas of polyethylene encasements with an adhesive PVC, 10 mil minimum thick tape or equal.

L. Trace Wire, Trace Wire Terminal Access Box and Marker Posts with Test station:

1. Place trace wire in trench adjacent to the sewer main, as shown in the Drawings.

2. Terminate trace wire in a trace wire terminal access box or marker posts with test station.

3. Minimum bury of trace wire from sewer main to terminal access box or marker post: 36 inches.

4. Boring with Casing Pipe, Dry Boring and Directional Boring:

a. Attach trace wire to carrier pipe as required.

b. Install a terminal access box or marker post with test station at each end of the boring or casing pipe.

5. Test trace wire to ensure continuity.

6. Maximum length between trace wire terminal access boxes or marker posts: As shown in the Drawings or specified in Section 01 10 00 – Special Provisions.

M. Marker Post with Test Station and Decals:

1. Furnish and install marker posts with test station, as shown in the Drawings or specified in Section 01 10 00 – Special Provisions.

2. Maximum spacing as specified in Section 01 10 00 – Special Provisions or as shown in the Drawings.

3. See Drawings or Section 01 10 00 – Special Provisions for special wording (If Required)

4. Place decal on each marker post.

N. Depth of Cover:

1. Sewer Force Main: Minimum depth of cover shall be 5.5 feet, unless noted otherwise in the Drawings.

2. Depth of cover is measured from top of pipe to finish grade elevation.

3.04 RESTRAINED JOINT PIPE INSTALLATION

A. Restrained Joint Ductile Iron Pipe:

1. Provide restrained joint ductile iron pipe as shown in the Drawings. Include detailed laying schedule.

2. Field cutting of restrained joint pipe not allowed.

   a. Exceptions: Locations that utilize a "field cut" restrained joint end kit as provided and recommended by pipe manufacturer and shown in the Drawings.

3. Protect restraining mechanisms, tie rods, clamps or other components of dissimilar metal against corrosion by hand application of a suitable coating or by encasement of entire assembly with polyethylene film in accordance with ANSI/AWWA C105.

B. Concrete Thrust Blocks:

1. Place concrete thrust blocks at bends, tees and dead ends against undisturbed soil.

2. Location and Size: As shown in the Drawings.

3.05 HDPE PIPE INSTALLATION

A. Location: As shown in the Drawings. Install pipe to the lines and grades shown in the Drawings.

B. The Contractor shall use the proper tools and equipment necessary to safely install the high-density polyethylene (HDPE) pipe and fittings. The installation shall be in conformance with the manufacturer's requirements and instructions.

C. HDPE pipe and fittings shall be assembled in the field with butt fusion joints. ASTM F2620 and the pipe manufacturer's recommended procedure shall be observed for butt fusion joints

D. Butt fusion joints shall be made by qualified fusion technicians.

1. Each fusion technician shall be separately qualified to make a butt fusion joint.

E. Butt fusion machines shall incorporate the following properties, including the following elements:

1. Heat Plate:

   a. Heat plates and the non-stick coatings on heating surfaces shall be in good condition without gouges or scratches in the heating surfaces.

   b. The non-stick coating shall be intact and free of any contamination.

   c. Heater controls and temperature indicators shall function properly, and electrical cords and connections shall be in good condition.

   d. The heat plate shall maintain a uniform and consistent temperature on all areas of the heating surfaces on both sides of the heat plate.

2. Carriage:

   a. Carriage shall travel smoothly with no binding at less than 50 psi for hydraulic fusion machines.

   b. Clamps shall be in good condition with proper inserts for the pipe size being fused.

F. If required by the Section 01 10 00 - Special Provisions, a data logger shall be provided on the fusion machine and fusion reports for each butt fusion joint performed on the project, including joints that were rejected shall be provided. The joint technician's joint report shall include:

1. Pipe or fitting size, DR, and pressure rating
2. Fusion equipment size and identification
3. Fusion technician identification
4. Job identification number and fusion number
5. Fusion joining parameters
6. Ambient temperature

G. The following equipment shall be required during fusion:

1. Pipe rollers shall be used to support pipe to either side of the butt fusion machine to provide vertical and lateral pipe alignment through the butt fusions machine.
2. A protective enclosure that provides for full machine motion of the clamps, heat plate, fusion assembly and carriage shall be provided during fusion in inclement and/or windy weather. Pipe ends shall be covered or blocked where open pipe ends could allow prevailing winds to blow through the pipe.

H. Horizontal directional drilling of HDPE pipe shall conform to ASTM D2321 and pipe manufacturer's recommendations.

3.06 BORING WITH CASING PIPE

A. Location: As shown in the Drawings. Install pipe to the lines and grades shown in the Drawings.

B. Refer to permit.

1. Boring under federal and state highways shall be done in strict compliance with all conditions of the permit, including but not limited to:
   a. State Policy for Accommodating Utilities on State Highway Right-of-Way.
   b. State Standard Specifications for Highway Construction, latest edition, including all current supplemental specifications.
2. Boring under railroad tracks shall be done in strict compliance with all conditions of the railroad permit.
3. Refer to permit provided by governmental (County or Municipal) agency. Boring shall be done in strict compliance with all conditions of the permit.

C. Encase sanitary sewer mains and service lines that cross roadways from toe of fill slope to toe of fill slope and urban streets to a point 6 feet back of curb or as shown in the Drawings.

D. Pits for boring, tunneling or jacking not permitted closer to roadway than toe of fill slope or toe of foreslope in rural areas or 2 feet back of curb in urban sections or as shown in the Drawings.

E. Installation of casing and pipe accomplished by boring, tunneling or jacking methods.

1. Use of water under pressure (jetting) or puddling not permitted.

2. Water used to lubricate cutter and pipe, with Engineer approval, considered as dry boring.

F. Boring or tunneling operation, including location of bore pit, shall be conducted in a manner which is not detrimental to the roadway being crossed.

G. Take prompt remedial action when excessive voids or oversized bored holes are produced by filling the bore with concrete or pressurized grout and beginning a new bore hole. Obtain approval of Engineer prior to abandoning a completed bored or tunneled hole unless safety is an immediate concern.

H. Bore hole diameter for casing pipe shall not to exceed the casing pipe diameter by more than 1 1/2 inches for casing pipe having inside diameter of 12 inches or less.

I. Bore hole diameter for casing pipe shall not to exceed the casing pipe diameter by more than 2 inches for casing pipe having inside diameter of greater than 12 inches.

J. Install sanitary sewer main 4 inches or greater in diameter through casing pipe using chocks strapped to sewer pipe and large enough to provide clearance between casing and pipe couplings.

1. Follow manufacturer's recommendations, minimum.

2. Spacing of Chocks:

a. Maximum 10-foot centers for ductile iron pipe

b. Maximum 6-foot centers for PVC pipe

c. or as shown in the Drawings.

K. Leave space between carrier pipe and casing open.

L. Seal annular space at end of casing with rubber end seal with stainless bands.

M. Backfill bore pit.

1. See Section 31 23 33 – Trenching for Utilities.

2. Backfill over-excavated areas around the casing with compacted clean aggregate or rock.

3. Backfill Compaction Density for Bore Pit: Per the geotechnical report or at least 95 percent of maximum dry density, Standard Proctor, if geotechnical report unavailable.

3.07 DRY BORING

A. Location: As shown in the Drawings. Install pipe to the lines and grades shown in the Drawings.

B. Use of water under pressure (jetting) or puddling is not permitted.

C. Water used to lubricate cutter and pipe, with Engineer approval, considered as dry boring.

D. Hole diameter for sanitary sewer main not to exceed outside diameter of bell or coupling plus 4 inches for pipe having inside diameter 4 inches or more.

E. Where unstable soil conditions exist, conduct boring operation in a manner which is not detrimental to adjacent features or structures.

F. Take prompt remedial action when excessive voids or oversize bore hole is produced or when abandoning a bored hole. Obtain approval of Engineer prior to taking action.

G. Pressure grout all voids or abandoned holes caused by boring or jacking.

H. Backfill Compaction Density for Bore Pit: Per the geotechnical report or at least 95 percent of maximum dry density, Standard Proctor, if geotechnical report unavailable.

3.08 DIRECTIONAL BORING

A. Location: As shown in the Drawings. Install pipe to the lines and grades shown in the Drawings.

B. In situations that are shown as open-cut in the drawings, deviations from the design profile may be cause for rejection of directional drilling as a proposed method of construction.

C. Examination of Site:

1. Verify horizontal and vertical alignment.

2. Review soils report.

3. Verify depth and location of waterlines and other utilities.

4. Notify Engineer immediately of any observations affecting the work.

D. Diameter of bore hole only large enough to properly install sanitary sewer without causing excessive stress on pipe.

E. Do not exceed maximum bending radius of pipe as given by manufacturer.

F. If required by the Section 01 10 00 - Special Provisions, Contractor to plot the actual installed horizontal and vertical alignment of the pilot bore at intervals not to exceed 50 feet. Such data shall be provided with the as-built drawings.

3.09 SERVICES

A. Location: As shown in the Drawings. Install pipe to the lines and grades shown in the Drawings.

B. Connection to Main:

1. Wye with watertight, rubber gasket joints, as shown in the Drawings.

2. Saddles shall provide watertight, rubber gasket joints. Solvent weld saddle to PVC main and hold in place with stainless steel straps.

3. Rotate wye or saddle 30 degrees up from horizontal.

4. Install watertight plugs at end of future service lines.

C. Connection to Existing Service Line:

1. Watertight flexible coupling shall provide connection of pipes of same or different sizes and materials quickly and easily.

2. Shall include a stainless steel shear ring.

3. Watertight flexible coupling shall provide positive seal against infiltration and exfiltration.

4. Watertight flexible coupling shall be leakproof, root proof and be resistant to chemicals, ultraviolet rays, fungus growth, and normal sewer gases.

5. Watertight flexible coupling shall have stainless steel clamps that are corrosion-resistant and rustproof.

3.10 FIELD QUALITY CONTROL

A. If tests indicate work does not meet specified requirements, remove defective materials/work and replace and retest; and/or take necessary remedial action and retest, all at no cost to Owner.

B. Compaction density testing shall be performed on compacted fill in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 6938.

1. Results shall be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 "standard proctor", ASTM D 1557 "modified proctor" or AASHTO T 180.

2. Frequency of Backfill Compaction Tests:

a. Under Paving, Slabs-on-Grade and Similar Construction:

(1) 2 tests per 150 linear feet of main line, test lower portion and test upper portion of trench or as determined by Engineer.

(2) 1 test of each service line or as determined by Engineer.

b. Non-paved Area:

(1) 2 tests per 300 linear feet of main line, test lower portion and test upper portion of trench or as determined by Engineer.

(2) 1 test of each service line or as determined by Engineer.

3. If tests indicate work does not meet specified requirements, remove defective materials/work and replace and retest; and/or take necessary remedial action and retest, all at no cost to Owner.

C. Perform hydrostatic test of pressure sewer pipe (force mains) at Contractor’s expense.

1. If tests indicate work does not meet specified requirements, remove defective materials/work and replace and retest; and/or take necessary remedial action and retest, all at no cost to Owner.

D. Perform low pressure air test of gravity flow sewer pipe at Contractor's expense.

1. If tests indicate work does not meet specified requirements, remove defective materials/work and replace and retest; and/or take necessary remedial action and retest, all at no cost to Owner.

E. Perform alignment and deflection test of gravity flow sewer pipe at Contractor's expense.

1. If tests indicate work does not meet specified requirements, remove defective materials/work and replace and retest; and/or take necessary remedial action and retest, all at no cost to Owner.

F. Perform televised inspection of completed sanitary sewer system at Contractor's expense.

1. If tests indicate work does not meet specified requirements, remove defective materials/work and replace and retest; and/or take necessary remedial action and retest, all at no cost to Owner.

G. Trace Wire Test:

1. If trace wire installed, Contractor shall perform a continuity test on all trace wire prior to the acceptance. This test may be performed by either hiring an acceptable underground utility locating firm to physically locate the trace wire in the presence of a representative of Owner or via low voltage circuit completed with the use of a suitable voltage source and meter to ensure continuity of the trace wire.

2. In the event that continuity cannot be demonstrated or difficulties with the locating or continuity test arise, the cause shall be isolated and corrected. Thereafter, the section in which the defective test occurred shall be retested as a unit and continuity of that section confirmed, all at no cost to Owner.

3.11 ALIGNMENT TOLERANCE

A. Apply the following tolerances for sanitary sewer piping installed by open trench construction or installed inside a casing pipe.

1. Gravity Sewer Main:

a. General alignment shall be checked using televised inspection of the gravity sewer main.

b. Maximum allowable horizontal and vertical alignment variance from design line and grade shall be the greater of:

(1) +/- 5% of the inside diameter of the pipe.

(2) or +/- 1/2 inch.

c. Remove and reinstall pipe to proper grade where there is standing water greater than the maximum allowable depth.

2. Force Main: Do not allow horizontal and vertical alignment of trenched force mains to vary from design line and grade by more than 3 inches.

B. Apply the following tolerances for sanitary sewer piping installed by directional boring.

1. Gravity Sewer Main:

a. General alignment shall be checked using televised inspection.

b. Maximum allowable horizontal and vertical alignment variance from design line and grade shall be:

(1) Horizontally: +/- 1.0 foot per 100 feet.

(2) Vertically: +/- 0.2 feet up to 100 feet; and an additional +/- 0.1 foot per 100 feet thereafter.

c. Remove and reinstall pipe to proper grade where there is standing water greater than the maximum allowable depth.

2. Pressurized Pipe:

a. Maximum allowable horizontal and vertical alignment variance from design line and grade shall be:

(1) Horizontally: +/- 2.0 feet.

(2) Vertically: +/- 1.0 foot. Maintain the minimum depth of cover specified in the specifications or shown in the Drawings.

3.12 CLEANING SEWER LINES

A. General:

1. Plug downstream manholes.

2. Flush and clean sewer lines and manholes prior to testing.

3. Remove debris at manholes.

4. Do not allow debris to enter existing sewer system.

3.13 TESTING

A. Hydrostatic Testing of Pressure Sewer Pipe (Force Main)

1. General:

a. Perform Hydrostatic Pressure Testing of force main piping and appurtenances in accordance with AWWA C600 or C605.

b. Test performed simultaneously with flushing.

c. Furnish and install temporary pipe plugs, caps, flanges, valves or other pipe termination devices and blocking as necessary to permit hydrostatic pressure testing of the pipeline to be performed.

2. Preparation:

a. Slowly fill pipeline with clean water.

b. Expel air from system. Extreme care must be taken to ensure that all air is expelled from the pipeline before testing. This may require several

cycles of pressurizing and bleeding the trapped air, prior to beginning the test.

(1) Open air valve(s) to release air and close air valves prior to testing.

(2) Install corporation stops at high points, as necessary, and open to release air. Close corporation stops, prior to beginning the test.

(a) Owner's option after testing completed and accepted: Remove corporation stop and install plug, or leave corporation stop in place and cap.

c. The pipeline should stand full of water for at least 24 hours prior to conducting the hydrostatic test, to allow air to escape.

3. Test:

a. Test Pressure: 150 psi or as directed by Engineer.

(1) The pressure applied at the test site shall be the pressure necessary to create the specified test pressure at the lowest point along the section of the pipeline being tested. The pressure applied at the test site shall be determined based on the specified test pressure, and the relative elevation of the lowest point along the section of pipeline being tested and the elevation of the test gage.

(2) Test pressure shall not be less than 1.25 times the working pressure at highest point of test section. (Working pressure is the anticipated maximum sustained operating pressure.)

(3) Test pressure shall not be less than 1.50 times the working pressure at lowest point of test section. (Working pressure is the anticipated maximum sustained operating pressure.)

(4) Test pressure shall not exceed 1.5 times the pressure rating of the pipe (as specified by the manufacturer).

(5) Test pressure shall not exceed the rated working pressure of the valves, fittings and appurtenances, or the thrust restraint design pressure.

(6) The pipeline shall be allowed to stabilize at the test pressure before conducting the hydrostatic test.

b. Minimum Test Period: 2 hours.

c. Testing Allowance:

(1) Testing allowance is the maximum quantity of makeup water that is added into the section of the pipeline undergoing hydrostatic testing, in order to maintain pressure within +/- 5 psi of specified test pressure throughout the test period.

(2) No pipe installation will be accepted, if the quantity of makeup water is greater than that determined by the following formula:

$Q = LD \times \sqrt{P}$ divided by 148,000 where

Q = Quantity of makeup water, in gallons per hour

L = Length of pipe section being tested, in feet

D = Nominal diameter of the pipe, in inches

P = Average test pressure during the hydrostatic test, in pounds per square inch (gauge)

$\sqrt{P}$ means the square root of P

d. Replace damaged or defective pipe, fittings, appurtenances or joints that are discovered during or following the test.

e. Completion of Hydrostatic Test:

(1) If the quantity of makeup water is less than the testing allowance, as stated above, the Hydrostatic Test for the section of the pipeline being tested passes.

(2) If the quantity of makeup water is greater than the testing allowance, as stated above, the Hydrostatic Test for the section of the pipeline being tested fails.

(a) Locate and repair all leaks.

(b) Repeat Hydrostatic Test, until satisfactory results are obtained.

B. Low Pressure Air Test of Gravity Flow PVC Sewer Pipe:

1. General:

a. Test in accordance with ASTM F 1417.

b. Test individual section(s) between pneumatic plugs.

c. Test pressure of 3.5 psi at start of test.

d. More than 1.0 psi pressure drop during test time indicates failed test.

2. Preparation:

a. Flush line to eliminate debris and to wet pipe surface.

b. Install pneumatic plugs at ends of test section.

(1) Safety Precautions:

(a) No one allowed in manhole during test.

(b) Install plugs securely.

(c) Brace plugs if necessary.

(d) Do not over pressurize lines.

(e) Seal length equal to or greater than pipe diameter.

(f) Use regulator or relief valve set no higher than 9 psi.

c. Pass all air through single control point.

3. Test Procedure:

a. Verify pneumatic plugs are installed and properly seated to form seal.

b. Add air to internal pressure of 4 psi.

c. Allow pressure to stabilize 2 to 5 minutes depending on pipe size.

d. Reduce pressure to 3.5 psi to begin test period.

e. More than 1.0 psi pressure drop during test time indicates failed test. Test Time: See table.

TABLE 1 - Minimum Specified Time Required for a 1.0 psig Pressure Drop for Size and Length of Pipe Indicated for Q = 0.0015

Note 1 = See Practice UNI-B-6, Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe.

Note 2 - Consult with pipe and appurtenances manufacturer for maximum test pressure for pipe size greater than 30 in. in diameter.

Pipe Dia., in.	Min. Time, min's	Length for Min. Time, ft.	Time for Longer Length, sec.	Specification Time for Length (L) Shown, min's							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	0.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142.26	160.15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153.50	179:29	205:07	230.46

4. Defective Materials and/or Workmanship:

a. Acceptance based on leakage test.

b. Locate and repair all visible leaks.

c. Replace damaged or defective pipe, fittings or joints.

d. Repeat test, until satisfactory results are obtained.

C. Alignment and Deflection Test of All Gravity Flow Sewer Pipe:

1. Provide alignment and deflection test 30 days or more after backfilling trench.

2. Alignment shall be checked by using either a laser beam or lamping.

3. Deflection testing: Use rigid ball or mandrel having not less than 95 percent of base inside diameter or average inside diameter of pipe depending on which is specified in ASTM to which the pipe is manufactured.

a. Allowable Deflection: 5 percent or less.

b. Mechanical pulling devices not allowed.

4. Defective Materials and/or Workmanship:

a. Acceptance based on alignment and deflection test.

b. Locate misaligned and/or deflected section.

c. Correct alignment and/or deflection.

d. Replace damaged or defective materials.

e. Repeat alignment and deflection test, until satisfactory results are obtained.

D. Televised Inspection:

1. Provide televised inspection of completed gravity sanitary sewer main performed by testing laboratory, independent Contractor or method approved by Engineer.

2. Includes:

a. Digital recording, in a format agreed upon by Owner and Engineer.

b. Written log of location of:

(1) Service wyes or saddle as measured from manhole.

(2) Location of defects in pipe or joints.

(3) Location of debris in pipe.

(4) Location of any sag.

(5) Other notable items in pipe.

3. Defective Materials and/or Workmanship:

a. Acceptance based on televised inspection.

b. Repair defects in pipe.

c. Replace damaged materials.

d. Repeat TV inspection, until satisfactory results are obtained.

END OF SECTION

SECTION 33 39 13

MANHOLES AND COVERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Monolithic concrete manholes with transition to iron cover frame, iron covers, anchorage and accessories.

B. Modular precast concrete manhole sections with tongue-and-groove joints with transition to iron cover frame, iron covers, anchorage and accessories.

C. Bituminous Dampproofing.

1.02 REFERENCES

A. ASTM A 48 – Standard Specification for Gray Iron Castings

B. ASTM A 123 – Standard Specification for Zinc (Hot-Dip galvanized) Coatings on Iron and Steel Products

C. ASTM A 240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

D. ASTM A 615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

E. ASTM C 309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

F. ASTM C 94 – Standard Specification for Ready-Mixed Concrete

G. ASTM C 443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

H. ASTM C 476 – Standard Specification for Grout for Masonry

I. ASTM C 478 – Standard Specification for Circular Precast Reinforced Concrete Manhole Sections

J. ASTM C 877 – Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections

K. ASTM C 923 – Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

L. ASTM C 990 – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

M. ASTM C 1244 – Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill

N. ASTM D 41 – Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

O. ASTM D 449 – Standard Specification for Asphalt Used in Dampproofing and Waterproofing

P. ASTM D 4101 – Standard Specification for Polypropylene Injection and Extrusion Materials

Q. ASTM F 593 – Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

R. ASTM F 594 – Standard Specification for Stainless Steel Nuts

S. AASHTO M 198 – Standard Specification for joint for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

T. AASHTO M 199 – Standard Specification for Precast Reinforced Concrete Manhole Sections

U. AASHTO M 306 – Standard Specification for Drainage, Sewer, Utility, and Related Castings

V. Fed. Spec. SS-C-153C – Cement, Bituminous, Plastic

W. State Standard Specifications, latest revision

1.03 UNIT PRICES

A. Manhole Bases:

1. Manhole bases, both Cast-In-Place and precast, are not paid for directly but are considered subsidiary to the construction of the vertical shaft of the manhole.

2. Includes excavation, hand trimming excavation, bedding, structural concrete, reinforcing steel, grouting flow line, backfilling, compaction of backfill, and incidentals thereto.

B. Drop Connection:

1. Drop connections are not paid for directly but are considered subsidiary to the construction of the vertical shaft of the manhole.

2. Includes excavation, hand trimming excavation, bedding, structural concrete, reinforcing steel, pipe fittings, pipe connections, grouting flow line, backfilling, compaction of backfill, and incidentals thereto.

C. Manhole Frames and Covers:

1. Manhole frames and covers are not paid for directly but are considered subsidiary to the construction of the vertical shaft of the manholes.

D. Cleaning, Inspection, and Testing:

1. Cleaning, inspection, and testing of manholes are incidental to construction of structures and will not be paid for separately.

E. Manhole stub-out pipe:

1. Stub-out Pipe: Shall be measured and paid for by the linear foot (LF) for each respective size and type of pipe.

2. Includes excavation, hand trimming excavation, pipe, bedding, backfilling and compaction of backfill and incidentals thereto.

F. Manhole stub-out pipe plug and marker:

1. Manhole Stub-out Pipe Plug and Marker: Shall be measured and paid for as one unit (1 each), regardless of size of plug.

2. Includes excavation, hand trimming excavation, pipe plug, bedding, backfilling and compaction of backfill, end of pipe marker and incidentals thereto.

G. Manholes:

1. Method of Measurement and Pay Unit: By the vertical foot (VF) for each respective size and type of shaft shown on the bid form.

2. Pay length in vertical feet is measured from flow line of the base to top of cast iron frame to nearest 1/10 of a foot.

3. Includes excavation, hand trimming excavation, bedding, base, structural concrete, reinforcing steel, precast units, steps, pipe connections, grouting flow line invert, exterior dampproofing, joint and joint materials, adjustment rings, manhole frame and cover, backfilling, compaction of backfill and incidentals thereto.

H. External Manhole Frame Seals and Extension(s):

1. Method of Measurement: If External Manhole Frame Seals and Extension(s) are required in Section 01 10 00 – Special Provisions, then each manhole receiving an External Manhole Frame Seal and Extension(s) shall be measured as one unit (1 each).

2. Pay Unit: By the unit (each), regardless of size or length of External Manhole Frame Seal and number of Extension(s) used on a manhole.

3. Includes supplying, installing and testing of external frame seal, including sleeves, extension(s), wedges, stainless steel compression bands and tightening bands, and appurtenances, complete with incidentals thereto.

I. Internal Manhole Frame Seals and Extension(s):

1. Method of Measurement: If Internal Manhole Frame Seals and Extension(s) are required in Section 01 10 00 – Special Provisions, then each manhole receiving an Internal Manhole Frame Seal and Extension(s) shall be measured as one unit (1 each).

2. Pay Unit: By the unit (each), regardless of size or length of Internal Manhole Frame Seal and number of Extension(s) used on a manhole.

3. Includes supplying, installing and testing of internal frame seal, including sleeves, extension(s), wedges, stainless steel expansion bands, and appurtenances, complete with incidentals thereto.

J. Adjustment of Existing Manhole:

1. Method of Measurement: Adjustment of existing manhole shall be measured as one unit (1 each) for each existing manhole adjusted.

2. Pay Unit: By the unit (each), regardless of size or length of the adjustment used on a manhole.

1.04 SUBMITTALS

A. Shop Drawings: Indicate manhole locations, elevations, piping and conduit penetrations, pipe connectors, exterior water proofing, and alignment and elevations of penetrations.

B. Product Data: Provide configuration and dimensions for manhole, frame and cover, construction components and features.

1.05 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum 3 years experience.

PART 2 - PRODUCTS

2.01 MANHOLE SHAFT AND BASE

A. Manhole Shaft and Cone Sections: Reinforced precast concrete in accordance with ASTM C 478, with resilient pipe connectors complying with ASTM C 923.

1. Rated to meet requirements for H-20 traffic loading.
2. Concentric round shaft sections, with an eccentric cone top section, unless otherwise noted in the Specifications or Drawings.
3. Tongue and groove joints.
4. Wall opening(s) provided to receive pipe sections.

B. Manhole Base:

1. Manholes installed on new piping: Precast base with an integral shaft section, in accordance with ASTM C 478.
2. All other manholes: Use precast or Cast-In-Place concrete base, according to Drawings and Section 01 10 00 – Special Provisions.
3. Cast-in-Place Concrete Base:
    a. Base shaft section shall be embedded at least 3 inches into poured in place reinforce concrete base.

C. Cast-In-Place Concrete:

1. See Section 03 30 00 – Cast-In-Place Concrete
2. Minimum compressive strength of 3,500 psi in 28 days.
3. Concrete Reinforcement: ASTM A 615 Grade 60.

D. Non-Shrink Grout:

1. Shall be high-strength mortar or grout, which does not shrink in a plastic state, is dimensionally stable in the hardened state and permanently bonds to a clean concrete substrate.
2. Grout shall conform to the requirements of ASTM C 476, Standard Specification for Grout for Masonry.

3. The minimum design compressive strength shall be six thousand (6,000) pounds per square inch at twenty-four (24) hours and nine thousand (9,000) pounds per square inch at twenty-eight (28) days.

E. Joint Sealant:

1. Preformed Bituminous Joint Material: Cold-applied bituminous manhole joint sealing compound recommended by the manufacturer for the intended use and approved by Engineer. Comply with ASTM C 990.

2. Preformed Flexible Butyl Rubber Jointing Material: Cold-applied manhole joint sealing compound recommended by the manufacturer for the intended use and approved by Engineer. Comply with ASTM C 990.

3. Rubber O-ring or Profile Gasket: If required, furnish and install a flexible joint complying with ASTM C 443.

F. Exterior Bituminous Dampproofing:

1. 2 coats of asphalt dampproofing applied to exterior at manhole manufacturer's shop or plant under controlled environmental conditions.

2. Field application not allowed without approval of Engineer.

3. Asphalt Primer Coat: ASTM D 41, compatible with substrate and applied in accordance with manufacturer's recommendations.

4. Dampproofing Asphalt Coat: ASTM D 449, compatible with substrate and applied in accordance with manufacturer's recommendations.

2.02 MANHOLE FRAME AND COVER

A. Comply with AASHTO M 306.

B. Comply with ASTM A48.

C. Casting certified for 40,000 pound proof-load according to AASHTO M 306.

D. Load Capacity: Casting rated to meet requirements for H-20 traffic loading.

E. Gray Cast Iron, ferrous casting, smooth, well cleaned by shot blasting, uniform quality, free of blowholes, shrinkage, distortion or other defects, machined horizontal bearing surfaces, solid cover.

F. Casting certified as being manufactured in the United States of America.

G. Nominal Frame Dimension:

1. Nominal Inside Frame: Twenty-four inches (24") in diameter clear opening or as shown on the Drawings.

2. Minimum Height of Frame: Seven inches (7") or as shown on the Drawings.

H. Cover:

1. One lift hole (pick hole).

2. Smooth patterned surface without logos or images.

2.03 MANHOLE STEPS

A. Comply with ASTM C 478.

B. Manufacture using polypropylene encased steel.

C. 1/2 inch diameter Grade 60 deformed steel reinforcing bar encapsulated in molded copolymer polypropylene ASTM C 478, ASTM D 4101 and ASTM A 615.

D. Provide steps in all manholes unless specified otherwise.

1. Place first step no more than 36 inches from top of casting.

2. 10 inches nominal step tread width, 16 inches on center vertically, factory installed into manhole wall and meeting ASTM C 478 and all OSHA requirements.

3. Align with vertical side of eccentric cone top section.

2.04 ADJUSTMENT RING(S)

A. Use one of the following methods for grade adjustments of manhole frame and cover assemblies:

1. Precast reinforced concrete grade adjustment rings complying with ASTM C 478, free from cracks, voids and other defects.

2. Engineer approved masonry units and high strength grout, as approved by Engineer, to adjust frame to grade when adjustment necessary is less than 4 (four) inches.

3. High density polyethylene adjustment ring, rubber adjustment ring, expanded polypropylene adjustment ring or other specialty frame adjustment rings, as approved by Engineer.

B. Do not use adjustment ring material that is subject to damage by hot mix asphalt (HMA) when installation will be in contact with HMA.

C. Adjustment ring(s) shall be capable of supporting the minimum requirements of AASHTO H-20 loading.

D. Ensure the inside diameter of the adjustment ring is not less than the inside diameter of the manhole frame.

2.05 PIPE CONNECTIONS

A. Precast Manhole Shaft and Precast Base Section: Provide flexible, watertight gasket per ASTM C 923 with shaft section. Watertight gasket shall be designed to stop the movement of water along the pipe into the manhole.

B. Cast-In-Place Base and Cut/Chipped Openings (Knockouts):

1. Waterstop Grouting Ring: Furnish and install waterstop grouting ring that surrounds pipe and attaches to the pipe with stainless steel band(s). The grouting ring gasket shall be installed on the pipe at the center of the manhole wall and shall be designed to stop the movement of water along the interface between a pipe and a surrounding non-shrink grout collar.

2. Fill opening between manhole wall and pipe with non-shrink grout seal.

2.06 FRAME SEALS AND EXTENSIONS

A. Internal or External Frame Seal and Extension. If required in Section 01 10 00 – Special Provisions, furnished and install an internal or external manhole frame seal and extension(s).

1. General:

   a. Frame seals shall consist of a flexible internal or external rubber sleeve, extensions, wedge strips, and stainless steel expansion or tightening bands designed to prevent leakage of water into the manhole for a minimum design life of twenty-five (25) years.

   b. The manhole frame seal and any extension(s) shall be designed to remain watertight during repeated movement of the frame a minimum of two (2) vertical inches and one (1) horizontal inch throughout the minimum design life of twenty-five (25) years.

2. External Manhole Frame Seals and Extension(s):

   a. The external manhole frame seal and extension(s) shall span the entire adjustment area of the manhole by connection the lower base ring of the casting to the top of the eccentric cone section of the manhole.

   b. The flexible rubber sleeves and extension(s) shall be an extruded or molded high grade rubber compound that conforms to the requirements of ASTM C 923.

   c. Compression bands shall conform to the requirements of Type 304, stainless steel bands as defined by ASTM A 240.

   d. Type 304, stainless steel studs and nuts used in the compression mechanism shall conform to the requirements of ASTM F 593 and ASTM F 594.

   e. The minimum adjustment range of the compression bands shall be two (2) diameter inches.

      (i) Install bands to lock the sleeve and extension(s) into place and to provide a positive watertight seal.

      (ii) Once tightened, lock bands into place.

      (iii) Use only manufacturer recommended installation tools and sealants.

   f. The minimum thickness of the sleeve for external manhole frame seals and extension(s) shall be three-sixteenths (3⁄16) inch.

3. Internal Frame Seal Manhole Frame Seals and Extension(s):

   a. Sleeve and Extension.

      (i) Double pleated minimum, with minimum thickness shall be three-sixteenths (3⁄16) inch, according to ASTM C 923.

      (ii) Minimum allowable vertical expansion of at least 2 inches.

(iii) Integrally formed expansion band recess top and bottom with multiple sealing fins.

b. Expansion Bands.

(i) One-piece band assembly to compress sleeve or extension against manhole and casting surfaces.

(ii) 16 gage ASTM A240, Type 304 stainless steel, minimum 1-3/4 inch width, minimum adjustment range of two (2) inches more than the manhole inside diameter.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify depth and location of other buried utilities and structures in the area.

B. Verify items provided by other sections of work are properly sized and located.

C. Verify that built-in items are in proper location and ready for roughing into work.

D. Verify excavation for manholes is ready to receive work and excavation dimensions and elevations are as shown in the Drawings.

3.02 PREPARATION

A. Excavation:

1. Excavate to the lines and grades as shown in Drawings or as directed by Engineer.

2. Replace unnecessary over-excavation at no additional cost.

3. The excavation shall be wide enough to allow thorough tamping of the backfill adjacent to the structure. The minimum bottom excavation width shall be two (2) feet wider than the maximum horizontal width of the structure.

4. Excavation shall be done in a manner that does not create collected or standing water.

5. Conduct excavation operations in a manner that prevents surface water and foreign matter from entering the excavation, structure, extensions, and adjacent pipe.

B. Subgrade Preparation.

1. Cut Sections (Undisturbed Soil): Prepare subgrade and hand grade to accurate elevation required to place structure base or subbase.

2. Fill Sections: Compact fill and hand grade to accurate elevation required to place structure base or subbase, or install stabilization material as directed by Engineer.

3. Unstable Subgrade: If unstable subgrade is encountered, install stabilization material as directed by Engineer. Over-excavate below the lower surface of the structure when Engineer determines that the soils encountered will not provide adequate support for the structure. Replace over-excavated material to the

established elevation using compacted well graded crushed rock bedding or other suitable material as directed by Engineer.

4. Excavation in Rock: Over-excavate a minimum of six (6) additional inches below the lower surface of the structure when encountering a rock ledge at the proposed bottom of the structure. Replace the over-excavated material using compacted well graded crushed rock bedding or other suitable material as directed by Engineer to eliminate any part of the structure from resting on the rock ledge.

3.03 MANHOLES

A. General:

1. Construct manholes using Cast-In-Place or precast sections, cast iron frames, cover, pipe connections, and steps.

   a. If required in Section 01 10 00 – Special Provisions, furnished and install internal or external Manhole Frame Seal and Extension(s).

2. Maintain sanitary sewer service at all times unless specified otherwise in the Contract Documents.

   a. Divert sanitary sewer flow as necessary to maintain sewer service.

   b. Obtain approval of the sewer flow diversion plan from Engineer.

3. Coordinate placement of inlet and outlet pipe opening(s) or sleeves required to provide correct size, shape and location for installation of pipes, ducts, fitting or other appurtenances.

B. Handling:

1. Handle and place the manhole section(s) and appurtenances in a manner that avoids damaging the manhole, pipe, bedding material or appurtenances.

2. Use sling to lift and rig to protect manhole and appurtenances during handling.

3. Deliver manholes and appurtenances to excavation in sound, undamaged condition.

4. Before constructing the manhole, inspect the manhole, adjacent pipe, and extensions for cracks or other defects.

C. Precast Base with Integral Shaft Section:

1. Ensure subgrade properly prepared.

2. Ensure proper vertical and horizontal alignment.

3. Place precast concrete base section on firmly compacted accurately graded subgrade; set plumb and level to correct elevation.

D. Cast-In-Place Manhole Base:

1. See Section 03 30 00 – Cast-in-Place Concrete.

2. Ensure subgrade properly prepared.

3. Form and pour base plumb and level to dimension and to the elevations shown in the Drawings or as directed by Engineer.

4. Ensure proper vertical and horizontal alignment.

5. Place manhole shaft sections on base plumb and level, at correct elevation, as shown in Drawings.

E. Precast or Cast-In-Place Shaft Sections:

1. Install shaft sections as required to achieve finish elevation.

2. Place manhole sections plumb and level, at correct elevation as shown in Drawings.

3. Brace or anchor the manhole sections as necessary to prevent displacement after establishing final position.

4. Cut and fit manhole sections for pipe, conduit and sleeves, as needed.

F. Substitutions: Precast structures may be substituted for designated Cast-In-Place structures so long as the structure is constructed as specified in the contract documents and according to Drawings.

G. Adjustment Ring(s):

1. Construct manholes with the following adjustment ring stack heights:

a. Minimum adjustment ring stack height:

(i) 4 (four) inches for new manholes.

(ii) Does not include frame and cover height.

b. Maximum adjustment ring stack height:

(i) 12 (twelve) inches for new manholes.

(ii) 16 (sixteen) inches for existing manholes.

(iii) For greater adjustment, modify lower shaft section(s).

(iv) Does not include frame and cover height.

H. Joint Sealant:

1. Finished joints in manhole sections shall resist passage of solids or fluids.

2. Rubber O-ring or Profile Gaskets:

a. Preformed Butyl or Cold-Applied Bituminous Manhole Joint Sealing Compound.

(i) Clean and inspect all tongue-and-groove surfaces. Surfaces shall be free from all dust and debris.

(ii) Use only manufacturer-recommended sizes for specific manhole diameters.

(iii) Place the preformed butyl or bituminous jointing material next to the vertical surface.

(iv) Wrap the material completely around the joint overlapping each end. Knead the ends together to form a unified splice. Make sure all protective paper is removed.

(v) Lower the next section into the final position, making sure the steps are aligned.

(vi) Keep the additional shaft sections level/plumb while setting.

b. Rubber O-Ring or Profile Gasket, If required:

(i) Clean and inspect all tongue-and-groove surfaces. Surfaces shall be free from all dust and debris.

(ii) Lubricate the gasket as recommended by manufacturer, before placing it onto the manhole.

(iii) Lubricate the joint as recommended by manufacturer, before placing next section onto the manhole.

(iv) Lower the lubricated end of the next section, making sure steps are aligned (if applicable), into final position.

(v) Keep the additional shaft sections level/plumb while setting to prevent rolling the gasket.

I. Lift Holes:

1. Fill lift holes with nonshrink grout.

2. Apply trowel grade asbestos roof coating, to exterior. Fed. Spec. SS-C-153C for bituminous plastic cement, Type I, asphaltic base or equivalent.

J. Adjustment of Existing Manhole:

1. Casting Extension Rings.

a. Furnish and install iron casting extension rings when allowed by the contract documents, in conjunction with pavement overlays.

b. Install according to the manufacturer's recommendation and adjust for proper alignment.

2. Minor Adjustment (Adding or Removing Adjustment Rings).

a. Carefully remove casting frame and cover.

b. Modify adjustment ring stack height by one of the following methods:

(i) Add adjustment rings as necessary to adjust existing manhole to finished pavement grade or finished site grade, to a maximum ring stack height of 16 inches, not including frame and cover height.

a) Bed each concrete ring with bituminous or butyl jointing material.

b) Bed other types of adjustment rings with manufacturer's approved product.

(ii) Remove one or more adjustment rings, as appropriate, to reduce casting elevation.

c. Reinstall existing casting on modified adjustment ring stack.

d. If there is an existing Frame Seal and Extension(s) infiltration barrier on the manhole, replace the Frame Seal and Extension(s) using only new materials.

3. Major Adjustment (Adding, Removing, or Modifying Shaft or Cone Section).

a. When adjustment is greater than can be accomplished through adding or removing adjustment rings, a major adjustment will be required.

(i) Carefully remove casting frame and cover.

(ii) Remove adjusting Rings, as necessary.

(iii) Remove top manhole section.

(iv) Remove other manhole shaft section(s), as needed.

(v) Remove and replace, add or modify manhole shaft section and/or top section, as appropriate.

(vi) Add adjustment rings as necessary to adjust manhole to finished pavement grade or finished site grade, with adjustment ring stack height of between 4 and 16 inches, not including frame and cover height

(vii) Reinstall existing casting on modified adjustment manhole.

(viii) If there is an existing Frame Seal and Extension(s) infiltration barrier on the manhole, replace the Frame Seal and Extension(s) using only new materials.

K. Frame and Cover:

1. Set frame and cover to the elevation shown in Drawings or as directed by Engineer.

2. Set frame and cover level without tipping to correct elevation.

3. Use grade adjustment rings and masonry units as approved by Engineer to adjust frame to grade.

4. Where a manhole is to be in a paved area, adjust the casting to match the slope of the finished surface, within ¼ inch.

L. Invert:

1. Construct manhole invert up to one half of pipe diameter to produce a smooth half pipe shape between inlet and outlet pipe flowlines.

2. Changes in flow direction shall be a smooth uniform curve, made with the largest possible radius.

3. Slope invert top upward toward manhole wall at 1/2 inch per foot perpendicular to flow line.

4. Keep void between pipe and structure wall free of debris and concrete, when using a Resilient Pipe Connector complying with ASTM C 923.

5. Shape manhole invert to provide a smooth transition between pipe flowlines.

6. Remove projections and repair voids to provide a hydraulically smooth channel between ends of pipes.

7. Finish the surface of the channel to produce a dense, smooth surface using a steel trowel.

M. Dampproofing:

1. General:

a. Allow the exterior dampproofing of manhole to cure in accordance with the manufacturer's recommendations before commencing backfilling operations.

b. Avoid damaging any damp proofing coating during backfilling.

c. Immediately repair any damage to the damp-proof coating without additional cost.

2. Field Application of Dampproofing:

a. Allowed only with approval of Engineer

b. Verify existing conditions before starting work.

c. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.

d. Verify items which penetrate surfaces to receive dampproofing are securely installed.

e. Protect adjacent surfaces not to receive dampproofing.

f. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.

g. Apply bituminous material to seal penetrations, small cracks or minor honeycomb in substrate.

h. Prime surfaces in accordance with manufacturer's instructions.

i. Apply dampproofing with roller or as per manufacturer's instructions.

j. Allow each coat to dry before applying the next coat in accordance with the manufacturer's recommendations.

k. Apply from top of manhole below frame to bottom of manhole.

N. Manholes Located in Asphaltic Concrete Pavement or Outside Concrete Pavement: Build 4 foot by 4 foot concrete pad with reinforcing bars. Thickness of concrete dependent on depth of cast iron manhole frame, surfacing depth and as shown on the Drawings.

O. Drop Connections:

1. Construct drop connections at the locations indicated in Drawings or as directed by Engineer.

2. Use pipe, fittings, and connections of the same type as the existing, or as shown in Drawings.

P. Stub-out:

1. Construct manhole pipe stub-out at the locations indicated in Drawings or as directed by Engineer.

2. Stub-outs for future connections shall consist of a short length of pipe connected to the wall of the structure.

a. Unless otherwise indicated, the minimum length of the stub-out shall be five (5) feet.

3. The pipe shall have a spigot and a bell end. Finish the spigot end to be smooth and flush with the inside of the structure wall.

4. Plug bell end of stub-out using a watertight pipe plug acceptable to Engineer.

5. Install end of pipe marker of two inch PVC and four (4) foot length of ¼ inch diameter reinforcing steel in the ground, or as shown on the Drawings.

3.04 PIPE CONNECTIONS

A. Install and bed pipes, and connect to manhole.

1. Install pipe flush with inside wall of manhole structure.

2. Place bedding and pipe embedment material according to Drawings and Section 01 10 00 – Special Provisions.

3. Provide pipe joint, non-shear coupling, or other approved flexible coupling within 2 feet of structure wall to allow for differential settlement between the manhole and the pipe.

B. Waterstop Grouting Ring: Where Resilient Pipe Connector complying with ASTM C 923 are not installed in manhole wall, furnish and install waterstop grouting ring that surrounds pipe and attaches to the pipe with stainless steel band(s). The grouting ring gasket shall be installed on the pipe at the center of the manhole wall and shall be designed to stop the movement of water along the interface between a pipe and a surrounding non-shrink grout collar.

C. Cut and Chipped Opening (Knockout) in Manhole.

1. Saw opening to approximate dimensions with a masonry saw. Saw to depth sufficient to sever reinforcing steel.

2. Remove concrete and expand opening to a diameter at least 6 (six) inches larger than the outside diameter of the new pipe.

3. Cut off all reinforcing steel protruding from the structure wall.

4. Furnish and install a watertight seal (waterstop grouting ring) on the pipe.

5. Fill opening between structure wall and pipe with non-shrink grout.

3.05 INTERNAL OR EXTERNAL FRAME SEAL AND EXTENSION:

A. If required in Section 01 10 00 – Special Provisions, furnished and install an internal or external Manhole Frame Seal and Extension(s).

1. Furnish and install Manhole Frame Seals and Extension(s) in compliance with manufacturer's recommendation.

2. This work includes furnishing and installing internal or external manhole frame seals including sleeves, extensions, wedges, compression bands, expansion bands and tightening bands.

3. The surface preparation prior to installation of manhole frame seal shall be in accordance with manufacturer's instructions.

4. Extend seal a minimum of 3 (three) inches below the lowest adjustment ring.

5. Extend seal to a minimum of 2 (two) inches above the flange of the casting for a standard two piece casting, or to a minimum of 2 (two) inches above the top of the base section of the casting for an adjustable three piece casting.

6. Use multiple seals, extensions, if necessary.

7. Install compression bands (external frame seal) or expansion bands (internal frame seal) to lock the rubber sleeve or extension into place and to provide a positive watertight seal. Once tightened, lock bands into place. Use only manufacturer recommended installation tools and sealants.

8. Do not use external frame seal if the seal will be permanently exposed to sunlight.

3.06 BACKFILL AND COMPACTION

A. Inspect the pipe and structures before commencing backfilling operations to verify that all pipes and structures are undamaged, in the proper alignment at proper grade, and have not settled.

B. Place backfill material simultaneously on all sides of manhole so the fill is kept at approximately the same elevation at all times. Do not place backfill in a manner that creates unbalanced loading on the structure.

C. Compact the three (3) feet closest to manhole wall using pneumatic or hand tampers or other equipment and methods acceptable to Engineer. Such compaction to be done in uniform lifts not exceeding six (6) inches in compacted thickness.

D. Ensure proper and uniform compaction of backfill material around structure.

E. Avoid damaging any damp proofing coating, external manhole frame seals or other external appurtenances during backfilling. Immediately repair any damage without additional cost

F. Backfill material shall not contain frozen lumps, stones greater than two (2) inches in diameter, or other objectionable material, unless approved by Engineer in writing.

G. The completed backfill shall not yield under repeated loading by heavy trucks or equipment.

H. Using equipment and methods acceptable to Engineer, manipulate backfill materials having a moisture content outside the acceptable range to adjust to an acceptable moisture content.

I. When requested by Engineer, expose select locations for density and moisture content testing. Rework or remove and replace any materials that do not comply with compaction requirements.

3.07 CLEANING, INSPECTION, AND TESTING OF STRUCTURES

A. Cleaning:

1. Clean all manholes by removing sheeting, bracing, shoring, forms, soil sediment, concrete waste, and other debris.

2. Do not discharge soil sediment or debris to existing piping network/system.

B. Visual Inspection:

1. Examine structure for:

a. Proper placement of seals, gaskets, and embedments.

b. Groundwater infiltration or surface water inflow.

c. Damage to structure or castings.

d. Slipped forms.

e. Indication of displacement of reinforcement.

f. Porous areas or voids.

g. Repair:

(i) After visual inspection of the completed manhole; repair honeycomb areas, visible leaks, tie holes, or other damage areas. Remove concrete webs or protrusions.

(ii) Repair to eliminate any visible infiltration or inflow in manhole.

2. Verify that the structure is set to true line, grade, and plumb.

3. Verify structure dimensions and thicknesses.

C. Testing:

1. Notify Engineer a minimum of twenty-four (24) hours before scheduling testing. Do not perform any performance testing without Engineer present, unless approved by Engineer in writing.

2. Repeat testing after locating and correcting any deficient installations at no additional cost.

3. Manhole Vacuum Testing, ASTM C 1244.

a. Conduct final test after manhole construction is complete, all repairs and connections have been made, invert has been installed and backfill material has not been placed.

(i) Vacuum testing of a manhole that is backfilled shall not be done, unless approved by Engineer in writing.

(ii) CAUTION: Vacuum testing a backfilled manhole is not recommended, especially in the presence of ground water. Vacuum testing a manhole system that is already subjected to hydrostatic pressure may exceed the design limits of critical flexible connectors leading to a system failure.

b. Vacuum Test.

(i) Applicable only for new manholes isolated from connecting existing lines.

(ii) Use manufactured vacuum test equipment meeting Engineer's approval. Follow the testing equipment manufacturer's recommended procedures throughout.

(iii) Use extreme care and follow safety precautions during testing operations. Keep personnel clear of manholes during testing.

(iv) Seal all openings except manhole top access using pneumatic plugs rated for test pressures. Install plugs according to the test equipment manufacturer's recommendations.

(v) Install the vacuum tester head assembly on the manhole top access, and inflate the seal.

(vi) Evacuate the manhole to 5 psi vacuum. Close the isolation valve and start the test. Record the starting time.

(vii) Maintain vacuum in the manhole for the time indicated in Table 1 below for the diameter and depth of manhole being tested.

(viii) Test failure is indicated by vacuum loss greater than 0.5 psi within the minimum test time indicated in Table 1 following for the depth and diameter of the manhole being tested.

c. Repair:

(i) If any test fails, repair(s) shall be made and a retest shall be completed.

Table 1: Minimum Vacuum Test Times for Various Manhole Diameters

Depth feet	Pipe Diameter, inches				
	48"	54"	60"	66"	72"
	Time Seconds				
8'	20	23	26	29	33
10'	25	29	33	36	41
12'	30	35	39	43	49
14'	35	41	46	51	57
16'	40	46	52	58	67
18'	45	52	59	65	73
20'	50	53	65	72	81
22'	55	64	72	79	89
24'	59	64	78	87	97
26'	64	75	85	94	105
28'	69	81	91	101	113
30'	74	87	98	108	121

4. Written Report:

   a. Furnish a written report to Engineer covering the vacuum testing and the vacuum test results.

   b. The written report shall contain:

      (i) The location of each manhole tested.

      (ii) A written summary of the visual condition the manhole.

      (iii) A written record of the testing performed and test results, including test date and time(s) and test pressure(s).

      (iv) A written record of any repairs that were completed, if vacuum test failed, and results of retesting after repairs completed.

3.08 RECORD DRAWINGS:

A. Keep accurate location record of manholes.

B. Provide Engineer with minimum of 3 distance ties from the center of manhole cover to permanent topographical features (trees, buildings, fire hydrants, etc.).

C. If required, (See Section 01 10 00 – Special Provisions) provide Engineer, with GPS Coordinates of center of manhole frame and cover.

END OF SECTION

SECTION 33 41 11

STORM DRAINAGE PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Storm drainage piping, fittings and accessories.

B. Connection of drainage system to existing storm sewer system or open channel.

C. Manholes, junction boxes, grate inlet, curb inlets, drop curb inlets and area inlets.

1.02 REFERENCES

A. AASHTO M 36 – Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains; American Association of State Highway and Transportation Officials.

B. AASHTO M 170 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, ad Sewer Pipe.

C. AASHTO M 199 – Standard Specification for Precast Reinforced Concrete Manhole Sections.

D. AASHTO M 206 – Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, ad Sewer Pipe.

E. AASHTO M 207 – Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.

F. AASHTO M 232 – Standard Specification for Zinc Coating (Hot-Dip) On Iron and Steel Hardware.

G. AASHTO M 298 – Standard Specification for Coatings of Zinc Mechanically Deposited on Steel.

H. AASHTO M 294 – Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter.

I. ASTM C 14 – Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.

J. ASTM C 76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

K. ASTM C 443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

L. ASTM A 615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

M. ASTM A 929 – Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe.

N. ASTM D 698 – Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).

O. ASTM D 1056 – Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.

P. ASTM D 1556 – Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.

Q. ASTM D 1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).

R. ASTM D 1785 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

S. ASTM D 2167 – Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.

T. ASTM D 2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity – Flow Applications.

U. ASTM D 2729 – Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

V. ASTM D 2751 – Standard Specification for Acrylonitrile – Butadiene – Styrene (ABS) Sewer Pipe and Fittings.

W. ASTM D 6938 – Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

X. ASTM D 3034 – Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

Y. ASTM F 679 – Standard Specification for Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings.

Z. ASTM F 794 – Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

AA. ASTM F 894 – Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drains Pipe.

BB. ASTM F 949 – Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings.

1.03 UNIT PRICES

A. Pipe:

1. Method of Measurement:

a. Measured along centerline of pipe, to the nearest foot.

b. No deduction for junction boxes/manholes or fittings installed in the line.

2. Pay Unit: By the linear foot (LF) for each respective size and type of pipe.

a. Includes excavation, hand trimming excavation, pipe, placement, assembly, bedding, backfilling and compaction of backfill, testing and incidentals thereto.

b. Testing includes:

(i) Alignment testing of pipe.

(ii) Compacted density testing of backfill.

(iii) Concrete compressive strength testing.

(iv) Televising inspection.

B. Special Pipe Fittings (Elbows, Bends, Flared End Sections):

1. Method of Measurement and Pay Unit: By the unit, Each, for at the contract unit price for the various sizes in the accepted work.

2. Includes hand trimming excavation, bedding, backfilling, connection to pipe and incidentals thereto.

C. Manholes, Junction Boxes, Curb Inlets, Drop Curb Inlets and Area Inlets:

1. Method of Measurement and Pay Unit: By the unit, Each, for at the contract unit price for the various sizes in the accepted work.

2. Includes excavation, hand trimming excavation, bedding, backfilling, compaction, foundation pad, concrete, reinforcing steel manhole ring and cover, castings, inlet filter, erosion and silt control measures and incidentals thereto.

D. Connection to Existing Storm Drainage Pipe or Junction:

1. Method of Measurement and Pay Unit: By the unit, Each.

2. Includes excavation, hand trimming excavation, bedding, backfilling and compaction of backfill, adapters, fittings, thrust restraints, couplings, coring the wall of the structure, sleeves, gaskets and incidentals thereto.

E. Dewatering of Trench:

1. Dewatering, including intercepting and diverting site drainage and surface water flows away from excavations and trenches, and removing standing water from trench or excavation with a sump and pump shall be considered incidental and subsidiary to other items of work for which direct payment is made.

2. Includes providing all permits required for the dewatering and paying all permit costs, pump, piping, wells and/or well points, dewatering equipment, assembly and disassembly, backfilling and compaction of backfill, energy cost and incidentals thereto.

F. Erosion Control Measures:

1. Method of Measurement and Payment: Subsidiary to items in which direct payment is made.

2. Erosion control measures include before, during and after construction.

G. TV Inspection:

1. Considered to be a subsidiary item included in the cost of the item for which payment is made.

1.04 DEFINITIONS

A. Bedding: Fill placed under, beside and directly over pipe prior to subsequent backfill operations.

1.05 SUBMITTALS

A. Product Data: Provide data indicating pipe and pipe accessories.

B. Manufacturer's Installation Instructions: Indicate special procedures required to install products specified.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Project Record Documents:

1. Record location of pipe runs, connections and invert elevations.

2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

E. Testing:

1. Alignment and Deflection Test of Pipe, provide copy of Test Records to Engineer.

2. Televising of Storm Drainage Pipe, provide copy of Televising to Engineer.

PART 2 - PRODUCTS

2.01 PIPE FOR CULVERTS AND STORM DRAINS

A. Reinforced Concrete Pipe (RCP):

1. Round RCP

a. Conform to ASTM C76 and AASHTO M 170.

b. Thickness/Rating: Class III, minimum, Wall B.

2. Arch RCP

a. Conform to ASTM C506 and AASHTO M 206.

b. Thickness/Rating: Class A-III, minimum.

3. Elliptical RCP

a. Conform to ASTM C507 and AASHTO M 207.

b. Thickness/Rating: Class HE-III, minimum (horizontal orientation).

4. Joints: Tongue and Groove

a. Seal joints with cold-application material of either a single component or multiple component type. Material shall conform to either ASTM C 877 or C 990 standards.

5. Joints: O-Ring or Gasketed

a. Pipes using O-ring or profile gaskets may be substituted for tongue and groove pipes at no additional cost to the Owner.

b. The design of rings or gasketed joints and the physical requirements for preformed flexible joint sealants shall conform to ASTM C 990, and rubber-type gaskets shall conform to ASTM C 443.

(i) The base polymer shall be a blend of neoprene and EPDM meeting the physical requirements of ASTM D 1056, Class 2C2.

(ii) The closed cell rubber shall meet the ozone testing requirement of ASTM D 1171 of seventy (70) hours at forty degrees Celsius (40^{o} C) at 100 PHM, bent loop with no cracks and shall have a quality retention rating of not less than 70 percent when tested for weather resistance.

(iii) Each seal shall be completely covered with a natural skin and shall be assembled into a continuous ring which shall conform to the joint size and shape.

(iv) Cross sectional dimensions shall conform to RMA Class II tolerances and installation shall be in accordance with the manufacturer's recommendations.

B. Corrugated Metal Pipe (CMP):

1. Corrugated Steel Pipe, Pipe Arches and Underdrains:

a. Conform to AASHTO M36, Type I, or ASTM A 929 steel circular section with annular or helical corrugations.

b. Zinc-coated steel or aluminum-coated steel materials shall not be mixed in any installation.

c. Bolts, nuts, washers and other hardware used with coupling bands galvanized AASHTO M232 or mechanically galvanized AASHTO M298, Class 50.

d. Minimum Gauge or Sheet Thickness for Steel Culverts:

Nominal Diameter (Inches)	Sheet Thickness Gauge (Inches)
8 thru 24	16 (0.057)
30 thru 36	14 (0.072)
42 thru 54	12 (0.101)
60 thru 72	10 (0.129)
Over 72	8 (0.168)

2. Connecting Bands: Connecting bands shall be of the type, size and sheet thickness of band, and the size of angles, bolts, rods and lugs as indicated or where not indicated as specified in the applicable standards or specifications for the pipe. Exterior rivet heads in the longitudinal seam under the connecting band shall be countersunk or the rivets shall be omitted and the seam welded. Connecting bands with annular or helical corrugations to match pipe ends.

C. Plastic Pipe:

1. Polyvinyl Chloride (PVC):

a. PVC plastic meeting ASTM D1784, minimum cell class 12454-B.

b. Minimum pipe stiffness of 46 psi.

c. Integral bell and spigot joints with elastomeric seals according to ASTM D 3212 and ASTM F 477.

d. Solid/Smooth Wall PVC Pipe

(i) Conform to ASTM D 3034 and ASTM F 679.

(ii) Thickness/Rating: SDR 35, minimum.

e. Profile PVC Pipe

(i) Smooth interior and ribbed exterior.

(ii) Conform to ASTM F 794, Series 46.

f. Corrugated PVC Pipe

(i) Smooth interior and corrugated exterior.

(ii) Conform to ASTM F 949.

g. Composite Pipe

(i) Conform to ASTM D 2680.

2. High Density Polyethylene Pipe (HDPE) and Fittings:

a. Conform to AASHTO M294, Type S, corrugated exterior and smooth interior.

b. HDPE material meeting ASTM D 3350, minimum cell class 335420 C.

c. Minimum pipe stiffness at 5% deflection according to ASTM D 2412.

d. Integral bell and spigot joints with elastomeric seals complying with ASTM F 477.

e. Corrugated HDPE Pipe

(i) Conform to AASHTO M252 and M294, Type C or S.

(ii) Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 335420C.

f. Profile Wall HDPE Pipe

(i) Conform to AASHTO F 894.

(ii) Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 335434C.

g. Closed-Cell Synthetic Expanded Rubber Gaskets: ASTM D 1056, Grade 2A2.

2.02 PIPE ACCESSORIES

A. Fittings: Same material as pipe molded or formed to suit pipe size and joint design.

B. Concrete Flared-End Sections:

1. AASHTO M170, Class III.

2. AASHTO M206, Class A-III.

3. AASHTO M207, Class HE-III.

C. Metal Flared-End Sections:

1. Steel Flared-End Sections: AASHTO M36 or ASTM A 929. Galvanized bolts, nuts, washers and other hardware items used with coupling bands, AASHTO M232 or mechanically galvanized, AASHTO M298, Class 50.

2. Minimum gauge or sheet thickness for steel flared-end sections same as pipe culverts.

2.03 MANHOLES, JUNCTION BOXES, CURB INLETS, DROP CURB INLETS AND AREA INLETS

A. Concrete:

1. Minimum Compressive Strength: 3,500 psi.

2. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches.

B. Reinforcing Steel:

1. ASTM A 615: Grade 60 deformed billet-steel bars.

C. Precast Reinforced Concrete Round Manhole Riser:

1. Refer to Section 33 39 14 – Manholes and Covers.

2. Conform to AASHTO M199.

D. Precast Reinforced Concrete Box: Manufactured in accordance with and conforming to ASTM C 1433.

E. Cast-In-Place Concrete Structures:

1. The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground.

2. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

3. Base and Deck shall be set level at elevations shown to receive concrete wall section(s), riser blocks and castings.

F. Steps

1. Comply with ASTM C 478 and all OSHA requirements.

2. Manufacture using polypropylene encased steel.

3. 1/2 inch diameter Grade 60 deformed steel reinforcing bar encapsulated in molded copolymer polypropylene ASTM C 478, ASTM D 4101 and ASTM A 615.

4. 10 inches nominal step tread width.

5. Provide steps in all structures unless specified otherwise.

G. Precast Concrete Segmental Blocks: Precast concrete segmental block shall conform to ASTM C 139, not more than 8 inches thick, not less than 8 inches long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

H. Castings:

1. Shall be iron, ferrous casting, smooth, well cleaned by shot blasting, uniform quality, free of blowholes, shrinkage, distortion or other defects, machined horizontal bearing surfaces made from cast gray iron, ASTM A 48, Class 35B or cast ductile iron, ASTM A 536, Grade 65-45-12.

2. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated in the Drawings and following Specifications.

3. All frames and covers shall be machined so that each cover will fit properly in its frame with no rocking. No casting will be accepted that is warped, cracked, has swells, or that has been plugged or filled.

4. Load Capacity:

a. Castings rated to meet requirements for H-20 traffic loading.

b. Submit certification on the ability of frame and cover or gratings to carry the imposed live load.

2.04 MORTAR

A. Mortar for pipe joints, connections to other drainage structures, and block construction shall conform to the requirements of ASTM C 270.

1. Type S or M

2. 28 day Compressive Strength: 1,800 psi, minimum

3. Mix Proportions: 1 part mortar to 2-1/4 to 3 parts sand

4. Water Retention: 75%, minimum

2.05 BEDDING

A. The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

B. Concrete Pipe Requirements: When no bedding class is specified or detailed on the Drawings, concrete pipe shall be bedded in granular material minimum 4 inch in depth in trenches with soil foundation. Depth of granular bedding in trenches with rock foundation shall be 1/2 inch in depth per foot of depth of fill, minimum depth of bedding shall be 8 inch up to maximum depth of 24 inches. The middle third of the granular bedding shall be loosely placed. Bell holes and depressions for joints shall be removed and formed so entire barrel of pipe is uniformly supported. The bell hole and

depressions for the joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

C. Corrugated Metal Pipe Requirements: When no bedding class is specified or detailed on the Drawings, bedding for corrugated metal pipe and pipe arch shall be in accordance with ASTM A 798. It is not required to shape the bedding to the pipe geometry. However, for pipe arches, either shape the bedding to the relatively flat bottom arc or fine grade the foundation to a shallow v-shape.

D. Plastic Pipe Requirements: When no bedding class is specified or detailed on the Drawings, bedding for PVC, PE, SRPE and PP pipe shall meet the requirements of ASTM D 2321 and manufacturer's recommendations. Use Class IB or II material for bedding, haunching, and initial backfill. Use Class I, II, or III material for PP pipe bedding, haunching and initial backfill.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify measurements at site; make necessary field measurements to accurately determine pipe makeup lengths or closures.

B. Examine site conditions to ensure construction operations do not pose hazards to adjacent structures or facilities.

3.02 TRENCHING

A. Refer to Section 31 23 33 – Trenching for Utilities.

3.03 INSTALLATION - PIPE

A. Verify that trench excavation cut is ready to receive work and excavation dimensions and elevations are as indicated in the Drawings.

B. Install pipe, fittings and accessories in accordance with manufacturer's instructions.

C. Seal joints soil-tight.

D. Install piping system beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions.

E. Lay pipe to slope gradients noted in the Drawings.

F. The open end of the pipes shall be protected at all times against the entrance of earth or other foreign material.

G. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary.

H. Reinforced Concrete Pipe (RCP):

1. Place pipe such that joint openings on the outside or inside of the pipe do not exceed 1/8 inch at the bottom and 5/8 inch at the top.

2. Mortar:

a. The mortar shall be used within 30 minutes after the ingredients are mixed with water.

b. After each pipe has been laid and firmly bedded in place, tongue and groove exterior joints, lift holes and other voids shall be completely filled with mortar.

c. If the pipes are tongue and groove construction and are 36 inches in diameter or larger, the joint space on the inside surface of the pipe shall be wiped clean, completely filled with mortar and finished smooth.

d. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

3. If a rubber O-ring or profile gasket is utilized for RCP, coat the rubber gasket and joint with soap-based lubricant immediately prior to closing the joint.

4. Fill lift holes of concrete pipe with cement mortar, precast concrete or plastic plugs.

I. Connect to storm sewer system or open channel.

J. Install erosion and silt control measures to keep pipe free from silt.

3.04 INSTALLATION - MANHOLES, JUNCTION BOXES, CURB INLETS, DROP CURB INLETS AND AREA INLETS

A. Form bottom of excavation clean and smooth to correct elevation.

B. Form and place cast-in-place concrete base pad with provision for storm sewer pipe end sections.

C. Level top surface of base pad; sleeve concrete shaft sections to receive storm sewer pipe sections.

D. Establish elevations and pipe inverts for inlets and outlets as indicated.

E. All wall forms shall be cast-in-place using form panels or surfaces cabable of producing a uniform surface, texture and appearance at least equal to that obtained by using plywood form panels of good condition as specified in Specification Section 03 30 00 Cast-In Place Concrete.

F. Use of excavated earth back form shall not be permitted. All walls shall be formed with form panels.

G. Mount lid and frame level in grout, secured to top section to elevation indicated.

H. Install erosion and silt control measures to keep inlet structure free from silt.

3.05 PROTECTION

A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

B. Protect pipe and drainage structures from the entry of silt. Contractor to install appropriate erosion control and silt control measures during and after construction. Contractor to remove any accumulated silt prior to the acceptance of the project.

3.06 PIPING ALIGNMENT TOLERANCE

A. Apply the following tolerances for piping installed by open trench construction or installed inside a casing pipe.

B. General alignment shall be checked using televised inspection of all gravity mains greater than 20 linear feet, and must be completed prior to paving.

C. Maximum allowable horizontal and vertical alignment variance from design line and grade shall be the greater of:

1. +/- 5% of the inside diameter of the pipe.

2. or +/- 1/2 inch.

D. Maximum allowable reverse slope (sag) in gravity main shall be that which causes a standing water depth of 1" or 10% of the inside diameter of the pipe, whichever is greater, at any point along the line.

E. Remove and reinstall pipe to proper grade where there is standing water greater than the maximum allowable depth.

F. Sags shall only be allowed where entering and exiting grades are adequate to provide a velocity of 2 feet per second or more.

3.07 CLEANING STORM DRAINAGE PIPES

A. Plug downstream manholes.

B. Flush and clean drainage lines and manholes prior to testing.

C. Remove debris at junctions and manholes.

D. Do not allow debris to enter existing drainage system.

3.08 FIELD QUALITY CONTROL

A. Refer to Section 31 23 33 – Trenching for Utilities.

B. Perform televised inspection of completed storm sewer system at Contractor's expense.

1. If tests indicate work does not meet specified requirements, remove defective materials/work and replace and retest; and/or take necessary remedial action and retest, all at no cost to Owner.

3.09 PIPING ALIGNMENT AND DEFLECTION TESTING

A. Provide alignment and deflection test 30 days or more after backfilling trench.

B. Alignment shall be checked by providing a televised inspection of completed storm drainage pipe performed by testing laboratory, independent Contractor or method approved by Engineer.

1. Televised inspection shall include:

a. Digital recording, in a format agreed upon by Owner and Engineer.

b. Written log of location of:

(i) Location of defects in pipe or joints.

(ii) Location of debris in pipe.

(iii) Location of any sag.

(iv) Other notable items in pipe

c. Defective Materials and/or Workmanship:

(i) Acceptance based on televised inspection.

(ii) Repair defects in pipe.

(iii) Replace damage materials.

(iv) Repeat TV inspection, until satisfactory results are obtained.

C. Deflection testing: Use rigid ball or mandrel having not less than 95 percent of base inside diameter or average inside diameter of pipe depending on which is specified in ASTM to which the pipe is manufactured.

1. Allowable Deflection: 5 percent or less.

2. Mechanical pulling devices not allowed.

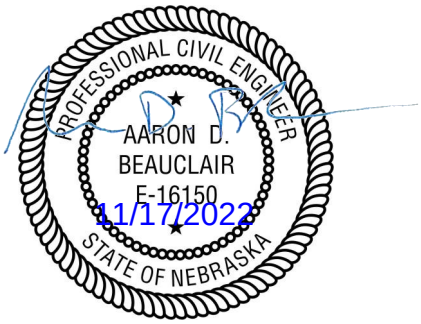
3. Defective Materials and/or Workmanship:

a. Locate and correct misaligned and/or deflected sections.

b. Replace damaged or defective materials.

c. Repeat alignment and deflection test, until satisfactory results are obtained.

END OF SECTION



THIS PAGE CONCLUDES

THE

SPECIFICATIONS

FOR THE

2022 CAMPGROUND IMPROVEMENTS

FOR

DAVID CITY, NEBRASKA