

CITIZENS ENERGY GROUP

I-69 SECTION 6.5 SANITARY SEWER CONFLICT RELOCATIONS IN-CONTRACT



Jeff Glover

05/12/2020

Prepared by:
Black & Veatch Corporation
Citizens Project No. 92RE04119

May 2020

CITIZENS ENERGY GROUP
I-69 SECTION 6.5 SANITARY SEWER CONFLICT RELOCATIONS IN-CONTRACT
SPECIFICATIONS

TABLE OF CONTENTS

<u>Section No.</u>	<u>Section Title</u>
<u>DIVISION 1</u>	GENERAL REQUIREMENTS
01010	Summary of Work
01011	Site Conditions
01015	Archaeological Finds
01025	Measurement and Payment
01050	Construction Engineering
01060	Reference Standards
01300	Contractor Submittals
01311	Construction Schedule
01318	Meetings
01320	Construction Progress Documentation
01380	Preconstruction Audio-Video Documentation
01400	Quality Control
01500	Temporary Construction Facilities
01505	Mobilization and Demobilization
01520	Security
01526	Trench Safety System
01530	Protection of Existing Facilities
01560	Environmental Controls
01570	Traffic Maintenance
01620	Product Delivery, Storage, and Protection
01740	Warranties and Guarantees
01800	Permits and Regulatory Requirements
01910	Weather Protection Standard
01940	Substitutions
01980	Close-Out Procedures
<u>DIVISION 2</u>	SITE WORK
02070	Concrete Coring
02075	Contaminated Soil Removal
02100	Site Preparation
02125	Erosion and Sediment Control
02140	Control of Groundwater and Surface Water
02150	Shoring for Surface Structures and Open Cut
02200	Excavation and Backfill
02205	Trimming and Fine Grading
02210	Controlled Low Strength Material
02215	Sewer Video Recording and Inspection
02216	Sewer Cleaning
02245	Geotextiles
02336	Horizontal Directional Drilling Installation
02343	Temporary Support

CITIZENS ENERGY GROUP
I-69 SECTION 6.5 SANITARY SEWER CONFLICT RELOCATIONS IN-CONTRACT
SPECIFICATIONS

TABLE OF CONTENTS

02470	Pre- and Post- Construction Inspections
02510	Roadways, Driveways, Walks and Cubing
02535	Bypass Pumping
02550	Gravity Sanitary Sewer Pipe
02560	Sanitary Sewer Force Mains & Low Pressure Sewer (LPS)
02702	Sewer Pipe Installation and Testing
02730	Sanitary Laterals
02900	Restoring Lawns and Landscaping
02920	Topsoil

DIVISION 3 CONCRETE AND SHOTCRETE

03200	Steel Reinforcement
03290	Joints in Concrete
03300	Cast-In-Place Concrete
03315	Ancillary Grout
03400	Precast Concrete Structures

DIVISION 5 METALS

05500	Metal Fabrications
-------	--------------------

DIVISION 11 EQUIPMENT

11105	Grinder Pump Station Unit
-------	---------------------------

DIVISION 15 MECHANICAL

15101	Valves and Appurtenances
-------	--------------------------

LIST OF ATTACHMENTS

01300A	Partial Submittals List
	Citizens Energy Group Sanitary Standards Manual

SECTION 01010 – SUMMARY OF WORK

PART 1 - GENERAL

1.1 GENERAL DESCRIPTION OF THE WORK

- A. The Work to be performed under this Contract shall consist of furnishing tools, equipment, materials, supplies, and manufactured articles, and furnishing all labor, transportation, and services, including fuel, power, water, and essential communications, and performing all work or other operations required for the fulfillment of the Contract in accordance with the Contract Documents. The Work shall be complete, and all work, materials, and services not expressly indicated or called for in the Contract Documents, which may be necessary for the complete and proper construction of the Work in good faith, shall be provided by CONTRACTOR as though originally so indicated, at no increase in cost to OWNER.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of this Contract comprises the construction of the I-69 Section 6.5 Sanitary Conflict Relocations, a sewer design project consisting of the following major components:
1. Conflict #2: Located at approximately S.R. 37 and S. Belmont Avenue. Includes abandonment of an existing 18-inch diameter PVC sewer located between existing Manhole #410645 and existing Manhole #410643 and installation of replacement 18-inch diameter, PVC sewer along an alignment avoiding structures within the proposed I-69 limited access right-of-way. Project also includes 30-inch diameter steel casing of the sewer beneath the proposed interstate right-of-way and approximately 60-inch diameter pre-cast manholes.
 2. Conflict #3: Located at Southport Road, approximately 750 feet east of S.R. 37. Includes abandonment of an 8-inch force main serving Lift Station 223 to be relocated along a parallel alignment to the east and buried at a depth to ensure sufficient ground cover following re-grading in the area.
 3. Conflict #5 & #6: Located at approximately S.R. 37 south of W. Edgewood Avenue. Includes abandonment of an existing 12-inch diameter VCP sewer located between existing Manhole #760087 and approximately 425 feet east of Manhole #760091 and installation of replacement 12-inch diameter, PVC sewer along an alignment avoiding structures within the proposed I-69 limited access right-of-way. Project also includes 24" diameter steel casing of the sewer beneath the proposed interstate right-of-way and 48-inch diameter pre-cast manholes.

4. Conflict #7: Located on the west side of S.R. 37 from approximately 200 feet south of Edgewood Avenue to approximately 1,000 feet north of Edgewood Avenue along S. Belmont Avenue. Includes abandonment of the existing 8-inch PVC sanitary sewer between existing Manhole #760215 and Manhole #760208 along the existing S. Belmont Avenue right-of-way between 6020 S. Belmont Avenue and 5970 S. Belmont Avenue and installation of 1-1/4-inch diameter HDPE low-pressure sewer pipe and associated valving and lateral connections from a new grinder pump station assembly at 5970 S. Belmont Avenue and 6016 S. Belmont Avenue to the discharge point at Manhole #760208.
5. Conflict #15: Located at approximately I-465 WB and the exit to Mann Road. Includes abandonment of an existing 8-inch diameter PVC sewer located between existing Manhole #710818 and Manhole #710176 and installation of replacement 8-inch diameter, PVC sewer along an alignment avoiding structures within the proposed I-69 limited access right-of-way. Project also includes 48-inch diameter pre-cast manholes and removal of Manhole #710176.
6. Conflict #16: Located at I-465 EB at Manhole # 711112 west of the White River. Includes abandonment of an existing 18-inch diameter RCP sewer located between existing Manhole #711112 and existing CSO Outfall No. 275, and installation of replacement 18-inch diameter, RCP sewer along an alignment avoiding structures within the proposed I-69 limited access right-of-way. Project also includes 60-inch diameter pre-cast manholes, an inline check valve installed within a proposed manhole, and a new CSO outfall structure with pre-cast concrete end section per INDOT standards.
7. Conflict #21: Located at approximately the intersection of W. Thompson Road and Concord Street. Includes abandonment of existing 15-inch diameter RCP sewer located South of existing Manhole #760098, and abandonment of existing Manhole #760098. Project also includes installation of 60-inch diameter doghouse manhole.
8. Conflict #22: Located at Wellingshire Drive, immediately south of Southport Road. Includes adjusting existing Manhole #410547 and its casting to the proposed grade elevation.
9. Conflict #23: Located at the northwest quadrant of the intersection of Southport Road and S.R. 37. Includes abandonment of the sewer service laterals north and south of the existing 8" PVC sewer main between Manhole #7600393 and Manhole #760395 EXCEPT sewer lateral running north, which services the Changes in Latitude, LLC property. This service lateral, the existing 8" PVC sewer main, and Manholes #7600393 and #7600394 are to be protected in place. Abandonment of Manhole #7600395. Install of a new, 48-inch diameter, doghouse manhole located approximately 6 feet east of the existing service lateral leading to the Changes in Latitude, LLC property. This will be the new termination point of the sewer.

10. Conflict #25: Located at the intersections of Bluff Road and S. Belmont Avenue at Wicker Road, east of S.R. 37. Includes installation of 2-inch diameter HDPE low-pressure sewer pipe and associated valving and lateral connections from new grinder pump station assemblies at 8314, 8336, 8340, 8344, 8350, 8410, 8436, 8450, and 8438 S. Belmont Avenue to the discharge point at a proposed 12-foot diameter pre-cast manhole structure on the existing South Marion County Regional Interceptor (SMCRI) near Bluff Road.

1.3 CONTRACT METHOD

- A. The Work hereunder will be constructed under a unit price contract with a not-to-exceed value.

1.4 WORK BY OTHERS

- A. Interference With Work On Utilities:

1. CONTRACTOR shall cooperate fully with all utility forces of OWNER or forces of other public or private agencies engaged in the relocation, altering, or otherwise rearranging of any facilities which interfere with the progress of the Work, and shall schedule the Work so as to minimize interference with said relocation, altering, or other rearranging of facilities. OWNER will initialize contact with utilities. Further details regarding protection of existing utilities and other facilities are provided in Section 01530 – Protection of Existing Facilities.

1.5 WORK SEQUENCE

- A. No interruption of the existing sewer system shall be allowed during the time period defined in the Contract. CONTRACTOR shall set up bypass to the system as necessary. CONTRACTOR shall submit Bypass Flow Control Quality Work Plan per Section 01400 – Quality Control prior to beginning of any bypass work.

1.6 CONTRACTOR USE OF SITE

- A. Unless otherwise specified, CONTRACTOR's use of the Site shall be limited to its construction operations, including on-Site storage of materials and on-Site fabrication facilities. Also see the Construction Contract.

1.7 OUTAGE PLAN AND REQUESTS

- A. Unless the Contract Documents indicate otherwise, CONTRACTOR shall not remove from service, de-energize, or modify settings for any existing operating tank, pipeline, valve, channel, equipment, structure, road, or any other facility without permission from CONSTRUCTION INSPECTOR and OWNER.

1. CONTRACTOR to supply temporary service prior to any scheduled service outage.

- B. Where the Work requires modifications to existing facilities or construction of new facilities and connection of new facilities to existing facilities, CONTRACTOR shall submit a detailed outage plan and schedule for CONSTRUCTION INSPECTOR's approval a minimum of two weeks in advance of the time that such outage is planned.

- C. A completed system outage request shall accompany each outage plan. The outage plans shall be coordinated with the construction schedule and shall meet the restrictions and conditions of the Contract Documents. The outage plan shall describe CONTRACTOR's method for preventing bypassing of other treatment units; the length of time required to complete said operation; any necessary temporary power, controls, instrumentation, or alarms required to maintain control, monitoring, and alarms for the treatment plant processes; and the manpower, plant, and equipment which CONTRACTOR will furnish for proper operation of associated treatment units. All costs for preparing and implementing the outage plans shall be at no increase in cost to OWNER.
- D. CONSTRUCTION INSPECTOR shall be notified in writing at least seven days in advance of the required outage if the schedule for performing the Work has changed or if revisions to the outage plan are required.
- E. CONTRACTOR shall provide written confirmation of the shutdown date and time two working days prior to the actual shutdown.

1.8 OWNER USE OF THE SITE

- A. OWNER may utilize all or part of the existing Site facilities during the entire period of construction for the conduct of OWNER's normal operations. CONTRACTOR shall cooperate and coordinate with OWNER to facilitate OWNER's operations and to minimize interference with CONTRACTOR's operations. In any event, OWNER shall be allowed access to all existing facilities on the Site for OWNER's normal operations during the period of construction.

1.9 PROJECT MEETINGS

- A. See Section 01318 – Meetings.

1.10 NOTIFICATION TO RESIDENTS OF PENDING CONSTRUCTION

- A. At each construction area, open cut area, and area where construction activities will be ongoing on the surface, CONTRACTOR shall work through OWNER to notify in writing the residents and businesses of a street and in an easement on which sewer construction is to take place at least one week in advance of said construction. CONTRACTOR shall work through OWNER to distribute leaflets or door hangers to each resident on the street, and such notification shall indicate the approximate date and nature of construction in the area.
- B. At each street that will be affected by truck traffic or general re-routing due to the project, CONTRACTOR shall work through OWNER to notify the affected residents and businesses at least one week in advance of said construction. CONTRACTOR shall work through OWNER to distribute leaflets or door hangers to each resident on the street, and such notification shall indicate the approximate date and nature of construction in the area.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION 01010 -

SECTION 01011 – SITE CONDITIONS

PART 1 - GENERAL

1.1 SITE INVESTIGATION AND REPRESENTATION

- A. CONTRACTOR acknowledges it has satisfied itself as to the nature and location of the Work; the general and local conditions, particularly those bearing on access to the site, availability of transportation, disposal, handling, and storing materials; availability of labor, water, electric power, and roads; uncertainties about weather, river stages, or similar physical conditions at the site; the ground conformation and conditions; the character of equipment and facilities needed preliminary to and during the prosecution of the Work; and all other matters which can in any way affect the Work or the cost thereof under this Contract.
- B. CONTRACTOR acknowledges it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials and groundwater to be encountered from inspecting the site and from evaluating information derived from exploratory work which may have been done by OWNER as presented in the Geotechnical Engineering Investigation, and from information presented herein, as a part of these Contract Documents. Any failure by CONTRACTOR to acquaint itself with all the available information will not relieve CONTRACTOR from responsibility for properly estimating the difficulty or cost to successfully perform the Work. Neither OWNER nor ENGINEER assumes responsibility for any conclusion or interpretation made by CONTRACTOR on the basis of the information made available by OWNER or ENGINEER.
- C. By submitting a Proposal, CONTRACTOR acknowledges it has read and understands the Report of Geotechnical Exploration for the I-69 Section 6.5 Sanitary Sewer Conflict Relocations Project dated March 2020, and any and all addenda to such, and CONTRACTOR has incorporated any and all necessary work and cost associated with the geotechnical conditions.

1.2 EROSION CONTROL

- A. Construction site erosion control must comply with the applicable construction site erosion control plan and permit.

1.3 LINE AND GRADE

- A. Comply with Section 01050 – Construction Engineering and Section 01400 – Quality Control.

1.4 PROFILE ELEVATIONS

- A. Existing ground profiles shown on the Contract Drawings were plotted from field surveys by others.

1.5 EXISTING UTILITIES

- A. Comply with the Construction Contract.

1.6 RESPONSIBILITY FOR UTILITY PROPERTIES AND SERVICE

- A. Comply with the Construction Contract.
- B. Neither OWNER nor its officers or agents shall be responsible to CONTRACTOR for damages resulting from CONTRACTOR's failure to protect utilities encountered in the Work.
- C. CONTRACTOR shall at all times provide unobstructed access to fire hydrants, underground conduits, manholes, and water and gas valve boxes.
- D. Where CONTRACTOR's operations could cause damage or inconvenience to railway, fiber optic cable, telegraph, telephone, television, power, oil, gas, water, sewer, irrigation, or other systems adjacent or near the Work, no operations shall be commenced until CONTRACTOR has made all arrangements necessary to protect these utilities and services and CONSTRUCTION INSPECTOR has been notified of these arrangements.
- E. Notify CONSTRUCTION INSPECTOR and all utility offices affected by the construction operation at least 15 days before commencing construction operations. CONTRACTOR shall not expose any utility without first obtaining permission from the appropriate agency and notifying CONSTRUCTION INSPECTOR of this permission. Once permission has been granted, locate and, if necessary, expose and provide temporary support and/or relocation in advance of operations.
- F. Protect all utility poles from damage. If interfering utility poles or guide wires are encountered, CONTRACTOR shall notify CONSTRUCTION INSPECTOR and the appropriate utility company before construction operations begin to permit the necessary arrangements for protecting or relocating the interfering poles' installations.
- G. CONTRACTOR shall be solely and directly responsible to OWNER and operators of such utility properties for any damage, injury, expense, loss, inconvenience, delay, suits, actions, or claims of any character brought due to any injuries or damage which may result from the construction operations under this Contract.
- H. In the event of interruption to domestic water, sewer, storm drain, or other utility services resulting from accidental breakage due to construction operations, promptly notify the proper authority and inform CONSTRUCTION INSPECTOR. Cooperate with said authority in restoring service as promptly as possible, and bear all repair costs without extending the construction schedule. In no event shall interruption of any water or utility service be allowed unless prior approval is granted by the utility owner.
- I. CONTRACTOR shall replace, at its own expense, any and all other existing utilities removed or damaged during construction, unless otherwise provided for in these Contract Documents.

1.7 RELOCATIONS REQUIRED BY CONSTRUCTION

- A. Where existing utilities, structures, or other physical obstructions block or impede construction under this Contract, they shall be relocated in accordance with Section 02015 – Utility Relocation. Such relocations shall be considered as required by construction. All other relocations shall be treated in accordance with Paragraph 1.9.A.
- B. CONTRACTOR shall give immediate notice to CONSTRUCTION INSPECTOR and the owner of the utility when a physical conflict is determined to exist. Any delays resulting from the required utility relocations are CONTRACTOR's responsibility.

1.8 UTILITY INTERFERENCES INCIDENTAL TO CONSTRUCTION

- A. Comply with the Construction Contract.

1.9 SERVICES AND UTILITIES IN THE WORK AREA

- A. A list with the major services and utilities is included in the Contract Drawings, indicating the name and telephone number of the contact person to be notified prior to commencing any work and if conflicts or emergencies arise during the Work progress. CONTRACTOR is responsible for coordinating all utility work with the affected utility companies. CONTRACTOR is responsible for meeting the project completion time and coordinating all utilities to complete the Work within the project timetable.

1.10 FIELD RELOCATION

- A. During the Work progress, minor Work relocations may be necessary. Such relocations shall be made only with CONSTRUCTION INSPECTOR's agreement. If existing structures are encountered which will prevent construction as shown, notify CONSTRUCTION INSPECTOR before continuing with the Work so CONSTRUCTION INSPECTOR may make such field revisions as necessary to avoid conflict with the existing structures. If CONTRACTOR shall fail to notify CONSTRUCTION INSPECTOR when an existing structure is encountered and proceeds with the Work despite this interference, CONTRACTOR shall be responsible for any damage that may occur.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION 01011 -

SECTION 01015 – ARCHAEOLOGICAL FINDS

PART 1 - GENERAL

1.1 SCOPE

- A. It is the intent of this Section to provide for the preservation and protection of such material of an archaeological or paleontological nature as may be of scientific or historical value, to provide for expeditious protection, removal, or investigation of such material, and to provide CONTRACTOR such compensation or relief as may be appropriate for unforeseen Work or for work stoppage directed by OWNER under the provisions of this Section.

1.2 DEFINITIONS

- A. Archaeological Finds are defined as evidence of human occupation or use of an area within the Contract limits prior to the year 1840. Such evidence may consist of skeletons, stone, utensils, or other indications of habitations or structures.
- B. Paleontological Finds are defined as evidence of prehistoric plant or animal life, such as skeletons, bones, fossils, or casts and other indications such as pictographs.

1.3 FINDS

- A. Should Finds be made within the Contract limits, CONTRACTOR shall immediately stop Work in the vicinity of the Find and notify CONSTRUCTION INSPECTOR. Work in other areas may continue without interruption unless otherwise directed by CONSTRUCTION INSPECTOR.
- B. CONSTRUCTION INSPECTOR may order Work stopped in other areas if, in CONSTRUCTION INSPECTOR's opinion, the Find is more extensive than may appear from uncovered material.
- C. Protection of Finds:
 1. Cover, fence, or otherwise protect all Finds, as determined by CONSTRUCTION INSPECTOR, until written notice has been provided by CONSTRUCTION INSPECTOR to resume Work.
 2. Cover the Find with plastic film held in place by earth, rocks, or other weights placed outside the Find unless otherwise directed by CONSTRUCTION INSPECTOR. Should additional backfilling be necessary for safety or to prevent caving, place backfill material loosely over the plastic film.
 3. Divert surface runoff away from the Find by ditching or such other means acceptable to CONSTRUCTION INSPECTOR. Refer to Section 02125 – Erosion and Sediment Control, for erosion control requirements.

4. Place a temporary fence to prevent unauthorized access when determined necessary by CONSTRUCTION INSPECTOR.
5. Dewater Finds made below the water table as directed by CONSTRUCTION INSPECTOR.

D. Removal of Finds:

1. All Finds are the property of OWNER. Do not remove or disturb Finds without OWNER's written authorization.
2. Should OWNER elect to have a Find removed, provide such equipment, labor, and material acceptable to CONSTRUCTION INSPECTOR to permit the removal of the Find without damage.

- E. No further disturbance of the deposits shall ensue until CONTRACTOR has been notified by CONSTRUCTION INSPECTOR that Work may proceed. Compensation to CONTRACTOR to avoid the Find shall be determined in accordance with the provisions of the Construction Contract.

1.4 EXTENSION OF TIME OF COMPLETION

- A. Should the critical path for completion of Work for this Contract be delayed beyond the required time of completion solely due to a stop-work order issued by OWNER under the provisions of this Section, the time for completion will be appropriately extended as provided in the Construction Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION 01015 -

SECTION 01025 – MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Payment for all Work in compliance with the Contract Documents, inclusive of furnishing all manpower, equipment, materials, transportation, and performance of all operations relative to construction of this Project, will be made under Contract Item Numbers listed on the Itemized Proposal and herein. Work for which there is not a Contract Item will be considered incidental to the Contract and no additional compensation will be allowed unless approved by OWNER.
- B. OWNER reserves the right to alter the Contract Documents, modify incidental Work, as may be necessary, and increase or decrease quantities of Work to be performed in accordance with such changes, including, but not necessarily limited to, deduction or cancellation of any one or more of the Contract Items. Cancellation of or decrease in quantities shall not be cause for a claim by CONTRACTOR for lost overhead or profit.
- C. CONTRACTOR shall take no advantage of any apparent error or omission in the Contract Documents, and ENGINEER shall be permitted to make corrections and interpretations, as may be deemed necessary for fulfillment of the intent of the Contract Documents.
- D. Contract Items, which are to be measured in terms of weight shall be weighed on scales which have been approved by CONSTRUCTION INSPECTOR prior to receipt of any weighed material. Approved weight tickets must be given to CONSTRUCTION INSPECTOR prior to the material being placed.
- E. CONSTRUCTION INSPECTOR will make measurements and determinations, as necessary to classify the Work within Contract Items and determine the quantities for pay purposes.
- F. Undistributed items are for potential work, done at OWNER's discretion, beyond the Project scope and limits at the time of bidding or for work that could not be defined at the time of bidding. The Work associated with undistributed items shall only be undertaken with the approval of CONSTRUCTION INSPECTOR and/or OWNER.
- G. Partial payment for lump sum items will be made according to the Schedule of Values. The approved and finalized Schedule of Values shall subdivide the Work into component parts in sufficient detail to serve as the basis for payment applications during construction.
- H. Proposals will be considered irregular and may be rejected if OWNER determines any Contract Item price is significantly unbalanced to the potential detriment of OWNER.

1.2 MOBILIZATION AND DEMOBILIZATION (ITEM 1)

- A. Description: The Work shall consist of all labor, equipment, transportation, and materials necessary for the movement of the CONTRACTOR to and from the Project Site, including, but not necessarily limited to: pre-construction condition documentation; transportation of equipment; siting and setting up temporary utilities; securing permits; providing initial submittals; implementing safety programs; and establishing, furnishing, maintaining, and removing temporary construction offices, parking areas, and storage facilities. The primary specification sections related to this Contract Item are 01011, 01300, 01500, 01505, and 01520.
- B. Basis of Payment: Mobilization and Demobilization shall be paid for at the contract LUMP SUM price, as shown in the Itemized Proposal. Payment for this item shall be 75% of the LUMP SUM on the initial Payment Application and 25% of the LUMP SUM on the final Payment Application.

1.3 CONSTRUCTION ENGINEERING (ITEM 2)

- A. Description: This Work shall consist of all labor, equipment, transportation, and materials necessary to provide Construction Engineering, including, but not necessarily limited to: establishing and maintaining surveying and Project control, benchmarks, and survey centerlines necessary for construction of the Work; referencing the necessary control points and Project benchmarks; running level circuit(s) to establish elevations of project benchmarks; surveying existing pavement cross-sections and centerline profiles prior to disturbance for use in pavement replacement and restoration, including providing documentation to CONSTRUCTION INSPECTOR; surveying existing utility casting elevations prior to construction and identifying adjustments needed to accommodate proposed pavement resurfacing and/or replacement; verifying elevation at proposed sanitary connections prior to construction; surveying existing ground elevations prior to construction at proposed casting locations and identifying adjustments needed to accommodate proposed pavement resurfacing and/or replacement; Project management, coordination, and supervision; recording construction progress documentation including daily field reports, correspondence, transmittals, permit records, and document control; completing pre-condition surveys; conducting on-going Project quality assurance and control including establishing and managing an effective Quality Control Program, providing an approved Quality Control Engineer, maintaining compliance with industry standards and inspection, participation in Project meetings including preconstruction, weekly progress, pre-installation, and quality control; participating in public outreach and involvement; writing submittals, including samples, value engineering proposals, requests for information, and shop drawings; scheduling projects; photographing construction; maintaining As-Built Drawings; cleaning streets; removing snow; controlling dust and mud; protecting existing facilities; environmental controls; delivering, storing, and protecting products; requesting substitutions; and all other incidentals not directly engaged in construction of the Project but which are necessary to support the Work. This Work shall include all tasks. The primary specification sections related to this Contract Item are 01050.

- B. Basis of Payment: Construction Engineering shall be paid for at the contract LUMP SUM price, as shown in the Itemized Proposal, at the estimated completion percentage at each monthly Payment Application agreed upon by CONSTRUCTION INSPECTOR and CONTRACTOR.

1.4 MAINTENANCE OF TRAFFIC (ITEM 3)

- A. Description: This Work shall consist of all labor, equipment, transportation, and materials to provide, install, and maintain traffic controls, and protection in accordance with the Indiana Manual on Uniform Traffic Control Devices for Streets and Highways. Traffic controls include, but are not necessarily limited to: signals; pavement markings; channelizing devices; warning lights; arrowboards; flaggers; signs and their supports; Type III barricade assemblies with sand bags; and any other device used for the purpose of regulating, detouring, warning, or guiding traffic through or around the construction zone and not specifically paid for elsewhere. The primary specification section related to this Contract Item is 01570.
- B. Basis of Payment: Maintenance of Traffic shall be paid for at the contract LUMP SUM price as shown in the Itemized Proposal at the estimated completion percentage at each monthly Payment Application agreed upon by CONSTRUCTION INSPECTOR and CONTRACTOR.

1.5 EROSION CONTROL (ITEM 4)

- A. Description: This Work shall consist of all labor, equipment, transportation, and materials required to set up, maintain, and remove construction related temporary erosion control including, but not necessarily limited to: creating temporary construction entrances; providing appropriate runoff control for material storage areas, temporary concrete truck “wash down” areas, temporary debris storage areas, and any other areas subject to runoff; sediment control fence; inlet protection; temporary erosion control side ditch protection; slope and ditch restoration; hay bale erosion control; all measures to comply with Chapter 600 of the City of Indianapolis Stormwater Specification Manual; all other measures to comply with Rule 5 requirements; and clean-up, all in accordance with the Contract Documents. The primary specification sections related to this Contract Item are 01560, 02100, 02125, and 02245.
- B. Basis of Payment: Erosion Control shall be paid for at the contract LUMP SUM price as shown in the Itemized Proposal at the estimated completion percentage at each monthly Payment Application agreed upon by CONSTRUCTION INSPECTOR and CONTRACTOR.

1.6 SANITARY SEWER PIPE ABANDONMENT, FLOWABLE FILL, LARGER THAN 12-INCH, ALL DEPTHS (ITEM 5, 6, 7)

- A. Description: This Work shall consist of all labor, equipment, transportation, and materials required to plug and abandon sewer pipes larger than 12 inches per the Contract Documents, including, but not limited to: saw cutting and removing pavement; all excavation; permanent and temporary shoring of the excavation; groundwater control, treatment, and disposal; cutting, plugging, and removing sewer segments; furnishing and installing pipe plugs and fittings, filling abandoned sewer pipes with flowable fill (controlled low strength material), backfill, and compaction; plugging of manhole connections using concrete plugs; bypass pumping; protection, replacement, or repair of utilities, drainage systems, structures, and miscellaneous property; removal and legal disposal of surplus excavated material; and clean up, all in accordance with the Contract Documents. The primary specification sections related to this Contract Item are 02140, 02150, 02200, 02210, 02535, 02550, 02560, and 02702.
- B. Basis of Payment: Sewer Pipe Abandonment, Flowable Fill, Larger than 12-Inch, All Depths shall be paid for at the contract unit price per LINEAR FOOT, as shown in the Itemized Proposal.

1.7 SANITARY SEWER PIPE ABANDONMENT, FLOWABLE FILL, 12-INCH AND UNDER, ALL DEPTHS (ITEM 8, 9)

- A. Description: This Work shall consist of all labor, equipment, transportation, and materials required to plug and abandon sewer pipes 12 inches and under per the Contract Documents, including, but not limited to: saw cutting and removing pavement; all excavation; permanent and temporary shoring of the excavation; groundwater control, treatment, and disposal; cutting, plugging, and removing sewer segments; furnishing and installing pipe plugs and fittings, filling abandoned sewer pipes with flowable fill (controlled low strength material), backfill, and compaction; plugging of manhole connections using concrete plugs; bypass pumping; protection, replacement, or repair of utilities, drainage systems, structures, and miscellaneous property; removal and legal disposal of surplus excavated material; and clean up, all in accordance with the Contract Documents. The primary specification sections related to this Contract Item are 02140, 02150, 02200, 02210, 02535, 02550, 02560, and 02702.
- B. Basis of Payment: Sewer Pipe Abandonment, Flowable Fill, 12-Inch and Under, All Depths shall be paid for at the contract unit price per LINEAR FOOT, as shown in the Itemized Proposal.

1.8 MANHOLE REMOVAL, ALL DEPTHS (ITEM 10)

- A. Description: This Work shall consist of all labor, equipment, transportation, and materials required to remove manholes per the Contract Documents, including, but not limited to: saw cutting and removing pavement; all excavation; permanent and temporary shoring of the excavation; groundwater control, treatment, and disposal; replacement, or repair of utilities, drainage systems, structures, and miscellaneous property; removal and legal disposal of surplus excavated material; and clean up; final

grading; and restoring lawns, landscaping, and fencing; all in accordance with the Contract Documents. The primary specification sections related to this Contract Item are 02140, 02150, 02200, and 02550.

- B. Basis of Payment: Manhole Removals, All Depths shall be paid for at the contract unit price per VERTICAL LINEAR FOOT, as shown in the Itemized Proposal.

1.9 SANITARY SEWER, OPEN-CUT, ALL SIZES, ALL DEPTHS (ITEM 11, 13, 14, 16)

- A. Description: This Work shall consist of all labor, equipment, transportation, and materials required to install gravity sanitary sewers, all depths, by open-cut methods, including, but not necessarily limited to: saw cutting and removing pavement; all excavation; permanent and temporary shoring of the excavation; groundwater control, treatment, and disposal; furnishing and installing pipe and fittings, bedding, haunching, and cover; granular material; backfill and compaction; testing; watertight plugs; bypass pumping; protection, replacement, or repair of utilities, drainage systems, structures, and miscellaneous property; removal and legal disposal of surplus excavated material; clean up; final grading; and restoring lawns, landscaping, and fencing; all in accordance with the Contract Documents. The primary specification sections related to this Contract Item are 02140, 02150, 02200, and 02550.

- B. Basis of Payment: Sanitary Sewer, Open-Cut, All Sizes, All Depths shall be paid for at the contract unit price per LINEAR FOOT, as shown in the Itemized Proposal.

1.10 SANITARY SEWER & CASING PIPE, TRENCHLESS INSTALLATION, ALL SIZES, ALL DEPTHS (ITEM 12, 15)

- A. Description: This Work shall consist of all labor, equipment, transportation and materials required to excavate and install gravity sanitary sewer using trenchless installation methods, including, but not necessarily limited to: pipe jacking and boring and all required ancillary and safety equipment; inspection, locating, potholing, protection, replacement or repair of existing utilities; control, capture, handling and disposal of groundwater; handling and disposal of excavated material; initial and final sewer lining, as applicable; grouting; geotechnical instrumentation; clean up; final grading; and restoring lawns, landscaping, and fencing; all in accordance with the Contract Documents. Additionally, this Work shall consist of all labor, equipment, transportation and materials required to install, maintain and abandon trenchless sewer launch and receiving pits, including, but not necessarily limited to: saw cutting and removing pavement; all excavation; permanent and temporary shoring of the excavation; groundwater control, treatment and disposal; development of shaft base and thrust blocks; soil improvement by compaction; scaffolding and temporary supports; bypass pumping and flow control; ventilation and safety equipment; formwork; reinforcing steel; removal of scaffolding and temporary supports; flowable fill; granular material; backfill and compaction; watertight pipe connections; applicable testing; protection, replacement or repair of utilities, drainage systems, structures, and miscellaneous property; providing and installing all required temporary or permanent sanitary mainline and lateral sewer pipe or storm sewer pipe within the shafts, whether a new sewer specified on the drawings or a replacement of known or unknown existing

sewers and laterals, unless specifically called out for payment elsewhere; removal of surplus excavated material; and clean-up, all in accordance with the Contract Documents. The primary specification sections related to this Contract Item are 02140, 02150, 02200, 02335, 02415, and 02550.

- B. Basis of Payment: Sanitary Sewer, Trenchless Installation, All Sizes, All Depths shall be paid for at the contract unit price per LINEAR FOOT, as shown in the Itemized Proposal.

1.11 SANITARY FORCE MAIN, OPEN-CUT, 8-INCH, ALL DEPTHS (ITEM 17)

- A. Description: This Work shall consist of all labor, equipment, transportation, and materials required to install sanitary sewers force main, all depths, by open-cut methods, including, but not necessarily limited to: saw cutting and removing pavement; all excavation; permanent and temporary shoring of the excavation; groundwater control, treatment, and disposal; furnishing and installing pipe and fittings, bedding, haunching, and cover; granular material; backfill and compaction; testing; watertight plugs; bypass pumping; protection, replacement, or repair of utilities, drainage systems, structures, and miscellaneous property; removal and legal disposal of surplus excavated material; clean up; final grading; and restoring lawns, landscaping, and fencing; all in accordance with the Contract Documents. The primary specification sections related to this Contract Item are 02140, 02150, 02200, 02550, and 02560.

- B. Basis of Payment: Sanitary Force Main, Open-Cut, 8-Inch, All Depths shall be paid for at the contract unit price per LINEAR FOOT, as shown in the Itemized Proposal.

1.12 SANITARY LOW PRESSURE SEWER, FITTINGS, & TRACER WIRE, TRENCHLESS, ALL SIZES, ALL DEPTHS (ITEM 18, 19)

- A. Description: This Work shall consist of all labor, equipment, transportation, and materials required to install sanitary low pressure sewer pipe, all depths, by trenchless methods using B-Borrow or native backfill or other required material at pits and other open excavations, including, but not necessarily limited to: saw cutting and removing pavement; all excavation including pits for trenchless excavation; permanent and temporary shoring of the excavation; groundwater control, treatment, and disposal; furnishing and installing pipe and fittings, tracer wire and connectors, bedding, haunching, and cover; flowable fill, granular material; backfill and compaction; testing; watertight plugs; bypass pumping; protection, replacement, or repair of utilities, drainage systems, structures, and miscellaneous property; removal and legal disposal of surplus excavated material; clean up; final grading; and restoring lawns, landscaping, and fencing; all in accordance with the Contract Documents. The primary specification sections related to this Contract Item are 02140, 02150, 02200, 02550, and 02560.

- B. Basis of Payment: Sanitary Low Pressure Sewer, Fittings, & Tracer Wire, Trenchless, 2-Inch, All Depths shall be paid for at the contract unit price per LINEAR FOOT, as shown in the Itemized Proposal.

1.13 SANITARY LOW PRESSURE SEWER LATERAL, FITTINGS, & TRACER WIRE, OPEN-CUT, 1-1/4-INCH, ALL DEPTHS (ITEM 20)

- A. Description: This Work shall consist of all labor, equipment, transportation, and materials required to install sanitary sewers force main, all depths, by open-cut methods, including, but not necessarily limited to: saw cutting and removing pavement; all excavation; permanent and temporary shoring of the excavation; groundwater control, treatment, and disposal; furnishing and installing pipe and fittings, tracer wire and connectors, bedding, haunching, and cover; granular material; backfill and compaction; testing; watertight plugs; bypass pumping; protection, replacement, or repair of utilities, drainage systems, structures, and miscellaneous property; removal and legal disposal of surplus excavated material; clean up; final grading; and restoring lawns, landscaping, and fencing; all in accordance with the Contract Documents. The primary specification sections related to this Contract Item are 02140, 02150, 02200, 02550, and 02560.
- B. Basis of Payment: Sanitary Low Pressure Sewer, Fittings, & Tracer Wire, Open-Cut, 1-1/4-Inch, All Depths shall be paid for at the contract unit price per LINEAR FOOT, as shown in the Itemized Proposal.

1.14 PRECAST SANITARY MANHOLE, ALL SIZES, ALL DEPTHS (ITEM 21, 22, 23)

- A. Description: This Work shall consist of all labor, equipment, transportation, and materials required to furnish and install concrete manholes including, but not necessarily limited to: saw cutting and removal of pavement; all excavation; permanent and temporary shoring of the excavation; groundwater control, treatment, and disposal; base sections, riser sections, tops, manhole frame, casting, and adjusting rings; core drilling and modification to openings; concrete fill; flexible watertight pipe seals; installation of flow channels and benches; installation of sanitary sewer pipe, fittings, and modifications; joint materials; granular material; backfill and compaction; testing; protection, replacement, or repair of utilities, drainage systems, structures, and miscellaneous property; removal of surplus excavated material; and clean up; final grading; and restoring lawns, landscaping, and fencing; all in accordance with the Contract Documents. The primary specification sections related to this Contract Item are 02140, 02150, 02200, 02550, and 03400.
- B. Basis of Payment: Precast Sanitary Manhole, All Sizes, All Depths shall be paid for at the contract unit price per EACH installed, as shown in the Itemized Proposal.

1.15 SANITARY FORCE MAIN AIR RELEASE VALVE AND MANHOLE, ALL DEPTHS (ITEM 24)

- A. Description: This Work shall consist of all labor, equipment, transportation, and materials required to install sanitary force main air release valve and manhole per the Contract Documents, including, but not limited to: saw cutting and removing pavement; all excavation; permanent and temporary shoring of the excavation; groundwater control, treatment, and disposal; furnishing and installing pipe, fittings, and valves; bedding, haunching, cover, granular material, backfill and compaction; testing;

watertight plugs; bypass pumping; protection, replacement, or repair of utilities, drainage systems, structures, and miscellaneous property; removal and legal disposal of surplus excavated material; clean up; final grading; and restoring lawns, landscaping, and fencing; all in accordance with the Contract Documents. The primary specification sections related to this Contract Item are 02140, 02150, 02200, 02550, 03400 and 15101.

- B. Basis of Payment: Sanitary Force Main Air Release Valve and Manhole, All Depths shall be paid for at the contract unit price per EACH installed, as shown in the Itemized Proposal.

1.16 COMBINED SEWER OUTFALL, HEADWALL WITH FLAP GATE, 18-INCH DIAMETER (ITEM 25)

- A. Description: This Work shall consist of all labor, equipment, transportation, and materials required to install a concrete headwall and flap gate on an 18 inch diameter combined sewer outfall per the Contract Documents, including, but not limited to: all excavation; site preparation, bedding, granular material, backfill, compaction, and grading; protection; permanent and temporary shoring of the excavation; backfill and compaction for structure; groundwater control, treatment, and disposal; soil improvements by compaction; formwork; reinforcing steel; precast and cast-in-place reinforced concrete; flap gate and thimble installation; removal of formwork, and temporary supports; flexible watertight pipe seals; protection, replacement or repair of utilities, drainage systems, structures, and miscellaneous property; removal and legal disposal of surplus excavated material; clean up; final grading; and restoring lawns, landscaping, and fencing; all in accordance with the Contract Documents. The primary specification sections related to this Contract Item are 02140, 02150, 02200, 02550, 03200, 03290, 03300.

- B. Basis of Payment: Combined Sewer Outfall, Headwall with Flap Gate, 18-Inch Diameter shall be paid for at the contract LUMP SUM price as shown in the Itemized Proposal.

1.17 SANITARY LOW PRESSURE SEWER STRUCTURE, LATERAL ASSEMBLY WITH VALVES AND FITTINGS, ALL SIZES, ALL DEPTHS (ITEM 26)

- A. Description: This Work shall consist of all labor, equipment, transportation, and materials required to furnish and install lateral assembly with valves and fittings including, but not necessarily limited to: saw cutting and removal of pavement; all excavation; permanent and temporary shoring of the excavation; groundwater control, treatment, and disposal; manhole sections, frame and cover; core drilling and modification to openings; concrete fill; flexible watertight pipe seals; installation of pipe, fittings, valves, and modifications; joint materials; granular material; backfill and compaction; testing; protection, replacement, or repair of utilities, drainage systems, structures, and miscellaneous property; removal of surplus excavated material; and clean up; final grading; and restoring lawns, landscaping, and fencing; all in accordance with the Contract Documents. The primary specification sections related to this Contract Item are 02140, 02150, 02200, 02550, 03400, and 15101.

- B. Basis of Payment: Precast Low Pressure Sewer Structure, Lateral Assembly with Valves and Fittings, All Depths shall be paid for at the contract unit price per EACH installed, as shown in the Itemized Proposal.

1.18 SANITARY LOW PRESSURE SEWER STRUCTURE, FLUSHING ASSEMBLY WITH VALVES AND FITTINGS, 2-INCH, ALL DEPTHS (ITEM 27)

- A. Description: This Work shall consist of all labor, equipment, transportation, and materials required to furnish and install flushing assembly with valves and fittings including, but not necessarily limited to: saw cutting and removal of pavement; all excavation; permanent and temporary shoring of the excavation; groundwater control, treatment, and disposal; concrete manhole sections, tops, manhole frame, casting, and adjusting rings; core drilling and modification to openings; concrete fill; flexible watertight pipe seals; installation of flow channels and benches; installation of pipe, fittings, valves, and modifications; joint materials; granular material; backfill and compaction; testing; protection, replacement, or repair of utilities, drainage systems, structures, and miscellaneous property; removal of surplus excavated material; and clean up; final grading; and restoring lawns, landscaping, and fencing; all in accordance with the Contract Documents. The primary specification sections related to this Contract Item are 02140, 02150, 02200, 02550, 03400, and 15101.
- B. Basis of Payment: Precast Low Pressure Sewer Structure, Flushing Assembly with Valves and Fittings, All Depths shall be paid for at the contract unit price per EACH installed, as shown in the Itemized Proposal.

1.19 LOW PRESSURE SEWER ISOLATION VALVE, ALL SIZES (ITEM 28)

- A. Description: This Work shall consist of all labor, equipment, transportation, and materials required to furnish and install isolation valves and fittings including, but not necessarily limited to: saw cutting and removal of pavement; all excavation; permanent and temporary shoring of the excavation; groundwater control, treatment, and disposal; installation of pipe, fittings, valves, valve box and cover suitable for traffic loading, and modifications; joint materials; granular material; backfill and compaction; testing; protection, replacement, or repair of utilities, drainage systems, structures, and miscellaneous property; removal of surplus excavated material; and clean up; final grading; and restoration; all in accordance with the Contract Documents. The primary specification sections related to this Contract Item are 02140, 02150, 02200, 02550, 03400, and 15101.
- B. Basis of Payment: Low Pressure Sewer Isolation Valve, 2-Inch shall be paid for at the contract unit price per EACH installed, as shown in the Itemized Proposal.

1.20 GRINDER PUMP STATION, ALL MODELS, AND SEPTIC ABANDONMENT (ITEM 29, 30)

- A. Description: This Work shall consist of all labor, equipment, transportation, and materials required to install the grinder pump station unit, with two (2) year manufacturer's warranty and existing septic tank abandonment, including, but not limited to; researching the existing internal plumbing pipe and sewer lateral; removal of landscaping and fencing as required; excavation; concrete and asphalt removal; dewatering; temporary trench safety system for excavation; installation of grinder pump station unit and precast ballasts; vent piping; electrical panel upgrades as specified in the "Septic Tank Elimination Program (STEP) Enrollment Agreement; installation of pump control panel; wiring of the pump panel and pump station unit; connection of lateral piping; stone bedding and backfill; backfill and compaction; testing; pump station unit startup; protection, replacement, or repair of utilities, drainage systems, structures, and miscellaneous property; removal of surplus excavated material; and clean up; final grading; and restoring lawns, landscaping, and fencing; Additionally, this Work shall consist of all labor, equipment, transportation and materials required to clean and abandon existing on-site septic system per Indiana State Department of Health, Residential On-Site Sewage Systems Rule 410 IAC 6-8.3 and Commercial On-Site Sewage Systems Rule 410 IAC 6-10.1, all in accordance with the Contract Documents. The primary specifications related to this Contract Item are Sections 01526, 01530, 01560, 02075, 02125, 02140, 02200, 02730, 02900, and 11105.
- B. Basis of Payment: Grinder Pump Station and Septic Abandonment shall be paid for at the contract unit price per EACH installed and abandoned, as shown in the Itemized Proposal.

1.21 LOW PRESSURE SEWER INTERNAL MANHOLE DROP CONNECTION, ALL SIZES, ALL DEPTHS (ITEM 31, 32)

- A. Description: This Work shall consist of all labor, equipment, transportation, and materials required to connect the low pressure sewer to existing or new manholes, including, but not necessarily limited to: saw cutting; core drilling and modification to openings; installation of pipe, fittings, connectors, supports, and modifications; joint materials; flexible watertight pipe seals; testing; protection, replacement, or repair of utilities, drainage systems, structures, and miscellaneous property; removal of surplus excavated material; and clean up; final grading; and restoring lawns, landscaping, and fencing; all in accordance with the Contract Documents. The primary specification sections related to this Contract Item are 02140, 02150, 02200, 02550, 03400, 05500, and 15101.
- B. Basis of Payment: Low Pressure Sewer Internal Manhole Drop Connection, All Sizes, All Depths shall be paid for at the contract unit price per EACH installed, as shown in the Itemized Proposal.

1.22 PAVEMENT REMOVAL AND RESTORATION (ITEM 33, 34, 35)

- A. Description: This Work shall consist of all labor, equipment, transportation, and materials to provide new pavement and pavement restoration, including, but not necessarily limited to: removal and proper disposal of pavement; sub-base preparation, base placement, pavement placement; rotomill and resurfacing; adjusting castings and utility boxes; pavement markings; replacement or repair of utilities, drainage systems, structures, and miscellaneous property; and clean-up, all in accordance with the Contract Documents. The primary specification related to this Contract Item is 02510.
- B. Basis of Payment: Pavement Removal and Restoration shall be paid for at the contract unit price per SQUARE YARD actually installed as directed by CONSTRUCTION INSPECTOR, as shown in the Itemized Proposal.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION 01025 -

SECTION 01050 – CONSTRUCTION ENGINEERING

PART 1 - GENERAL

1.1 SCOPE

- A. All construction engineering shall be performed by CONTRACTOR. Construction Engineering shall include: re-establishing the survey points and survey centerlines; referencing the necessary control points; running a level circuit to establish elevations of project benchmarks; documenting existing pavement elevations; and as-built documentation.
- B. All control points, baselines, and bench marks are shown or referenced on the Drawings. CONTRACTOR is responsible for replacing all disturbed control points during construction.

1.2 QUALITY REQUIREMENTS

- A. The layout of control points, centerlines, benchmarks, and other items shall be consistent with standard engineering practices. All surveys required for the layout of the Work specified in the Contract Documents shall be of second-order class I, or better, as defined in "Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys" prepared by the Federal Geodetic Control Committee for the U.S. Department of Commerce.

PART 2 - PRODUCTS

2.1 FIELD BOOKS AND PAPER

- A. The field books shall be the standard 6-ring field books (6-1/2 x 8 inches) normally used in surveying.
- B. The paper shall be the standard 6-hole weather resistant paper (5-1/2 x 7-1/4 inches) normally used in surveying.

PART 3 - EXECUTION

3.1 CHECKS AND CONTROL

- A. CONTRACTOR shall perform all necessary Construction Engineering, including layout, to insure that the Work conforms to the lines, grades, and elevations shown on the Contract Documents. Construction Engineering shall include: establishing all necessary lines, points, corners, etc., with adequate references for the recovery of said items during construction; running a level circuit to establish additional benchmarks for use during construction; and setting stakes for structures, slopes, subgrade, paving, and any other stakes required for control lines and grades.

- B. CONTRACTOR shall furnish all equipment, personnel, and materials, including stakes and flagging as necessary, for performing the Construction Engineering.
- C. Field notes shall be kept in standard field notebooks supplied by CONTRACTOR in a clear, orderly, and neat manner consistent with standard engineering practices and procedures. The field books shall be available for inspection by CONSTRUCTION INSPECTOR at all times and shall become the property of OWNER on completion of the Work.
- D. When staking piping and structures, CONTRACTOR shall perform the necessary checking to establish the proper location and grade. Cleanouts shall be set to best fit the final grade elevation and conditions of the site.
- E. CONSTRUCTION INSPECTOR may check the accuracy of the Construction Engineering as necessary but will assume no responsibility for the accuracy of engineering layout or the final result of construction accuracy.
- F. The supervision of CONTRACTOR's Construction Engineering personnel shall be the responsibility of CONTRACTOR, and any errors resulting from the operations of such personnel shall be corrected at the expense of CONTRACTOR and at no additional cost to OWNER.

3.2 CONSTRUCTION ENGINEERING FOR STORM, SANITARY, AND COMBINED SEWER INSTALLATION

- A. Construction Engineering for storm, sanitary, or combined sewer installation shall be performed under the direction and supervision of a registered Land Surveyor in the State of Indiana and include, but not be limited to:
 - 1. Horizontal location of all structures and survey centerline.
 - 2. Existing utility casting or access structure elevations where modification to the existing pavement or ground elevation is required or anticipated for construction of the Work.
 - 3. Existing pavement/ground elevations at all proposed structure locations prior to ordering materials to confirm required structure dimensions. CONTRACTOR shall account for required pavement resurfacing or replacement thicknesses and the resulting final pavement elevation and/or ground elevation when ordering and setting all adjustment items so that the top of the adjusted utility castings or access structures are flush with the specified final pavement cross-section and/or ground elevation, resulting in a smooth transition across the top.
 - 4. Locating and documenting, with dimensions, all traffic loops, signal detection equipment and accessories, pavement markings, and detector housings.
 - 5. Establishing and maintaining survey control points and running a level circuit(s) to confirm elevations of project benchmarks.
 - 6. Existing cross-sections (pavement centerline and edge of pavement locations and elevations) at intervals of 25 feet for all roadways where complete roadway reconstruction is required, or where the full depth of existing pavement is likely to

be removed along both existing pavement edges as result of pipe trenching or incidental damage. This data is to be used by CONTRACTOR as a reference for roadway replacement. This survey is to be completed prior to disturbing the pavement. CONTRACTOR shall provide CONSTRUCTION INSPECTOR with documentation of an area's cross-section survey prior to construction in the given area.

7. Existing storm water drainage culvert pipe inverts and at least 25 feet of existing ditch centerline upstream and/or downstream of each culvert end wherever incidental pipe replacement is required. This data is to be used by CONTRACTOR as a reference for setting the culvert and restoring the ditch grade line. ENGINEER may also use the survey documentation to make adjustments to the culvert or ditch inverts as needed to correct minor existing drainage problems or to provide adequate cover over the new culvert pipe. No additional compensation shall be allowed for culvert pipe or ditch invert adjustments up to 6 inches deeper than existing that may be required by ENGINEER. The survey is to be completed prior to disturbing the culvert. CONTRACTOR shall provide CONSTRUCTION INSPECTOR with documentation of the survey prior to construction in the given area.
 8. Verifying or determining horizontal locations, elevations, and dimensions of all existing sanitary facilities to where the Work will be connected. This is to be completed prior to construction of any items that may be affected by the existing facility horizontal location, elevation, and/or dimension varying from what is shown on the Drawings.
- B. As-Built Drawings shall be performed under the direction and supervision of a registered Professional Engineer in the State of Indiana, and all surveying for As-Built Drawings shall be performed under the direction and supervision of a registered Professional Surveyor in the State of Indiana and shall include but not be limited to the following requirements:
1. Each submission of As-Built Drawings shall be signed and sealed by a Registered Professional Engineer and a Registered Professional Surveyor in the State of Indiana.
 2. Keep a record of any changes in sewer alignment, length, and elevations noted with the exact horizontal and vertical location of utilities, sewers, and other items encountered during construction.
 3. Maintain one set of full-sized, black-line white prints of the Contract Drawings and Shop Drawings, which shall be referred to as As-Built Drawings. Mark these As-Built Drawings to show progress of the actual installation, noting where installation varies from that shown originally. Show cross references on the Contract Drawings where details are provided in the Shop Drawings. Prepare the marked up As-Built Drawings in an accurate and understandable manner. Meet with CONSTRUCTION INSPECTOR and OWNER on a monthly basis and demonstrate that all of the required information is being recorded and checked as soon as possible after obtaining it, with daily as a minimum.

4. At a minimum, include the following types of information on the As-Built Drawings:
 - a. Dimensional changes to drawings.
 - b. Revisions to details shown on drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed utilities.
 - j. Changes made that deviate from the information shown on the Contract Drawings and Shop Drawings. Identify as change order, construction work change directives, requests for information, and ENGINEER's written orders by number where applicable.
 - k. Details not on the original Contract Drawings.
 - l. Field reports for variable and concealed conditions.
 - m. As-Built information of the Work that is shown only schematically.
 - o. As-Built cross sections of surface structures.
 - p. As-Built check of points of intersection, points of curvature, and points of tangency.
 - q. Core drill holes and holes drilled for grouting.
 - r. Certified invert elevations at least every 50 feet.
 - s. Geotechnical conditions that affect the project or ground support, i.e. major joints, shear zones, and fault zones.
 - t. Piezometric and other groundwater records.
 - u. Other information determined to be necessary by ENGINEER.
5. Mark As-Built Drawings with erasable red colored pencil. Use other colors for different categories of work at the same location.

6. Transmit the marked up As-Built Drawing prints to ENGINEER upon substantial completion.
7. CONTRACTOR shall be provided with one set of CAD drawings in electronic format for use in recording as-built information. No representation as to the accuracy or completeness of these drawings is made to CONTRACTOR. Submit for approval to ENGINEER every sixth month after Notice to Proceed, one full set of As-Built CAD Drawings in electronic format. The As-Built CAD Drawings shall comply with the following:
 - a. Same CAD program, version, and operating system as the original Contract Drawings.
 - b. Incorporate all changes, additions, and information required for the As-Built Drawings. Delete, redraw, and add notations and details where applicable.
 - c. Prepare new drawings as part of the As-Built CAD Drawing set where ENGINEER determines that neither the original Contract Drawings nor the Shop Drawings are suitable to show the as-built installation information.
 - d. Formats, title block, scale, scope of detailing, and notations, as required by ENGINEER.
 - e. Record all progress and changes two weeks prior to the submittal dates.
 - f. Along with the electronic As-Built CAD Drawings, provide five hard copies as necessary for circulation and review comments.
8. Transmit a final set of As-Built CAD drawings to ENGINEER for approval upon substantial completion. This final transmittal shall consist of one set in electronic format and five sets of hard copy prints, printed 24 x 36 inches, collated, and bound.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION 01050 -

SECTION 01060 – REFERENCE STANDARDS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. All materials, products, and construction procedures used during the execution of this Contract or incorporated in the Work shall comply with the latest provisions of applicable codes, regulations, and standards, unless noted otherwise.

1.2 CONTRACT DOCUMENTS

- A. Specific provisions of codes, regulations, and standards may be referenced in the Contract Documents to assist CONTRACTOR and identify options selected by ENGINEER. Such references do not relieve CONTRACTOR from compliance with other applicable provisions of the codes, regulations, and standards not specifically referenced.

1.3 CHANGE IN WORK

- A. Should any change in the Work be required to comply with local regulations, field conditions, or the request of other parties, CONTRACTOR shall obtain approval from ENGINEER before performing any work not contained in the Contract. In the event of disagreement as to the necessity of such change, the decision of the OWNER will be final and binding. Where conformance to agency or association reference standards is not a matter of law and applicable regulation, deviations are permitted where such deviation is a matter specifically described, detailed, or required in these Contract Documents to conform to OWNER's needs and financial requirements.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION 01060 -

SECTION 01300 – CONTRACTOR SUBMITTALS

PART 1 - GENERAL

1.1 SCOPE

- A. Submit all submittals required by the Contract Documents to CONSTRUCTION INSPECTOR unless otherwise noted.
- B. CONTRACTOR shall submit the following items to CONSTRUCTION INSPECTOR for review by ENGINEER:
 - 1. A preliminary schedule of Shop Drawings and Samples within 10 days after the Notice to Proceed.
 - 2. Proposed Substitutes ("Or-Equal") submittals listed in the Bid shall be submitted within 7 days after the Notice to Proceed.
 - 3. A list with all permits and licenses CONTRACTOR shall obtain indicating the agency required to grant the permit, the expected submittal date for the permit and required date for receiving the permit shall be submitted within 15 days after the Notice to Proceed.

1.2 PRECONSTRUCTION CONFERENCE SUBMITTALS

- A. None.

1.3 SUBMITTAL REQUIREMENTS

- A. Wherever called for in the Contract Documents or where required by ENGINEER, CONTRACTOR shall furnish to CONSTRUCTION INSPECTOR for review by ENGINEER one electronic copy for each submittal.
- B. Submittals shall be accompanied by ENGINEER's standard submittal/transmittal form, a reproducible copy of which is available from CONSTRUCTION INSPECTOR. Any submittal not accompanied by such a form, or where all applicable items on the form are not completed, shall be returned for re-submittal.
- C. Organization:
 - 1. A single submittal/transmittal form shall be used for each technical specification section or item or class of material or equipment for which a submittal is required. A single submittal covering multiple sections will not be acceptable, unless the primary specification references other sections for components. Example: if a pump section references other sections for the motor, protective coating, anchor bolts, local control panel, and variable frequency drive, a single submittal would be accepted; a single submittal covering vertical turbine pumps and horizontal split case pumps would not be acceptable.

2. On the transmittal form, index the components of the submittal and insert tabs in the submittal to match the components. Relate the submittal components to specification paragraph and subparagraph, Contract Drawing number, detail number, schedule title, major component, and/or bid list item, as applicable.
3. Unless indicated otherwise, terminology and equipment names and numbers used in submittals shall match those used in the Contract Documents.

D. Format:

1. Minimum sheet size shall be 8.5 x 11 inches. Maximum sheet size shall be 24 x 36 inches. Number every page in sequence in each submittal. Properly collate, staple, and/or bind each copy of a submittal, as appropriate.
 2. Where product data from a manufacturer is submitted, clearly mark which model is proposed, with all pertinent data, capacities, dimensions, clearances, diagrams, controls, connections, anchorage, and supports. Sufficient detail level shall be presented for assessing compliance with the Contract Documents.
 3. Each submittal shall be assigned a unique number and shall be numbered sequentially. The submittal numbers shall be clearly noted on the transmittal. Original submittals shall be assigned a numeric submittal number. Re-submittals shall bear an alpha-numeric system, which consists of the number assigned to the original submittal for that item, followed by a letter of the alphabet to represent it is a subsequent re-submittal of the original. For example, if submittal 25 requires a re-submittal, the first re-submittal will bear the designation "25-A" and the second re-submittal will bear the designation "25-B" and so on.
- E. Disorganized submittals which do not meet the requirements above will be returned without review.
- F. Except as may otherwise be indicated herein, ENGINEER will return a letter for each submittal to CONTRACTOR with comments noted thereon, within 10 business days following receipt by ENGINEER. It is considered reasonable that CONTRACTOR shall make a complete and acceptable submittal by the first re-submittal on an item. OWNER reserves the right to withhold monies due to CONTRACTOR to cover additional costs for ENGINEER's review beyond the first re-submittal. ENGINEER's maximum review period for each submittal or re-submittal will be 10 business days. Thus, for a submittal requiring two re-submittals before it is complete, the maximum review period could be 30 business days.
- G. If a submittal is returned to CONTRACTOR marked "NO EXCEPTIONS NOTED," formal revision and resubmission will not be required.
- H. If a submittal is returned marked "MAKE CORRECTIONS NOTED," CONTRACTOR shall make the corrections on the submittal, but formal revision and resubmission will not be required.

- I. If a submittal is returned marked "AMEND-RESUBMIT," CONTRACTOR shall revise it and shall resubmit the required number of copies for review. Re-submitting portions of multi-page or multi-drawing submittals will not be allowed. For example, if a Shop Drawing submittal consisting of 10 drawings contains one drawing noted as "AMEND - RESUBMIT," the submittal as a whole is deemed "AMEND - RESUBMIT," and all 10 drawings are required to be re-submitted.
- J. If a submittal is returned marked "REJECTED-RESUBMIT," it shall mean either the submitted material or product does not satisfy the specifications, the submittal is so incomplete it cannot be reviewed, or is a substitution request not submitted in accordance with the Construction Contract. CONTRACTOR shall prepare a new submittal and shall submit the required number of copies for review.
- K. Re-submitting rejected portions of a previous submittal shall not be allowed. Every change from a submittal to a re-submittal or from a re-submittal to a subsequent re-submittal shall be identified and flagged on the re-submittal.
- L. Fabricating an item shall be commenced only after ENGINEER has reviewed the pertinent submittals and returned copies to CONTRACTOR marked either "NO EXCEPTIONS NOTED" or "MAKE CORRECTIONS NOTED." Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as changes to the contract requirements.
- M. All submittals shall be carefully reviewed by an authorized representative of CONTRACTOR, prior to submission. Each submittal shall be dated, signed, and certified by CONTRACTOR'S Quality Control Engineer as being correct and in strict conformance with the Contract Documents. ENGINEER will only review submittals which have been so certified by CONTRACTOR. All non-certified submittals will be returned to CONTRACTOR without action taken by ENGINEER, and any delays caused thereby shall be the total responsibility of CONTRACTOR.
- N. ENGINEER's review of submittals shall not relieve CONTRACTOR of the entire responsibility for the correctness of details and dimensions. CONTRACTOR shall assume all responsibility and risk for any misfits due to any errors in submittals. CONTRACTOR shall be responsible for the dimensions and the design of adequate connections and details.

1.4 SHOP DRAWINGS

- A. Wherever called for in the Contract Documents or where required by ENGINEER, CONTRACTOR shall furnish for review by ENGINEER one electronic copy for each submittal. The term "Shop Drawings", as used herein, shall be understood to include detail design calculations, shop-prepared drawings, fabrication and installation drawings, erection drawings, lists, graphs, catalog sheets, data sheets, and similar items. Whenever CONTRACTOR is required to submit a design or design calculations as part of a submittal, such calculations shall bear the signature and seal of a Professional Engineer registered in the appropriate branch and in the State of Indiana, unless otherwise indicated. Formal procedures for developing and reviewing

CONTRACTOR designs shall be followed, as specified in Section 01400 – Quality Control.

- B. All Shop Drawings shall be carefully reviewed by an authorized representative of CONTRACTOR, prior to submission. Each sheet of a shop drawing submittal shall be dated, signed, and certified by CONTRACTOR's Quality Control Engineer as being correct and in strict conformance with the Contract Documents.
- C. After a Shop Drawing is accepted, CONTRACTOR shall furnish up to two copies to CONSTRUCTION INSPECTOR for use on site.

1.5 CONTRACTOR'S SCHEDULE

- A. CONTRACTOR's Construction Schedule and reports shall be prepared and submitted to CONSTRUCTION INSPECTOR in accordance with Section 01311 – Construction Schedule.

1.6 SAMPLES

- A. Whenever samples are required in the Contract Documents, CONTRACTOR shall submit not less than three physical samples of each item or material.
- B. Unless otherwise indicated, samples shall be submitted a minimum of 15 days prior to ordering such material.
- C. Samples shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and Manufacturer's name. Upon receiving acceptance of ENGINEER, one set of the samples will be stamped and dated by ENGINEER and returned to CONTRACTOR, one set of samples will be retained by ENGINEER, and one set of samples shall remain at the Site until completion of the Work.
- D. Unless indicated otherwise, all colors and textures for items presented in sample submittals shall be from the manufacturer's standard colors and standard materials, products, or equipment lines. If the samples represent non-standard colors, materials, products, or equipment lines and their selection will require an increase in Contract Times or Price, CONTRACTOR shall clearly indicate same on the submittal's transmittal page.
- E. Schedule sample submittals such that:
 - 1. Sample submittals for color and texture selection are complete so ENGINEER has 15 days to assemble color panels and select color and texture dependent products and materials without delay to the construction schedule.
 - 2. After ENGINEER selects colors and textures, CONTRACTOR has sufficient time to provide the products or materials without delay to the construction schedule. The Contract Times will not be extended for CONTRACTOR's failure to allow enough review and approval or selection time, failure to submit all samples requiring color or texture selection, or failure to submit complete or approvable samples.

1.7 AS-BUILT DRAWINGS

- A. As-Built Drawings shall be maintained and submitted in accordance with the requirements of the Construction Contract and Section 01050 – Construction Engineering.
- B. As-Built Drawings shall be accessible to OWNER, CONSTRUCTION INSPECTOR, and ENGINEER at all times during the construction period.
- C. Final payment will not be acted on until the As-Built Drawings have been prepared and delivered to OWNER in the format specified in the Construction Contract and Section 01050 – Construction Engineering.
- D. The as-built information submitted by CONTRACTOR will be incorporated by ENGINEER into Project Record Drawings. In preparing the Project Record Drawings, ENGINEER will assume the as-built information submitted by CONTRACTOR is correct, and CONTRACTOR shall be responsible for the accuracy of such information and for any errors or omissions which may appear on the Project Record Drawings as a result.

1.8 WARRANTIES AND GUARANTEES

- A. Warranties and Guarantees shall be prepared in accordance with the requirements of Section 01740 – Warranties and Guarantees and submitted in accordance with Section 01300 – Contractor Submittals.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 ELECTRONIC DOCUMENT SUBMITTALS

- A. All documents submitted for purposes of administration of the contract are to be in electronic (PDF) format and transmitted via email.
 - 1. Beyond submittals for review, information, and closeout, this procedure applies to requests for information (RFIs), progress documentation, contract modification documents (e.g., work directive changes, field orders, change proposals, change orders), applications for payment, field reports and meeting minutes, testing records, construction photographs, and any other document any participant wishes to make part of the Project Record. The intent shall be that construction phase documentation be paperless to the greatest extent possible.
 - 2. It is CONTRACTOR's responsibility to submit documents in PDF format.

3. Contract will need an email address, Internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com).
4. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to actual physical samples or color selection charts. Transmittals for these items must still be provided via email so that team members may take action on them, however; and to act as a record of the submittal made, selections determined, and action taken.

3.2 PARTIAL SUBMITTALS LIST

- A. Refer to Attachment A included at the end of this Section.
- B. Where a conflict exists between the Partial Submittals List in Attachment A and other Specifications, the other Specifications shall take precedence.
- C. The partial submittals list has been prepared as a convenience to CONTRACTOR and CONSTRUCTION INSPECTOR. There may be other submittal requirements in the Contract Documents that are not included in this partial submittals list. In particular, submittal requirements of the Construction Contract and Contract Drawings are not included in this list.

- END OF SECTION 01300 -

Attachment A – Partial Submittals List

Appendix A - Partial Submittal List				
Section No.	Paragraph No.	Submittal	Submittal Date	Action
01300	1.1.B.1	Preliminary Schedule of Shop Drawings and Samples	10 days after NTP	ENGINEER Review
01300	1.1.B.2	Proposed Substitutes	7 days after NTP	ENGINEER Review
01300	1.1.B.3	List of Permits and Licenses	15 days after NTP	ENGINEER Review
01311	1.3.B.1	Preliminary Project Schedule (PPS)	10 days after NTP	ENGINEER Review and Acceptance
01311	1.3.C.1	Preliminary Schedule of Values (SOV)	20 days after NTP	CONSTRUCTION INSPECTOR Review and ENGINEER Acceptance
01311	1.3.D.1	Overall Project Schedule (OPS)	20 days after NTP	CONSTRUCTION INSPECTOR Review and ENGINEER Acceptance
01311	1.3.E.1	Near Term Schedule (NTS)	7 days after NTP / Update Monthly	CONSTRUCTION INSPECTOR Review and ENGINEER Acceptance
01311	1.3.F.1	Updated OPS, SOV, NTS	As described in section 01311	ENGINEER Acceptance
01320	1.2.A	Contractors daily field report	Within one working day after work was performed	CONSTRUCTION INSPECTOR Review
01400	1.2.A	Qualification of Quality Control Contractor Rep.	5 days after NTP	ENGINEER Acceptance
01400	1.2.B	Quality Control Program (QCP)	20 Days after NTP	ENGINEER Acceptance
01400	1.2.C	Proposed Revisions to QCP	When change made	ENGINEER Acceptance
01400	1.2.D.1	QWP - Water Control Plan	25 days after NTP	ENGINEER Acceptance
01400	3.4.C	Completed Designs	As required	ENGINEER Acceptance
01526	1.3	Trench Safety System Submittals	15 days prior to use	For Information
01560	3.9.D.1.d	Major or Hazardous Spill Report	As soon as possible	For Information
01570	1.1.C	Traffic Maintenance Plan	15 days after NTP	CONSTRUCTION INSPECTOR Approval
01570	1.2.A	Detailed dimensioned Shop Drawing and data for traffic maintenance	Prior to start of work	ENGINEER Acceptance
01740	1.4	Warranties	As described in section 01740	ENGINEER Review
01800	1.1.I	Copies of Permits	Upon receipt	Information only
01910	1.4.A	Proposed Methods of Weather Protection	15 days after NTP	CONSTRUCTION INSPECTOR Approval
01940	1.4.A&D	Request for Substitution of Product or Construction Method	Prior to substitution	OWNER Approval
01980	1.2.B.1	Release from Side Agreements and Special Easements	Substantial Completion	For Information
01980	1.2.D	Final Payment Application	Per Construction Contract	CONSTRUCTION INSPECTOR Approval
02070	1.2.A	Concrete Coring Submittals	As required to meet schedule	ENGINEER Acceptance
02070	1.2.B	Concrete Coring Request	Prior to coring	ENGINEER Acceptance
02075	1.2	Contaminated Soil Removal Submittals	As required to meet schedule	ENGINEER Acceptance

Appendix A - Partial Submittal List				
Section No.	Paragraph No.	Submittal	Submittal Date	Action
02125	1.2.B	Geotextile Fabrics Manufacturer's Product Data	15 days prior to use	ENGINEER Acceptance
02140	1.5.B	Water Control Plan Submittals	10 days after NTP	ENGINEER Acceptance
02140	1.5.D	Copies of Permits	Within the time specified in 02140	ENGINEER Acceptance
02150	1.3.A	Shoring Plans & Shop Drawing	15 days prior to start of work	ENGINEER Review
02210	1.2.B	Controlled Low Strength Material Shop Drawings	15 days prior to use	ENGINEER Acceptance
02215	1.4	Sewer Video Recording	As described in section 02215	ENGINEER Acceptance
02245	1.3.B	Geotextiles Shop Drawings	15 days prior to use	ENGINEER Acceptance
02245	1.3.C	Geotextile Samples	15 days prior to use	ENGINEER Acceptance
02245	1.3.D	Geotextile Certifications	15 days prior to use	ENGINEER Acceptance
02336	1.3.B.1	Manufacturer's Certificate of Compliance	Prior to start of work	ENGINEER Review
02336	1.3.B.2	Reports and Factory Tests	Prior to start of work	ENGINEER Review
02336	1.3.B.3	Materials, Methods, and Fraction Mitigation Plan	Prior to start of work	ENGINEER Acceptance
01336	1.3.B.4	Experience Requirements	Prior to start of work	ENGINEER Acceptance
02343	1.5	Temporary Support Submittals	15 days prior to start of work	ENGINEER Acceptance
02360	1.5.A	Data Covering Design and Installation	As described in section 02360	ENGINEER Acceptance
02366	1.4	Detailed Grouting Plan	Prior to use	ENGINEER Acceptance
02470	1.2.B	Construction Inspector Qualifications and Experience	5 days after NTP	ENGINEER Acceptance
02470	1.2.D	Pre-Construction Inspection Report	15 days prior to start of excavation	ENGINEER Acceptance
02510	1.2.A	Shop drawings and data	15 days prior to start of work	ENGINEER Acceptance
02510	1.2.B	Test results	As required	For Information
02535	1.3.A	Sewage Flow Control Plan	As required	ENGINEER Acceptance
02535	1.3.B	Copy of Property Owner/ Resident Notifications	Prior to notification distribution	ENGINEER Acceptance
02550	1.3.A	Pipe and pipe fitting Shop Drawings	Prior to use	ENGINEER Acceptance
02560	1.3.B	Testing Reports	Substantial Completion	CONSTRUCTION INSPECTOR and ENGINEER Review
02702	1.3	Laying Schedule	One week before laying pipe	ENGINEER Review and Acceptance
02730	1.4.A	Shop Drawings	Prior to use	ENGINEER Acceptance
03200	1.3.A	Shop Bending Diagrams, Placing Lists, and Drawings	Prior to fabrication	ENGINEER Acceptance
03200	1.3.B	Concrete Reinforcement Steel and Inserts Details	15 days after NTP	ENGINEER Acceptance
03290	1.3	Shop Drawings	As described in section 03290	CONSTRUCTION INSPECTOR and ENGINEER Review
03300	1.3	Concrete Mix Designs	As described in section 03300	ENGINEER Review
03315	1.3.B	Certified Test Results	Prior to use	ENGINEER Review
03400	1.2	Shop Drawings for Precast Concrete Structures	Prior to fabrication	ENGINEER Acceptance
11105	1.3.A.1	Shop Drawings and Data	30 days prior to use	ENGINEER Acceptance

Appendix A - Partial Submittal List				
Section No.	Paragraph No.	Submittal	Submittal Date	Action
11105	1.3.A.2	Operations and Maintenance Manual	Substantial Completion	ENGINEER Review
15101	1.4.A	Shop Drawings	Prior to Use	ENGINEER Acceptance
15101	1.4.B	Testing Reports	Substantial Completion	CONSTRUCTION INSPECTOR and ENGINEER Review

SECTION 01311 – CONSTRUCTION SCHEDULE

PART 1 - GENERAL

1.1 SCOPE

- A. Prepare, furnish, distribute, and provide periodic updates of the construction program/schedules as specified herein.

Critical Path Method (CPM) – A network analysis technique used to predict Project duration by analyzing which sequence of activities (which path) has the least amount of scheduling flexibility (the least amount of float). A scheduling technique utilizing activities, durations, and interrelationships/dependencies (logic), such that all activities are interrelated with logic ties from the beginning of the Project to the completion of the Project. Early dates are calculated by means of a forward pass using a specified start date. Late dates are calculated by means of a backward pass starting from a specified completion date (usually the forward pass's calculated Project early finish date)

1.2 SUBMITTALS

A. General:

1. Make all submittals in accordance with Section 01300 – Contractor Submittals.
2. Submit electronic copies of all schedule files attached to each transmittal.

B. Preliminary Project Schedule (PPS):

1. Submit the PPS 10 days after the date of the Notice to Proceed for CONSTRUCTION INSPECTOR review and acceptance.
2. If required, resubmit, incorporating all revisions, within five days after receipt of a returned review copy.
3. The PPS shall be based on the Project as described in the Contract Documents. It shall not show any value engineering and/or proposed changes to the Contract.

C. Schedule of Values (SOV):

1. Submit the preliminary SOV within 20 days after the date of the Notice to Proceed. The preliminary SOV shall be consistent with the lump sum prices in the itemized bid schedule and the requirements of Section 01025 – Measurement and Payment.
2. If required, resubmit, incorporating all revisions, within five days after receipt of a returned review copy.

D. Overall Project Schedule (OPS):

1. Submit the OPS to CONSTRUCTION INSPECTOR for approval within 20 days after date of the Notice to Proceed.
2. If required, resubmit, incorporating all revisions, within seven days after receipt of a returned copy.
3. The Baseline OPS shall be based on the Project as described in the Contract Documents. It shall not show any value engineering and/or proposed changes to the Contract.

E. Near Term Schedule (NTS):

1. Submit the first NTS to CONSTRUCTION INSPECTOR for approval within seven days of the Notice to Proceed.

F. Updating OPS, SOV, and NTS:

1. Submit a monthly update of the OPS and NTS and updated cash flow projections with each request for payment. Provide each update on a compact disk in P6 format. Include with the monthly update, a complete Claim Digger report indicating all comparisons between the previous schedule and the current update. A narrative describing the Project Work planned and completed for the period shall be provided along with a description of Work planned for the next monthly period. All changes made to the schedule must be described in the narrative and correlated to the Claim Digger report. All changes are subject to approval of CONSTRUCTION INSPECTOR. Changes made to each activity shall be recorded utilizing the Notebook function in P6, including the date of the change, a description of the change, and the reason the change was made. Custom Notebook categories shall be created for each schedule update to record the changes. A report shall be prepared summarizing each month's changes. If an activity is changed in the OPS, then the corresponding activity in the SOV shall be identically changed. Redistribute the values such that the total of all the values remains equal to the total Contract value. Provide a detailed report with calculations justifying these changes.

G. Updating PPS:

1. The PPS shall be updated immediately upon acceptance. The updated PPS shall be approved, and suggested changes made, prior to monthly request for payment. The PPS shall be updated monthly until the acceptance of the OPS. Once the OPS is accepted, the updated data in the PPS shall be transferred to the OPS and submitted (both schedules shall have the same Data Date upon transfer).

1.4 INITIAL DEVELOPMENT AND REVIEW

- A. Prior to development of the schedule, CONTRACTOR shall meet with CONSTRUCTION INSPECTOR to discuss and agree on how the Work Breakdown Structure (WBS) will be set up, activity codes, activity identification, calendars, resource loading, cost loading,

cost accounts, and the basic structure of the schedule. Prepare outlines of all schedule information for discussion at this meeting.

- B. Acceptance of CONTRACTOR's PPS, SOV, OPS, and NTS and revisions thereto, shall in no way relieve CONTRACTOR of any duties and obligations under the Contract. Such approval is limited to the format of the schedule and does not in any way indicate approval of, or concurrence with, CONTRACTOR's means, methods, and ability to carry out the Work.

PART 2 - PRODUCTS

2.1 PRELIMINARY PROJECT SCHEDULE (PPS)

- A. The PPS shall be a bar chart or time scaled network diagram including all construction activities for the Project, but showing CONTRACTOR's proposed logic and order of activities during the first 30 days after the Notice to Proceed.

2.2 SCHEDULE OF VALUES (SOV)

A. Activity List:

- 1. The OPS shall be a "cost and resource loaded" schedule. Each activity comprising the OPS shall have a value or a cost assigned to it. As such, the SOV is actually a complete listing of the OPS' activities and corresponding values. This detailed cost breakdown is subject to the acceptance of CONSTRUCTION INSPECTOR.

B. Format:

- 1. Produce the SOV in the Microsoft Excel spreadsheet program. Submit the review copy of the SOV on 8.5 x 11 inch paper and provide an electronic copy on a compact disk or flash drive.

C. Activity Identification:

- 1. The SOV shall include the description, value, and identification number for each OPS activity. Each identification number of each activity shall be identical to each activity ID number assigned in the OPS.

D. Values:

- 1. The value of each activity shall be a complete and total value, including all taxes, overhead, and profit. The sum of all the values of the activities shall equal the total Contract value.

E. Stored Material and Equipment:

- 1. Activities for which progress payments will be requested for stored material shall be broken down into at least two activities. The first activity shall be the cost of the material, delivered and unloaded, including taxes if required. The second activity

shall be the cost of installation plus overhead and profit. Only the activities broken out in the SOV, as described above, shall be paid as a stored material. Equipment shall be broken down further to include activities and values for commissioning and start-up and operator training. Only the activities broken out in the SOV, as described above, shall be paid as stored materials or as stored equipment.

F. Cash Flow Projection:

1. Along with the SOV submittal each month with each payment request, provide a monthly cash flow projection indicating the estimated value of each monthly payment request. This projection shall be updated each month and provided along with the schedule narrative.

G. Tax Exemption:

1. Obtain a tax-exempt number from OWNER to avoid paying sales tax.

2.3 OVERALL PROJECT SCHEDULE (OPS)

A. The OPS shall be comprised of the detailed proposed operations and activities for the duration of the Project. The OPS shall include the following:

1. The OPS shall be a resource loaded CPM schedule covering the entire Project and completely detailing CONTRACTOR's proposed operations for the construction of the Work. The OPS shall contain sufficient details to represent the Work, subject to the acceptance by CONSTRUCTION INSPECTOR, with a means to monitor and follow progress of all phases of the Work; comply with limits imposed by the Scope of Work, with contractually specified interim milestones and completion dates; and with constraints, restraints, or sequences included in the Contract. The schedule detail shall be subject to acceptance by CONSTRUCTION INSPECTOR.
2. A mathematical analysis of the CPM network diagram.
3. A trend chart showing early, on-time, and late completion envelopes and actual progress trend since the start of the Project.
4. A narrative report that describes CONTRACTOR's planned actions for carrying out each phase and portion of the Work and that summarizes the current status and progress of the Work. The report shall include descriptions of temporary construction, facility disruptions, OWNER's staff interface, and coordination needs. The number of workers, including subcontractors, currently on-site (separated by trade) and shift shall be indicated, as well as the type and size of each major piece of equipment required for the Work.

B. In preparing the OPS, CONTRACTOR shall meet individually with each subcontractor. Each subcontractor shall provide CONTRACTOR with detailed activity information, including manpower requirements and appropriate durations, to complete each element of the Project. Each subcontractor shall also provide CONTRACTOR with anticipated shop drawing and submittal dates and fabrication and delivery durations for key construction materials, systems, and equipment. For subcontractors and vendors not

selected at the time of this data collection, CONTRACTOR shall provide provisional data. Such provisional data shall later be reviewed with those subcontractors and vendors as they are selected and the OPS adjusted as necessary.

C. The following are requirements specific to the P6 software:

1. Calendars shall be Project Level Calendars and shall detail the intended work hours per day, holidays, and other non-work periods. Calendars shall include restrictions at least one year past the contractual completion date. No Global Calendars are allowed.
2. Resources shall be loaded under a resource hierarchy with the Project as the first level. All resources shall have a unique Project identifier.
3. The following User Preferences must be maintained at all times, unless otherwise approved by CONSTRUCTION INSPECTOR:
 - a. Time Units:
 - (1) Units Format – Unit of Time – Days.
 - (2) Durations Format – Unit of Time – Days.
 - (3) Hours per Time Period:
 - Hours/Day = 8.
 - Hours/Week = 40.
 - Hours/Month = 173.
 - Hours/Year = 2080.
4. Schedule Options shall be set as follows:
 - a. The calendar for scheduling relationship lag shall be the predecessor's activity calendar.
 - b. Schedule shall be run in Retained Logic.
 - c. Start-to-start lags shall be calculated based on Early Start.
 - d. Critical activities shall be defined as the Longest Path.
 - e. Total Float shall be computed as finish float.
5. A multi-level hierarchal WBS shall be used to layout the schedule. Level 1 shall be the Project level. Level 2 shall be broken into three sections: Pre-construction, Construction, and Post-construction. CONTRACTOR shall expand on other levels to provide sufficient detail. The SOV shall be used as the basis for the WBS.

6. Out-of-sequence progress must be corrected prior to the submission of each update. CONTRACTOR shall include in the schedule narrative details on how out-of-sequence progress was corrected and which activities and logic ties were changed due to each specific instance of out-of-sequence progress.
7. Constraints can be used in the schedule, but must be approved by CONSTRUCTION INSPECTOR. The following are the only software constraints that will be allowed, subject to approval by CONSTRUCTION INSPECTOR. Other software constraints are not allowed.
 - a. Finish-on-or-before – Late Finish constraint (typically used for contractual finish milestones).
 - b. Start-on-or-after – Early Start constraint (typically used for contractual start milestones).
 - c. As-late-as-possible – Zero Free Float constraint (can be used in certain situations as approved by CONSTRUCTION INSPECTOR).

D. The CPM Network Diagram shall:

1. Be prepared in the form of a time-scaled CPM network.
2. Group activities by building, structure, facility, and major exterior area of Work, such as yard piping and electrical underground distribution. The identification number of the individual activities shall be coded such to provide the grouping.
3. Be prepared in the chronological order of the beginning of each item of Work.
4. Identify each column or path by:
 - a. Distinct graphic delineation.
 - b. Major structures.
5. Have a horizontal time scale based on calendar days and identify the Monday of each week.
6. Show the order and interdependence of the activities and the sequence in which the Work is to be accomplished as planned by CONTRACTOR. The diagram shall show how the start of a given activity is dependent upon the completion of the preceding activities and how its completion restricts the start of following activities. Float need not be shown on the network diagram.
7. Be prepared in such a manner that sub-networks relating to particular phases or portions of the Work can be readily extracted or revised. Such sub-networks shall include, but may not be limited to, the following portions of the Work:
 - a. Each major piece of equipment.
 - b. Each primary system.

- c. Activities to be performed in limited access areas or requiring interface with other contractors.
 - d. Structures.
8. Show the following information related to the activities:
- a. Activity ID (number).
 - b. Activity name (description).
 - c. Estimated duration, in working days, of each activity.
 - d. Value of each activity, including profit, overhead, and taxes.
 - e. Major equipment requirements give examples.
 - f. Lags or lag factors may be used at CONTRACTOR's option. Finish-to-start relationships shall not have lags. Negative lags shall not be used.
 - g. Activity Codes including the following at a minimum: responsibility, area, and work type. All Activity Codes shall be Project Activity Codes, no Global Activity Codes are allowed.
 - h. Calendar assignment.
 - i. WBS assignment.
 - j. Resource allocation for each activity in the CPM Schedule shall identify the man-hours, the physical quantity of material to be installed (cubic yards of concrete, linear feet of pipe, etc.), as well as any activity requiring unusual shift work, such as two shifts, six day weeks, specified overtime, or work at times other than regular days or hours. Any activities containing unit price items, as specified in CONTRACTOR's bid proposal, shall equal the amount of the quantity specified in the Contract. CONSTRUCTION INSPECTOR reserves the right to accept or reject any value and allocation of the man-hours and/or the materials.
 - k. CONTRACTOR may elect to use cost accounts to cost load the CPM schedule (as opposed to the WBS). If this is the case, CONTRACTOR shall submit a cross reference register of the activities in the CPM Schedule to the Project's approved detailed cost breakdown. This register shall reflect that each activity in the CPM Schedule has a cross reference to the Project's approved detailed cost breakdown and the total values of all activities in the CPM Schedule, for example, quantities, manhours, and cost, shall correspond to their respective total values of the Project's approved detailed cost breakdown. The cross-reference register shall be subject to the review and acceptance by CONSTRUCTION INSPECTOR. Cross references shall physically exist in the Schedule.

- I. Cost, Manhours, and Materials shall be loaded on the schedule activities as follows:
 - (1) A single "Nonlabor" resource shall be created called "Cost Resource" with Price/Unit of 1\$. Activity cost shall be entered as lump sum.
 - (2) A single "Labor" resource shall be created called "Manhours Resource" with Price/Unit of 1\$. Manhours needed to accomplish Work on each activity shall be entered against this resource.
 - (3) A single "Material" resource shall be created called "Material Resource" with Price/Unit of 0\$. Materials needed to accomplish Work on each activity shall be entered the physical quantity of material to be installed (cubic yards of concrete, linear feet of pipe, etc.).
 - (4) A P6 file containing SOV as WBS and above-mentioned resources will be given to CONTRACTOR at the kick-off meeting to facilitate cost loading requirement for CPM schedule.
9. Show all activities relating to the construction of the Work. Activities that are interdependent due to restrictions to available manpower, construction equipment, or site restraints shall also be shown.
10. Show all temporary construction activities required for permanent Work.
11. Show where existing facilities will be taken out of service.
12. Show the following events and milestones in addition to construction activities:
 - a. Notice to Proceed.
 - b. Operating Test Period prior to the completion date.
 - c. Milestone dates.
 - d. OWNER coordination.
 - e. Notification periods.
 - f. Coordination with separate contracts.
 - g. OWNER activities impacting the Work.
13. Provide the network information detail such that the duration of activities will generally range from three to 20 days, with not more than one percent of those activities outside those limits. The activities which comprise separate portions of the Work shall be separately identifiable by coding.

14. Be plotted on 24- x 36-inch size sheets with the flow of activities from left to right. Printing shall be suitable for half-size reproduction. No lettering or numbering shall be less than 1/8 inch in height for capitals and numbers. The critical path shall be clearly marked and readily identifiable. Wherever possible, the activities relating to a particular sub-network shall be grouped together on a single sheet.
15. Submittals, submittal reviews and approvals, manufacture, tests, delivery, installation activities for long lead items, critical materials, and equipment shall be represented in the OPS, PPS, and NTS. Descriptions of each activity shall include sufficient detail to identify the unique scope of each activity. If and when a submittal receives authorization for the activity to partially proceed and that partial authorization is sufficient to enable the commencement of some, but not all, successor activities, then the original submittal activity shall be broken down into multiple activities, as necessary to accurately reflect the logic of CONTRACTOR's current plan. Show the following for each:
 - a. Submittal date (include estimated number of drawings in submittal).
 - b. Review period, based on the schedules noted in Section 01300 – Contractor Submittals. The shop drawing process shall have sufficient float to account for the revision and re-submission of shop drawings.
 - c. Fabrication duration.
 - d. Delivery dates.
16. Show decision dates for selection of finishes or products.
17. Show Adverse Weather Days:
 - a. The schedule shall account for adverse weather days by the use of clearly defined calendars that account for expected seasonal weather conditions (including winter shutdown periods) and environmental permit requirements for the planning and scheduling of activities. CONTRACTOR shall also provide the work days per week, holidays, the number of shifts per day, and the number of hours per shift. CONTRACTOR shall incorporate any seasonal restrictions to the Work within calendars assigned to activities, and shall not incorporate an activity with a description of “Winter Shutdown” that requires constraints.
 - b. Any calendars related to specific resources (i.e., a specific person or piece of equipment) shall be established as Resource Calendars, with the Calendar name clearly identifying the resource.
 - c. All other calendars developed by CONTRACTOR shall be established as Project Calendars.
 - d. These are the minimum days that need to be considered for above ground work. It is CONTRACTOR's responsibility to determine if additional days are warranted and to apply them to the schedule calendars.

- e. CONTRACTOR shall assign the restricted calendars to relevant schedule activities that would be affected by adverse weather.

E. Mathematical Analysis:

1. The mathematical analysis of the network diagram shall be based on the network diagram and shall be a computer printout tabulating each activity and showing the following information for each activity:
 - a. Activity ID (number).
 - b. Activity name (description).
 - c. Estimated duration, in working days of each activity.
 - d. Earliest start date, by calendar date (Start Date).
 - e. Earliest finish date, by calendar date (Finish Date).
 - f. Latest start date, by calendar date.
 - g. Latest finish date, by calendar date.
 - h. Total Float belongs to the Contract and shall not be considered as available for the exclusive use of or benefit of either OWNER or CONTRACTOR. Total Float is the number of days an activity may be delayed without extending the completion of either the Project or an interim milestone. Float is available on a first-come, first-served basis to all identified "responsible" parties in the schedule. During the course of Contract execution, any float generated due to the efficiencies of either party is not for the sole use of the party generating the float; rather it is a shared commodity to be reasonably used by either party.
 - i. Critical activities and activities on the critical path shall be marked.
2. The earliest start and finish dates shall be regarded as CONTRACTOR's intended start and finish dates.
3. CONTRACTOR shall provide CONSTRUCTION INSPECTOR with the following:
 - a. The calendars used for computation of the dates specified, showing the calendar dates of each working day, and shall incorporate CONTRACTOR's assumptions of working days, with due consideration being given to discretionary, legal and statutory holidays, Saturdays and Sundays, and weather shutdowns.
 - b. A list of symbols, acronyms, and codes used in the preparation of the network diagram.
4. A schedule run report shall be included with all schedule submissions.

2.4 NEAR TERM SCHEDULE (NTS)

- A. CONTRACTOR shall develop and refine a detailed NTS showing the day to day activities with committed completion dates which must be performed during the upcoming four to six-week period. The detailed schedule shall represent CONTRACTOR's best approach to the Work which must be accomplished to maintain progress consistent with the OPS. The NTS must show proposed facility disruptions, the length of each disruption, and key OWNER interface activities.

PART 3 - EXECUTION

3.1 UPDATING

- A. The OPS update shall coincide with the end of the pay period. The update shall be used to create the monthly payment requisition. The OPS update shall be submitted in its entirety within five days of the end of the pay period. Submittal and approval of Schedule updates shall be a condition precedent to making monthly payments.
- B. Monthly progress shall be proposed by CONTRACTOR and reviewed and accepted by CONSTRUCTION INSPECTOR prior to submission of the schedule updates. CONTRACTOR shall prepare a list of progress and payment requests to discuss with CONSTRUCTION INSPECTOR two days after the end of the pay period. A meeting shall be held between CONTRACTOR and CONSTRUCTION INSPECTOR three days after the end of the pay period to discuss CONTRACTOR's proposed progress and payment. The results and agreements from this meeting shall constitute the official data for the schedule update.
- C. Progress shall be input based on the remaining duration. All out-of-sequence progress must be corrected prior to submission of the OPS. Schedule submissions with out-of-sequence progress will be rejected immediately. Update the CPM Schedule monthly, whether or not CONSTRUCTION INSPECTOR has accepted the prior updated Schedule, to reflect actual progress. The update shall include the historical record of actual start and finish dates for activities completed. For in-progress activities, the update shall include percent complete based on an agreed percent completed between both parties and remaining duration based on the amount of workdays required to complete the activity. Default (automatic) updating of the schedule is prohibited. Actual Start and Finish dates shall not be automatically updated by default mechanisms that may be included in the CPM scheduling software systems.
- D. When it is discovered that elements of the original Project are missing from the schedule, CONTRACTOR shall add them in such a way that they do not affect any successor activities. It is CONTRACTOR's responsibility to mitigate the affect of any elements that are missing from the schedule.
- E. Provide a written narrative report with each update including:
 - 1. A written status review of the Project.

2. A written discussion of problem areas including current and anticipated delay factors and their impact.
 3. Direct action taken, or proposed, and its effect.
 4. A detailed written description of revisions including:
 - a. Their effect on the schedule due to the change.
 - b. Revisions in duration of activities.
 - c. Other changes that may affect the schedule.
 5. A listing of behind-schedule materials and equipment procurement activities. This list is an update of the submittal, manpower, and key monthly completion and delivery dates showing the OPS task number.
 6. Job progress relative to the OPS, including an Early/Late Start, Early/Late Finish, and Total Float Report.
 7. A listing of any significant changes in the activities and restraints occurring since the last update and why the changes were made.
- F. CPM Network Diagram:
1. An updated CPM Network Diagram with all activities and restraints shall be furnished. This includes providing an As-Built Schedule with completion dates to the OPS for all key monthly completion and delivery dates. All approved change orders shall be listed and the effects of change orders shown on the OPS.
 2. Provide updated OPS graphics showing progress-to-date and completion schedule. The critical path or paths shall be clearly identified.
- G. Provide a trend chart showing Project completion dates of significant areas of the Project.
- H. Provide a listing of critical Work to be performed prior to the next Project Coordination Meeting, specifically listing what must be done during the next 30 days to stay on the OPS critical path schedule and its task number.
- I. At each Monthly Schedule Meeting, CONTRACTOR shall present for discussion the most current update of the OPS and NTS.
- J. If a schedule submission is rejected by CONSTRUCTION INSPECTOR or OWNER, CONTRACTOR shall review the recommendations, make changes as necessary, and resubmit a revised schedule submission, including a schedule narrative report, within five days of the transmission of the rejection or recommendation for re-submission.
- K. If, after a schedule has been accepted, CONTRACTOR or CONSTRUCTION INSPECTOR discovers that any aspect of the schedule has an error or omission, it shall be corrected by CONTRACTOR in the next schedule submission.

3.2 SCHEDULING CONFERENCES

- A. CONTRACTOR shall attend a scheduling conference with CONSTRUCTION INSPECTOR and OWNER. The conference shall be held after CONTRACTOR has made significant progress in assembling the OPS and has a reasonably close to finished product. The purpose of the conference will be to allow CONTRACTOR to present the OPS to CONSTRUCTION INSPECTOR and OWNER to facilitate the review and acceptance process.
- B. CONTRACTOR and CONTRACTOR's approved scheduler shall attend a meeting with CONSTRUCTION INSPECTOR and OWNER to discuss the schedule on a monthly or more frequent basis as determined by CONSTRUCTION INSPECTOR.

3.3 CHANGES DUE TO ADDED/DELETED/CHANGED WORK

A. Changes to the Contract:

1. In the event a notice of a change to the contract is received, the appropriate changes to the schedules shall be made, as necessary, to incorporate the anticipated added/deleted/changed Work; and CONTRACTOR shall notify CONSTRUCTION INSPECTOR in writing within 10 calendar days the effects of such change to the schedule.
2. Change to the Contract includes, but is not limited to: extra work; Agreed Prices; Orders on Contracts; Suspensions of Work Directed by CONSTRUCTION INSPECTOR; Changed Condition; and Value Engineering Change Proposals.
3. Added, deleted, and/or extra Work associated with Orders On Contract shall be reflected in the next Monthly Progress Schedule Submission in anticipation of and prior to the date in which the Work physically takes place without regard to the dates when the actual Order On Contract was approved. The effect of the change to the Contract on the projects Critical Path shall be stated. Added, deleted, and/or extra Work not identified as a Change Order, Work Change Directive, or Written Amendment in a progress schedule will not constitute approval of an excusable delay by OWNER.
4. Extra Work or additional Work that does not affect the controlling operation on the critical path will not be considered as the basis for a time extension. All schedule activities effected by added, deleted, or changed Work that is included in a signed Order-On-Contract, Field Change Order, or Authorization of Extra Work (with the exception of minor quantity changes that do not impact contract milestones), or Work activities performed by CONTRACTOR at risk in anticipation of such OWNER approval, shall be assigned an appropriate Activity Code (Added/Changed Work) and Code Value (sequentially numbered) to denote which Changed Contract Work order number correlates to those activities of Work. Added, deleted, and/or extra work not identified as a Change Order, Work Change Directive, or Written Amendment in a progress schedule will not constitute approval of an excusable delay by OWNER.

B. Time Impact Analysis:

1. A Time Impact Analysis (TIA) shall be submitted to CONSTRUCTION INSPECTOR for each request by CONTRACTOR for an adjustment of contract time, or when CONTRACTOR or CONSTRUCTION INSPECTOR consider that an approved or anticipated change to the contract may impact the critical path and contract progress by more than a calendar month. The TIA shall be based on a revised OPS and shall be submitted as an electronic file containing:
 - a. The TIA illustrating the impacts of each change or delay on the current scheduled completion date or internal milestone, as appropriate.
 - b. The analysis shall use the accepted OPS that has a data date closest to and prior to the event. This shall then be compared against the accepted Baseline OPS for the purpose of the TIA.
2. If CONSTRUCTION INSPECTOR determines that the accepted schedule used does not appropriately represent the conditions prior to the event, the accepted schedule shall be updated to the day before the event being analyzed.
3. The TIA shall include an impacted schedule developed from incorporating the actual or anticipated event into the accepted schedule by adding or deleting activities, or by changing durations or logic of existing activities.
4. If the impact schedule shows that incorporating the event negatively modifies the critical path and scheduled completion date of the accepted schedule, and CONSTRUCTION INSPECTOR accepts the impacted schedule, the difference between scheduled completion dates of the two schedules shall be equal to the proposed adjustment of contract time.
5. CONSTRUCTION INSPECTOR may construct and utilize an appropriate Project schedule or use another recognized method to determine adjustments in contract time until CONTRACTOR provides the TIA.
6. CONTRACTOR shall submit a TIA within 15 days of receiving a written request for a TIA from CONSTRUCTION INSPECTOR.
7. CONTRACTOR shall allow CONSTRUCTION INSPECTOR 15 days after receipt to accept or reject the submitted TIA. All accepted TIA schedule changes shall be included in the next OPS update submission.
8. Request for a contract time extension will not be processed until the receipt and approval of a TIA.

3.4 RECOVERY SCHEDULE

- A. If the latest completion time for any Work on the current OPS results in an activity being delayed ten percent or more of the time beyond the required Contract duration or any specified Milestone duration, as adjusted if appropriate, CONSTRUCTION INSPECTOR may require CONTRACTOR to submit a Recovery Schedule and written description of

the plan to recover all lost time and maintain the required Completion Date or specified Interim Milestone Date(s).

- B. The Recovery Schedule shall include resource assignments that show where additional labor and/or equipment resources will be allocated. The submittal may be supplemented with a request for a Contract Time Extension. CONTRACTOR shall provide a reasonable plan for accomplishing the Work of the Contract within the current completion date, or to the requested contract extension date.

3.5 FAILURE TO SUBMIT RECOVERY SCHEDULE

- A. No progress payment for this item of Work shall be made until the progress schedule is “accepted” or “accepted as noted” by CONSTRUCTION INSPECTOR.
- B. If CONTRACTOR’s revised Progress Schedule submission does not address the written comments provided by CONSTRUCTION INSPECTOR, and does not include a written explanation with a reasonable rational for not addressing those comments, the submission shall be considered deficient.

- END OF SECTION 01311-

SECTION 01318 – MEETINGS

PART 1 - GENERAL

1.1 SCOPE

- A. This Section includes the requirements related to meetings required for the Project.
- B. In addition to the meetings described in this Section, CONTRACTOR shall attend and participate in other meetings arranged by CONSTRUCTION INSPECTOR, ENGINEER, or OWNER for other purposes, including, but not limited to, coordination with regulatory agencies, local authorities, utilities, and property owners.

1.2 SUMMARY

- A. CONSTRUCTION INSPECTOR will schedule and conduct a preconstruction conference in accordance with the Construction Contract and this Section.
- B. CONSTRUCTION INSPECTOR will schedule and administer weekly progress meetings; quality control coordination meetings; monthly As-Built Drawing coordination meetings; and pre-installation meetings as required; and specially called meetings throughout the progress of Work.
- C. CONSTRUCTION INSPECTOR will:
 - 1. Prepare agenda for meetings.
 - 2. Distribute written notice of specially called meetings a minimum of one working day in advance of meeting date.
 - 3. Make physical arrangements for meetings.
 - 4. Preside at meetings.
 - 5. Record minutes; include significant proceedings and decisions.
 - 6. Prepare formal minutes and distribute within four working days after each meeting:
 - a. To meeting participants.
 - b. To parties affected by decisions made at meeting.
 - c. Furnish both OWNER and CONTRACTOR with three copies of minutes.
- D. Representatives of CONTRACTOR, Subcontractors, and Suppliers attending meetings shall be qualified and authorized to act on behalf of entity each represents.

- E. If no corrections/additions are received within seven calendar days from the distribution of the minutes, the minutes automatically become a part of the official record as presented.

1.3 PRECONSTRUCTION CONFERENCE

A. When:

- 1. Within 20 days after Effective Date of Contract, but before CONTRACTOR starts work at site.

B. Location:

- 1. To be selected by OWNER after contract award.

C. Attendance:

- 1. CONTRACTOR's Project Manager.
- 2. CONTRACTOR's Resident Superintendent.
- 3. CONTRACTOR's "hands-on" person designated by CONTRACTOR to submit Shop Drawings to CONSTRUCTION INSPECTOR.
- 4. Subcontractors' or suppliers' representatives CONTRACTOR may desire to invite or CONSTRUCTION INSPECTOR may request.
- 5. CONSTRUCTION INSPECTOR's representatives.
- 6. OWNER's representatives.
- 7. Local utility representatives.
- 8. Governmental representatives, as appropriate.
- 9. Others as requested by CONTRACTOR, OWNER, or ENGINEER.

- D. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established.

- E. CONSTRUCTION INSPECTOR shall preside at the preconstruction conference and arrange for keeping and distributing the minutes for all persons in attendance.

- F. The first day of the conference shall discuss the agenda items listed below. The subsequent days shall be spent on reviewing the Drawings, Specifications, and important CONTRACTOR Submittals in extensive detail.

G. Completed agenda includes, but is not limited to the following:

1. Presentation of preliminary progress schedule by CONTRACTOR.
2. Presentation of the schedule of submittals, Shop Drawings, and sample submissions by CONTRACTOR.
3. Transmission, review, and distribution of CONTRACTOR submittals.
4. Check of required bonds and insurance policies.
5. Project Safety.
6. CONTRACTOR assignments for safety and first aid.
7. Liquidated damages.
8. Maintaining record documents.
9. Procedures for handling submittals such as substitutions and Shop Drawings.
10. Operation and Maintenance (O&M) submittal procedures.
11. Direction of correspondence and coordinating responsibility.
12. Weekly progress meetings.
13. Equal opportunity requirements.
14. Laboratory and field testing requirements.
15. Provisions for inventory of material stored on-site or off-site, if off-site storage is authorized.
16. Schedule of values, application for progress payment, and progress payment procedures.
17. Change Order procedures.
18. Posting of OWNER's sign.
19. CONTRACTOR's proposed Erosion Control Plan.
20. Critical work sequencing.
21. Major equipment deliveries and priorities.
22. Approval of formats for daily report forms.
23. Approval of transmittal formats.

1.4 QUALITY CONTROL COORDINATION MEETING

A. When:

1. After Preconstruction Conference, before start of work, and prior to acceptance by ENGINEER of CONTRACTOR's quality control (QC) plan. Meetings shall continue as often as necessary, as determined by ENGINEER, until all Quality Program Manuals, Quality Work Plans, Testing and Inspection Plans, and Design Process Control Procedures are approved.

B. Location:

1. On Site or another location determined by OWNER.

C. Attendance:

1. CONTRACTOR's Project Manager and Quality Control Engineer.
2. CONSTRUCTION INSPECTOR's representatives.
3. OWNER's representatives.

D. Suggested agenda includes, but is not limited to the following:

1. CONTRACTOR's proposed QC system procedures, including the forms that will be used to record QC operations, control activities, testing, and administration of the system for both on-site and off-site work.
2. Discussion of the interrelationship between CONTRACTOR's management and control and OWNER's control specifications.

1.5 WEEKLY PROGRESS MEETINGS

A. Schedule:

1. Weekly.

B. Location:

1. On Site or another location determined by OWNER.

C. CONSTRUCTION INSPECTOR shall schedule and hold regular on-Site progress meetings and at other times as requested by CONTRACTOR, or as required by progress of the Work. CONTRACTOR shall attend each meeting. OWNER, ENGINEER, or CONTRACTOR, may also request attendance by representatives of CONTRACTOR's suppliers, manufacturers, and/or other subcontractors.

- D. CONSTRUCTION INSPECTOR will preside at the progress meetings and will arrange for keeping and distributing the minutes. The purpose of the meetings is to review the progress of the Work, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop. During each meeting, CONTRACTOR shall present any issues that may impact its progress along with the suggested resolution of these issues.
- E. Attendance:
1. CONTRACTOR's Project Manager.
 2. CONTRACTOR's Resident Superintendent
 3. CONSTRUCTION INSPECTOR's representatives.
 4. OWNER's representatives.
 5. Affected Subcontractors (when requested).
 6. Local utility representatives, if applicable.
- F. Suggested Agenda:
1. Project safety concerns.
 2. Review minutes of previous meeting.
 3. Review Work progress since previous meeting.
 4. Field observations, problems, and conflicts.
 5. Installation of initial support systems.
 6. Review upcoming Project Construction Schedule.
 7. Problems impeding Construction Schedule.
 8. Corrective measures and procedures to regain conformance with projected Construction Progress Schedule.
 9. Revisions to Construction Progress Schedule.
 10. Review of off-site fabrication and delivery schedules.
 11. Issues raised by OWNER, CONSTRUCTION INSPECTOR, and/or ENGINEER.
 12. Progress and schedule for succeeding work period.
 13. Coordination of schedules.

14. Review and update submittal schedules.
15. Maintenance of quality standards.
16. Pending changes and substitutions.
17. Any claims against the Contract.
18. Review proposed changes for:
 - a. Effect on Construction Progress Schedule and completion date.
 - b. Effect on other contracts.
19. Other business.

- G. At least once a month, the agenda for this meeting shall include a review of progress on the development of As-Built Drawings to ensure that information is being recorded correctly.
- H. Agenda containing specific subjects to be discussed shall be provided to each attendee at least one work day before the meeting.

1.6 PRE-INSTALLATION MEETINGS

- A. Schedule prior to each construction activity that requires coordination with other construction.
- B. Location:
 1. On Site or another location determined by OWNER.
- C. Attendance:
 1. CONTRACTOR's Resident Superintendent, Safety Officer, and Quality Control Engineer.
 2. ENGINEER's representatives (when requested).
 3. CONSTRUCTION INSPECTOR's representatives.
 4. Local utility representatives, if applicable.
- D. Suggested Agenda:
 1. The Contract Documents.
 2. Options.
 3. Related Requests for Interpretation (RFIs).

4. Related Change Orders.
5. Purchases.
6. Deliveries.
7. Submittals.
8. Review of mockups.
9. Possible conflicts.
10. Compatibility of materials and compatibility problems.
11. Time schedules.
12. Weather limitations.
13. Manufacturer's written recommendations.
14. Warranty requirements.
15. Acceptability of substrates.
16. Temporary facilities and controls.
17. Space and access limitations.
18. Regulations of authorities having jurisdiction.
19. Testing and inspection requirements.
20. Installation procedures.
21. Coordination with other work.
22. Required performance results.
23. Protection of adjacent work.
24. Protection of construction and personnel.
25. Site Ingress and Egress plan.
26. Traffic Control Plan.
27. Applicable Permits.

1.7 PUBLIC INVOLVEMENT

- A. CONTRACTOR shall attend a minimum of one public information meetings prior to construction and one public information meetings during the conduct of the Project. Each meeting may last up to four hours and will be held in Indianapolis near the Project site. CONTRACTOR's Project Manager and Superintendent shall attend each meeting along with others CONTRACTOR chooses. During each meeting, CONTRACTOR's representatives shall be prepared to answer questions from the public and to present the construction schedule, safety program, traffic control plans, and other Project elements of interest. OWNER shall be responsible for organizing and conducting the meetings and for reserving and paying for the meeting space. CONTRACTOR shall include the cost of attendance by its personnel at the meetings in the bid cost.

1.8 SCHEDULING CONFERENCE AND MEETINGS

- A. See Section 01311 – Construction Schedule.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION 01318 -

SECTION 01320 – CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Project Record Documents are the records that demonstrate the actions of CONTRACTOR throughout the construction and verification/testing of the Project. These documents include, but are not limited to: correspondence; transmittals; submittals; Requests for Interpretation (RFIs) and responses thereto; certifications; insurance documents; training records; meeting minutes; test results; audit reports and associated documents; change documents; records of cost reimbursable work; permits and documents associated with the monitoring of those permits; documentation required for hazardous materials management; tracking logs; project record documents; operations and maintenance manuals and related documents; operator and technician training records; operations and maintenance records; and service bulletins.
- B. Construction progress documentation includes:
1. CONTRACTOR's Daily Field Reports.
 2. Construction Photographs.
 3. Operation and Maintenance (O&M) Records.
 4. Permit Documentation.
 5. Fabrication Records.
 6. Document Control and Tracking.
- C. In addition to normal business records, progress documentation requirements shall include documenting any existing environmental conditions, transportation coordination, and emergency services.

1.2 CONTRACTOR'S DAILY FIELD REPORTS

- A. Submit one copy of CONTRACTOR's Daily Field Report to CONSTRUCTION INSPECTOR within one working day from the date Work was performed. The Daily Field Report will include:
1. Contract name and number, Name of Contractor, Name, signature, and title of employee completing the report.
 2. Report number – number each report sequentially.
 3. Weather conditions.

4. Date Work was performed.
5. Construction schedule activity number.
6. Activity description.
7. Work performed per shift.
8. Current problems and constraints.
9. Potential problems and delays.
10. Requests for Interpretation (RFI).
11. Site visitations to include purpose of visit.
12. Daily manpower including Subcontractors: identify all personnel in workforce, including office, supervisory, production, maintenance, craft personnel, etc., and also include schedule activity number.
13. Major construction equipment used in performing Work and construction equipment idle for the day.
14. Soil and Rock samples collected for testing, types of testing to be performed, destination laboratory to perform testing, and lab testing results returned from laboratory.
15. Measured quantities of water discharged from each discharge location per day.
16. Measured quantities of service water introduced for CONTRACTOR's operations at each location per day.
17. Remarks and instructions from ENGINEER, etc.

1.3 CONSTRUCTION PHOTOGRAPHS

- A. CONTRACTOR shall furnish a series of construction photographs.
- B. PHOTOGRAPHS are to be taken of major components of the Work before they are covered and of views to be determined by CONSTRUCTION INSPECTOR. A minimum of 25 construction photographs shall be taken each month until the Work is completed. Photographs shall be taken with a digital camera with a resolution of at least 12 megapixels. Digital copies of each picture taken during the month shall be submitted to CONSTRUCTION INSPECTOR at the time of preparation of the monthly estimate for progress payment.
- C. No extra payment shall be made for construction photographs.

1.4 OPERATION AND MAINTENANCE RECORDS

- A. Maintain on Site or another location determined by OWNER all of the records that relate to management administration, operations, and maintenance, and associated activities in a manner accessible for inspection by ENGINEER or CONSTRUCTION INSPECTOR.

1.5 PERMIT DOCUMENTATION

- A. Maintain on Site or another location determined by OWNER all permit drawings and permits in a manner accessible for inspection by ENGINEER or CONSTRUCTION INSPECTOR.

1.6 FABRICATION RECORDS

- A. Maintain on Site or another location determined by OWNER up-to-date, complete, and accurate field and plant records to document consistency with the Project Specifications in a manner accessible for inspection by ENGINEER or CONSTRUCTION INSPECTOR.

1.7 DOCUMENT TRACKING

- A. All correspondence shall include the Project name and Contract number along with the specific subject of the letter. When replying to a specific letter, the letter or transmittal shall be referenced by serial number, date, and subject. Where a submittal is referenced, the applicable specification section number shall also be referenced. All correspondence shall be serialized and separated into incoming and outgoing correspondence logs.

Maintain a document control system to monitor the generation, status, and filing of documents. Documents such as Change Orders (proposed and approved), Request for Proposals, Request for Interpretation, Design Clarifications, Meeting Minutes, Applications for Payment, reports, and transmittal letters shall be controlled using the system.

- B. Maintain one copy of each submittal on Site or another location determined by OWNER at all times throughout the construction period as Project Record Documents. Incorporate all changes or corrections as soon as possible. Maintain Project Record Documents in good order in a clean, dry, legible condition apart from the Contract Documents. Provide access to the Project Record Documents to ENGINEER, CONSTRUCTION INSPECTOR, and OWNER during normal working hours.
- C. Document tracking shall provide that all changes be promptly distributed to all locations. Obsolete documents shall be eliminated from use, or be retained for the record and clearly identified as such.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION 01320 -

SECTION 01380 – PRECONSTRUCTION AUDIO-VIDEO DOCUMENTATION

PART 1 - GENERAL

1.1 SCOPE

- A. The Work of this Section includes, but is not limited to, Preconstruction Audio-Video Documentation consisting of high definition color video recording, with audio description, of surface features along the entire line of the Project and including all Work, easement, and storage areas and all access roadways, and, prior to audio-video recording, visual investigation of all areas to be inventoried with notations made to items not readily visible by recording methods including, but not limited to, size, type, and condition of driveway culverts, headwalls, etc. Audio-video recording shall be performed by an independent company or individual having at least three years of experience in similar type work and shall be done prior to commencement of the construction or delivery of any equipment, materials, or supplies to the site of Work.
- B. The purpose of the high definition color audio-video recording of the Project is to provide the necessary information for restoration of surface features after completion of the Project. This recording must, therefore, cover the Project area in its entirety to assist in returning those areas affected by construction to their original condition with as little controversy as possible. Video recording shall be performed no more than 12 months prior to construction in the area, and any areas recorded more than 12 months prior to the construction shall be redone at no additional cost to OWNER.
- C. Pre-construction inspections and related photography are covered in Section 02470 – Pre- and Post-Construction Inspections.
- D. Work in this Section does not relieve CONTRACTOR of its contractual obligation to furnish construction photographs as defined in Section 01320 – Construction Progress Documentation.

1.2 QUALIFICATIONS

- A. Color audio-video recording must be compiled by a professional videographer with at least three years verifiable experience in color audio-video recording of similar type projects for municipal agencies. The names of the company, individual videographer(s), and additional requested information must be submitted within 5 days after the Notice to Proceed for acceptance by CONSTRUCTION INSPECTOR.

1.3 OWNERSHIP OF RECORDINGS

- A. All recordings produced will become the permanent property of OWNER. The CONTRACTOR shall deliver four copies of all video recordings to CONSTRUCTION INSPECTOR for review by CONSTRUCTION INSPECTOR at least 5 days prior to the start of any construction.

- B. Any portion of the recorded coverage deemed unacceptable by CONSTRUCTION INSPECTOR must be re-recorded by CONTRACTOR at no additional cost to OWNER.

PART 2 - PRODUCTS

2.1 ELECTRONIC REQUIREMENTS

- A. Audio-video recording shall be DVD NTSC format.

PART 3 - EXECUTION

3.1 COVERAGE OF RECORDING

- A. The area to be recorded shall include, but not be limited to, all existing driveways, sidewalks, curbs, ditches, streets, landscaping, trees, culverts, catch basins, headwalls, retaining walls, fences, visible utilities, and all buildings located within the zone of influence of construction. Of particular concern are any existing faults, fractures, defects, or other imperfections exhibited by the above-mentioned surface features. Audio description shall be made simultaneously with and support the video coverage.
 1. All streets and railroads adjacent to excavation sites shall be recorded for the full width of the public right-of-way.
 2. Easement areas shall be recorded for the full width of the perpetual and temporary easements and all other adjacent areas lying within 50 feet of the easement. The size and locations of all easements are shown on the Contract Drawings.
 3. CONTRACTOR shall furnish color audio and video of all exterior surfaces of buildings specifically identified by CONSTRUCTION INSPECTOR to receive such coverage. At a minimum, any structure or building within any permanent or temporary easement. Buildings so identified may include houses, apartments, factories, warehouses, retail stores, and other structures. Exterior building coverage shall include, but not be limited to, walls, visible foundations, chimney, porches, and trim.
 4. Bridges and those areas adjacent to and within 200 feet of any bridges appearing on the Contract Drawings shall be audio-video recorded. Exterior bridge supports, structural members, visible footings, side walls, underside, and deck shall receive special, although not exclusive, attention. Existing cracks, faults, fractures, defects, or other imperfections shall be of particular concern.

3.2 LOCATION INFORMATION

- A. All DVD disks shall be properly identified by disk number, location, date, and Project name in a manner acceptable to CONSTRUCTION INSPECTOR.

- B. A record of the contents of each disk shall be supplied on a run sheet identifying each segment in the disk by location, i.e., street or easement viewing side, traveling direction, sewer stationings, and all referenced by disk indexing.
- C. A brief report and inventory of all disks completed, referenced by location and disk number, shall be furnished to CONSTRUCTION INSPECTOR upon completion of the Work and delivery of the disks.
- D. All video recordings shall begin with the date and time of recording, the Project name, the sheet numbers or engineering stationing as shown on the Contract Drawings, the name of the street, easement or building being recorded, the direction of travel, and the viewing side.
- E. Houses and buildings shall be identified visually by house or building number, when possible, in such a manner that the progress of the recording and the proposed system may be located by reference to the houses and buildings.
- F. The engineering stationing numbers must be continuous and correspond to the Project sewer stationing and include the standard engineering symbols. This information must appear in the lower half of the viewing screen. Below the engineering stationing shall appear the name of the Project, name of the area covered, direction of travel, viewing side, date, time, etc.
- G. In easements, where hand-held video equipment must be used, the engineering stationing cannot be automatically reproduced on the disk. Local landmarks on the route or other recognizable features off to the side of the sewer route shall be visually and audibly noted at frequent intervals to identify the camera location.
- H. All disks are to be accompanied by a notarized statement verifying the original unedited quality of the disks.

3.3 ENTERING PRIVATE PROPERTY

- A. If it becomes necessary to enter onto private property, CONTRACTOR shall notify the owner of such property at least 24 hours or more in advance of the planned entry to obtain their permission to do so. Should the owner of the property refuse to give their permission for said entry, CONTRACTOR shall notify CONSTRUCTION INSPECTOR. CONTRACTOR is advised that it shall not enter any private property before permission is granted to do so, or CONSTRUCTION INSPECTOR notifies CONTRACTOR in writing that the legal right to enter the property has been obtained. CONTRACTOR shall be held liable for entry made other than stated above.
- B. CONTRACTOR shall, at its own expense, repair or restore any areas damaged during the Work of this Section.

3.4 SITE RECORDING CONDITIONS

- A. All recording shall be done during times of good visibility. No outside recording shall be done during periods of visible precipitation or when the ground area is covered with

snow, leaves, or debris unless otherwise authorized in writing by CONSTRUCTION INSPECTOR.

- B. In order to produce the proper detail and perspective, adequate auxiliary lighting will be required to fill in shadow areas caused by trees, utility poles, road signs, and other such objects, as well as other conditions requiring artificial illumination.
- C. The average rate of speed in the general direction of travel of the conveyance used during recording shall not exceed 48 feet per minute. Panning rates and zoom-in zoom-out rates shall be controlled sufficiently such that playback will produce adequate clarity of the objects being viewed.
- D. When conventional wheeled vehicles are used as conveyances for the recording, the distance from the camera lens to the ground shall not be less than 8 feet to ensure proper perspective. In instances where coverage will be required in areas not accessible to conventional wheeled vehicles, such coverage shall be obtained by walking or by special conveyance approved by CONSTRUCTION INSPECTOR, but with the same requirements for disk quality and content as specified herein except as may be specifically exempted by CONSTRUCTION INSPECTOR in writing.

- END OF SECTION 01380 -

SECTION 01400 – QUALITY CONTROL

PART 1 - GENERAL

1.1 SCOPE

- A. Specific quality control requirements for the Work are indicated throughout the Contract Documents. The requirements of this Section are primarily related to performance of the Work beyond furnishing of manufactured products. The term “Quality Control” includes inspection, sampling and testing, and associated requirements.
- B. Manage quality in all phases of the Project including activities of subcontractors and suppliers to achieve an end product in compliance with the Contract Documents.
- C. Establish, implement, maintain, and manage an effective CONTRACTOR’s Quality Control Program (QCP), to control, document, and assure that the Work complies with the requirements of the Contract Documents.
- D. Provide an approved Quality Control Engineer who will be responsible for overseeing the quality of the Work, developing and implementing Quality Work Plans (QWP) for the Work covered in the Specifications, and ensuring that corrective actions are taken to address non-conforming Work. The Quality Control Engineer shall be a licensed Professional Engineer registered in the State of Indiana with a minimum of five years of experience in the construction industry performing in a Quality Control Engineer role. Alternate Quality Control certifications recognized in the construction industry shall be reviewed by OWNER for acceptance.
- E. CONTRACTOR’s QCP shall meet with all requirements herein, as well as ISO Standards 9000 and 9001.
- F. CONTRACTOR’s QCP shall apply to all Work provided under this Contract, including design, components, equipment, systems, services, software, and construction.

1.2 SUBMITTALS

- A. Submit qualifications of CONTRACTOR’s Quality Control Contractor Representative to CONSTRUCTION INSPECTOR for acceptance by ENGINEER within 5 days of Notice to Proceed.
- B. Submit CONTRACTOR’s QCP to CONSTRUCTION INSPECTOR for ENGINEER acceptance within 20 days of Notice to Proceed.
- C. Notify ENGINEER in writing of any proposed changes to the QCP. All proposed changes are subject to acceptance of ENGINEER. Review the QCP at a minimum yearly frequency to assure the program’s continued adequacy to meet the requirements of the Contract Documents, and incorporate changes to overcome deficiencies and to enhance the program.

D. Submit the following QWP to CONSTRUCTION INSPECTOR for acceptance by ENGINEER at least 25 days after Notice to Proceed:

1. Submit Water Control Plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONTRACTOR'S QUALITY CONTROL PROGRAM (QCP)

- A. The QCP shall consist of plans, procedures, and the independent organization necessary to assure adequate control and assurance of quality for design, materials, equipment, testing, start-up, coordination, workmanship, fabrication, installation, and operations for both on-site and off-site Work by CONTRACTOR including subcontractors, suppliers, laboratories, and consultants.
- B. The QCP shall include training to assure that suitable proficiency is achieved and sustained by personnel performing activities that affect and ensure quality.
- C. The QCP shall identify the organization, staffing, and responsibilities of personnel implementing the QCP. The organization responsible for the QCP shall be separate from that responsible for supervision of production.
- D. The QCP shall contain, as a minimum, the following elements:
 1. Management Responsibility.
 2. Documented Quality Management.
 3. Design Process Control Procedures.
 4. Purchasing.
 5. QWP.
 6. Installation.
 7. Inspection at Place of Manufacture.
 8. Sampling and Testing.
 9. Inspection and Testing Service.
 10. Measuring and Testing Equipment.
- E. Incorporate changes to the approved QCP directed by ENGINEER as the Work progresses to obtain the quality performance required by the Contract Documents.

3.2 MANAGEMENT RESPONSIBILITY

- A. CONTRACTOR's Quality Control Engineer shall be assigned to this Project from 15 days after Notice to Proceed until final completion.
- B. CONTRACTOR's Quality Control Engineer shall have authority and organizational freedom to act in all quality matters for the Project, and shall not be subordinate to any of CONTRACTOR's personnel that directly perform, supervise, or progress the Work.
- C. CONTRACTOR's Quality Control Engineer shall have a direct reporting relationship to CONTRACTOR's corporate quality management.
- D. Remove and replace CONTRACTOR's Quality Control Engineer at the direction of ENGINEER due to review of resume, interview, observance of individual's performance, or lack of organizational independence from production pressures.

3.3 DOCUMENTED QUALITY MANAGEMENT

- A. Define the requirements, resources, and methods for the positive administration and control measures which will assure Work is performed as required by the Contract Documents.
- B. CONTRACTOR's QCP shall consist of:
 - 1. Quality Program Manual.
 - 2. QWP.
 - 3. Testing and Inspection Plans.

3.4 DESIGN PROCESS CONTROL PROCEDURES

- A. Design process control procedures shall be established, documented, implemented, and maintained to control the preparation, review, and ENGINEER/OWNER approval of the design work required by the Contract Documents. This includes, but is not limited to, the following designs:
 - 1. Value Engineering Proposals.
- B. Persons performing design work shall be identified with their responsibilities defined and their qualifications stated within the procedures. The procedures shall also include a complete description of the design criteria to be used in the design and the Quality Assurance (QA)/ Quality Control (QC) procedures to be followed by the designer. All designs must be performed, signed, and sealed by a Professional Engineer licensed in the State of Indiana and with qualifications acceptable to OWNER.
- C. Submit completed designs to CONSTRUCTION INSPECTOR for acceptance by ENGINEER.

3.5 PURCHASING

- A. Control the procurement of materials, parts, components, equipment, supplies, or services by providing sufficient written detail within purchasing documents, conveying Contract Document requirements.
- B. Control procurement through Procurement Document Control, Supplier/Sub-Supplier Selection Qualification, Supplier Quality Survey, Pre-Award Quality Surveys, Supplier Quality Approval, Source/Vendor Surveillance, Source/Vendor Inspection, Release for Shipment, and Receiving Inspection.

3.6 QUALITY WORK PLANS (QWP)

- A. Develop and implement QWPs for definable features of work and obtain approval from CONSTRUCTION INSPECTOR prior to performing the Work covered by the plan. The information accepted in approved QWPs shall not change specification requirements unless the plan contains specific references to the specification section requirement and specifically requests a change in the specification item.
- B. QWP shall include, but not be limited to the following:
 - 1. CONTRACTOR Means and Methods to be employed (i.e. tools, equipment, measuring devices, testing procedures) to ensure compliance with Contract Document requirements.
 - 2. Construction sequences.
 - 3. Site specific training and certification requirements for all workers involved.
 - 4. Specific training and certification requirements for CONTRACTOR personnel.
 - 5. Equipment, material verification, storage and preparation, installation steps, quality issues including material degradation, attachment, geometry, performance, and good practices to assure high quality results.
 - 6. Special equipment operating requirements.
 - 7. Manufacturer's recommended procedures.
 - 8. Controls to be implemented.
 - 9. Documentation to be employed, including example forms.
 - 10. Verification that existing field conditions have been captured (i.e., field notes, sketches, photos, and videos).
 - 11. Verification that As-Built Drawings are current.

12. Nonconforming conditions identification, documentation, correction, and acceptance prior to subsequent Work.
13. Assurance that Codes, Standards, and Contract Specifications are met.
14. Testing and Inspection Plans.
15. Other requirements specified in the Technical Specifications and on the Contract Drawings.

C. Testing and Inspection Plans shall include, as a minimum, the following:

1. Procedures to produce objective evidence that the structures, systems, components, or services, including those provided by consultants, subcontractors, suppliers, and testing laboratories meet the requirements of the Contract Documents.
2. Plans to manage, perform, document, and follow-up as needed on all required inspections and tests.
3. Coordination requirements with OWNER to ensure that concrete and shotcrete testing performed by OWNER shall meet the Quality requirements of OWNER.
4. Testing procedures, guidelines, standards, and example forms.
5. Inspection checklists with acceptance criteria.
6. CONTRACTOR's, ENGINEER's, and OWNER's hold points.

3.7 INSTALLATION

- A. CONTRACTOR shall inspect materials or equipment upon their arrival on the Site and immediately prior to installation and shall reject damaged or defective items. Nonconforming material, parts, components, equipment, and supplies, as practicable, shall be identified to preclude inadvertent use.
- B. Assure that all materials, parts, components, equipment, and supplies to be utilized are identified and traceable, including traceability for multiple similar items from several sources, to documentation that substantiates compliance with Contract Document requirements.
- C. CONTRACTOR shall verify measurements and dimensions of the Work as an integral step of starting each installation.
- D. Where installations include manufactured products, CONTRACTOR shall comply with manufacturer's applicable instructions and recommendations for installation, to whatever extent these are more explicit or more stringent than applicable requirements indicated in the Contract Documents.

3.8 INSPECTION AT PLACE OF MANUFACTURE

- A. Unless otherwise indicated, all products, materials, and equipment shall be subject to inspection by OWNER at the place of manufacture.
- B. The presence of OWNER or OWNER's representative at the place of manufacture shall not relieve CONTRACTOR of the responsibility for providing products, materials, and equipment that comply with all requirements of the Contract Documents. Compliance is a duty of CONTRACTOR and said duty shall not be avoided by any act or omission on the part of OWNER, CONSTRUCTION INSPECTOR, or ENGINEER.
- C. If Work done away from the construction site is to be inspected on behalf of OWNER during its fabrication, manufacture, testing, or before shipment, CONTRACTOR shall give notice to CONSTRUCTION INSPECTOR of the place and time where such fabrication, manufacture, testing, or shipping is to be done. Such notice shall be in writing and delivered to CONSTRUCTION INSPECTOR 15 days in advance so that the necessary arrangements for the inspection can be made.

3.9 SAMPLING AND TESTING

- A. Unless otherwise indicated, all sampling and testing will be in accordance with the methods prescribed in the current standards of the ASTM, as applicable to the class and nature of the article or materials considered; however, OWNER reserves the right to use or require any generally-accepted system of sampling and testing which, in the opinion of ENGINEER, will assure OWNER that the quality of the workmanship is in full accord with the Contract Documents.
- B. Any waiver by OWNER of any specific testing or other quality assurance measures, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the testing or other quality assurance requirements originally indicated, and whether or not such guarantee is accompanied by a performance bond to assure execution of any necessary corrective or remedial work, shall not be construed as a waiver of any requirements of the Contract Documents.
- C. Notwithstanding the existence of such waiver, OWNER reserves the right to make independent investigations and tests, and failure of any portion of the Work to meet any of the requirements of the Contract Documents shall be reasonable cause for OWNER to require the removal or correction and reconstruction of any such work in accordance with the Construction Contract.

3.10 MEASURING AND TESTING EQUIPMENT

- A. Describe methods for ensuring that equipment used for inspection, measuring, and testing is in calibration or satisfactory condition to provide accurate inspection, measurement, or test results.
- B. Assure proper handling, storage, and care of calibrated inspection, measuring, and testing equipment.

- C. Calibrate inspection, measuring, and testing equipment against certified standards traceable to either National Bureau of Standards or to accepted values of natural physical constants at regular established and documented intervals acceptable to CONSTRUCTION INSPECTOR.
- D. Remove from service and repair or replace equipment from service that is found to be out of calibration or that has been subjected to possible damage. The impact of the previous use of equipment found to be out of calibration shall be the subject of a Non-Conformance Report. Maintain traceability of equipment versus measurement location to determine where nonconforming equipment was used.
- E. Assure that all calibrated equipment utilized for inspection, measuring, or testing is of the proper range and type.
- F. Inspection, measuring, and test equipment shall have some indication attesting to the current calibration status including at a minimum:
 - 1. Entity that performed the last calibration.
 - 2. Date that the last calibration was performed.

- END OF SECTION 01400 -

SECTION 01500 – TEMPORARY CONSTRUCTION FACILITIES

PART 1 - GENERAL

1.1 SCOPE

- A. Temporary utilities and services.
- B. Construction aids.
- C. Access roads and parking areas.
- D. Temporary controls.

1.2 RESPONSIBILITY

- A. All construction facilities and temporary controls remain the property of CONTRACTOR to establish and maintain in a safe and useful condition until removed from the construction site.
- B. Access to dumpsters by OWNER and CONSTRUCTION INSPECTOR personnel and refuse haulers must be maintained throughout construction.

1.3 TEMPORARY UTILITIES AND SERVICES

A. Applicable Utilities:

- 1. CONTRACTOR shall furnish, maintain, and be responsible for the cost associated with the temporary utility services as noted in the following paragraphs and as required or as needed for the Work. No OWNER facilities shall be utilized by CONTRACTOR.

B. Temporary Electric Service:

- 1. CONTRACTOR shall provide all electrical power for temporary offices, lighting, and operation of CONTRACTOR's plant or equipment, or for any other use by CONTRACTOR. Temporary electrical service shall be maintained until the Work is accepted.

C. Temporary Heating:

- 1. If required for the Work, CONTRACTOR shall furnish fuel or power and provide and operate all temporary heating units. Heat shall be provided, as necessary, to: thaw or heat materials; control humidity; protect all water-bearing materials against injury by frost or freezing; and provide heat required for operations. Temporary heating units shall be adequately vented and approved devices which will not damage finished areas. CONTRACTOR shall also furnish all tarpaulins and temporary enclosures necessary to provide this protection.

2. CONTRACTOR shall provide heat to a minimum of 55°F in enclosed and existing buildings or as required or recommended for the normal operation of the existing facilities or construction operations.

D. Temporary Ventilation:

1. If required for the Work, CONTRACTOR shall provide, operate, and furnish power for temporary ventilation required for the proper installation and curing of materials and safety of workmen.

E. Temporary Water:

1. CONTRACTOR shall furnish potable drinking water in suitable dispensers and with sanitary cups for the use of all construction personnel and OWNER's and CONSTRUCTION INSPECTOR's representatives on the job.
2. If required for the Work, CONTRACTOR shall coordinate with the local water utility for water supply for construction purposes. CONTRACTOR shall pay the local water utility directly for all water usage.
3. CONTRACTOR shall provide all temporary piping, hoses, etc., required to transport water to the point of usage.
4. Large quantities of water for testing pipelines and tanks shall be drawn only at night or as directed by OWNER.

F. Temporary Sanitary Facilities:

1. CONTRACTOR shall provide temporary toilet facilities and maintain these during the entire period of construction under this Contract for the use of all construction personnel and OWNER's and CONSTRUCTION INSPECTOR's representatives on the job. A sufficient number of chemical toilets shall be provided to conveniently serve the needs of all personnel and OWNER's and CONSTRUCTION INSPECTOR's representatives.
2. Chemical toilets and their maintenance shall meet the requirements of State and Local health regulations and ordinances. Any facilities or maintenance methods failing to meet these requirements shall be corrected immediately.
3. Local commercial or OWNER toilet facilities shall not be used by construction personnel.
4. Chemical toilets shall be provided at locations to be determined by CONTRACTOR, subject to approval by CONSTRUCTION INSPECTOR, and shall be in addition to the facilities described in Paragraph 1.7 below.

G. Temporary Pumping and Site Drainage:

1. CONTRACTOR shall keep the site free from water at all times to permit continuous access and to prevent damage to the Work.

H. Temporary Fencing:

1. CONTRACTOR shall supply and maintain temporary fencing to protect work sites and materials storage areas.

1.4 CONSTRUCTION AIDS

A. Material Hoists and Cranes:

1. CONTRACTOR shall provide material hoists required for normal use by all trades and employ skilled hoist operators. Provide all necessary guards, signals, safety devices, etc., required for safe hoist operation. The construction and operation of material hoists shall be in accordance with the applicable ANSI Standards, the "Manual Code of Accident Prevention in Construction" of the Associated General Contractors of America, OSHA, and of other Federal, State, and municipal codes or ordinances. CONTRACTOR shall prohibit the use of material hoists for transporting personnel. Hoists shall be located to avoid risk of damage to completed Work.

- B. Special rigging and hoisting facilities shall be provided by each trade requiring their use.

1.5 ACCESS ROADS AND PARKING AREAS

- A. CONTRACTOR shall construct temporary roadways and parking areas within the site, as required, to provide proper access to site for delivery of material and equipment of all trades. Roadways and parking areas shall be constructed and maintained to keep the surface free from mud, snow, ice, and standing water and to keep mud from being picked up and deposited on adjacent streets and roadways. Location of the temporary roads and parking areas shall be approved by CONSTRUCTION INSPECTOR.

- B. At the completion of the Work or when directed by CONSTRUCTION INSPECTOR, material used for temporary road and parking areas shall be removed, unless otherwise approved by CONSTRUCTION INSPECTOR.

1.6 TEMPORARY CONTROLS

- A. See Section 01560 – Environmental Controls.

1.7 REMOVAL OF TEMPORARY CONSTRUCTION

- A. Remove the various temporary facilities, services, and controls and legally dispose of them as soon as CONSTRUCTION INSPECTOR deems permissible. Portions of the site used for temporary facilities shall be properly reconditioned and restored to a condition acceptable to CONSTRUCTION INSPECTOR.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION 01500 -

SECTION 01505 – MOBILIZATION AND DEMOBILIZATION

PART 1 - GENERAL

1.1 SCOPE

A. Mobilization and Demobilization shall include the following principal items as required for the proper performance and completion of the Work:

1. Obtain all required permits.
2. Install temporary construction utilities, including power, wiring, and lighting facilities.
3. Install erosion control measures.
4. Establish fire protection system.
5. Provide all on-site communication facilities, including telephones and radio pagers.
6. Provide on-site sanitary facilities and potable water facilities.
7. Arrange for and erect CONTRACTOR's work and storage yard.
8. Construct and implement security features and requirements including perimeter fencing.
9. Have all OSHA required notices and establish safety programs.
10. Complete initial submittal requirements.
11. Remove all temporary utilities, field office trailers, and furnishings away from Project Site at Project completion as directed by CONSTRUCTION INSPECTOR.
12. Restore surfaces damaged as a result of construction activities, including mobilization and demobilization, which are not included under other Items and as directed by CONSTRUCTION INSPECTOR.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION 01505 -

SECTION 01520 – SECURITY

PART 1 - GENERAL

1.1 SCOPE

A. CONTRACTOR shall:

1. Protect Work from theft, vandalism, and unauthorized entry.
2. Initiate security program in coordination with OWNER's existing security system at mobilization.
3. Maintain security program until CONSTRUCTION INSPECTOR's acceptance of Work.
4. Be responsible for the security, protection, and safety of all equipment, materials, vehicles, and persons located within the Site.
5. Assure its workers' and sub-contractors' workers' status to rightfully work in the United States through compliance with the Immigration and Naturalization Service's I-9 process ("I-9 Check").
6. Prior to placement, perform a criminal conviction screening through an authorized background-reporting agency covering at least a seven year period, and including all locations in which the worker resided during that period for personnel in the following positions:
 - a. Project Managers.
 - b. Project Superintendents, Shift Foremen, and Walking Bosses.
 - c. Safety Directors.
7. Assure to the extent possible that no workers pose a threat to the safe working environment at the Site.

1.2 TEMPORARY FENCING

- ##### A. Furnish, install, and maintain temporary fencing to protect work sites, materials storage areas, and areas shown on the Contract Documents as requiring fencing.

1.3 ENTRY CONTROL

A. CONTRACTOR shall:

1. Restrict entry of persons and vehicles into Site.
2. Allow entry only to authorized persons with proper identification.

3. Maintain log of workmen and visitors and make log available to OWNER on request. Transmit a copy of the log to CONSTRUCTION INSPECTOR on a monthly basis.
4. Coordinate access of OWNER'S personnel to Site in coordination with OWNER'S security forces.
5. CONTRACTOR shall control entrance of persons and vehicles related to OWNER's operations.
6. Unless otherwise approved by CONSTRUCTION INSPECTOR, all CONTRACTOR, sub-contractor, consultant, vendor, and supplier personnel shall park their vehicles in designated parking lots or spaces inside the fenced perimeter.

1.4 RESTRICTIONS

- A. CONTRACTOR shall not allow cameras on site or photographs taken except by written approval of OWNER.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION 01520 -

SECTION 01526 – TRENCH SAFETY SYSTEM

PART 1 - GENERAL

1.1 SCOPE

- A. Trench safety system for the construction of trench excavations.
- B. Trench safety system for structural excavations which fall under provisions of State and Federal trench safety laws.
- C. All provisions of the Contract Documents regarding safety shall be strictly adhered to by CONTRACTOR during the progress of the Work.

1.2 DEFINITIONS

- A. A trench shall be defined as a typically narrow excavation (in relation to its depth) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 20 feet.
- B. The trench safety system requirements shall apply to larger open excavations if the erection of structures or other installations limits the space between the excavation slope and these structures and installations to dimensions equivalent of a trench as defined above.
- C. Trench safety systems include, but are not limited to: sloping; sheeting; trench boxes or trench shields; sheet piling; cribbing; bracing; shoring; dewatering; or diversion of water to provide adequate drainage.

1.3 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01300 – Contractor Submittals.
- B. Submit a safety program specifically for the construction of each trenching excavation 15 days prior to use. Design the trench safety program to be in accordance with OSHA 29CFR standards governing the presence and activities of individuals working in and around trench excavations.
- C. Construction and shop drawings containing deviations from OSHA standards or special designs shall be sealed by a Professional Engineer registered in the State of Indiana retained and paid by CONTRACTOR.

1.4 REGULATORY REQUIREMENTS

- A. Install and maintain trench safety systems in accordance with the detail specifications set out in the provision of Excavations, Trenching, and Shoring, Federal Occupation Safety and Health Administration (OSHA) Standards, 29CFR, Part 1926, Subpart P(current edition). The Sections that are incorporated into these specifications by reference include Sections 1926-650 through 1926-652.

- B. Trench safety systems provisions of IOSHA 29.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and maintain trench safety systems in accordance with provisions of OSHA and IOSHA.
- B. Develop and implement a CONTRACTOR's Trench Safety Program to include designating a competent person who shall verify that shoring, trench boxes, and other pre-manufactured systems are certified for the actual installation conditions. Transmit the Trench Safety Program to CONSTRUCTION INSPECTOR for information within 30 days of Notice to Proceed.

3.2 INSPECTION

- A. Inspect the trench safety systems daily to ensure that the installed systems and operations meet regulatory requirements and other personnel protection regulations requirements.
- B. If evidence of possible cave-ins or slides is apparent, CONTRACTOR shall immediately stop work in the trench and move personnel to safe locations until the necessary precautions have been taken by CONTRACTOR to safeguard personnel entering the trench after approval from CONTRACTOR's designated safety representative.
- C. Maintain a permanent record of daily inspections. All copies of daily inspection reports shall be provided to CONSTRUCTION INSPECTOR for information on a monthly basis.

3.3 FIELD QUALITY CONTROL

- A. CONTRACTOR's designated safety representative shall verify specific applicability of the selected or specially designed trench safety systems for each field condition encountered on the project.

- END OF SECTION 01526 -

SECTION 01530 – PROTECTION OF EXISTING FACILITIES

PART 1 - GENERAL

1.1 SCOPE

- A. CONTRACTOR shall protect all existing utilities and improvements not designated for removal and shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than prior to such damage or temporary relocation, all in accordance with the Contract Documents.

1.2 RIGHTS-OF-WAY

- A. CONTRACTOR shall not perform any Work that may damage or otherwise impact pipelines, including but not limited to: oil, gas, sewer, or water; cables, including but not limited to telephone, fiber optic, or electric transmission; fences; or any other utility or structure. CONTRACTOR shall not enter upon any easement until notified in writing by CONSTRUCTION INSPECTOR that OWNER has secured authority from the proper party.
- B. After authority has been obtained, CONTRACTOR shall give said party due notice of its intention to begin work, if required by said party, and shall remove, shore, support, or otherwise protect any pipeline, conduit, or structure that may be impacted by the Work.

1.3 PROTECTION OF STREET OR ROADWAY MARKERS

- A. CONTRACTOR shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization as approved by CONSTRUCTION INSPECTOR. No pavement breaking operations or excavation activities shall be started until CONTRACTOR completes a survey of all permanent marker points that may be disturbed by the construction operations. Survey markers or points disturbed by CONTRACTOR shall be accurately restored to the satisfaction of CONSTRUCTION INSPECTOR after street or roadway resurfacing has been completed.

1.4 RESTORATION OF PAVEMENT

A. General:

- 1. A minimum of one travel lane of all paved areas cut or damaged during construction shall be replaced with similar materials of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract Documents. The pavement restoration requirement to match existing sections shall apply to all components of existing sections, including sub-base, base, and pavement. Pavements which are subject to partial removal shall be neatly saw cut in straight lines.

B. Temporary Resurfacing:

1. Wherever required by the Contract Documents, CONTRACTOR shall place temporary surfacing promptly after backfilling and shall maintain such surfacing for the period of time noted in the Contract Documents before proceeding with the final restoration of improvements.

C. Permanent Resurfacing:

1. In order to obtain a satisfactory junction with adjacent surfaces, CONTRACTOR shall saw, cut back, and trim the edge so as to provide a clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement. Damaged edges of pavement along excavations and elsewhere shall be trimmed back by saw cutting in straight lines. All pavement restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed pavement.

D. Restoration of Sidewalks or Private Driveways:

1. Whenever sidewalks or private roads have been removed for purposes of construction, CONTRACTOR shall place suitable temporary sidewalks or roadways promptly after backfilling and shall maintain them in a satisfactory condition for the period of time noted in the Contract Documents. If no such time is so fixed, CONTRACTOR shall maintain said temporary sidewalks or roadways until the final restoration thereof has been made.

1.5 EXISTING UTILITIES AND IMPROVEMENTS

- A. CONTRACTOR shall protect underground utilities and other improvements which may be impaired during construction operations, regardless of whether or not the utilities are indicated on the Contract Drawings. CONTRACTOR shall take all possible precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.
- B. Coordination with any applicable utility or utilities shall be the sole responsibility of CONTRACTOR. CONTRACTOR shall be responsible for the availability and accuracy of information relating to the utilities.
- C. The plans show all known utilities located within the Project limits according to information and data furnished to OWNER or ENGINEER by the various utility companies. The accuracy of the plans in this respect is not guaranteed or warranted by OWNER.
- D. All of the permanent and temporary utility facilities in their present or relocated positions shall have been considered in the bid. No additional compensation will be allowed for suspensions, delays, interference, hindrances, inconvenience, or damage sustained by CONTRACTOR due to said utility facilities or the operations of moving them. However, if the prosecution of the Work is delayed for an unreasonable period of time, CONTRACTOR may make a claim therefore as provided in the Construction Contract.

- E. For sewer construction within the public right of way, permanent easement, or temporary easement, CONTRACTOR shall coordinate with affected utilities to protect, relocate, shore, or replace existing utilities at no additional cost to OWNER.
- F. Citizens Energy Group (Citizens) chooses to protect its own facilities and will provide CONTRACTOR a schedule of estimated costs upon request.
- G. Field tile, storm drains, and culverts encountered and affected by the Scope of Work specified within the Contract Documents shall be given a positive outlet. Any field tile, storm drains, or culverts damaged by CONTRACTOR's operations shall be replaced by CONTRACTOR at its own expense.
- H. Right of Access:
 - 1. The Right of Access is reserved to OWNER, ENGINEER, and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the Work of this Contract.
- I. Underground Utilities Indicated:
 - 1. Existing utility lines that are indicated or the locations of which are made known to CONTRACTOR prior to excavation and that are to be retained, and all utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired or replaced by CONTRACTOR at its own expense, unless otherwise repaired by the owner of the damaged utility. If the owner of the damaged utility performs its own repairs, CONTRACTOR shall reimburse said owner for the costs of repair.
- J. Underground Utilities Not Indicated:
 - 1. In the event that CONTRACTOR damages existing utility lines that are not indicated or the locations of which are not made known to CONTRACTOR prior to excavation, a verbal report of such damage shall be made immediately to CONSTRUCTION INSPECTOR and a written report thereof shall be made promptly thereafter. CONTRACTOR shall notify the utility owner of the damage. If directed by CONSTRUCTION INSPECTOR, repairs shall be made by CONTRACTOR under the provisions for changes and extra Work contained in the Construction Contract.
- K. Costs for: locating and repairing damage not due to failure of CONTRACTOR to exercise reasonable care; removing or relocating such utility facilities not indicated in the Contract Documents with reasonable accuracy; and for equipment on the Project which was actually working on that portion of the Work which was interrupted or idled by removal or relocation of such utility facilities, and which was necessarily idled during such Work; will be paid for as extra Work in accordance with the provisions of the Construction Contract.

L. Approval of Repairs:

1. All repairs to a damaged utility or improvement are subject to inspection and approval by an authorized representative of the utility or improvement owner before being concealed by backfill or other Work.

M. Maintaining in Service:

1. Unless indicated otherwise, oil and gasoline pipelines, power, and telephone or communication ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the Work shall remain continuously in service during all the operations under this Contract, unless other arrangements satisfactory to OWNER are made with the owner of said pipelines, ducts, main, irrigation line, sewer, storm drain, pole, wire, or cable. CONTRACTOR shall be responsible for and shall repair all damage due to its operations, and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after the completion of backfilling and compaction.

1.6 TREES OR SHRUBS WITHIN STREET RIGHTS-OF-WAY AND PROJECT SITE

A. General:

1. Except where trees or shrubs are indicated to be removed, CONTRACTOR shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within street rights-of-way and Project site, and shall not trim or remove any trees unless such trees have been approved for trimming or removal by OWNER. Existing trees and shrubs which are damaged during construction shall be trimmed or replaced by CONTRACTOR or a certified tree company with permission from OWNER at no additional cost to OWNER.

B. Trimming:

1. Symmetry of the tree shall be preserved, no stubs or splits or torn branches left, and clean cuts shall be made close to the trunk or large branch. Spikes shall not be used for climbing live trees. Cuts over 1-1/2 inches in diameter shall be coated with a tree paint product that is waterproof, adhesive, and elastic, and free from kerosene, coal tar, creosote, or other material injurious to the life of the tree.

C. Replacement:

1. CONTRACTOR shall immediately notify CONSTRUCTION INSPECTOR if any tree or shrub is damaged by CONTRACTOR's operations. If, in the opinion of CONSTRUCTION INSPECTOR, the damage is such that replacement is necessary, CONTRACTOR shall replace the tree or shrub at its own expense. The tree or shrub shall be of a like size and variety as the one damaged, or, if of a smaller size, CONTRACTOR shall pay to the owner of said tree or shrub a compensatory payment acceptable to the owner of said tree or shrub, subject to the approval of CONSTRUCTION INSPECTOR.

Planting of replacement trees and shrubs shall be in accordance with Section 02900 – Restoring Lawns and Landscaping. Unless otherwise indicated, CONTRACTOR shall water and maintain the replacement trees and shrubs for six months after planting.

1.7 LAWN AREAS

- A. Lawn or landscaped areas damaged during construction shall be repaired to match the preconstruction condition to the satisfaction of the land owner and CONSTRUCTION INSPECTOR.

1.8 NOTIFICATION BY CONTRACTOR

- A. Prior to any excavation in the vicinity of any existing underground facilities, CONTRACTOR shall notify the respective authorities representing the owners or agencies responsible for such facilities not less than three days nor more than seven days prior to excavation so that a representative of the said owners can be present during such Work if they so desire. At least two days prior to the start of any excavation, CONTRACTOR shall also contact the Underground Location Service (Holey Moley) at 1-800-382-5544.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION 01530 -

SECTION 01560 – ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.1 SCOPE

- A. Environmental controls and other control-related practices which shall be utilized by CONTRACTOR during construction activities.
- B. No separate payment will be made for Work performed under this Section. Include cost of Work performed under this Section in pay items of which this Work is a component.
- C. Material handling and storage associated with construction activity shall meet the spill prevention and spill response requirements in Indiana Administrative Code 327 IAC 2-6.1.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION AND INSTALLATION

- A. No clearing, grubbing, or rough cutting shall be permitted until erosion and sediment control systems are in place, other than site Work specifically directed by CONSTRUCTION INSPECTOR for soil testing and surveying purposes.
- B. Equipment and vehicles shall be prohibited by CONTRACTOR from maneuvering on areas outside of dedicated rights-of-way and easements for construction unless CONTRACTOR has obtained additional easements or agreements satisfactory to OWNER. Damage caused by construction traffic to erosion and sediment control systems shall be repaired immediately by CONTRACTOR at no additional cost to OWNER.
- C. CONTRACTOR shall be responsible for collecting, storing, hauling, and disposing of spoil, silt, and waste materials as specified herein and elsewhere in other applicable specifications and in compliance with applicable Federal, State, and Local rules and regulations.
- D. CONTRACTOR shall conduct all construction operations under this Contract in conformance with the erosion control practices described on the Contract Drawings and in this or other applicable specifications.
- E. CONTRACTOR shall install, maintain, and inspect erosion and sediment control measures and practices as specified in the Contract Drawings and in this or other applicable specifications.

3.2 TOPSOIL PLACEMENT FOR EROSION AND SEDIMENT CONTROL SYSTEMS

- A. When topsoil is specified as a component of another Specification, CONTRACTOR shall conduct erosion control practices described in this Section during topsoil placement operations.
1. When placing topsoil, maintain erosion and sediment control systems, such as swales, grade stabilization structures, berms, dikes, waterways, and sediment basins.
 2. Maintain grades which have been previously established on areas to receive topsoil.
 3. After the areas to receive topsoil have been brought to grade, and immediately prior to dumping and spreading the topsoil, loosen the subgrade by disking or by scarifying to a depth of at least 2 inches to permit bonding of the topsoil to the subsoil.
 4. No sod or seed shall be placed on soil which has been treated with soil sterilant until sufficient time has elapsed to permit dissipation of toxic materials.

3.3 AIR POLLUTION AND DUST CONTROL

- A. Applicable regulations regarding air pollution control are provided in the Construction Contract and shall be adhered to by CONTRACTOR during the progress of the Work.
- B. Implement dust control methods directed at minimizing dust creation and movement on construction sites and roads to prevent airborne sediment from traveling off-site and damaging persons and/or properties. CONTRACTOR shall be responsible for any dust-related damage to include pollution of air, streams, and sewers, as well as any health hazards, traffic safety, and off-site cleaning due to generation of dust from construction activities.
- C. Control blowing dust by using one or more of the following methods:
1. Mulches bound with chemical binders.
 2. Temporary vegetative cover.
 3. Spray-on adhesives on mineral soils when not used by traffic.
 4. Tillage to roughen surface and bring clods to the surface.
 5. Irrigation by water sprinkling.
 6. Barriers using solid board fences, snow fences, burlap fences, crate walls, bales of hay, or similar materials.
- D. Implement dust control methods immediately whenever dust can be observed blowing on the Project site.

- E. Backup or stand-by power generation equipment, if needed, shall conform to all Local, State, and Federal air emission regulations.

3.4 KEEPING STREETS CLEAN

- A. Keep streets clean of construction debris and mud carried by construction vehicles and equipment. Install coarse gravel stabilized construction exits and vehicle wash areas, as necessary, to keep the adjoining streets clean at construction, staging, storage, and disposal areas.
- B. In lieu of or in addition to stabilized construction exits, shovel or sweep the pavement with a street sweeper to the extent necessary to keep the street clean. Water hosing or sweeping of debris and mud into adjacent areas shall not be allowed.
- C. Provide street cleaning with a street sweeper as needed and, if necessary, at the direction of CONSTRUCTION INSPECTOR.

3.5 WASHING AREAS

- A. Design, furnish, install, operate, and maintain wheel washing facilities at designated special areas to ensure that mud, sediment, muck, and debris are removed from the undercarriage and wheels of haulage equipment before entering public streets. Vehicles such as concrete delivery trucks or dump trucks and other construction equipment shall not be washed at locations where the runoff will flow directly into a watercourse or storm water conveyance system. Locate these areas where the wash water will spread out and evaporate or infiltrate directly into the ground or where the runoff can be collected in a temporary holding or seepage basin. Beneath wash areas, construct a gravel or rock base to minimize mud production.
- B. Wash all trucks before leaving the site sufficiently to prevent mud from being tracked off site or on to public streets.
- C. Remove the solid residue resulting from washing operations from the site on a daily basis.
- D. Submit a design for wheel washing facilities at each construction site to ENGINEER for acceptance within 15 days of Notice to Proceed. Locate wheel washing facilities so that all construction vehicles and loaded muck haulage vehicles shall pass through the facility prior to re-entering public streets. These facilities shall include as a minimum:
 - 1. A system by which vehicles automatically activate and deactivate the wash-water sprays upon entering and exiting the wheel wash facility.
 - 2. A trench constructed at the center of the facility that allows for the wash-water collection. The trench shall be protected with a metal grate.
 - 3. Sediment laden water collected at the trench shall be conveyed through a trench, sump, or pipeline to CONTRACTOR's water treatment facility.

4. Bituminous or concrete paved pads and berms shall be constructed on either side of the trench to retain and direct wash-water toward the collection trench.
5. The access between the wheel wash and the site exit shall be paved with bituminous concrete, concrete, or a minimum 6 inch layer of crushed stone.

3.6 STORAGE OF CONSTRUCTION MATERIALS AND CHEMICALS

- A. Isolate sites where chemicals, cements, solvents, paints, or other potential water pollutants are stored in areas where they will not cause runoff pollution. Provide chemical clean up kits on site in accordance with CONTRACTOR's health and safety representative.
- B. Store fuel and oils only in locations where containment basin is sufficient to collect 100 percent of cumulative volume for the fuel and oil containers. Maintain sufficient numbers of clean-up kits at each location where oil and fuel are stored in accordance with CONTRACTOR's health and safety representative.
- C. Store toxic chemicals and materials, such as pesticides, paints, and acids in accordance with manufacturers' guidelines. Protect groundwater resources from leaching by placing a plastic mat, packed clay, tar paper, or other impervious materials on any areas where toxic liquids are to be opened and stored.

3.7 DEMOLITION AREAS

- A. Demolition activities which create large amounts of dust with significant concentrations of heavy metals or other toxic pollutants shall use dust control techniques to limit transport of airborne pollutants. Water or slurry used to control dust contaminated with heavy metals or toxic pollutants shall be retained on the site and shall not be allowed to run directly into watercourses or storm water conveyance systems. Methods of ultimate disposal of these materials shall be carried out in accordance with applicable Local, State, and Federal health and safety regulations.

3.8 PREVENTION AND READINESS

- A. CONTRACTOR shall prepare a contact list in the event of a spill on the site. The contact list will have names and contact numbers. The contact list will specify first responders and a chain of command and include information on what circumstances require the initiation of the contact list and chain of command.
- B. CONTRACTOR shall maintain a list of qualified contractors, Vac-trucks, tank pumpers, and other equipment or businesses qualified to perform clean-up operations. Absorbent materials and supplies need to be available onsite in sufficient quantities to address minor spills. All employees need to be trained in proper spill response procedures.
- C. All construction personnel and equipment operators must be aware of and trained for prevention of spills.

3.9 SPILL RESPONSE

- A. All materials used in the course of a cleanup shall be disposed in a manner approved by Indiana Department of Environmental Management (IDEM).
- B. Using water to flush spilled material will not be permitted unless authorized by a state, federal, or local agency. Tarps can be used to cover spilled material during rain events.
- C. Minor Spills:
 - 1. Approximately 10 gallons or less of pollutant with no contamination of ground or surface waters. Minor spills can be generally controlled by the first responder with help from other site personnel. At the discovery of the spill:
 - a. Contain spill to prevent material from entering storm or groundwater. Do not flush with water or bury.
 - b. Use absorbent material to clean up spills and dispose of properly. Spills on impervious surfaces should be contained with a dry absorbent. Spills on clayey soils should be contained by constructing an earthen dike and should be disposed of as soon as possible to prevent migration deeper into the soil and groundwater. Dispose of contaminated soils or absorbents properly in accordance with all Federal, State, and Local regulations.
 - c. Contact 911 if this spill could be a safety issue.
 - d. Contact supervisors and designated inspectors immediately.
 - e. Contaminated solids shall be removed to an approved landfill in accordance with the requirements of Section 02075 – Contaminated Soil Removal.
- D. Major or Hazardous Spills:
 - 1. More than 10 gallons with the potential for death, injury, or illness to humans or animals or has the potential for surface or groundwater pollution.
 - a. Control or contain the spill without risking bodily harm.
 - b. Temporarily plug storm drains, if possible, to prevent migration of the spill into the stormwater system.
 - c. Immediately contact 911 to report any hazardous material spill.
 - d. Contact supervisors and designated inspectors immediately. Other officials responsible for storm water facilities should be contacted as applicable. CONTRACTOR is responsible for having these contact numbers available at the job site. A written report shall be submitted to OWNER as soon as possible.
 - e. Notify the Citizens Environmental Stewardship Hotline at 317-402-8636.

- f. As soon as possible but within two hours of discovery, contact the IDEM, Office of Emergency Response, 1-888-233-7745. The following information shall be noted for future reports to IDEM or the National Response Center:
 - (1) Name, address, and phone number of person making the spill report.
 - (2) Location of the spill.
 - (3) Time of the spill.
 - (4) Identification of the spilled substance.
 - (5) Approximate quantity of the substance that has been spilled or may be further spilled.
 - (6) Duration and source of the spill.
 - (7) Name and location of the damaged waters.
 - (8) Name of spill response organization.
 - (9) Measures taken in the spill response.
 - (10) Other information that may be pertinent.

E. Additional regulation or requirements may be required. A spill response professional should be consulted to ensure that all appropriate and required steps have been taken. Contaminated material should only be removed from the site after approval is given by Office of Emergency Response.

3.10 SPILL PREVENTION AND MATERIAL HANDLING PRACTICES

A. Vehicle and Equipment Fueling:

1. Description and Purpose:

- a. Vehicle equipment fueling procedures and practices are designed to prevent fuel spills and leaks and reduce or eliminate contamination of stormwater. This can be accomplished by using offsite commercial facilities, fueling in designated areas only, enclosing or covering stored fuel, implementing spill controls, and training employees and subcontractors in proper fueling procedures.

2. Limitations:

- a. Onsite vehicle and equipment fueling should only be used where it is impractical to send vehicles and equipment offsite to a commercial fueling station.

3. Implementation:

- a. Use offsite commercial fueling stations when possible. Performing this Work offsite eliminates the need for a separate fueling area at a site.
- b. Discourage “topping-off” of fuel tanks.
- c. Absorbent spill cleanup materials and spill kits shall be available in fueling areas and on fueling trucks. Spill material shall be disposed of properly after use, in accordance with all Federal, State, and Local regulations.
- d. Drip pans or absorbent pads should be used during vehicle and equipment fueling, unless the fueling is performed over an impermeable surface in a dedicated fueling area.
- e. Use absorbent materials on small spills. Do not hose down or bury the spill. Remove the absorbent materials promptly and dispose of properly.
- f. Avoid mobile fueling of mobile construction equipment; rather, transport the equipment to designated fueling areas.
- g. Train employees and subcontractors in proper fueling and cleanup procedures.
- h. Dedicated fueling areas shall be protected from stormwater run-on and runoff and shall be located at least 50 feet away from the downstream drainage facilities, stormwater conveyances, or waterways.
- i. Fueling must be performed on level-grade areas.
- j. Protect fueling areas with berms and dikes to contain spills.
- k. Nozzles used in vehicle and equipment fueling shall be equipped with an automatic shutoff to control drips.
- l. Fueling operations shall not be left unattended.
- m. Federal, State, and Local regulations shall be observed for any stationary above ground storage tanks.
- n. All petroleum products shall be stored in tightly sealed containers which are clearly labeled.

4. Inspection and Maintenance:

- a. Vehicles and equipment shall be inspected daily for leaks. Leaks must be repaired immediately or the source of the leak removed from the Project site.
- b. Maintain spill cleanup materials onsite and in close proximity to fueling areas.
- c. Immediately clean up spills and properly dispose of contaminated materials.

B. Solid Waste Management:

1. Description and Purpose:

- a. Solid waste management procedures and practices are designed to prevent or reduce the discharge of pollutants to stormwater from solid or construction waste by providing designated waste collection areas and containers, arranging for regular disposal, and training employees and subcontractors.

2. Suitable Applications:

- a. This Best Management Practice (BMP) is suitable for construction sites where the following wastes are generated or stored:
 - (1) Solid waste generated from trees and shrubs removed during land clearing, demolition of existing structures (rubble), and building construction.
 - (2) Packaging materials including wood, paper, and plastic.
 - (3) Scrap or surplus building materials including scrap metals, rubber, plastic, glass pieces, and masonry products.
 - (4) Domestic wastes including food containers such as beverage cans, coffee cups, paper bags, plastic wrappers, and cigarettes.
 - (5) Construction waste including brick, mortar, timber, steel and metal scraps, pipe and electrical cuttings, non-hazardous equipment parts, Styrofoam, and other packaging for construction materials.

3. Implementation:

- a. The following steps will help keep a clean site and reduce stormwater pollution:
 - (1) Select designated waste collection areas onsite.
 - (2) Inform trash-hauling contractors that only watertight dumpsters are acceptable for onsite use.
 - (3) Inspect dumpsters for leaks and repair any and all dumpsters that are not watertight.
 - (4) Provide an adequate number of containers with lids or covers that can be placed over the container to prevent loss of wastes from wind and to prevent the collection of rainwater.
 - (5) Plan for additional containers and more frequent pickup during the demolition phase of construction, as applicable.
 - (6) Collect site trash daily, especially during rainy and windy conditions.

- (7) Remove solid waste promptly from erosion and sediment control devices that tend to collect litter.
- (8) Ensure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acid, pesticides, additives, and curing compounds) are not disposed of in dumpsters designed for construction debris.
- (9) Do not hose out dumpsters on the construction site. Dumpster cleaning should be conducted by the trash hauling contractor off site.
- (10) Arrange for regular waste collection before containers overflow.
- (11) Clean up immediately if a container spills, leaks, or overflows.
- (12) Make sure that construction waste is collected, removed, and disposed of only at authorized disposal areas. Solid waste storage areas should not be located in areas prone to flooding or ponding.
- (13) Locate solid waste dumpsters a minimum of 50 feet away from storm water inlets or other drainage facilities.
- (14) Minimize the potential for spills or leaks to drain immediately into a drainage facility.
- (15) Do not bury construction waste on-site.
- (16) Cover dump trucks hauling material from the construction site with a tarpaulin.

4. Inspection and Maintenance:

- a. Inspect construction waste areas regularly.
- b. Arrange for regular waste collection.
- c. Vehicle Maintenance Areas:

- (1) Purpose – To prevent spills during the normal maintenance of construction machinery.
- (2) Implementation:
 - Where and when feasible, maintenance shall be performed offsite in covered facility with an impervious floor.
 - Use a dedicated site for machinery maintenance.
 - Maintenance areas shall be located at least 50 feet from storm water inlets or water bodies.
 - Maintain spill kits and absorbent materials in close proximity to maintenance areas. Utilize drip pans and absorbent pads to prevent oils or other maintenance fluids from reaching the soil surfaces.

- Inspect equipment daily for leaks or worn hoses. Repair or replace as needed to prevent onsite spills.
- Properly dispose of all spilled fluids and fluids removed from machinery.

d. Fluids, Paints, Solvents, and Other Chemicals Storage and Use:

(1) Purpose – To prevent spills during the use and storage of the materials.

(2) Implementation:

- Store materials in manufacturer's containers.
- Maintain SDS (safety data sheets) on all products.
- Store materials in a weather proof/vandal resistant locker or building.
- Keep materials away from flammable sources.
- Follow manufacturer's instructions for the proper use and storage of all materials.
- For bulk material stored onsite, provide diking or double containment to capture leaks or failures.
- No washout of solvent from paint supplies shall be completed near or into a storm water inlet or other drainage facility.
- All paint containers and curing compounds shall be tightly sealed and stored when not required for use. Excess paint shall not be discharged to the storm system, but shall be properly disposed according to the manufacturer's instructions and in accordance with all Federal, State, and Local regulations.

e. Disposal of Sediment-laden Water:

(1) Purpose – To prevent the purposeful discharge of sediment-laden water into waters of the United States.

(2) Implementation:

- Sediment-laden water from pumping operations shall not be discharged into or near storm water conveyances, wetlands, rivers, streams, and impoundments or into natural or manmade channels leading thereto.
- Dewatering of sediment-laden water from trenches, or other excavations by means of a pump or similar means, shall discharge into a manufactured filter bag in accordance with the manufacturer's recommendations unless the pumped water is routed through another erosion control measure such as a sediment trap or outlets onto a well-established vegetated area without eroding.
- Filter bags shall either be biodegradable or be properly disposed of from the site. The bags must be sized appropriately for the amount of flow. The practice shall be installed on an erosion resistant surface.
- Pumping operations that are moving clean water through a site are not required to have a pumping bag or similar device at the outlet. The point of discharge shall be protected to prevent soil erosion.

f. Concrete Washout Area:

- (1) Provide a designated concrete washout area for use of washing out concrete trucks in order to contain potential stormwater pollutants. One of the following methods shall be used:
 - A minimum of 10 x 10 x 3 foot deep area (or larger as required to contain liquid and solid waste from concrete washout operations) with a polyethylene lining.
 - The concrete washout area shall be a pre-fabricated containment system that shall be installed and maintained in accordance with the manufacturer's instructions.
 - A polyethylene-lined roll-off dumpster may be used when other methods are not practical.
- (2) The concrete washout area shall include identifying signage and orange safety fencing around its perimeter.
- (3) Locate washout areas at least 50 feet from storm drains, open ditches, or water bodies.
- (4) Concrete wastes shall be allowed to set. Hardened wastes shall be broken up and then disposed of by CONTRACTOR properly. Liquid that collects in the washout area could be high in alkalinity and could contain pollutants. Liquid must be disposed of properly.
- (5) Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile or dispose in the trash.
- (6) Review the concrete management techniques (such as handling of concrete waste and washout) with the ready-mix concrete supplier before any deliveries are made.
- (7) Incorporate requirements for concrete waste management into material supplier and subcontractors' agreements.
- (8) Store dry and wet materials under cover and away from drainage facilities.
- (9) Avoid mixing excess amounts of fresh concrete.
- (10) Perform washout of concrete trucks offsite or in designated areas only.
- (11) Do not wash concrete trucks into storm drains, open ditches, streets, or streams.
- (12) Do not allow excess concrete to be dumped onsite, except in designated areas.

g. Fertilizers:

- (1) Fertilizers shall be applied only in the minimum amounts recommended by the manufacturer.
- (2) Fertilizers shall be worked into the soil to limit exposure to storm water.
- (3) Fertilizers shall be stored in a covered shed and partially used bags shall be transferred to a sealable bin to avoid spills.
- (4) Fertilizers should not be applied to bare soil or when rain is imminent.

h. Chlorinated Water, as applicable:

- (1) Following completion of the disinfection and testing of water lines, the heavily chlorinated water will be neutralized and disposed of in accordance with AWWA C 651, Appendix C.

- END OF SECTION 01560 -

SECTION 01570 – TRAFFIC MAINTENANCE

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. CONTRACTOR shall maintain and protect vehicular and pedestrian traffic and the Work while the Contract is in force in accordance with the provisions of this Section and the Contract Drawings.
- B. CONTRACTOR shall coordinate Work under this Contract with authorities having jurisdiction, including acquiring all required permits and approvals.
- C. 15 days after Notice to Proceed, CONTRACTOR shall submit, in writing to CONSTRUCTION INSPECTOR, a detailed plan for maintaining traffic on all streets and highways affected by this Project.
- D. Section contains provisions to ensure public safety by police direction of traffic.
- E. Section contains maintenance of traffic signs from Notice to Proceed until the completion of the Work as described herein.

1.2 SUBMITTALS

- A. Detailed, dimensioned shop drawings and data conforming to the requirements of Section 01300 – Contractor Submittals shall be submitted to CONSTRUCTION INSPECTOR and accepted by ENGINEER before fabrication and shipment of Work specified under this Section begins.
- B. Weekly log of police services including all details such as date, time, duration, location, and purpose.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TRAFFIC FACILITIES AND TRAFFIC CONTROL – GENERAL

- A. The road shall be kept open to all traffic while undergoing improvements. Where so provided on the plans, the traffic may be bypassed over an approved detour route. The detour route markings shall be erected, maintained, and removed by CONTRACTOR. Maintenance of traffic shall be in accordance with the details as shown on the Contract Drawings or as directed. In the event an alternate plan for maintaining traffic is requested by CONTRACTOR, it shall be submitted in writing to CONSTRUCTION INSPECTOR, as soon as possible, for consideration. If approved, the alternate plan shall not increase the cost of maintaining traffic to OWNER.

- B. The portion of the roadway being used by public traffic shall be kept in such condition that traffic will be adequately accommodated. Drums in accordance with Section 801.09 of the Indiana Department of Transportation (INDOT) Standard Specifications shall be placed at 200 feet intervals where drop-offs are greater than 3 inches adjacent to the shoulder until the aggregate or earth wedge has been placed. Temporary approaches to businesses, parking lots, residences, garages, farms, crossings, intersections with trails, roads, and streets shall be provided in a safe condition. All traffic control devices shall be maintained at no additional cost to OWNER.
- C. Regulatory controls shall not be changed without prior approval. Regulatory control devices may be relocated in order to permit necessary construction, providing these control devices remain effective and convey the intended meaning after relocation to a position which complies with the requirements of the Manual on Uniform Traffic Control Devices (MUTCD). After completion of the construction, regulatory control devices which were relocated to facilitate construction shall be permanently installed with no additional payment, in accordance with the plans, or as otherwise directed. Any traffic control devices damaged, while being moved or handled, shall be replaced with no additional payment. All other traffic control devices necessary to maintain safe traffic operations and routings shall not be removed, changed, or relocated, except as authorized. Traffic control devices removed without authorization shall be replaced with no additional payment.
- D. CONTRACTOR shall obtain all permits required for Work within public right of way, including the closure of traffic lanes, from the Indianapolis Department of Code Enforcement and the INDOT where applicable.
- E. Facilities for vehicular and pedestrian traffic as required for the Project, including all temporary walks, roads, bridges, culverts, and traffic control devices, shall be constructed and maintained by CONTRACTOR.
- F. During the progress of the Work, CONTRACTOR shall make ample provision for both vehicular and foot traffic on any public road and shall indemnify and hold harmless OWNER from any expense whatsoever due to CONTRACTOR's operations over said roadways. CONTRACTOR shall so organize and conduct its Work such that traffic can be properly maintained.
- G. The provisions of this Section shall not in any way relieve CONTRACTOR of any of its legal responsibilities or liabilities for the safety of the public. CONTRACTOR shall provide and maintain safeguards, safety devices, and protective equipment and take any other needed actions that may be necessary to protect the public and property in connection with the Work. CONTRACTOR shall restore all original pavement markings, signs, and traffic control devices.

3.2 LOCAL TRAFFIC

- A. For local traffic, CONTRACTOR shall provide and maintain in a safe condition, including snow and ice removal, such drives, temporary roadways, bypasses, sidewalks, or temporary structures as may be necessary to provide vehicular and pedestrian ingress and egress for the residents and facilities adjacent to the improvements. Temporary approaches and crossings of intersecting highways shall also be provided and maintained in a safe condition.
- B. CONTRACTOR shall also provide free access to all municipal, commercial, residential, and factory entrances, fire hydrants and water and gas valves located along the line of its Work. CONTRACTOR shall lay and maintain temporary driveways, bridges, and trench crossings which in the opinion of CONSTRUCTION INSPECTOR are necessary to maintain access to factories and to reasonably accommodate the public at no additional cost to OWNER.

3.3 THROUGH TRAFFIC

- A. When the street affected by the Project construction is being used by through traffic, including periods of suspension of the Work, CONTRACTOR shall so maintain by the use of labor, equipment, and materials that portion of the street being used, such that it is smooth, free from holes, ruts, ridges, bumps, and dust. The street being used shall be provided with snow removal and the necessary outlets to drain freely. Pipe trenches or other openings left in hard surface pavements shall be maintained with material as specified.
- B. The proper authorities shall have the right to enter upon that portion of the Work where CONTRACTOR is responsible for maintaining traffic to remove snow and ice and place abrasives at their own expense, as necessary. CONTRACTOR shall be responsible for the removal of placed abrasives for which no claim for additional compensation shall be allowed nor shall CONTRACTOR be relieved in any way of its obligation for maintenance of traffic.
- C. CONTRACTOR shall lay and maintain temporary bridges and trench crossings such as in the opinion of CONSTRUCTION INSPECTOR and OWNER are necessary to accommodate through traffic and the general public. All temporary crossings shall be submitted to CONSTRUCTION INSPECTOR, in accordance with Section 1.2 of this specification. Temporary bridges and trench crossings shall be designed, signed, and sealed by a licensed Professional Engineer registered in the State of Indiana.

3.4 TRAFFIC CONTROL

- A. The installation, maintenance, and operation of all traffic controls and traffic control devices shall conform to the requirements of the INDOT Standard Specifications and the Indiana Manual on Uniform Traffic Control Devices. Traffic control devices shall be provided with suitable supports of sufficient strength and stability.
- B. Faces of construction signs, barricades, vertical panels, and drum banks shall be suitably reflectorized using sheeting complying with the requirements of the INDOT Standard Specifications Article 801.04.

- C. Traffic cones shall be a highly visible orange color. Pavement markings for traffic maintenance shall conform to the INDOT Standard Specifications Article 801.12 unless otherwise specified.
- D. Barricades and channelizing devices such as cones, vertical panels, hazard markers, and drums shall be highly visible. They shall also be protected by adequate advance warning devices and by suitable lighting or reflectorization at night (between the hours of sunset to sunrise). All such devices shall be provided by CONTRACTOR. Detour signs, traffic control signs, barricades, construction lighting, etc., shall be replaced whenever damaged, stolen, or vandalized.
- E. Equipment and material stored on the street shall be marked at all times. At night any such material or equipment stored between the side ditches, or between lines 5 feet behind any raised curbs, shall be clearly outlined with dependable lighted devices that are approved by CONSTRUCTION INSPECTOR. In addition, CONTRACTOR shall provide any other lights, barricades, etc., that may be needed for the protection of pedestrian traffic.
- F. The removal of any existing pavement markings necessary to conform with the design or the sequence of operations of any phase of construction of this Project shall be in accordance with Section 808.09 of the INDOT Standard Specifications with the exception that such removal will not be paid for directly but shall be included in the pay item for "Maintenance of Traffic", as described in Section 01025 – Measurement and Payment.

3.5 TRAFFIC MAINTAINED

A. Special Detours:

- 1. When the Itemized Proposal and Declarations contains a pay item for maintenance of detours or removing existing structures and maintaining traffic, the payment for such pay item shall cover all cost of constructing and maintaining such detour or detours, including the construction of temporary bridges and accessory features and the removal of the same in accordance with Section 713.07 of the INDOT Standard Specifications.

B. Maintenance Directed by CONSTRUCTION INSPECTOR:

- 1. If special maintenance is directed for the benefit of the traveling public, payment will be made on the basis of unit prices or in accordance with the Contract Documents for extra or unforeseen Work. CONSTRUCTION INSPECTOR will be the sole judge of Work to be classed as special maintenance.

C. Traffic Control for Long-Term Shoulder Closure:

- 1. At locations determined by CONTRACTOR where Work is necessary beyond 10 feet of the edge of the through lane of a roadway, concrete temporary traffic barrier shall be placed for a distance of 100 feet upstream and downstream of the Work along the shoulder of the roadway. A 2-foot horizontal offset shall be provided from the existing edge of the travel lane to the face of the concrete barrier. At the upstream end, the barrier shall be tapered away from the roadway centerline at a

rate of 10:1 for a distance of 110 feet. At the downstream end of the temporary barrier, an impact attenuator (TL-2) shall be provided. Temporary compacted aggregate base shall be used to provide a construction platform behind the concrete barrier, allowing construction vehicles to back into the site from the downstream end of the barrier.

D. Traffic Control for Long-Term Lane Closure:

1. At locations determined by CONTRACTOR where work is necessary within 10 feet from the edge of the through lane of a roadway, concrete temporary traffic barrier shall be placed for a distance of 100 feet upstream and downstream of the work along the existing centerline of the roadway. A 2 foot horizontal offset shall be provided from the centerline of the roadway to the face of the concrete barrier. At the upstream end, the barrier shall be tapered away from the roadway centerline at a rate of 10:1 for a distance of 110 feet. At the downstream end of the temporary barrier, an impact attenuator (TL-2) shall be provided. Temporary asphalt pavement shall be provided along the opposite side of the roadway to allow the perpetuation of two 11 foot wide travel lanes and a 3 foot wide shoulder. The existing lanes of traffic shall be tapered over a distance of 310 feet both upstream and downstream of the work area. Construction access shall be from the downstream end of the concrete barrier over the existing asphalt pavement.

E. Traffic Control for Patching on a Two-Lane Roadway:

1. Unless otherwise directed or permitted, the Work specified shall be arranged and prosecuted in accordance with the applicable requirements or the Contract Documents and Section 801 of the INDOT Standard Specifications, and as set out herein.
2. Only one lane may be closed at a time.
3. A minimum of two drums shall be placed on the traffic approach side of each concrete patch or opened hole.
4. Patching on a two-lane roadway shall be in accordance with Section 305 of the INDOT Standard Specifications and the details shown on the plans. Traffic restrictions will be permitted during daylight hours only. If CONTRACTOR is unable to fill an area to be patched with concrete during daylight hours, the patch shall be filled with No. 53 aggregate for the times other than daylight hours. Drums in accordance with Section 801.09 of the INDOT Standard Specifications shall be placed at the side of the roadway at the patch location. If an opened hole cannot be patched for two or more calendar days, a 150 mm (6 inch) asphalt cap shall be placed in the hole if concrete cannot be obtained. A flagman will be required while the roadway is temporarily patched.

F. Maintaining Traffic – Prosecution and Progress:

1. Maintenance of traffic shall be the sole responsibility of CONTRACTOR. Access and traffic to all businesses, residences, for all postal deliveries and all emergency traffic such as police, fire, medical, etc. within the Project limits, shall be maintained at all times.

2. Unless otherwise directed, or permitted, the Work specified shall be arranged and prosecuted in accordance with all applicable provisions of this Technical Specification, the Contract Documents, and Section 801 of the INDOT Standard Specifications and as set out herein.
3. The names and telephone numbers of CONTRACTOR's superintendent and two other responsible employees shall be furnished at the pre-construction conference.
4. These employees shall be on call and available at nights, weekends, or during other non-working periods to repair or replace all traffic control devices which may become damaged or inoperative.
5. In the event CONTRACTOR requests to perform an alternative traffic maintenance that is not in accordance with the sequence of operations as called for within the Contract Documents, CONTRACTOR shall submit its alternate plan in writing to CONSTRUCTION INSPECTOR and obtain approval at least two weeks prior to the commencement of these activities.
6. Should CONTRACTOR propose a street closure not otherwise identified within the Contract Documents, CONTRACTOR shall submit a written request to CONSTRUCTION INSPECTOR for review and approval at least three weeks prior to the planned closure.
7. CONSTRUCTION INSPECTOR will give written notification of the acceptance or denial of any maintenance of traffic proposals and, if approved, CONSTRUCTION INSPECTOR will inform the Public Information Office at 317-327-4700, which will give notice to all public agencies and businesses within the Project area. The failure to accept any reasonable request shall not entitle CONTRACTOR to an extension in contract time or to an increase in Contract price.
8. When conduit or cable is being placed between 7:00 A.M. and 6:00 P.M. steel plating shall be utilized in order to ensure that movement through the intersection is not deterred.
9. Pedestrian traffic shall also be maintained with disruptions kept to a minimum.
10. Open trenches, if permitted by CONSTRUCTION INSPECTOR, shall be spanned per current Occupational Safety and Health Association (OSHA) requirements and with the concurrence of CONSTRUCTION INSPECTOR.
11. Any trenching areas adjacent to a sidewalk shall be barricaded. If adequate sidewalk area is not available, CONTRACTOR shall divert pedestrian traffic across the street and shall provide all materials necessary to provide for the crossover.
12. Trenching in the streets shall not be left open during off-working hours. The trenches shall be either backfilled with crushed stone or steel plated per current OWNER's ordinances or regulations.

G. Maintaining Traffic Resurfacing Operations:

1. Maintenance of traffic shall be the sole responsibility of CONTRACTOR.

2. Unless otherwise directed or permitted by CONSTRUCTION INSPECTOR, CONTRACTOR shall schedule its work and maintain two-way traffic at all times.
 3. The traffic control for resurfacing requires a minimum of two uniformed flaggers or two CONTRACTOR's employees with suitable training, orange vests, paddleboards, and any other required or needed items.
 4. The restriction of lanes on roadways with two or more lanes requires CONTRACTOR to furnish and maintain a flashing arrow sign with minimum size board of 36 x 72 inches. It shall be operated continuously when necessary to divert traffic and shall be a portable sign panel equipped with 15 hooded, amber sealed beam lamps arranged to form a double arrow. The power source to the unit shall be a portable generator or approved commercial source capable of continuous operation. CONTRACTOR shall use traffic cones to channel traffic into the appropriate lane channel when resurfacing roadways with three or more lanes.
 5. Surface Removal (Residential and Thoroughfare) shall require at least three traffic control personnel.
 6. CONTRACTOR shall protect traffic on all streets while moving equipment throughout this Project.
 7. CONTRACTOR shall schedule the Work of adjusting castings on roadways with four or more lanes in order to maintain an unobstructed lane of traffic in each direction at all times. The use of arrow boards and traffic cones or drums shall be required.
 8. Construction signs for Residential streets may be "Portable Type" as set out in Section 801.03 of the INDOT Standard Specifications.
- H. Where a street affected by Project construction is being used by through traffic, including periods of suspension of the Work, CONTRACTOR shall furnish and maintain pavement markings, lights, warning signs, road construction traffic maintained signs, end construction signs, barricades, temporary guardrail, and such other traffic control devices, and watchmen and flaggers, as may be necessary to maintain safe traffic conditions within the Work limits.
- I. CONTRACTOR shall furnish and erect regulatory signs and guide signs within the Work limits on all traffic-maintained projects. The responsibility for maintenance of these signs shall rest with CONTRACTOR. The erection and removal of all regulatory signs shall be approved by CONSTRUCTION INSPECTOR.
- J. Existing signs and traffic control devices within the Work limits shall remain in use during the construction period. If CONTRACTOR needs to relocate or modify existing signs or traffic control devices as a consequence of its work, CONTRACTOR shall provide suitable supports and may modify the devices after receiving prior approval from CONSTRUCTION INSPECTOR and the maintaining agency. Routine maintenance of existing traffic control devices will remain the responsibility of the maintaining agency. The function of existing Stop or Yield signs shall be retained at all times, although their position may be adjusted. Existing signs that must be relocated laterally shall be placed in accordance with the INDOT Standard Specifications.

CONTRACTOR shall restore all relocated or modified signs to the position and condition which existed prior to construction.

- K. When an existing signal operation must be interrupted for a period, CONTRACTOR shall provide a temporary traffic control method approved by CONSTRUCTION INSPECTOR and the authority maintaining the signal at no additional cost to OWNER.
- L. Whenever it is necessary for CONTRACTOR to divert the flow of traffic from its normal channel into another channel, the channel for such diverted traffic shall be clearly marked by CONTRACTOR with cones, drums, barricades, vertical panels, pavement markings, or flashing arrow panels. This method of marking shall also be used where work is being done adjacent to the part of the street or highway in use by the public or where work is being done on the shoulder where the roadway is being used by the public. During darkness hours, barricades and drums shall be supplemented with yellow flashing or steady burning electric warning lights in accordance with the INDOT Standard Specifications.
- M. CONTRACTOR shall obtain the approval of CONSTRUCTION INSPECTOR and the proper authorities before closing a traffic lane or establishing a one-way traffic operation.

3.6 PAVEMENT MARKING OPERATIONS

- A. Moving marking operations shall be performed by a truck equipped with necessary flashers and warning signs and shall be protected by a similarly equipped trailing vehicle or vehicles separated a sufficient distance to provide adequate advance warning to overtaking traffic. The marking operation should use the extreme left or right lane when possible. Where three or more lanes exist, the operation shall allow traffic to pass on one side only.
- B. Stationary marking operations in intersections, school zones, gores, and other areas shall be protected with traffic control devices such as advance warning signs and cones.

3.7 FLAGMEN

- A. Whenever one-way traffic is established, at least two flagmen shall be used, unless otherwise permitted by CONSTRUCTION INSPECTOR, and signs, cones, barricades, and other traffic control devices shall be erected by CONTRACTOR in accordance with the INDOT Standard Specifications. Traffic control devices shall be reflectorized as previously noted herein. CONTRACTOR shall maintain positive and quick means of communication between the flagmen at the opposite ends of the restricted area.
- B. Flagmen shall be equipped according to the INDOT Standard Specifications for flagging traffic. At night, flagmen stations shall be adequately illuminated, and flagmen shall use a reflectorized Stop/Slow sign or a red light approved by CONSTRUCTION INSPECTOR.
- C. The control and regulation of traffic by the flagmen and performance of their duties shall conform to the INDOT Standard Specifications. CONTRACTOR may, in lieu of flagmen, or supplementing them, furnish, install, and operate a temporary traffic signal

or signals, for the purpose of regulating traffic in accordance with a written agreement approved by OWNER and the proper authorities.

3.8 PERFORMANCE

- A. In the event of CONTRACTOR's failure to comply with these provisions, OWNER may cause the same to be done and will deduct the cost of such work from any moneys due to or become due CONTRACTOR under this agreement, but the performance of such work by OWNER or at its insistence shall serve in no way to release CONTRACTOR from its general or particular liability for the safety of the public or of the Work.

3.9 GENERAL MAINTENANCE OF TRAFFIC

- A. Unless otherwise permitted, directed, or ordered by OWNER or CONSTRUCTION INSPECTOR, traffic shall be specifically maintained as follows:
1. A minimum of one lane for emergency vehicles is to be provided at all times on all streets affected by this Project.
 2. All trenches and openings shall be backfilled as soon as possible or as specified and the pavement restored.
 3. CONTRACTOR shall confer with CONSTRUCTION INSPECTOR, local property owners, and others who may be affected by the Project before starting any work at locations affecting said parties, and the carrying out of this work with respect to traffic maintenance shall be covered by agreements reached at such conferences.
 4. The location, design, and construction of driveways, roads, and access and egress points for construction equipment vehicles to public streets which may be required by CONTRACTOR for construction on easements and other locations shall be approved by CONSTRUCTION INSPECTOR. All such points shall be provided with adequate warning signs.
 5. No parking or standing of vehicles or construction equipment on streets will be permitted.
 6. CONTRACTOR shall provide dust control on all streets in this Project in accordance with INDOT Standard Specifications, the provisions of the Construction Contract, and Section 01560 – Environmental Controls to the satisfaction of CONSTRUCTION INSPECTOR and OWNER. When in the opinion of OWNER, CONTRACTOR has sequenced its operations and managed its work to avoid the excessive need for police services, but public safety or convenience requires the services of additional policemen to direct traffic, OWNER may direct CONTRACTOR to provide manpower within or adjacent to the location of the Work at the expense of OWNER. When so directed:
 - a. Make all arrangements for obtaining the necessary manpower.
 - b. Ensure that invoices for police services are transmitted directly from the Police Department to OWNER.

- c. CONTRACTOR shall pay all incidental costs for providing these services.
 - d. Police shall not be used to serve as watchmen to protect CONTRACTOR's equipment and materials or to warn pedestrians of hazards such as open trenches.
7. Pavement and shoulders having an edge drop of more than 3 inches shall be delineated with drums in accordance with Section 801.09 of the INDOT Standard Specifications. Delineation shall be at a maximum spacing of 200 feet. The use of cones in accordance with Section 801.08 of the INDOT Standard Specifications will be permitted during daylight hours in lieu of drums.
 8. If it is necessary to close a road for the purpose of installing or replacing a storm or sanitary pipe and/or structure, the road shall not be closed until the pipe and/or structure is at the Project site.
 9. At least three weeks before a road is to be closed to traffic, notification shall be given of such intention. Detour route marker assemblies shall be erected and maintained along the detour route as directed by CONSTRUCTION INSPECTOR or OWNER. Barricades shall not be erected nor the traffic interfered with until approved.

- END OF SECTION 01570 -

SECTION 01620 – PRODUCT DELIVERY, STORAGE, AND PROTECTION

PART 1 - GENERAL

1.1 APPLICABILITY

- A. This Section applies to all products furnished under this Contract. Shipments of equipment or materials to be used by CONTRACTOR or its Subcontractors shall be delivered to the site only during regular working hours. All shipping papers and shipments shall be addressed and consigned to CONTRACTOR. Under no circumstances will OWNER accept shipments directed to it or CONSTRUCTION INSPECTOR unless otherwise specified.

1.2 DELIVERY

- A. Products shall not be delivered to the Project site until related shop drawings have been reviewed and approved by ENGINEER and until appropriate storage facilities are in place.
- B. Products shall be delivered to the site in manufacturer's original, unopened, labeled containers.
- C. CONTRACTOR shall not drop, roll, or skid products off delivery vehicles. Hand carry or use suitable materials handling equipment.

1.3 STORAGE AND PROTECTION

A. General:

- 1. CONTRACTOR shall store and protect products in accordance with the manufacturer's recommendations and the requirements specified herein. No on-site existing storage facilities are available for use by CONTRACTOR. All on-site facilities for storage shall be furnished by CONTRACTOR.
- 2. CONTRACTOR shall not block or restrict the use of the Public Right of Way, access roads, or private property with stored materials.
- 3. CONTRACTOR shall not store products where they will interfere with operations of OWNER or other contractors.
- 4. CONTRACTOR shall protect all products from damage or deterioration by weather.
- 5. CONTRACTOR shall not store any products directly on the ground.

B. Uncovered Storage:

- 1. Materials not subject to deterioration or contamination by weather may be stored uncovered at the Project site. Such materials may include reinforcing steel, piping, precast concrete, and castings. All such material shall be stored on wood blocking

where practical. Aggregates and sand may be stored uncovered provided that they are protected from contamination by other materials.

C. Covered Storage:

1. The following types of material may be stored out-of-doors if covered with material impervious to water:
 - a. Rough lumber.
 - b. Concrete masonry units.
 - c. Equipment as specifically allowed by CONSTRUCTION INSPECTOR.
2. CONTRACTOR shall tie down covers with rope and slope to prevent accumulation of water on covers. All materials shall be stored on wood blocking or pallets.

D. Fully Protected Storage:

1. CONTRACTOR shall store all products not named above in buildings or trailers which have a concrete or wooden floor, a roof, and fully closed walls on all sides.
2. CONTRACTOR shall provide heated storage space for materials which would be damaged by freezing.
3. CONTRACTOR shall protect mechanical and electrical equipment from being contaminated by dust and dirt.
4. CONTRACTOR shall maintain temperature and humidity at levels recommended by manufacturers for electrical and electronic equipment.
5. Store lubricants, fluids, and fuels in compliance with Occupational Safety and Health Association (OSHA) and environmental requirements in a manner acceptable to CONSTRUCTION INSPECTOR.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION 01620 -

SECTION 01740 – WARRANTIES AND GUARANTEES

PART 1 - GENERAL

1.1 SCOPE

- A. This Section provides procedures and requirements for warranting the Work. The enumerated warranties herein are in no way intended to abrogate any implied warranties as associated with goods supplied under this Contract.

1.2 SUMMARY

A. Work Included:

1. Preparation of Warranties for submittal.
2. Requirements for the content and submittal of Warranties.

1.3 DEFINITIONS

A. Warranty:

1. There are three general types of warranties required for this Work; all are made to OWNER:
 - a. CONTRACTOR's Express Warranty – A formal statement that CONTRACTOR warrants to OWNER that: materials and equipment furnished under the Contract are of good quality and new unless otherwise required or permitted by the Contract Documents; the Work is free from defects not inherent in the quality required or permitted; the Work conforms to the requirements of the Contract Documents; the Work is complete and fully functional; and any failure to conform to these stipulations, or the occurrence of any defects or failures in the Work, shall be remedied by CONTRACTOR at its own expense. Work not conforming to these requirements, including substitutions not properly approved and authorized, shall be considered defective. CONTRACTOR's Express Warranty excludes remedy for damage or defect caused by abuse, improper or insufficient maintenance, improper operation, or normal wear and tear under intended usage. If required by OWNER, CONTRACTOR shall furnish satisfactory evidence as to the kind and quality of materials and equipment furnished. CONTRACTOR shall be aware that CONTRACTOR's Express Warranty is the warranty upon which OWNER chiefly relies to ensure the integrity and serviceability of the Work. OWNER has little interest in any equipment manufacturer's usual warranty as such warranties are fraught with exclusions, provide inferior coverage to CONTRACTOR's Express Warranty, and generally have a substantially shorter term than CONTRACTOR's Express Warranty. CONTRACTOR is hereby advised that OWNER has no interest in tailoring activities to preserve, protect, and utilize the manufacturer's usual warranty on any equipment or system, and that OWNER shall rely on CONTRACTOR's Express Warranty, plus CONTRACTOR's Special Express Warranty and Manufacturer's Extended Express Warranties as are specified.

- b. CONTRACTOR's Special Express Warranties – The form, format, and conditions of CONTRACTOR's Special Express Warranties are described in the various specification Sections of the Contract Documents. These are formal warranties above and beyond CONTRACTOR's Express Warranty and manufacturer's standard warranties. These warranties may be based on performance, power consumption, maintenance projections, or other operating parameters. Extended warranties, service contracts, and performance bonds are also included under this category. CONTRACTOR shall provide a Warranty Bond equal to 100% of the value for the Work that is to be warranted by CONTRACTOR's Special Express Warranty as identified in CONTRACTOR's Schedule of Values. The warranty duration and Work covered by the bond shall be described in the related detailed Specifications.
- c. Manufacturer's Extended Express Warranties – These are formal statements or certifications by manufacturers which warrant to OWNER that products and equipment are free from defects in material and workmanship. These are warranties issued with products and equipment which supplement CONTRACTOR's Express Warranty and extend coverage past the expiration of CONTRACTOR's Express Warranty. Included with the Manufacturer's Extended Express Warranty data shall be notification of the availability of any extension to standard warranty, including terms.

1.4 SUBMITTALS

- A. As a part of the submittals for each item of equipment or group of equipment items, include a Draft Warranty containing all of the language and terms specified.
- B. Following completion of the terms for establishment of the Warranty specified, prepare Warranties for submittal per the following:
 - 1. Warranties for products or portions of the Work, established on a particular date as specified herein, may be submitted as a group.
 - 2. Label each submittal with the title "WARRANTY," the Project name and effective date; and CONTRACTOR's name, address, and telephone number.
 - 3. A Table of Contents shall be included identifying each item with the number and title of Specification Section and the name of the product or Work item.
 - 4. Separate Warranty for each Specification Section item with index tab sheets. Label tabs to conform to Table of Contents.
- C. The Warranty shall contain, as applicable:
 - 1. Effective starting date and end date of the Warranty period.
 - 2. Statement of the terms and conditions of the Warranty, if any.
 - 3. Statement that all Maintenance and Operating information has been provided and approved.

4. Statement that all training and training materials have been provided and approved.
 5. Statement that the equipment or system has been reviewed and accepted by the manufacturer in accordance with provisions of the individual Sections in Divisions 2 through 16 of the Project Manual, as applicable.
 6. Certification by CONTRACTOR and/or Manufacturer that the statements noted above are true and correct. This certification shall be signed by a person authorized to sign Contract Documents on behalf of CONTRACTOR.
- D. Special warranties, as required by the Contract Documents, shall be submitted in accordance with the requirements of this Section.

PART 2 - PRODUCTS

2.1 WARRANTIES

A. Term or Period:

1. CONTRACTOR's Express Warranty shall extend for three calendar years from the date of Substantial Completion of the Work or acceptance date of the product or portion of Work thereof, whichever is the later date. Special Express Warranties and Manufacturer's Extended Express Warranties shall have the term given in the Specification Section describing them.

B. CONTRACTOR's Responsibilities:

1. During the Warranty period, CONTRACTOR is responsible for repair or replacement of all failures and defects, exclusive of ordinary and routine maintenance and failures directly traceable to the lack thereof. This requirement shall be thoroughly explained by CONTRACTOR to all prospective equipment suppliers.
2. The provisions of any usual Warranties, terms of sale, etc., by suppliers shall not be substituted for this requirement, except where such provides an extended Warranty beyond the requirements of this Section.

PART 3 - EXECUTION

3.1 EXECUTION OF WARRANTY

- A. The approved Draft Warranty will be executed and placed in effect as the Final Warranty on the date of Substantial Completion of the Work for the specific equipment item or group named in the Warranty.
- B. The warranty period for the Work shall begin with final approval of all Work associated with the Project (i.e., upon issuance of the substantial completion certificate).

- C. It shall be noted that the warranty period for equipment used initially in temporary service shall only begin with final approval of all Work associated with the Project.

- END OF SECTION 01740 -

SECTION 01800 – PERMITS AND REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

- A. OWNER is responsible for obtaining the following permits, approvals, and notifications:
1. Facilities Construction Permit from Indiana Department of Environmental Management (IDEM).
 2. Any modifications to the existing National Pollutant Discharge Elimination System (NPDES) permit, as necessary.
- B. CONTRACTOR shall be responsible for obtaining the following permits if required:
1. Right of Way Permits from the City of Indianapolis, DBNS (for excavation, encroachments, oversized loads, lane closures, noise, 24-hour work hours waiver, etc.).
 2. Temporary Construction Access Permits.
 3. Temporary Construction Dewatering Systems Report from the Indiana Department of Natural Resources (IDNR). A copy of each report shall be provided to the Owner.
 4. All other required permits and/or notices, permit/notice extensions, and/or permit and/or notice renewals. CONTRACTOR shall also provide information required by DBNS in accordance with Indianapolis Municipal Code Title II, Chapter 391, Article III, Section 391-302 to obtain approval that noise generated by construction operations will not adversely impact the public and all others for the specific Project.
- C. Throughout the Project, CONTRACTOR shall provide any additional notices related to Rule 5 requirements at no additional cost to OWNER. CONTRACTOR shall also provide the required notice of termination to the Rule 5 IDEM Coordinator.
- D. Follow all Federal, State, and Local laws and regulations for storm water drainage and erosion control for any muck/excavated material disposal locations that may occur within Marion County or outside of Marion County.
- E. Obtain all other required permits. CONTRACTOR shall appropriately display permits in the manner required by the permitting agencies.
- F. Specific mention of the above state permits does not exclude any other permit(s) that may be required for the Project.

- G. Abide by all provisions, conditions, and requirements and pay fees for each permit required for the Project.
- H. Should OWNER fail to acquire any permits specified herein prior to the Notice to Proceed date, and such failure affects the controlling operation of CONTRACTOR's approved schedule, CONTRACTOR's sole remedy shall be for a time extension.
- I. Submit copies of all permits obtained by CONTRACTOR to CONSTRUCTION INSPECTOR for Information upon receipt.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION 01800 -

SECTION 01910 – WEATHER PROTECTION STANDARD

PART 1 - GENERAL

1.1 SCOPE

- A. This Section contains standards for providing temporary enclosures and heat to permit construction work to be carried on during inclement weather.

1.2 DEFINITIONS

- A. Weather Protection – The temporary protection of that portion of the Work adversely affected by moisture, rain, wind, and cold by covering, enclosing, and/or heating.

1.3 WEATHER PROTECTION

- A. Weather Protection shall provide adequate working areas during inclement weather as determined by CONSTRUCTION INSPECTOR and be consistent with the approved construction schedule to permit the continuous progress of all Work necessary to maintain an orderly and efficient sequence of construction operations.
- B. In the event of inclement weather, CONTRACTOR shall protect the Work and materials from damage or injury from the weather.
 - 1. When required, protection shall be provided by use of tarpaulins, wood and building-paper shelters, or other suitable means.
 - 2. If, in the opinion of CONSTRUCTION INSPECTOR, any portion of the Work or materials has been damaged by reason of failure on the part of CONTRACTOR to so protect the Work, such Work and materials shall be removed and replaced with new materials and work to the satisfaction of CONSTRUCTION INSPECTOR.
- C. Furnish and install all Weather Protection material and be responsible for all costs, including heating required to maintain a minimum temperature of 40°F at the Work surface.
 - 1. This provision does not supersede any specific requirements for methods of construction and/or curing of materials.
- D. During cold weather, materials shall be preheated, if required, and the materials and adjacent structure into which they are to be incorporated shall be made and kept sufficiently warm so that a proper bond will take place and a proper curing, aging, or drying will result. Protected spaces shall be artificially heated by suitable means which will result in a moist or a dry atmosphere according to the particular requirements of the Work being protected. Ingredients for concrete and mortar shall be sufficiently heated so that the mixture will be warm throughout when used.
- E. Installation of weather protection and heating devices shall comply with all safety regulations including provisions for adequate ventilation and fire protection devices.

- F. Furnish and install Fahrenheit thermometers at places designated by CONSTRUCTION INSPECTOR in order to determine if specified temperatures are maintained.
- G. CONTRACTOR is responsible for snow removal required to maintain access to the construction site; designated parking areas for OWNER, CONSTRUCTION INSPECTOR, and other OWNER representatives; storage and staging areas; and to perform its Work. CONTRACTOR shall also be responsible for snow removal on all roads which are fully or partially closed due to the Work.

1.4 SUBMITTALS

- A. Within 15 calendar days after the Notice to Proceed, submit to CONSTRUCTION INSPECTOR for approval three copies of proposed methods of Weather Protection in accordance with Section 01300 – Contractor Submittals.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION 01910 -

SECTION 01940 – SUBSTITUTIONS

PART 1 - GENERAL

1.1 SCOPE

- A. This Section includes the requirements related to CONTRACTOR's responsibilities for substitutions.

1.2 EQUIVALENT MATERIALS AND EQUIPMENT

- A. Whenever a material, article, or method is specified or described by using the name of a proprietary product or the name of a particular manufacturer or vendor, the specific item mentioned shall be understood as establishing the type, function, dimension, appearance, and quality desired and is to be the basis upon which bids are to be prepared. Other manufacturer's materials, articles, and methods not named will be considered as substitutions provided required information is submitted in the manner set forth herein and provided substitution will not require substantial revisions of the Contract Documents.

1.3 BASIS OF BIDS

- A. Bids shall be based on materials, articles, and methods named and specified in the Contract Documents.

1.4 SUBMITTAL OF PROPOSED SUBSTITUTIONS

- A. In order for substitutions to be considered, CONTRACTOR shall submit to ENGINEER complete data, as set forth herein, to permit complete analysis of all proposed substitutions.
- B. The provisions of Section 01300 – Contractor Submittals concerning review time by ENGINEER do not apply to substitution requests. ENGINEER will take such time as required to ensure full compliance with all Contract requirements.
- C. A request for substitution of product may be submitted, after CONTRACTOR:
 - 1. Has investigated the proposed product and determined that it is equal to or superior to specified product, furnishes a certification to that effect, and waives all rights to additional payment or time that may subsequently become necessary due to the failure of the substituted product to perform adequately.
 - 2. Agrees to provide the same warranties or bonds for the product substitutions as for the specified product.
 - 3. Agrees to reimburse OWNER for reasonable charges of ENGINEER for evaluating each proposed substitutions.
 - 4. Agrees to be responsible for coordinating and paying for any necessary changes to other work required by approved substitutions or product options which

CONTRACTOR selects and shall pay all such costs, including the costs of the services of ENGINEER to revise the Contract Documents, if such revisions are required.

5. Waives all claims for additional costs due to substitution which may subsequently become apparent.
 6. Is offering either a substantial credit to OWNER for acceptance of the substitution or appropriate justification that the product to be provided as the substitution is substantially superior in quality, performance, compatibility with adjacent products, durability, vandal-resistance, or in other important ways.
- D. Three copies of the following data shall be submitted in order for the substitutions to be considered:
1. For products provide:
 - a. Identification, including manufacturer's name and address.
 - b. Manufacturer's literature, including but not necessarily limited to:
 - (1) Product description, performance, and test data.
 - (2) Reference standards.
 - c. Samples where appropriate.
 - d. Point-by-point comparison to the specification in these Contract Documents to show how the proposed substitution is equal or superior to the specified item.
 - e. Name and address of similar projects on which product was used, and date of installation.
 2. For construction methods provide:
 - a. Detailed description of proposed method.
 - b. Drawings illustrating methods.
 - c. Name and address of similar projects on which method was used and date of use.
 3. Itemized comparison of proposed substitution with product or method specified. Different types of products and methods will be considered provided final performance is at least equal to that specified. The burden of responsibility in furnishing this information is with CONTRACTOR. If incomplete or irrelevant data is submitted, the data will be returned and the request will be denied.
 4. Data relating to impact on construction schedule occasioned by the proposed substitution.

5. Relation to separate contracts.
 6. Proposed monetary changes supported by accurate cost data on proposed substitution in comparison with product or method specified, including costs for redesigns required. Costs for redesigns due to substituted items are the responsibility of CONTRACTOR.
- E. In making request for substitution, CONTRACTOR represents:
1. It has investigated proposed product or method and determined that it is equal or superior in all respects to that specified. It shall provide the same guarantee for substitution as for product or method specified.
 2. It shall coordinate installation of accepted substitution into the Work, making such design and construction changes as may be required for the Work to be completed in all respects in accordance with contract requirements without additional cost to OWNER.

1.5 OWNER'S DECISION

- A. OWNER, in consultation with ENGINEER, will determine whether or not the material or article submitted is equal to the named material or article. OWNER's decisions regarding evaluation of substitutions shall be considered final and binding. Request for time extensions and additional costs based on submission of acceptance or rejection of substitutions will not be allowed.
- B. All approved substitutions will be incorporated into the Contract by Change Order.

1.6 REJECTION OF PROPOSED SUBSTITUTION

- A. Substitutions will not be considered at any time if:
1. They are indicated or implied on CONTRACTOR's drawings or Project data submittals without formal request submitted in accordance with this Section.
 2. Acceptance will require substantial revision of Contract Documents.
 3. Acceptance will create problems in stocking of repair parts and in future maintenance by OWNER.
 4. ENGINEER determines that the material or article submitted is not equal to the named material or article.
 5. Additional costs are incurred by OWNER.
 6. A time extension is required.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION 01940 -

SECTION 01980 – CLOSE-OUT PROCEDURES

PART 1 - GENERAL

1.1 SCOPE

- A. This Section includes administrative and procedural requirements for Contract close-out.

1.2 SUBMITTALS

- A. Submittals shall be made in accordance with Section 01300 – Contractor Submittals.
- B. Releases from Agreements:
 - 1. Furnish OWNER with written releases from property owners or public agencies where side agreements or special easements have been made.
- C. Spare Parts and Special Tools:
 - 1. As required by the individual Specification Sections.
- D. Final Application for Payment:
 - 1. Submit in accordance with the Construction Contract.
 - 2. Submittals to provide with this application include, but are not limited to, the following:
 - a. All maintenance and operating instructions.
 - b. Schedules.
 - c. Guarantees.
 - d. Bonds.
 - e. Certificates of Inspection.
 - f. As-Built Drawings.
 - g. Releases or waivers of liens or claims.
 - h. All other documents as required by the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 DEMOBILIZATION AND FINAL CLEANING

- A. Demobilize in accordance with Section 01505 – Mobilization and Demobilization.
- B. Provide final site clean-up and restoration after removal of temporary construction facilities in accordance with Section 01500 – Temporary Construction Facilities.

- END OF SECTION 01980 -

SECTION 02070 – CONCRETE CORING

PART 1 - GENERAL

1.1 SCOPE

- A. This Section includes requirements for providing cored openings into or through existing reinforced concrete floors, walls, slabs, roofs, and other existing concrete or masonry surfaces for the purpose of installing piping or equipment, as shown on the Contract Drawings, or as specified in this or other Sections of these Specifications, or as may be required to complete the Work or the installation of any equipment included under this Contract.
- B. Furnish all labor, materials, equipment, and incidentals required to complete the Work.
- C. Conduit and piping penetrations of new concrete or masonry work shall be coordinated and installed at the time of concrete or masonry placement. Coring of new work is not an acceptable substitute for coordinated installation and will not be permitted without written permission from ENGINEER.

1.2 SUBMITTALS

- A. All submittals shall be made in accordance with Section 01300 – Contractor Submittals and shall describe, at a minimum, epoxy adhesive storage, mixing, and application data, including shelf life, pot life, and curing time.
- B. Prior to any coring, submit a Coring Request to ENGINEER including:
 - 1. Plans, elevations, or sections showing location of each hole.
 - 2. Equipment or pipe size and purpose.
 - 3. Core size.
 - 4. Sealing requirements.
 - 5. Anticipated equipment to be shut down, including time required.
 - 6. Outage Request Form, if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Epoxy Adhesives:
 - 1. Sikadur 23, Lo-Mod Gel or approved equal.

2.2 MATERIALS

A. Epoxy Adhesives:

1. 100% solids, 2-component epoxy-resin system.
2. Moisture insensitive.
3. Vapor barrier after cure.
4. Non-Sag Consistency.

2.3 EQUIPMENT

A. Coring Equipment:

1. Equipment shall be in satisfactory working condition.
2. Core bits shall be sharp and capable of drilling a smooth, uniform hole for the full depth required.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions:

1. Inspect all surfaces to be cored and notify CONSTRUCTION INSPECTOR of conditions detrimental to the core drilling.
2. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to CONSTRUCTION INSPECTOR.

B. CONTRACTOR shall use every available means possible, including x-ray, to attempt to locate conduit and reinforcing steel prior to coring.

C. Whenever possible, cores shall be located to avoid cutting through conduit or reinforcing steel. Coring through conduit or reinforcing steel requires prior acceptance by CONSTRUCTION INSPECTOR.

3.2 PREPARATION

A. Relocate small piping and conduit, as required, to allow sufficient room for coring and subsequent equipment or piping installation.

B. All coring shall be scheduled with CONSTRUCTION INSPECTOR and approved prior to beginning the Work.

- C. CONTRACTOR shall protect all equipment in the Work area, as required, to prevent damage due to dust or debris from coring equipment and operations.

3.3 INSTALLATION

- A. Sizes and locations of cored holes shall be carefully coordinated with equipment requirements and dimensions so as to provide sufficient opening for installation or future maintenance.
- B. Under no circumstances shall holes be cored through concrete beams or columns.
- C. Do not proceed until approval is obtained from CONSTRUCTION INSPECTOR.
- D. Unless specifically shown otherwise, cored openings for pipes or conduit shall be of sufficient diameter to allow the installation of mechanical seals so as to close the annular opening in a watertight manner.
- E. CONTRACTOR shall adequately support and secure coring equipment to assure a straight, true-cored hole.
- F. CONTRACTOR shall:
 - 1. Have suitable plugs on hand to seal the cored holes in the event that a tank, basin, or channel must be placed back in service before the Work can be completed.
 - 2. Perform coring operations as quickly as possible. Minimize disturbance caused by coring to adjacent plant operations.
 - 3. Prevent cored plug from dropping away from hole in a harmful or dangerous manner.
 - 4. Examine cored opening for irregularities, large chips or fragments, and voids. Report findings of any such defects promptly to CONSTRUCTION INSPECTOR.
 - 5. Apply a thin, smooth layer of epoxy adhesive to concrete surfaces and exposed reinforcing steel.
 - 6. Apply epoxy adhesive in accordance with manufacturer's printed instructions, including curing time.

3.4 CLEANING

- A. CONTRACTOR shall:
 - 1. Dispose of concrete plug off-site.
 - 2. Clean all areas and equipment of dust and debris caused by coring operations.

3. Plug and patch all bolt holes used to support coring equipment with non-shrink, non-metallic grout specified in Section 03315 – Ancillary Grout.

- END OF SECTION 02070 -

SECTION 02075 – CONTAMINATED SOIL REMOVAL

PART 1 - GENERAL

1.1 SCOPE

- A. The Work specified in this Section shall be required if the CONTRACTOR encounters any suspect contaminated soil from excavations at any location within the Project areas.
- B. The Work includes the removal, testing, and legal disposal of suspect contaminated soil, if encountered, from excavations at any location within the Project areas, whether or not noted in geotechnical reports provided under this project or by others as part of the highway extension project.
- C. CONTRACTOR shall obtain the services of a Qualified Environmental Professional with appropriate experience in contaminated or hazardous waste operations or an equally competent person that is trained, knowledgeable, and qualified in the techniques of excavation and disposal of contaminated soil to oversee the Project.
- D. Contaminated soil shall be removed from the Project site and transported to a certified landfill selected by CONTRACTOR and legally disposed of. CONTRACTOR shall be responsible for all transactions and agreements with the landfill owner or operator.
- E. CONTRACTOR shall supply all labor, materials, services, insurance, permits, and equipment necessary to carry out the Work in accordance with the applicable Federal, State, and Local regulations and these Specifications.
- F. All contaminated soil shall be removed from the excavation and be stockpiled and covered with a double layer of 10 mil poly for future removal by CONTRACTOR. A silt fence shall be erected around the soil stockpile area to prevent and control migration of eroding soil.
- G. CONTRACTOR shall submit to CONSTRUCTION INSPECTOR certified disposal tickets with gross-, tare-, and net-weights per load of impacted soil disposed at the landfill and signed Special Waste Disposal Notification, or equivalent, per load of impacted soil.
- H. CONTRACTOR is responsible for providing a schedule of soil removal activities to CONSTRUCTION INSPECTOR for information upon request.

1.2 SUBMITTALS

- A. Submittals shall be made in accordance with Section 01300 – Contractor Submittals. CONTRACTOR shall submit a detailed plan of action for the removal of the suspect contaminated soil to CONSTRUCTION INSPECTOR prior to starting Work. The plan shall include a schedule for removal activities, removal procedures, and soil storage location and design. CONTRACTOR shall submit disposal records to CONSTRUCTION INSPECTOR within 20 days after soil removal. CONTRACTOR

shall provide a revised construction schedule, if necessary, to CONSTRUCTION INSPECTOR.

B. The following shall be completed during removal:

1. Submit weekly job progress reports detailing removal activity. Include review of progress with respect to milestones and schedules, major problems and action taken, injury reports, equipment breakdowns, and sampling progress.
2. Submit copies of all transport manifests, trip tickets, and disposal receipts.

1.3 EMERGENCY PLANNING

- A. An emergency plan shall be developed by CONTRACTOR prior to remediation initiation and agreed to by CONSTRUCTION INSPECTOR.
- B. Emergency procedures shall be in written form and prominently posted. Everyone prior to entering the Work area must read and sign these procedures to acknowledge receipt and understanding of Work site layout and emergency procedures.
- C. Emergency planning shall include written notification of police, fire, and emergency medical personnel of planned remediation activities work schedule and layout of Work area, particularly barriers that may affect response capabilities.
- D. Emergency planning shall include considerations of fire, explosion, toxic atmospheres, electrical hazards, slips, trips and falls, confined spaces, and heat related injury. Written procedures shall be developed, and employee training in procedures shall be provided.
- E. Telephone numbers of all emergency response personnel shall be prominently posted in the clean change area and equipment room, along with the location of the nearest telephone.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SEQUENCE

- A. If physical evidence of suspect impacted soil is encountered, such as the presence of petroleum- or chemical-like odors, stained soils, sheens, etc., CONSTRUCTION INSPECTOR shall be contacted to have a waste determination conducted. OWNER reserves the right to make a determination without laboratory sampling and analysis if the cause of suspicion cannot be substantiated or verified, in which case the soil shall be handled as non-impacted soil at no additional cost to OWNER.
- B. Remove all contaminated soil. Site screen using a Photo Ionization Detector (PID).

- C. While the waste determination is being made, the suspect impacted soil shall be separated and staged on an impermeable surface, such as plastic sheeting or roll-off dumpster, and covered to prevent contact with precipitation. The plastic sheeting, or equivalent, used to stage and cover the soil shall have sufficient thickness to prevent infiltration and withstand environmental conditions.
- D. While the suspect soil is staged, CONTRACTOR shall visually inspect the staged material daily for signs of leakage. No leakage will be permitted and CONTRACTOR shall repair all leaks, at no additional cost to OWNER, in a manner satisfactory to CONSTRUCTION INSPECTOR.
- E. If the waste is determined to be impacted, CONSTRUCTION INSPECTOR shall work with CONTRACTOR to properly document the impacted soil for disposal at the CONTRACTOR-selected solid waste landfill. If the waste determination shows the soil is non-impacted, then the material can be handled as regular non-impacted soils.
- F. The selected landfill shall be a municipal solid waste disposal facility permitted by the Indiana Department of Environmental Management (IDEM) to accept such materials.
- G. Following landfill approval and completion of associated documentation, such as Special Waste Disposal Notifications, CONTRACTOR shall load, haul, and dispose of the impacted soil at the selected landfill.
- H. In order to be accepted by the landfill, the impacted soil shall have a moisture content sufficient to pass a Paint Filter Test, i.e. no free liquids. No water runoff from the impacted soil shall be permitted to infiltrate the ground surface, enter surface waters, or enter the municipal storm or sanitary sewer system without prior permission from OWNER.
- I. Dispose of all contaminated soil in accordance with Federal, State, and Local regulations.
- J. Following notification from CONSTRUCTION INSPECTOR that the suspect soil is non-impacted, conform to the applicable provisions of the Sections regarding earthwork and protection of the environment.

3.2 QUALITY CONTROL

- A. While performing site soil removal work, CONTRACTOR shall be subject to on-site inspection by Occupational Safety and Health Association (OSHA) and United States Environmental Protection Agency (USEPA) inspectors and/or local building or health officials. If found to be in violation of 40 CFR Parts 280 and 281 and State Rules Title 327 Article 2, Rule 6 and Title 329 Article 9, CONTRACTOR shall cease all work immediately and until the violation is resolved. Standby time required to resolve the violation shall be at CONTRACTOR's expense.
- B. Submit proof of qualifications of testing laboratory and personnel.

- END OF SECTION 02075 -

SECTION 02100 – SITE PREPARATION

PART 1 - GENERAL

1.1 SCOPE

- A. The Work of this Section includes: measures required during CONTRACTOR's initial move onto the Site to protect existing fences, buildings and associated improvements, streets, and utilities downslope of construction areas from damage due to boulders, trees, or other objects dislodged during the construction process; clearing, grubbing, and stripping; and, regrading of certain areas to receive embankment fill.

1.2 SITE INSPECTION

- A. Prior to moving onto the Site, CONTRACTOR shall inspect the Site conditions and review maps of the existing site and pipeline routes and facilities delineating OWNER's property, right-of-way lines, and easement limits.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PRIMARY SITE ACCESS

- A. CONTRACTOR shall develop any necessary access and access restrictions to the Site, including access barriers to prohibit entry of unauthorized persons.
- B. Where existing utilities interfere with the Work, CONTRACTOR shall notify the utility owner and ENGINEER before proceeding, in accordance with the Construction Contract.
- C. Where CONTRACTOR desires additional space for operations relating to the Work that is not shown in the Contract Documents, CONTRACTOR shall acquire and utilize such additional space at no additional cost to OWNER.

3.2 CLEARING, GRUBBING, AND STRIPPING

- A. Construction areas shall be cleared of grass and weeds to a depth of at least 6 inches and cleared of structures, pavement, sidewalks, concrete or masonry debris, trees, logs, upturned stumps, loose boulders, and any other objectionable material of any kind which would interfere with the performance or completion of the Work, create a hazard to safety, impair the subsequent usefulness of the Work or obstruct its operation. Loose boulders within 10 feet of the top of cut lines shall be incorporated in landscaping or removed from the Site. Trees and other natural vegetation outside the actual lines of construction shall be protected from damage during construction, as directed by CONSTRUCTION INSPECTOR.

- B. Within the limits of clearing, the areas below the natural ground surface shall be grubbed to a depth necessary to remove all stumps, roots, buried logs, and all other objectionable material. Septic tanks, drain fields, and connection lines and any other underground structures, debris, or waste shall be removed if found on the Site. All objectionable material from the clearing and grubbing process shall be removed from the Site and disposed of in approved safe locations. Open burning is not permitted.
- C. Unless otherwise indicated, native trees larger than 3 inches in diameter at the base shall not be removed without CONSTRUCTION INSPECTOR's approval.
- D. The removal, if necessary for CONTRACTOR's choice of means and methods, of any trees, shrubs, fences, or other improvements located outside of rights-of-way and not indicated for removal on the plans, shall be arranged with the owner of the property and shall be removed and replaced at no additional cost to OWNER.
- E. Unless otherwise provided, any existing structure or parts thereof, fence, building, or other encumbrance or obstruction upon or within the limits of the right-of-way which interferes in any way with the new construction shall be removed with no additional payment. Materials belonging to owners of abutting property shall be stockpiled neatly and in an acceptable manner upon their property or otherwise disposed of, as required.
- F. Materials not specifically reserved on the Drawings or in the Contract Documents shall become the property of CONTRACTOR, except as set out in the Construction Contract. Such materials shall be removed or disposed of as specified or directed. Materials reserved for use by OWNER shall be removed without damage in sections which can be readily transported; such materials shall be stockpiled neatly at accessible points. No material shall be disposed of except as provided herein.

3.3 OVEREXCAVATION, REGRADING, AND BACKFILL UNDER FILL AREAS

- A. After the fill areas have been cleared, grubbed, and excavated, the areas to receive fill will require overexcavation, regrading, and backfill consisting of the removal and/or stockpiling of undesirable soils. The ground surface shall be recontoured for keying the fill and removing severe or abrupt changes in the topography of the Site. The overexcavated volumes to a level 2-1/2 feet below the existing ground contours shall be backfilled and compacted in accordance with the requirements of Section 02200 – Excavation and Backfill.
- B. Unauthorized over-excavation shall be without additional cost to OWNER.

- C. After excavation is complete, notify CONSTRUCTION INSPECTOR and allow inspection of bottom of subgrade areas intended for support of pipe, footings, mats, or slabs. CONSTRUCTION INSPECTOR will inspect the prepared subgrades within one shift after notification. If unsuitable subgrade soil is present, perform overexcavation and subgrade stabilization to a horizontal and vertical extent necessary to reach suitable subgrade soil, as determined by CONSTRUCTION INSPECTOR. Unsuitable soils shall be either properly compacted in place or overexcavation shall extend through the unsuitable soils to remove them to an underlying competent subsoil grade.

- END OF SECTION 02100 -

SECTION 02125 – EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 SCOPE

- A. CONTRACTOR shall provide erosion control barriers, complete and in place, in accordance with the Contract Documents and all other applicable Federal, State, and Local requirements, including the requirements found in the latest edition of Chapter 600 of the City of Indianapolis Stormwater Specifications Manual.
- B. All Work shall comply with the requirements set forth in 327 IAC-15-1 and 327 IAC-15-5 and any and all subsequent additions and revisions.

1.2 SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 – Contractor Submittals.
- B. Manufacturer's catalog sheets on geotextile fabrics shall be submitted to ENGINEER for acceptance 15 days prior to use.

PART 2 - PRODUCTS

2.1 FABRIC

- A. Fabric may be woven or non-woven, made from polypropylene, polyethylene, or polyamid, and shall contain sufficient UV inhibitors so that it will last for six months in outdoor exposure at temperatures between zero and 120°F.
- B. Fabric shall have the following properties:

Parameter	Standard Method	Value
Grab tensile strength	ASTM D4632	100 lb
Burst strength	ASTM D3786	200 psi
Apparent opening size	ASTM D4751	Between 200 and 70 sieve size

- C. Fabric shall have a minimum filtering efficiency of 85 percent.
- D. Fabric Manufacturer, or equal:
 - 1. Mirafi by TenCate Geosynthetics North America.

2.2 POSTS

- A. Posts shall be wood, at least 2 x 2 inches, or steel 1-1/2 inch, T-shaped with protective coating, at least 6 feet long with protective coating.

2.3 FENCING

- A. Woven wire fabric fencing shall be galvanized, mesh spacing of 6 inches, maximum 14 gauge, at least 30 inches tall.

2.4 FASTENERS

- A. Fasteners to wood posts shall be steel, at least 1-1/2 inches long.
- B. Fasteners to steel posts shall be galvanized clips.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide erosion control barriers at the indicated locations and as required to prevent erosion and silt loss from the Site.
- B. CONTRACTOR shall not commence clearing, grubbing, earthwork, or other activities which may cause erosion until barriers are in place.

3.2 INSTALLATION

- A. Barrier systems shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.
- B. Attach the woven wire fencing to the posts that are spaced a maximum of 8 feet apart and embedded a minimum of 12 inches. Install posts at a slight angle toward the source of the anticipated runoff.
- C. Trench in the toe of the filter fabric barrier with a spade or mechanical trencher so that the downward face of the trench is flat and perpendicular to the direction of flow. Lay fabric along the edges of the trench. Backfill and compact.
- D. Securely fasten the fabric materials to the woven wire fencing with tie wires.
- E. Reinforced fabric barrier shall have a height of 18 inches.
- F. Provide the filter fabric in continuous rolls and cut to the length of the fence to minimize the use of joints. When joints are necessary, splice the fabric together only at a support post with a minimum 6-inch overlap and seal securely.

3.3 MAINTENANCE

- A. Regularly inspect and repair or replace damaged components of the barrier. Unless otherwise directed, maintain the erosion control system until final acceptance; then remove erosion and sediment control systems promptly.

- B. Remove sediment deposits when silt reaches a depth of 1/2 the height of the barrier, or when the fabric begins to bulge, whichever is less. Dispose of sediments as indicated on the Contract Drawings at a site arranged by CONTRACTOR which is not in or adjacent to a stream or floodplain.
- C. Control dust and air-borne particulates in accordance with the requirements of the Construction Contract.
- D. Comply with the requirements of the Rule 5 permit.

3.4 CLEAN-UP

- A. Remove all erosion and sediment control temporary structures following final acceptance of the Work.

- END OF SECTION 02125 -

SECTION 02140 – CONTROL OF GROUNDWATER AND SURFACE WATER

PART 1 - GENERAL

1.1 SCOPE

- A. Work described in this Section includes furnishing all labor, equipment, tools, and incidentals required for all dewatering and for discharging all removed water in accordance with Contract Documents requirements. This Work includes installing, operating, removing, and abandoning all facilities required to maintain open excavations and trenches in a dewatered condition to permit unrestricted construction operations.
- B. Adequate standby equipment shall be kept available at all times to ensure efficient dewatering and maintenance of dewatering operation during power failure. CONTRACTOR shall be responsible for continuous control of water at all times during the course of construction.
- C. Construct all permanent work in areas free from water. Design, construct, and maintain all pumping systems, dikes, levees, cofferdams, and diversion and drainage channels, as necessary, to maintain the areas free from water and to protect the areas to be occupied by permanent work from water damage. Remove temporary works after they have served their purpose.
- D. CONTRACTOR shall be responsible for the stability of all temporary and permanent slopes, trenches, grades, foundations, materials, and structures during the course of the Contract. Repair and replace all slopes, grades, foundations, materials, and structures damaged by water, both surface and sub-surface, to the lines, grades, and conditions existing prior to the damage at no additional cost to OWNER.
- E. Dewatering wells installed by CONTRACTOR shall be located within the construction limits shown on the Contract Drawings.

1.2 DEFINITIONS

- A. Groundwater Control – Dewatering and depressurizing water-bearing soil and rock layers using deep wells, well-point systems, vacuum-assisted wells, or eductor systems. Using sump pumps does not constitute groundwater control. Sump pumps are a means to collect and remove water from excavations.
- B. Dewatering – Lowering the water table and intercepting seepage that would otherwise emerge from slopes or bottoms of excavations and disposing of removed water.
- C. Depressurization – The reduction in piezometric pressure within a soil or rock strata not controlled by dewatering alone.
- D. Controlling excavation drainage by sump pumping – All necessary ditching and sump excavations to collect water in the sump and operating the sump pump and drainage facilities installed.

- E. Controlling surface drainage – Diverting surface water away from excavations by ditches or other means.

1.3 REFERENCE REGULATIONS

- A. Indiana Administrative Code, Article 12 – Water Well Drilling and Groundwater.
- B. Indiana Administrative Code, Article 13 – Water Well Drillers.

1.4 QUALITY CONTROL

- A. CONTRACTOR or Subcontractor designing and installing any dewatering system shall have a minimum of five years experience in dewatering excavations in similar ground and depths.
- B. CONTRACTOR or Subcontractor shall be licensed as a water well driller (IAC 13-2-1).

1.5 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of Section 01300 – Contractor Submittals and as specified hereinafter.
- B. Water Control Plan:
 - 1. Submit a complete Quality Work Plan (QWP) for Water Control within 10 days after Notice to Proceed including narrative, working drawings, and supporting documents showing the type of water control system proposed for each structure and for the dewatering and control of groundwater in other areas where required. Obtain ENGINEER's acceptance for the QWP prior to installing the system.
 - 2. In addition to the requirements of Section 01400 – Quality Control, the Water Control Plan, including working drawings and supporting documents shall show:
 - a. System arrangement and location in relation to the excavation support system.
 - b. Complete description of equipment and materials to be used.
 - c. Installation, operation, and maintenance procedures.
 - d. Drawdown curves for the range of pumping rates anticipated and estimate for anticipated dewatering system discharge rate in gallons per minute.
 - e. Standby equipment and power supply.
 - f. Location and size for berms, dikes, settling basins, sumps, and discharge items.
 - g. Water quality baseline sampling plan.
 - h. Pollution control facilities.

- i. Discharge locations.
 - j. Number and location for observation wells.
 3. Working drawings and supporting documents shall be revised and resubmitted if the system is modified during installation or during operation.
- C. Copies of all permits or other enforceable documents required to perform dewatering and discharge the water as specified below.
- D. Submit to ENGINEER during construction within the specified time:
 1. Measured discharge rates for each discharge point and an estimate of the discharge rate from each well and water source. Submit for each point and well when discharge is initiated, at changes in discharge rate greater than 50 percent and at a frequency of weekly. Submittals shall be made within two working days of such initiation, change, and taking of each reading.
 2. Monitoring Data including results from all monitoring information required by permits and herein, also including, but not limited to:
 - a. Location and number for dewatering and recharge wells in operation.
 - b. Water levels in all dewatering wells, well points, monitoring wells, piezometers, and recharge/injection wells.
 - c. Descriptions of problems with the dewatering system and any remedial actions implemented.
 3. Qualifications for persons or subcontractor responsible for the dewatering operation.

1.6 JOB CONDITIONS

A. Permits:

1. CONTRACTOR shall submit a report of the proposed activities to the Indiana Department of Natural Resources (IDNR) and obtain approval prior to installing dewatering wells.

B. Responsibilities:

1. Take measures to prevent damage to properties, buildings or structures, sewers and other utility installations, pavements, sidewalks, improvements, and work.
2. Do not overload or obstruct existing facilities.
3. Modify the system at no additional cost to OWNER if, after installation and while in operation, it causes or threatens to cause damage to existing buildings, structures, utilities, facilities, or other adjoining property.

4. Measure and evaluate if movements are being caused to adjacent buildings, structures, utilities, facilities, or other adjoining properties by dewatering operations.
5. Repair damage, disruption, or interference resulting directly or indirectly from dewatering operations at no additional cost to OWNER and to CONSTRUCTION INSPECTOR's approval.
6. Restore, maintain, and monitor on a weekly basis all existing piezometric observation wells located within or on the Project site. Additional piezometric observation wells shall be required to monitor the ground water level to ensure proper dewatering prior to excavation below the static water table. The number of wells required will vary to meet CONTRACTOR's responsibilities and will depend on the size and depth of the excavations required for the Work to be constructed.
7. Prior to discharge at all dewatering discharge locations, baseline groundwater quality shall be established at each dewatering location in accordance with Paragraph 3.8. Baseline data will be reviewed by the Indiana Department of Environmental Management (IDEM) to ensure groundwater discharge meet Indiana Water Quality Standards under IAC Title 327 Section 2-1-6. Submit a copy of the baseline data to ENGINEER for information concurrent with submittal to IDEM.
8. Submit plans and details for protecting downstream contracts where applicable. These plans shall include details for bulkheads, pumping facilities, dikes, and drainage.

1.7 APPLICABLE AREAS FOR DEWATERING

- A. Handling surface water run-off is applicable in the vicinity of all open excavation work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 WATER CARE

- A. Furnish, install, maintain, and operate necessary pumping and other equipment to dewater the various parts of the Work and to maintain the foundation and other parts free from water, as required for constructing each part of the Work.
- B. Install all drainage ditches, sumps, and pumps to control excessive seepage on excavated slopes, to drain isolated zones with perched water tables, and to drain impervious surfaces at final excavation elevation.
- C. Construction water shall be discharged at approved locations and at approved rates following treatment to comply with all applicable Federal, State, and Local codes, laws, regulations, and ordinances.

- D. After they have served their purpose, remove all temporary protective work at a satisfactory time and in a satisfactory manner. All diversion channels, sedimentation basins, and other temporary excavations in areas where the compacted fill or other structures will be constructed shall be cleaned out, backfilled, and processed under the same Division 2 Sections as those governing the compacted fill.
- E. When the temporary works will not adversely affect any permanent work item or the planned usage of the Project, CONTRACTOR may be permitted to leave such temporary works in place. In such instances, breeching dikes, levees, and cofferdams may be required and grout filling all wells. Otherwise, the temporary works and all debris shall be completely removed, and the site restored to its original condition.
- F. Intercept and divert surface drainage away from the excavation by using dikes, curb walls, ditches, pipes, sumps, or other means.
- G. Design surface drainage systems so they do not cause erosion on or off the site or cause unwanted water flow.

3.2 WELL RECORDS

- A. A water well driller must submit, on an approved form, accurate records for each well drilled to include the following information:
 - 1. Method to construct well.
 - 2. Proposed well use (monitoring, dewatering).
 - 3. Pumping information, including each of the following:
 - a. Pump type, screened interval, and the pump setting depth, if applicable.
 - b. Whether the well was bailer, air, or pump tested.
 - c. Pump testing rate and length of time.
 - 4. Specifications for the well casing and the well screen.
 - 5. Well inside diameter.
 - 6. Total well depth.
 - 7. Static water level in the well.
 - 8. Owner name, address, and telephone number (and the builder, if different from the owner).
 - 9. Drilling company name and address.
 - 10. Equipment operator name and license number.

11. Type and thickness for formations or materials encountered including color, hardness, and a geological description.
12. A statement for the accuracy of the information contained on the form, which is signed by the water well driller or his authorized representative upon an affirmation or attestation.
13. Type, depth, and thickness of grouting materials and installation method.
14. Specific roadway directions to the well including a reference to the nearest major highway or street intersection.

3.3 DEWATERING

- A. By using well points, pumps, tile drains, or other approved methods, CONTRACTOR shall prevent water accumulation in excavated areas. Should water accumulate, it shall be promptly removed.
- B. Excavations shall be continuously dewatered using groundwater control systems meeting the requirements of Federal Regulations 29 CFR Part 1926 to produce the following results:
 1. For sewer installation in open-cut or trenchless (jack and bore) construction, reduce the piezometric level to at least 2 feet below the trench bottom elevation.
 2. For structural excavations, reduce the piezometric level to at least 3 feet below the excavation bottom elevation.
 3. Where hydrostatic pressure in a confined water-bearing layer exists below the excavation; depressurize this zone to eliminate risk of uplift or other instability to the excavation or installed works. Allowable piezometric elevations are defined by submittals for the groundwater control plan.
- C. Dewatering shall be accomplished well enough in advance of excavation to ensure groundwater is already lowered prior to completing the final excavation to finish subgrade.

3.4 DEWATERING WELL DRILLING PROCEDURES

- A. A water well driller shall operate all equipment according to generally accepted standards in the industry. The driller is responsible for initiating, maintaining, and supervising operations and shall take appropriate precautions to prevent damage, injury, or other loss to persons and property at the drilling site.

3.5 DEWATERING WELL LOCATIONS

- A. Locate dewatering wells as follows:
 1. Use every natural protection to promote the maintenance for the well and its surroundings and to protect the quantity and quality of ground water encountered during well construction.

2. Locate wells reasonably accessible to equipment for proper cleaning, repair, testing, inspection, and other maintenance.
3. As far as practicable from any:
 - a. High capacity well.
 - b. Known contamination source.
4. Protect the well against surface water ponding, drainage, or flooding. Earthen materials shall be placed around the pitless unit or finished well casing in a manner to drain surface water away from the well. The finished well casing or pitless unit shall extend at least 1 foot above the ground level and, if located in a designated flood hazard area, must:
 - a. Be at least 2 feet above the regulatory flood elevation; or
 - b. Be equipped with a watertight pitless unit cap or well seal and vented to an elevation at least 2 feet above the elevation of the regulatory flood.

3.6 DEWATERING WELL INSTALLATION

A. Casing:

1. Equip wells with a casing having an inside diameter of at least 2 inches or as otherwise specified herein. The well casing inside diameter shall allow for easy installation and future removal of the permanent pumping equipment.
2. Case wells to a depth of at least 25 feet below the ground surface.
3. Casing shall be constructed of a steel or thermoplastic material. Ferrous casing shall be new, first class material that meets the American Society for Testing Materials (ASTM) standards ASTM A120 (1984) or ASTM A53 (1987) or American Petroleum Institute (API) standards API5A or API5L (1987). Thermoplastic pipe shall comply with ASTM F480 (1981).
4. Casing used under this Section must be new. Salvaged casing is considered new, if the casing still functions as it did new.

B. Well Screens:

1. A well drilled in an unconsolidated formation shall be equipped with a well screen having adequate openings to provide for maximum water transmittance with respect to the size of the water bearing formation or gravel pack.
2. Screens will be designed to prevent the loss of native or engineered soils.
3. Approved screen materials are stainless steel, brass, bronze, fiberglass, and polyvinyl chloride or acrylonitrile butadiene styrene plastic.

C. Well Pits:

1. The design for a well pit that contains a well must be approved by the OWNER before construction.

D. Construction Water:

1. Water used in the drilling process shall be obtained from a source that will not result in contaminating the well or water bearing zones penetrated by the well.

E. Well Grouting:

1. Grouting materials shall consist of:
 - a. Neat cement with no more five percent by weight of bentonite additive.
 - b. Bentonite slurry, which can include polymers designed to retard swelling.
 - c. Pelletized, granular, medium grade, or coarse grade crushed bentonite.
 - d. Other materials approved by the commission.
2. If neat cement or a bentonite slurry is used for grouting, the cement or slurry shall be pumped into place from the bottom of the annular space upward in a continuous operation with a grout pipe or the well casing using the positive displacement method.
3. Grouting material, other than neat cement or bentonite slurry, shall be introduced in a manner to prevent bridging the annulus between the outside of the well casing and the borehole.
4. A borehole annulus shall be grouted upon the earlier of the following:
 - a. Within 24 hours after installing the well casing.
 - b. Before drilling equipment is removed from the site.

F. Well Construction Standards:

1. A dewatering well shall be equipped with casing having a nominal diameter of at least 2 inches. The casing shall be clean and free of grease, oil, or other contaminants that would impact water quality.
2. Upon installation, a dewatering well must be fitted with a temporary cap which remains in place until pumping equipment is installed. The cap shall be a type that prevents vermin or other potential contaminants from entering the well.
3. Earthen materials shall be placed around the well casing to drain surface water away from the dewatering well.

- G. Provide observation wells, as necessary, to monitor piezometric elevations for excavations and in accordance with the following:
1. Provide at least one observation well for each structural excavation requiring groundwater control. Install additional observation wells, as necessary, at maximum 100-foot spacing around the periphery of each surface excavation.
 2. In addition to the observation wells associated with structural excavations, provide at least one observation well for each 100 linear foot section of open excavation requiring groundwater control. Provide a minimum of one observation well for open excavations of less than 100 linear feet.
 3. Existing observation wells installed for CONTRACTOR's use may be incorporated into the groundwater control plan.
 4. All existing observation wells shown on the Contract Drawings shall be closed in accordance with IC-25-39 and 312 IAC-13 by CONTRACTOR upon completing the Project whether or not they are incorporated into the QWP for groundwater control. Upper piezometer pipe shall be removed to at least 2 feet below grade (in non-paved areas), and the ground surface shall be restored to match the adjacent ground surface.
- H. Dewater by means which will ensure dry excavations, preserve final lines and grades, and not disturb or displace adjacent soil.
- I. Provide and maintain adequate size ditches to collect surface water and seepage which may enter the excavations and divert the water into a sump. Provide and maintain CONTRACTOR designed drains, pumps, discharge lines, drainage channels, FRAC tanks, oil water separators, settling basins, and filter bags prior to discharge to storm sewers if incorporated into the QWP and approved by ENGINEER and the jurisdictional agency concerned.
- J. All destabilized subgrade conditions caused by inadequate or untimely dewatering operations shall be undercut and backfilled with suitable backfill material at no additional cost to OWNER.
- K. The release of groundwater to its static level shall be performed 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, pipelines, or sewers.
- L. Under no circumstances shall surface water and/or groundwater be discharged to, disposed of, or allowed to flow into the Citizens Energy Group sanitary sewer system, except as provided in an Industrial Discharge Pretreatment Permit.
- M. Should a storm sewer become blocked or have its capacity restricted due to the dewatering operations, CONTRACTOR shall make arrangements for the cleaning of the sewer and appurtenances at no additional expense to OWNER.
- N. OWNER reserves the right to order installation activities to stop when dewatering operations are not in conformance with these specifications.

3.7 BASELINE WATER QUALITY PROCEDURES

- A. Prior to dewatering, collect and analyze groundwater samples from area to be dewatered to ensure dewatering discharge meets the State of Indiana Water Quality Standards (IAC Title 327 Section 2-1-6).
- B. Prior to dewatering, collect and analyze groundwater near discharge locations to establish water quality baseline measurements. At all dewatering discharge locations, groundwater should be analyzed for the following Water Quality Parameters:
 - 1. Temperature – field measured.
 - 2. pH – both field and laboratory measurements.
 - 3. Dissolved Oxygen (DO) – both field and laboratory measurements.
 - 4. Total Suspended Solid (TSS) – both field (turbidity) and laboratory.
 - 5. Other Contaminants of Concern (COC) as may be required by IDEM at specific dewater discharge locations.
- C. Baseline Sample Collection:
 - 1. Submit a water quality baseline sampling plan as a part of the QWP to CONSTRUCTION INSPECTOR. At a minimum the following information shall be included in the sampling plan:
 - a. A site map showing locations of all sample points and devices.
 - b. Sampling schedule.
 - c. Procedures for field measurements.
 - d. Procedures for purging wells.
 - e. Procedures for obtaining samples from wells.
 - f. Procedures for establishing field quality assurance/quality control.
 - g. Chain of custody procedures.
 - 2. Observation wells must be constructed per IAC 312 Article 13 and installed at least 50 feet from the dewatering well area.
 - 3. Time-dependent parameters (DO and pH) must be submitted to the laboratory within eight hours of sample collection.
 - 4. Submit baseline laboratory results to OWNER to confirm discharge water meets Indiana Water Quality Standards (IAC Title 327 Section 2-1-6) at all discharge locations.

5. CONSTRUCTION INSPECTOR and/or OWNER shall be permitted to make independent readings and/or collect duplicate samples.

D. Field Monitoring:

1. After approval authority authorizes discharge(s), provide continuous field monitoring for the discharge water to demonstrate compliance with the water quality requirements.
2. CONTRACTOR shall maintain a daily log relating to the authorized discharge(s). The following information shall be recorded on field logs and provided to CONSTRUCTION INSPECTOR:
 - a. Flow information.
 - b. Sample results.
 - c. Records of visual observations.
 - d. Notations of any problems relating to discharge.
 - e. Name of receiving water.
3. Samples shall be taken, as often as necessary, to provide representative information as it pertains to the nature and volume of the discharge(s). At a minimum, samples shall be collected not less than once per day and not less than once for every 100,000 gallons of water discharged.
4. If field measurements fall outside of the acceptable range, as compared to the baseline measurements, Construction Inspector shall be contacted immediately. Acceptable ranges include:

Parameter	Acceptable Range
Temperature	Temperature rise shall not exceed 5°F.
pH	No pH values below 6 or above 9.
Dissolved Oxygen	Average of at least 5 milligrams per liter (mg/L) per day. Not less than 4 mg/L.
Total Suspended Solids	Shall not change more than +/- 2 Nephelometric Turbidity Units (NTUs).

5. At dewatering discharge locations, the discharge shall also be visually monitored for signs of impact from construction activities, such as the presence of bubbles or foam, visible turbidity, etc. If detected, CONSTRUCTION INSPECTOR shall be contacted immediately.

E. Impacted Dewatering Discharge Disposal:

1. Impacted dewatering discharge shall be defined as dewatering discharge water that exceeds State of Indiana Water Quality Standards IAC Title 327 Section 2-1-6.
2. If impacted dewatering discharge is encountered during the baseline water quality tests or during field monitoring, CONTRACTOR shall prevent such impacted water from being discharged into receiving waters prior to treatment. CONTRACTOR shall arrange for disposal of impacted dewatering discharge to the publicly owned treatment works or locate an alternative non-impacted dewatering location with approval of CONSTRUCTION INSPECTOR.

- END OF SECTION 02140 -

SECTION 02150 – SHORING FOR SURFACE STRUCTURES AND OPEN CUT

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This Section includes design and construction parameters for CONTRACTOR-designed temporary shoring as necessary for trenches or structures where such systems are not shown on the Drawings. This Section is supplemental to Section 01526 – Trench Safety System. In case of conflict, the stricter of the conflicting requirements shall govern.
- B. Shoring refers to providing all components of the excavation support system including, but not limited to, soldier piles and lagging, sheet piles, struts, wales, freezeways, jet grout walls, slurry walls, others as appropriate, or any other support system as appropriate. Use other methods of support only when approved by ENGINEER and OWNER. Shoring shall be designed, installed, maintained and, where applicable, removed by the CONTRACTOR in accordance with this Section and the Contract Documents.

1.2 SYSTEM DESCRIPTION

- A. The shoring system as described in the Specifications, shall be comprised of some or all of the following major items:
 - 1. Soldier piles – Vertical steel member consisting of steel wide flange “WF,” or steel “H” pile, installed in pre-drilled holes, plumbed vertically, and grouted in place with lean concrete. Driven steel members will also be allowed.
 - 2. Wales – Horizontal steel member consisting of steel wide flange “WF,” or steel “H” pile, installed across the inside face of the braced excavation.
 - 3. Lagging – Timber, concrete, or steel supports installed to span between individual soldier piles or steel rings.
 - 4. Cross bracing or struts – Horizontal steel members consisting of steel wide flange “WF,” or steel “H” or pipe pile, installed across open excavation from wale to wale to brace shoring wall and reduce horizontal wale spans, where necessary.
 - 5. Steel liner plates.
 - 6. Sheet piles – Vertical steel sheets driven or vibrated into the ground.
 - 7. Trench boxes.
- B. CONTRACTOR shall design and construct the shoring system in accordance with all applicable codes, and in accordance with the specific requirements described herein:
 - 1. CONTRACTOR shall design and construct shoring based on Occupational Safety and Health Association (OSHA) requirements. CONTRACTOR shall take into

account all surcharge loadings. Surcharge loadings can be due to such things as construction equipment, material or soil stockpiles, sloping ground adjacent to shoring, and adjacent building foundations. CONTRACTOR shall assure that his assumed conditions and loadings are not exceeded in the field during construction.

2. As a minimum, CONTRACTOR shall design shoring to withstand soil and groundwater loads.
3. CONTRACTOR shall embed soldier piles into the ground below the excavation bottom a distance determined by CONTRACTOR's design, but in no case shall embedment be less than 15 feet.
4. Penetration of tight sheeting or walls intended to function as a groundwater cut-off shall be designed for a minimum factor of safety of 1.5 against piping.
5. CONTRACTOR shall install a sufficient number of braces, wales, and struts to satisfy the requirement that the shoring system be stiff and to keep deflections to a practical minimum. CONTRACTOR shall balance this requirement with the need to keep enough clear opening to allow safe and sufficient access for excavation of soil within shoring system and construction of the applicable pipe/structures.
6. CONTRACTOR may, at its option and discretion as space permits, elect to construct the shoring system with the upper portion of the excavation sloped or benched and the lower portion shored. In this case, CONTRACTOR shall construct all slopes in accordance with OSHA regulations. CONTRACTOR may, at its option as space permits, elect to construct a stepped excavation support system.
7. The design of shoring shall conform to accepted engineering practice. Shoring shall be designed by a Professional Engineer licensed in the State of Indiana, with a minimum of 10 years experience in the design of the types of shoring systems proposed. ENGINEER's and OWNER's approval of CONTRACTOR's plans and methods of construction does not relieve CONTRACTOR of its sole responsibility for the adequacy of this support.
8. The design shall preclude the loss of ground between support elements that would lead to voids behind shoring and settlement behind shoring walls.
9. Temporary shoring systems shall be designed such that no penetrations shall be made in permanent structures.

C. Performance Criteria:

1. CONTRACTOR shall be solely responsible for, and bear the sole burden of cost for, any and all damages resulting from improper shoring or failure to shore.
2. The safety of workmen, the protection of adjacent structures, property, and utilities, and the installation of adequate supports for all excavations shall be the sole responsibility of CONTRACTOR.

3. The design, planning, installation, and removal if required, of all shoring shall be accomplished in such a manner as to maintain stability of the required excavation and to prevent movement of soil and rock that may cause damage to adjacent shoring systems, structures, and utilities, damage or delay the Work, or endanger life and health.
4. Sheet piles, if used, shall be driven in full interlock to within 1 inch in 10 feet of plumb.
5. Soldier piles, if used, shall be installed to a vertical plumbness of 3 inches in 50 feet of plumb. CONTRACTOR shall monitor verticality during installation to assure this criterion is met.

1.3 SUBMITTALS

- A. Submit plans for shoring to ENGINEER for review in accordance with Section 01300 – Contractor Submittals at least 15 days prior to commencement of Work. No excavations shall be started until ENGINEER has reviewed and approved CONTRACTOR's shoring design. Submittals shall include:
 1. Design assumptions, analyses, calculations, and information on CONTRACTOR's proposed method of installation and removal, if required, of all shoring.
 2. The maximum design load to be carried by the various members of the support system.
 3. Detailed drawings showing all pertinent dimensions, spacings, and relationships among the components of the shoring, as well as the construction sequence and scheduling.
 4. The method of bracing and methods/procedures for protecting existing sewers, structures, and utilities when installing shoring.
 5. The full excavation depth and depths below the main excavation to which the support system will be installed.
 6. Detailed sequence of shoring system installation and removal.
 7. Detailed drawings and descriptions of the method to be used by CONTRACTOR to monitor shoring and adjacent ground/structure movements.
 8. Methods for sealing shoring around existing sewers to preclude the entry of soil and groundwater into the excavation.
 9. Provisions for dealing with boulders encountered during pile installation.
- B. In addition to the Quality Control Submittal requirements of Section 01400 – Quality Control, submit proof of experience and qualifications required in this Section.
- C. CONTRACTOR shall obtain and submit all necessary permits.

1.4 QUALITY ASSURANCE

- A. Work of this Section shall be performed by an individual or firm of established reputation or, if newly organized, whose personnel have previously established a reputation in the same field, for at least five years, which is regularly engaged in and which maintains a regular force of workmen skilled in design, installation, and maintenance of shoring.
- B. All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the type of materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local approved testing agency not more than six months prior to commencing Work; unless having been continuously employed in similar welding jobs since last certification. Machines and electrodes similar to those used in the Work shall be used in qualification tests. CONTRACTOR shall furnish all material and bear the expense of qualifying welders.

1.5 PROJECT CONDITIONS

A. Existing Utilities:

- 1. Contract Drawings may not show all utilities. CONTRACTOR shall field-check locations of utilities in accordance with the Construction Contract. CONTRACTOR shall protect from damage any overhead wires and any sewer, water, gas, electric, or other pipelines or conduits uncovered during Work.
- 2. Where utilities are anticipated or encountered unexpectedly, excavate by hand or other excavation methods acceptable to the utility owner.
- 3. If existing utilities identified in the Contract Drawings interfere with CONTRACTOR's proposed method of support, any necessary modification, support, or relocation shall be performed at no additional cost to OWNER.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All equipment and materials furnished and installed under this Section shall be new, suitable for the conditions of service to which they will be subject, and equal to the best of their respective classes. Grade and quality shall meet the applicable cited specifications and standards. CONTRACTOR shall select materials that conform to the requirements of Paragraph 2.2 below. Alternate materials and systems are subject to approval by ENGINEER.

2.2 MATERIALS

A. Steel Supports:

- 1. Steel supports and auxiliary structural members shall be free of rust and defects which may impair or reduce their structural integrity.

2. All appurtenances required for use shall be provided with the steel members to include tie rods, collar braces, bolts, splice plates, drift pins, etc.
3. Soldier piles, bracing, posts, beams, channels, plates, rods, and bars shall be structural steel conforming to ASTM A572, unless otherwise noted on the Contract Drawings. Bolts shall conform to ASTM A325.

B. Timber:

1. Timber for lagging, blocking, cribbing, or other parts of initial support shall be sound hardwood of rectangular cross section.
2. Use timber lagging of commercial grade or better.

C. Grout:

1. Grout for soldier pile embedment shall be minimum 2,000 psi unconfined compressive strength (28-day strength).

D. Steel Sheet Piling:

1. Steel sheet piling shall conform to ASTM A328.

E. Filter Fabric:

1. Polypropylene, staple fiber, needle punched non-woven heat set on one side to ensure consistent roll width and roll-out.
2. Resistant to ultraviolet degradation and to biological and chemical environments normally found in soils.
3. Minimum Average Roll Values:

Property	Test Method	Value
Grab Tensile Strength	ASTM D4632	80 pounds
Grab Elongation	ASTM D4632	50 percent
Puncture Strength	ASTM D4833	50 percent
Mullen Burst	ASTM D3786	150 pounds
Trapezoidal Tear	ASTM D4533	30 pounds
Apparent Opening Size	ASTM D4751	No.70 US Std. Sieve
Permittivity	ASTM D4491	2.0 sec ⁻¹
Permeability	ASTM D4491	0.22
Water Flow Rate	ASTM D4491	110 gpm / square foot
UV Resistance	ASTM D4355	70 percent at 500 hours

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify surface conditions and utility locations. Protect utilities and improvements, as called for in the Contract Documents, or required by the Utility Companies.
- B. Verify field measurements are as indicated on the Contract Drawings.
- C. Verify layout of Work before beginning installation.
- D. Examine the available boring data before beginning design and installation of the shoring system.

3.2 INSTALLATION

- A. Steel soldier piles and steel sheet piling must be driven using high frequency vibratory hammers or similar high frequency installation equipment capable of driving the piling to the depths as described in the CONTRACTOR's submittal.

3.3 EXCAVATION

- A. Protect utilities, adjacent structures, and property from damage resulting from CONTRACTOR's activities.
- B. Provide necessary groundwater control and drainage in accordance with Sections 02125 – Erosion and Sediment Control and 02140 – Control of Groundwater and Surface Water.
- C. The methods of constructing the temporary shoring are at the option of CONTRACTOR and subject to comment by ENGINEER. Excavations shall be made to the lines, grade, and dimensions shown on CONTRACTOR's Shop Drawings. If the excavation is found to be deviating from the true lines and grade, CONTRACTOR shall immediately make the necessary changes to bring the excavation back to the correct position. Any excess deviation beyond that specified herein shall be remedied by CONTRACTOR at his own expense.
- D. All materials encountered shall be regarded as unclassified and shall be excavated, regardless of the nature thereof, and all excavated material must be removed and disposed of as described in Section 02200 – Excavation and Backfill.
- E. Every precaution shall be taken to prevent the entry of water, mud, and foreign matter into the excavation at all times.
- F. Any and all excess excavation or over-excavation performed by CONTRACTOR for any purpose or reason, except as may be ordered in writing by CONSTRUCTION INSPECTOR, shall be at the expense of CONTRACTOR. Any damage done to the Work by CONTRACTOR's operations shall be repaired by and at the expense of CONTRACTOR and in a manner approved by CONSTRUCTION INSPECTOR.

- G. Excavate only as much as can safely stand unsupported prior to installing shoring depending on site specific conditions. However, in no case shall more than 4 feet be left unsupported at any time. Install supports immediately after excavation.
- H. For structure excavations, a concrete mud slab shall be installed as soon as final depth and stable bottom conditions have been reached and accepted by CONSTRUCTION INSPECTOR.

3.4 TREMIE CONCRETE SEALING SLABS

- A. To preclude dewatering outside the excavation, CONTRACTOR may choose to excavate below the water table under flooded conditions within an impermeable support system. Upon reaching grade, a tremie concrete seal is placed at the bottom of the excavation.
- B. Prior to placing a tremie concrete seal, the bottom shall be sounded to ensure that design depth has been achieved across the full area of the excavation. The edge of the excavation where the sealing slab will contact the wall shall be cleaned to ensure a tight seal.
- C. The sealing slab shall be designed to resist full hydrostatic pressure at the base of the slab. The design shall not rely on relief wells or seepage ports to reduce hydrostatic pressure at the base of the slab.
- D. The submittal for tremie concrete sealing slabs shall, as a minimum, address the following items: design hydrostatic pressure, sealing slab design, structural connection between sealing slab and support wall, and sequence of installation.

3.5 MONITORING

- A. Monitor and record daily readings on the shoring to detect any vertical or horizontal movement. Measurements shall be referenced from an initial position of the shoring, as jointly established and agreed upon by CONTRACTOR and CONSTRUCTION INSPECTOR.
- B. Should deflections become excessive and jeopardize worker safety or the structural integrity of the system or adjacent systems, CONTRACTOR shall stop the excavation work until corrective measures have been taken and the deflections have been reduced to acceptable limits.
- C. Where surface structures or utilities exist adjacent to the excavation, monitor adjacent ground and structures in accordance with approved geotechnical instrumentation and monitoring plan, including warning and action levels, to verify that no settlement is occurring or has occurred as a result of CONTRACTOR's construction activities.

3.6 BACKFILL

- A. Backfill all open cut excavations in accordance with Section 02200 – Excavation and Backfill and the Contract Drawings.

- B. In general, remove bracing above the top of the pipe and structures as the excavation is re-filled in a manner to avoid the caving in of the bank or disturbance to adjacent areas or structures. Obtain CONSTRUCTION INSPECTOR approval prior to the removal of any bracing. CONTRACTOR shall be responsible for injury to the structures, existing utilities, and to other property or persons from failure to leave such shoring and bracing in place even though permission for removal has been obtained.
- C. All excavation support, including sheet pile or liner plates, intended as temporary support shall be removed.
- D. All excavation support, including sheet pile or liner plates, intended as permanent shall be removed to a depth of 3 feet below the ground surface. Carefully backfill voids left by the withdrawal of the shoring by ramming or other CONSTRUCTION INSPECTOR approved method and compact with appropriate backfill materials.
- E. No separate payment shall be made for the backfilling of voids.

- END OF SECTION 02150 -

SECTION 02200 – EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 SCOPE

- A. Excavation and backfilling for all potable water mains, raw water mains, sanitary and storm sewer lines, force mains, power and instrumentation cables, and other utilities as shown on the Contract Documents and specified herein.
- B. Excavation and backfill for structures, structural backfill, granular bedding, and backfill under concrete slabs.
- C. Locating existing underground utilities and structures within the site limits.
- D. Disposal of excess excavated material.

1.2 CLASSIFICATION

- A. Excavated materials will be unclassified regardless of the nature of the materials encountered.

1.3 QUALITY ASSURANCE

- A. Testing and inspection services as required by this Section shall be provided by OWNER in accordance with Section 01400 – Quality Control.

1.4 REFERENCE STANDARDS AND REGULATIONS

- A. Indiana Department of Transportation (INDOT) Standard Specifications: Edition at time of Bid.
- B. Occupational Safety and Health Administration (OSHA) Standards 29 CFR Part 1926 including Subparts A, B, C, D, and P.
- C. Citizens Energy Group Sanitary Standards Manual.
- D. Indianapolis Storm Water Design and Construction Specification Manual.

1.5 CARE OF EXISTING STRUCTURES AND PROPERTY

- A. All poles, fences, sewer, gas, water, drainage or other pipes, wires, conduits, manholes, buildings, structures, and property in the proximity of any excavation shall be supported and protected from damage by CONTRACTOR during construction.
- B. Wherever poles, sewer, gas, water, drainage or other pipes, or conduits require support, CONTRACTOR shall coordinate with the owner of the utility to support said poles, pipes, and conduits without damage to them and without interrupting their use during the

progress of the Work. The manner of supporting such pipes, etc., shall be subject to review by CONSTRUCTION INSPECTOR.

- C. Any damage to poles, fences, sewer, gas, water, drainage or other pipes, wires, conduits, manholes, buildings, structures, and property resulting from CONTRACTOR's work shall be promptly repaired by CONTRACTOR at no additional cost to OWNER. The quality of all such repair work shall be to the satisfaction of CONSTRUCTION INSPECTOR.

1.6 EXISTING UNDERGROUND STRUCTURES AND UTILITIES

- A. The Contract Documents show the location of utilities based on the best available information; however, neither OWNER nor ENGINEER accepts any responsibility for the accuracy of this information nor do they guarantee that all utilities within the work area are shown.
- B. CONTRACTOR, prior to the start of construction, shall verify the location of any existing underground utilities and structures within the site limits. Such verification shall include, but not be limited to, contacting the Underground Location Service (Holey Moley) at 1-800-382-5544 at least 48 hours prior to the start of any activities involving excavation. It shall be CONTRACTOR's responsibility to make any and all exploratory investigations which may be necessary to verify or locate the utility pipes, wires, structures, and appurtenances of others. CONTRACTOR shall notify CONSTRUCTION INSPECTOR of any conflicts between the location called for in the information furnished and the actual location of any existing underground utilities or structures. Any conflicts found shall be recorded as directed by CONSTRUCTION INSPECTOR.
- C. CONTRACTOR shall comply with all other provisions of the Construction Contract.
- D. CONTRACTOR shall anticipate utility service connections between the utilities in the right of way and individual properties and take appropriate steps to protect existing utility service connections.

PART 2 - PRODUCTS

2.1 PIPELINE AND UTILITY TRENCHING

- A. Backfill Materials:
 - 1. Bedding, haunching, initial backfill, and final backfill requirements are the same for sanitary sewers, laterals, and force mains.
 - 2. The minimum requirements are as follows:
 - a. The minimum requirements are determined by the type and size of pipe being installed and are as follows:
 - (1) Flexible Pipe – including PVC, Centrifugally Cast Fiberglass Reinforced Polymer Mortar, and Closed Profile Large Diameter PVC:

- Bedding, Haunching, and Initial Backfill – No.8 crushed stone or No. 8 fractured-faced aggregate. The minimum depths shall be as follows:

Pipe Size, inches	Depth Below Barrel, inches	Depth Above Top of Pipe, inches
6 or less	4	4
8 to 15	4	12
18 and larger	8	12

3. For all installations, the bedding material shall be placed in the trench bottom and compacted prior to laying the pipe.
4. The bell holes shall be excavated for bell and spigot pipe so the entire pipe barrel rests on the bedding. The bedding shall be such that after the pipe has been placed to line and grade, there remains a 4 inch minimum depth of material below the pipe barrel and a minimum of 3 inches below the bell.
5. For all installations, the haunching material shall be shovel sliced or otherwise carefully placed and “walked” or hand tamped to the springline (1/2 the outside diameter) to ensure compaction of the haunch area and complete filling of all voids. The initial backfill shall be added in 6 inch lifts with each “walked” in for compaction.
6. Final backfill requirements are determined by the location of the excavation, as follows:
 - a. Unless directed by CONSTRUCTION INSPECTOR, all excavations beneath existing (or proposed as a part of this contract) Class I or Class II pavement, paved shoulders, or drive approaches shall be backfilled with controlled low strength material. All cut areas under sidewalks shall be backfilled with sand or No. 53 stone.
 - b. INDOT B-Borrow backfill may be used on trenches greater than 4 feet in width or beneath Class III pavements.
 - c. For all other installations within 5 feet of the edge of existing or proposed pavement, curbs, gutters, or similar structures:
 - (1) Trenches shall be backfilled with structural “B-Borrow” for structural installations per INDOT Standard Specifications – Section 211.
 - (2) Backfill shall be compacted to achieve not less than 95 percent Standard Proctor Dry Density per ASTM D698.
 - d. Outside 5 feet of the edge of pavement, curbs, gutters, or similar structures trench shall be backfilled with clean fill material free of rocks larger than 3 inches in diameter, frozen lumps of soil, wood, or other extraneous material. Backfill shall be compacted to achieve not less than 92 percent Standard Proctor maximum dry density.

e. For definition, Pavement classes are as follows:

- (1) Class I Pavement includes all streets constructed or resurfaced within five years of permit application on asphalt streets and 15 years on concrete streets.
- (2) Class II Roadway Pavement includes all thoroughfares and primary arterials.
- (3) Class III Pavements are all other streets.

7. Backfill shall be added and compacted in 12 inch balanced lifts by means of mechanical tampers.
8. Controlled low strength material (CLSM) may be used as a substitute for B-Borrow, and shall conform to the requirements and as detailed in Section 02210 – Controlled Low Strength Material.
9. Jetting or flooding of the backfill shall not be used to meet the compaction requirements.

2.2 STRUCTURAL BACKFILL

- A. Structural backfill, as indicated on the Contract Documents, shall be No. 8 or No. 9 crushed limestone complying with the INDOT Standard Specifications (Section 904.05).
- B. The particle size shall be less than 2 inches, contain no more than 8 percent by weight passing a #200 sieve and the uniformity coefficient shall be greater than 4.
- C. Structural fill shall be compacted to at least 95 percent of the maximum Standard Proctor dry density, as determined by ASTM D698.

2.3 GRANULAR BACKFILL

- A. Granular backfill shall be natural sand or a mixture of sand with gravel, crushed gravel, or crushed stone complying with the INDOT Standard Specifications (Section 211.02, B Borrow).

2.4 BACKFILL

- A. Backfill may be previously excavated materials free from cinders, construction debris, vegetation, or other extraneous material and suitable for the intended purpose and compaction requirements.

PART 3 - EXECUTION

3.1 TRENCH INSTALLATIONS

- A. The minimum width of the trench at and below the top of the sanitary sewer, lateral, or force main shall be only as wide as necessary for proper installation and backfilling.

- B. The minimum trench width for sanitary sewers, laterals, and force mains shall not be less than the greater of the following:

Minimum Width = Pipe O.D. + 16 inches

or

Minimum Width = (Pipe O.D. x 1.25) + 12 inches

- C. Under no circumstances shall the distance from the trench wall to the outside edge of the pipe be less than 6 inches for pipes 6 inches and less, and 8 inches for pipes 8 inches and larger.
- D. For flexible conduits, the lateral resistance of in-situ soils shall be of sufficient stiffness to provide the required pipe support. Where unstable trench sidewall conditions exist, or where trench depth dictates the use of a moveable trench box, CONSTRUCTION INSPECTOR shall determine the width of compacted bedding and backfill material necessary to provide adequate pipe side support.
- E. The minimum and maximum trench widths above the top of the sanitary sewer, lateral, and force main shall be determined by CONTRACTOR and shall be in conformance with all applicable safety regulations including, but not limited to, those promulgated by OSHA.

3.2 SEPTIC SYSTEM ABANDONMENT

- A. Abandon septic system in accordance with Indiana State Department of Health Rule 410 IAC 6-8.3-90 "Abandonment of an on-site sewage System." Abandon septic system after grinder pump unit is successfully installed and start-up and testing completed.
- B. A licensed septic tank CONTRACTOR shall pump all contents from the septic tank in the on-site sewage system and the septic tank shall either be:
1. Lid removed or crushed into the tank and the hole and tank backfilled with debris-free sand, granular material, or soil material that is compacted to prevent settling. The material must be compacted in lifts not to exceed one foot to reach a final maximum density greater than 90%.
 2. Filled with flowable fill.

3.3 GENERAL TRENCHING REQUIREMENTS

- A. Whenever pipe trenches are inadvertently excavated below the designed bedding bottom, CONTRACTOR shall fill the over-excavated area with compacted No. 8 crushed stone or No. 8 fractured face aggregate and shaped to form a firm, uniform trench base.
- B. In cases where a firm foundation is not encountered at the required grade, CONTRACTOR shall remove the unstable material to a sufficient depth not less than 6 inches and replace such unstable material with either No. 2 crushed stone, No. 8 crushed stone, or No. 8 fractured faced aggregate. When compacted and properly shaped, the fill material shall produce a uniform and stable foundation along the entire length of the pipe. If more than 1 foot of unstable material is encountered, CONTRACTOR shall take

additional measures to ensure that additional stabilization is provided, such as geotextile fabric wrapping of the trench section or as approved by CONSTRUCTION INSPECTOR.

- C. All rocks, boulders, and stones 6 inches in diameter and larger shall be removed. Boulders or rocks are not to be used for any portion of the trench backfill.
- D. The pipe trench shall not be excavated more than 100 feet in advance of pipe laying unless approved by CONSTRUCTION INSPECTOR.
- E. In cases where material is deposited along open trenches, the material shall be placed and protected so that no damage will result to the work or adjacent property as a result of rain or surface wash.

3.4 STRUCTURAL EXCAVATION

- A. Excavate to the depth and dimensions necessary for the construction, maintain excavations in good order, and provide barricades and warning lights as required. If underground utilities and/or structures not shown on the Contract Documents are encountered, notify CONSTRUCTION INSPECTOR and do not proceed until instructions are obtained. Notify CONSTRUCTION INSPECTOR if springs or running water are encountered.
- B. The bottom of all excavations shall be undisturbed earth unless otherwise noted, and shall be approved before subsequent work is started. Subgrade shall be proof-rolled with a loaded tandem axle dump truck or similar rubber tired vehicle, weighing at least 20 tons. Proof-rolling, as indicated, will be required only on roadways. Structure subgrades will be evaluated by CONSTRUCTION INSPECTOR as deemed necessary. Soils which are observed to rut or deflect excessively under the moving load shall either be scarified and recompacted or undercut and replaced with properly compacted fill.
- C. Where excavation and backfill below the Limits of Excavation defined on the Contract Documents is ordered in writing by CONSTRUCTION INSPECTOR, such additional excavation and structural backfill will be paid for as extra Work. Where the Limit of Excavation is not defined, the limit shall be taken as the base of the footing or mud slab where applicable.
- D. Do not excavate for any structure until that structure is scheduled for construction. If the bearing capacity of the foundation soils is reduced because the excavation is allowed to remain open prior to commencing work or dewatering is inadequate, the weathered or unsuitable soil shall be removed and replaced with 2,000 psi concrete or compacted structural backfill at the expense of CONTRACTOR.
- E. Excavations carried below depths indicated on the Contract Documents without the previous written approval of CONSTRUCTION INSPECTOR shall be filled with 2,000 psi concrete or compacted structural backfill to the correct elevation at the expense of CONTRACTOR.

3.5 STRUCTURAL FILLING, BEDDING, AND BACKFILLING

- A. Obtain CONSTRUCTION INSPECTOR's approval of existing conditions before starting filling operations. Remove all vegetation, formwork, rubbish, and other debris. Excavate muddy subgrade. Do not fill on frozen subgrade. The quantity of structural fill or granular fill required beneath concrete slabs and foundations is dependent on the limits of excavation required to install the footings and foundation walls, as well as on the extent of any unstable soil requiring removal. Fill limits shall be from undisturbed soil to the necessary lines and grades under all concrete slabs and foundations of buildings, tanks, and miscellaneous structures.
- B. Lifts shall not exceed 12 inches. Backfill beneath paved areas and structures shall be compacted to 95 percent of Standard Proctor. Backfill in other areas shall be compacted to meet the requirements of the latest edition of the Indianapolis Sanitary District Standards.
- C. Provide structural backfill to achieve necessary lines and grades under all structures.
- D. Provide granular backfill, where indicated on the Contract Documents, to achieve necessary grades under concrete slabs and elsewhere as indicated.
- E. Do not backfill until new concrete has properly cured and wall coatings have been approved. Leakage tests shall be completed before backfilling.
- F. Exercise care during backfilling operations to avoid any puncture, break, or other damage to waterproofing systems. Notify CONSTRUCTION INSPECTOR at least five days in advance, and allow CONSTRUCTION INSPECTOR to observe backfilling operations adjacent to waterproofing.
- G. Where backfilling is required on both sides of structures, backfill and compact simultaneously on opposite sides in even layers. Other backfilling sequences shall be as specifically indicated.
- H. CLSM shall be used for backfill where compaction requirements cannot be met due to restricted areas.

3.6 DISPOSAL OF EXCAVATED MATERIAL

- A. Excavated material not used for backfilling or site grading shall be removed from the site and legally disposed of promptly. No long-term stockpiling of excavated material on site will be allowed.

- END OF SECTION 02200 -

SECTION 02205 – TRIMMING AND FINE GRADING

PART 1 - GENERAL

1.1 SCOPE

- A. This Section provides the requirements and procedures for the trimming and fine grading of all shoulders, ditches, side slopes, sidewalks, and subgrade, whether in excavation or embankment. In the case of the subgrade surface, the Work also includes the compaction of the surface upon which the pavement structure shall be placed.

1.2 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO) T18.
- B. AASHTO T191.
- C. AASHTO T238.
- D. AASHTO T239.
- E. AASHTO T224.

1.3 QUALITY CONTROL

- A. Provide finish grades without low or high spots, with even and smooth gradients, and in conformance with the Contract Drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 - 1. In the event the field conditions are not as shown on the Contract Drawings or as outlined in the Specifications, CONTRACTOR shall notify CONSTRUCTION INSPECTOR in writing.
 - 2. Subgrade:
 - a. Specified elevations shall be verified. Verify that prior earthwork operations have shaped, trimmed, and finished subgrade.

3. Spot/Invert Elevations:

- a. Verify that field elevations of site improvements such as drainage and utility fixtures, pavements, existing plantings, and subsurface piping conform to Contract Drawings.

3.2 SURFACE PREPARATION

- A. The subgrade shall be cleaned of construction debris, waste, harmful chemicals, and stones larger than 3 inches.

3.3 FINISH GRADING

- A. The areas to be graded shall be cleared of unsatisfactory material and shall then be compacted, as directed.
- B. A maximum tolerance of plus or minus 1 inch shall be allowed, provided this deviation from grade shall not continue for more than 100 feet in any direction.
- C. Any depressions that occur during compaction shall be filled with additional granular fill material. The surface shall then be re-graded and compacted true to the lines and grades required.
- D. Subgrade upon which pavement structure and sidewalk are placed shall be graded and compacted to 95 percent of maximum density, in accordance with the following specifications. This operation shall be performed prior to pavement structure construction.
 1. Each layer shall be uniformly compacted to the specified density before the next layer is placed. The specified density shall be obtained by utilizing approved compaction equipment such as: pneumatic tired compaction equipment; three-wheeled power rollers; vibratory, sheepsfoot, or tamping rollers or, another approved type of compaction equipment.
 2. Densities:
 - a. The maximum dry density will be determined by AASHTO T180.
 - b. Field density of soil in place shall be determined by either AASHTO T191 or a nuclear moisture density gauge conforming to AASHTO T238 and T239.
 - c. The method of correcting for oversize particles in soil compaction test results shall conform to AASHTO T224.
 3. Compaction of Earth Embankment:
 - a. The resulting subgrade surface shall be compacted, as required, to not less than 95 percent of Standard Proctor, measured to a depth of 12 inches below the surface.

- b. Earth in embankment sections below a plane of 3 feet below subgrade shall be compacted to not less than 92 percent of Standard Proctor. The remainder of roadway sections up to subgrade shall be compacted to 95 percent of Standard Proctor.
- E. All slopes shall be graded and finished to conform to the lines and grades indicated on the Contract Drawings.
- F. Finish gradients shall provide a free and uninterrupted flow of water without erosion.
- G. Areas to be topsoiled shall be trimmed and graded to the lines and grades as indicated on the Contract Drawings or as directed.

3.4 FIELD QUALITY CONTROL

A. Staking and Layout:

- 1. Provide sufficient grade staking to determine correct lines and levels.

B. Based on CONTRACTOR's survey, CONSTRUCTION INSPECTOR is to approve:

- 1. Subgrades.
- 2. Finish grades prior to planting.
- 3. Finish grades after planting.

3.5 ADJUSTING

A. Any low spots or high spots shall be repaired and remedied subsequent to installation of landscape plantings.

B. Plantings and other site improvements not conforming to finish grades shall be reset.

3.6 CLEAN UP

A. Excess material and debris shall be removed from the site upon completion of finish grading.

3.7 PROTECTION

A. Fine graded area shall be secured from construction work, vehicles, and machinery. Fencing or other temporary means shall be used to control traffic, pedestrians, and material storage.

- END OF SECTION 02205 -

SECTION 02210 – CONTROLLED LOW STRENGTH MATERIAL

PART 1 - GENERAL

1.1 SCOPE

- A. CONTRACTOR shall provide Controlled Low Strength Material (CLSM), complete and in place, in accordance with the Contract Documents.
- B. CLSM shall be placed where indicated and may be used, if CONSTRUCTION INSPECTOR approves, for the following purposes:
 - 1. Normal CLSM with high slump, non-segregating consistency that readily flows and fills voids and difficult to reach places: pipe zone fill, trench zone fill, pipe abandonment, structure backfill, and structure cavity fill.

1.2 SUBMITTALS

- A. Submittals shall be furnished in accordance with Section 01300 – Contractor Submittals 15 days prior to use.
- B. Shop Drawings:
 - 1. CLSM mix designs which show the proportions and gradations of all materials proposed for each type of CLSM indicated. Each mix design shall be accompanied by independent laboratory test results of the indicated properties.
 - 2. If CONTRACTOR proposes to provide lower strength CLSM with aggregates that do not conform to ASTM C33 - Concrete Aggregate, Shop Drawings shall include a testing program that will be used to control the variability of the aggregates. The testing program shall be acceptable to ENGINEER.

1.3 QUALITY ASSURANCE

- A. All testing will be done by a testing laboratory selected by OWNER at OWNER's expense, except as otherwise indicated.
- B. If tests of the CLSM show non-compliance with the specifications, CONTRACTOR shall make changes, as may be required, to achieve compliance. Performing and paying for subsequent testing to show compliance shall be CONTRACTOR's responsibility.
- C. Correlation Tests:
 - 1. CONTRACTOR shall perform a field correlation test for each mix of CLSM used in pipe zone, trench zone, or backfill used in amounts greater than 100 cubic yards or when CLSM is required to support traffic or other live loads on the fill less than seven days after placing CLSM.

2. Field correlation tests shall be performed in a test pit similar in cross section to the Work and at least 10 feet long at a location near the Work. The proposed location shall be acceptable to CONSTRUCTION INSPECTOR.
3. Laboratory and field tests shall be performed on samples taken from the same CLSM batch mix. All tests shall be performed by a laboratory at CONTRACTOR'S expense.
4. Testing shall be performed once each two hours during the first eight hours, once each eight hours during the first week, and once each 24 hours until the CLSM mix reaches the maximum design strength.
 - a. Compression testing shall be in accordance with ASTM D4832 - Preparation and Testing of Soil-Cement Slurry Test Cylinders.
 - b. Setting test shall be in accordance with ASTM C403 - Time of Setting of Concrete Mixtures by Penetration Resistance.
 - c. Density tests shall be in accordance with ASTM C138 - Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.

PART 2 - PRODUCTS

2.1 CONTROLLED LOW STRENGTH MATERIAL

- A. CLSM shall be a mixture of cement, pozzolan, coarse and fine aggregate, admixtures, and water, mixed in accordance with ASTM C94 - Ready Mixed Concrete.
- B. Composition:
 1. The following parameters shall be within the indicated limits and as necessary to produce the indicated compressive strengths:
 - a. Mix proportions as necessary.
 - b. Entrained air content shall be between 20 percent minimum and 30 percent maximum.
 - c. Water reducing agent content as necessary.
- C. Properties:
 1. Density shall be between 120 PCF minimum and 145 PCF maximum.
 2. Slump shall be as required by CONTRACTOR's methods but shall not promote segregation nor shall slump exceed 9 inches.

3. Compressive strength at 28 days:

- a. Between 100 psi minimum and 300 psi maximum. Unless specifically indicated otherwise, all CLSM shall be Normal CLSM.

2.2 CEMENT

- A. Cement shall be Type I in accordance with ASTM C150 - Portland Cement.

2.3 POZZOLAN

- A. Pozzolan shall be Type F or C in accordance with ASTM C618 - Flyash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete. Pozzolan content, by weight, in normal CLSM shall not be greater than cement content.

2.4 AGGREGATE

- A. Aggregate shall consist of a well graded mixture of crushed rock, soil, or sand, with a nominal maximum size of 3/8 inch. One hundred percent shall pass the 3/4 inch sieve; no more than 30 percent shall be retained on the 3/8 inch sieve; and no more than 12 percent shall pass the number 200 sieve. If more than 5 percent of the aggregate passes the number 200 sieve, the material passing the number 200 sieve shall have a plasticity index of less than 0.73 (liquid limit-20), when tested in accordance with ASTM D4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils. All aggregate shall be free from organic matter and shall not contain more alkali, sulfates, or salts than the native materials at the Site.

2.5 ADMIXTURES

- A. Air entraining admixtures shall be in accordance with ASTM C260 - Air-Entraining Admixtures for Concrete.
- B. Water reducing admixtures shall be in accordance with ASTM C494 - Chemical Admixtures for Concrete.

2.6 WATER

- A. Water shall be potable, clean, free from objectionable quantities of silt, organic matter, alkali, salt, and other impurities.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Subgrade and compacted fill to receive CLSM shall be prepared according to Section 02200 – Excavation and Backfill.

3.2 BATCHING, MIXING, AND DELIVERY

- A. Batching, mixing, and delivery of CLSM shall conform to ASTM C94. CLSM shall be mixed at a batch plant acceptable to CONSTRUCTION INSPECTOR and shall be delivered in standard transit mix trucks.

3.3 PLACEMENT

- A. CLSM shall be placed by tailgate discharge, conveyor belts, pumped, or other means acceptable to CONSTRUCTION INSPECTOR. CLSM shall be consolidated in place by vibrator, shovel, or rod to fill all crevices and pockets. Avoid over-consolidation which causes separation of aggregate sizes.
- B. CLSM shall be continuously placed against fresh material unless otherwise approved by CONSTRUCTION INSPECTOR. When new material is placed against existing CLSM, the placement area shall be free from all loose and foreign material. The surface of the existing material shall be soaked with water a minimum of one hour before placement of fresh material, but no standing water shall be allowed when placement begins.
- C. Temperature of the CLSM shall be between 50 and 90°F, when placed. CLSM shall not be placed when the air temperature is below 40°F. No CLSM shall be placed against frozen subgrade or other materials having temperature less than 32°F.

3.4 FINISHING

- A. The finish surface shall be smooth and to the grade indicated or directed by CONSTRUCTION INSPECTOR. Surfaces shall be free from fins, bulges, ridges, offsets, and honeycombing. Finishing by wood float, steel trowel, or similar methods is not required.

3.5 CURING

- A. CLSM shall be kept damp for a minimum of seven days or until final backfill is placed.

3.6 PROTECTION

- A. CLSM shall be protected from freezing for 72 hours after placement.
- B. No fill or loading shall be placed on CLSM until probe penetration resistance, as measured in accordance with ASTM C803 - Standard Test Method for Penetration Resistance of Hardened Concrete, exceeds 650 psi.
- C. CLSM shall be protected from running water, rain, and other damage until the material has been accepted and final fill completed.

- END OF SECTION 02210 -

SECTION 02215 – SEWER VIDEO RECORDING AND INSPECTION

PART 1 - GENERAL

1.1 SCOPE

- A. The Contractor shall provide all labor, materials, and equipment necessary to inspect the sewer in accordance with the plans and as specified within, or as designated by the Engineer. Video recording and inspection shall be performed (1) before and (2) after sewer rehabilitation, as well as (3) one year after project completion. The Contractor shall video record the combined sewer prior to rehabilitation to verify the exact locations and elevations of existing laterals and confirm if they are active or not. Video recording performed prior to sewer rehabilitation shall be reviewed and approved by the Engineer before rehabilitation work begins. Video recording work performed after sewer rehabilitation and manhole rehabilitation must be reviewed and approved by the Engineer prior to acceptance which occurs upon project completion. Video recording work performed one year after project completion must be reviewed and approved. The video recordings shall be performed in the downstream direction (when possible) and in the same direction for pre-lining and post-lining inspections.

1.2 RELATED SECTIONS

- A. Section 02216 Sewer Cleaning
B. Section 02535 Bypass Pumping

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. All work shall meet or exceed the requirements of the National Association of Sewer Service Companies (NASSCO) Recommended Specifications for Sewer Collection System Rehabilitation (latest edition), except as otherwise specified herein. Televising work shall be completed by a Pipeline Assessment Certification Program (PACP) certified operator using PipeTech® software.

1.4 SUBMITTALS

- A. Header Sheet. All header sheets accompanying video recordings shall have proper values entered for the following fields.
1. Surveyor Name – Name of technician holding NASSCO certification
 2. Certificate Number – Technician's NASSCO certification number
 3. System Owner
 4. Survey Customer
 5. Drainage Area

6. P/O Number
7. Pipe Segment Reference – The segment reference shall be a total of 19 characters. The 9 character upstream manhole designation followed by a colon and ended with the 9 character downstream manhole designation.

EXAMPLE: 0369S1234:0369S1235

8. Date – Date of the TV inspection
9. Time – Time of the TV inspection
10. Location – Address of the nearest house to the beginning manhole
11. Locality
12. Further Location Details
13. Upstream Manhole – The naming convention to be used shall be the complete 9 character structure number. This consist of the 4 numeric digits of the sewer district in which the structure resides followed by a capitalized letter to show the sewer type (S=sanitary, T=storm and C=combined). The final 4 characters shall be the 4 numeric digits representing the number of the structure.

EXAMPLE: 0369S1234.

- a. This structure is located in sewer district 369 is a sanitary sewer and is manhole number 1234.
 - b. If an unknown manhole is encountered the Contractor shall notify the Engineer to have a structure number assigned per MSIUS protocol. Until such time that a structure number is issued for a newly discovered manhole, the contractor shall name the new structure with the same 9 character structure number as the upstream manhole followed by an “A”, “B”, “C”, etc. At the conclusion of the project all temporary manhole number references must be corrected within all submitted project files.
14. Rim to Invert (Upstream Manhole) – Depth in feet and tenths of a foot.
 15. Downstream Manhole – Same naming convention as listed under the Upstream Manhole.
 16. Rim to Invert (Downstream Manhole) – Depth in feet and tenths of a foot.
 17. Use of Sewer – “Combined”, “Sanitary”, or “Storm”.
 18. Direction of Survey – Downstream (when possible).
 19. Flow Control – Type utilized during CCTV recording.

20. Height – Diameter of Sewer in inches.
21. Width – Only required for non-circular sewers.
22. Shape
23. Material
24. Pipe Joint Length – Enter length in feet and tenths of a foot.
25. Total Length – Enter the length from the record plan information given on the project plans in feet and tenths of a foot.
26. Length Surveyed – Length in feet and tenths of a foot inspected by CCTV.
27. Year Laid – Enter year from record plans
28. Tape/Media Number
29. Pre-Cleaning – Enter type utilized prior to CCTV recording.

B. Pipetech software normally uses Date, Time, Upstream Manhole Number and Downstream Manhole Number to check for duplicated CCTV inspections. Therefore, valid data within these fields is required or videos with similar information may not be loaded into the project library.

C. Any video/header that is not properly labeled will be rejected.

D. The City will check all “PTL” files for defect coding errors using routines developed by PipeTech. Any reports generated by these reports which indicate errors within the “PTL” files will cause those videos to be rejected.

E. All defect coding corrections shall be completed in the associated “PTD” file and not the “PTL” file.

F. Logs

1. Written logs shall be kept by the Contractor showing the location, in relation to adjacent manholes of: each infiltration point, laterals, services, joints, voids, unusual conditions, roots, deposits, scale, corrosion, changes of pipe (material, size, shape, slope), and other discernible features. All logs shall be put into a final report. Two copies of the final report shall be submitted to the Engineer.

G. Video Recordings

1. The Contractor shall furnish the Owner with two video recordings of all internal inspections. Acceptable media for the video recordings are digital video disc (DVD), or external hard drive. All video submittals shall contain at a minimum 10 separate pipe segments per submittal, unless otherwise approved by the Engineer. The City reserves the right to require resubmittal on a different medium if the video is of poor quality on the originally submitted medium.

2. The initial video recording(s) of the project shall be submitted to the City for review immediately after they have been finished so that the City can ensure that the proper naming conventions and the required information are being utilized.
 3. All discs containing the video recordings shall be accompanied by a cover sheet and shall be labeled with the following information:
 - a. Contractor's Name
 - b. Number
 - c. Project Title
 - d. Date
 - e. Segment References for all segments on the disk
 4. All media shall be premium grade and previously unrecorded. All video recordings shall have a continuous on-screen display indicating sewer section identification and distance from the entering manhole, as well as on screen display identifying laterals and any pipe defects which shall be coordinated with the written logs.
- H. Consolidated Final Video Recording. The Contractor shall consolidate the pre and post video recordings into a continuous downstream sequence. Recordings shall begin and end at manholes if more than one disc or tape is required for the project. The written logs shall also be assembled into pre and post lining documents corresponding to the consolidated video recordings.

1.5 QUALITY ASSURANCE

- A. The sewer inspection Contractor shall be a firm having a minimum of 3 years continuous successful experience in the inspection of sewers similar to that required for this project. The sewer inspection shall be completed by a certified operator of NASSCO's Pipeline Assessment and Certification Program (PACP) using PipeTech® software
- B. The Contractor shall document all internal sewer inspections via video recordings, digital photos and a database utilizing PipeTech® software. Any sewer inspection data or video that is not PipeTech® software is not acceptable. All videos shall be in one of the following formats: Mpeg-1, Mpeg-2 or Mpeg-4.

1.6 SEQUENCING

- A. The Contractor performing video recording and inspection will be required to coordinate his work with other trades.
- B. Video recording shall be performed first before sewer rehabilitation to identify active laterals and condition of pipe, then after sewer rehabilitation, and then again one year after sewer rehabilitation project completion for a total of three times.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. The television camera shall be specifically designed and constructed for sewer inspection with a capacity for radial viewing (360°) and of proper height to allow inspection of the sewer, service lateral connections, and manhole structure; including the cone-section or corbel.
- B. The radial view camera must be solid state color and have remote control of the rotational lens. The camera shall be capable of viewing the complete circumference of the pipe, and manhole structure; including the cone-section or corbel. Cameras incorporating mirrors for viewing sides or using exposed rotating heads are not acceptable. The camera lens shall be an auto-iris type with remote controlled manual override.
- C. The camera light head shall include a high-intensity side viewing lighting system to allow illumination of internal sections of lateral sewer connections. Lighting for the camera shall illuminate the entire periphery of the sewer for a distance of 30 feet ahead of the camera. The camera shall have a minimum resolution of 600 lines and shall be operable in 100 percent humidity conditions. Picture quality and definition shall be to the satisfaction of the Engineer. Communications shall be provided for controlling the winches, pumping unit, and monitor control.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General

- 1. The entire sewer to be cleaned or rehabilitated shall be televised for a visual and audio record of the sewer.
- 2. The length of each sewer segment shall be determined by the use of a kevlar tape.
- 3. For maintenance cleaning the maximum allowable flow that will be permitted is 20% of the original diameter of the pipe. For rehabilitation work the entire sewer perimeter shall be visible during the post cleaning and post rehabilitation sewer video recordings and inspections. If the required flows cannot be maintained the contractor shall consider the use of by-pass pumping or alternate work hours during reduced flow conditions.

B. Television Inspection

- 1. The inspection will be done one sewer section at a time and the section being inspected will be isolated from the remainder of the sewer system.

2. The camera shall be moved through the sewer with the direction of flow at a uniform slow rate and the camera lens shall be located at the spring line of the pipe. In no case will the video camera record while moving at a speed greater than 30 feet per minute. In the event that access to a manhole is restricted or conditions within the sewer will not permit for inspection in the direction of the flow, permission may be granted on a case by case basis to televise against the flow. In all cases the pre and post inspection recordings must be performed in the same direction.
3. The Contractor shall document all visible internal defects within each sewer segment. When the Contractor encounters a defect, they shall stop the camera, pan, tilt and zoom to the defect and code it according to PACP Standards. The continuous defect code shall only be utilized when a defect is truly continuous (repeated beyond the first three feet) and must be coded with a start and finish code at its beginning and end. Submittals with open ended continuous defect coding will be rejected.
4. The articulating-head camera shall also be positioned at each manhole to record the condition of each manhole structure. The CCTV operator shall pan and zoom up from the invert for each manhole and obtain the best possible image of the manhole including the cone and corbel section.
5. The camera shall be positioned so that it is able to pan, tilt and zoom up each lateral connection to a distance of 5 feet so that the lateral condition and status can be determined.
6. Measurement for location of laterals, defects, and other features shall be at the ground level by means of a metering device. The importance of accurate distance measurements is emphasized. Marking on the cable or the like which would require interpolation for depth of manhole, will not be allowed. Accuracy of the distance meter shall be checked by use of a kevlar tape. A measuring target or sealing packer in front of the television camera shall be used as the measurement reference point, and the meter reading shall show the location of the measurement reference point.
7. When sewer conditions prevent forward movement of the camera, the Contractor shall withdraw the camera and televise the line from the opposite direction.
8. When an unknown manhole or structure is encountered, the contractor shall name it per the convention stated in section 1.05.A.13 and stop the recording at this structure. The contractor shall then begin a new video at the unknown manhole and video to the previously planned downstream manhole.

C. Physical Inspection for Man-Entry Size Sewers (48" and Larger)

1. Physical inspections shall be performed if the Contractor is unable to pan, tilt or zoom up any lateral due to its orientation or defects in the pipe and if the initial reconnaissance video reveals the need for point repairs or other serious defects provided the Contractor is satisfied that the sewer is structurally safe for entry. The Contractor shall prepare a written report of his findings which shall include, as a

minimum, footages from entering manhole, clock position, and a description of any conditions listed below using photographs to illustrate as necessary.

3.2 SCHEDULES

- A. The cost of the TV work shall be included in the unit price bid per lineal foot for Rehabilitated Pipe items of the Contract. Lineal foot is listed as three times the total length of the pipe to be inspected.

- END OF SECTION 02215 -

SECTION 02216 – SEWER CLEANING

PART 1 - GENERAL

1.1 SCOPE

- A. The Contractor shall provide all labor, materials, and equipment necessary to clean the sewer and manholes as specified within or as designated by the Engineer. Any sewer waste material disposal costs are to be included in this item as well. The sewer shall be video recorded according to Section 02215 - Sewer Video Recording and Inspection following cleaning and prior to sewer rehabilitation.

1.2 RELATED SECTIONS

- A. Section 02215 Sewer Video Recording and Inspection

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. All work shall meet or exceed the requirements of the National Association of Sewer Service Companies (NASSCO) Recommended Specifications for Sewer Collection System Rehabilitation (latest edition), except as otherwise specified herein.

1.4 QUALITY ASSURANCE

- A. Codes. Perform all work in accordance with the most recent federal, state, and local codes.
- B. Contractor's Qualifications. The sewer cleaning Contractor shall be a firm having a minimum of 3 years continuous successful experience in sewer cleaning similar to that required for this Project.

PART 2 - EXECUTION

2.1 CLEANING

- A. During sewer cleaning operation, precautions shall be taken to protect the sewer from damage that might be inflicted by the improper use of cleaning equipment. Whenever hydraulically propelled cleaning tools or any tools which retard the flow of water in the sewer are used, precautions shall be taken to ensure that the water pressure created does not cause any damage or flooding to any property.
- B. If during the cleaning process the Contractor identifies locations where point repairs will be required, these locations must be brought to the attention of the Engineer for consideration of compensation.
- C. Pre-Rehabilitation Cleaning. All sewers to be rehabilitated shall first be cleaned by the Contractor. All bricks, concrete, sand, dirt, roots, grease, mineral deposits and any other solid or semisolid material shall be removed using hydraulic, high velocity

hydraulic, mechanical sewer cleaning equipment, or physical means without damage to the existing sewer so that the sewer invert is completely clear and free of deposits. Deposits not located in the invert shall be removed to the satisfaction of the Engineer for all sewer diameters. Selection of the equipment used shall be based on the condition of the sewer at the time the work commences.

1. Hydraulic. Hydraulic cleaning equipment shall be of a movable dam type and constructed in such a way that a portion of the dam may be collapsed at any time during the cleaning operation to protect against flooding of the sewer. The movable dam shall be equal in diameter to the sewer being cleaned and shall provide a flexible scraper around the outer periphery to ensure removal of foreign material.
2. High Velocity Hydraulic. High velocity hydraulic sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a minimum of 600 feet of 3/4 inch inside diameter high pressure hose with a selection of two or more high velocity nozzles. The nozzles shall have a minimum capacity of 30 gallons per minute (gpm) at a working pressure of 1,000 to 1,500 pounds per square inch (psi). The nozzles shall be capable of producing a scouring action from 15 degrees to 45 degrees in all size sewers. Equipment shall also include a high velocity gun for washing and scouring manhole walls and floor. The gun capacity shall be capable of producing flows from a fine spray to a long-distance solid stream. The equipment shall carry its own water tank, auxiliary engines, pumps, and hydraulically & driven hose reel. All controls shall be located so that the equipment can be operated above ground. Unless otherwise approved by the CITY, the cleaning process to be employed shall be performed in a "step" process. Successive steps of lengths of a maximum of 50 feet longer than the preceding steps are made until the total length to be cleaned is completed. Each time this process is used to clean a section of pipe is referred to as a "pass." If after three such "passes," the line still requires additional cleaning, the line will then be deemed as heavy cleaning based on evaluation of pre-cleaning videotape and consensus of the City.
3. Mechanical. Power rodding machines shall be either a sectional or continuous type capable of holding a minimum of 1,000 feet of rod. The machine shall have a positive rod drive and produce a minimum 2,000-pound rod pull. To ensure safe operation, the machine shall have a fully enclosed body and an automatic safety throw-out clutch or relief valve. Bucket machines will not be permitted. Engineer's approval must be obtained before beginning any Mechanical cleaning processes.
4. Root Removal. All roots shall be removed from the interior of the sewer by following processes:
 - a. Mechanical. Root removal may include the use of mechanical devices, such as rodding machines, expanding root cutters and porcupines, and hydraulic cleaning equipment.
 - b. Chemical. Chemical treatment to remove roots may be used. The application of an approved-label herbicide to the roots shall be done in accordance with the

manufacturer's recommendations in such a manner to prevent any damage to the sewer and surrounding vegetation. Any damaged sewer or vegetation shall be replaced. Chemical herbicides used shall have no adverse effects on the materials used for sewer rehabilitation, nor shall they interfere with the bonding of rehabilitation materials to the sewer wall. All precautions, as recommended by the manufacturer, shall be adhered to concerning handling and application of the herbicide.

2.2 PROTECTION

- A. Material Removal and Disposal. All material resulting from the cleaning operation shall be removed at the downstream manhole of the sewer section being cleaned. Passing material from sewer section to sewer section will not be permitted. All materials shall become the property of the Contractor and removed from the site at the end of each workday. Contractor is responsible for disposal of materials. The Contractor will not be allowed to accumulate material on the site of work.

2.3 SCHEDULES

- A. Payment. This item shall be paid at the unit price bid per linear foot of sewer cleaning as measured from center of manhole to center of manhole along the centerline of the sewer ready to be lined.

- END OF SECTION 02216 -

SECTION 02245 – GEOTEXTILES

PART 1 - GENERAL

1.1 SCOPE

- A. CONTRACTOR shall provide geotextiles, complete and in place, in accordance with the Contract Documents.
- B. The following definitions apply to the work of this Section:
 - 1. Fabric – Geotextile, a permeable geosynthetic comprised solely of textiles.
 - 2. Minimum Average Roll Value (MinARV) – Minimum of series of average roll values representative of geotextile provided.
 - 3. Maximum Average Roll Value (MaxARV) – Maximum of series of average roll values representative of geotextile provided.
 - 4. Nondestructive Sample – Sample representative of finished geotextile, prepared for testing without destruction of geotextile.
 - 5. Overlap – Distance measured perpendicular from overlapping edge of one sheet to underlying edge of adjacent sheet.
 - 6. Seam Efficiency – Ratio of tensile strength across seam to strength of intact geotextile, when tested according to American Society for Testing and Materials (ASTM) D4884.
 - 7. Woven geotextile – A geotextile fabric composed of polymeric yarn interlaced to form a planar structure with uniform weave pattern.
 - 8. Nonwoven geotextile – A geotextile fabric composed of a pervious sheet of polymeric fibers interlaced to form a planar structure with uniform random fiber pattern.

1.2 REFERENCE STANDARDS

- A. The following standards are referenced in this Section:
 - 1. Federal Standard No. 751a.
 - 2. ASTM D4355 – Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon-Arc Type Apparatus.
 - 3. ASTM D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity.

4. ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
5. ASTM D4595 – Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
6. ASTM D4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile.
7. ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
8. ASTM D4884 – Standard Test Method for Strength of Sewn or Thermally Bonded Seams of Sewn Geotextiles.
9. ASTM D4886 – Standard Test Method for Abrasion Resistance of Geotextiles (Sand Paper/Sliding Block Method).

1.3 SUBMITTALS

- A. Furnish submittals in accordance with Section 01300 – Contractor Submittals 15 days prior to use.
- B. Shop Drawings:
 1. Manufacturer material specifications and product literature.
 2. Installation drawings showing geotextile sheet layout, location of seams, direction of overlap, and sewn seams.
 3. Description of proposed method of geotextile deployment, sewing equipment, sewing methods, and provisions for holding geotextile temporarily in place until permanently secured.
- C. Samples:
 1. Geotextile shall be one-piece, minimum 18 inches long, taken across full width of roll of each type and weight of geotextile. Label each with brand name and furnish documentation of lot and roll number from which each sample was obtained.
 2. Field Sewn Seam shall be 5 feet length of seam, 12 inches wide with seam along center for each type and weight of geotextile.
 3. Securing Pin and Washer: one each.
- D. Certifications:
 1. Certification from geotextile manufacturer that products satisfy the indicated requirements.

2. Field seam efficiency test results.

PART 2 - PRODUCTS

2.1 WOVEN GEOTEXTILE

- A. Woven geotextile shall be composed of polymeric yarn interlaced to form a planar structure with uniform weave pattern. Products shall be calendared or finished so that yarns will retain their relative position with respect to each other.
- B. Polymeric yarn shall be long-chain synthetic polymers (polyester or polypropylene) with stabilizers or inhibitors added to make filaments resistant to deterioration due to heat and ultraviolet light exposure.
- C. Sheet edges shall be selvaged or finished to prevent outer material from separating from sheet.
- D. Unseamed sheet width shall be minimum 6-1/2 feet.
- E. Nominal weight per square yard shall be 6 ounces.
- F. Physical Properties:

PHYSICAL PROPERTY REQUIREMENTS FOR WOVEN GEOTEXTILE		
Property	Requirement	Test Method
Apparent Opening Size (AOS)	No. 10 to No. 100 U.S. Standard Sieve Size	ASTM D4751
Water Permittivity	0.02 to 3.34 sec. ⁻¹ , MinARV	ASTM D4491 (Falling Head)
Vertical Waterflow Rate	10 to 150gpm/sq ft, MinARV	
Wide Width Strip Tensile Strength	60 to 1,500 lb/in.-width, MinARV	ASTM D4595
Wide Width Strip Elongation	14 to 60 percent, MaxARV	
Trapezoidal Tear Strength	30 to 200 lb, MinARV	ASTM D4533
Puncture Strength	50 to 250 lb, MinARV	ASTM D4833
Abrasion Resistance	5 to 25 percent loss, 250 cycles, MaxARV	ASTM D 4886
Ultraviolet Radiation Resistance	70 to 90 percent strength retention, MinARV after 500 hours	ASTM D4355

2.2 NONWOVEN GEOTEXTILE

- A. Nonwoven geotextile shall be composed of a pervious sheet of polymeric fibers interlaced to form a planar structure with uniform random fiber pattern. Products shall be calendared or finished so that yarns will retain their relative position with respect to each other.
- B. Polymeric yarn shall be long-chain synthetic polymers (polyester, polypropylene, or polyethylene) with stabilizers or inhibitors added to make filaments resistant to deterioration due to heat and ultraviolet light exposure.
- C. Geotextile edges shall be selvaged or finished to prevent outer material from separating from sheet.
- D. Unseamed sheet width shall be minimum 6 feet.
- E. Nominal weight per square yard shall be 12 ounces.
- F. Physical Properties:

PHYSICAL PROPERTY REQUIREMENTS FOR NON-WOVEN GEOTEXTILE		
Property	Requirement	Test Method
Apparent Opening Size (AOS)	No.100 to No.140 U.S. Standard Sieve Size	ASTM D4751
Water Permittivity	1.2 sec. ⁻¹ , MinARV	ASTM D4491 (Falling Head)
Vertical Waterflow Rate	90 gpm/sq ft, MinARV	
Wide Width Strip Tensile Strength	300 MinARV	ASTM D4595
Wide Width Strip Elongation	70 percent, MaxARV	
Trapezoidal Tear Strength	120 lb, MinARV	ASTM D4533
Puncture Strength	130 lb, MinARV	ASTM D4833
Ultraviolet Radiation Resistance	90 percent strength retention, MinARV after 500 hours	ASTM D4355

2.3 SEWING THREAD

- A. Sewing thread shall be polypropylene, polyester, or Kevlar thread with durability equal to or greater than durability of geotextile sewn.

2.4 SECURING PINS

- A. Securing pins shall be steel rods or bars conforming to the following:
 - 1. 3/16-inch diameter.
 - 2. Pointed at one end; head on other end, sufficiently large to retain washer.
 - 3. Minimum length of 12 inches.
- B. Steel washers for securing pins shall be:
 - 1. Outside diameter of not less than 1-1/2 inches.
 - 2. Inside diameter of 1/4 inch.
 - 3. Thickness of 1/8 inch.
- C. Steel Wire Staples:
 - 1. U-shaped.
 - 2. 10 gauge.
 - 3. Minimum 6 inches long.

PART 3 - EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver each roll with sufficient information attached to identify manufacturer and product name or number.
- B. Handle products in manner that maintains undamaged condition.
- C. Do not store products directly on ground. Ship and store geotextile with suitable wrapping for protection against moisture and ultraviolet exposure. Store geotextile in a way that protects it from elements. If stored outdoors, elevate and protect geotextile with waterproof cover.

3.2 LAYING GEOTEXTILE

- A. Notify CONSTRUCTION INSPECTOR whenever geotextiles are to be placed. Do not place geotextile prior to obtaining CONSTRUCTION INSPECTOR's approval of underlying materials.
- B. Lay and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.

3.3 ORIENTATION ON SLOPES

- A. Orient geotextile with long dimension of each sheet parallel to direction of slope.
- B. Geotextile may be oriented with long dimension of sheet transverse to direction of slope only if sheet width, without unsewn seams, is sufficient to cover entire slope and anchor trench and extend at least 18 inches beyond toe of slope.

3.4 JOINTS

A. Unseamed Joints:

- 1. Unseamed joints shall be overlapped to the following dimensions unless otherwise indicated:
 - a. For foundation/subgrade stabilization, a minimum of 18 inches.
 - b. For riprap, a minimum of 18 inches.
 - c. For drain trenches, a minimum of 18 inches, except overlap shall equal trench width if trench width is less than 18 inches.
 - d. For other applications, a minimum of 12 inches.

B. Sewn seams shall be used wherever stress transfer from one geotextile sheet to another is necessary. Sewn seams, as approved by CONSTRUCTION INSPECTOR, also may be used instead of overlap at joints for applications that do not require stress transfer.

- 1. Seam efficiency shall be minimum 70 percent, verified by preparing and testing minimum of one set of nondestructive samples per acre of each type and weight of geotextile provided. Test according to ASTM D4884.
- 2. Type "J" type seams are preferred, but flat or butterfly seams are acceptable.
- 3. Stitch count shall be a minimum of 3 to maximum of 7 stitches per inch.
- 4. Stitch type shall be double-thread chainstitch Type 401, Federal Standard No. 751a.
- 5. Stitch location shall be 2 inches from geotextile sheet edges, or more if necessary, to develop required seam strength.
- 6. Sewing machine shall be capable of penetrating four layers of geotextile.

3.5 SECURING GEOTEXTILE

- A. Secure geotextile during installation, as necessary, with sand bags or other means approved by CONSTRUCTION INSPECTOR.

B. Securing Pins:

1. Insert securing pins with washers through geotextile, midway between edges of overlaps and 6 inches from free edges.
2. Spacing:

Slope	Maximum Pin Spacing, feet
Steeper than 3:1	2
3:1 to 4:1	3
Flatter than 4:1	5

3. Install additional pins across each geotextile sheet, as necessary, to prevent slippage of geotextile or to prevent wind from blowing geotextile out of position.
4. Push each securing pin through geotextile until washer bears against geotextile and secures it firmly to subgrade.

3.6 PLACING PRODUCTS OVER GEOTEXTILE

- A. Notify CONSTRUCTION INSPECTOR before placing material over geotextile. Do not cover installed geotextile prior to receiving authorization from CONSTRUCTION INSPECTOR to proceed.
- B. If tears, punctures, or other geotextile damage occurs during placement of overlying products, remove overlying products, as necessary to expose damaged geotextile. Repair damage as indicated below.

3.7 INSTALLING GEOTEXTILE IN TRENCHES

- A. Place geotextile in a way that will completely envelope granular drain material to be placed in trench and with indicated overlap at joints. Overlap geotextile in direction of flow. Place geotextile in a way and with sufficient slack for geotextile to contact trench bottom and sides fully when trench is backfilled.
- B. After granular drain material is placed to grade, fold geotextile over top of granular drain material, unless otherwise indicated. Maintain overlap until overlying fill or backfill is placed.

3.8 RIPRAP APPLICATIONS

- A. Overlap geotextile at each joint with upstream sheet of geotextile overlapping downstream sheet.
- B. Sew joints where wave runup may occur.

3.9 GEOTEXTILE-REINFORCED EARTH WALL APPLICATIONS

- A. Sew exposed joints; extend sewn seams minimum 3 feet behind face of wall.
- B. Protect exposed geotextile from damage and deterioration until permanent facing is applied.

3.10 REPAIRING GEOTEXTILE

- A. Repair or replace torn, punctured, flawed, deteriorated, or otherwise damaged geotextile. Repair damaged geotextile by placing patch of undamaged geotextile over damaged area plus at least 18 inches in all directions beyond damaged area. Remove interfering material, as necessary to, expose damaged geotextile for repair. Sew patches or secure them with pins and washers, as indicated above for securing geotextile, or by other means approved by CONSTRUCTION INSPECTOR.

3.11 REPLACING CONTAMINATED GEOTEXTILE

- A. Protect geotextile from contamination that would interfere, in the opinion of CONSTRUCTION INSPECTOR, with its intended function. Remove and replace contaminated geotextile with clean geotextile.

- END OF SECTION 02245 -

SECTION 02336 – HORIZONTAL DIRECTIONAL DRILLING INSTALLATION

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Work of this Section includes, but is not limited to, installing the low pressure sewer (LPS) by the horizontal directional drilling (HDD) method as indicated on the Contract Drawings and all Work necessary and required for construction of the project as indicated. Codes, specifications and standards referred to by number or title shall form a part of this Section to the extent required by the references thereto. Latest edition shall apply, unless otherwise shown or specified.

1.2 RELATED SECTIONS:

- A. Section 01300 – Contractor Submittals
- B. Section 01526 – Trench Safety System
- C. Section 01560 – Environmental Controls
- D. Section 02125 – Erosion and Sediment Control
- E. Section 02200 – Excavation and Backfill
- F. Section 02560 – Sanitary Sewer Force Main and Low Pressure Sewer (LPS)
- G. Section 02730 – Sanitary Laterals

1.3 SUBMITTALS:

- A. Submittals shall be as specified in Section 01300 – Contractor Submittals.
- B. Submit the following:
 - 1. Manufacturer's Certificate of Compliance certifying compliance with the referenced specifications and standards.
 - 2. Certified copies of reports of factory tests specified in this Section and required by the referenced standards.
 - 3. Before beginning any Work, CONTRACTOR shall submit to CONSTRUCTION INSPECTOR for review by ENGINEER plans and details describing the materials and methods which it proposes to use, including revisions, if any, to the Fraction Mitigation Contingency Plan included in the Contract Drawings. CONTRACTOR shall not proceed with the Work until such drawings and methods have been reviewed by ENGINEER. The review by ENGINEER of any drawings or method shall not relieve CONTRACTOR of its responsibility in any way.

4. Experience requirements per subsection 3.4.

PART 2 - PRODUCTS

2.1 Pipe

- A. Low Pressure Sewer sanitary pipe shall meet the requirements as specified in Section 02560 – Sanitary Sewer Force Main and Low Pressure Sewer (LPS) and Section 02730 – Sanitary Laterals.

2.2 Tracer Wire

- A. Tracer wire shall be Copperhead Direct Burial #12 AWG Solid, steel core hard drawn extra high strength horizontal directional drill tracer wire, 1150# average tensile break load, 45 mil high molecular weight-high density green polyethylene jacket complying with ASTM D-1248, 30 volt rating or approved equal.

2.3 Tracer Wire Connectors

- A. Tracer wire connectors shall be Snake Bite DryConn wire connectors or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. All directional drilling Work performed must be in accordance with laws, permits, requirements and regulations of the authority having jurisdiction of the rights-of- way.
- B. In the event boring appurtenances or equipment are lost, CONTRACTOR shall promptly notify CONSTRUCTION INSPECTOR. CONTRACTOR shall discuss options to retrieve the equipment with CONSTRUCTION INSPECTOR and then retrieval Work will proceed accordingly, at no additional cost to OWNER. CONTRACTOR is also responsible for all necessary costs associated with restoring any surface features disturbed by the retrieval Work, at no additional cost to OWNER.

3.2 SURFACE AND SUBSURFACE CONDITIONS

- A. CONTRACTOR shall verify the location of all known and unknown utilities and structures by test pitting prior to any boring or drilling. These utilities and structures may include, but are not limited to:
 1. Underground utilities such as, but not limited to, storm drains; electric cables; water mains; sewer lines and septic systems; gas, telephone, fiber optic and cable television lines; wells; field drain tiles; all utility laterals.

2. Above-ground utilities and other obstructions such as, but not limited to, electric and telephone poles, buildings, trees, and existing road signs.
- B. CONTRACTOR is responsible for inspecting the site, for conducting investigations, surveys and tests, including subsurface investigations and tests, CONTRACTOR determines are necessary for the complete execution of all the Work under this Contract.

3.3 EQUIPMENT

- A. The directional drilling system to be used shall have the following features:
1. The system shall be remotely steerable and permit electronic monitoring of tunnel depth and location. The system shall be able to control the depth and direction of the pipe and must be accurate to a window of ± 2 inches.
 2. The system shall utilize a fluid-cutting process, using a liquid clay such as bentonite. This clay shall be totally inert and contain no risk to the environment.
 3. The liquid clay shall remain in the tunnel to increase the stability of the tunnel and to provide a lubricant to reduce frictional drag when the pipe is installed.
 4. The spoils shall be recovered by use of a vacuum system mounted on a vehicle for removal of the spoils. Spoils shall not be discharged into sewers or storm drains. CONTRACTOR is responsible for disposal of all spoil material.
 5. Equipment shall be fitted with a permanent alarm system capable of detecting any electrical current. The system will have an audible alarm to warn the operator when the drill head nears electrified cables within a safe operating distance. Refer to subsection 3.5 for additional safety requirements.

3.4 EXPERIENCE

- A. CONTRACTOR shall also provide documentation showing successful completion of at least 50,000 linear feet of directional drilling or shall obtain the services of an experienced directional drilling subcontractor meeting the experience requirements of this Section to supervise the installation prior to commencing any Work. Conventional trenching shall not be considered as applicable experience.
- B. All supervisory personnel shall be adequately trained and shall have at least four (4) years of experience in directional drilling. Prior to commencing any Work, CONTRACTOR shall also submit the names and resumes of all supervisory field personnel for review by ENGINEER.

3.5 SAFETY

- A. Mechanical, pneumatic or water-jetting methods shall not be acceptable due to the risk of surface subsidence and damage.
- B. Upon completion of drilling and pipe installation, CONTRACTOR shall remove all spoils from all starting and termination pits and shall restore pits to their original condition.
- C. Where junctions, manholes or grinder pumps are to be installed, adequate protection in the form of steel plates in traffic areas and timber shutters in other areas shall be used until such times as the manhole or grinder pump is installed, and the pit is backfilled and stabilized. CONTRACTOR shall be responsible for maintaining these areas.
- D. Because directional drilling may be performed while existing buried electrical cables are energized; the following safety requirements shall be met:
 - 1. All drilling equipment must have a permanent, inherent alarm system capable of detecting an electrical current. The ground system shall be equipped with an audible alarm to warn the operator when the drill head nears electrified cable within a safe operating distance.
 - 2. All crews shall be provided with heavy gauge ground cables with connectors, hot boots and gloves.
 - 3. All supervisory personnel shall be adequately trained and have direct supervisory experience in directional drilling.

3.6 DRILLING PROCEDURE

- A. Prior to any alterations to the Work site, CONTRACTOR shall electronically record the entire Work area, including entry and exit points. One copy of the recording shall be given to CONSTRUCTION INSPECTOR and one copy shall remain with CONTRACTOR for a period of one year following the completion of the project.
- B. The Work site as indicated on the Contract Drawings shall be graded or filled to provide a level working area. No alterations beyond what is required for operations shall be made. CONTRACTOR shall confine all activities to the designated Work areas and construction limits.
- C. The entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on the Contract Drawings. If CONTRACTOR is using a magnetic guidance system, the drill path will be surveyed for any surface geo-magnetic variations or anomalies.
- D. Environmental protection necessary to contain any hydraulic or drilling fluid spills shall be put in place as needed, including berms, liners, turbidity curtains and other erosion control measures as specified in Section 02125 and in Section 01560 and the Fraction Mitigation Contingency Plan as shown in the Contract Drawings.

CONTRACTOR shall adhere to all applicable environmental regulations. Fuel and oil must not be stored in bulk containers within 200 feet of any water-body or wetland.

- E. Pipe resting on paved or hardened surfaces (i.e., sidewalks, asphalt, concrete, gravel, etc.) shall be placed on pipe rollers before being pulled into the drill hole with rollers spaced close enough to prevent excessive sagging and dragging of the pipe upon rough surfaces which could scar the pipe.
- F. The directional drilling operator shall have full control of the direction of the drilling tool at all times. Shallow, misdirected, or other unsuccessful drilling shall be abandoned and filled at the direction of CONSTRUCTION INSPECTOR and at no additional cost to OWNER.
- G. The maximum drill angle shall be fifteen degrees measured perpendicular to grade to the design depth elevation.
- H. A pilot hole shall be drilled on the drill path with no deviations greater than 5% of depth over a length of 100 feet. In the event that the pilot hole does deviate from the drill path more than 5% of depth in 100 feet, CONTRACTOR shall notify CONSTRUCTION INSPECTOR and CONSTRUCTION INSPECTOR may require CONTRACTOR to pull back and re-drill from the location along the drill path before the deviation.
- I. In the event of a drilling fluid fracture, inadvertent returns, or returns loss occurs during pilot hole drilling operations, fluids will be contained by use of vacuum truck (per the Fraction Mitigation Contingency Plan).
- J. Upon successful completion of the pilot hole, CONTRACTOR will ream the drill hole to a minimum of 25% greater than the outside diameter of the installed pipe using the appropriate tools. In no case shall the size of the reaming operations result in a hole size greater than 150% of the outside diameter of the installed pipe. CONTRACTOR will not attempt to ream at one time more than the drilling equipment and mud system are designed to safely handle.
- K. After successfully reaming the drill hole to the required diameter, CONTRACTOR shall pull the pipe through the drill hole. In front of the pipe will be a swiveling mandrel. Once pull-back operations have commenced, operations must continue without interruption until the pipe is completely pulled into the drill hole. During pull-back operations CONTRACTOR shall not apply more than the maximum safe pipe pull pressure at any time.
- L. Two strands of tracer wire shall be pulled back with the pipe. The wires shall be installed along the pipe and terminating above ground with the lead taped around each structure. The wire shall be brought up to the ground level every five hundred (500) feet through a vinyl coated aluminum riser pipe with cap and/or at all line valve boxes. The tracer wires shall be connected using Snake Bite DryConn wire connectors or approved equal. The riser pipe and cap shall not be placed in areas subject to vehicular traffic. The tracer wire shall be capable of, and demonstrated to have, continuous transmission of tracing signal along the full length of the installed pipe.

- M. In the event the pipe becomes stuck during pull-back, CONTRACTOR shall cease pulling operations to allow any potential hydro-lock to subside prior to re-commencing pulling operations. If the pipe remains stuck, CONTRACTOR shall notify CONSTRUCTION INSPECTOR. CONTRACTOR shall discuss options with CONSTRUCTION INSPECTOR and ENGINEER and then Work will proceed accordingly.
- N. At all drill pits and directional drilling entrances and exits to the surface, a backhoe or equivalent shall be used to gradually return the bore depth to the prescribed depth.
- O. All drill pits and directional drilling entrances and exits to the surface shall be backfilled and compacted as specified in Section 02200.
- P. Provide completed forms or computer-generated output to CONSTRUCTION INSPECTOR on a daily basis for checking line and grade of the drilling operation.

3.7 ENVIRONMENTAL PROVISIONS

- A. CONTRACTOR shall be responsible for additional environmental provisions associated with the HDD operation beyond those covered by Section 02125 – Erosion and Sediment Control and Section 01560 – Environmental Controls. The HDD operation is to be operated in a manner to prevent the discharge of water, drilling mud, and cutting to adjacent creeks or land areas involved during the construction process. Equipment and procedures to maximize the recirculation or reuse of drilling mud to minimize waste may be provided. All excavated pits used in the drilling operation shall be constructed to completely contain the drill fluid and prevent its escape to waterways and/or groundwater.
- B. CONTRACTOR shall be responsible for submitting to CONSTRUCTION INSPECTOR the proposed plan for erosion control/environmental protection. At a minimum, CONTRACTOR shall have on site sufficient quantity equipment (graders, shovels, etc.) and materials (such as groundsheets, hay bales, booms, and absorbent pads) for cleanup and contingencies for use in the event of inadvertent leaks, seeps, or spills. Waste drilling mud and cuttings shall be disposed by CONTRACTOR to an approved offsite location.

3.8 PIPE RELAXATION

- A. After the pipe has been installed, allow pipe manufacturer's recommended amount of time, but not less than four (4) hours, for cooling and relaxation due to tensile stressing prior to hydrostatic testing.

3.9 TESTING AND INSPECTION

- A. The pipe is required to be hydrostatically tested, after the complete installation and in accordance with specifications for hydrostatic testing in Section 02560 – Low Pressure Sewer (LPS).
- B. A horizontal tolerance of up to three (3) feet left or right of the planned alignment will be permitted at any point on the alignment provided the pipeline is still within the easement or right-of-way where it was planned.
- C. There shall be no allowance for length. The alignment of each pilot bore must be approved by CONSTRUCTION INSPECTOR before pipe can be pulled. If the pilot bore fails to conform to the above tolerances, CONSTRUCTION INSPECTOR may require a new pilot boring to be made.
- D. Sections of pipe that do not meet the aforementioned requirements shall be replaced by CONTRACTOR at no additional cost to OWNER. New pipe installed that does not meet the aforementioned requirements shall be grouted and abandoned in place or removed and all voids filled as directed by the CONSTRUCTION INSPECTOR, at no additional cost to OWNER.

- END OF SECTION 02336 -

SECTION 02343 – TEMPORARY SUPPORT

PART 1 - GENERAL

1.1 SCOPE

- A. This Section specifies design requirements and performance for CONTRACTOR-designed temporary support (support of excavation).
- B. Support refers to all component of the excavation support system, including, but not limited to, bracing, sheeting, struts, walers, or any other support including internal bracing, where applicable. Support shall be designed, provided, installed, maintained, and removed by CONTRACTOR, in accordance with this Section.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Where conflicts between these specifications and the referenced specification, code, or standard occur, the more restrictive specification shall govern. The publications are referenced in the text by basic designation only. Where a date is given for referenced standards, that edition shall be used. Where no date is given for referenced standards, the latest edition available on the date of issue of Contract Documents shall be used.
 - 1. Occupational Safety and Health Administration (OSHA): 29 CFR Part 1926, Subpart P – Excavations, and Subpart S – Underground Construction, Caissons, Cofferdams and Compressed Air.
 - 2. Geotechnical Engineering Investigation.
 - 3. Geotechnical data and reports by others for I-69 Highway Extension Project.

1.3 DESIGN REQUIREMENTS

- A. CONTRACTOR shall design and construct the temporary support system in accordance with all applicable codes and in accordance with the requirements specified.
- B. The design of temporary support shall conform to accepted engineering practice in this field. ENGINEER's approval of CONTRACTOR's plans and methods of construction does not relieve CONTRACTOR of CONTRACTOR's responsibility for the adequacy of this support.
- C. The design shall be consistent with the ground conditions in the Geotechnical Engineering Investigation.

1.4 PERFORMANCE CRITERIA

- A. CONTRACTOR shall be solely responsible for, and bear the sole burden of cost for, any and all damages resulting from improper shoring or failure to shore, or inadequate support of excavation or failure of support of excavation.
- B. The safety of workmen, the protection of adjacent structures, reserved areas, properties, utilities, facilities and the installation of adequate supports for all excavations shall be the sole responsibility of CONTRACTOR.
- C. The design, planning, installation, and removal, as required, of all support of excavation shall be accomplished in such a manner as to maintain stability of the excavation and to prevent movement of soil that may cause damage to adjacent support of excavation, structures, utilities, or facilities, damage or delay the work, or endanger life and health.

1.5 SUBMITTALS

- A. Submit Drawings for temporary support for review at least 15 days prior to commencement of the Work in accordance with Section 01300 – Contractor Submittals. No excavation shall be started until ENGINEER has reviewed and approved CONTRACTOR's support of excavation design.
- B. CONTRACTOR shall submit support of excavation design to ENGINEER for acceptance, which includes, as a minimum, the following:
 - 1. Design assumptions, analyses, detailed calculations, and a complete description of CONTRACTOR's proposed method of installation (and removal, if required) of all support of excavation. Check for any concerns with groundwater and/or basil instability to include infiltration, boiling, heave, and buoyancy. Also provide analysis to indicate the deflected wall parameters including the maximum lateral deformations, shear stresses, and bending stresses for the support of excavation where ground movements are of concern. Provide calculations for each stage of construction.
 - 2. The maximum design load to be carried by the various members of the support system, and the factor of safety (FOS) of each member.
 - 3. Detailed excavation support drawings, showing all pertinent dimensions, spacings, connection details, and relationships among the components of the support of excavation, as well as construction sequence and scheduling.
 - 4. The methods of bracing, post-tensioning, etc.
 - 5. The full excavation depth, and depths below the main excavation to which the support system will be installed.
 - 6. Detailed sequence of construction, bracing removal, and removal of above and below grade obstructions.

7. Instrumentation to monitor support of excavation performance and ground movement resulting from excavation operations.
 8. Pit drainage and control of water plans, after temporary support construction including bottom plug/mud slab installation is complete, including procedures to prevent or remediate adverse water inflows during rainfall events.
 9. Provisions for ground stabilization and ground loss control.
- C. Quality Control Submittals: Submit proof of experience and qualifications required in this section.
- D. Submit details of handling and disposal of excavated soils, including all pertinent permits for such Work.

1.6 QUALITY ASSURANCE

- A. Qualifications of Designer and Installer: Work of this Section shall be performed by an individual or firm of established reputation or, if newly organized, whose personnel have previously established a reputation in the same field for at least 5 years, which is regularly engaged in, and skilled in installation and maintenance of support of excavation.
- B. Welding Requirements: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the type of materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local approved testing agency not more than 6 months prior to commencing work; unless having been continuously employed in similar welding jobs since last certification. Machines and electrodes similar to those used in the work shall be used in qualification tests. CONTRACTOR shall furnish all material and bear the expense of qualifying welders.
- C. The design and calculations shall be performed and stamped by a Professional Engineer licensed in the State of Indiana and experienced in the design of earth retaining structures.

1.7 PROJECT CONDITIONS

- A. Existing Ground and Groundwater Conditions: Refer to Geological Conditions described in the Geotechnical Engineering Investigation.
- B. Existing Utilities: CONTRACTOR shall protect from damage any overhead lines, sewer, water, gas, electric, fiber-optic or other pipelines or conduits uncovered or encountered during excavation whether or not shown on the Drawings.
1. Where utilities are anticipated or encountered, excavate by hand or other excavation methods acceptable to the utility owner.

2. If known existing utilities interfere with CONTRACTOR's proposed method of support, any required modification or relocation shall be performed at no additional cost to OWNER.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Construction materials and equipment to be selected by CONTRACTOR shall be within the guidelines described in this Section and subject to ENGINEER's review and approval.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. CONTRACTOR is responsible for verifying the locations of existing utilities prior to any design or excavation. Existing utilities plans provided for information only and review and approval by ENGINEER of the design, means and method of temporary support submitted by CONTRACTOR does not relieve CONTRACTOR from his responsibility to protect existing or repair damaged utilities due to work specified in this section.
- B. Field Measurements: Verify that field measurements are as indicated on the Drawings.
- C. Layout: Verify layout of work before beginning installation. CONTRACTOR shall verify the adequacy of site plan and space for the required construction equipment. Construction equipment or materials shall not occupy or be stored outside of the designated staging area.
- D. Existing Conditions: Provide support system appropriate for the conditions presented in the Geotechnical Engineering Investigation.
- E. Safety: All CONTRACTOR work areas shall be secured and protected from unauthorized entry to prevent injury. All work areas and storage facilities shall comply with applicable OSHA regulations.

3.2 EXCAVATION AND SUPPORT

- A. Protect or repair utilities damaged by operations of this Section. Monitor and protect adjacent structures and properties from damage and disfiguration.
- B. Provide necessary groundwater control and drainage in accordance with Section 02140 – Control of Groundwater and Surface Water.
- C. The support of excavation installation methods are at the option of CONTRACTOR and subject to review and approval by ENGINEER. Excavations shall be made to the line, grade, and dimensions shown on CONTRACTOR's submittals. If the excavation is found to be deviating from the true lines and grade, CONTRACTOR shall

immediately make the necessary changes to bring the excavation back to the correct position.

- D. For the purpose of backfilling of the jacking and reception pits all materials encountered shall be regarded as unclassified and shall be excavated, regardless of the nature thereof. All excavated material not returned to the excavation as backfill must be removed from the site and disposed of by CONTRACTOR in accordance with local requirements and all associated permits obtained and paid for by CONTRACTOR.
- E. Excavation shall be done in such a manner as to provide adequate support at all times to conduits, structures, or adjacent roads, and so as to offer no hazard to pedestrians or vehicles. Bracing and shoring shall be substantial and safe, and all work shall be done in full conformity and subject to the inspection of all affected parties.
- F. Every precaution shall be taken to prevent the inflow of water, mud and foreign matter into the excavation at all times. CONTRACTOR shall promptly and continuously control water inflow and dispose of all water from any source that may accumulate in the excavation. This shall include all necessary pumping, bailing, draining, and sedimentation prior to discharge. CONTRACTOR shall plan for rainfall events which may affect operations in and from excavations. Any and all excess excavation or over-excavation performed by CONTRACTOR for any purpose or reason, except as may be ordered in writing by ENGINEER, shall be at the expense of CONTRACTOR. Any damage done to the work by CONTRACTOR's operations shall be repaired by and at the expense of CONTRACTOR in a manner approved by ENGINEER.
- G. Excavate only as deep as the ground can safely stand unsupported prior to installing the support system, but in no case shall more than 4 feet be left unsupported at any time, as required by OSHA regulations.
- H. For structural excavations, a bottom plug/mud slab shall be installed in the excavation as soon as final depth has been reached and accepted by ENGINEER.

3.3 REMOVAL

- A. All shoring shall be removed unless specified otherwise by ENGINEER or where the removal may damage installed structures/pipelines. Removal of shoring will be done at no additional cost to OWNER. No additional payment will be made for any support elements left in place in excavations.
- B. During backfilling, temporary support elements shall not be removed until alternative support is available, such as substituted struts, backfill in place, or ability of the support system to act effectively as a cantilever without detrimental deflection.
- C. Backfill shall conform to the requirements in Section 02200 – Excavation and Backfill.
- D. Testing and placement of all backfill is subject to approval by ENGINEER.

- END OF SECTION 02343 -

SECTION 02470 – PRE- AND POST-CONSTRUCTION INSPECTIONS

PART 1 - GENERAL

1.1 SCOPE

- A. The Work in this Section includes requirements for CONTRACTOR to perform pre-construction inspections for structures, houses, buildings, and other facilities as described herein.

1.2 SUBMITTALS

- A. Qualifications and experience of proposed Claims Specialist conforming to the requirements of Paragraph 3.1 of this Section.
- B. Submit qualifications and experience of proposed specialist to perform preconstruction inspections to CONSTRUCTION INSPECTOR for acceptance within 5 days of the issuance of the Notice to Proceed.
- C. Pre-construction inspection reports, as described in Paragraph 3.1 of this Section.
- D. All pre-construction inspection reports shall be submitted to CONSTRUCTION INSPECTOR at least 15 days prior to commencement of excavation.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 INSPECTIONS

- A. Prior to the start of construction, CONTRACTOR shall conduct pre-construction inspections. These inspections should be done initially, and later repeated as follows:
 - 1. Temporary Earth Retention Systems/Shoring:
 - a. Perform pre-construction inspection for all structures, houses, utilities, and other facilities located 75 feet of the structure or open cut excavations.
- B. For Pre-Construction Surveys:
 - 1. Pre-construction inspections shall be undertaken by qualified specialists having at least five years of documented experience. The specialists must also be approved by OWNER and CONTRACTOR'S insurance carrier. The pre-construction inspections shall thoroughly document all existing damage or defects to both the interior and exterior of all structures, houses, buildings, or facilities.

The interior conditions of all portions of all structures, including all walls, partitions, floors, and ceilings shall be thoroughly documented by diagrams, transcribed

notes, digital video, and photographs to show the location and extent of existing damage, deterioration, and cracks, including their dimensions, extent, and other relevant features.

2. A minimum of 10 interior and 30 exterior photographs shall be taken for each structure, house, building, or facility. Close-up, detailed color photographs shall be taken of all cracks, deterioration, and other observable effects in the exterior portions of all buildings and other property improvements including, but not limited to, retaining walls, driveways, and sidewalks. The minimum size of all color photographic prints shall be 4 x 6 inches and printed on Fuji film paper or approved equal in glossy format. If necessary, macro lenses and flash illumination shall be used to ensure cracks and other defects are shown clearly in the photographs. Photos shall contain an accurate date stamp.
 3. In addition to type-written reports with hardcopy photographs, surveys shall also include a walk-through digital video with audio commentary for each surveyed structure or improvement within the specified survey boundaries. Audio comments shall include names of survey staff, property type, name of owner, date and time of survey, and comments about the condition of the observed structure. Video-audio recordings shall be made with digital camcorders and three copies shall be submitted on DVD disks attached to written reports.
 4. CONTRACTOR shall prepare and deliver to CONSTRUCTION INSPECTOR prior to the start of construction at each site, three bound copies of each of the pre-construction inspections containing all field notes taken, sketches and diagrams prepared, color prints of all photographs obtained, DVD disks, descriptions, and reports, all signed and witnessed by those taking part in the inspection. OWNER will, upon request, present one of these copies to the property owner or responsible party for each property or utility affected.
 5. As construction progresses, CONTRACTOR shall re-inspect as often as necessary in the opinion of CONSTRUCTION INSPECTOR to verify the adequacy of his construction methods for prevention of damage and to obtain sufficient evidence for use in defense against possible claims for damage from third parties.
 6. CONTRACTOR shall also re-inspect all structures, houses, building, and facilities where property owners claim that damage is occurring as a result of CONTRACTOR'S construction operations.
 7. Three copies of all data obtained by CONTRACTOR, from each re-inspection shall be delivered to CONSTRUCTION INSPECTOR within three days of the inspection. OWNER will, upon request, present one of the submitted copies to the property owner or responsible party for each property or utility affected.
- C. Nothing contained herein shall relieve CONTRACTOR of responsibility for claims arising from CONTRACTOR's construction operations whether within or outside of the limits of the required inspection. Failure to inspect any structure, whether or not required by these Contract Documents or inadequacy of the inspections, shall not relieve CONTRACTOR of CONTRACTOR's responsibility. CONTRACTOR shall indemnify OWNER and CONSTRUCTION INSPECTOR from such claims.

- D. CONTRACTOR shall engage the services of an independent Claims Specialist, being a licensed engineer in the State of Indiana and having appropriate claims experience, to evaluate any claims that may arise as a result of other construction activities.
- E. The Claims Specialist shall prepare a written response to the claimant within two weeks of the date of the complaint. The response letter or report shall include all supporting data that were used to evaluate the claim. Copies of all correspondence with the claimant shall be submitted to OWNER and CONSTRUCTION INSPECTOR upon responding.
- F. In the event that any property owner denies access for the survey of structures and facilities within the specified limits, CONTRACTOR shall notify such property owner, by certified mail, on the intent of the survey. If after two weeks, access is still denied, CONTRACTOR shall notify the property owner once again by certified mail, stating that this is their final notification. CONTRACTOR shall submit to OWNER copies of all correspondences between CONTRACTOR and the property owner(s). OWNER, upon review of the submitted correspondences, may waive requirements set forth in Paragraph A and B above. However, CONTRACTOR is fully responsible for claims and damage arising from his construction operation regardless of property location and the ability to conduct Pre-Construction Inspections.
- G. CONSTRUCTION INSPECTOR or OWNER may reject the Claims Specialist if there is reason to believe that material ownership interests exist between the Claims Specialist and CONTRACTOR, the vibration specialist, or there exists relationships other than contractor/subcontractor among the aforementioned entities, or for other reasons.

- END OF SECTION 02470 -

SECTION 02510 – ROADWAYS, DRIVEWAYS, WALKS, AND CURBING

PART 1 - GENERAL

1.1 SCOPE

- A. The Work under this Section includes, but is not limited to, the restoration to a condition equal to or better than that at the time of entry and to the satisfaction of CONSTRUCTION INSPECTOR, all roadways, driveways, parking areas, walks, and curbing, inclusive of all cinder, gravel, waterbound macadam, bituminous macadam, asphalt, and brick or concrete types, disturbed during the construction of the drains or sewers and appurtenances included under this Contract.
- B. In general, this Work shall include concrete, steel reinforcement, brick, stone, cinders, gravel, asphalt, and other bituminous materials; curbs, gutters, and vitrified clay pipe road drains; and all labor materials, tools, and appurtenances required for the proper completion of the Contract.
- C. Designations of types of pavement, drives, walks, and curbs given in the specifications or on the Contract Drawings were determined by surface inspection only and may be at variance with the exact type in place as determined when excavated. CONTRACTOR shall be responsible for restoring the pavement of the exact type encountered regardless of type indicated in the specifications or on the Contract Drawings at no additional cost to OWNER. It shall be the sole responsibility of CONTRACTOR to verify the pavement type to CONTRACTOR's satisfaction before entering CONTRACTOR's Proposal.

Indianapolis Department of Public Works (DPW) has indicated that the classes of the streets impacted by the Work are as follows.

<u>Street</u>	<u>Class</u>
Southport Road	Minor Arterial
Wellingshire Boulevard	Local
Concord Street	Local
West Thompson Road	Local
State Road 37	Principal Arterial – Other
South Belmont Avenue	Local
Winslet Boulevard	Local
Bluff Road	Local
Wicker Road	Local

- D. In order to minimize erosion and sediment runoff, roadways, parking areas, and sidewalks shall be paved or otherwise stabilized as soon as possible.
- E. All final paving and final fencing shall be done at the end of construction. Any damaged areas prior to acceptance are to be restored including clean-up, at no additional cost to OWNER.

- F. The Work of this Section also include the construction of new roadways, driveways, and parking areas, as indicated on the Contract Drawings.

1.2 SUBMITTALS

- A. Detailed, dimensioned shop drawings, and data conforming to the requirements of Section 01300 – Contractor Submittals shall be submitted to ENGINEER and accepted 15 days prior to start of Work.
- B. Test Results, as required.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete in pavements shall have a slump of not greater than 3 inches as determined in accordance with the "Standard Test Method for Slump of Portland Cement Concrete", the American Society for Testing and Materials (ASTM) C143.
- B. Concrete shall be air-entrained and shall conform to the requirements of Section 03300 – Cast-in-Place Concrete, except as modified herein.
- C. Hot pour material for joints shall meet AASHTO M-173.
- D. Pre-molded material for expansion joints shall meet the American Association of State Highway and Transportation Officials (AASHTO) M-153 and M-213.
- E. Elastic joint sealer shall meet the Indiana Department of Transportation (INDOT) Standard Specifications Section 503.

PART 3 - EXECUTION

3.1 CONSTRUCTION

- A. The Work to be performed under this Section shall be done in strict accordance with the pavement restoration details shown on the Contract Drawings.
- B. All pavements and walks disturbed by CONTRACTOR's operations shall be relaid to the thickness of the adjoining pavement, but in no case less than the minimum indicated on the Contract Drawings. In all cases, the restoring of pavements shall apply both to foundation courses and to the wearing surface.
- C. Rigid pavements (concrete, asphalt on concrete, or asphalt and brick on concrete) and flexible pavements (asphalt, bituminous macadam, or waterbound macadam) shall be saw cut and removed to the extent necessary to secure 18 inches of firm bearing on undisturbed original subgrade.

- D. Loose pavements (cinder or gravel) shall be replaced where removed or damaged as indicated by cracks and settlements in adjoining pavement, with a minimum of 12 inches of firm bearing.
- E. Curbing shall be replaced in kind where removed or damaged.
- F. No additional payment will be made for pavements removed or replaced outside the limits specified herein, or as indicated on the Contract Drawings.
- G. Any damage or failure of restored roadways or driveways, during the 12-month guarantee period, due to settlement or improper workmanship or materials, must be satisfactorily replaced or repaired at CONTRACTOR's expense.
- H. The following INDOT Standard Specifications Construction and Material Items are to be used for constructing and restoring roadways, driveways, walks, and curbing:

<u>INDOT Item</u>	<u>Section No.</u>
Portland Cement Pavement or Base	500
Stabilized Crushed Aggregate Surface	300
Aggregate Base	300
Tack Coat	406
Prime Coat	405
Curbing	605
Underdrains	715
Sidewalks	604
Joint Sealer	503

- I. The demolition, excavation, and removal of existing pavements, bases, and curbs is to be done as described under Section 02050 – Demolition and as herein specified.
- J. All pavements, bases, and surfaces are to be finished to same elevation as the existing adjacent surface. The transverse and all other slopes of pavements shall be restored.
- K. All existing joints for concrete pavements and bases are to be restored in the same location and manner as existing joints, where possible. Joints for concrete pavements and bases shall be constructed and placed, as per plan details.
- L. CONTRACTOR shall remove the minimum amount of existing pavement, curbing, driveway, and other roadway and paved area appurtenances necessary to construct the new sewers and repave over the sewer or conduit trench, as per details on the Contract Drawings.
- M. All rigid and flexible pavements and pavement bases shall be cut for the sewer trench prior to excavation by sawing, and extreme care must be exercised so that no damage is done to the undisturbed adjoining pavement or to the edges of the sewer trench. The sawed or cut edge shall be smooth and straight. The existing pavement and appurtenances shall be cut and removed as per the repaving details.

- N. Backfill for pipeline and other excavations below aggregate or paved roadway surfaces shall be in accordance with Sections 02200 – Excavation and Backfill and 02550 – Gravity Sanitary Sewer Pipe.
- O. Should cracks or settlements appear in adjoining pavements, the paving shall be removed to the extent necessary to secure firm and undisturbed bearing and shall be replaced to the satisfaction of CONSTRUCTION INSPECTOR and at no additional cost to OWNER.
- P. Temporary restoration of street and paved surfaces shall be made promptly on completion of the sewer or structure with special backfill or as directed. Settlements occurring in or adjacent to the sewer trench shall be immediately refilled to proper grade.
- Q. On unpaved streets or driveways which were constructed of aggregate, CONTRACTOR will be required to remove all surplus excavation, open all side ditches and existing drains, and restore the street or driveway and adjacent areas to the same condition as found prior to the time it was disturbed or destroyed by the construction work.
- R. On unimproved or graded streets, all surplus excavation shall be removed, all side ditches and existing drains opened up, and the roadway and adjacent street areas shall be shaped, bladed, and surfaced as required as per the repaving details and in a manner satisfactory to CONSTRUCTION INSPECTOR.
- S. Where the pavement cracks and settles outside the limits shown or specified after CONTRACTOR has opened up the sewer trench, such cracks and settlements will be attributed to CONTRACTOR's work, and the additional area shall be taken care of in the same manner as repaving over the sewer trench.
- T. Where pavement is to be replaced beyond the trench limits, the existing subgrade shall be shaped, compacted, and excavated to the required elevation to receive the pavement restoration, as per plan detail.

3.2 ROADWAYS ON FLEXIBLE BASE, DRIVEWAYS, AND PARKING AREAS

- A. Driveways and driveway approaches of aprons and parking areas shall be restored to the same width, dimensions, size, shape, location, and grade as the existing pavement or surface in accordance with the details on the Contract Drawings.
- B. Existing ash, cinder, crushed stone, aggregate, and earth driveways or parking areas shall be restored, as per plan detail.
- C. Existing bituminous driveways or parking areas on an aggregate base shall be restored, as per plan detail.
- D. Existing bituminous driveways or parking areas on rigid bases shall be restored, as per plan detail.
- E. Existing Portland cement concrete or brick driveways or parking areas shall be replaced, as per plan detail.

- F. For driveways and driveway approaches abutting street curbing, if the existing curb or curb and gutter is concrete it shall be removed to the first joint each side of the driveway. The underdrain shall be examined to see if it is in good condition.

If not, it shall be relaid with the necessary new pipe and to the proper grade, backfilled, and properly compacted. A new curb or curb and gutter of the same design and size of that removed shall be constructed with 1/4-inch premolded expansion joints at each end and at 10-foot intervals in between. The radius on the upper front face of the curb shall match the existing curb as near as possible. That part of the new curb across the driveway shall be dropped to a point 2 inches above the gutter with the front of the dropped portion being rounded with a radius tool similar to the one used on the top of curb. The face curb forms shall be removed as soon as the curb has set enough to prevent it from slumping and the curb hand finished.

- G. Portland cement concrete driveways and approaches shall be cut longitudinally down the center with a contraction joint, as per plan detail. The remainder of the drive shall be cut with transverse contraction joints so that blocks of about 36 square feet are made or as directed. Concrete driveways shall have a 1/2 inch preformed joint filler and 1/2-inch sealer placed between the driveway and sidewalk. Concrete driveway approaches and aprons shall have a 1/2-inch preformed expansion joint filler with sealer between the approach and the walk and also between the approach and the curb.
- H. Restoration of driveways and parking areas shall be done in full rectangular blocks or as directed. Patching or piecing will not be permitted. Any existing parking lot or driveway lane markings shall be restored.

3.3 REINFORCED CONCRETE ROADWAYS AND PARKING AREAS

- A. CONTRACTOR shall construct reinforced concrete pavement consisting of a 4-inch aggregate base course and a 9-inch reinforced concrete wearing course.
- B. Subgrade:
 - 1. The entire area to be occupied by the roadway shall be cleared, and the excavation or compacted fill made, as required, and brought to the proper cross-sections, as shown on the Contract Drawings. Pipe trenches and other excavations shall be backfilled to the top of the subgrade, as required, with special backfill material, and thoroughly compacted within the limits of the roadways and parking areas. After the surface of the subgrade has been properly shaped, and before any stone is placed, the entire subgrade shall be thoroughly rolled and compacted. Rolling shall be done with an approved type of self-propelled roller, weighing not less than 10 tons. All hollows and depressions which develop during the rolling shall be filled with acceptable material, and the subgrade rerolled. The process of filling and rolling shall be repeated until no depressions develop, and the entire subgrade has been brought to a uniform condition of stability. All places which, in the opinion of CONSTRUCTION INSPECTOR, cannot be properly rolled, shall be tamped with hand tampers weighing not less than 80 pounds per square foot of tamping surface. Subgrade shall be compacted as indicated on details on the Contract Drawings.

2. In making the compacted fill and in doing the final subgrade rolling, CONTRACTOR shall ensure that the material to be compacted and/or rolled has the proper moisture content to secure maximum compaction.
3. During the process of construction, the road bed shall be maintained in such condition that it will be well-drained at all times.

C. Base Course:

1. The base course shall consist of one course of aggregate foundation having a depth of not less than 4 inches, as indicated on the Contract Drawings.
2. The finished surface of the base course shall be uniformly 9 inches below the finished grade of the pavement.

D. Concrete Pavement:

1. The pavement for the concrete roadways shall consist of Portland cement concrete having a finished thickness of not less than 9 inches and as detailed on the Contract Drawings.

E. Joints in Concrete Pavement:

1. In general, contraction joints shall be placed transversely at 20-foot intervals.
2. Longitudinal joints shall be placed at the centerline of the pavements, where parking areas are adjacent to the roadways and, in general, shall be placed longitudinally at approximately 12-foot intervals.
3. All joints shall be sealed with hot poured material.
4. Continuous joints shall be formed around manhole, inlet, and catch basin castings.

F. Reinforcing Steel:

1. All concrete pavement in roadways and parking areas shall be reinforced with 6 x 12 - W8.6/W4 steel mesh furnished and installed under this Section in conformance with the requirements of Section 03200 – Steel Reinforcement. Care shall be exercised to lift and support mesh during placing of concrete to ensure proper positioning of steel in the finished slab.

3.4 CURBING

- A. Curbing includes the relaying of existing stone curbing salvaged from the site, the furnishing and constructing of new stone curbs, and the furnishing and constructing of new cast-in-place or precast concrete curbing in reasonably close conformity with the existing curbing prior to its removal in accordance with details on the Contract Drawings.
- B. Existing stone curbing disturbed or destroyed during construction shall be replaced with stone curbing unless otherwise permitted by CONSTRUCTION INSPECTOR.

C. The interspersing of stone and concrete curb will not be permitted.

3.5 SIDEWALKS AND CURB RAMPS

- A. In general, existing cinder, crushed stone, or slag sidewalks shall be replaced to a 6-inch compacted depth, of equal width, location, and grade as the old walk with crushed aggregate screenings. All sidewalk ramps to a public street or alley shall conform to the latest Americans with Disabilities Act (ADA) regulations.
- B. In general, existing concrete, flagstone, asphalt, or brick sidewalks and curb ramps shall be replaced with new concrete sidewalks. All existing walks shall be cut by sawing when required for excavation. Concrete sidewalks shall be replaced for their full width regardless of the extent of damage. The sidewalks shall be restored in full rectangular blocks longitudinally either for the full width of the existing walk or to the nearest longitudinal joint for unusually wide walks. No patching or piecing of blocks will be permitted.
- C. New concrete sidewalks at driveways shall be not less than 6 inches in thickness laid upon a 4-inch cushion blanket course. All other new concrete sidewalk shall be not less than 4 inches in thickness laid upon a 6-inch cushion blanket course.
- D. The new concrete sidewalk shall be the same width and grade and be built at the same location as the existing walks.

3.6 CASTING ADJUSTMENT

- A. Manhole, inlet basin, catch basin, and other castings that are located in existing or proposed roadways shall be adjusted to new roadway pavement grades, as required. The Work shall consist of carefully removing and cleaning the existing casting frame, adjusting the height of supporting walls with brick masonry as shown for new manholes, and resetting the existing frame in a bed of mortar or concrete. No measurement will be made for adjustment of castings, and the cost shall be included in the various items included in the Proposal.

3.7 RESTORATION

- A. CONTRACTOR shall restore any disturbed surfaces or structures in accordance with these Specifications and as shown on the Contract Drawings. CONTRACTOR shall take particular care to ensure that all sidewalks, steps, curbs, driveways, streets, roadways, fences, mailboxes, drainage ditches, culvert pipes, and other property or structures that may be disturbed or damaged during construction of the Work, either directly or indirectly, are restored to a condition equal to or better than the original condition encountered.

- END OF SECTION 02510 -

SECTION 02535 - BYPASS PUMPING

PART 1 – GENERAL

1.1 SCOPE

- A. The CONTRACTOR shall provide all labor, materials, and equipment necessary to reduce/control or eliminate flows via bypass pumping, chases, fluming or other appropriate methods through a segment or segments of pipe, or structure designated for inspection and/or rehabilitation. The CONTRACTOR shall be solely responsible for controlling and maintaining all sewage flow within the system while conducting work. Plugging of any sewer line shall not be permitted without bypass pumping.

1.2 RELATED SECTIONS

- A. Section 02550 – Gravity Sanitary Sewer
- B. Section 02560 – Sanitary Sewer Force Main and LPS
- C. Section 02702 – Sewer Pipe Installation and Testing

1.3 SUBMITTALS

- A. The CONTRACTOR shall provide, for the ENGINEER's Record, a method of reducing/controlling the sewage flow that will include but is not limited to:
 - 1. A recommended sequence of operations.
 - 2. Sketches or drawings showing locations of the bypass sewer and construction procedures for crossing streets, excavations for benching along with support methods, all required permit information, applications, fees, etc., to obtain access to the streets when required by the bypass method selected by the CONTRACTOR.
 - 3. Key operational factors (i.e. maximum flow elevations upstream of dams, pump sizes and flow rates.)
 - 4. Locations of manholes from which sewage is to be pumped, locations of receiving manholes, and new manholes.
 - 5. A contingency plan to prevent damage during high flows.
 - 6. Method of handling traffic where streets are to be excavated.
- B. The CONTRACTOR shall submit a copy of all property owner/resident notifications to the ENGINEER prior to notification distribution per Section 2.01B.

PART 2 - EXECUTION

2.1 PREPARATION

- A. Right of Entry. When private property must be crossed for bypass pumping the CONTRACTOR shall obtain written Right of Entry (ROE) signed by the property owner. The ROE shall describe the extent of work, items to be restored, warranty and schedule. A signed copy of the ROE shall be provided to the ENGINEER prior to commencing work. The cost for obtaining the Right of Entry and associated restoration work shall be included in the unit bid prices for bypass pumping.
- B. The CONTRACTOR shall provide 48-hour prior written notification to all property owners and or residents whose sewer lateral will be affected by the diversion of flow in the sewer. The notice shall clearly state the approximate time when sewage cannot be received as well as when the sewer will be available again for receiving sewage, and the purpose of the work. It shall also advise all affected customers against water usage until the sewer line is placed back in service, and shall clearly state the potential consequences of the use of residential wastewater generating facilities during the time when the building sewer service will be out of service (i.e. sewer back-up).
- C. A door hanger reminder shall be placed 24 hours (excluding weekends and holidays) prior to reducing the sanitary service. Both property owners (i.e. landlords) and residents must understand the requirements prior to reducing the sanitary service.

2.2 INSTALLATION

- A. Bypass pumping shall be established prior to sewer videotaping and inspection and modifications. Base dry weather flow, peak 3-month flow, and peak 10-year flow in the sewer are summarized in the table below. The CONTRACTOR shall install flow monitoring equipment to confirm bypass pumping capacity required.

Conflict #	Pipe Size, Type, and Location	Base Dry Weather Flow (GPM)	3-Month Peak Flow (GPM)	10-Year Peak Flow (GPM)
Conflict #2	21" PVC Gravity, S.R. 37 near S. Belmont Avenue (MH#410646 to MH#410642)	370	1,770	2,380
Conflict #3	8" PVC Force Main, Southport Road near Winslet Boulevard (LS223 to MH#410648)	Pump rated at 450 gpm	N/A	
Conflict #5	12" PVC Gravity, S. Belmont Avenue between MH#760398 and MH#760397	Not Modeled	Theoretical capacity at 500 gpm	
Conflict #6	12" VCP Gravity, S.R. 37 near Edgewood Avenue (MH#760092 to MH#760087)	200	250	285
Conflict #15	12" VCP Gravity, I-465 and Mann Road Exit Ramp (MH#710084 to MH#710176)	175	535	765
Conflict #16	18" RCP CSO, I-465 at White River (MH#711112 to Outfall #275)	N/A	Overflows during larger rain events (>3 inches)	

1. If high flows are possible in this sewer, the CONTRACTOR shall have a contingency plan to prevent damage during high flows. The City will not be responsible for any damages due to high flows.
 2. CONTRACTOR shall provide one standby pump equal in capacity to the largest pump installed. Primary and backup power shall also be provided; one source, primary or backup, shall be a diesel engine-generator.
 3. CONTRACTOR shall be responsible for monitoring the bypass pumping operation at all times until work is complete. An operator shall be on site 24 hours a day while bypass pumping system is in operation. An alarm for high level shall be installed in the bypass suction manhole and shall alert the operator on site. The water level of the sewer in the bypass suction manhole shall not exceed 2 ft. above the invert of the upstream pipe.
 4. The CONTRACTOR should also be aware that adjacent sewers may not be available for bypass discharge due to surcharged conditions in those sewers during heavy rains.
- B. The bypass shall be made by plugging an existing upstream manhole, if necessary, and pumping the sewage into a downstream manhole or adjacent system approved by the Engineer. When required, the CONTRACTOR shall also bypass laterals by pumping from a cleanout. If a new cleanout is required it shall be installed per Drawings. All pumps and temporary bypass sewer piping shall be of adequate capacity and size to handle the peak flow and any necessary dewatering. Note to Engineer: Insert type of pipe to be used for the bypass, if required. The bypass pumping shall not prohibit access when crossing private access drives or public streets and shall either have temporary pavement or be securely plated. The bypass sewer may be laid over ground in all other instances. The bypass shall be a header for all bypass and dewatering pumping. Check valves shall be placed ahead of all pumping connections.
- C. The CONTRACTOR may suggest alternate routing or methods of controlling the sewage, but shall submit their recommendations to the Engineer in writing complete with sketches or drawings showing locations of the bypass sewer and construction procedures for crossing streets, excavations for benching along with support methods, all required permit information, applications, fees, etc. CONTRACTOR. The Engineer will review the proposed alterations to ensure that the receiving sewers can accept the flow and that no access or street interference is created. Neither the City nor the Engineer will be responsible for damages due to high flows.
- D. All commercial establishments shall be provided with temporary sewer service. The means and methods shall be coordinated with the managers and the affected residents.
- E. Under no circumstances will the dumping of raw sewage on private property, streets and roads be allowed nor will surcharging of the sewers be allowed due to insufficient pumping.
- F. CONTRACTOR shall provide sound attenuation for bypass pumping to limit noise level to no more than 70 dB at a distance of 30 feet from the noise source.

2.3 REPAIR/RESTORATION

A. Site Restoration.

1. The CONTRACTOR shall be aware of the conditions at each site. This shall include but not be limited to trees, shrubbery, landscaping, structures, fences, mailboxes, driveways, curbs, sidewalks, pavements, etc. The CONTRACTOR shall videotape all ROE areas prior to use. All pre-construction conditions shall be fully restored as close to the original conditions as practicable.
2. When working on private property, the CONTRACTOR shall obtain Acknowledgement-of-Completion (AOC) from the property OWNER that work was completed in accordance with the Right of Entry (ROE) agreement. No payment for this work will be made until the copy of AOC is submitted to the Engineer.

2.4 FIELD QUALITY CONTROL

- ### A. Record Only Permits.
- When a new cleanout or other additions to a private lateral are required for bypass pumping, the Inspector shall complete a record only permit for that lateral which shall document all changes or additions.

2.5 CLEANING

- ### A. Purging.
- After all construction operations have been completed the CONTRACTOR shall purge the bypass sewer system of all sewage before disconnecting the pumps and piping with water. All water used for purging the bypass system shall either be collected and disposed of offsite or routed in to the sanitary sewer. Under no circumstances will the dumping of raw sewage on private property, streets and roads be allowed due to purging the system.

2.6 PROTECTION

- ### A. Precautions shall be taken to ensure that bypass pumping and flow control operations shall not cause flooding or damage to public or private properties. In the event flooding or damage occurs, the CONTRACTOR shall make provisions to correct such damage at no additional cost to the City. The CONTRACTOR shall be responsible for any damages to public or private property, overflows from the sewer system and violations resulting in fines as a result of the dewatering/bypass operation.

2.7 SCHEDULES

- ### A. Payment.
- This item shall be paid at the unit price bid per lump sum for the bypass necessary to meet all project requirements.

- END OF SECTION 02535 -

SECTION 02550 – GRAVITY SANITARY SEWER PIPE

PART 1 - GENERAL

1.1 SCOPE

- A. Work under this Section includes, but is not limited to, the installation and testing of gravity sanitary sewer pipe, fittings, and connections. Acceptable diameters and depths for any given pipe material and application shall be in accordance with the latest edition of the Citizens Sanitary Standards Manual, unless otherwise specified.
- B. Material Markings:
1. Each length of pipe and each manhole or other structure shall be marked in accordance with the requirements of each respective American Society for Testing and Materials (ASTM), American Water Works Associations (AWWA), and/or American National Standards Institute (ANSI) Standard referenced within this Section.
- C. Certification of Materials:
1. OWNER reserves the right to require material certification from the manufacturer prior to construction to ensure the material supplied conforms to the prescribed requirements.
 2. Upon request, CONTRACTOR shall furnish a certificate of conformance to the required ASTM, AWWA, or ANSI Standards, this Section, and other conformance certifications in the form of affidavits of conformance, test results, and/or copies of test reports.
 3. Provisions for obtaining this certification shall be the responsibility of CONTRACTOR. OWNER does not assume the responsibility for the expense of obtaining material certification.
- D. Handling, Storage, and Color:
1. The manufacturer shall package the pipe in a manner designed to deliver the pipe to the Project site neatly, intact, and without physical damage. The transportation carrier shall use an appropriate method to ensure the pipe is properly supported, stacked, and restrained during transport. On-site, the pipe shall be stored on clean, level ground to prevent scratching or gouging.
 2. The interior of the pipe shall be light colored to facilitate closed-circuit television (CCTV) inspection. The pipe exterior may be colored per the manufacturer's standard color scheme with the exception of blue. Blue pipe shall not be used to avoid confusion with water pipes.

1.2 QUALITY ASSURANCE

- A. All similar components shall be manufactured and furnished by one manufacturer unless specifically approved by ENGINEER in writing.
- B. Maximum allowed infiltration in new gravity sanitary sewers shall be 100 gallons per 24-hour period per inch-diameter-mile.

1.3 SUBMITTALS

- A. CONTRACTOR shall submit Shop Drawings in accordance with Section 01300 – Contractor Submittals for the pipe and pipe fittings furnished herein. Shop Drawing submittals shall include descriptive literature, pressure ratings, certification of all applicable ASTM standards, design calculations, and manufacturer's installation instructions. No field work shall begin prior to Shop Drawing approval.

PART 2 - PRODUCTS

2.1 REINFORCED CONCRETE PIPE

- A. Reinforced concrete pipe (RCP) shall be in accordance with ASTM C76. Pipe wall thickness shall be not less than Wall B. All pipe installed using open-cut installation shall be Class III up to 15 feet of cover and Class IV for covers from over 15 feet up to 24 feet. All pipe laid at depths greater than 25 feet shall utilize an improved joint to resist higher head conditions, with joint sections manufactured in accordance with ASTM C361 with a joint rating of at least 50 feet. When special conditions exist and as authorized by OWNER, RCP manufactured in accordance with ASTM C655 may be used. The minimum D-load design for ASTM C655 pipe shall be 1,000 and the minimum increment of D-load shall be at least 200, if multiple pipe designs are proposed on a single project. For pipe designed in accordance with ASTM C76 or C655, factors of safety shall be 1.5 for D-loads of 2,000 and less, 1.25 for D-loads of 3,000 and higher, and uniformly decreasing between 1.5 and 1.25 for D-loads between 2,000 and 3,000. The wall thickness shall not be less than the wall thickness used to verify the D-load strength.
- B. Steel reinforcement shall be in accordance with and placed to the requirements of the applicable tables in ASTM C76, ASTM C361, or per the approved D-load design. Longitudinal reinforcement shall be continuous, and all reinforcement shall have a minimum concrete cover of 1-inch. Minimum cover requirements do not apply to the mating surfaces of the joint, gasket seat, or end of longitudinals. Elliptical reinforcement shall not be permitted.
- C. Lift holes are not allowed.
- D. RCP shall be manufactured to provide additional protection against hydrogen sulfide-based internal corrosion. Aggregate used in the concrete mix for RCP manufacture shall be calcium carbonate. Alkalinity of the hardened RCP shall be at least 0.7 calcium carbonate equivalent based on alkalinity testing in accordance with ASTM C497. The manufacturer shall verify that the alkalinity requirement is achieved by

testing at least one section of RCP for every 500 consecutive feet of RCP produced, in accordance with ASTM C497. Additionally, the RCP shall be manufactured to provide a sacrificial depth of concrete cover over the reinforcing steel of not less than ½-inch in addition to the 1-inch cover requirements within ASTM C76.

- E. All joints for pipes in accordance with ASTM C76 and ASTM C655 shall comply with the requirements of ASTM C443. All joints and gaskets shall be designed in accordance with ASTM C361 for high head conditions. Only one style of joint system or configuration shall be permitted between adjacent manholes. Joints shall be tested immediately after installation of each RCP section according to ASTM C1103.
- F. Pipe possessing the following defects may be rejected for installation: variation from straight centerline; elliptical shape; illegible markings; fractures in excess of 0.01 inch or cracks passing through the pipe wall; damaged ends where such damage would prevent making a satisfactory joint, voids and/or honeycombing in the pipe walls; delamination of pipe liner; cracking and crazing of liner; or, other noticeable defects in pipe or liner manufacture.
- G. All markings required by the appropriate ASTM specification shall be legibly marked on each section of pipe.
- H. Manufacture and test pipe sections in accordance with ASTM C76, C361, or C655 as appropriate for the strength, class, size, and joint design utilized.
- I. Special shaped pipe shall conform to the specifications for straight pipe insofar as applicable.

2.2 POLYVINYL CHLORIDE (PVC) PIPE

- A. For pipe installations up to 25 feet deep, PVC sanitary sewer pipe and fittings 8 inches through 15 inches in diameter shall be the integral wall bell and spigot-type with elastomeric seal joints and smooth walls conforming to ASTM D 3034 and a minimum of SDR 35.

For pipe installation within 1.5 vertical feet or 10 horizontal feet of a water main, sanitary sewer pipe will conform to ASTM D2241, SDR 21 pressure PVC pipe.

PVC sanitary sewer pipe and fittings 18 inches in diameter and larger shall be smooth wall conforming to ASTM F 679. All fittings shall be heavy walled fittings.

Pipe shall have a minimum pipe stiffness of 46 psi when measured at 5% vertical ring deflection and tested in accordance with ASTM D 2412 and a minimum tensile strength of 34.50 MPa.

- B. For pipe installations over 25 feet deep, PVC sanitary sewer pipe materials shall be ASTM D 2241 (SDR 26 minimum) with minimum cell classification of 12454, AWWA C900 (DR 25 min), or AWWA C905 (DR 25 min). When pipe conforming to AWWA Standards is used, all fittings shall also be made of PVC.

C. Joints and Gaskets:

1. Flexible gasketed joints shall be compression type so that when assembled, the gasket inside the bell will be compressed radially on the pipe spigot to form a watertight seal.
2. For pipe conforming to ASTM D 3034 and F 679, the joint shall meet the requirements of ASTM D 3212.
3. For pipe conforming to ASTM D 2241, AWWA C900, and AWWA C905, the joint shall meet the requirements of ASTM D 3139.
4. The assembly of joints shall be in accordance with the pipe manufacturer's recommendations.
5. All gaskets shall meet the requirements of ASTM F 477.
6. Solvent welded joints and coupling joints are not acceptable.

D. Field Cutting of Pipe:

1. All field-cutting of pipe shall be done in a neat, trim manner using a hand or power saw, and the cut end shall be beveled using a file or wheel to produce a smooth bevel of approximately 15° and be a minimum depth of 1/3 the pipe wall thickness or beveled as specifically recommended by the pipe manufacturer. Field cut pipe will only be allowed to be installed at manholes, at prefabricated tees and wyes, and at the connection of new sanitary sewer to existing sanitary sewer.

E. Rejection of Damaged Pipe:

1. PVC pipe possessing the following defects may be rejected for installation: variation from straight centerline; elliptical shape; illegible markings, as required; deep or excessive gouges or scratches of the pipe wall; fractures, punctures, or cracks passing through the pipe wall; and, damaged ends where such damage would prevent making a satisfactory joint.

F. Pipe Markings:

1. For PVC pipe, each length of pipe must be marked per ASTM and AWWA requirements and at a minimum with the following: name of manufacturer; tradename or trademark; nominal pipe size; production/extrusion code; material and cell class designation; ASTM designation; and, SDR number.
2. In addition, the plain end of each pipe length shall have rings painted around the pipe at the proper location to allow field checking of the correct setting depth of the pipe in the bell.

G. Manufacture and Construction:

1. Pipes shall be manufactured and tested in accordance with appropriate ASTM and

AWWA standards to result in a solid wall pipe.

2. Tees, wyes, and other fittings shall be heavy-walled and capable of withstanding the same stresses as the pipe to which they are connected. All fittings shall be fabricated from pipe meeting the requirements of these standards.

PART 3 - EXECUTION

3.1 GENERAL

- A. CONTRACTOR shall furnish and set all line and grade stakes (HUB). A Professional Engineer or Land Surveyor registered in the State of Indiana will be required to set, or oversee the setting of, all bench mark stakes necessary for the installation of any sanitary sewer being constructed. Bench marks shall be set in strategic locations within the Project to facilitate the installation of grade stakes. The method of establishing and following line and grade in conformance with the approved Contract Documents shall be determined by CONTRACTOR.
- B. Suitable tools and equipment shall be used for the safe and convenient handling of all materials and for the installation of all sanitary sewers. All material shall be unloaded with care. Care shall be taken to prevent pipe coatings, encasements, or wrappings from being damaged. Each section of pipe shall be carefully examined for cracks and other defects prior to installation. Pipe or fittings found to be cracked, broken, or otherwise defective either before, during, or after installation, shall be removed and replaced with material free from defects. All pipes, gaskets, and other fittings shall be thoroughly cleaned prior to installation and shall be kept clean during construction.
- C. The point of commencement for laying pipe should be the lowest point in the proposed line. Provisions for beginning construction at other than the lowest point in the proposed line shall be approved by CONSTRUCTION INSPECTOR. All bell and spigot pipe shall be laid with the bell end or with the receiving groove end of tongue and groove pipe pointing upgrade or toward the lift station end of force mains. Each pipe shall be laid on an even firm bed throughout its length so that no uneven strain will come to any single portion of the pipe. Particular care shall be taken to prevent the total load from bearing on the pipe sockets. All bells of bell and spigot pipes shall be carefully placed into a receiving hole excavated into the pipe bedding material. All pipes shall be properly joined utilizing the manufacturer's assembly marks. Adequate pressure shall be applied to the center of each tongue and groove pipe to ensure the proper joint seal is achieved.
- D. Before extending a sanitary sewer, CONTRACTOR shall provide a watertight bulkhead or seal in the existing sewer immediately downstream of the point of connection or the most practical location, as determined by CONSTRUCTION INSPECTOR. This bulkhead shall be left in place until the new sanitary sewer has been cleaned of all accumulated water and debris and accepted by OWNER. During all work stoppages in construction of the sanitary sewer, the open face of the last pipe laid shall be plugged with a watertight seal to prevent sand, water, earth, or other materials from entering the pipe. Whenever pipe and special castings are required to be cut, the cutting shall be done by skilled workers in such manner as to leave a smooth end at

right angles to the axis of the pipe without damage to the pipe casting or lining. Cutting torches shall not be used.

- E. Until such time as a minimum of 6 feet of compacted fill material has been placed over the installed sanitary sewer or lateral, CONTRACTOR shall not use heavy equipment in such a way as to cause damage to these pipelines or structures.
- F. OWNER reserves the right to order pipe installation discontinued whenever, in OWNER's opinion, there is danger of the quality of work being impaired because of cold weather. CONTRACTOR shall be responsible for heating the pipe and jointing material so as to prevent freezing of joints. No flexible or semi-rigid pipe shall be laid when the air temperature is less than 32°F unless proper precautions, per the manufacturer's recommendations, are taken by CONTRACTOR and the method is approved by CONSTRUCTION INSPECTOR and OWNER. When pipes with rubber gaskets or resilient-type joints are to be laid in cold weather, sufficiently warm the gasket or joint material to facilitate making a proper joint. No portion of a sanitary sewer facility shall be installed directly onto frozen ground or backfilled with frozen material.
- G. All construction activities within the public right-of-way, including but not limited to surface removal, backfilling, and restoration, shall be in accordance with the latest version of the City of Indianapolis Department of Code Enforcement's "Regulations for Cuts within the Public Right-of-Way."

3.2 JOINT TEST

- A. All sewers greater than 24 inches shall be joint tested using air or water under low pressure. All joints shall be tested. Testing procedures shall be per ASTM C1103 and as follows:
 - 1. Waiting Period:
 - a. The joint test may be done immediately after the installation of each RCP section and placement of final backfill.
 - 2. Equipment:
 - a. Equipment used shall be made specifically for joint testing of pipelines. CONTRACTOR shall modify equipment, as needed, to insure compatibility between the test apparatus and air equipment, including valve stem threading and size.
 - 3. Testing Procedures:
 - a. Joint Test Apparatus Installation:
 - (1) Clean the joint and interior joint surfaces.
 - (2) Move the joint test apparatus into the sewer line to the joint to be tested and position it over the joint. Make sure the end element sealing tubes

straddle both sides of the joint and the hoses are attached. For the water test, the bleed-off petcock must be located at top dead center.

- (3) Inflate end element sealing tubes with air in accordance with equipment and manufacturer's instructions.

b. Joint Air Test:

- (1) Pressurize the void volume with air to 3.5 psi plus the necessary adjustment for groundwater above the top of pipe (maximum 2.0 psi adjustment for a 5.5 psi maximum total). Allow the air pressure and temperature to stabilize before shutting off the air supply. Start the timing of the test. The air pressure adjustment shall be per these specifications.
- (2) Measure the pressure drop for 5 seconds.
- (3) After the joint test is completed, exhaust void volume, then exhaust end element tubes prior to removal of the testing apparatus.

c. Joint Water Test:

- (1) Introduce water into the void volume until water flows evenly from open petcock. Close the petcock and pressurize with water to 3.5 psi plus the necessary adjustment for groundwater above the top of pipe (maximum 2.0 psi adjustment for a 5.5 psi maximum total). Shut off the water supply and start test timing.
- (2) Measure the pressure drop for 5 seconds.
- (3) After the joint test is completed, exhaust end element tubes, which will automatically release the water from the void volume, prior to removal of the testing apparatus.

d. Determination of Line Acceptance:

- (1) If the pressure holds or drops less than 1 psi for the 5-second test time, the joint shall have passed the test.

e. Determination of Line Failure:

- (1) If the pressure drops 1 psi or more during the 5-second test time, the joint shall have failed the test. If the joint fails, CONTRACTOR shall repair and retest, as necessary. The method of repair shall be per approval of OWNER. Grouting is not an acceptable method of repair.

3.3 WATER INFILTRATION TEST

- A. All gravity sanitary sewers shall be watertight and free from leakage. The rate of infiltration into the sanitary sewer system between any two adjacent manholes or the entire system shall not be in excess of 100 gallons per inch of pipe diameter per mile

per day (gpd/in-dia/mi). CONTRACTOR may be required to conduct a weir test to determine if the 100 gal/in/mi/day maximum allowable infiltration rate is being exceeded. The weir test will be required if water is observed in the sewer at any time during the acceptance process. The weir test will be at the sole discretion of CONSTRUCTION INSPECTOR and OWNER. CONTRACTOR shall be required to repair all visible leaks, even if the allowable infiltration requirements are met. The method of repair shall meet the approval of OWNER. Grouting of the joint or crack to repair the leakage shall not be permitted. If the defective portion of the sanitary sewer cannot be located, CONTRACTOR shall remove and reconstruct as much of the Work as necessary to obtain a system that passes infiltration requirements.

3.4 MANDREL DEFLECTION TEST FOR FLEXIBLE PIPE

- A. All sanitary sewers using flexible pipe shall be tested for deflection by means of a go/no-go mandrel gage or other methods as approved by OWNER.
- B. The mandrel deflection test shall be done no sooner than 30 days after final backfill has been placed.
- C. Mandrels shall be constructed with nine or ten arms. Mandrels with fewer than nine arms are not allowed. The Length (L) shall be measured between points of contact on the mandrel arm. The Diameter (D) mandrel dimension shall carry a tolerance of ± 0.01 inch.
- D. The allowable deflection shall be based on the pipe type as follows:

1. PVC Pipe

The allowable deflection for PVC pipe shall be 5% of the base inside diameter as determined by ASTM D3034 and F679. The dimensions are as follows:

DIMENSIONS FOR MANDREL			
Nominal Pipe Diameter, inches	Length (L) of Mandrel, inches	Base ID of Pipe, inches	Diameter (D) ⁽¹⁾ for Deflection of 5%, inches
8	8.0	7.665	7.28
10	10.0	9.563	9.08
12	10.0	11.361	10.79
15	12.0	13.898	13.20

⁽¹⁾ The diameter is based on SDR 35 pipe thickness, if thicker pipe is used, the diameter may be adjusted accordingly.

- 2. The allowable deflection for Closed Profile PVC shall be 5% based on the inside diameter as determined on a case-by-case evaluation of the pipe design.

E. Testing Procedure:

1. The mandrel shall be hand pulled through all sections of the sewer lines. If the mandrel can be hand pulled through the entire length of the section tested, the section shall have passed the test.
2. If the mandrel cannot be hand pulled through the entire length of the section tested, the section shall have failed the test. The CONTRACTOR shall be required to uncover, replace, or repair any section of sewer not passing the mandrel test.

F. Alternate deflection testing of flexible sewers may be completed at CONTRACTOR's option utilizing laser profiling. Testing shall be done no sooner than 30 days after final backfill has been placed.

3.5 AIR TEST OR MANDREL TEST FAILURES

A. To determine the location of any air or mandrel test failure, a visual inspection by means of CCTV is required on lines where manned entry is not possible. The pipe shall be thoroughly cleaned before televising. CONTRACTOR personnel performing the pipe inspection shall have NASSCO Pipeline Assessment & Certification Program (PACP) certification for video inspection. A digital copy of the inspection shall be submitted to OWNER for review.

- END OF SECTION 02550 -

SECTION 02560 - SANITARY SEWER FORCE MAINS & LOW PRESSURE SEWER (LPS)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work of this Section involves all labor, materials, and equipment necessary for the complete installation of the sanitary sewer force mains and low pressure sewer (LPS), as shown on the Contract Drawings and specified herein. Pipe materials shall be of the size and type shown on the Drawings and as allowed by these specifications.

1.2 RELATED SECTIONS:

- A. Section 02200 – Excavation and Backfill
- B. Section 02702 – Sewer Pipe Installation and Testing

1.3 SUBMITTALS:

- A. Shop drawings shall be submitted in accordance with Section 01300 – Contractor Submittals and shall include manufacturers catalog cuts, material information, and certifications of proof of compliance with all applicable standards.
- B. Three (3) copies of all required testing reports shall be provided to CONSTRUCTION INSPECTOR upon completion of the work and before final payment.

PART 2 - PRODUCTS

2.1 PIPE MATERIAL

- A. Pipe material specified in the Contract Documents shall be per the latest version of the Citizens Energy Group Sanitary Standards Manual.

2.2 TRACER WIRE

- A. Tracer wire installation shall be per the latest version of the Citizens Energy Group Sanitary Standards Manual.

PART 3 – EXECUTION

3.1 GENERAL

- A. CONTRACTOR shall install force main pipe in accordance with the latest version of the Citizens Energy Group Sanitary Standards Manual.

3.3 LOCATING (TRACER) WIRE

- A. For open-cut installation of force main, mainline or lateral pipe tracer wire shall be installed in one continuous length between access points. Wire ends shall be accessible inside the structures and manholes or via riser pipes. The wires shall be gathered and secured to prevent access or maintenance problems. The ends shall be fastened to the structure or manhole wall or riser pipe within one foot of the casting in a visible location that is accessible for connection without entering the structure.
- B. The wires shall be installed along the pipe, fastened securely to the pipe at five (5) foot intervals, and terminating above ground with the lead taped around each structure. The wire shall be brought up to the ground level every four hundred (400) feet through a vinyl coated aluminum riser pipe with cap and/or at all line valve boxes. The wires shall be connected using DBR Direct Burial Splice Kit manufactured by 3M Electrical Products Division, Austin, TX or approved equal. The riser pipe and cap shall not be placed in areas subject to vehicular traffic. The tracer wire shall be capable of, and demonstrated to have, continuous transmission of tracing signal along the full length of the installed pipe.
- C. If any appurtenant structure, such as an air release valve, is required as part of the force main installation, the wire shall be cut with each end entering the structure under the casting frame.

3.4 AIR TEST

- A. Air leak testing shall be performed on the new section of force main, prior to connection with the existing force main, in accordance with the latest version of the Citizens Energy Group Sanitary Standards Manual prior to final connection.

- END OF SECTION 02560 -

SECTION 02702 - SEWER PIPE INSTALLATION AND TESTING

PART 1 - GENERAL

1.1 SCOPE

- A. This section covers the installation and testing of all Reinforced Concrete Pipe (RCP) sewer pipe, Polyvinyl Chloride (PVC) sewer pipe, and High-Density Polyethylene (HDPE) low pressure sewer pipe. Pipe trenching, embedment, and backfill are covered in Section 02200 – Excavation and Backfill.

1.2 DELIVERY, STORAGE, AND HANDLING

- A. Handling and storage shall be in accordance with Section 01620 - Product Delivery, Storage, and Protection .
- B. Pipe, fittings, and appurtenances shall be transported, stored, and handled in a manner which prevents damage. Hooks shall not be permitted to come in contact with joint surfaces. Plastic pipe shall be shaded if necessary to prevent curvature due to thermal expansion. Damaged pipe and fittings shall be removed from the site.

1.3 LAYING SCHEDULE

- A. The CONTRACTOR shall submit a laying schedule to the ENGINEER. The schedule shall be updated as needed to provide at least one week notice on all pipeline installation.

PART 2- PRODUCTS

2.1 MATERIALS

- A. Sewer pipe materials are specified in Section 02550 – Gravity Sanitary Sewer Pipe and Section 02560 – Sanitary Sewer Force Mains & Low Pressure Sewer.

PART 3- EXECUTION

3.1 ALIGNMENT

- A. Piping shall be laid to the lines and grades indicated on the Drawings. Laser beam equipment or surveying instruments shall be used to maintain alignment and grade. At least one elevation measurement shall be made on each length of pipe.
- B. If laser beam equipment is used, periodic elevation measurements shall be made with surveying instruments to verify accuracy of grades. If such measurements indicate thermal deflection of the laser beam due to differences between the ground temperature and the air temperature within the pipe, precautions shall be taken to prevent or minimize further thermal deflections.

3.2 LAYING PIPE

- A. Pipe shall be protected from lateral displacement by embedment material installed as specified in the Trenching and Backfilling section. Pipe shall not be laid in water or under unsuitable weather or trench conditions.
- B. Pipe laying shall begin at the lowest elevation with bell ends facing the direction of laying, except when reverse laying is permitted by ENGINEER.
- C. Foreign material shall be kept out of the pipe during installation. No debris, tools, clothing, or other foreign objects shall be placed in the pipe.
- D. Whenever pipe laying is stopped, the open end of the pipe shall be closed with a tight-fitting end board to keep out soil. The end board shall have perforations to admit water and prevent flotation of the pipe in the event the trench becomes flooded.
- E. Core holes and handling holes in concrete pipe shall be repaired by cementing a properly shaped concrete plug in place with epoxy cement or by other methods acceptable to ENGINEER. Plugs shall be provided by the pipe manufacturer and shall be sized and designed to match the pipe supplied.

3.3 JOINTING

- A. All joint preparation and jointing procedures shall comply with the instructions and recommendations of the manufacturer.
- B. Rubber Gasketed Joints.
 - 1. Rubber gaskets shall be positioned on the joint in accordance with the manufacturer's recommendations. Immediately before joints are pushed together, all joint surfaces shall be thoroughly cleaned and coated with the lubricant furnished with the pipe. The gasket shall be lubricated and positioned in the spigot groove so that the gasket is distributed uniformly around the pipe circumference. The position of the rubber gasket shall be checked with a feeler gauge after each joint is completed. If the gasket is not in the proper position, the joint shall be pulled apart, the gasket removed and discarded, and the joint re-assembled using a new, properly lubricated gasket.
 - 2. Joint lubricant shall be stored in closed containers and shall be kept clean. When installing pipe in cold weather, the joint surfaces and gaskets shall be kept warm and the joint lubricant shall be protected from freezing.
 - 3. For rubber and steel joints, each exterior joint recess shall be filled with joint grout. A diaper shall be used to prevent foreign material from entering the joint recess before grouting and to serve as a form for the grout. Each diaper shall be of sufficient length to encircle the pipe, leaving enough space between the ends to allow the grout to be poured. Joint grout shall be poured between the diaper and the pipe and shall be allowed to run down to the bottom of the pipe. The grout shall be rodded while being poured, using a stiff wire curved to the approximate shape of the pipe. Each joint recess shall be completely filled with grout for the full circumference of the pipe.

4. Not less than two lengths of pipe shall be in final position in advance of exterior joint grouting. If placing of pipe embedment is resumed before the grout has attained initial set, care shall be taken to prevent damage to the grout while placing and compacting embedment material.
5. After trench backfilling has been completed, the interior joint recess of pipe with rubber and steel joints shall be filled with mortar following the recommendations of the pipe manufacturer. Joint surfaces shall be damp, but free from standing water, when the mortar is placed. Mortar shall be thoroughly compacted to completely fill the recess and shall be finished smooth. All excess mortar shall be removed from the pipe.

C. Flexible Sealant Joints.

1. Joints made with flexible joint sealant shall be coated with adhesive as directed by the sealant manufacturer, and the joint sealant shall be positioned in accordance with the manufacturer's installation instructions. The pipe sections forming the joint shall be pulled together with sufficient force to uniformly fill and seal the annular space in the joint. Joints shall not be made when adverse weather conditions may prevent proper sealing, nor when the temperature of the pipe and sealing materials is too low to achieve proper sealing.

D. Mastic Joints.

1. Surfaces of pipe to be joined with mastic joints shall be primed, if recommended by the mastic manufacturer. Immediately before joining the pipes, a uniform layer of mastic shall be applied to the joint surfaces. After the pipes are in final position, the mastic shall completely fill and seal the annular space in the joint. Joints shall not be made when weather conditions may interfere with obtaining a satisfactory seal.

E. Field Cut Joints or Connections Between Dissimilar Pipe Materials.

1. Where indicated on the Drawings or required to facilitate installation of field cut joints in PVC or composite sewer pipe, or connections between PVC or composite sewer pipe and pipe of other materials, couplings may be used in accordance with the instructions of the coupling manufacturer and pipe manufacturer.

3.4 TEE BRANCHES

- A. Tee branches shall be installed at locations indicated on the Drawings. Tee branch locations shall be marked in advance of the construction of sewers to any property to which sewer service will be extended and, if the locations have not been designated, sewer construction shall be stopped until the necessary tee branch locations have been established. Tee branches shall be installed with the lower lip not more than 2 inches below the outside top of the pipe and shall remain uncovered until their locations have been recorded.

- B. Each tee branch shall be closed with a suitable plug and shall be marked with a wooden strip extending vertically from the tee to 12 inches above the ground surface. Markers shall be securely anchored and maintained upright until backfilling has been completed.

3.5 SERVICE CONNECTIONS

- A. Service connections shall not be installed as vertical risers but shall be laid on a slope not to exceed 2 vertical to 1 horizontal. Each service connection pipe shall have a solid bearing on undisturbed earth.

3.6 CONCRETE ENCASUREMENT

- A. Concrete encasement shall be installed where indicated on the Drawings. A pipe joint shall be provided within 12 inches of each end of the concrete encasement. Concrete and reinforcing steel shall be as specified in Section 03300 - Cast-in-Place Concrete. All pipe which is to be encased shall be suitably supported and blocked in proper position and shall be anchored against flotation.

3.7 ACCEPTANCE TESTS

- A. Each reach of sewer shall meet the requirements of the following acceptance tests. All defects shall be repaired to the satisfaction of ENGINEER.

- B. Lamping

- 1. Unless otherwise indicated on the Drawings, each section of sewer line between manholes shall be straight and uniformly graded. Each section will be lamped by ENGINEER. CONTRACTOR shall furnish suitable assistants to assist ENGINEER.

- C. Exfiltration

- 1. An exfiltration test shall be conducted, in accordance with the requirements of ASTM C969, on each reach of sewer between manholes. The first line between manholes shall be tested before backfilling and before any additional sewer pipe is installed. Thereafter, exfiltration testing shall be done after backfilling, and individual or multiple reaches may be tested at the option of CONTRACTOR.
 - 2. Exfiltration tests shall be conducted by blocking off all manhole openings except those connecting with the reach being tested, filling the line, and measuring the water required to maintain a constant level in the manholes. Each manhole shall be subjected to at least one exfiltration test.
 - 3. During the exfiltration test, the water depth above the pipe invert at the lower end shall be at least to the elevation of the ground surface, unless otherwise specified. The maximum depth of the water at the lower end shall not exceed 25 feet, and the minimum depth of the water at the upper end shall be at least 5 feet above the crown of the pipe or 5 feet above groundwater elevation, whichever is higher.

4. The total exfiltration shall not exceed 100 gallons per inch of nominal diameter per mile of pipe per day for each reach tested. For purposes of determining maximum allowable leakage, nominal diameter and depth of manholes shall be included. The exfiltration tests shall be maintained on each reach for at least 2 hours and shall be longer if necessary, in the opinion of ENGINEER, to locate all leaks.
5. CONTRACTOR shall provide, at his own expense, all necessary piping between the reach to be tested and the source of water supply, and all labor, equipment, and materials required for the tests. The methods used and the time of conducting exfiltration tests shall be acceptable to ENGINEER.

D. Low Pressure Air Testing

1. With prior approval by ENGINEER, low pressure air testing may be used in lieu of exfiltration testing for 24-inch diameter and smaller pipe. Air testing shall not be used for manholes, or for pipe larger than 24 inches in diameter.
2. Low pressure air testing shall comply with ASTM C828 for PVC, and composite pipe, and shall comply with ASTM C924 for concrete pipe. The schedule of testing shall be submitted to ENGINEER prior to starting the tests. The time of conducting the tests shall be acceptable to ENGINEER.
3. The time elapsed for a 1 psi drop in air pressure shall be not less than, nor shall the air loss exceed, the limits set forth in the governing standard.
4. If the length of sewer to be tested is fully or partially submerged in groundwater, the test pressure shall be increased if necessary to overcome the actual static pressure exerted by the groundwater. If a test pressure greater than 8 psi results, air testing shall not be used, and exfiltration testing will be required.
5. Leaks shall be located by testing short sections of pipe. Leaks shall be repaired and the reach of sewer retested.

E. Infiltration

1. If, at any time prior to expiration of the correction period stipulated in the General Conditions, infiltration exceeds 100 gallons per inch of nominal diameter per mile of sewer per day, CONTRACTOR shall locate the leaks and make repairs as necessary to control the infiltration.

F. Deflection

1. After backfilling is completed, and before acceptance of the work, each reach of PVC and composite sewer pipe shall be checked for excessive deflection by pulling a mandrel through the pipe, or by other methods acceptable to ENGINEER. Pipe with diametrical deflection exceeding 5 percent of the inside diameter shall be uncovered, and the bedding and backfill replaced to prevent excessive deflection. Repaired pipe shall be retested.

3.8 CLEANING

- A. The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until the work has been accepted. All joint contact surfaces shall be kept clean until the joint is completed.

- END OF SECTION 02702 -

SECTION 02730 - SANITARY LATERALS

PART 1 – GENERAL

1.1 SCOPE OF WORK

- A. The Work under this Section includes, but is not limited to, the installation and testing of low pressure sanitary sewer pipe laterals, lateral assemblies, fittings, and connections.

1.2 RELATED SECTIONS:

- A. Section 01300 – Contractor Submittals
- B. Section 01526 – Trench Safety System
- C. Section 02200 – Excavation and Backfill
- D. Section 02336 – Horizontal Directional Drilling Installation
- E. Section 02560 – Low Pressure Sewer (LPS)
- F. Section 11105 – Grinder Pump Station Unit

1.3 QUALITY ASSURANCE

- A. All similar components shall be manufactured and furnished by one manufacturer unless specifically approved by ENGINEER in writing.

1.4 SUBMITTALS

- A. CONTRACTOR shall submit shop drawings in accordance with Section 01300 – Contractor Submittals for the materials furnished herein. Shop Drawing submittals shall include descriptive literature, pressure ratings, and certification of all applicable ASTM standards, design calculations, and manufacturer’s installation instructions.

PART 2 - PRODUCTS

2.1 PIPE MATERIAL

- A. Pipe material to be installed downstream of the grinder pump station unit shall be 1.25-inch HDPE, DR-11, PE 4710, AWWA C901. All fittings, bends, tees, couplers shall be equal to the adjacent pipe as necessary for the LPS installation.
- B. Pipe material to be installed upstream of the grinder pump station unit shall be 4.5” O.D. DWV (Schedule 40) PVC pipe.

2.2 TRACER WIRE AND TRACER WIRE CONNECTIONS

- A. Refer to Section 02560 – Low Pressure Sewer (LPS).

PART 3 - EXECUTION

3.1 LATERAL INSTALLATION

- A. CONTRACTOR shall install laterals per the latest edition of the Citizens Energy Group Sanitary Standards Manual, latest edition.

3.2 LATERAL ASSEMBLY INSTALLATION

- A. CONTRACTOR shall install the lateral assembly at the right-of-way line or easement per the Citizens Energy Group Sanitary Standards Manual, latest edition.

3.3 LOCATION OF SERVICE CONNECTIONS

- A. The Contract Drawings indicate a 1.25" service connection with a lateral assembly for low pressure sewer systems to service each property located within the project area. The location of the service connection is only schematic and is not intended to represent the exact installation location.
- B. CONTRACTOR shall contact each individual property owner to determine the installation location for the lateral, lateral assembly and grinder pump station unit.
- C. A written log of location and depth for the lateral assemblies shall be kept by the CONTRACTOR and transmitted to the CONSTRUCTION INSPECTOR with the as-built data. This data shall include the horizontal length of the stub from the low pressure sewer system to the lateral assembly at the right-of-wayline.
- D. CONTRACTOR shall complete the homeowner contact form as approved by the OWNER. The homeowner contact form shall record the name of the property owner, address of property, date and time of contact and any other remarks pertinent to the property, and include a drawing showing the determined locations for the lateral, lateral assembly and grinder pump station unit. The homeowner contact form shall be signed by the CONTRACTOR and property owner and provided to the OWNER.

3.4 LOCATING TRACER WIRE

- A. Two strands of tracer wire shall be pulled back with the pipe. The wire shall be installed along the pipe and terminating above ground with the lead taped around each structure. The wire shall be brought up to the ground level every five hundred (500) feet through a vinyl coated aluminum riser pipe with cap and/or at all line valve boxes. The riser pipe and cap shall not be placed in areas subject to vehicular traffic. The tracer wire shall be capable of, and demonstrated to have, continuous transmission of tracing signal along the full length of the installed pipe.

3.5 SERVICE CONNECTIONS PRIOR TO FINAL ACCEPTANCE

- A. CONTRACTOR agrees that, after Substantial Completion, or partial Substantial Completion, and, if requested and authorized by OWNER, connections to the sewer will be allowed prior to the Final Acceptance of the project by OWNER. Such requests for connection shall be confirmed in writing and provided to OWNER that the connection is necessary in order to eliminate an existing health hazard. Substantial completion shall be defined as the completion of all requirements necessary to enable the Work to be performed for the purpose for which it was constructed. This shall include, but not be limited to, all necessary testing as required by the laws and regulations of OWNER and these Contract Documents. Substantial completion shall be determined by OWNER.

- END OF SECTION 02730 -

SECTION 02900 – RESTORING LAWNS AND LANDSCAPING

PART 1 - GENERAL

1.1 SCOPE

- A. The Work under this Section includes, but is not limited to, the surface preparation, sodding and seeding the lawn areas, and replacement of all trees, shrubs, plants, and vegetation adjacent to the Work which were disturbed or damaged and their restoration to the same condition which prevailed at the time of CONTRACTOR entry upon the Work, or as directed by CONSTRUCTION INSPECTOR, and in full accord with provisions of any easements with property owners where work is in such easements.
- B. In general, this shall include: the replacement of all trees, shrubs, plants, and vegetation; the re-handling and placing of stored topsoil, the furnishing and placing of additional topsoil to provide 4 inches of topsoil in all disturbed areas to be seeded; the furnishing and placing of all fertilizer, sod, and grass seed required to plant and maintain the lawn areas; and, also the watering, weeding, cutting, and replacement of lawn areas, as required, to obtain a well-kept turf that is properly dense and free from weeds.
- C. In general, the Work under this Section shall include the grounds preparation, the lawn care, and the proper furnishing, planting, care, and guarantee of all trees, shrubbery, and ground cover, as defined herein.
- D. Additional topsoil required, as approved by CONSTRUCTION INSPECTOR, for the sodding, seeding, and planting shall be furnished by CONTRACTOR at no additional cost and shall meet the requirements for topsoil, as herein specified.
- E. All existing lawns and areas of vegetative growth disturbed by CONTRACTOR and other designated areas are to be restored with 4 inches of topsoil and grass seed unless otherwise shown on the Contract Drawings or called for in the Specifications or easements.

1.2 GUARANTY AND REPLACEMENT

- A. CONTRACTOR shall maintain all plantings by watering, cultivating, weeding, pruning, and protection against surface erosion during the guaranty period. The cost of the water shall be borne by CONTRACTOR.
- B. All plants shall be guaranteed for one year and for the duration of one full growing season after date of acceptance of the Contract Drawings. At the end of the guarantee period, any dead, unhealthy, or badly impaired plants shall be replaced. All replacements shall be plants of the same kind as originally indicated on the Contract Drawings and of size comparable to that of growing plants adjacent to them. The cost of such replacement shall be borne by CONTRACTOR at no additional cost to OWNER.

PART 2 - PRODUCTS

2.1 ADDITIONAL TOPSOIL

- A. Additional topsoil, when required, shall be in accordance with the requirements of Section 02920 – Topsoil.

2.2 QUALITY AND CHARACTERISTICS OF PLANTINGS

- A. Plants shall be of sound, first quality, well cared for nursery stock, free from mechanical and insectivorous defects, pruning wounds, and disease. Trunks and branches shall be straight, and leaders, foliage heads, and root systems shall be thrifty. All plants shall be normal for the species.
- B. All plants shall be subject to inspection and approval by CONSTRUCTION INSPECTOR at the place of growth before digging, for quality, size, and variety. However, such approval shall not impair the right of rejection at the Project Site by CONSTRUCTION INSPECTOR. CONTRACTOR shall remove rejected plants from the Site.
- C. Plants shall be freshly dug before shipment under favorable weather conditions and with care to preserve fibrous roots. Handling, protecting, packing, and shipping shall accord with approved methods. In general, bare root stock shall have primary roots cut clean and no closer than 5 inches from the main stem. The root system shall be balanced with the center of the plant, shall be clay coated, and shall have primary root system diameters, as follows:

<u>Plant Height</u>	<u>Primary Root System Diameter</u>	<u>Plant Caliper</u>	<u>Primary Root System Diameter</u>
1 to 2 feet	12 inches	1 to 1-1/4"	24 inches
3 to 4 feet	16 inches	1-1/2 to 1-3/4"	28 inches
5 to 6 feet	20 inches	2 to 2-1/2"	34 inches
8 to 10 feet	24 inches	3 to 4"	40 inches
		4 to 5"	44 inches

- 1. Intermediate heights or calipers shall be interpolated between those given. Diameters of stems shall be calipered 6 inches above normal ground level. Plants with root systems normally asymmetrical with the stem shall be dug and shipped with root system 50 percent greater than that tabulated herein.
- D. Balled and burlapped stock shall conform to the requirements for bare root stock as such apply. Balls shall be full and delivered unbroken. They shall be of sizes as follows:

<u>Plant Height</u>	<u>Root System Diameter</u>	<u>Plant Caliper</u>	<u>Root System Diameter</u>
1 to 2 feet	8 inches	1 to 1-1/4"	20 inches
3 to 4 feet	12 inches	1-1/2 to 1-3/4"	24 inches
5 to 6 feet	16 inches	2 to 2-1/2"	30 inches
8 to 10 feet	20 inches	3 to 4"	38 inches
		4 to 5"	44 inches

Intermediate heights or calipers shall be interpolated. The ball measurement given shall be that of the horizontal diameter; the vertical diameter can be 2 inches less.

- E. All trees and shrubs shall be tagged and the label shall state the botanical name and size of the respective species. The labels shall be attached firmly and of such nature as to be permanently legible.
- F. Each shipment of plants shall be accompanied by all necessary certificates of nursery inspection, as may be required by Federal or State statutes.

2.3 SUBSTITUTIONS

- A. If reasonable proof is submitted that any plant disturbed or specified is not obtainable, a proposal will be considered for the nearest equivalent size or variety. If substitutions are approved, any reductions in cost of materials shall accrue as a credit to OWNER. Partial substitutions of any one variety and size shall not be allowed.

PART 3 - EXECUTION

3.1 PREPARATION OF LAWN AREAS

- A. The sub-grade for the lawn areas shall be as specified in Section 02920 – Topsoil.
- B. CONTRACTOR shall use all existing topsoil that had been previously removed and stored under this Contract before additional topsoil is obtained from another source.
- C. After the topsoil has been carefully spread, CONTRACTOR shall spread and uniformly distribute commercial fertilizer conforming to Section 621 of the Indiana Department of Transportation (INDOT) Standard Specifications.

3.2 SODDING

- A. Existing sodded lawns disturbed by CONTRACTOR and other designated shall be sodded in accordance with Section 621 of the INDOT Standard Specifications.

3.3 SEEDING

- A. Seeding and mulching shall be performed in conformance with Section 621 of the INDOT Standard Specifications, except all disturbed grassed areas, but not sodded, and shall be seeded with the following mixture (percentages are by weight):
 - 1. 40 percent Kentucky Bluegrass.
 - 2. 40 percent Creeping Red Fescue.
 - 3. 20 percent Oregon Perennial Ryegrass.

3.4 MAINTENANCE

- A. Maintenance of the sodded and the seeded areas shall consist of watering, weeding, cutting, trimming, and a minimum of two applications of fertilizer for the grass as is necessary for obtaining and keeping of a sound weed-free turf in accordance with Section 621 of the INDOT Standard Specifications. This requirement of maintenance shall continue until, in CONSTRUCTION INSPECTOR's opinion, a satisfactory turf is established but in no case less than three months from the date of acceptance. New sodded and seeded areas shall be maintained at a blade length of between 2 inches and 3 inches.

3.5 TREES, SHRUBBERY, AND GROUND COVER

- A. Areas to be landscaped and planted shall include the various areas shown on the Contract Drawings and any areas disturbed by CONTRACTOR. CONTRACTOR shall turn over to OWNER these various areas with all landscaping showing proper development, satisfactory growth, and that it is properly trimmed.
- B. CONTRACTOR's attention is called to the fact that the Work shall include such watering, weeding of plant beds, spraying, pruning, a minimum of two applications of fertilizer, and replacement of all partial or complete kills until final acceptance.
- C. In general, no planting shall be done until after the topsoil has been placed. All planting shall be watered in a manner and at times to accord with proper horticultural practice.
- D. No tree over 2-1/2 inches in diameter, measured 6 inches above the ground surface, whether within the street right-of-way or on private property within any easement, shall be removed without the prior written approval of CONSTRUCTION INSPECTOR, unless otherwise shown or noted on the Contract Drawings.
- E. Wherever and whenever possible, trees will be protected and saved, and only those trees which are directly in the line of construction, as determined by CONSTRUCTION INSPECTOR, will be considered for possible removal.
- F. Prior to construction, CONTRACTOR shall mark all trees over 2-1/2 inches in diameter at 6 inches above the ground which CONTRACTOR plans to remove, and trees so marked shall not be removed until directed, in writing, by CONSTRUCTION INSPECTOR.
- G. CONTRACTOR shall replace all trees which measure over 2-1/2 inches in diameter at 6 inches above ground which are removed from within the public right-of-way or any easement with a tree which measures not less than 2-1/2 inches in diameter at 6 inches above ground.
- H. Where CONSTRUCTION INSPECTOR determines a clear lane of access will be needed by OWNER to maintain the sewer, CONSTRUCTION INSPECTOR will direct, in writing, those trees which will be relocated from an easement or right-of-way when replanting.

- I. Replacement trees shall be of landscape quality, of the same species and variety as were removed, and shall be replanted as near as practicable to the original location, subject to the approval of CONSTRUCTION INSPECTOR.
- J. Under no circumstances shall any tree over 2-1/2 inches in diameter at 6 inches above ground on private property be removed without the written consent of the property owner unless such trees are clearly noted for removal on the Contract Drawings. If any such trees over within the temporary easements are damaged or removed, whether purposefully or accidentally, CONTRACTOR shall be liable to the individual property owners for damage.

3.6 PLANTING SEASON

- A. The fall planting season is considered to be from the first of September until the time when the ground is no longer workable. The spring planting season is considered to be from the time the ground is workable to the first of June.

3.7 PREPARATION OF BEDS AND PITS

- A. CONTRACTOR shall perform all excavation to the finished grades shown on the Contract Drawings as required for the proper completion of Work of this Contract, and CONTRACTOR shall remove all excess excavated materials, as described in Section 02200 – Excavation and Backfill.
- B. Tree Pits and those for shrubs shall be excavated to a depth of at least 12 inches deeper than the depth of the ball and to a diameter of approximately 24 inches greater than that of the ball to be placed therein. The sides of the pit shall be vertical. Topsoil in quantity sufficient for compacted backfill of the pit shall be placed adjacent thereto, ready for planting.
- C. Planting Beds shall be staked out to proper contour, the subsoil loosened to a depth of 3 inches, and covered evenly with approximately a 6-inch-deep planting beds containing 3 parts topsoil to 1 part peat moss. Over these beds, install a 2-inch-deep bed of mulch before planting.

3.8 PLANTING

- A. All planting shall be done in the planting season as defined in Paragraph 3.6, unless otherwise permitted by CONSTRUCTION INSPECTOR. Every effort shall be made to do all planting while the soil is in good workable condition.
- B. Trees shall be planted according to the Tree, Shrubs, and Ground Covers Specification provided by the Indianapolis Parks and Recreation Urban Forestry Section.
- C. Group plantings shall take into account the proper sizing and arrangement for appearance with the better appearing sides of individual plants faced outward. The planting distances, as indicated, shall be generally maintained. A proper and harmonious effect of massed shrubbery, where such is intended, shall also be established. Sufficient topsoil shall be placed in the bottom of the pits so that plants shall be at proper grade when placed in the pit.

- D. Plantings of bare root systems shall be made with roots spread naturally in a previously wetted pit and to a depth that will place the bedding surface slightly higher than it was at the nursery. Topsoil or loam fill shall be placed firmly, but not tightly, so as to encase the roots in a natural position and shall properly support the planting in a vertical position. Pits shall be filled so as to provide a water cup.
- E. Balled and burlapped plantings, after placement in the pit, shall have the top half of the burlap removed with the bottom half-remaining. After the plants are placed in the pits, the pits shall be 3/4 filled with topsoil firmly around the ball to provide proper support, and water shall be placed in the remaining portion of the pit to the top. After the water has been absorbed by the soil in the pit, the pit shall then be filled with dry topsoil.
- F. All trees shall be tied securely to a minimum of three notched stakes either 3 inches square or 2 x 4 inches, 2 feet long, well driven into firm ground. Ties shall be two strands of 10 gauge twisted wire making an angle of not more than 45 degrees with the ground. Wire shall be rubber covered where in contact with the tree and positioned just above a branch. Tree trunks shall be wrapped spirally with 6-ounce burlap, securely tied and extending from ground to 12 inches above crown. No nylon string will be allowed.
- G. All plantings shall be watered in a manner and at times to accord with proper horticultural practices. Should plantings settle out of the vertical, they shall be straightened so as to avoid damage to the root system and even to the extent of loosening and repacking pit filling. Beddings shall be smoothed and cut to an outline that conforms to the planting.
- H. After planting is completed, all planted areas and specimens shall be mulched with peat moss to minimum of 3 inches depth.

3.9 FLORA AND ROOT PROTECTION AND CUTTING

- A. To preserve trees that are not to be removed, CONTRACTOR is prohibited from transporting, using, or storing equipment, tools, materials, or debris beneath the canopies of trees to be preserved. CONTRACTOR shall take care to prevent any and all damage to tree roots, trunks, and canopies of designated trees from tools and equipment during construction, except as may be necessary and approved by the Flora Permit and/or the City Arborist.
- B. Necessary tree pruning and removal for this project shall be performed in accordance with American National Standards Institute (ANSI) A300 – American National Standards for Tree Care Operations – Standard Practice Series. Failure to conform to these specifications may result in tree damage requiring implementation of mitigating measures and/or assessment of additional tree removals and replacements at no additional cost to OWNER.
- C. Protection during removal of existing materials:
 - 1. Extra care is to be taken during the removal of existing materials to prevent breakage of any roots within the dripline (root zone) of any flora.
 - 2. Dripline (root zone) dimensions are defined by size classifications of flora in the Department of Parks and Recreation’s Augering Specifications. The following specifications refer to roots within the dripline (root zone).

3. No roots are to be broken with equipment during removal of existing walks, curbs, or any other facilities, unless roots are pre-cut on tree side of excavation with some type of rotary saw or grinding tool such as a chain saw, stump grinder, rock cutter, etc.
4. Exposed portions of the flora and roots are to be kept free of contact with any equipment or materials. Construction fencing should be placed at the perimeter of the area to be protected to help prevent unnecessary damage.
5. No concrete or other foreign materials shall be placed directly against cut portions of roots or within 6 inches of cut portions.
6. There shall be four classifications of root sizes according to the size of the main stem or any particular flora:
 - a. Class 1: Root diameter = 20 - 25 percent of main stem diameter.
 - b. Class 2: Root diameter = 15 - 20 percent of main stem diameter.
 - c. Class 3: Root diameter = 10 - 15 percent of main stem diameter.
 - d. Class 4: Root diameter = 1 - 10 percent of main stem diameter.
7. No more than one Class 1 root may be cut from any given flora. No more than two Class 2 roots may be cut from any given flora. No more than four Class 3 roots may be cut from any given flora. No limit for Class 4 roots.
8. Root removal in excess of the above specifications shall result in the required removal and replacement of the impacted flora at no additional cost to OWNER.
9. No roots greater than 25 percent of the trunk diameter of flora may be cut or ground off at the trunk.
10. No roots may be cut within 24 inches of the trunk of any flora.

D. Clean Cutting and Backfilling Roots:

1. All pre-cut and damaged roots shall be clean cut with a sharp chainsaw or handsaw prior to backfill of topsoil.
2. All cut roots must be clean cut perpendicular to the natural direction of root growth at the point where clean cut is to occur.
3. All clean cuts shall occur beyond (toward the trunk line) all previously broken tissues at a minimum sufficient distance to clear such tissues.
4. All damaged roots shall be backfilled with existing topsoil within 60 minutes of being clean cut.
5. All damaged roots must have at least 6 inches of clearance from all permanent construction materials except topsoil.

6. All root-damaged flora shall be heavily watered within 24 hours following backfill and three additional times at 48-hour intervals.

E. Grade Change and Augering Specifications:

1. When final grades are to be elevated above existing grades, extra care is to be taken during removal of existing materials. Backhoes and other equipment shall scrape or lift concrete away from roots rather than scoop up material; concrete shall be broken with jackhammers and removed manually, etc.
2. When elevating grade less than 12 inches, not more than 20 percent of the surface area within the dripline of any flora may be paved or compacted with any machinery.
3. Undamaged roots shall be covered with at least 2 inches of sand or soil base prior to the placement of a gravel base or the pouring of concrete. Concrete and gravel are not to be poured directly against tissues of flora.
4. When augering in accordance with the current Department of Parks and Recreation Augering Specifications is not possible, all roots within the dripline as defined therein must be cut per the previous root cutting specifications.

- END OF SECTION 02900 -

SECTION 02920 – TOPSOIL

PART 1 - GENERAL

1.1 SCOPE

- A. The Work under this Section consists of surface preparation and placement of topsoil on all areas to receive seeding and/or planting.

PART 2 - PRODUCTS

2.1 MATERIAL SOURCE

- A. Topsoil material shall be supplied from onsite stockpiles as specified in Section 02200 – Excavation and Backfill or off-site sources and shall meet the requirements specified below.

2.2 TOPSOIL

- A. Topsoil shall consist of natural, fertile, agricultural soil capable of sustaining plant and lawn growth. The material shall be free of stones 2 inches or larger, stumps, clay lumps, roots, brush, or other objectionable materials.
- B. The topsoil or soil mixture shall have a pH range of 5.6 to 7.6 or adjusted to this range by addition of agricultural limestone.
- C. The topsoil shall contain not less than 5 percent organic material, as determined by the loss on ignition of samples dried at 80°C.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Immediately prior to dumping and spreading topsoil on any area, the surface of the subgrade shall be loosened or disked to a minimum depth of 2 inches to facilitate bonding of the topsoil to the covered subgrade soil.

3.2 INSTALLATION

- A. After surface preparation, topsoil shall be evenly spread to a minimum finished depth of 4 inches for seeded areas and 8 inches for planting areas. The topsoil surface shall conform to the required lines and grades as shown on the Contract Drawings.

- END OF SECTION 02920 -

SECTION 03200 – STEEL REINFORCEMENT

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Work of this Section includes, but is not limited to, all reinforcing steel required for properly reinforcing all concrete structures that are to be built under this Contract. In general, this shall include the steel reinforcing in foundations, structures, conduits, and encasements and any type of structural elements shown on the Contract Drawings.
- B. In general, the Work of this Section shall include the furnishing, testing, storing, protecting, shaping, placing, and maintaining in position of all steel reinforcement, irrespective of type, together with any supporting chairs and clips, tie wires, spacers, bolsters, and other fastenings, wire clips for wrapping, and the furnishing of all labor, materials, tools, and equipment necessary to complete the Work as shown on the Contract Drawings, specified or required for the proper completion of the installation.

1.2 REFERENCE STANDARDS

- A. American Concrete Institute (ACI) 315 – Details and Detailing of Concrete Reinforcement.
- B. ACI 318 – Building Code Requirements for Reinforced Concrete.
- C. Concrete Reinforcing Steel Institute (CRSI) MSP-1– Concrete Reinforcing Steel Institute Manual of Standard Practice.
- D. Wire Reinforcement Institute (WRI) – Manual of Standard Practice for Welded Wire Fabric.
- E. American Welding Society (AWS) D1.4 – Structural Welding Code - Reinforcing Steel.
- F. American Society for Testing and Materials (ASTM) A82 – Specification for Steel Wire, Plain, for Concrete Reinforcement.
- G. ASTM A185 – Specification for Welded Steel Wire Fabric, Plain, for Concrete Reinforcement.
- H. ASTM A497 – Standard Specification for Welded Steel Wire Reinforcement, Deformed, for Concrete.
- I. ASTM A615 – Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- J. ASTM A706 – Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

1.3 CONTRACTOR SUBMITTALS

- A. CONTRACTOR shall furnish shop bending diagrams, placing lists, and drawings of all reinforcement steel prior to fabrication in accordance with the requirements of Section 01300 – Contractor Submittals.
- B. Details of the concrete reinforcement steel and concrete inserts shall be submitted by CONTRACTOR to CONSTRUCTION INSPECTOR for acceptance within 15 days after receipt by CONTRACTOR of the Notice to Proceed. Said details of reinforcement steel for fabrication and erection shall conform to ACI 315 and the requirements specified and shown. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch, measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. The shop drawings shall include bar placement diagrams that clearly indicate the dimensions of each bar splice. Where possible, this submittal shall be coordinated and submitted simultaneously with the joint placement submittals required by Section 03290 – Joints in Concrete. Each separate submittal shall include only one major structure.
- C. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, CONTRACTOR shall submit manufacturer's literature which contains instructions and recommendations for installation of each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and shop drawings which show the location of each coupler with details of how they are to be installed in the formwork.

1.4 QUALITY ASSURANCE

- A. Reinforcement bars and welded steel wire shall be inspected and tested at the mill at which they are rolled or fabricated, in accordance with ASTM Designation A615 and A185 respectively, and two certified copies of such tests shall be furnished to CONSTRUCTION INSPECTOR. Costs for both initial tests and any costs associated with additional tests due to material failing initial tests shall be paid by CONTRACTOR.
- B. If requested by CONSTRUCTION INSPECTOR, CONTRACTOR shall provide samples from each heat of reinforcement steel delivered in a quantity adequate for testing.

PART 2 - PRODUCTS

2.1 REINFORCEMENT STEEL

- A. Reinforcement Steel for all cast-in-place reinforced concrete construction shall also conform to the following requirements:
 - 1. Reinforcing Bars to be in accordance with Section 703 of the Indiana Department of Transportation (INDOT) 2012 Standard Specifications.
 - 2. Bar reinforcement shall conform to the requirements of ASTM A615 for Grade 60 Billet Steel Reinforcement or as otherwise shown. Rebar conforming to ASTM A615

shall not be welded in the shop or in the field. Tack welded pre-assemblies are not allowed unless rebar conforms to ASTM A706.

2. Low Alloy bar reinforcement conforming to ASTM A706, Grade 60, shall only be used where specifically shown on the Contract Drawings.
3. Welded wire fabric reinforcement shall conform to the requirements of ASTM A185 and the details shown; provided that welded wire fabric with longitudinal wire of W4 size wire and smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W4 size shall be furnished in flat sheets only.
4. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A82.

C. Accessories:

1. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement. All bar supports shall meet the requirements of the CRSI Manual of Standard Practice. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/8 inch minimum thickness of plastic coating that extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.
2. Concrete blocks (dobies) used to support and position reinforcement steel shall have the same or higher compressive strength as specified for the concrete in which it is located. Wire ties shall be embedded in concrete block bar supports.

2.3 MECHANICAL COUPLERS

- A. Mechanical couplers shall be provided where shown and/or where approved by CONSTRUCTION INSPECTOR. The couplers shall develop a tensile strength that exceeds 125 percent of the yield strength of the reinforcement bars being spliced.
- B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied. This shall apply to all mechanical splices, including those splices intended for future connections.
- C. The reinforcement steel and coupler used shall be compatible for obtaining the required strength of the connection. Straight threaded type couplers shall require the use of the next larger size reinforcing bar or shall be used with reinforcing bars with specially forged ends which provide upset threads which do not decrease the basic cross section of the bar.
- D. Couplers shall be Lenton Form Saver, as manufactured by Erico Products; Dowel Bar Splicer System, as manufactured by Richmond Screw Anchor Company; or equal.

2.4 WELDED SPLICES

- A. Welding of reinforcing steel for any purpose is not permitted unless specifically detailed in the Contract Drawings. Welded reinforcing shall conform to ASTM A706.

2.5 EPOXY GROUT

- A. Epoxy for grouting reinforcing bars shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled. Epoxy grout shall meet the requirements found in Section 03315 – Ancillary Grout.

PART 3 - EXECUTION

3.1 GENERAL

- A. All reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated and placed in accordance with the requirements of the Building Code and the supplementary requirements specified herein.

3.2 FABRICATION

A. General:

1. Reinforcement steel shall be accurately formed to the dimensions and shapes shown, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Contract Drawings. Stirrups and tie bars shall be bent around a pin having a diameter not less than 1-1/2 inches for No. 3 bars, 2 inches for No. 4 bars, and 2-1/2 inches for No. 5 bars. Bends for other bars shall be made around a pin having a diameter not less than six times the bar diameter, except for bars larger than 1 inch, in which case the bends shall be made around a pin of 8 bar diameters. Bars shall be bent cold.
2. CONTRACTOR shall fabricate reinforcement bars for structures in accordance with approved bending diagrams, placing lists, and placing drawings.

- B. Bars used for concrete reinforcement shall meet the following requirements for fabricating tolerances:

1. Sheared length: ± 1 inch.
2. Depth of truss bars: + 0, - 1/2 inch.
3. Stirrups, ties, and spirals: $\pm 1/2$ inch.
4. All other bends: ± 1 inch.

3.3 PLACING

- A. Reinforcement steel shall be accurately positioned as shown and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcement steel shall be supported by concrete, plastic or metal supports, spacers, or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the bars without settlement but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties that are embedded in the blocks. For concrete over formwork, CONTRACTOR shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.
- B. Limitations on the use of bar support materials shall be as follows:
 - 1. Concrete Dobies are permitted at all locations except where architectural finish is required.
 - 2. Plastic Coated Wire Bar Supports are permitted at all locations except on grade.
 - 3. Plastic Bar Spacers are permitted on all wall forms.
- C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
- D. Bars, additional to those shown, which may be found necessary or desirable by CONTRACTOR for the purpose of securing reinforcement in position shall be provided by CONTRACTOR at its own expense.
- E. Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the Building Code.
- F. Bars may be moved, as necessary, to avoid interference with other reinforcement steel, conduits, or embedded items. If bars are moved more than one bar diameter or enough to exceed the above tolerances, the resulting arrangement of bars shall be as acceptable to CONSTRUCTION INSPECTOR.
- G. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters. Slab bolsters shall be spaced not more than 30 inches on centers; shall extend continuously across the entire width of the reinforcement mat; and, shall support the reinforcement mat in the plane shown.
- H. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

- I. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars. When used to space the reinforcing bars from wall forms, the forms and bars shall be located so that there is no deflection of the accessory when the forms are tightened into position.

3.4 SPACING OF BARS

- A. The clear distance between parallel bars, except in columns and between multiple layers of bars in beams, shall be not less than the nominal diameter of the bars nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than 1 inch.
- B. Where reinforcement in beams or girders is placed in two or more layers, the clear distance between layers shall be not less than 1 inch.
- C. In columns, the clear distance between longitudinal bars shall be not less than 1-1/2 times the bar diameter, nor less than 1-1/2 times the maximum size of the coarse aggregate, nor less than 1-1/2 inches.
- D. The clear distance between bars shall also apply to the distance between a contact splice and adjacent splices or bars.
- E. Concrete cover over the principal reinforcing steel shall be provided as indicated on the Contract Drawings, unless otherwise shown.

3.5 SPLICING

A. General:

1. Reinforcement bar splices shall only be used at locations shown. When it is necessary to splice reinforcement at points other than where shown, the character of the splice shall be as acceptable to CONSTRUCTION INSPECTOR.
2. Unless otherwise indicated, dowels shall match the size and spacing of the spliced bar.

B. Splices of Reinforcement:

1. The length of lap for reinforcement bars, unless otherwise shown, shall be in accordance with ACI 318, Section 12.15.1 for a Class B splice and the table listing of lap lengths on the Contract Drawings.
2. Laps of welded wire fabric shall be in accordance with ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

C. Bending or Straightening:

1. Reinforcement shall not be straightened or re-bent in a manner that will injure the material. Bars with kinks or bends not shown shall not be used. All bars shall be bent cold, unless otherwise permitted by CONSTRUCTION INSPECTOR. No bars

partially embedded in concrete shall be field-bent except as shown or specifically permitted by CONSTRUCTION INSPECTOR.

- D. Couplers that are located at a joint face shall be a type that can be set either flush or recessed from the face as shown. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. Couplers intended for future connections shall be recessed a minimum of 1/2 inch from the concrete surface. After the concrete is placed, the coupler shall be plugged with plastic plugs which have an O-ring seal and the recess filled with sealant to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged.
- E. Unless noted otherwise, mechanical coupler spacing and capacity shall match the spacing and capacity of the reinforcing shown for the adjacent section.

3.6 STORAGE AND PROTECTION

- A. All steel for reinforcement shall be delivered at the site of the Work without rust, other than that which may have accumulated in normal transit. It shall be sorted for size and length and shall be properly tagged, with substantial tags securely attached to each bundle properly identifying the bars as to use intended. Bars shall be stored in racks and protected from the weather by housing. Reinforcing steel shall not be stored in contact with the ground.
- B. All steel shall be kept free from oil, grease, dirt, or other objectionable adhering substances, and it shall be satisfactorily cleaned of scale and heavy or flaky rust before being placed in the Work. If, after having been placed in the Work, the concreting is delayed or interrupted for any considerable number of days, the steel shall be well protected.

3.8 CLEANING AND PROTECTION

- A. Reinforcement steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.
- B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcement shall be re-inspected and, if necessary, re-cleaned.

3.9 EMBEDMENT OF DRILLED REINFORCING STEEL DOWELS

A. Hole Preparation:

1. The hole diameter shall be as recommended by the epoxy manufacturer but shall be no larger than 1/4 inch greater than the diameter of the outer surface of the reinforcing bar deformations.
2. The depth of the hole shall be as recommended by the epoxy manufacturer to fully develop the bar but shall not be less than 12 bar diameters, unless noted otherwise.

3. The hole shall be drilled by methods that do not interfere with the proper bonding of epoxy.
4. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes to be drilled shall be adjusted to avoid drilling through or nicking any existing reinforcing bars.
5. The hole shall be blown clean with clean, dry compressed air to remove all dust and loose particles.
6. Epoxy shall be injected into the hole through a tube placed to the bottom of the hole. The tube shall be withdrawn as epoxy is placed but kept immersed to prevent formation of air pockets. The hole shall be filled to a depth that insures that excess material will be expelled from the hole during dowel placement.
7. Dowels shall be twisted during insertion into the partially filled hole so as to guarantee full wetting of the bar surface with epoxy. The bar shall be inserted slowly enough to avoid developing air pockets.

- END OF SECTION 03200 -

SECTION 03290 – JOINTS IN CONCRETE

PART 1 - GENERAL

1.1 SCOPE

- A. CONTRACTOR shall provide joints in concrete, complete and in place, in accordance with the Contract Documents.
- B. Joints in concrete structures shall be the types defined below and will be permitted only where indicated, unless specifically accepted by ENGINEER.

1.2 TYPES OF JOINTS

- A. Construction Joints - When fresh concrete is placed against a hardened concrete surface, the joint between the two pours is called a construction joint (also referred to as a “cold joint”). Construction joints, unlike expansion and contraction joints, are not intended to allow for movement of concrete members. Unless otherwise indicated, joints in water bearing members shall be provided with a flatstrip-type waterstop and/or sealant groove of the shape indicated. Reinforcing bars, if needed, shall be continuous through the joint, as detailed on the Contract Drawings. A bonding agent shall be applied to the hardened concrete surface of the joint prior to placing the fresh concrete.
- B. Contraction Joints - Contraction joints are also formed when fresh concrete is placed against a hardened concrete surface except that the fresh concrete shall not be permitted to bond with the hardened surface of the earlier pour, which shall be coated with a bond breaker. The slab reinforcement shall be stopped 4-1/2 inches from the joint; which is provided with a sleeve-type dowel, to allow shrinkage of the concrete of the later pour. Waterstop and/or sealant groove shall also be provided when indicated.
- C. Expansion Joints - To allow the concrete to expand freely, a space is provided between the two pours, and the joint shall be formed as indicated. The space is obtained by placing a filler joint material against the earlier pour to act as a form for the later pour. Unless otherwise indicated, expansion joints in water bearing members shall be provided with a center-bulb type waterstop, as indicated.
 - 1. Premolded expansion joint material shall be installed with the edge at the indicated distance below or back from finished concrete surface and shall have a slightly tapered, dressed, and oiled wood strip secured to or placed at the edge thereof during concrete placement, which shall later be removed to form space for sealing material.
 - 2. The space so formed shall be filled with a joint sealant material, as indicated below. In order to keep the two wall or slab elements in line, the joint shall also be provided with a sleeve-type dowel, as indicated.
- D. Control Joints - The function of the control joint is to provide a weaker plane in the concrete where shrinkage cracks will probably occur. A groove, of the shape and

dimensions indicated, is formed or saw-cut in the concrete. This groove is afterward filled with a joint sealant material.

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 – Contractor Submittals 15 days prior to use.

B. Shop Drawings:

1. Placement drawings showing the location and type of all joints for each structure.
2. Certified test reports from the sealant manufacturer on the actual batch of material being supplied indicating compliance with requirements shall be furnished before the sealant is used on the job.
3. Copies of Waterstop Welding Certification to be provided by manufacturer or authorized agent of manufacturer. Every person who is to be involved with waterstop installation is required to have individual Certification on file with CONSTRUCTION INSPECTOR, which states said individuals are certified and trained to install waterstop per manufacturer's recommendations and specifications.
4. Manufacturer's information demonstrating compliance of the following with indicated requirements:
 - a. Bearing Pad.
 - b. Neoprene Sponge.
 - c. Preformed Joint Filler.
 - d. Backing Rod.
 - e. Bond Breaker.
 - f. Waterstop.
 - g. Slip Dowels.
 - h. Polyvinyl Chloride Pipe (PVC) Tubing.

C. Samples:

1. Prior to production of the material required under this Section, qualification samples of waterstops shall be submitted which represent in all respects the material proposed. Such samples shall consist of extruded or molded sections of each size or shape to be used. The balance of the material to be used shall not be produced until after CONSTRUCTION INSPECTOR has reviewed the qualification samples.

D. Certificates:

1. Written certification from the manufacturer as an integral part of the shipping form, to show that all of the material shipped to this Project meets or exceeds the physical property requirements of the Contract Documents. Supplier certificates are not acceptable.

1.4 QUALITY ASSURANCE

- A. It is required that all waterstop field joints shall be subject to inspection, and no such work shall be scheduled or started without having made prior arrangements with CONSTRUCTION INSPECTOR for the required inspections. Not less than 24 hours notice shall be given for scheduling such inspections.
- B. Field joints in waterstops shall be subject to inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of the material to water pressure at any point. Defective joints shall be replaced with material which passes inspection; faulty material shall be removed from the Site and disposed of.
- C. The following waterstop defects represent a partial list of defects which shall be grounds for rejection:
1. Offsets at joints greater than 1/16-inch or 15 percent of material thickness, at any point, whichever is less.
 2. Exterior crack at joint, due to incomplete bond, which is deeper than 1/16 inch or 15 percent of material thickness, at any point, whichever is less.
 3. Any combination of offset or exterior crack which will result in a net reduction in the cross section of the waterstop in excess of 1/16-inch or 15 percent of material thickness at any point, whichever is less.
 4. Misalignment of joint which results in misalignment of the waterstop in excess of 1/2-inch in 10 feet.
 5. Porosity in the welded joint as evidenced by visual inspection.
 6. Bubbles or inadequate bonding which can be detected with a penknife test. If, while prodding the entire joint with the point of a pen knife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.
 7. Visible signs of separation when the cooled splice is bent by hand at any sharp angle.
 8. Any evidence of burned material.

D. PVC Waterstop Samples:

1. Prior to use of the waterstop material in the field, a sample of a prefabricated (shop made fitting) mitered cross and a tee constructed of each size or shape of material

to be used shall be submitted. These samples shall be prefabricated (shop made fitting) so that the material and workmanship represent in all respects the fittings to be provided. Field samples of prefabricated (shop made fitting) fittings (crosses, tees, etc.) will also be selected at random by CONSTRUCTION INSPECTOR for testing by a laboratory at OWNER's expense. When tested, tensile strength across the joints shall be at least 1120 psi.

E. Construction Joint Sealant:

1. CONTRACTOR shall prepare adhesion and cohesion test specimens, as required herein, at intervals of five working days while sealants are being installed.

F. The sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure in laboratory and field tests:

1. Sealant specimen shall be prepared between two concrete blocks (1 inch x 2 inches x 3 inches). Spacing between the blocks shall be 1 inch. Coated spacers (2 inches x 1-1/2 inches x 1/2 inch) shall be used to insure sealant cross-sections of 1/2 inch x 2 inches with a width of 1 inch.
2. Sealant shall be cast and cured according to manufacturer's recommendations except that curing period shall be not less than 24 hours.
3. Following curing period, the gap between blocks shall be widened to 1/2-inch. Spacers shall be used to maintain this gap for 24 hours prior to inspection for failure.

1.5 SPECIAL WARRANTY REQUIREMENTS

- A. CONTRACTOR shall furnish a 5-year written warranty of the entire sealant installation against faulty and/or incompatible materials and workmanship, together with a statement that CONTRACTOR agrees to repair or replace, to the satisfaction of OWNER, any such defective areas which become evident within said 5-year guarantee period. The required warranty applies to construction joints, with or without waterstop, waterstop materials, and the sealant installation. All construction joints in water containing structures shall be covered by this warranty.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Joint materials shall be listed as compliant with National Sanitation Foundation (NSF) Standard 61.

2.2 WATERSTOPS

A. PVC Waterstops:

1. Waterstops shall be extruded from an elastomeric polyvinyl chloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet

the requirements of this Section. No reclaimed or scrap material shall be used. CONTRACTOR shall obtain from the waterstop manufacturer and shall furnish to CONSTRUCTION INSPECTOR for review, current test reports and a written certification of the manufacturer that the material to be shipped to the job meets the physical requirements as outlined in the U.S. Army Corps of Engineers Specification CRD-C572-PVC Waterstops and those listed herein.

B. Flatstrip and Center-Bulb Waterstops:

- Flatstrip and center-bulb waterstops shall be as manufactured by Greenstreak Plastic Products Co., Profiles 646, 679, 732, and 735; Tamms Horn/Durajoint Types 9, 10, 11, and 11A; or equal; provided that at no place shall the thickness of flat strip waterstops, including the center bulb type, be less than 3/8 inch. Waterstop shall be provided with factory installed hog rings at 12 inches on centers along the waterstop.

C. Multi-Rib Waterstops:

- Multi-rib waterstops, where required, shall be as manufactured by Greenstreak Plastic Products Co., Profiles 789 and 790; Tamms Horn/Durajoint Types 25 and 26; or equal. Prefabricated (shop made fitting) joint fittings shall be used at all intersections of the ribbed-type waterstops.

D. Retrofit Waterstops:

- Retrofit waterstops and batten bars shall be as manufactured by Greenstreak Plastic Products Co., Style #609, or approved equal. Waterstop shall be supplied as a complete system including waterstop, SS batten bar, SS anchor bolts, and epoxy gel.

E. Waterstop Testing Requirements:

- When tested in accordance with the test standards, the waterstop material shall meet or exceed the following requirements:

<u>Physical Property, Sheet Material</u>	<u>Value</u>	<u>ASTM Std</u>
Tensile Strength-min (psi)	2,000	D638 Type IV
Ultimate Elongation-min (percent)	350	D638 Type IV
Low Temp Brittleness-max (°F)	-35	D746
Stiffness in Flexure-min (psi)	600	D747
Accelerated Extraction (CRD-C572):		
Tensile Strength-min (psi)	1,500	D638, Type IV
Ultimate Elongation-min (percent)	300	D638, Type IV

Effect of Alkalies (CRD-C572):

Change in Weight (percent)	plus 0.25/minus 0.10	-----
Change in Durometer, Shore A	plus and minus 5	D2240

Finish Waterstop:

Tensile Strength-min (psi)	400	D638 Type IV
Ultimate Elongation-min (percent)	280	D638, Type IV

F. Pre-formed Hydrophilic Waterstop:

1. Hydrophilic (bentonite-free) waterstops shall be Hydrotite CJ10202k as manufactured by Greenstreak Plastic Products Co.; or Adeka Ultraseal MC2010 as manufactured by Asahi Denka.; or approved equal.
2. Hydrophilic waterstop shall be the type which expands in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast.
3. Waterstop shall be manufactured from chloroprene rubber and modified chloroprene rubber with hydrophilic properties. Waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete. The minimum expansion ratio of modified chloroprene shall be not less than 2 to 1 volumetric change in distilled water at 70 °F (21 °C).

<u>Physical Property, Chloroprene</u>	<u>Value</u>	<u>ASTM Std.</u>
Tensile Strength-min (psi)	1275	D412
Ultimate Elongation-min (percent)	350	D412
Hardness, Shore A	55 plus and minus 5	D2240

<u>Physical Property</u> <u>Modified Chloroprene</u>	<u>Value</u>	<u>ASTM Std.</u>
Tensile Strength-min (psi)	300	D412
Ultimate Elongation-min (percent)	600	D412
Hardness, Shore A	55 plus and minus 5	D2240

4. Bonding agent for hydrophilic waterstop shall be the manufacturer's recommended adhesive for wet, rough concrete.

G. Other Types of Waterstops:

1. When types of waterstops not listed above are indicated, they shall be subjected to the same requirements as those listed herein. Metal waterstops shall not be used.

2.3 JOINT SEALANT FOR WATER BEARING JOINTS

A. Joint sealant shall be polyurethane polymer designed for bonding to concrete which is continuously submerged in water. No material will be acceptable which has an unsatisfactory history as to bond or durability when used in the joints of water retaining structures.

B. Joint sealant material shall meet the following requirements (73 °F and 5 percent relative humidity):

Work Life	45 - 180 minutes
Time to Reach 20 Shore "A" Hardness (at 77 °F, 200 gr quantity)	24 hours, maximum
Ultimate Hardness (ASTM D2240)	20 - 45 Shore "A"
Tensile Strength (ASTM D412)	175 psi, minimum
Ultimate Elongation (ASTM D412)	400 percent, minimum
Tear Resistance (Die C, ASTM D624)	75 pounds per inch of thickness, minimum
Color	Light Gray

C. Polyurethane sealants for waterstop joints in concrete shall conform to the following requirements:

1. Sealant shall be 2-part polyurethane with the physical properties of the cured sealant conforming to or exceeding the requirements of American National Standards Institute (ANSI)/American Society for Testing and Materials (ASTM) C920 – Elastomeric Joint Sealant, or Federal Specification TT-S-0227 E(3) – Sealing Compound, Elastomeric Type, Multicomponent, for Caulking, Sealing, and Glazing Buildings and Other Structures, for 2-part material, as applicable.
2. For vertical joints and overhead horizontal joints, only "non-sag" compounds shall be used; all such compounds shall conform to the requirements of ANSI/ASTM C920 Class 25, Grade NS, or Federal Specification TT-S-0227 E(3), Type II, Class A.
3. For plane horizontal joints, the self-leveling compounds which meet the requirements of ANSI/ASTM C920 Class 25, Grade P, or Federal Specification TTS-0227 E(3), Type I shall be used. For joints subject to either pedestrian or vehicular traffic, a compound providing non-tracking characteristics, and having a Shore "A" hardness range of 35 to 45, shall be used.

4. Primer materials, if recommended by the sealant manufacturer, shall conform to the printed recommendations of the manufacturer.

D. Sealants, indicated, shall be PSI-270 as manufactured by Polymeric Systems Inc.; Sikaflex 2C as manufactured by Sika Corporation; or approved equal.

2.4 JOINT MATERIALS

A. Bearing Pad:

1. Bearing pad shall be neoprene conforming to ASTM D2000 – Standard Classification System for Rubber Products in Automotive Applications, BC 420, 40 durometer hardness, unless otherwise indicated.

B. Neoprene Sponge:

1. Sponge shall be neoprene, closed-cell, expanded, conforming to ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber, type 2C5-E1.

C. Joint Filler:

1. Joint filler for expansion joints in waterholding structures shall be neoprene conforming to ASTM D1056, Type 2C5-E1.

2. Joint filler material in other locations shall be of the preformed non-extruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. Bituminous fiber type will not be permitted. All non-extruding and resilient type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction, for Type I, except as otherwise indicated.

2.5 BACKING ROD

A. Backing rod shall be an extruded closed-cell, polyethylene foam rod. The material shall be compatible with the joint sealant material and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi. The rod shall be 1/8 inch larger in diameter than the joint width except that a 1 inch diameter rod shall be used for a 3/4 inch wide joint.

2.6 BOND BREAKER

A. Bond breaker shall be Super Bond Breaker as manufactured by Burke Company; Select Cure CRB as manufactured by Select Products Co.; or equal. It shall contain a fugitive dye so that areas of application will be readily distinguishable.

B. Bonding agent for hydrophilic waterstop shall be the manufacturer's recommended adhesive for wet, rough concrete.

2.7 SLIP DOWELS

- A. Slip dowels in joints shall be smooth epoxy-coated bars, conforming to ASTM A775 - Epoxy Coated Reinforcing Steel Bars.

2.8 PVC TUBING

- A. PVC tubing in joints shall be Sch. SDR 13.5, conforming to ASTM D2241 - Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

PART 3 - EXECUTION

3.1 GENERAL

- A. Waterstops shall be embedded in the concrete across joints, as indicated. Waterstops shall be fully continuous for the extent of the joint. Splices necessary to provide such continuity shall be accomplished in conformance to printed instructions of manufacturer of the waterstops. CONTRACTOR shall take suitable precautions and means to support and protect the waterstops during the progress of the Work and shall repair or replace, at its own expense, any waterstops damaged during the progress of the Work. Waterstops shall be stored so as to permit free circulation of air around the waterstop material.
- B. When any waterstop is installed in the concrete on one side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than two days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

3.2 SPLICES IN PVC WATERSTOPS

- A. Splices in PVC waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations. It is essential that:
 - 1. The material not be damaged by heat sealing.
 - 2. The splices have a tensile strength of not less than 80 percent of the unspliced material tensile strength.
 - 3. The continuity of the waterstop ribs and of its tubular center axis be maintained. No edge welding is allowed.
- B. Butt joints of the ends of two identical waterstop sections may be made while the material is in the forms.
- C. All joints with waterstops involving more than two ends to be jointed together, and all joints which involve an angle cut, alignment change, or the joining of two dissimilar waterstop sections shall be prefabricated (shop made fitting) prior to placement in the

forms, allowing not less than 24-inch-long strips of waterstop material beyond the joint. Upon being inspected and approved, such prefabricated (shop made fitting) waterstop joint assemblies shall be installed in the forms, and the ends of the 24-inch strips shall be butt welded to the straight run portions of waterstop in place in the forms.

- D. Where a centerbulb waterstop intersects and is jointed with a non-centerbulb waterstop, care shall be taken to seal the end of the centerbulb, using additional PVC material, if needed.

3.3 JOINT CONSTRUCTION

- A. In order to eliminate a faulty installation that may result in joint leakage, particular care shall be taken of the correct positioning of the waterstops during installation. Adequate provisions must be made to support and anchor the waterstops during the progress of the Work and to insure proper embedment in the concrete. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints. The center axis of the waterstops shall be coincident with the joint openings. Maximum density and imperviousness of the concrete shall be insured by thoroughly working it in the vicinity of all joints.
- B. In placing PVC waterstops in the forms, means shall be provided to prevent them from being folded over by the concrete as it is placed. Waterstops shall be held in place with light wire ties on 12-inch centers which shall be passed through hog rings at the edge of the waterstop and tied to the curtain of reinforcing steel. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked. In placing concrete around horizontal waterstops, with their flat face in a horizontal plane, concrete shall be worked under the waterstops by hand so as to avoid the formation of air and rock pockets.
- C. In placing centerbulb waterstops in expansion joints, the centerbulb shall be centered on the joint filler material.
- D. Waterstop in vertical wall joints shall stop 6 inches from the top of the wall where such waterstop does not connect with any other waterstop and is not to be connected to a future concrete placement.
- E. Construction joints and other types of joints shall be provided where indicated. When not indicated, construction joints shall be provided at 25-foot maximum spacing for all concrete construction. Where joints are indicated spaced greater than 40 feet apart, additional joints shall be provided to maintain the 25-foot maximum spacing. The location of all joints, of any type, shall be submitted for acceptance by CONSTRUCTION INSPECTOR.
- F. Special care shall be used in preparing concrete surfaces at joints where bonding between two sections of concrete is required. Unless otherwise indicated, such bonding will be required at all horizontal joints in walls. Surfaces shall be prepared in accordance with the requirements of Section 03300 - Cast-in-Place Concrete. Except on horizontal wall construction joints, wall to slab joints, or where otherwise indicated, at all joints where waterstops are required, the joint face of the first pour shall be coated with a bond breaker, as indicated herein.

- G. Existing surfaces to receive a retrofit waterstop shall be clean and free from any loose or foreign material. Surface shall be given a light sandblast or hydroblast finish to 1/8-inch amplitude prior to application of epoxy and waterstop.
- H. Construction joints in water-bearing floor slabs, and elsewhere as indicated, shall be provided with tapered grooves which shall be filled with a construction joint sealant. The material used for forming the tapered grooves shall be left in the grooves until just before the grooves are cleaned and filled with joint sealant. After removing the forms from the grooves, all laitance and fins shall be removed, and the grooves shall be sand-blasted. The grooves shall be allowed to become thoroughly dry, after which they shall be blown out; immediately thereafter, they shall be primed, bond breaker tape placed in the bottom of the groove and filled with the construction joint sealant. The primer shall be furnished by the sealant manufacturer. No sealant will be permitted to be used without a primer. Care shall be used to completely fill the sealant grooves. Areas designated to receive a sealant fillet shall be thoroughly cleaned, as outlined for the tapered grooves, prior to application of the sealant.
- I. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the manufacturer, taking special care to properly mix the sealant prior to application. The sides of the sealant groove shall not be coated with bond breaker, curing compound, or any other substance which would interfere with proper bonding of the sealant. Sealant shall achieve final cure at least seven days before the structure is filled with water.
- J. Sealant shall be installed by a competent waterproofing specialty contractor who has a successful record of performance in similar installations.
- K. Thorough, uniform mixing of 2-part, catalyst-cured materials is essential; special care shall be taken to properly mix the sealer before its application. Before any sealer is placed, CONTRACTOR shall arrange to have the crew doing the Work carefully instructed on the proper method of mixing and application by a representative of the sealant manufacturer.
- L. Any joint sealant which fails to fully and properly cure after the manufacturer's recommended curing time for the conditions of the Work hereunder shall be completely removed; the groove shall be thoroughly sandblasted to remove all traces of the uncured or partially cured sealant and primer and shall be re-sealed with the indicated joint sealant. Costs of such removal, joint treatment, re-sealing, and appurtenant work shall be CONTRACTOR's responsibility.
- M. Hydrophilic Waterstop:
 - 1. Where a hydrophilic waterstop is called for in the Contract Documents, it shall be installed with the manufacturer's instructions and recommendations, except as modified herein.
 - 2. When requested by CONSTRUCTION INSPECTOR, CONTRACTOR shall arrange for the manufacturer to furnish technical assistance in the field.

3. Hydrophilic waterstop shall only be used where complete confinement by concrete is provided. Hydrophilic waterstop shall not be used in expansion or contraction joints or in the first 6 inches of any non-intersecting joint.
 4. The hydrophilic waterstop shall be located as near as possible to the center of the joint, and it shall be continuous around the entire joint. The minimum distance from the edge of the waterstop to the face of the member shall be 5 inches.
 5. Where the thickness of the concrete member to be placed on the hydrophilic waterstop is less than 12 inches, the waterstop shall be placed in grooves formed or ground into the concrete. The groove shall be at least 3/4-inch-deep and 1-1/4 inches wide. When placed in the groove, the minimum distance from the edge of the waterstop to the face of the member shall be 2-1/2 inches.
 6. Where a hydrophilic waterstop is used in combination with PVC waterstop, the hydrophilic waterstop shall overlap the PVC waterstop for a minimum of 6 inches and shall be adhered to PVC waterstop with single component water-swelling sealant, as recommended by manufacturer.
 7. The hydrophilic waterstop shall not be installed where the air temperature falls outside the manufacturer's recommended range.
 8. The concrete surface under the hydrophilic waterstop shall be smooth and uniform. The concrete shall be ground smooth, if needed. Alternately, the hydrophilic waterstop shall be bonded to the surface using an epoxy grout which completely fills all voids and irregularities beneath the waterstop material. Prior to installation, the concrete surface shall be wire brushed to remove any laitance or other materials that may interfere with the bonding of epoxy.
 9. The hydrophilic waterstop shall be secured in place with concrete nails and washers at 12-inch maximum spacing. This shall be in addition to the adhesive recommended by the manufacturer.
- N. Retrofit waterstops shall be set in a bed of epoxy over a sandblasted surface with stainless steel batten bars and 1/4-inch diameter stainless steel anchors at 6 inches on center, staggered, and in accordance with the manufacturer's written recommendations.

- END OF SECTION 03290 -

SECTION 03300 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SCOPE

- A. CONTRACTOR shall furnish all materials for cast-in-place concrete, inclusive of all required formwork, in accordance with the provisions of this Section and shall form, mix, place, cure, repair, finish, and do all other concrete masonry as required to produce finished concrete, in accordance with the requirements of the Contract Documents.
- B. The following types of concrete are covered in this Section:
1. Class A Concrete (5,000 pounds per square inch [psi]) shall be used for the following structures:
 - a. Below grade structures, including but not limited to, base slabs, invert slabs, foundation walls, retaining walls, interior slabs, roof slabs, building frame members (beams and columns), footings, pile caps, and equipment pads.
 - b. Above grade structures, not including sidewalks and pavements.
 2. Class B Concrete (4,000 psi) shall be used for the following structures:
 - a. Sidewalks and pavements.
 3. Class C Concrete (3,000 psi) shall be used for mud slabs, protection (working) slabs, manhole fills for sewers, concrete cradles, concrete backfill, concrete fillets, concrete encasement, thrust blocks, fence and guard post embedment, underground ductbank encasement, mass concrete fill, for shaping channel inverts, and elsewhere when so ordered by CONSTRUCTION INSPECTOR.
 4. Lean Concrete (1,500 psi) shall be used for filling cavities and for other non-structural miscellaneous use, where future excavation is not anticipated.
 5. Cement Grout (4,000 psi) shall use 4,000 psi grout where specified in the Contract Documents, unless other strength is specified.
- C. In general, the Work under this Section shall include all forms, labor, materials, tools, and appliances necessary to complete the Work in accordance with the Contract. Including but not limited to, the following: furnishing and installing all form work; furnishing and installing reinforcing bars, as shown on the Contract Drawings and as specified in Section 03200 – Steel Reinforcement; installing sheeting and shoring; construction and expansion joints; dewatering; furnishing of cement, aggregates, water, and joint materials such as tar paper, polyethylene film, and floor hardener; the mixing, transporting, placing, finishing, moisture proofing, curing, and protecting of the concrete; and, all equipment bases.

- D. Inserts, including anchor bolts, sleeves, castings, pipe, electrical conduit, toe pockets, and manhole steps shall be set in conformance with this Section.
- E. Concrete used to refill unauthorized excavations shall be provided at CONTRACTOR's expense.

1.2 REFERENCE STANDARDS

A. American Concrete Institute Standards (ACI):

1. ACI 117 – Standard Tolerances for Concrete Construction and Materials.
2. ACI 214 – Recommended Practice for Evaluation of Strength Test Results of Concrete.
3. ACI 301 – Structural Concrete for Buildings.
4. ACI 304.2R – Placing Concrete by Pumping Methods.
5. ACI 305R – Hot Weather Concreting.
6. ACI 306.1 – Cold Weather Concreting.
7. ACI 309 – Consolidation of Concrete.
8. ACI 315 – Details and Detailing of Concrete Reinforcement.
9. ACI 318 – Building Code Requirements for Reinforced Concrete.
10. ACI 350.1 – Tightness Testing of Environmental Structures.
11. ACI 350-D6 – Concrete Sanitary Engineering Structures.

B. American Society for Testing and Materials (ASTM):

1. ASTM C31 – Practices for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 – Concrete Aggregates.
3. ASTM C39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C42 – Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
5. ASTM C88 – Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate.
6. ASTM C94 – Ready-Mixed Concrete.

7. ASTM C117 – Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing.
8. ASTM C136 – Method for Sieve Analysis of Fine and Coarse Aggregates.
9. ASTM C143 – Test Method for Slump of Hydraulic Cement Concrete.
10. ASTM C150 – Portland Cement.
11. ASTM C156 – Test Methods for Water Retention by Concrete Curing Materials.
12. ASTM C157 – Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete.
13. ASTM C171 – Sheet Materials for Curing Concrete.
14. ASTM C172 – Sampling Fresh Concrete.
15. ASTM C173 – Air Content of Freshly Mixed Concrete by the Volumetric Method.
16. ASTM C192 – Practice for Making and Curing Concrete Test Specimens in the Laboratory.
17. ASTM C231 – Air Content of Freshly Mixed Concrete by the Pressure Method.
18. ASTM C260 – Air-Entraining Admixtures for Concrete.
19. ASTM C309 – Liquid Membrane-Forming Compounds for Curing Concrete.
20. ASTM C494 – Chemical Admixtures for Concrete.
21. ASTM C1077 – Practice for Laboratories Testing Concrete and Concrete Aggregates for use in Construction & Criteria for Laboratory Evaluation.
22. ASTM D41 – Asphalt Primer used in Roofing, Dampproofing and Waterproofing.
23. ASTM D175 – Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
24. ASTM D448 – Classification for Sizes of Aggregate for Road and Bridge Construction.
25. ASTM D449 – Asphalt used in Dampproofing, and Waterproofing.
26. ASTM D1752 – Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
27. ASTM D2419 – Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
28. ASTM E119 – Method for Fire Tests of Building Construction and Materials.

29. ASTM E1643 – Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
30. ASTM E1745 – Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

1.3 SUBMITTALS

A. Mix Designs:

1. With proposal, CONTRACTOR shall submit to CONSTRUCTION INSPECTOR for acceptance and in accordance with the requirements of Section 01300 – Contractor Submittals preliminary concrete mix designs which shall show the proportions and gradations of all materials proposed for each class and type of concrete specified herein.
2. An independent testing laboratory acceptable to OWNER shall check the mix designs. This shall be accompanied by a certified test report from the testing laboratory showing, for at least three different water contents, the slump and the 7- and 28-day concrete strengths obtained when using the materials approved for the Work. CONTRACTOR shall pay all costs associated with the Work done by the independent testing laboratory.
3. The strength determinations shall be based on not less than three concrete test specimens for each age and water content.
4. No concrete shall be placed in the Work until all information has been furnished to CONSTRUCTION INSPECTOR, including 28-day concrete strength test results for the different mixes which are to be used on the job.
5. All costs related to such checking shall be borne by CONTRACTOR. Since laboratory trial batches require 35 calendar days to complete, CONTRACTOR may consider testing more than one mix design for each class of concrete.

B. Furnish the following submittals in accordance with ACI 301:

1. Steel Reinforcement Shop Drawings including placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
2. Formwork Shop Drawings prepared by or under the supervision of a qualified Professional Engineer licensed in the State of Indiana, detailing fabrication, assembly, and support of formwork:
 - a. Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.

3. Joint Placement Drawings that shall include a plan for sequencing the concrete pours as well as joint type and location.
4. Material Certificates signed by the manufacturer and CONTRACTOR, certifying that each of the following material items comply or exceed the specified requirements:
 - a. Cementitious materials.
 - b. Current tests for cement.
 - c. Admixture certification. Chloride ion content must be included.
 - d. Aggregate gradation.
 - e. Form materials and form-release agents.
 - f. Steel reinforcement and accessories.
 - g. Fiber reinforcement.
 - h. Waterstops.
 - i. Curing compounds and methods of curing.
 - j. Floor and slab treatments.
 - k. Bonding agents.
 - l. Adhesives.
 - m. Vapor retarders.
 - n. Semi-rigid joint filler.
 - o. Joint-filler strips.
 - p. Repair materials.
 - q. Moisture proofing materials
 - r. Damp proofing agent.

1.4 CONCRETE CONFERENCE

- A. See Section 01318 – Meetings.

1.5 QUALITY ASSURANCE

A. General:

1. Prepare and submit Quality Work Plans (QWPs) 15 days prior to use, as required by Section 01400 – Quality Control.
2. Tests on component materials and for compressive strength shall be performed, as indicated herein. Test for determining slump will be in accordance with the requirements of ASTM C143.
3. Laboratory tests on cement, aggregates, and concrete, if directed by CONSTRUCTION INSPECTOR for verification of compliance after the approval of the mix design, will be arranged for and paid for by OWNER. However, CONTRACTOR shall pay the cost of any additional tests and investigation on Work performed which does not meet the Specifications. In this event, the laboratory tests will meet or exceed the requirements of ASTM C1077.
4. Concrete for testing shall be supplied by CONTRACTOR at no additional cost to OWNER, and CONTRACTOR shall assist OWNER or its representative in obtaining samples, and disposal and cleanup of excess material.

B. Field Compression Tests:

1. Among criteria from which CONSTRUCTION INSPECTOR may judge the quality of concrete placed will be that of compressive strengths shown by tests on cylinders and cores. Test cylinders will be made from concrete incorporated or to be incorporated into the Work.
2. Compression test specimens will be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as specified to confirm continued compliance with these Specifications.
3. Concrete cores from completed Work may be taken by, or at the instance of, CONSTRUCTION INSPECTOR and at OWNER expense, but core holes directed by CONSTRUCTION INSPECTOR shall be refilled at CONTRACTOR's expense.
4. Cylinders and cores shall be made and tested in accordance with ASTM C31, C39, and C42. Specimens shall be 6 inch diameter by 12 inch high cylinders.
5. Compression test specimens will be taken during construction from the first placement of each class of concrete each day and at intervals thereafter as selected by CONSTRUCTION INSPECTOR, to ensure continued compliance with these specifications. Each set of test specimens will be a minimum of four cylinders.
6. Compression tests shall be performed in accordance with ASTM C39. One test cylinder will be tested at 1 day and one at 3 days. Two test cylinders will be tested at 7 days and two at 28 days. Any remaining cylinders will be held to verify test results, if required.

7. All testing noted above shall be done by an independent testing laboratory acceptable to OWNER. All costs associated with testing shall be paid by CONTRACTOR.

C. Field Air Content Tests:

1. Air content tests will be taken during construction at intervals as selected by CONSTRUCTION INSPECTOR and OWNER, to ensure continued compliance with these specifications.
2. Air content tests for concrete shall be of the Pressure Method, made in accordance with ASTM C231.
3. Concrete which fails to meet the specified air content of 5 to 7 percent will be rejected.

D. Evaluation and Acceptance of Concrete:

1. Evaluation and acceptance of the compressive strength of concrete will be according to the requirements of ACI 318, Chapter 5 "Concrete Quality," and as indicated herein.
2. A statistical analysis of compression test results will be performed according to the requirements of ACI 214.
3. Should the strengths shown by test or tests be of values less than those required by ACI 318, CONSTRUCTION INSPECTOR may determine and institute supplementary tests and/or corrective measures inclusive of re-testing cement and aggregates; readjusting the proportions of the ingredients of the concrete; revising procedures of mixing, transportation, and placing; providing for the addition of cement; conducting load tests on structures or any other measure deemed appropriate, at no additional cost to OWNER; and, for the institution and/or proving such measures, CONSTRUCTION INSPECTOR may suspend concreting operations.
4. All concrete that fails to meet the ACI requirements and these Specifications is subject to removal and replacement at no additional cost to OWNER.

E. Construction Tolerances:

1. CONTRACTOR shall set and maintain concrete forms and perform finishing operations to ensure that the completed Work is within tolerances.
2. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances.
3. Tolerance is the permissible variation from lines, grades, or dimensions indicated on the Contract Drawings.
4. Where tolerances are not stated in the specifications, permissible deviations will be in accordance with ACI 117.

5. The following construction tolerances apply to finished walls and slabs unless otherwise indicated:

<u>Item</u>	<u>Tolerance</u>
Variation of the constructed linear outline from the established position in plan.	In 10 feet: 1/4 inch In 20 feet or more: 1/2 inch
Variation from the level or from the grades shown.	In 10 feet: 1/4 inch In 20 feet or more: 1/2 inch
Variation from the plumb.	In 10 feet: 1/4 inch In 20 feet or more: 1/2 inch
Variation in the thickness of slabs and walls.	Minus 1/4 inch Plus 1/2 inch
Variation in the locations and sizes of slabs and wall openings.	Plus or minus 1/4 inch

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. General:

1. Cement for concrete shall not be obtained from kilns which burn hazardous waste fuel.
2. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Cement reclaimed from cleaning bags or leaking containers shall not be used. All cement shall be used in the sequence of receipt of shipments.
3. All materials shall comply with the requirements of Sections 201, 203, and 204 of ACI 301, as applicable.
4. Storage of materials shall conform to the requirements of Section 205 of ACI 301.
5. Ready-mix concrete shall conform to the requirements of ASTM C94.

B. Cement:

1. Cement shall be standard brand Portland cement conforming to ASTM C150 for Type II. A minimum of 85 percent of cement by weight shall pass a 325 screen.
2. Cement shall be subject to inspection at the place of manufacture and on the site of construction and to such tests as may be ordered by CONSTRUCTION INSPECTOR. OWNER and its representatives shall, at all times, have free access

to inspect the method of manufacture, storage, transportation, and protection, and shall have liberty to inspect the manufacturer's daily laboratory records of tests and analyses.

3. Air-entraining cement will not be permitted.
4. A single brand of cement, acceptable to CONSTRUCTION INSPECTOR, shall be used throughout the Work.
5. The cement shall be suitably protected from exposure to moisture until used.
6. Cement that has become lumpy shall not be used.
7. Where storage of cement is necessary, CONTRACTOR shall provide, at the site of the Work, or accessible thereto, a weather-tight building suitable for the storage of cement. In order to prevent delays or interruptions to the Work, the building shall have floors raised at least 12 inches above the ground surface and be large enough to provide storage for a sufficient supply of cement while still allowing segregation of different lots or deliveries.
8. Cement kept in storage three months or more shall be re-tested, if required. If the tests prove any cement unsatisfactory, which has been delivered to the site of the Work, such cement shall be at once plainly marked for identification and promptly removed from the Work and its vicinity. Cubes, beams, or briquettes shall be made at any time for the purpose of tests from concrete or mortar being used in the Work, if directed by CONSTRUCTION INSPECTOR.
9. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling.
10. Certified mill test reports, including fineness, for each shipment of cement to be used shall be submitted to CONSTRUCTION INSPECTOR, if requested, regarding compliance with these Specifications.
11. If concrete is mixed on the site of construction, all cement shall be delivered in paper sacks or in strong cloth bags or stored in approved bulk storage facilities. Each bag of cement shall contain not less than 94 pounds of cement net weight, and each barrel measure shall contain four bags. No cement shall be used unless delivered in the original packages with the brand and the name of the manufacturer plainly marked thereon.
12. Cement shall not be used unless it has passed satisfactorily the tests prescribed for specific gravity, fineness, time for setting, and soundness, in the form of standard briquettes. The tensile test shall conform to ASTM C190 - Standard Test Method for Tensile Strength of Hydraulic Cement Mortars. If any cement is proven unsatisfactory on the first tests, it shall be subjected to a second set of tests, including the 28-day tensile test. Any cement used prior to the completion of the 28-day test will be at CONTRACTOR's risk, and if the cement does not comply with the requirements for the 28-day test, OWNER may require any work in which the cement was used to be removed and replaced at CONTRACTOR's expense.

13. OWNER reserves the right to take samples of cement at the place of manufacture, by a representative of OWNER who will conduct the necessary tests at the expense of OWNER.

C. Water:

1. Water for mixing and curing shall be potable. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids (over 1000 milligrams per liter [mg/l] total dissolved solids [TDS]) shall not be used. Water contaminated with sewage or oil; or water containing dirt, clay, filth, or vegetable matter; or river or lake water; shall not be used.
2. The water used in mixing concrete shall be accurately measured for each batch. The quantity to be added shall vary, as hereinafter provided, with the moisture content of the materials and with the condition of the weather. In general, all water for mixing and curing purposes shall be obtained from local utility water mains at CONTRACTOR expense.

D. Aggregates:

1. General:

- a. Aggregates shall be obtained from pits and locations acceptable to CONSTRUCTION INSPECTOR; shall be non-reactive; and, shall conform to ASTM C33. Maximum size of coarse aggregate shall be as indicated herein. Lightweight sand for fine aggregate will not be permitted.
- b. Fine and coarse aggregates shall be kept separate prior to their admission into the concrete mixer and shall be kept clean and free from foreign substances. The methods used in piling and handling of aggregates shall be such as to prevent the segregation of the several sizes of particles.
- c. Adequate storage capacity shall be provided either at the source of supply or at the site of the Work so that sufficient aggregate of each kind and the specified quality may be maintained at all times.
- d. When aggregates that are satisfactory to CONSTRUCTION INSPECTOR have been selected, CONTRACTOR shall secure CONTRACTOR's entire supply of each material from the same source so as to maintain the same quality and grading throughout the Work.
- e. Should it become necessary to change the source or characteristic of the materials used, this shall only be done as additional proportioning and other tests have been completed for the new materials are subject to such safeguards as CONSTRUCTION INSPECTOR may impose for the maintenance of the quality of the aggregate herein specified. CONSTRUCTION INSPECTOR must approve any changes to the mix design or material source suppliers.

2. Coarse Aggregates:

- a. Indiana Department of Transportation (INDOT) Standard Specifications Class A, Size 8, 3/4-inch maximum size or conform to the following.
- b. Coarse aggregates shall consist of clean, hard, durable gravel, crushed gravel, crushed rock, or a combination thereof. The coarse aggregates shall be prepared and handled in two or more size groups for combined aggregates with a maximum size greater than 3/4 inch. When the aggregates are proportioned for each batch of concrete, the two size groups shall be combined.
- c. Coarse aggregate shall meet the requirements of ASTM C33, except as herein modified. Coarse aggregate shall be composed of strong, durable, broken stone or gravel and shall conform to the following requirements:

<u>Contained Deleterious Matter</u>	<u>Percentage by Weight</u>
Removed by decantation	1.0
Clay lumps and friable particles	5.0
Coal	0.5
Soft particles	2.0
Chert as a soft impurity	1.0
Total soft particles and chert as a soft impurity	2.0
Flat and elongated particles (long dimension more than 5 times short)	15.0

Tests for impurities shall be made in accordance with methods listed in ASTM C33.

- d. Coarse aggregate shall show good weathering qualities as it appears in pit or quarry and, when subjected to 10 cycles of the sodium sulfate tests for soundness, and according to the procedures of ASTM C88, shall not show a weighted average loss of more than 10 percent.
- e. Coarse aggregate, unless otherwise specified or shown on the Contract Drawings, shall be well graded between the following limits:

For Class A, B, and C Concrete

Size Number 57 (ASTM C33, Table 2)
Size Number 8 (ASTM C33, Table 2)

- f. In thin sections, such as roof and floor slabs that are poured on supported forms or where otherwise directed, the maximum size of coarse aggregate to be used in the concrete shall be, as described in ASTM C33, Table 2, "Grading Requirements for Coarse Aggregates", size No. 8.
- g. After acceptance of grading, a variation in the quantities passing any sieve size of more than 10 percent of the total shall not be permitted.

- h. Tests for size and grading of the fine and coarse aggregates shall be made in accordance with ASTM C136.
- i. The use of slag is strictly prohibited.

3. Fine Aggregates:

- a. INDOT Standard Specifications, Size #23 or conform to the following.
- b. Fine aggregates shall be natural sand or a combination of natural and manufactured sand that are hard and durable. When tested in accordance with ASTM D2419, the sand equivalency shall not be less than 75 percent for an average of three samples, nor less than 70 percent for an individual test. Gradation of fine aggregate shall conform to ASTM C33. The fineness modulus of sand used shall not be over 3.00.
- c. The fine aggregate or sand used in concrete shall meet the requirements of ASTM C33, except as herein modified.
- d. Fine aggregate shall be clean, siliceous sand, having not more than 3 percent by weight of foreign matter such as loam, clay, dirt, or other impurities and shall be free from injurious amounts of organic impurities.
- e. When subjected to the calorimetric tests for organic impurities and producing a color darker than the standard, it shall be rejected unless it passes the mortar strength test.
- f. Fine aggregate, when subjected to the mortar strength test, shall have tensile and compressive strength, at the end of 7 and 28 days, not less than 100 percent of those developed by mortar of the same proportions and consistency and made of the same cement and standard Ottawa sand.
- g. Fine aggregates shall be well graded from coarse to fine, and when tested by means of laboratory sieves, shall conform to the following requirements:

<u>Passing</u>	<u>Percentage by Weight</u>
3/8-inch sieve	100
No. 4 sieve	95 to 100
No. 8 sieve	80 to 100
No. 16 sieve	50 to 85
No. 32 sieve	25 to 60
No. 50 sieve	10 to 30
No. 100 sieve	2 to 10
Weight Removed by Decantation	not more than 3

The decantation test shall be made in accordance with ASTM C117.

- h. The use of slag is strictly prohibited.

4. Combined Aggregates:

- a. Combined aggregates shall be well graded from coarse to fine sizes and shall be uniformly graded between screen sizes to produce concrete that has optimum workability and consolidation characteristics. Where a trial batch is required for a mix design, the final combined aggregate gradations will be established during the trial batch process.
- b. When tested in accordance with ASTM C33, the ratio of silica released to reduction in alkalinity shall not exceed 1.0.
- c. When tested in accordance with ASTM C33, the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.
- d. When tested in accordance with ASTM C33, the coarse aggregate shall show a loss not exceeding 42 percent after 500 revolutions or 10.5 percent after 100 revolutions.
- e. When tested in accordance with ASTM C33, the loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using sodium sulfate.
- f. The use of slag is strictly prohibited.

E. Admixtures:

1. General:

- a. All admixtures shall be compatible and be furnished by a single manufacturer capable of providing qualified field service representation. Admixtures shall be used in accordance with manufacturer's recommendations.
- b. If the use of an admixture is producing an inferior end result, CONTRACTOR shall discontinue use of the admixture. Admixtures shall not contain thiocyanates or more than 0.05 percent chloride ion and shall be non-toxic after 30 days.
- c. The exact formulation and amount of the admixture to be used shall be that recommended by the manufacturer of the admixture which has been approved by CONSTRUCTION INSPECTOR, and the use thereof shall be under the strict supervision of the manufacturer to produce a concrete of the highest possible density, impermeability, and strength. The manufacturer's recommendation in this regard shall be made after selection of the aggregates to be used and the design of the concrete mix, as provided in this Section.
- d. Admixtures shall conform to the requirements of ASTM C494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used.

2. Air-entraining Agents:

- a. Air-entraining agents shall meet the requirements of ASTM C260.
- b. The quantity of admixture shall be such as to produce an air content in the freshly mixed concrete of 6 percent plus or minus 1 percent as determined in accordance with ASTM C231 or C173, unless otherwise noted on the Contract Drawings.
- c. The air-entraining agent shall be added to the batch in a portion of the mixing water.
- d. The solution shall be batched by means of a mechanical batcher capable of accurate measurement.
- e. Air content shall be tested at the point of placement.
- f. Air entraining agent shall be Micro-Air by BASF; Daravair by W.R. Grace; Sika AEA-15 by Sika Corporation; or approved equal.
- g. OWNER reserves the right, at any time, to sample and test the air-entraining agent.

3. Set Controlling and Water Reducing Admixtures:

- a. Admixtures to the concrete may be used to provide a benefit in water reduction, increased density, improved workability, control of shrinkage, or control of rate of setting, but only with the permission of CONSTRUCTION INSPECTOR. Acceptable evidence must be presented to CONSTRUCTION INSPECTOR that such proposed admixtures, in addition to imparting the desired quality, shall cause no detrimental effect in any of the other desirable properties of the concrete. The admixture, if used, shall be added by means of an approved dispenser to accurately control the amount used in each batch of concrete.
- b. Calcium chloride admixtures will not be permitted.
- c. Concrete shall not contain more than one water-reducing admixture.
- d. Set controlling admixture may be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently greater than 80°F, a set retarding admixture such as Plastocrete by Sika Corporation; Pozzolith 300R by BASF; Daratard by W.R. Grace; or approved equal shall be used. Where the air temperature at the time of placement is expected to be consistently less than 40°F, a non-corrosive set accelerating admixture such as Plastocrete 161FL by Sika Corporation; Pozzutec 20 by BASF; Daraset by W.R. Grace; or approved equal shall be used.
- e. Normal range water reducer shall conform to ASTM C494, Type A. WRDA 79 by W.R. Grace; Pozzolith 322-N by BASF; Plastocrete 161 by Sika Corporation; or

approved equal. The quantity of admixture used and the method of mixing shall be in accordance with the Manufacturer's instructions and recommendations.

- f. Mid-range water reducer shall be Daracem by WR Grace; Pozzolith Polyhed by BASF, or approved equal. Mid-range water reducer shall conform to ASATM C494, Type D.
 - g. High range water reducer shall conform to ASTM C494, Type F or G. Daracem 100 or WDRA 19 by W.R. Grace; Sikament FF or Sikament 86 by Sika Corporation; Rheobuild 1000 or Rheobuild 716 by BASF; or approved equal. High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified. No more than 14 ounces of water reducer per sack of cement shall be used. Water reducer shall be considered as part of the mixing water when calculating water cement ratio.
 - h. ASTM C494, Type F admixtures:
 - (1) Do not combine a naphalene based admixture with a polycarboxylate based admixture. Concrete trucks must be cleaned prior to transporting new concrete mix designs.
 - i. If the high range water reducer is added to the concrete at the job site, it may be used in conjunction with the same water reducer added at the batch plant. Concrete shall have a slump of 3 inches plus or minus 1/2 inch prior to adding the high range water-reducing admixture at the job site. The high range water-reducing admixture shall be accurately measured, and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the job site system.
 - j. High range water reducer shall be used in all concrete containing silica fume admixture.
 - k. All water reducer admixtures in the concrete shall be by the same manufacturer.
 - l. Concrete shall be mixed at mixing speed for a minimum of 30 mixer revolutions after the addition of the high range water reducer.
4. Silica Fume:
- a. Silica fume shall be Force 10,000 by WR Grace; MB-SF by Master Builders; or approved equal.
 - b. Silica fume shall be shipped and added to the mix in the form of a liquid suspension.
 - c. Specialized dispensing equipment recommended by the manufacturer shall be used to add the admixture.
 - d. Mix water shall be adjusted to account for the suspension water in the admixture.

5. Corrosion Inhibiting Admixtures

a. Not Used.

6. Flyash:

a. Flyash shall not be used as an admixture in concrete.

2.2 CURING MATERIALS

A. Materials for curing concrete, as indicated herein, shall conform to the following requirements and ASTM C309 Type I, Class B:

1. All curing compounds shall be clear resin based. Sodium silicate compounds shall not be allowed. Concrete curing compound shall be Kurez by Euclid Chemical Company; MB-429 as manufactured by BASF; L&M Cure R; or approved equal. Water based resin curing compounds shall be used only where local air quality regulations prohibit the use of a solvent based compound. Water based curing compounds shall be Aqua-Cure by Euclid Chemical Company; Masterkure-W by BASF; L&M Cure R-2; or approved equal. Curing compounds must contain 30% solids in accordance with ASTM C1315, Type 1, Class B.
2. Polyethylene sheet for use as concrete curing blanket shall be clear pigmented and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C156 shall not exceed 0.055 grams per square centimeter of surface.
3. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall also conform to ASTM C171. The waterproof paper sheeting shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, have a nominal thickness of 2 mils, and be permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A (1) (2). The loss of moisture, when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 gram per square centimeter of surface.
4. Polyethylene-coated burlap for use as concrete curing blanket shall be 4-mil thick, white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss of moisture, when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 grams per square centimeter of surface.
5. Curing mats for use in Curing Method 6, as indicated in this Section, shall be heavy shag rugs or carpets or cotton mats quilted at 4 inches on center. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.
6. Evaporation retardant shall be a material such as Confilm as manufactured by BASF; Eucobar as manufactured by Euclid Chemical Company; E-CON as manufactured by L & M Construction Chemicals, Inc.; or approved equal.

2.3 MISCELLANEOUS MATERIALS

- A. Dampproofing agent shall be an asphalt emulsion, such as Hydrocide 600 by Sonneborn; Damp-proofing Asphalt Coating by Euclid Chemical Company; Sealmatic by W. R. Meadows Inc., or approved equal.
- B. The moisture proofing shall consist of one gallon per 100 square foot asphalt primer, applied by brush or spray, followed by 30 pounds asphalt coat per 100 square foot surface, applied hot, according to the manufacturer's recommendation. The asphalt primer and finish coat shall conform to the requirements of ASTM D41 and D449, Type I, respectively.
- C. Bonding agents shall be epoxy adhesives conforming to the following:
 - 1. For bonding freshly-mixed, plastic concrete to hardened concrete, use Sikadur 32 Hi-Mod Epoxy Adhesive, as manufactured by Sika Corporation; Concsive Liquid (LPL), as manufactured by BASF; BurkEpoxy MV as manufactured by The Burke Company; Weld-Crete as manufactured by Larsen Products Corporation, Rockville, Maryland; Euroweld as manufactured by Euclid Chemical Company, Euclid, Ohio; or approved equal.
 - 2. For bonding hardened concrete or masonry to steel, use Sikadur 31 Hi-Mod Gel as manufactured by Sika Corporation; BurkEpoxy NS as manufactured by The Burke Company; Concsive Paste (LPL) as manufactured by BASF; or approved equal.

2.4 CONCRETE DESIGN REQUIREMENTS

A. General:

- 1. Concrete shall be composed of cement, admixtures, aggregates, and water of the qualities indicated.
- 2. Depending on the tests made under these Specifications and full size trial batches at the site, the water-cement ratio and mix may be varied to produce concrete of the required strength, watertightness, and resistance to weathering.
- 3. It is the intent of these Specifications to secure, for every part of the Work, concrete of homogeneous structure that, when properly cured and hardened, will have the required strength, durability, and consistency. However, when required, the mixture of cement, sand, and coarse aggregate shall be modified by changing the relative volumes of fine and coarse aggregate and keeping the total volume the same.
- 4. The exact proportions in which these materials are to be used for different parts of the Work will be determined during the trial batch. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results at no

additional cost to OWNER. All changes shall be subject to review by CONSTRUCTION INSPECTOR.

5. The concrete mix design shall limit the rise in temperature due to heat of hydration to less than 30°F.

B. Fine Aggregate Composition:

1. In mix designs for structural concrete, the percentage of fine aggregate in total aggregate by weight shall be as indicated in the following table:

Fine Aggregate	
Fineness Modulus	Maximum Percent
2.7 or less	41
2.7 to 2.8	42
2.8 to 2.9	43
2.9 to 3.0	44

2. For other concrete, the maximum percentage of fine aggregate of total aggregate, by weight, shall not exceed 50 percent.

C. Water-Cement Ratio and Concrete Strength:

1. The concrete mix will be evaluated and comply with ACI 318. The concrete mix shall comply with the following properties:

Type of Concrete	Min 28-Day Compressive Strength, psi	Max Size Aggregate, in	Minimum Cement per cu yd, lbs (bags)	Max W/C Ratio by Weight
Class "A" Concrete	5,000	1	705 (7.5)	0.45
Class "B" Concrete	4,000	1	611 (6.5)	0.45
Class "C" Concrete	3,000	1	470 (5)	0.50

NOTE: CONTRACTOR is cautioned that the limiting parameters above are not a mix design. Additional cement or water reducing agent may be required to achieve workability required by CONTRACTOR construction methods and aggregates. CONTRACTOR is responsible for providing concrete with the required workability. The weight of a bag of Portland cement will be taken as 94 pounds.

- D. The freshly mixed concrete shall have an air content of 6 percent plus or minus 1 percent as determined in accordance with ASTM C231 or ASTM C173, unless otherwise specified on the Contract Drawings.
- E. Adjustments to Mix Design: The mixes shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability, and surface

finish, and CONTRACTOR shall be entitled to no additional compensation because of such changes.

2.5 CONSISTENCY

- A. The quantity of water in a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete which can be worked properly into place without segregation and which can be compacted by vibratory methods to give the desired density, impermeability, and smoothness of surface.
- B. The amount of water used in concrete, inclusive of free water contained in the aggregates but exclusive of water absorbed by the aggregates, shall not exceed 5 gallons per sack of cement for Class A concrete and 7 gallons per sack of cement for Class B concrete.
- C. The quantity of water shall be changed as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency.
- D. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C143.
- E. The maximum allowable slumps for the various types of construction indicated shall be:

<u>Type of Construction</u>	<u>Slump</u>
Foundation walls, external walls below grade, retaining walls, equipment foundations, all footings, slabs on grade, and pavements	4 inches
Slabs, beams and girders poured on supported forms, building columns, and all interior walls	4 inches

2.6 TRIAL BATCH TESTS

- A. Before placing any concrete, a testing laboratory selected by CONTRACTOR and approved by CONSTRUCTION INSPECTOR shall prepare a trial batch of each class of concrete, based on the preliminary concrete mixes submitted by CONTRACTOR. During the trial batch the aggregate proportions may be adjusted by the testing laboratory using the two coarse aggregate size ranges to obtain the required properties. If one size range produces an acceptable mix, a second size range need not be used. Such adjustments will be considered refinements to the mix design and will not be the basis for extra compensation to CONTRACTOR. All concrete shall conform to the requirements of this Section, whether the aggregate proportions are from CONTRACTOR's preliminary mix design or whether the proportions have been adjusted during the trial batch process. The trial batch shall be prepared using the aggregates, cement, and admixtures proposed for the Project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain six compression test specimens from each batch. All costs associated with such testing shall be paid by CONTRACTOR.

- B. The determination of compressive strength will be made by testing 6 inch diameter by 12 inch high cylinders; made, cured, and tested in accordance with ASTM C39 and ASTM C192. Three compression test cylinders will be tested at 7 days and 3 at 28 days. The average compressive strength for the 3 cylinders tested at 28 days for any given trial batch shall not be less than 125 percent of the specified compressive strength.
- C. A sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements of ASTM C136. Values shall be given for percent passing each sieve.

2.7 READY-MIXED (CENTRAL-MIXED OR TRANSIT-MIXED) CONCRETE

- A. When ready-mixed concrete is authorized by CONSTRUCTION INSPECTOR, it shall conform to the requirements of these Contract Documents.
- B. Ready-mixed concrete shall meet all the requirements as to materials, batching, mixing, transporting, and placing as indicated herein and is in accordance with ASTM C94, including the following supplementary requirements.
- C. A representative of OWNER shall have access to the batching or mixing plant for the purpose of inspecting materials used in the mix, for checking proportions of the mix, and for checking the time of departure of each truck from the plant to the job site.
- D. The truck-mixer used in transporting central-mixed concrete shall have its drum rotating continuously at agitating speed from the time it is charged, including water, until it is discharged.
- E. Ready-mixed concrete shall be delivered to the site of the Work, and discharge shall be completed within one hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first. In any case, the concrete shall be discharged prior to the period of initial set.
- F. Truck mixers shall be equipped with counters to record the number of revolutions of the drum. The counter shall be of the recording type and able to be reset and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
- G. For truck-mixed concrete, when CONSTRUCTION INSPECTOR requires that a specified quantity of water be added to the dry cement and aggregates in the truck-mixer drum, the mixer drum shall rotate continuously from the time water is added until the mix is discharged. The mixing period shall include not less than 50 or more than 100 revolutions of the drum or blades at rated mixing speed. Drum speeds shall be as recommended by the mixer manufacturer or as directed by CONSTRUCTION INSPECTOR.
- H. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.
- I. The truck-mixer drum shall not be loaded beyond its rated capacity, or as such, capacity is reduced to prevent spill.

- J. Truck mixers and their operation shall be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than 1 inch when the required slump is 3 inches or less, or if they differ by more than 2 inches when the required slump is more than 3 inches, the mixer shall not be used on the Work unless the cause is determined, corrected and verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum shall be checked before a further attempt to use the unit will be permitted.
- K. Where ready-mix concrete is used, CONTRACTOR shall furnish delivery tickets at the time of delivery of each load of concrete. Each ticket shall show the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate added at the batching plant and the amount allowed to be added at the site for the specific design mix. In addition, each ticket shall state the mix number, total cubic yards batched this load, total cubic yards batched this date for this Project, and the time of day, to the nearest minute, corresponding to the times when the batch was dispatched, when it left the plant, when it arrived at the site, when unloading began, and when unloading was finished.
- L. Each batch of ready-mixed concrete delivered at the job site shall be accompanied by a delivery ticket furnished to CONSTRUCTION INSPECTOR.
- M. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by CONSTRUCTION INSPECTOR.
- N. The truck-mixer drum shall be cleaned thoroughly with clear water after each batch, and all water shall be removed from the drum. No cleaning water shall be allowed to contaminate the concrete during the discharge operation.
- O. Weigh-tickets shall be prepared for each truck showing the normal batch size; the actual weights of cement, aggregate, and water; and the time of loading at the plant. A blank shall also be provided on the weigh-ticket for the time of arrival at the site. A copy of the weigh-ticket shall be delivered to CONSTRUCTION INSPECTOR for each batch of concrete delivered to the site.
- P. Ready-mixed concrete (central-mixed and transit-mixed) will be rejected if there is evidence of improper proportions of ingredients, inclusive of water; if there is evidence of initial set; if more than 60 minutes transpires after batching or mixing before concrete is placed unless otherwise permitted by CONSTRUCTION INSPECTOR; if mixers or trucks are overloaded; or if successive batches are not uniform.

PART 3 - EXECUTION

3.1 PROPORTIONING AND MIXING

- A. Proportioning of the mix shall conform to the requirements of ACI 301, Chapter 3 "Proportioning."
- B. Mixing shall conform to the requirements of ACI 301, Chapter 7.
- C. Slumps shall be as indicated herein.
- D. Re-tempering of concrete or mortar at any time shall not be permitted.

3.2 PREPARATION OF SURFACES FOR CONCRETING

A. General:

- 1. Earth and rock surfaces shall be thoroughly wetted by sprinkling prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.

B. Joints:

- 1. Joints, either vertical or horizontal, shall be made only where called for by the Contract Drawings or as specified.
- 2. Concrete surfaces upon or against which concrete is to be placed, where the placement of the concrete has been stopped or interrupted so that, as determined by CONSTRUCTION INSPECTOR, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints.
- 3. If CONTRACTOR chooses to make his major slab pours in sections smaller than those indicated on the Contract Drawings, between expansion joints or between edges and expansion joints, he shall submit his schedule of pours to CONSTRUCTION INSPECTOR for acceptance together with the details of the reinforcing bars for those pours 15 days prior to the pours. CONTRACTOR shall take into account the location of reinforcing bar laps when determining the limits of each pour.
- 4. When placing of concrete is to be interrupted long enough for the concrete to take a set the working face shall be given a shape by the use of forms or other means that will secure proper union with subsequent Work. Construction joints shall be made only where acceptable to CONSTRUCTION INSPECTOR.
- 5. The surfaces of horizontal joints shall be given a compacted, roughened surface with keyways and waterstops, as indicated in the Contract Documents.

6. In general, the width of keys shall be 1/3 the width of the walls, and the depth of keys shall be 1/6 the width of the walls. All keys shall be continuous, and none smaller than 4 inches in width and 1-1/2 inches in depth shall be used.
7. All joints shall be provided with plastic waterstops in accordance with Section 03290 – Joints in Concrete.
8. Except where the Contract Drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of all laitance, loose or defective concrete, and foreign material, and be roughened to a minimum 1/4-inch amplitude. Such cleaning and roughening shall be accomplished by hydro-blasting, bush hammering, or sandblasting (exposing aggregate) followed by thorough washing. All pools of water shall be removed from the surface of construction joints before the new concrete is placed.
9. Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by hydro-blasting or sandblasting (exposing aggregate). The joint surface shall be coated with an epoxy bonding agent, unless indicated otherwise by CONSTRUCTION INSPECTOR.
10. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the Work. No concrete shall be deposited underwater nor shall CONTRACTOR allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, shall be subject to the review of CONSTRUCTION INSPECTOR.
11. The exposed edges of concrete walls and wall copings and other points of protruding angle, and all "coursing" indicated on the Contract Drawings, shall be chamfered and with special care that the lines are true, sharp, and continuous and uniformly mitered at all points of juncture.
12. In all walls and in places where the working and consolidation of concrete is difficult because of the congestion of steel; inserts; or for other reasons, as determined by CONSTRUCTION INSPECTOR, the placing of concrete shall be preceded by a deposit of grout, consisting of 1 part cement, 3 parts sand, and sufficient quantity of water for a grout that will flow. This grout mix shall be placed to a depth or thickness of 2 inches.
13. At least one hour must elapse, after depositing concrete in the columns or walls, before depositing in beams, girders, or slabs supported thereon. Beams, girders, brackets, column capitals, and haunches shall be considered as part of the floor or roof system and shall be placed integrally therewith.

14. Where called for on the Contract Drawings and particularly where concrete pipe connects to concrete structures, CONTRACTOR shall furnish and install a premolded sponge rubber expansion joint filler equal to ASTM D1752, Type I.

C. Care and Protection of New Work:

1. Fresh concrete shall be protected from heavy rains, flowing water, and mechanical injury. CONTRACTOR shall not permit walking upon concrete until it has set sufficiently. Projecting steel reinforcement or inserts shall likewise be protected from disturbance until the concrete has set.
2. Protection of new Work shall include such operations as the provision and maintenance of curbs; of guard rail or bumpers to shield structures above grade; of planking over necessary traffic crossings; of wood treads upon concrete steps in a manner to safeguard surfaces and nosings from injury; and of paper or wood covering, or plank runways, on finished floors as is appropriate to obviate damage from traffic or from other Work, such as the erection of piping and equipment and the finishing and painting of building interiors.
3. In each of these and similar cases, the intent of this protection is to assure concrete work free from damage or unsightly defects at the completion of the Contract, and the presence or occurrence of such damage or defect shall entail measures remedial thereof by CONTRACTOR, at his expense, and even to the extent of replacing the Work if so ordered by CONSTRUCTION INSPECTOR.
4. Comply with the requirements of Cold Weather Placement and Curing in Cold Weather Sections of this Specification.
5. Comply with the requirements of ACI 305 Hot Weather Concreting.

D. Embedded Items:

1. No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by CONSTRUCTION INSPECTOR at least four hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from previous work shall be cleaned before the surrounding or adjacent concrete is placed.
2. CONTRACTOR shall build into the concrete the steel reinforcement, pipes, slants, sleeves, anchor bolts, steps, castings, electrical conduits, and other inserts, and shall leave the small openings shown upon the Contract Drawings or as directed. Great care shall be taken to keep inserts and openings at proper lines and grade, and to thoroughly tamp under and around them so that there will not be a passage for water. Where inserts are placed in the floors for openings, the top of such shall be 2 inches above the elevation of the finished floor, unless otherwise specified.

E. Corrosion Protection:

1. Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2 inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.

F. Openings for pipes, inserts for pipe hangers and brackets, and anchors shall, where practicable, be provided during the placing of concrete.

G. Anchor bolts shall be accurately set and shall be maintained in position by templates while being embedded in concrete.

H. Cleaning:

1. The surfaces of all metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.3 FORMS

- A. CONTRACTOR shall furnish all labor and materials for all forms required for the construction of the Work and shall have a sufficient number of each resource on the site to avoid unnecessary delay. It is the intent of these Contract Documents that CONTRACTOR shall provide the smoothest possible forms for all concrete surfaces which will be exposed and for the interior surfaces of all concrete conduits, channels, and tanks which contain or transmit water or sewage. The forms for such exposed surfaces shall be of metal or plywood, adequately supported, or shall be lined with plywood, masonite board or similar lining, and/or with metal. The sections of lining material shall be as large as practical in order to minimize joints which shall be tight fitted to assure continuous smooth surfaces.
- B. The design of forms shall be satisfactory to CONSTRUCTION INSPECTOR but need not be submitted for approval unless specifically requested.
- C. Temporary openings shall be provided to the inside of all forms and in column forms to facilitate cleaning and inspection immediately before depositing concrete.
- D. All forms shall be true to the required shape, clean, of sufficient strength, and so braced that they will maintain their proper position during the placing and spading or vibrating of the concrete. They shall be watertight; and if necessary, caulking shall be used to obtain the required tightness.
- E. Tie rods or other means for holding forms shall be of a type acceptable to CONSTRUCTION INSPECTOR, and no wooden spreaders shall be used unless specifically authorized, in which case especial care must be used in assuring removal at time of pouring the concrete.

- F. In general, where watertight work is essential, the metal wall ties shall be of a type that will permit removal to a distance approximately 1-1/2 inches from the face of the wall, free from spalling, and allowing for patching immediately after removal of forms. Twisted wire ties will not be permitted.
- G. Concrete blocks or other approved means must be used to maintain proper distance between steel and forms.
- H. All forms shall be thoroughly cleaned and wetted just before placing the concrete, and, if necessary, to secure a smooth surface, they shall be coated with an approved non-staining substance. Suitable moldings or bevel strips shall be placed in the forms to prevent inside or outside sharp edges. No sharp edges will be permitted in the finished Work.
- I. Forms shall not be struck or removed until permitted by CONSTRUCTION INSPECTOR. In general, forms shall not be removed until the concrete has attained sufficient strength to assure structural stability under all dead and construction loads and until removal can be accomplished without marring concrete surfaces.
- J. The determination of when forms may be removed shall take heed of temperature and humidity. Under favorable conditions, as determined by CONSTRUCTION INSPECTOR, forms shall be kept in place for minimum periods following completion of pour, as follows:

Walls - self-supporting - depending on height and thickness	24-48 hours
Beam sides and unloaded columns	36 hours
Beam and slab bottoms - depending on span and loading and providing that CONTRACTOR may be required to reshore beams immediately after forms are removed	7-14 days

3.4 HANDLING, TRANSPORTING, AND PLACING

- A. Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section. No aluminum materials shall be used in conveying any concrete.
- B. Concrete that during or before placing does not conform to the requirements indicated herein shall be rejected and immediately removed from the Work. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced by CONTRACTOR at no additional cost to OWNER.
- C. Placing:
 - 1. CONTRACTOR shall give CONSTRUCTION INSPECTOR 24 hours notice of his intent to place concrete to enable prior inspection of forms and of conditions

incidental to the pour. Permission to place concrete will not be given until suitable access has been provided to all points of the proposed pour.

2. Provision shall be made for transporting the concrete rapidly from the place of mixing to the Site and with as little vibration as possible, so that the tendency of the water to rise to the top may be reduced to a minimum.
3. The concrete shall be placed before it has had time to obtain its initial set, and under no conditions shall it be re-tempered and used. Any concrete that may have become compacted during transportation shall be satisfactorily re-mixed just before being placed in the form.
4. Before placing concrete, forms shall be thoroughly wetted and the space inside the forms shall be thoroughly cleaned of all chips, shavings, or other debris.
5. The placing of concrete shall be a continuous operation throughout any pour and shall be carried on at such a rate that all concrete surfaces not yet to grade shall not have reached their initial set before additional concrete is placed.
6. Care shall be taken to avoid disturbing steel reinforcement that extends into concrete that has partially set.

D. Placement in Wall and Column Forms:

1. Concrete shall not be dropped through reinforcement steel or into any deep form, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, means such as hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation.
2. In all walls and in places where the working and consolidation of concrete is difficult because of the congestion of steel or because of inserts or for other reasons as determined by CONSTRUCTION INSPECTOR, the placing of concrete shall be preceded by a deposit of grout, consisting of 1 part cement, 3 parts sand, and sufficient quantity of water for a grout that will flow. Grout shall be placed to a depth or thickness of 2 inches.
3. In no case shall the free fall of concrete exceed 6 feet in walls and 8 feet in columns below the ends of ducts, chutes, or buggies.
4. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6 feet in horizontal direction.
5. Concrete in wall forms shall be deposited in uniform horizontal layers not deeper than 2 feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members.
6. The rate of placing concrete in wall forms shall not exceed 5 feet of vertical rise per hour.

7. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.

E. Placement in Slabs and Slopes:

1. Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slab to the top for the full width of the placement.
2. As the Work progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up-slope direction.
3. In special cases, subject to the approval of CONSTRUCTION INSPECTOR, as where concrete is deposited on slopes, a comparatively stiffer mixture may be used, but great care shall be exercised to spread such concrete evenly, in layers not more than 4 inches in thickness, and to ram it thoroughly.
4. In general, the methods shall be such as to give a compact, dense, and impervious concrete with a smooth surface.
5. After concrete is placed, all laitance shall be removed.

F. Conveyor Belts and Chutes:

1. All ends of chutes, hopper gates, and all other points of concrete discharge throughout CONTRACTOR's conveying, hoisting, and placing system shall be designed and arranged so that concrete passing from them will not fall separated into whatever receptacle immediately receives it.
2. Conveyor belts, if used, shall be of a type acceptable to CONSTRUCTION INSPECTOR.
3. Chutes longer than 50 feet will not be permitted.
4. Minimum slopes of chutes shall be such that concrete of the indicated consistency will readily flow in them.
5. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted.
6. All conveyor belts and chutes shall be covered.
7. Long chutes may be permitted for moving concrete, under suitable limitations as to slope and re-handling of concrete, but such concrete from long chutes shall not be delivered directly to the forms. The use of short chutes and their arrangement for the placing of concrete will be subject to CONSTRUCTION INSPECTOR'S approval.

G. Pumping of Concrete:

1. If the pumped concrete does not produce satisfactory end results, CONTRACTOR shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.
2. The pumping equipment shall have two cylinders and be designed to operate with one cylinder in case the other one is not functioning. In lieu of this requirement, CONTRACTOR may have a standby pump on the site during pumping.
3. The minimum diameter of the hose conduits shall be in accordance with ACI 304.2R.
4. Pumping equipment and hose conduits that are not functioning properly shall be immediately replaced.
5. Aluminum conduits for conveying the concrete shall not be permitted.
6. Concrete samples for slump, air content, and test cylinders will be taken as directed by CONSTRUCTION INSPECTOR.

H. Temperature of Concrete:

1. The temperature of concrete when it is being placed shall be not more than 90°F or less than 55°F for sections less than 12 inches thickness nor less than 50°F for all other sections. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the minimum temperature. When the temperature of the concrete is 85°F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes.
2. All concrete placed shall have a temperature of between 50° and 90°F and shall be maintained at a temperature of not less than 50°F for at least 72 hours, or for as much longer time as is necessary to achieve a proper rate of curing for the concrete.

I. Hot Weather Placement:

1. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90°F, CONTRACTOR shall employ effective means, such as pre-cooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90°F. Any ice introduced shall be taken into account with corresponding adjustments made to the amount of mixing water.
2. When concrete is mixed during hot weather, CONTRACTOR shall follow the recommendations for Hot Weather Concreting, ACI-305R of the Manual of Concrete Practice.
3. When necessary CONTRACTOR shall pre-cool aggregates with water sprays and schedule the placing of successive layers of concrete so as to cause maximum release and dissipation of the heat of setting.

4. CONTRACTOR shall be entitled to no additional compensation on account of the foregoing requirements.

J. Cold Weather Placement:

1. All concrete materials, and all reinforcement, forms, inserts, and ground with which the concrete is to come in contact, shall be free from frost.
2. When the temperature is below 40°F, or predicted to go below 36° in the next 24 hours, or predicted to go below 32°F in the next 72 hours, no concrete shall be poured without express permission of CONSTRUCTION INSPECTOR. Permission so granted shall be for the day and location only and must again be requested on subsequent days when temperatures are as above. When such permission is granted, no concrete shall be poured until adequate covering material is on site and until a sufficient number of workmen are present to expedite finishing and covering to keep both as close behind the pouring as is practicable.
3. CONTRACTOR shall provide and use proper facilities for heating water and aggregates and protecting the newly mixed concrete from freezing, and satisfactory appliances shall be provided and used for covering and keeping warm the newly laid concrete. The use of chemicals in the concrete mix to reduce the temperature of freezing will not be permitted. Provide heated enclosures when required to pour concrete during cold weather.
4. Placement of concrete shall conform to ACI 306.1 and the following:
 - a. Remove all snow, ice, and frost from the surfaces, including reinforcement, against which concrete is to be placed. Before beginning concrete placement, thaw the sub-grade to a minimum depth of 6 inches. All reinforcement and embedded items shall be warmed to above 32°F prior to concrete placement.
 - b. The housing, covering, or other protection used in connection with the curing shall remain in place and intact at least 24 hours after artificial heating is discontinued.
5. Discontinuance of protection against freezing temperatures shall be such that the drop-in temperature of any portion of the concrete will be gradual and will not exceed 40°F in 24 hours. In the spring, when the mean daily temperature rises above 40°F for more than three successive days, the specified 72-hour protection at a temperature not lower than 50°F may be discontinued for as long as the mean daily temperature remains above 40°F, provided, that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.
6. CONTRACTOR shall not be entitled to additional compensation on account of the foregoing requirements.

3.5 ORDER OF PLACING CONCRETE

- A. The order of placing concrete in all parts of the Work shall be acceptable to CONSTRUCTION INSPECTOR. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints at the indicated locations.
- B. The surface of the concrete shall be level whenever a run of concrete is stopped. To insure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4-inch-thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 1/2 inch above the underside of the strip. About one hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and all laitance shall be removed.

3.6 TAMPING AND VIBRATING

- A. Concrete shall be consolidated by means of mechanical vibration equipment.
- B. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete.
- C. Vibrators shall be Group 3 per ACI 309, high speed power vibrators (8,000 to 12,000 revolutions per minute [rpm]) of an immersion type in sufficient number and with at least one standby unit as required. Group 2 vibrators may be used only at specific locations when accepted by CONSTRUCTION INSPECTOR.
- D. Vibrators shall be used only by personnel experienced in their use and shall be inserted and removed vertically (not dragged horizontally) at such regular intervals to ensure uniform consolidation throughout the entire section of concrete being placed. In no case shall vibrators be used to transport concrete inside the forms.
- E. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that all air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.
- F. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly.

- G. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the required results within 15 minutes after concrete of the prescribed consistency is placed in the forms.
- H. The vibrating head shall not contact the surfaces of the forms.
- I. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.7 TREATMENT OF SURFACE DEFECTS

- A. As soon as forms are removed, all exposed surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by CONSTRUCTION INSPECTOR. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects, shall be repaired, as indicated below. Concrete containing extensive voids, holes, honeycombing, or similar depression defects shall be completely removed and replaced. All repairs and replacements herein required shall be promptly executed at no increased cost to OWNER.
- B. Defective surfaces to be repaired shall be cut back from trueline a minimum depth of 1/2 inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, plus not less than 1/32-inch depth of the surface film from all hard portions by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar so that while the repair material is being applied the surfaces underneath will remain moist but not so wet as to overcome the suction upon which a good bond depends. The material used for repair shall consist of an epoxy grout or a pre-mix product acceptable to CONSTRUCTION INSPECTOR. For exposed walls, the cement shall contain such a proportion of Atlas White Portland cement as is required to make the color of the patch match the color of the surrounding concrete.
- C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. Holes then shall be repaired in an approved manner with dry-packed cement grout. Holes left by form-tying devices having a rectangular cross-section and other imperfections having a depth greater than their least surface dimension shall not be reamed but shall be repaired in an approved manner with non-shrink cement grout.
- D. All repairs shall be built up and shaped in such a manner that the completed Work will conform to the requirements of this Section, as applicable, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.

3.8 FINISHING CONCRETE SURFACES

A. Formed Surfaces:

1. All concrete surfaces built against forms shall receive the following finish:
 - a. Immediately after the removal of forms, the surface of the exposed concrete shall be moistened and all form ties shall be carefully snapped back to a depth of at least 1-1/2 inches below the concrete surface. The tie holes shall be reamed and neatly pointed up with non-shrink grout.
 - b. All fins and laps shall be removed, and all voids, honeycomb, and broken edges of concrete shall be picked out to sound concrete and carefully patched to correct lines with non-shrink grout.
 - c. Patched areas shall be thoroughly compacted into place and screeded off, so as to leave the patches slightly higher than the surrounding surface. The patches shall be left undisturbed for a period of 1 to 2 hours to permit initial shrinkage before being finished to match the adjoining surfaces.
2. Upon completion of this stage of the finishing work, CONTRACTOR shall continue with the curing.
3. During the above Work, CONTRACTOR shall cover all the exposed concrete with wet burlap, except that portion undergoing current finishing work, which shall be immediately recovered with burlap upon its completion.
4. In addition to the above described finishing operation, a final finish operation shall be given to all concrete surfaces (except manholes) built against forms and which will normally be exposed to view. This will include all interior walls, slab bottoms, edges in buildings, and all similar exterior surfaces, to a point 1 foot below final grade or 2 feet below normal liquid level. The final finish operation shall be a grout finish and shall be applied in the following manner:
 - a. The concrete surface shall be thoroughly moistened (but not soaked) and the entire surface painted with a sand-cement wash. The wash shall be composed of 1 part of Portland cement, of which portion approximately 33 percent shall be White Portland cement and 1 to 1-1/2 parts fine clean sand, passing a No. 30 sieve. The grout shall be of such consistency that it will not run when applied to vertical surfaces, and so that it will fill all voids in the surfaces of the concrete. The sand-cement grout shall be applied with a brush and thoroughly worked into the concrete at a rate that will completely fill all voids in the surface of the concrete and provide a firm, even texture, uniform in color. After the wash has started to harden slightly, but before it has taken its initial set, any excess material shall be removed with a straight edge, and in about an hour, the surface shall be rubbed with a rough cloth or pad to remove the excess wash entirely from the surface and leave the voids filled. The wash shall be applied without a break in application (time lapse sufficient to allow wash to set up) in any wall, beam, or column face except at corners, edges, or other offsets. Prior to final approval of the Work, any surface which has been disfigured by drippings or their

causes shall be thoroughly cleaned, using a weak solution of muriatic acid, if necessary, and grout finish application repeated as required. The entire grout finish operation shall be accomplished using a single brand of Portland cement and a single source for sand throughout the Work.

B. Unformed Surfaces:

1. After proper and adequate vibration and tamping, all unformed top surfaces of slabs, floors, walls, and curbs shall be brought to a uniform surface with suitable tools. Immediately after the concrete has been screeded, it shall be treated with a liquid evaporation retardant. The retardant shall be used again after each work operation, as necessary, to prevent drying/shrinkage cracks. The classes of finish specified for unformed concrete surfaces are designated and defined as follows:
 - a. Finish U1: Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8 inch. No further special finish is required.
 - b. Finish U2: After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Excessive floating of surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted. Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture. Surface irregularities shall not exceed 1/4 inch. Joints and edges shall be tooled where indicated or as determined by CONSTRUCTION INSPECTOR.
 - c. Finish U3: After the Finish U2 surface has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples, and trowel marks. The finish shall be smooth and free of all irregularities.
 - d. Finish U4: Trowel the Finish U2 surface to remove local depressions or high points. In addition, the surface shall be given a light hairbroom finish with brooming perpendicular to drainage unless otherwise indicated. The resulting surface shall be rough enough to provide a nonskid finish.
2. Unformed surfaces shall be finished according to the following schedule:

UNFORMED SURFACE FINISH SCHEDULE

<u>Area</u>	<u>Finish</u>
Grade slabs and foundations to be covered with concrete or fill material	U1
Water bearing slabs with slopes 10 percent and less	U3
Water bearing slabs with slopes greater than 10 percent	U4
Slabs not water bearing	U3
Top surface of walls	U3

3.9 WATERTIGHT STRUCTURES

- A. Specific requirement of this Contract is that of watertight structures, which applies to concrete structures designed to contain water, sewage, or sludge, and also to pits, basements, and the like where the masonry is intended, among other things, to prevent the entry of moisture. Watertightness is interpreted to signify the absence of active leakage visible as streams, trickles, or drops, and also complete freedom from dampness resulting from the penetration of moisture into the concrete. In particular, it is intended that below grade structures shall be dry and free of exterior moisture.
- B. Moisture proofing shall be applied, as specified herein, to the exterior concrete surfaces, below grade, of all concrete walls and top slabs which enclose usable building spaces which are designed for occupancy by either equipment or personnel, except those walls poured against sheet piling and except under slabs. Moisture proofing on walls that intercept grade shall terminate 6 inches below finished grade.
- C. Surfaces to receive moisture proofing shall be smooth, clean, and dry. All holes, joints, and cracks shall be pointed with mortar flush with surface, and high spots shall be cut off or ground smooth. Surfaces shall be carefully swept or dusted to remove all foreign matter immediately before application of moisture proofing.
- D. The moisture proofing shall consist of one gallon per 100 square foot asphalt primer, applied by brush or spray, followed by 30 pounds asphalt coat per 100 square foot surface, applied hot, according to the manufacturer's recommendation. The asphalt primer and finish coat shall conform to the requirements of ASTM D41 and D449, Type I, respectively.
- E. A layer of polyethylene film 4 mils thick shall be placed on the ground as a moisture barrier, prior to the placement of concrete building grade slabs and basement slabs (with or without grade beams), except where pile foundations are used. All joint laps shall be a minimum of 6 inches and shall be sealed by means of polyethylene tape.
- F. Under the requirement of watertight structures, CONTRACTOR shall remedy proven defects, even to the extent of replacing concrete work. Under certain conditions, and where acceptable to CONSTRUCTION INSPECTOR, correction may consist of caulking or of the application of waterproofing, each as approved. Any remedial work to effect watertightness shall be at CONTRACTOR's sole expense and shall not constitute grounds for additional compensation.
- G. CONTRACTOR, where required by CONSTRUCTION INSPECTOR, shall demonstrate the watertightness of tanks and other structures intended to contain liquids. CONTRACTOR at his expense shall provide for such testing.

3.10 CURING

- A. All concrete shall be cured for not less than seven days after placing, in accordance with the methods indicated below for the different parts of the Work:

<u>Surface to be Cured or Dampproofed</u>	<u>Method</u>
Unstripped forms	1
Wall sections with forms removed	4 or 6
Construction joints between footings and walls, and between floor slab and columns	2
Encasement concrete and thrust blocks	3 or 4
All concrete surfaces not specifically indicated in this Paragraph	4
Floor slabs on grade in Hydraulic Structures	5
Slabs not on grade	4 or 6

B. Method 1:

1. Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removal. If steel forms are used, the exposed concrete surfaces shall be kept continuously wet until the forms are removed. If forms are removed within seven days of placing the concrete, curing shall be continued in accordance with Method 6 below.

C. Method 2:

1. The surface shall be covered with burlap mats which shall be kept wet with water for the duration of the curing period until the concrete in the walls has been placed. No curing compound shall be applied to surfaces cured under Method 2.

D. Method 3:

1. The surface shall be covered with moist earth not less than four hours or more than 24 hours after the concrete is placed. Earthwork operations that may damage the concrete shall not begin until at least seven days after placement of concrete.

E. Method 4:

1. The surface shall be sprayed with a liquid curing compound.
2. It shall be applied in accordance with the manufacturer's printed instructions at a maximum coverage rate of 200 square feet per gallon and in such a manner as to cover the surface with a uniform film that will seal thoroughly.
3. Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the 7-day curing period. If the seal is damaged or broken

before the expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.

4. Wherever curing compound has been applied by mistake to surfaces against which concrete subsequently is to be placed and to which it is to adhere, compound shall be entirely removed by wet sandblasting just prior to the placing of new concrete.
5. Curing compound shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces and within two hours after removal of forms. Repairs to formed surfaces shall be made within the 2-hour period; provided, however, that any such repairs which cannot be made within the said 2-hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet-sandblasted to remove the curing compound.
6. At all locations where concrete is placed adjacent to a panel which has been coated with curing compound, the panel shall have curing compound reapplied to an area within 6 feet of the joint and to any other location where the curing membrane has been disturbed.
7. Prior to final acceptance of the Work, all visible traces of curing compound shall be removed from all surfaces in such a manner that does not damage the surface finish.

F. Method 5:

1. Until the concrete surface is covered with curing compound, the entire surface shall be kept damp by applying water, using nozzles that atomize the flow so that the surface is not marred or washed. The concrete shall be given a coat of curing compound in accordance with Method 4 above.
2. Not less than one hour or more than 4 hours after the curing compound has been applied, the surface shall be wetted with water delivered through a fog nozzle and concrete-curing blankets shall be placed on the slabs. The curing blankets shall be polyethylene sheet, polyethylene-coated waterproof paper sheeting, or polyethylene-coated burlap.
3. The blankets shall be laid with the edges butted together and with the joints between strips sealed with 2-inch-wide strips of sealing tape or with edges lapped not less than 4 inches and fastened together with a waterproof cement to form a continuous watertight joint.
4. Wood planks shall be used over the paper or plastic sheets in areas subject to heavy traffic.
5. It is intended that all slabs be kept constantly moist up to seven days of age.
6. The curing blankets shall be left in place during the 7-day curing period and shall not be removed until after concrete for adjacent work has been placed.

7. If the curing blankets become torn or otherwise ineffective, CONTRACTOR shall replace damaged sections.
8. During the first three days of the curing period, no traffic of any nature and no depositing, temporary or otherwise, of any materials shall be permitted on the curing blankets. During the remainder of the curing period, foot traffic and temporary depositing of materials that impose light pressure will be permitted only on top of plywood sheets of 5/8 inch minimum thickness laid over the curing blanket.
9. CONTRACTOR shall add water under the curing blanket as often as necessary to maintain damp concrete surfaces at all times.

G. Method 6:

1. This method applies to both walls and slabs.
2. The concrete shall be kept continuously wet by the application of water for a minimum period of at least seven consecutive days beginning immediately after the concrete has reached final set or forms have been removed.
3. While wall forms remain in place, the top exposed portion of the concrete shall be kept wet, in such a manner that the surplus water will find its way down between the concrete and the forms. After removal of forms, vertical surfaces shall be kept constantly moist by sprinkling with clean water at short intervals, unless otherwise directed during cold weather, or by covering with moistened burlap. A curing compound in conformance with ASTM C309 may also be utilized. However, it is CONTRACTOR's responsibility that subsequent finish and painting operations shall be compatible with this curing compound.
4. It is intended that all walls be kept constantly moist up to seven days of age and particularly so during any patching, finishing, and rubdown operations.
5. Until the concrete surface is covered with the curing medium, the entire surface shall be kept damp by applying water, using nozzles that atomize the flow so that the surface is not marred or washed.
6. Heavy curing mats shall be used as a curing medium to retain the moisture during the curing period. The curing medium shall be weighted or otherwise held substantially in contact with the concrete surface to prevent being dislodged by wind or any other causes. All edges shall be continuously held in place.
7. The curing blankets and concrete shall be kept continuously wet by the use of sprinklers or other means both during and after normal working hours.
8. Immediately after the application of water has terminated at the end of the curing period, the curing medium shall be removed, any dry spots shall be re-wetted, and curing compound shall be immediately applied in accordance with Method 4 above.
9. CONTRACTOR shall dispose of excess water from the curing operation to avoid damage to the Work.

3.11 CURING IN COLD WEATHER

- A. Water curing of concrete may be reduced to six days during periods when the mean daily temperature in the vicinity of the Work is less than 40°F; provided that, during the prescribed period of water curing when temperatures are such that concrete surfaces may freeze, water curing shall be temporarily discontinued. Concrete cured by water shall be protected against freezing temperatures for three days immediately following the 72 hours of protection at 50°F.
- B. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected for the first 24 hours from an excessive carbon dioxide atmosphere by application of curing compound; provided that the use of curing compound for such surfaces is otherwise permitted by these Specifications.

3.12 DAMPPROOFING

- A. The exterior surface of all buried roof slabs shall be dampproofed as follows:
- B. Immediately after completion of curing, the surface shall be sprayed with a dampproofing agent consisting of an asphalt emulsion. Application shall be in two coats. The first coat shall be diluted to 1/2 strength by the addition of water and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon of dilute solution. The second coat shall consist of an application of the undiluted material and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon. Dampproofing material shall be as indicated above.
- C. As soon as the material has taken an initial set, the entire area thus coated shall be coated with whitewash. Any formula for mixing the whitewash may be used if it produces a uniformly coated white surface and remains until placing of the backfill. If the whitewash fails to remain on the surface until the backfill is placed, CONTRACTOR shall apply additional whitewash.

3.13 EQUIPMENT BASES

- A. Where the Contract Drawings or the Specifications call for concrete foundations or bases above floor level to support equipment, such bases shall be formed as shown on the Contract Drawings, but otherwise shall be symmetrical with the equipment metal base and of plan dimensions 6 inches greater. The concrete foundation shall be poured to 1 inch below equipment base grade, with the upper edge chamfered on all sides. Anchor bolts, where required shall be positioned by template (furnished under the equipment item) to proper elevation and secured in place.
- B. After the equipment has been set in position and shimmed to elevation, the space between the concrete foundation and the equipment metal base shall be completely filled with Embeco 636 Pre-Mixed Grout, as manufactured by the BASF Company, Cleveland, Ohio, F-100 Level Fill Grout, as manufactured by the Sauereisen Chemical Company, or approved equal. Exterior edges of the fill shall be projected slightly beyond

the equipment metal base and chamfered. Where practicable, mortar filling as described shall be placed in the presence of the erector of the equipment.

3.14 PROTECTION

- A. CONTRACTOR shall protect all concrete against injury until final acceptance.
- B. In all structures, concrete shall be prevented from drying for at least the first seven days after placing, except where ordered otherwise during cold weather.
- C. Fresh concrete shall be protected from damage due to rain, hail, sleet, or snow. CONTRACTOR shall provide such protection while the concrete is still plastic and whenever precipitation is imminent or occurring.
- D. During hot weather, rapid evaporation of moisture from exposed concrete slabs shall be prevented, between the time of finishing and the applying of polyethylene plastic sheets or curing paper, by means of wind barriers or fog sprays, as directed by CONSTRUCTION INSPECTOR.
- E. Special attention shall be given to concrete slabs of thickness 8 inches or less.

3.15 PATCHING HOLES IN CONCRETE

A. Patching Small Holes:

- 1. Holes which are less than 12 inches in the least dimension shall be filled with non-shrink grout.
- 2. Small holes in members which are water-bearing or in contact with soil or other fill material shall be filled with non-shrink grout.

B. Patching Large Holes:

- 1. Holes which are larger than 12 inches in the least dimension shall have a keyway chipped into the edge of the opening all around, unless a formed keyway exists. The holes shall then be filled with concrete, as indicated herein.
- 2. Holes which are larger than 24 inches in the least dimension and which do not have reinforcing steel extending from the existing concrete, shall have reinforcing steel set in drilled holes filled with non-shrink grout. The reinforcing added shall match the reinforcing in the existing wall unless indicated otherwise.
- 3. Large holes in members that are water bearing or in contact with soil or other fill shall have a bentonite type waterstop material placed around the perimeter of the hole in accordance with the Specifications, unless there is an existing waterstop in place.

C. Bonding Agent:

1. All exposed surfaces of existing concrete shall be coated with an epoxy bonding agent prior to patching the holes.

3.16 CARE AND REPAIR OF CONCRETE

- A. CONTRACTOR shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed Work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at no additional cost to OWNER.

- END OF SECTION 03300 -

SECTION 03315 – ANCILLARY GROUT

PART 1 - GENERAL

1.1 SCOPE

- A. CONTRACTOR shall furnish all materials for grout in accordance with the provisions of this Section and shall form, mix, place, cure, repair, finish, and do all other work, as required, to produce finished grout, in accordance with the requirements of the Contract Documents.
- B. The following types of grout shall be covered in this Section:
 - 1. Non-Shrink Grout:
 - a. This type of grout is to be used wherever grout is shown in the Contract Documents, unless another type is specifically referenced.
 - 2. Cement Grout.
 - 3. Epoxy Grout.
 - 4. Topping Grout and Concrete Fill.

1.2 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM C109 – Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm Cube Specimens).
 - 2. ASTM C531 – Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical- Resistant Mortars, Grouts, and Monolithic Surfacing.
 - 3. ASTM C579 – Test Methods for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacing.
 - 4. ASTM C827 – Test Method for Early Volume Change of Cementitious Mixtures.
 - 5. ASTM D696 – Test Method for Coefficient of Linear Thermal Expansion of Plastics.
- B. U.S. Army Corps of Engineers:
 - 1. U.S.ACE - CRD-C 621 – Corps of Engineers Specification for Non-shrink Grout.

1.3 SUBMITTALS

- A. CONTRACTOR submittals shall conform with Section 01300 – Contractor Submittals.

- B. CONTRACTOR shall also submit to ENGINEER for acceptance, prior to use, certified test results verifying the compressive strength of the proposed grout mix, shrinkage, and expansion requirements specified herein; and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each type of non-shrink and epoxy grout to be used.

1.4 QUALITY ASSURANCE

A. Field Tests:

1. A testing laboratory selected and paid by OWNER will prepare not less than four compression cylinders during construction from the first placement of each type of grout, and at locations and intervals respectively thereafter, as selected by CONSTRUCTION INSPECTOR.
2. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed and paid for by OWNER, as specified in ASTM C109. Sufficient cylinders shall be prepared to provide representative compressive strength results at seven days and 28 days both in the field and laboratory, respectively.
3. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C579, Method B at intervals during construction as selected by CONSTRUCTION INSPECTOR. A set of four specimens will be made for testing at seven days and each earlier time period as appropriate, as approved by CONSTRUCTION INSPECTOR.
4. All grout, already placed, which fails to meet the requirements of these specifications, is subject to removal and replacement at the cost of CONTRACTOR.
5. CONTRACTOR shall be charged for the cost of any additional tests and investigation on Work performed which does not meet the Specifications.
6. Construction tolerances shall be as will be in accordance with ACI 117.

PART 2 - PRODUCTS

2.1 CEMENT GROUT

- A. Cement grout shall be composed of one part cement, three parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, White Portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 days shall be 4,000 pounds per square inch (psi).
- B. Cement grout materials shall use 4,000 psi grout where specified in the Contract Documents, unless other strength is specified.

2.2 PREPACKAGED GROUTS

A. Non-Shrink Grout:

1. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout specified herein shall be that recommended by the manufacturer for the particular application.
2. Class A non-shrink grout shall have a minimum 28-day compressive strength of 5,000 psi; shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C827; and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRD C 621.
3. Class B non-shrink grouts shall have a minimum 28-day compressive strength of 5,000 psi and shall meet the requirements of CRD C 621.
4. Manufacturers or approved equivalent:
 - a. Five Star Grout, Five Star Products, Inc.
 - b. Masterflow 928, Master Builders.
 - c. Unisorb V-1, Unisorb Machinery.
5. Application:
 - a. Class A non-shrink grout shall be used for the repair of all holes and defects in concrete members which are water-bearing or in contact with soil or other fill material; grouting under all equipment base plates; at all locations where grout is specified in the Contract Documents; except for those applications for Class B non-shrink grout and epoxy grout specified herein. Class A non-shrink grout may be used in place of Class B non-shrink grout for all applications.
 - b. Class B non-shrink grout shall be used for the repair of all holes and defects in concrete members which are not water-bearing and not in contact with soil or other fill material, grouting under all base plates for structural steel members, and grouting railing posts in place.

B. Epoxy Grout:

1. Epoxy grout shall be a pourable, non-shrink, 100 percent solids system. The epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all pre-measured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer.

Manufacturer's instructions shall be printed on each container in which the materials are packaged. Epoxy grout shall be BurkEpoxy Anchoring Grout by The Burke Company or approved equal.

2. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application.
3. The mixed epoxy grout system shall have a minimum working life of 45 minutes at 75°F.
4. The epoxy grout shall develop a compressive strength of 5,000 psi in 24 hours and 10,000 psi in seven days when tested in accordance with ASTM C579, Method B. There shall be no shrinkage (0.0 percent) and a maximum 4.0 percent expansion when tested in accordance with ASTM C827.
5. The epoxy grout shall exhibit a minimum effective bearing area of 95 percent. This shall be determined by a test consisting of filling a 2-inch diameter x 4-inch-high metal cylinder mold covered with a glass plate coated with a release agent. A weight shall be placed on the glass plate. At 24 hours after casting, the weight and plate shall be removed and the area in plan of all voids measured. The surface of the grout shall be probed with a sharp instrument to locate all voids.
6. The peak exotherm of a 2-inch diameter x 4-inch high cylinder shall not exceed 95°F when tested with 75°F material at laboratory temperature. The epoxy grout shall exhibit a maximum thermal coefficient of 30×10^{-6} inches/inch/°F when tested according to ASTM C531 or ASTM D696.
7. Application:
 - a. Epoxy grout shall be used to embed all anchor bolts and reinforcing steel required to be set in grout and for all other applications required in the Contract Documents.

2.3 CURING MATERIALS

- C. Curing materials shall be as specified in Section 03300 – Cast-in-Place Concrete for cement grout and as recommended by the manufacturer of prepackaged grouts.

2.4 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency that behaves in a moldable, non-flowing fashion; the type of grout to be used shall be as specified herein for the particular application.
- B. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

2.5 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 - EXECUTION

3.1 GENERAL

- A. All surface preparation, curing, and protection of cement grout shall be as specified below.
 - 1. Earth and rock surfaces shall be thoroughly wetted by sprinkling prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete. The finish of the grout surface shall match that of the adjacent concrete.
 - 2. Materials for curing concrete, as indicated herein, shall conform to the following requirements and ASTM C309 Type I, Class B:
 - a. All curing compounds shall be clear resin based. Sodium silicate compounds shall not be allowed. Concrete curing compound shall be Kurez by Euclid Chemical Company; MB-429 as manufactured by BASF; L&M Cure R; or approved equal. Water based resin curing compounds shall be used only where local air quality regulations prohibit the use of a solvent based compound. Water based curing compounds shall be Aqua-Cure by Euclid Chemical Company; Masterkure-W by BASF; L&M Cure R-2; or approved equal. Curing compounds must contain 30% solids in accordance with ASTM C1315, Type 1, Class B.
 - b. Polyethylene sheet for use as concrete curing blanket shall be clear pigmented and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C156 shall not exceed 0.055 grams per square centimeter of surface.
 - c. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall also conform to ASTM C171. The waterproof paper sheeting shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, have a nominal thickness of 2 mils, and be permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A (1) (2). The loss of moisture, when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 gram per square centimeter of surface.
 - d. Polyethylene-coated burlap for use as concrete curing blanket shall be 4-mil thick, white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss

of moisture, when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 grams per square centimeter of surface.

- e. Curing mats for use in Curing Method 6, as indicated in this Section, shall be heavy shag rugs or carpets or cotton mats quilted at 4 inches on center. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.
 - f. Evaporation retardant shall be a material such as Confilm as manufactured by BASF; Eucobar as manufactured by Euclid Chemical Company; E-CON as manufactured by L & M Construction Chemicals, Inc.; or approved equal.
3. Fresh concrete shall be protected from heavy rains, flowing water, and mechanical injury. CONTRACTOR shall not permit walking upon concrete until it has set sufficiently. Projecting steel reinforcement or inserts shall likewise be protected from disturbance until the concrete has set. Comply with the requirements of ACI 305 Hot Weather Concreting.
- B. Clean grout contact surfaces of oil, grease, scale, and other foreign matter. Chip away unsound concrete leaving surface level but rough.
 - C. Underside of base plates of machinery, rails, and bolts shall be free of grease, oil, dirt, or coatings.
 - D. CONTRACTOR shall provide a representative from the selected manufacturer of Class A non-shrink grout and epoxy grout on-site for technical assistance, upon request from OWNER or CONSTRUCTION INSPECTOR.
 - E. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by CONSTRUCTION INSPECTOR.

3.2 GROUTING PROCEDURES

A. Prepackage Grouts:

- 1. All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

B. Base Plate Grouting:

- 1. For base plates, the original concrete shall be blocked out or finished off at a sufficient distance below the plate to provide for a 1-inch thickness of grout or a thickness as shown on the Contract Drawings.
- 2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout. The mixture shall be of a trowelable consistency and tamped or rodded solidly into the space between the plate and the base concrete. A backing board or stop shall be provided at the back side of the space to be filled with grout. Where this method of placement is not practical or where required by CONSTRUCTION INSPECTOR, alternate

grouting methods shall be submitted for acceptance by CONSTRUCTION INSPECTOR.

C. Topping Grout:

1. All mechanical, electrical, and finish work shall be completed prior to placement of topping or concrete fill. The base slab shall be given a roughened textured surface by sandblasting or hydro-blasting exposing the aggregates to ensure bonding to the base slab.
2. The minimum thickness of grout topping and concrete fill shall be 1 inch. Where the finished surface of concrete fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2 inches wide x 1-1/2 inches deep.
3. The base slab shall be thoroughly cleaned and wetted prior to placing topping and concrete fill. No topping concrete shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat Type II cement grout shall be broomed into the surface of the slab just before topping of fill placement. The topping and fill shall be compacted by rolling or tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade.
4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top for the full width of the placement.
5. The surface shall be tested with a straight edge to detect high and low spots that shall be immediately eliminated. When the topping and fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.

3.3 MIXING AND PLACING

- A. Mix and place in accordance with manufacturer's written instructions.
- B. Provide sealing materials where necessary to retain grout until hardened.
- C. Work grout from one side to other. Avoid trapping air under base plates.
- D. Remove plastic anchor bolt sleeve tops where used and fill with grout at same time base plates are grouted.

3.4 CONSOLIDATION

- A. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled and free of any voids.

3.5 CURING

- A. Cure with curing compound or as recommended by grout manufacturer.

- END OF SECTION 03315 -

SECTION 03400 – PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.1 SCOPE

- A. The Work of this Section includes the manufacturing and installation of precast concrete structures as detailed on the Contract Drawings and specified herein. The manufacturing and installation includes all labor, materials, tools, equipment, and incidentals required to complete the Work.
- B. Precast structures included in this Section are concrete manholes as indicated on the Contract Drawings.
- C. CONTRACTOR is responsible for testing (when required), handling, storing, and transporting of precast structures.

1.2 SUBMITTALS

- A. Shop drawings shall be submitted in accordance with Section 01300 – Contractor Submittals. Submittals shall include information regarding structural design, size and dimensions, reinforcing, location of openings and embedded items, and catalog cuts of all associated materials including frames, hatches, steps, etc. Submit written certification from the manufacturer that all precast structures conform to the applicable standards and requirements specified in this Section. Submit manufacturer-recommended handling and storage requirements to CONSTRUCTION INSPECTOR for information prior to shipment to site.
- B. Product data for each type of product indicated.
- C. Design mixes for each concrete mix.
- D. Material certificates signed by manufacturer certifying that each of the following items complies with the Specification requirements for:
 - 1. Concrete materials.
 - 2. Reinforcing materials and prestressing tendons.
 - 3. Admixtures.
 - 4. Bearing pads.

1.3 QUALITY ASSURANCE

- A. Prior to casting concrete, CONSTRUCTION INSPECTOR will shop inspect each precast structure cover containing aluminum hatches to confirm proper placement of reinforcement steel and hatch formwork.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Precast concrete structures shall be delivered to the site complete and in structurally sound condition. CONTRACTOR shall take proper care in moving the structures to prevent cracking, breaking, or otherwise damaging the structures. Handle and store precast products in accordance with manufacturer recommendations.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Precast manholes, including drop manholes, shall be as indicated in the Contract Documents.
- B. Precast reinforced concrete manholes shall be manufactured, tested, and marked in accordance with ASTM C478. Manhole sections shall not be installed until at least five days after having been cast unless permitted in writing by OWNER.
- C. All joints between precast manhole elements (excluding adjusting rings) shall have a rubber gasket per ASTM C443, and 1/2-inch diameter butyl rubber rope sealant per ASTM C990.
- D. No “see through” lift holes shall be allowed on precast concrete manholes.
- E. Precast concrete structures shall be designed for H2O vehicular loading.

2.2 REJECTION OF DAMAGED MANHOLES

- A. Manholes possessing any of the following defects shall be subject to rejection:
 - 1. Fractures or cracks passing through the shell, except for a single end crack that does not exceed the depth of the joint.
 - 2. Defects that indicate imperfect proportioning, mixing, and molding.
 - 3. Surface defects indicating honeycombed or open profile; damaged ends, when such damage would prevent making a satisfactory joint.
 - 4. The internal diameter of the manhole section shall not vary more than 1 percent from the nominal diameter.
 - 5. Deviations more than 1/4 inch from the straight edge at any point across the top of the manhole cone section or riser ring.
 - 6. Visible steel bars along the inside or outside surface of the manhole except for reinforcement stirrups or spacers used to position the cage during manufacture, and reinforcement bars visible at the manhole structure end, provided these reinforcement bar ends are properly grouted in conformance with applicable ASTM specifications.

7. Manhole sections not clearly or completely marked with date of manufacture, trade name, size designation, part number, or ASTM number.

2.3 MANHOLE CONES

- A. Precast manhole cones shall be an eccentric offset type.
- B. The top internal portion of the cone shall have a minimum 4-inch uniform circumference to accept an internal chimney seal.
- C. The top of the cone shall be cast to accept one precast adjusting ring.

2.4 DROP MANHOLES

- A. Inside or outside drop manholes shall be constructed consistent with the requirements of Paragraph 2.1.

2.5 MONOLITHIC (CAST-IN-PLACE) SANITARY SEWER STRUCTURES

- A. Monolithic pour structures will be approved on a case-by-case basis provided information identifying the concrete mix, steel reinforcement details, pipe connections, and manhole dimensions are submitted by CONTRACTOR and approved by CONSTRUCTION INSPECTOR prior to construction.

2.6 CONCRETE BASES

- A. Base sections for 48- and 60-inch diameter precast manholes shall be constructed with the base and first riser section as one complete integral (monolithic) precast unit. The concrete base shall be as follows: a minimum of 6-inch thickness for 48-inch diameter structures and a minimum of 8-inch thickness for larger diameter structures. Monolithic pour or precast manholes shall be constructed of Class A (5000 psi) structural chloride resistant concrete. Precast manholes 72-inches in diameter and larger with separate base sections shall utilize a gasketed joint between the base section and first riser section.

2.7 FLOW CHANNELS AND BENCH WALLS

- A. The channels shall be shaped and formed with Concrete Fill, as specified in Section 03315 – Ancillary Grout, for a clean transition with proper hydraulics to allow the smooth conveyance of flow through the manholes. The bench wall shall be formed from the invert to a minimum height of 80 percent of the inside diameter of the inlet and outlet pipes to form a “U” shaped channel. The bench top shall be constructed at a 1/2-inch per foot slope from the manhole wall. Refer to the Contract Drawings for typical details of flow channels in manholes.
- B. Where a flow channel is constructed as an integral part of the precast base, it shall be shaped and formed as described above, with the exception that the bottom of the flow channel may be formed from the bottom of inlet and outlet pipes if the pipe wall thickness is not greater than 1-inch.

- C. For cast-in-place flow channels, the bottom invert of all pipes entering a manhole shall be at least 3 inches above the top of the base slab to the outlet invert so the finished sewer channel may be installed and shaped.
- D. For connections to existing sanitary sewer structures, flow channels shall be shaped as if it were a new manhole.

2.8 MANHOLE ADJUSTING RINGS

- A. Only concrete adjusting rings are allowed.
- B. Concrete adjusting rings shall conform to ASTM C478 and be free from voids, cracks, and other defects. The adjusting ring shall be from the same manufacturer as the manhole cone section to assure compatibility and a watertight seal as detailed in the Contract Documents. The minimum thickness of the concrete adjusting ring shall be 4 inches.

2.9 STEPS

- A. Steps are not permitted.

2.10 SEWER TO MANHOLE CONNECTORS

- A. Where indicated on the drawings, sewer pipe connections to rectangular precast manholes shall be made with continuous hydrophilic waterstop, Hydrotite CJ-1020-2K or approved equal, around the sewer pipe. Sewer pipe shall be grouted in place to rectangular precast manhole when this option is indicated on the drawings.
- B. Where indicated on the drawings, sewer pipe connections to manholes shall be made with resilient rubber connectors manufactured in accordance with ASTM C923. Connectors shall be secured to the manhole by either being cast-in or connected with an expandable stainless steel band. Connector shall be secured to the pipe with a stainless steel band. The stainless steel elements of the connector shall be totally nonmagnetic, Series 305 stainless steel.
- C. The resilient rubber connector shall be the sole element relied upon to assure a flexible, watertight seal from the sewer to the manhole.
- D. The resilient rubber connectors shall be as manufactured by Kor-N-Seal, Press Seal, A-Lok, or approved equal.

2.11 MANHOLE CHIMNEY SEAL

- A. Internal Manhole Chimney Seals shall consist of a flexible internal rubber sleeve, interlocking extensions, and stainless steel compression bands conforming to ASTM C923.
- B. The seal shall remain flexible throughout a 25-year design life, allowing repeated vertical movement of the frame of not less than 2 inches and repeated horizontal

movement of the frame of not less than 1/2 inch. The sleeve portion of the seal shall be a minimum double pleated with a minimum unexpanded vertical height of 8, 10, or 13 inches, respectively. The sleeve and extension shall have a minimum thickness of 3/16-inch and shall be made from a high-quality rubber compound conforming to the applicable requirements of ASTM C923, with a minimum 1,500 psi tensile strength, a maximum 18% compression set, and a hardness (durometer) of 48 ± 5 .

- C. The area of the seal that compresses against the manhole frame/casting and the chimney/cone shall provide a watertight seal.
- D. The bands shall be fabricated from 16-gauge stainless steel with no welded attachments and shall have a minimum adjustment range of 2 inches of diameter. Any screws, bolts, or nuts used to lock the band in place shall be stainless steel.
- E. The internal seals shall be as manufactured by Cretex Specialty Products, NPC Specialty Products, or approved equal.

PART 3 - EXECUTION

3.1 BEDDING

- A. The bedding for all manholes shall be a minimum of 6 inches of No. 8 crushed stone or No. 8 fractured-face aggregate.
- B. The stone or aggregate bedding material shall be placed to form a stable base.
- C. Where poor or unstable soil conditions exist, or over excavation has occurred, additional No. 8 crushed stone, No. 8 fractured faced aggregate, No. 2 stone, or lean concrete shall be used to form a stable base.

3.2 BACKFILLING

- A. Manhole backfilling and compaction requirements shall comply with the minimum requirements for the adjacent sanitary sewer pipe as found within these specifications.

3.3 PLACEMENT OF MANHOLE SECTIONS

- A. Precast manhole sections shall be placed and aligned to provide vertical sides. The completed manhole shall be rigid, true to dimensions, and watertight.
- B. The joints between manhole sections shall be properly sealed utilizing an approved rubber gasket and butyl rubber rope.
- C. Manhole cones shall be turned away from the wheel path of paved streets and the flow line of ditches. There shall be no castings located in the flow line of ditches.

3.4 PLACEMENT OF ADJUSTING RINGS

- A. Where one solid riser or barrel section cannot be used, final adjustments in elevation of the casting frame and cover shall be accomplished by the use of precast concrete adjusting rings of a minimum thickness of 4 inches as shown in the Contract Documents. The total number of adjusting rings shall not exceed three and the total height of adjusting rings shall not exceed 12 inches.
- B. Concrete adjustment rings less than 4 inches thick are not allowed. A water tight seal shall be provided between the cone section of the manhole and adjusting ring, each adjoining adjusting ring, and between the adjusting ring and casting by the use of two rows of one 1/2-inch diameter cords of extrudable preformed gasket material, non-asphaltic mastic, or trowelable grade butyl rubber, as shown on the Contract Drawings. This material shall be placed in joints and keyways and be of sufficient quantity to completely fill the joint cavity.
- C. The use of brick or block in lieu of adjustment rings is not allowed.

3.5 BUTYL RUBBER BACKPLASTER

- A. A trowelable grade butyl rubber base exterior backplaster material 1/4-inch minimum thickness, when dry, shall be installed on the outside of the manhole at each joint, extending 6 inches above and below the joint. It shall also be placed on the chimney section from 2 inches below the bottom adjustment ring on the cone section to, and covering, the base of the casting.

3.6 INTERNAL MANHOLE CHIMNEY SEAL

- A. Internal Chimney Seals shall be installed on the joints of all manholes between the casting frame and the cone section per manufacturer's recommendation.

3.7 CONNECTIONS TO MANHOLES

- A. Main line sanitary sewer connections to manholes shall be made using a flexible rubber connector as detailed in this specification.
- B. Saw cutting and hammer taps are prohibited.
- C. All connections shall provide for a watertight seal between the pipe and the manhole.
- D. The connector shall be the sole element relied upon to assure a flexible water tight seal of the pipe to the manhole.
- E. When connecting new pipe to existing manholes, a flow channel and bench walls shall be installed as detailed in this section.
- F. Lateral connections directly to manholes are not permitted.

3.8 LEAKAGE

- A. All manholes shall be watertight and free from leakage.
- B. Each manhole shall be visually inspected for leakage by CONSTRUCTION INSPECTOR after assembly and backfilling.
- C. If the manhole shows signs of leakage, the manhole shall be repaired to the satisfaction of OWNER and reinspected.

3.9 NEGATIVE AIR (VACUUM) TEST

- A. All manholes shall be tested for infiltration by means of a Negative Air (Vacuum) Pressure Test. Testing shall be done per ASTM C1244.
- B. All joints between the top of casting to the bottom of the manhole base shall be included in the test.
- C. The vacuum test shall be as follows:
 - 1. Waiting Period:
 - a. If possible, each manhole shall be tested immediately after assembly and prior to backfilling. If the test is done after backfilling, CONTRACTOR shall be responsible for re-excavation to locate and correct any leaks that have been identified. The vacuum test shall be done before the chimney seal is installed and tested.
 - 2. Equipment:
 - a. Equipment used shall be made specifically for vacuum testing of manholes.
 - 3. Testing Procedures:
 - a. Plug Installation:
 - (1) All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manhole.
 - b. Test Head Installation:
 - (1) The test head shall be placed at the top of the manhole casting in accordance with the manufacturer's recommendations.
 - c. Air Evacuation:
 - (1) A vacuum of 10 inches of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off.

d. Timing Pressure Rise:

- (1) The time for the vacuum reading to drop from 10 inches to 9 inches of mercury shall be measured. The allowable time shall be determined by using the following:

Minimum Test Times			
Manhole Depth, feet	Manhole Diameter, in		
	48	60	72
	Time, seconds		
8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121

e. Determination of Manhole Acceptance:

- (1) If the time shown for the designated manhole depth and diameter elapses before the vacuum reading drops 1 inch, the manhole shall have passed the test.

f. Determination of Manhole Failure:

- (1) If the vacuum reading drops more than 1 inch before the appropriate time has elapsed, the manhole shall have failed the test.

D. CONTRACTOR shall be required to uncover, replace, or repair any or all sections of the manhole and retest.

3.10 CHIMNEY SEAL LEAKAGE TEST

A. The leakage test shall be as follows:

1. Waiting Period:

- a. The leakage test shall be done after the manhole has passed the vacuum test.

B. Testing Procedures:

1. Install the chimney seal and only the bottom expansion band per manufacturer's recommendation. Fully tighten the bottom band. Do not install the top expansion band.
2. Pulling the top of the seal away from the manhole frame, pour 1 gallon of water behind the seal.
3. Observe the bottom seal for a minimum of 1 minute for leakage.
4. Drain the water by folding the top of the chimney seal down.
5. If the chimney seal passes the test, install the top expansion band per manufacturer's recommendation.

C. Determination of Chimney Seal Acceptance:

1. If the bottom expansion band holds water without leaking, the chimney seal shall have passed the test.

D. Determination of Chimney Seal Failure:

1. If the bottom expansion band has any leakage during the test time, the chimney seal will have failed the test.
2. CONTRACTOR shall be required to remove, replace, or reposition the bottom expansion band and retest.

- END OF SECTION 03400 -

SECTION 05500 – METAL FABRICATIONS

PART 1 - GENERAL

1.1 SCOPE

A. Section Includes:

1. Manhole covers and frames.
2. Any other miscellaneous metals item shown on the Contract Drawings or required for proper installation but not specifically noted.

1.2 REFERENCE STANDARDS

A. Submerged - At or below point 18 inches above peak (maximum) water surface elevations in water holding structures.

B. Comply with applicable portions of the following standards:

1. American Society for Testing and Materials (ASTM).
2. National Association of Architectural Metal Manufacturers (NAAMM).
3. American Institute of Steel Construction (AISC).
4. Occupational Safety and Health Administration (OSHA).
5. American Welding Society (AWS).
6. International Conference of Building Officials (ICBO).
7. American Iron and Steel Institute (AISI).
8. American Hot Dip Galvanizers Association (AHDGA).
9. Society for Protective Coatings (SSPC).
10. Aluminum Association (AA).

1.3 QUALITY ASSURANCE

A. Welding:

1. Steel:

- a. Conform to codes for arc and gas welding in building construction of AWS and to AISC Specifications. Surfaces to be welded shall be free from loose scale, rust, grease, paint, and other foreign material, except mill scale, which will

withstand vigorous wire brushing, may remain. No welding shall be done when base metal is lower than 0°F.

- b. Qualify welding operators in accordance with AWS D1.1. Qualification tests shall be run by recognized testing laboratory approved by ENGINEER at CONTRACTOR's expense.
- c. Welding operators shall be subject to examination for requalification using equipment, materials, and electrodes employed in execution of Work. Such requalification, if ordered by ENGINEER, shall be done at CONTRACTOR's expense.

2. Aluminum:

- a. Weld with gas metal arc (GMA) or gas tungsten arc (GTA) processes in accordance with manufacturer's recommendations as approved and in accordance with recommendations of AWS.

3. Stainless Steel:

- a. Conform to codes for Gas Tungsten Arc (GTA), also known as Tungsten Inert Gas (TIG), welding in building construction of AWS and to AISC Specifications. Surfaces to be welded shall be free from loose scale, rust, grease, paint, and other foreign material, except mill scale, which will withstand vigorous wire brushing, may remain. No welding shall be done when base metal is lower than 0°F.
- b. Qualify welding operators in accordance with AWS D1.6. Qualification tests shall be run by recognized testing laboratory approved by ENGINEER at CONTRACTOR's expense.
- c. Welding operators shall be subject to examination for requalification using equipment, materials, and electrodes employed in execution of Work. Such requalification, if ordered by ENGINEER, shall be done at CONTRACTOR's expense.

1.4 SUBMITTALS

- A. Submit the Manhole Casings, Frames, and Covers Shop Drawings to ENGINEER for acceptance prior to fabrication, including the following:
 1. Indicate materials, sizes, connections, anchors, and painting.
 2. Field measure structures and connections necessary and certify Shop Drawing reflects field installation requirements.
 3. Number of copies in accordance with Section 01300 – Contractor Submittals.

- B. Submit product data to ENGINEER for acceptance prior to fabrication including the following:
 - 1. Manufacturer's catalog sheets on pre-manufactured items.
- C. Submit in accordance with Section 01300 – Contractor Submittals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Structural Steel Shapes:
 - 1. W Shapes: ASTM A992, 50 kilopound per square inch (ksi).
 - 2. M Shapes: ASTM A572, 50 ksi.
 - 3. S, C and MC Shapes: ASTM A992, 50 ksi.
 - 4. L Shapes: ASTM A36.
 - 5. HP Shapes: ASTM A572 Grade 50.
 - 6. HSS Square/Rectangular Shapes: ASTM A500, Grade B, 46 ksi.
 - 7. HSS Round Shapes: ASTM A500, Grade B, 42 ksi.
 - 8. Pipe Shapes: ASTM A53, Grade B, 35 ksi.
 - 9. Plates and Bars: ASTM A36.
- B. Stainless Steel:
 - 1. Exterior and Submerged Uses: AISI, Type 316.
 - 2. Industrial Uses: AISI, Type 316.
 - 3. Interior and Architectural Uses: AISI, Type 304.
 - 4. Cast-in-Place Anchor Bolts: AISI, Type 302, 303, or 304.
- C. Aluminum Structural Shapes and Plates: Alloy 6061-T6 or 6063-T6; conform to referenced specifications and ASTM sections found in AA current construction manual series.
- D. Connection Bolts for Steel Members: ASTM A325.
- E. Anchor Bolts: ASTM A307, 1/2-inch minimum diameter; nonsubmerged – stainless steel; submerged - stainless steel.

- F. Anchor Rods: ASTM F1554 55 ksi.
- G. Connection Bolts for Aluminum: Stainless steel.
- H. Cast Iron: ASTM A48, Class 35B.
- I. Cast Aluminum: ASTM B26, Alloy 713.0, tenzaloy.
- J. Cast Ductile Iron: ASTM A536, Grade 65-45-12.

2.2 FABRICATION

A. Connections and Workmanship:

1. Fabricate details and connection assemblies in accordance with the Contract Drawings and Specifications, with projecting corners clipped and filler pieces welded flush.
2. Weld shop connections and bolt or weld field connections, unless otherwise noted or specified.
3. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.
4. Use connections of type and design required by forces to be resisted and to provide secure fastening.
 - a. AISC standard 2-angle web connections or single plate framing connections capable of supporting minimum of 50% total uniform load capacity of members joined as tabulated in uniform load constants of AISC M016.
 - b. Connections shall consist of minimum of two 3/4-inch diameter bolts or welds developing minimum of 10,000 pounds (lbs).
 - c. Make bearing type bolted connections with minimum 3/4-inch diameter bolts with threads included in shear plane, unless detailed otherwise.
5. Welding:
 - a. Grind exposed edges of welds to 1/8-inch minimum radius. Grind burrs, jagged edges, and surface defects smooth.
 - b. Prepare welds and adjacent areas so there is:
 - (1) No undercutting or reverse ridges on weld bead.
 - (2) No weld spatter on or adjacent to weld or other area to be painted or coated.
 - (3) No sharp peaks or ridges along weld bead.

- c. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
- 6. Bolting:
 - a. Draw up bolts or nuts tight in accordance with AISC specifications. Use bolts of lengths required so bolts do not project more than 1/4 inch beyond face of nut. Do not use washers unless specified. Provide hexagonal head bolts with hexagonal nuts.
 - b. Provide holes required for connection of adjacent or adjoining work wherever noted on the Contract Drawings. Locate holes for bolting equipment to supports to tolerance of $\pm 1/16$ inch of dimensions indicated.
 - c. All bolts (ASTM A193 Grade B8M), nuts (ASTM A194 Grade 8M), and washers (ASTM A240) shall be Type 316 stainless steel, unless specifically noted elsewhere.
- B. Fit work together in fabrication shop and deliver complete or in parts, ready to be set in-place or assembled in field.
- C. Galvanizing:
 - 1. Galvanize after fabrication.
 - 2. Galvanize by hot-dip process conforming with ASTM A123 and AHDGA specifications.
 - 3. Galvanize in plant having facilities to produce quality coatings and capacity for volume of work.
 - 4. Ship and handle in manner to avoid damage to zinc coating.
- D. Painting or Coating and Finishes:
 - 1. Do not paint or coat ferrous metal surfaces embedded in concrete.
 - 2. Where other finish is not specified, clean ferrous metal after fabrication to remove oil, mill scale, rust, and foreign matter in accordance with SSPC SP 6. Apply one coat of shop primer.
 - 3. Steel lintels and surfaces not accessible after assembly or erection shall be given two shop coats using different colors of paint to coating, 3.0 mil total dry thickness.
- E. Castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion, smooth, and well cleaned by shot blasting.

2.3 CASTINGS, FRAMES, AND COVERS

- A. Sanitary sewer manhole castings, frames, and covers shall be minimum 30-inch diameter in size. Model numbers and locations are provided as follows:

- B. Standard 30-inch diameter sanitary sewer manhole castings, frames, and covers indicated on the drawings shall be Neenah Model R-1557 or EJ Model equivalent for castings which sit atop slabs or manhole risers. All castings shall have a machined bearing surface with Type F concealed pickholes. Castings shall have a clear opening of 30 inches in diameter.
- C. Sanitary sewer manhole covers shall be a solid lid casting. The words "Sanitary Sewer" shall be cast in recessed letters 1-1/2 to 2 inches in height onto solid lid covers.
- D. Castings shall be manufactured in accordance with ASTM A48, Class 35B, and have a minimum tensile strength of 35,000 psi.
- E. Castings shall be uniform quality, free from blow holes, porosity, hard spots, shrinkage, distortion, or other defects. They shall be smooth and well-cleaned by shot blasting or other approved method.
- F. All castings shall be manufactured true to pattern; component parts shall fit together in a satisfactory manner. Round frames and covers shall be of nonrocking design or shall have machined horizontal bearing surfaces to prevent rocking and rattling under traffic. All castings shall be fully interchangeable.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Layout and install connectors, such as concrete anchors and anchor bolts, to secure metal fabrications to structure.
- B. Erect to lines and levels, plumb and true, and in correct relation to adjoining Work. Secure parts using concealed connections when practicable.
- C. Plumb and true vertical members to tolerance of $\pm 1/8$ inch in 10 feet. Level horizontal members to tolerance of $\pm 1/8$ inch in 10 feet.
- D. Provide items such as bolts, shims, blocks, nuts, washers, and wedging pieces to complete installation.
- E. Drill field holes for bolts. Do not burn holes.
- F. New holes or enlargement of non-conforming holes by use of cutting torch is cause for rejection of entire member.
- G. Perform cutting, drilling, and fitting required for installation of metal fabrications.
- H. Field welds shall be approved by CONSTRUCTION INSPECTOR before prime coating. Clean slag from welds prior to inspection.
- I. All aluminum surfaces in contact with concrete shall have bituminous coatings.

3.2 ADJUSTING AND CLEANING

A. Field repair of damaged galvanized coatings:

1. Repair galvanized surfaces damaged during shipping or erection/construction operations.
2. Repair surfaces using zinc-rich paint.
3. Prepare surfaces and apply in accordance with ASTM A780, Annex A2.

3.3 DELIVERY, STORAGE, AND HANDLING

- #### A. Tag miscellaneous iron, steel, and aluminum, including anchor bolts, concrete anchors, sleeves, and bases, or otherwise mark for ease of identification at the site.

- END OF SECTION 05500 -

SECTION 11105 - GRINDER PUMP STATION UNIT

PART 1 – GENERAL

1.1 SCOPE OF WORK

- A The Work of this Section shall include, but is not limited to, the CONTRACTOR installing complete factory-built grinder pump station unit(s) with venting as shown in the Contract Drawings. Each unit shall include a grinder pump core suitably mounted on an integral stand, tank, precast concrete ballast(s), vent piping, electrical quick disconnect, pump removal harness, discharge assembly/shut-off valve, anti-siphon valve, check valves, electrical alarm assembly and all necessary internal wiring and controls. For ease of serviceability, all pump motor/grinder units supplied shall be of like type and horsepower throughout the system, unless otherwise specified herein.

1.2 RELATED SECTIONS

- A Section 01300 – Contractor Submittals
- B Section 01530 – Protection of Existing Facilities
- C Section 01620 – Product Delivery, Storage and Protection
- D Section 02125 – Erosion and Sediment Control
- E Section 02200 – Excavation and Backfill
- F Section 02205 – Trimming and Fine Grading
- G Section 02730 – Sanitary Laterals
- H Section 02900 – Restoring Lawns and Landscaping

1.3 SUBMITTALS

- A Submit the following in accordance with Section 01300 – Contractor Submittals to CONSTRUCTION INSPECTOR for approval by ENGINEER 30 days prior to use:
 - 1. Complete shop drawings including dimensional and motor data, as well as materials of construction, parts lists, sample warranty, sample service performance plan, and similar.
 - 2. Operations and Maintenance Manual including cut-sheets, drawings, equipment and parts lists, descriptions, maintenance schedules, and similar that are required to instruct proper use of the system for those familiar and unfamiliar with such equipment.

1.4 MANUFACTURER

- A. Grinder pump station units, complete with all appurtenances, form an integral system, and as such, all stations shall be supplied by a single grinder pump station manufacturer.
- B. All grinder pump stations shall be Model DH071 or Model DH151, as manufactured by Environment One, or approved equal.

1.5 FACTORY TEST

- A. Each grinder pump shall be tested before delivery to the site, in accordance with the following requirements:
 - 1. The pump shall be visually inspected to conform that it is built in accordance with the Specification.
 - 2. The motor and seal housing chambers shall be hi-potted to test for moisture content and/or insulation defects.
 - 3. Pump shall be allowed to run dry to check for proper rotation.
 - 4. Discharge piping shall be attached, the pump submerged in water, and amp readings taken in each leg to check for an imbalanced stator winding. If there is a significant difference in readings, the stator windings shall be checked with a bridge to determine if an unbalanced resistance exists. If so, the stator shall be replaced.
- B. All tanks shall be factory leak tested at 5 psig to assure the integrity of all joints, seams and penetration. All necessary penetrations such as inlets, discharge fittings and cable connectors shall be included in this test along with their respective sealing means (grommets, gaskets, etc.). Tanks with discharge bulkhead shall be factory tested to be watertight.

1.6 WARRANTY PERFORMANCE CERTIFICATION

- A. Warranty certification shall be completed by the grinder pump station unit manufacturer.

PART 2 – PRODUCTS

2.1 PUMPS

- A. Pumps shall be Model Extreme series, as manufactured by Environment One, or approved equal.

2.2 GRINDER

- A. The grinder mechanism shall be specifically designed for use in a grinder pump. The grinder shall consist of a radial cutter threaded and locked to the motor shaft, and a matching shredding ring. The grinder components shall be constructed of forged 4140 or 440C stainless steel both hardened to a minimum Rockwell C55.
- B. The grinder shall be placed directly below the pumping elements and shall be direct driven by the motor shaft. The grinder assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to minimize clogging and jamming under all normal operating conditions including starting.
- C. The grinder shall be capable of grinding all materials found in normal domestic sewage as defined by NSF/ANSI 46, including, but not limited to, plastics, rubber, sanitary napkins, and disposable diapers into a finely ground slurry that shall pass freely through the passages of the pumps and the 1¼" diameter discharge.

2.3 BALLASTS

- A. Ballasts shall be pre-cast concrete with minimum dimensions of 36-inch square by 8-inches tall. Each shall include a lifting loop. Ballast shall be as manufactured by Covalen, or approved equal.
 - 1. Standard Type grinder pump station units require single ballasting and Floodway and Floodplain Type require double ballasting.

2.4 MOTOR

- A. Standard motors shall be provided. The motor shall be a capacitor start, ball bearing, air-cooled induction type motor with a low starting current not to exceed 30 amperes and high starting torque of 8.4 foot pounds, or approved equal. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor. This motor protector combination shall have been specifically investigated and listed by Underwriters Laboratories, Inc. (U.L.), for the application.

2.5 ELECTRICAL POWER/CONTROL CORD/WIRING

- A. Electric power/control cord shall be SOW/SOW-A water resistant 600 V, 60 degrees C, U.L. and or Canadian Standards Association (C.S.A) approved. The single cord shall incorporate both power and sensor leads, shall have a minimum of seven (7) conductors, and include a factory installed NEMA 6P electrical quick disconnect. All wiring in the grinder station shall be installed and functionally tested prior to shipment from the factory. All electrical cable penetrating or passing through the silhouette of the pump station must be guaranteed to be water-tight by the manufacturer and must be installed at the factory prior to shipment. Cable shall be direct buried and must be factory installed in the station, arriving at the jobsite with a minimum length of 50 feet

external to the station ready to unroll and connect the alarm panel/power source. Factory wiring and testing shall be a specific part of the U.L. listing.

- B. The motor cord-entry sealing assembly shall be a positive, redundantly water tight seal. The sealing components shall be mechanically isolated from any strains by a two-piece cord grip, which shall securely grip the molded cord jacket above the moisture-sealing components and bear any mechanical forces applied to the cord. Additionally, the cord grip shall provide redundant sealing of the molded cord jacket outside diameter.

2.6 MECHANICAL SEAL

- A. The pump/core shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. Seals may be constructed of silicon carbide or carbon ceramic and shall be held in place with stainless steel hardware.

2.7 TANK

- A. The tank shall be made of high-density polyethylene, injection-molded engineered polypropylene copolymer thermoplastic with a corrugated high-density polyethylene riser, or fiberglass reinforced polyester (filament wound technique construction; resin rich) with an integral anti-flotation ring/flange. Tanks shall be designed to withstand wall collapse or buckling based on a hydrostatic pressure of 62.4 pounds per square foot, a saturated soil weight of 135 pounds per cubic foot, and a soil modulus of 700 pounds per square foot. The tank shall be constructed to withstand or exceed 200 percent of the assumed loading at any depth. Tanks and covers shall be stabilized against UV degradation to UV-8 protection level (ASTM D2565). Covers shall be provided with bolt-on or twist-on tank connections and provisions for affixing a manufacturer provided padlock.
- B. The minimum total tank storage capacity shall be 70 gallons, or as required for proper pump operations and mitigation of odor building.
- C. The tank shall be furnished with an EPDM grommet fitting to accept a 4.50" OD DWV (Schedule 40) inlet pipe or approved equal.
- D. The station shall have all necessary penetrations factory sealed and tested. No field penetrations shall be acceptable.
- E. The discharge piping shall include a manual, fully-ported ball valve. The ball valve shall be constructed of bronze with a stainless steel ball, stainless steel stem and hardware, and Teflon seats with a rated pressure of 235 psi Water-Oil- Gas (WOG). The bulkhead penetration shall be factory-installed and warranted by the manufacturer to be watertight.
- F. All valves shall be operable from ground level with a color-coded actuation cord tagged green to open, red to close.

- G. The tank shall be equipped with a PVC vent flange to accept a 2" DWV (Schedule 40) vent pipe at a sufficient elevation to prevent infiltration. A bug screen shall be provided.

2.8 DISCHARGE HOSE AND DISCONNECT/VALVE

- A. Internal discharge piping: The tank shall be equipped with series 300 stainless steel piping, bronze, and/or engineered thermoplastic discharge piping jointed by tapered pipe threads or solvent cement.
- B. External discharge piping: 48 inches of series 300 stainless steel piping, high-density polyethylene (HDPE), or engineered thermoplastic flexible piping shall be installed to discharge connection.
- C. The discharge hose assembly shall include a shut-off valve rated for 200 psi WOG and a quick disconnect feature to simplify installation and pump removal. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.

2.9 ELECTRICAL QUICK DISCONNECT

- A. The accessway shall include a single NEMA 6P Electrical Quick Disconnect (EQD) for all power and control functions, factory installed with accessway penetrations warranted by the manufacturer to be watertight. The Electrical Supply Cable (ESC) shall be installed in the basin by the manufacturer. Field assembly of the ESC into the basin is not acceptable because of potential workmanship issues. The EQD shall require no tools for connecting, seal against water before the electrical connection is made, and include radial seals to assure a watertight seal regardless of tightening torque. Plug-type connections of the power cable onto the pump housing will not be acceptable due to the potential for leaks and electrical shorts. A junction box shall not be permitted in the accessway due to the large number of potential leak points. The EQD shall be so designed to be conducive to field wiring as required. The accessway shall also include an integral 2-inch vent to prevent sewage gases from accumulating in the tank.

2.10 ANTI-SIPHON VALVE

- A. The pump discharge shall be equipped with a factory-installed, gravity-operated, flapper-type integral anti-siphon valve built into the discharge piping. Moving parts shall be made of 300 series stainless steel and fabric-reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure proper operation even at a very low pressure. The valve body shall be injection-molded from an engineered thermoplastic resin. Holes or ports in the discharge piping are not acceptable anti-siphon devices. The anti-siphon port diameter shall be no less than 60% of the inside diameter of the pump discharge piping.

2.11 CHECK VALVE

- A. The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the discharge piping. The check valve shall provide a full-ported passageway when open and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Moving parts shall be made of a 300 series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back-pressure. The valve body shall be an injection molded part made of glass fill PVC. The working pressure of the valve shall be at least 235 psi. Ball-type check valves are unacceptable due to their limited sealing capability in slurry applications.

2.12 CONTROLS

- A. Non-fouling wastewater level controls for controlling pump operation (ON, OFF, and HIGH-LEVEL alarms) shall be accomplished by monitoring the pressure changes in an integral air column connected to a pressure switch. The level detection device shall have no moving parts in direct contact with the wastewater.
- B. High-level sensing shall be accomplished in the manner detailed above. Closure of the high-level sensing device shall energize an alarm circuit as well as a redundant pump-on circuit. For increased reliability, pump ON/OFF and high-level alarm functions shall not be controlled by the same switch. Float switches of any kind, including float trees, shall not be acceptable.

2.13 ALARM PANEL

- A. Each grinder pump station shall include a NEMA 4X, UL-listed alarm panel suitable for wall or pole mounting. The NEMA 4X enclosure shall be manufactured of thermoplastic polyester or poly carbonate to ensure corrosion resistance. The enclosure shall include a hinged, lockable cover with padlock, preventing access to electrical components, and creating a secured safety front to allow access only to authorized personnel. The enclosure shall not exceed 10.5" W x 14" H x 7" D, unless otherwise approved.
- B. The alarm panel shall contain one 15-amp, double-pole circuit breaker for the pump core's power circuit and one 15-amp single-pole circuit breaker for the alarm circuit. The panel shall contain a push-to-run feature, an internal run indicator, and a complete alarm circuit. All circuit boards in the alarm panel are to be protected with a conformal coating on both sides and the AC power circuit shall include an auto resetting fuse.
- C. The alarm panel shall include the following features: external audible and visual alarm; push-to-run switch; push-to-silence switch; redundant pump start; and high-level alarm capability. The alarm sequence is to be as follows when the pump and alarm breakers are on:

1. When liquid level in the sewage wet well rises above the alarm level, audible and visual alarms are activated, the mechanical floats or contacts on the alarm pressure switch activate, and the redundant pump starting system is energized.
 2. The audible alarm may be silenced by means of the externally mounted, push-to-silence button.
 3. Visual alarm remains illuminated until the sewage level in the wet well drops below the "off" setting of the alarm pressure switch.
- D. The visual alarm lamp shall be inside a red, oblong lens at least 3.75" L x 2.38" W x 1.5" H. Visual alarm shall be mounted atop the enclosure in such a manner as to maintain the NEMA 4X rating. The audible alarm shall be externally mounted on the bottom of the enclosure, capable of 93 dB @ 2 feet. The audible alarm shall be capable of being deactivated by depressing a NEMA 4X push-type switch that is encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure (push-to-silence button).
- E. The entire Alarm Panel shall be listed by Underwriters Laboratories, Inc. or approved equal.

2.14 SERVICEABILITY

- A. The grinder pump core and appurtenances shall include lifting mechanisms to facilitate easy core removal when necessary. The level sensor assembly must be easily removed from the pump assembly for service or replacement. All mechanical and electrical connections must provide easy disconnect capability for core unit removal and installation. Each electrical quick disconnect half must include a water-tight cover to protect the internal electrical pins, while the electrical quick disconnect is unplugged. A pump push-to-run feature shall be provided for field trouble shooting. The push-to-run feature must operate the pump even if the level sensor assembly has been removed from the pump assembly. All motor control components shall be mounted on a readily replaceable bracket for ease of field service.
- B. All maintenance tasks for the grinder pump station shall be possible without entry into the grinder pump station, as per OSHA 1910.146 Permit-Required Confined Space.

2.15 SAFETY

- A. The grinder pump shall be free from electrical and fire hazards as required in a residential environment. As evidence of compliance with this requirement, the completely assembled, factory wired, and tested grinder pump station shall be listed by Underwriters Laboratories, Inc., to be safe and appropriate for the intended use. UL listing of components of the station or third-party testing to UL standard shall not be accepted.
- B. The grinder pump shall meet accepted standards for plumbing equipment for use in or near residences, shall be free from noise, odor, or health hazards.

2.16 GENERATOR RECEPTACLE

- A. The alarm panel shall include a 20-amp, 250 VAC generator receptacle with NEMA L 14-20 configuration and with a spring-loaded, gasketed cover suitably mounted to provide access for connection of an external generator while maintaining a NEMA 4X rating. A 30-amp automatic transfer switch shall be provided, which automatically switches from AC power to generator power. Power shall be provided to the alarm panel through the generator receptacle whenever power is present at the receptacle, allowing the audible and visual alarms to function normally in generator mode. When power is no longer applied to the generator receptacle, the panel is automatically switched back to the AC Main power. No manual switching within the panel enclosure is necessary to switch from generator power back to AC Main, so the mode cannot be inadvertently left in the generator position after pumping down the station in generator mode as is the case with a manual transfer switch.

PART 3 – EXECUTION

3.1 DELIVERY AND INSTALLATION OF GRINDER PUMP UNITS

- A. All grinder pump units delivered to the job site shall be 100% completely assembled, including testing, and ready for installation. Grinder pump station units shall be individually mounted on wooden pallets. Grinder pump cores shall be shipped in a separate container and are only required to be installed in the tank. The grinder pump stations shall be stored in a weather tight lockable enclosure maintaining a minimum temperature of 50 °F.
- B. The grinder pump units, including the low pressure lateral from the lateral assembly to the grinder pump station unit, the grinder pump station unit, precast concrete ballast(s), vent piping, the electrical panel, and the gravity connection from the house to connection with the grinder pump station, shall be installed by the CONTRACTOR, and shall only be allowed to operate after the Owner- certified date of substantial completion. The CONTRACTOR shall install the grinder pump station unit within 30 days of delivery to the property owner, to avoid theft, damage, or inconveniences to the property with maintaining their property. The CONTRACTOR shall be required to coordinate in advance with the property for scheduling installation of the grinder pump unit.
- C. Grinder pump station units and control panels shall be installed in accordance with the manufacturers' specifications, local code requirements and as specified herein.
- D. Install grinder pump units on a minimum of 6 inches of stone bedding. Install precast ballast before hoisting grinder pump unit into excavated area. Ensure unit is level before backfilling. Backfill the grinder pump unit with washed #8 crushed stone above inlet and discharge piping. If the native soil condition consists of clean, compactible soil with less than 12% fines, free of ice, rocks, roots, and organic material, it may be an acceptable backfill. Such soil must be compacted in lifts not to exceed one foot to reach a final maximum density greater than 90%. Non-compactable clays and silts are NOT suitable backfill for this or any underground structure such as inlet or discharge lines. Native soil may be used as backfill above

the discharge line and placed in lifts not to exceed one foot to reach a final maximum density greater than 90%.

- E. CONTRACTOR shall furnish each property owner with a copy of the grinder pump station unit installation instructions and warranty information that the CONTRACTOR obtains from the grinder pump station unit manufacturer.

3.2 WARRANTY

- A. The grinder pump manufacturer shall provide a parts and labor warranty to the property owner on the complete station and accessories, including, but not limited to, panel and redundant check valve, for a period of twenty-four (24) months after OWNER acceptance and delivery of the complete station and accessories to the property owner. Any manufacturing defects found during the warranty period shall be reported to the manufacturer by the property owner and shall be corrected by the manufacturer at no cost to OWNER or property owner.

- END OF SECTION 11105 -

SECTION 15101 – VALVES AND APPURTENANCES

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Work of this Section includes, but is not limited to, providing and installing valves and appurtenances in sizes and capacities as shown in the Contract Documents.

1.2 RELATED SECTIONS:

- A. Section 01300 – Contractor Submittals
- B. Section 01620 – Product Delivery, Storage, and Protection
- C. Section 02560 – Low Pressure Sewer (LPS)

1.3 QUALITY ASSURANCE

- A. Provide in accordance with Contract Documents and as specified herein.
- B. Provide enclosures for atmospheres specified and indicated.

1.4 SUBMITTALS

- A. Shop Drawings for the specified equipment shall be submitted in accordance with Section 01300 – Contractor Submittals shall include manufacturer's catalog cut-sheets, material information, and certifications of proof of compliance with all applicable standards.
- B. Three (3) copies of all required testing reports shall be provided to the CONSTRUCTION INSPECTOR upon completion of the Work and before final payment.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Provide in accordance with Section 01620 – Product Delivery, Storage and Protection and as specified herein.
- B. Shipping:
 - 1. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.
 - 2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

3. CONTRACTOR shall obtain spare parts from the manufacturer at the same time as pertaining equipment. CONTRACTOR shall maintain possession of spare parts until Substantial Completion, at which time all spare parts shall be turned over to OWNER.
- C. Receiving:
1. Inspect and inventory items upon delivery to site.
 2. Store and safeguard equipment, material and spare parts in accordance with manufacturers written instructions.

PART 2 - PRODUCTS

2.1 LATERAL ASSEMBLY VALVE

- A. For each lateral assembly, provide a Uni-Lateral stainless steel lateral valve.
- B. The valve shall consist of a check valve, ball valve, and cleanout in one compact module as provided by E/One or approved equal.
- C. The valve shall be construction of 304 stainless steel and be compatible for use with 1 ¼" HDPE DR-11.

2.2 LATERAL ASSEMBLY PIT

- A. Pit chamber shall consist of 24" diameter precast RCP in paved areas and within 5 feet of paved areas.
- B. Pit chamber shall consist of 24" diameter HDPE for pit 5 feet or more outside of paved areas.
- C. Pit cover shall be NEENAH R-1772 frame and solid lid with 2 concealed pickholes and self-sealing gasket, with "SANITARY SEWER" stamped into surface RCP in paved areas and within 5 feet of paved areas.
- D. Pit cover (with "SEWER" stamped into surface) shall be Star Products #SP-V32026SEWER, or approved equal for pit 5 feet or more outside of paved areas.

2.3 BALL VALVE

- A. Provide fully ported ball valve as shown in the Contract Drawings. Ball valves shall be utilized in flushing assemblies and as mainline valves. Valve shall be rated for pressure applications. Approved product is the Full Port Polyethylene Ball Valve PE4710 as manufactured by Georg Fischer Central Plastics or approved equal.

2.4 AIR RELEASE STATION

- A. Air Release Stations shall be as provided by E/One or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Prior to installation, protect stored valves and appurtenances from damage due to exposure to sunlight, heat, dirt, debris, freezing and thawing, and vandalism.
- B. Clean all debris, dirt, gravel, etc. from inside of piping before placing valves in place.
- C. Erect and support valves in respective positions free from distortion and strain on appurtenances during handling and installation. Inspect material for defects in workmanship and material. Clean out debris and foreign material from valve openings and seats, test operating mechanisms to check functioning, and check nuts and bolts for tightness. Repair valves and other equipment which do not operate easily or are otherwise defective at no additional cost to OWNER.

3.2 AIR RELIEF STATION

- A. Install Air Release Stations in locations as shown in the Contract Drawings.

3.2 BALL VALVES

- A. Install valves per manufacturer's recommendation and as otherwise directed by the ENGINEER.

3.4 VALVE BOXES:

- A. Install valve box for each buried valve as indicated in the Contract Drawings.
- B. Set valve box so top is flush with finished surface and so box does not bear on valve, or pipe.

- END OF SECTION 15101 -

**TECHNICAL SPECIFICATIONS
MATERIAL AND WORKMANSHIP**

TABLE OF CONTENTS

Specification No.	Specification Title
DIVISION 01	GENERAL REQUIREMENTS
01 00 00	General Requirements
01 22 00	Measurement and Payment
01 31 14	Coordination with Plant Operations
01 32 00	Construction Progress Documentation
01 32 16	Construction Progress Schedule
01 32 36	Preconstruction Video Monitoring and Documentation
01 33 00	Contractor Submittals
01 40 00	Quality Requirements
01 50 00	Mobilization and Demobilization
01 74 23	Final Cleaning
01 76 01	Protecting Existing Facilities
01 78 23	Operation and Maintenance Data
01 78 39	Project Record Documents
DIVISION 02	EXISTING CONDITIONS
02 41 00	Demolition
DIVISION 03	CONCRETE
03 20 00	Concrete Reinforcement
03 30 00	Cast-in-Place Concrete
03 30 11	Grout
03 40 00	Precast Concrete Structures
DIVISION 07	THERMAL AND MOISTURE PROTECTION
07 10 00	Dampproofing and Waterproofing
DIVISION 09	FINISHES
09 97 00	Special Coatings
DIVISION 27	COMMUNICATIONS
27 05 43	Underground Ducts and Raceways for Communications Systems
DIVISION 31	EARTHWORK
31 10 00	Site Clearing
31 23 00	Excavation and Fill
31 23 19	Dewatering
31 25 00	Erosion and Sediment Controls
DIVISION 32	EXTERIOR IMPROVEMENTS
32 12 16.13	Plant-Mix Asphalt Paving
32 90 00	Planting

Specification No.	Specification Title
DIVISION 33	UTILITIES Underground Piping
33 05 23.31	Steel Ring Beam and Lagging Tunnel
33 05 24.31	Tunnel Carrier Piping System
33 05 24.35	HDPE Lined Sanitary RCP Piping
33 05 26.13	Identification Signs, Plaques, and Labeling
33 05 26.16	Identification Markers
33 05 26.22	Existing Underground Utilities
33 05 26.23	Underground Utility Line Marking Tracer Wires and Tape
DIVISION 40	PROCESS INTEGRATION
40 05 13	Process Piping
40 05 23	Process Valves
Attachments	Description
Attachment A	Geotech Report

CONTRACT SPECIFICATIONS

PROJECT NO. 92RE04106 and 92RE04107

SOUTHWEST DIVERSION INTERCEPTOR (SWDI) AND TWIN TRANSFER SLUDGE LINES (TRSL)

Relocation Across I465 and Along Warman Avenue

MAY 8, 2020

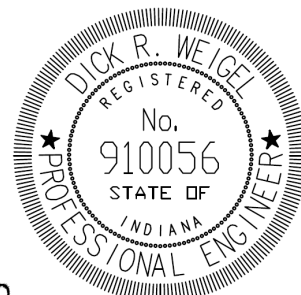


2020 North Meridian Street
Indianapolis, Indiana
46202



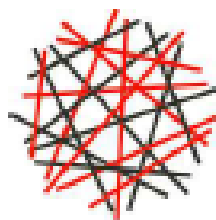
A handwritten signature in black ink that reads "Mark T. Westphal".

Mark T. Westphal, PE



A handwritten signature in black ink that reads "Dick R. Weigel".

Dick R. Weigel, PE



HWC

ENGINEERING

SECTION 01 00 00 - GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK UNDER THIS CONTRACT

- A. The Contract work provides for the construction of Citizen's Energy Group (CEG) projects SOUTHWEST DIVERSION INTERCEPTOR (SWDI) AND TWIN TRANSFER SLUDGE LINES (TRSL) RELOCATION ACROSS 465 CEG PROJECT NUMBERS: 92RE04106 (SWDI) & 92RE04107 (TRSL) pertinent and incidental thereof, including the furnishing of all labor, materials, supplies, equipment, work and services, ready for satisfactory and continuous operation, in accordance with the drawings and specifications.
- B. Work to be performed shall be in accordance with drawings and specifications prepared by The Etica Group, Inc., 7172 N. Keystone Ave. Suite G, Indianapolis, Indiana 46240. All work must at a minimum conform with CEG Standards.
- C. Responsibilities of Engineers
 - 1. Etica Group, Inc. is the design engineering firm for the project. During construction, Etica Group, Inc. will be responsible for processing and reviewing shop drawings, answering questions pertaining to plans and specifications, and visiting project sites as needed to answer questions from the Owner, Owner's project representative, or the Contractor.
 - 2. CEG is the contract operator for the two wastewater treatment plants in Indianapolis, Indiana.

1.2 SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION

- A. The Contractor shall be solely responsible for all obligations prescribed as employer obligations under all applicable State, Federal, and Local safety related laws and regulations. The Contractor must also, at a minimum, comply with all CEG Safety Rules and Regulations.
- B. The Owner requires the Contractor employees (and any sub-contracted employees) to attend onsite Safety Training prior to any onsite work commencing. *Other private property owners might also require onsite Safety Training if access to their private roadways leading to CEG's easements is necessary.*
- C. Personal Protective Equipment (PPE) must be worn at all times while on this project. Mandatory items are safety boots, reflective vest, hard hat with a current CEG Safety Orientation Sticker fixed to it, and safety glasses. Other PPE, such as gloves, ear plugs, etc., must be worn when applicable to comply with and exceed all OSHA regulations.
- D. The use of drugs, tobacco (including smokeless varieties) and alcohol is strictly

prohibited at all property owned, leased, or otherwise associated with the Owner. The possession of alcohol while on the job site is strictly prohibited.

1.3 REQUIRED CONSTRUCTION PERMITS

- A. The Design Build team is required to obtain all necessary permits for the described work. The Design Engineer has NOT obtained a Rule 5 Permit for Storm Water Run-Off Associated with Construction Activity for this project. The Design Engineer has NOT obtained an IDEM Sanitary Sewer Construction Permit for this project. The Design Engineer has also NOT obtained an IDNR Construction in a Floodway permit for this project. The Design Engineer has NOT obtained a Street Abandonment nor Construction In the Right of Way Permits from the City of Indianapolis nor INDOT for this project. Contractor is responsible for obtaining all other necessary permits for construction activities related to this project.
- B. Spill Response: Refer to the Storm Water Pollution Prevention Plan for Construction Activity developed by the Design Engineer for appropriate spill response, reporting, and clean-up procedures.

1.4 ALLOWABLE WORKING HOURS

- A. The allowable working hours shall be Monday through Friday, 7:00 a.m. to 5:00 p.m. unless otherwise approved by both the CEG AWT Plant Operations Department and the Owners Representative as specified in Part 1.3 of Section 01 31 14 – Coordination with Plant Operations

1.5 UNAVAILABILITY OF MATERIALS

- A. Bids shall be based on use of the materials specified, subject to the provisions of any addenda issued. If the Contractor is unable to furnish or use any of the materials or equipment specified because of any order by a governmental agency limiting the manufacture or use, or because of the supply in the general market for such material or equipment, the contractor shall offer substitutes therefor. The substitutes shall be suitable for the purpose, considering the factors of quality, serviceability, appearance, and maintenance. No substitute shall be used until it has been approved by the Engineer.
- B. No consideration will be given to the use of substitutes on account of market conditions unless the Contractor demonstrates that, for the item in question, he placed his order and submitted shop drawings without delay, that he has shown due diligence in attempting to locate the item as specified, and that the unavailability is due to market conditions in general throughout the particular industry.
- C. All substitutes shall be of equal or greater values as the materials that are substituted.

1.6 PRECONSTRUCTION CONFERENCE

A preconstruction conference will be held with the successful Contractor and subcontractors prior to the start of construction at which time the contractor shall be apprised of its responsibilities and obligations regarding the provisions contained in the Contract documents. The conference might include representatives from CEG and local utility companies, if needed, and any other concerned utility representatives to discuss the location, protection, and relocation, if required, of the various utilities.

1.7 CONSTRUCTION SCHEDULE

The construction schedule for this project shall be as required in Specification Section 01 32 16– Construction Progress Schedule.

1.8 PROVISIONS FOR CHANGES AND EXTRA WORK

A. Changes can be made to this contract to add or remove work from the Contract Documents under written work orders in accordance with the Contract Documents. Payment for extra work will be made at the unit price or lump sum previously agreed to between the Owner and Contractor. The written work orders for changes and extra work shall be completed as follows for formal documentation:

1. **ASI | Architectural Supplemental Information**
Sent by the Design Team to the General Contractor to solicit a proposal for extra work.
 - a. Design Team → RPR → Utility Contractor → General Contractor → INDOT → General Contractor → Utility Contractor → RPR → Design Team → CEG
2. **RFI | Request for Information**
General Contractor can ask the Engineer (Owner's Representative) or Design Team a question through this forum. The Owner's Representative can forward the RFI to the Design Team if necessary.
 - a. Utility Contractor → General Contractor → RPR → Design Team → RPR → General Contractor → Utility Contractor
3. **RFP | Request for Proposal**
Design Team can request a proposal from the Utility Contractor to do additional work.
 - a. Design Team → RPR → Utility Contractor → General Contractor → INDOT → General Contractor → Utility Contractor → RPR → Design Team → CEG
4. **AWA | Additional Work Authorization**
An AWA gives the General Contractor a written commitment that the Owner will pay for additional work described within the document as part of the next Change Order. Payment for the additional work cannot be paid until authorized through the next Change Order.

- a. Design Team → RPR → Utility Contractor → General Contractor → INDOT → General Contractor → Utility Contractor → RPR → Design Team → CEG

5. Change Order

A Change Order is a document that officially adds additional or removes excess funds from the Contract. Additional funds added to a Contract via a Change Order can be paid to the General Contractor only after its acceptance.

- a. RPR → Utility Contractor → General Contractor → INDOT → General Contractor → Utility Contractor → RPR → Design Team → CEG

1.9 ACCESS ROADS AND PARKING AREAS

- A. Provide and maintain vehicular access to the site and within the site for use by persons and equipment involved in the construction of the project. Maintain access roads and driveways with sufficient rock, stone, or gravel to provide a suitable support for vehicular traffic under anticipated loads.
- B. Provide and maintain temporary parking facilities for use by the Owner, construction personnel, the Owner's Representative, and the Engineer. Maintain parking facilities free of construction materials, mud, snow, ice, and debris.
- C. Contractor is to clean, by first removing large material followed by sweeping all streets affected by construction activity, at a minimum once per day or as directed by Owner, Owner's representative, or Engineer. The release of Fugitive Dust will be closely monitored as described in Part 1.12 below. Special attention shall be used at the location of the entry gates where the speed bumps can cause construction related material to fall off trucks and other vehicles. Contractor is responsible for removing all related construction material from Harding Street, Raymond Street, and all other surrounding streets without delay.
- D. Restore areas to original or to specified conditions shown on the drawings at completion of the work.
- E. See Section 01 31 14 Coordination with CEG Plant Operations for additional requirements.

1.10 MAINTAINING TRAFFIC

- A. If it is necessary to visit such sites, the Contractor shall enter the Belmont AWT Facility from the Hudnut Boulevard entrance. Access to the Southport AWT is on Southport Road.
- B. Construction information and caution signs shall be installed at all construction areas as directed by the Engineer and as indicated in the Maintenance of Traffic

Plan.

- C. See Section 01 31 14 for additional Requirements

1.11 WARNING LIGHTS AND ARROW BOARDS

The Contractor shall place sufficient warning lights and arrow boards on or near the work and keep them illuminated during periods of construction and reduced visibility (from twilight in the evening until sunrise) and shall be held responsible for any damages that any party or the Owner may sustain in consequences of neglecting the necessary precaution in prosecuting this work.

1.12 UTILITIES

- A. Temporary Removal: All existing utility systems which conflict with the construction of the work herein that can be temporarily removed and replaced shall be accomplished at the expense of the Contractor. Work shall be done by the utility unless the utility approves in writing that the work may be done by the Contractor.
- B. Permanent Relocation of Utilities: Electrical lines, telephone lines, site lighting, cable TV lines, storm sewer inlets, gas lines, wire lines, water and gas valve boxes, cable ways, associated fixtures and structures, and other utility appurtenances which would permanently interfere with the proposed improvements will be moved by the Contractor, utility, or utility installer. The Contractor shall be responsible for and include in his bid all costs associated with contacting the utilities and plant operators and coordinating and scheduling the work necessary to accomplish the relocation. For work to be performed by the utility, the Contractor shall give the utility adequate notice (minimum 30 days) so that utility relocation can be accomplished within the Contractor's scheduled work plan without any unnecessary delays. In case a utility line is accidentally damaged by the Contractor during construction, the Contractor shall notify the utility immediately to perform the necessary repairs and/or relocation.
- C. It is understood and agreed that the Contractor has considered in their bid all of the permanent and temporary utility appurtenances shown or otherwise indicated on the plans in their present positions and that no additional compensation will be allowed for any delays, inconvenience, or damage sustained due to any interference from said utility appurtenances or the operation of moving them either by the utility company or by Contractor.
- D. The Contractor shall be responsible to coordinate and schedule requirements and arrangements for temporary and permanent utility relocation.
- E. Payment for Temporary Utilities: The Contractor shall make all necessary applications and arrangements and pay all fees and charges for electrical power and light, gas service, water service, and telephone service required for the construction of this Contract during its entire progress unless otherwise stated within this specification. The Contractor shall also provide and pay for all temporary wiring, switches, connections, and meters.

1.13 FUGITIVE DUST AND NOISE CONTROL

Fugitive dust is defined as "the generation of particulate matter to the extent that some portion of the material escapes beyond the property line or boundaries of the property, right-of-way, or easement on which the source is located." The state rules on fugitive dust, which apply to all sources of dust (particulate matter) are found in the Indiana Administrative Code under 326 IAC 6-4 and 326 IAC 6-5. However, under 326 IAC 6-4-6, there are sources and activities that are not considered in violation of the fugitive dust rules. A source or combination of sources may be considered to be generating fugitive dust if the dust is visible crossing the property line (construction area) at or near ground level (IDEM). Fugitive dust production will be monitored closely during construction. Noise shall be minimized by use of properly constructed and maintained equipment provided with suitable mufflers, snubbers, and other sound attenuating devices and supports.

1.14 SUBMITTALS – SHOP DRAWINGS AND EQUIPMENT DATA

- A. The Contractor shall submit to the Engineer shop drawings and complete catalog data for every manufactured item of equipment and all components to be used in the work in accordance with the General Conditions. The shop drawings shall be of sufficient detail to assure that the item complies with all aspects of the specifications and shall provide the necessary data for installation, operation, and maintenance. All components of the project supplied by the Contractor must conform with the INDOT Buy America requirements.
- B. Completion of the project within the contracted time is critical, and shop drawing and catalog data quality can affect construction time. Shop drawings shall be legible. Faxed copies of the shop drawings are unacceptable and will be returned without review.
- C. "Typical" drawings are not acceptable. Manufacturer's standard drawings may be submitted provided they are made specific for this project by the following methods:
 - 1. Project name, equipment name, tag numbers, location, and/or other identifying description are included on the drawing.
 - 2. All special features, options, and/or modifications that are provided are noted.
 - 3. All options or features not provided are deleted, crossed out, or otherwise removed from consideration.
- D. The Engineer cannot review shop drawings and will not accept responsibility for any delays caused by incomplete shop drawing submittals. Complete submittals must include a response to each requirement listed in the specifications. Engineer's review of shop drawings will usually be completed within 14 calendar days after receipt.

- E. The procedure in seeking approval of the shop drawings shall be as follows:
1. The Contractor shall electronically submit one (1) complete set of drawings and one (1) reproducible sepia of any equipment shop drawings and other descriptive data together with one (1) copy of a letter of transmittal to the Engineer for approval. Contractor shall electronically submit additional sets of shop drawings for review if needed for his own use. The letter of transmittal shall contain the name of the project, workmanship and materials section number, the name of the Contractor, the list of drawings submitted including numbers and titles, requests for any approval of departures from the contract requirements, and any other pertinent information as required for the items listed in the Submittal Requirements Table at the end of this Section.
 2. If any corrections, other than those noted by the Engineers, are made on a shop drawing prior to resubmittal, such changes should be pointed out by the Contractor upon resubmittal.
 3. The Contractor shall revise and resubmit the shop drawings as required, until approval thereof is obtained.
 4. See Section 01 33 00 – Contractor Submittals for additional direction.
- F. This information specified to be furnished shall be submitted within the number of days specified after the Contract start time and before any material or equipment is released for manufacture or shipment.
- G. Contractor's Certification: Equipment data and shop drawings shall be submitted by the Contractor with a cover letter, and the Contractor's stamp of approval, indicating that they have reviewed, checked, and approved the data submitted; that they are in compliance with the requirements of the Project and with the provisions of the Contract Documents; and that all field measurements and construction criteria, materials, catalog numbers, and similar data have been verified. Contractor shall also certify that the work represented by the shop drawings and equipment data is recommended by the Contractor and that his Guaranty will fully apply.
- H. Failure to provide this information and certification with or on the submittals shall be cause for the return of shop drawings or equipment data without review or other action.
- I. Costs associated with the review of any third and subsequent submittals will be borne by the Contractor. If after two submittals the shop drawings are still found deficient or defective, the Contractor shall be responsible for payment to the Owner for the cost of Engineer's review time.

1.15 EQUIPMENT OPERATION AND MAINTENANCE DATA

The equipment operation and maintenance data requirements shall be as specified in

Specification Section 01 78 23, Operation and Maintenance Data.

1.16 PHOTOGRAPHS

- A. See Section 01 32 00 – Construction Progress Documentation, Part 1.3 – Construction Photographs.

1.17 DIGITAL VIDEO DISC

- A. The Contractor shall furnish to the Owner digital video disc records of the areas of construction before construction for the purpose of establishing, for the record, conditions prior to construction.
- B. See Section 01 32 36 – Preconstruction Video Monitoring and Documentation for additional description.

1.18 SANITARY FACILITIES

- A. The Contractor shall provide and maintain required temporary facilities and enclosures for all Contractors' personnel that:
 - 1. Are weather-tight, clean, and sanitary.
 - 2. Are provided with either natural light and ventilation or artificial light and mechanical ventilation.
 - 3. Are provided with toilet tissue in a suitable holder and hand-washing amenities.
 - 4. Comply with applicable legal and health requirements
 - 5. Are cleaned, at-minimum, on a bi-weekly basis or as-needed.
- B. Remove temporary toilet facilities when work is complete. There will be no payment made specifically for temporary sanitary facilities and the cost should be included with other items.
- C. Obtain permission from the Owner before allowing the use of facilities that have been permanently installed.

1.19 CONSTRUCTION PROGRESS MEETINGS

- A. A bi-weekly progress meeting will be conducted at the job site.
- B. A supervisory representative, authorized to make management decisions from the Contractor as well as on-site supervisory staff of the Contractor, Engineer, Owners Representative and Owner shall attend the progress meeting. The location and time of said meeting will be determined at the Preconstruction Conference.

- C. A written progress status report, neatly prepared, shall be presented by the Contractor at each bi-weekly status meeting. The status report shall include at least the following information: construction progress, delays, changes, problems, differing conditions, update of schedule, anticipated payment request for following month, personnel changes, and state regulations. The status report shall include information for all subcontractors.
- D. The Contractor shall require the attendance of subcontractor' supervisory personnel, as necessary, to assist in the presentation of the bi-weekly progress report.
- E. Five copies of the bi-weekly status report shall be prepared for distribution to the Owner's and Engineer's representatives.
- F. If the Contractor fails to have a supervisory representative attend the bi-weekly status meeting or if the Contractor fails to distribute a written status report as specified in paragraph C above, the Owner may withhold approval of a Request for Payment because such failure is defined as defective work in accordance with the General Conditions, until such time as the bi-weekly status meeting can be rescheduled at the convenience of the Owner and the Engineer.
- G. The bi-weekly progress meeting shall address any long term schedule issues. The Contractor shall develop a look-ahead schedule identifying the previous week; current week and a 2 week look ahead. The contractor's look ahead schedules shall provide sufficient detail to address all activities to be performed and to identify issues requiring Owner action or input. The Contractor shall furnish the look ahead schedule in electronic format to the Engineer for review two working days prior to the bi-weekly progress meeting.
- H. No later than 2 days prior to the bi-weekly status meeting, the Contractor shall furnish a list of critical items relating to the look-ahead schedule. During the meeting the parties will jointly determine whether additional items need to be listed, the priority of items, the parties responsible for resolving the critical item and the scheduled resolution date. The updated list will be distributed with the monthly meeting minutes. Nothing herein shall be construed to excuse the Contractor's obligation to timely provide either a Notice of Delay or a Notice of Potential Claim.

END OF SECTION 01 00 00

SECTION 01 22 00 - MEASUREMENT AND PAYMENT OF NON-STANDARD ITEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Payment for all Work for which there is not an Indiana Department of Transportation equivalent Item Number in compliance with the Contract Documents, inclusive of furnishing all manpower, equipment, materials, transportation, and performance of all operations relative to construction of this project, will be made under Contract Item Numbers listed herein. Work for which there is not a Contract Item listed herein nor a line on the Itemized Proposal and Declarations utilizing standard INDOT item numbers, will be considered incidental to the Contract and no additional compensation will be allowed unless approved by Owner.
- B. Owner reserves the right to alter the Contract Documents, modify incidental Work as may be necessary, and increase or decrease quantities of Work to be performed in accordance with such changers, including, but not necessarily limited to deduction or cancellation of any one or more of the Contract Items.
- C. Contractor shall take no advantage of any apparent error or omission in the Contract Documents and Engineer shall be permitted to make corrections and interpretations as may be deemed necessary for fulfillment of the intent of the Contract Documents.
- D. Contract Items which are to be measured in terms of weight shall be weighed on scales which have been approved by Engineer prior to receipt of any weighed material. Approved weight tickets must be given to Engineer prior to the material being placed.
- E. Engineer will make measurements and determinations as necessary to classify the Work within Contract Items and determine the quantities for pay purposes.
- F. Undistributed items are for potential work, at Owner's discretion, beyond the Project scope and limits at the time of bidding, or for work that could not be defined at the time of bidding. The work shall be completed only with the approval of Engineer and/or Owner.
- G. Partial payment for lump sum items will be made according to this section. The approved and finalized schedule of values shall subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction.
- H. Proposals will be considered irregular and may be rejected if Owner determines any Contract Item price is significantly unbalanced to the potential detriment of Owner.

- I. All lengths are reported as plan view lengths. The three-dimensional (3-D) lengths might vary from those included in the project quantities. The discrepancy in length might be most notable in the line item for the 8" PVC valve vault drain pipes.
- 1.2 ITEM 1: UTILITY LOCATING AND REPORTING (GPR, POT HOLING, ETC.)
- A. Description: This work shall consist of all labor, equipment, transportation and materials required to perform an extensive utility mapping operation to be delivered in electronic format (PDF and .DWG in State Plane Coordinates) to the Engineer. Locating methods covered under this item must provide both horizontal and vertical location information such as that provided by the ground penetrating radar (GPR) and pot holing methods. The utility mapping operation must be centered on the proposed sludge line alignment to field locate potential utility conflicts.
 - B. Basis of Payment: Utility locating and reporting shall be paid for as Lump Sum price as shown in the Itemize Proposal and Declaration after the Engineer receives and approves the deliverable.
- 1.3 ITEM 2 & 3: HDPE FORCE MAIN (16" DIA.) DOUBLE PIPE TRENCH INCL. PIPE BEDDING AND NATIVE OR FULL DEPTH GRANULAR BACKFILL
- A. Description: This work shall consist of all labor, equipment, transportation, and materials required, but not limited, to perform the saw cutting and removing pavement; all excavation; permanent and temporary shoring of the excavation; magnetic marking tape, locator (tracer) wire, furnishing, handling and installing pipe, joining, and fittings, furnishing and installing bedding, haunching, cover, flowable fill, granular material, backfill and compaction; testing; watertight plugs; protection, replacement or repair of utilities, drainage systems, structures, and miscellaneous property; restoration of affected side ditches; support of utility crossings with flowable fill as necessary; removal and legal offsite disposal of surplus excavated material; and clean up, all in accordance with the Contract Documents.
 - B. Measurement: HDPE Force Main Double pipe trench including pipe bedding and native or full depth granular backfill shall be measured in Lineal Feet horizontally along the centerline of the trench.
 - C. Basis of Payment: HDPE Force Main Double pipe trench including pipe bedding and native or full depth granular backfill, shall be paid for as unit price per Lineal Foot as shown in the Itemized Proposal and Declarations.
- 1.4 ITEM 4: DUCTILE IRON FORCE MAIN, (14" DIA.) DOUBLE PIPE TRENCH, INCL. FITTINGS, PIPE, ALL MEGALUGS, GASKET ACCESSORY KITS, CORROSION PROTECTION, ETC.
- A. Description: This item covers the cost of furnishing, joining, and installing the

Ductile Iron pipe as specified in Section 40 05 13, including fittings, excavation, excavation support, bedding, haunching, backfill, tracer wire, compaction, support of utility crossing, marking tape, and restoration of affected property by trench installation methods all in accordance with the Contract Documents. All corrosion protection as specified in Section 40 05 13, Part 2.2-A-5 is also included in this item.

- B. Measurement: Ductile Iron Pipe (14" Dia.), incl. fittings, all megalugs, gasket accessory kits, corrosion protection, etc., shall be measured in Lineal Feet horizontally along the centerline of the trench installed excluding the length of valves. Tees and wyes shall be measured along the centerline of each branch to the point of intersection in the fitting for each respective pipe diameter.
 - C. Basis of Payment: Ductile Iron Pipe, incl. fittings, all megalugs, gasket accessory kits, corrosion protection, etc., shall be paid for as unit price per Lineal Foot as shown in the Itemized Proposal and Declarations.
- 1.5 ITEM 5: CONNECTIONS TO EXISTING TRSL PIPELINES, MID-LINE, INCL. STRUCTURES, VALVES, PIPE, FITTINGS, JOINING, TEMPORARY BYPASS, ETC.
- A. Description: This work shall consist, as described in the plan sheets, of all labor, equipment, transportation, and materials required, but not limited, to perform the saw cutting and removing pavement; all excavation; permanent and temporary shoring of the excavation; treatment and disposal; furnishing, joining, and installing pipe and structures, all valves and fittings shown in the detail, locator (tracer) wire, marker tape, and fittings, furnishing and installing bedding, haunching, cover, flowable fill, grout, granular material, backfill and compaction; testing; watertight plugs; protection, replacement or repair of utilities, drainage systems, structures, and miscellaneous property; restoration of affected side ditches; support of utility crossings with flowable fill; bypass pumping, removal and legal offsite disposal of surplus excavated material; and clean up, all in accordance with the Contract Documents.
 - B. Measurement: Mid-line connections to the existing TRSL Pipelines, shall be measured as one complete unit installed and demonstrated to be functional for its intended use.
 - C. Basis of Payment: Mid-line connections to existing TRSL Pipelines, shall be paid for as unit price per Each as shown in the Itemized Proposal and Declarations.
- 1.6 ITEM 6: PIPE TRACER TEST STATION WITH LOCK, GREEN, RHINO MARKING & PROTECTION SYSTEMS
- A. Description: This Work shall consist of all labor, equipment, and transportation required to handle and install Rhino Marking & Protection Systems TriView™ Test Station; tracer wire connections; and all necessary tracer wire system grounding all in accordance with the Contract Documents.
 - B. Measurement: Pipe Tracer Test Station with Lock, Green, Rhino Marking &

Protection Systems, shall be measured as one complete unit installed.

- C. Basis of Payment: Pipe Tracer Test Station with Lock, Green, Rhino Marking & Protection Systems, shall be paid for as unit price per Each as shown in the Itemized Proposal and Declarations.
- 1.7 ITEM 7: PIPE TRACER TEST STATION WITH LOCK, ORANGE, RHINO MARKING & PROTECTION SYSTEMS
- A. Description: This Work shall consist of all labor, equipment, and transportation required to handle and install Rhino Marking & Protection Systems TriView™ Test Station; tracer wire connections; and all necessary tracer wire system grounding all in accordance with the Contract Documents.
 - B. Measurement: Pipe Tracer Test Station with Lock, Orange, Rhino Marking & Protection Systems, shall be measured as one complete unit installed.
 - C. Basis of Payment: Pipe Tracer Test Station with Lock, Orange, Rhino Marking & Protection Systems, shall be paid for as unit price per Each as shown in the Itemized Proposal and Declarations.
- 1.8 ITEM 8: 84" CLASS V, RCP SANITARY SEWER
- A. Description: This Work shall consist of all labor, equipment, transportation and materials required to furnish, handle and install Reinforced Concrete Pipe of 84" diameter, including, but not necessarily limited to: saw cutting and removal of pavement; all excavation; permanent and temporary shoring of the excavation, pipe, gasket, and liner material, any safety features; core drilling and modification to openings; flexible watertight pipe seals; flowable fill; granular material; backfill and compaction; testing; protection, replacement or repair of utilities, drainage systems, structures, and miscellaneous property incidental to construction; removal of surplus excavated material; and clean-up, all in accordance with the Contract Documents.
 - B. Measurement: 84" RCP Sanitary Sewer shall be measured in Linear Feet along the centerline of installed pipe.
 - C. Basis of Payment: 84" RCP Sanitary Sewer, shall be paid for as unit price per Linear Foot as shown in the Itemized Proposal and Declarations.
- 1.9 ITEM 9: 90" CLASS V, RCP SANITARY SEWER
- A. Description: This Work shall consist of all labor, equipment, transportation and materials required to furnish and install Reinforced Concrete Pipe of 84" diameter, including, but not necessarily limited to: saw cutting and removal of pavement; all excavation; permanent and temporary shoring of the excavation, pipe, gasket, and liner material, any safety features; core drilling and modification to openings; flexible watertight pipe seals; flowable fill; granular material; backfill and compaction; testing; protection, replacement or repair of utilities, drainage

systems, structures, and miscellaneous property incidental to construction; removal of surplus excavated material; and clean-up, all in accordance with the Contract Documents. It shall be assumed that the full width/depth of the Warman Avenue roadway within the project alignment will be removed for the installation of the pipeline and all costs for such removal shall be included within this item.

- B. Measurement: 90" RCP Sanitary Sewer shall be measured in Linear Feet along the centerline of installed pipe.
 - C. Basis of Payment: 90" RCP Sanitary Sewer, shall be paid for as unit price per Linear Foot as shown in the Itemized Proposal and Declarations.
- 1.10 ITEM 10: 465 STEEL RING BEAM AND LAGGING TUNNEL AND PRIMARY LINER
- A. Description: This Work shall consist of all labor, equipment, transportation and materials required to furnish and install the Steel Ring Beam and Lagging Tunnel and Primary Liner, specification 33 05 23.31, including, but not necessarily limited to: permitting, saw cutting and removal of pavement; all excavation; permanent and temporary shoring of the excavation, and liner materials, any safety equipment and features; flowable fill; All Non-Shrink Grout, per specification section 03 30 11, for filling of annular spaces between the primary liner and the carrier pipes; granular material; dewatering specific to this process; backfill and compaction; testing; protection, replacement or repair of utilities, drainage systems, structures, and miscellaneous property incidental to construction; temporary power; removal of surplus excavated material; and clean-up, all in accordance with the Contract Documents.
 - B. Measurement: Steel Ring Beam and Lagging Tunnel and Primary Liner shall be measured in Linear Feet along the centerline of installed Tunnel Liner Section.
 - C. Basis of Payment: Steel Ring Beam and Lagging Tunnel and Primary Liner, including the Non-Shrink Grout to fill Annular spaces, shall be paid for as unit price per Linear Foot as shown in the Itemized Proposal and Declarations.
- 1.11 ITEM 11: 84" NO-BELL CENTRIFUGALLY CAST FIBER REINFORCED POLYMER MORTAR PIPE (CCFRPM), CARRIER PIPE SANITARY SEWER
- A. Description: This Work shall consist of all labor, equipment, transportation and materials required to furnish, handle and install Centrifugally Cast Fiber Reinforced Polymer Mortar Pipe (CCFRMP, a.k.a. HOBAS) Pipe, per specification 33 05 24.31, of 84" diameter, through the utility tunnel; including, but not necessarily limited to: pipe spacers and supports to maintain the pipe level and true within the tunnel; permanent and temporary pipe supports, gasket, any ancillary materials, any safety features; flexible watertight pipe seals and grout; flowable fill; granular material; bedding, backfill and compaction at the ends of pipe extended to the upstream and downstream structures; testing; protection, replacement or repair of utilities, drainage systems, structures, and miscellaneous property incidental to construction; and clean-up, all in accordance with the

Contract Documents.

- B. Measurement: 84" CCFRPM Carrier Pipe Sanitary Sewer shall be measured in Linear Feet horizontally along the centerline of installed pipe.
- C. Basis of Payment: 84" CCFRPM Carrier Pipe Sanitary Sewer shall be paid for as unit price per Linear Foot as shown in the Itemized Proposal and Declarations.

1.12 ITEM 12: 14" DUCTILE IRON, FIELD LOCK, TUNNEL CARRIER PIPE, INCLUDING ALL FITTING, GASKETS, ACCESSORY KITS, CORROSION PROTECTION, ETC

- A. Description: This item covers the cost of furnishing, joining, and installing the Ductile Iron Field Lock Restrained Mechanical Joint Pipe, per specification 33 05 24.31, including all fittings, through the utility tunnel including, but not necessarily limited to: pipe spacers and supports to maintain the pipe level and true within the tunnel; permanent and temporary pipe supports, fittings, gasket, any ancillary materials, any safety features; flexible watertight pipe seals and grout; flowable fill; granular material; bedding, backfill and compaction at the ends of pipe extended to the upstream and downstream connections; testing; protection, replacement or repair of utilities and clean-up, all in accordance with the Contract Documents.
- B. Measurement: 14" DUCTILE IRON FIELD LOCK TUNNEL CARRIER PIPE, including all fittings, restrained joints; shall be measured in Lineal Feet horizontally along the centerline of each pipe installed excluding the length of valves. Tees and wyes shall be measured along the centerline of each branch to the point of intersection in the fitting for each respective pipe diameter.
- C. Basis of Payment: 14" DUCTILE IRON FIELD LOCK TUNNEL CARRIER PIPE including all fittings, restrained joints; and ancillary items described, shall be paid for as unit price per Lineal Foot as shown in the Itemized Proposal and Declarations.

1.13 ITEM 13: MAIN BORE SHAFT, TUNNEL CONSTRUCTION

- A. Description: This Work shall consist of all labor, equipment, transportation and materials required to furnish, handle and construct the Main Bore Shaft, including certified engineering design drawings and calculations; all excavation and disposal of material, sheeting and shoring measures as required, safety measures for the excavation and surrounding area, equipment necessary to provide access to the tunnel shaft and all other ancillary items necessary. The work shall also include demolition and cutting of paved surfaces; backfill, compaction and restoration of the Bore Shaft to final grades and surfaces, all in accordance with the Contract Documents.
- B. Measurement: MAIN BORE SHAFT shall be measured as one complete unit installed.

- C. Basis of Payment: MAIN BORE SHAFT shall be paid for as unit price per Each as shown in the Itemized Proposal and Declarations.

1.14 ITEM 14: BORE RECEIVING SHAFT, TUNNEL CONSTRUCTION

- A. Description: This Work shall consist of all labor, equipment, transportation and materials required to furnish, handle and construct the Bore Receiving Shaft, including certified engineering design drawings and calculations; all excavation and disposal of material, sheeting and shoring measures as required, safety measures for the excavation and surrounding area, equipment necessary to provide access to the tunnel shaft and all other ancillary items necessary. The work shall also include demolition and cutting of paved surfaces; backfill, compaction and restoration of the Bore Shaft to final grades and surfaces, all in accordance with the Contract Documents.
- B. Measurement: BORE RECEIVING SHAFT shall be measured as one complete unit installed.
- C. Basis of Payment: BORE RECEIVING SHAFT shall be paid for as unit price per Each as shown in the Itemized Proposal and Declarations.

END OF SECTION 01 22 00

Itemized Proposal and Declarations						
<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>UNITS</u>	<u>QUANTITY</u>	<u>UNIT PRICE</u>	<u>TOTAL PRICE</u>	
I-110-01001	MOBILIZATION AND DEMOBILIZATION	LSUM	1			
I-105-06845	CONSTRUCTION ENGINEERING	LSUM	1			
I-201-01015	CLEARING AND GRUBBING	LSUM	1			
I-203-04523	DEWATERING	LSUM	1			
I-807-78590	HANDHOLE	EACH	8			
I-715-04985	VAULT	EACH	3			
D-402-00062	HMA BASE, TYPE B	TON	880			
D-402-01121	HMA INTERMEDIATE, TYPE B	TON	220			
D-402-02122	HMA SURFACE, TYPE B	TON	165			
I-303-01180	COMPACTED AGGREGATE NO. 53	TONS	100			
I-502-06627	PCCP, 6 IN.	SYD	20			
D-610-07486	HMA FOR APPROACHES, TYPE A	TON	30			
I-805-95568	CONDUIT, PVC, 4 IN.	LFT	4400			
I-715-11699	VALVE WITH BOX, RESTRAINED GATE, DUCTILE IRON, 14 IN	EACH	6			
I-716-01382	AIR RELEASE VALVE	EACH	6			
I-801-06735	TUBULAR MARKER, PERMANENT	EACH	15			
I-720-03194	MANHOLE	EACH	10			
I-715-92537	PIPE PVC 8 IN	LFT	240			
I-715-09843	BYPASS PUMPING	LSUM	1			
I-611-08232	MAILBOX ASSEMBLY, SINGLE RESET	EACH	12			
I-202-09783	SEWER, SANITARY, ABANDON IN PLACE	LSUM	1			
1	Utility Locating/Reporting	LSUM	1			
2	16" HDPE, FM, Double Trench, Open, Native	LFT	3660			
3	16" HDPE, FM, Double Trench, Open, Granular	LFT	750			
4	14" DI, FM, Open Cut, Double Trench	LFT	93			
5	TRSL Tie-Ins	EACH	4			
6	Pipe Tracer Wire Test Station, Green	EACH	24			
7	Pipe Tracer Wire Test Station, Orange	EACH	12			
8	84" RCP Sanitary Sewer	LFT	2733			
9	90" RCP Sanitary Sewer	LFT	1041			
10	132" ID STEEL RING BEAM AND LAGGING TUNNEL	LFT	569			
11	84" Fiber Reinforced Polymer Mortar Pipe	LFT	616			
12	Pipe, Ductile Iron, 14"	LFT	1255			
13	Main Bore Shaft	EACH	1			
14	Receiving Bore Shaft	EACH	1			
	Total Bid Amount (in Figures)					
	Total Bid Amount (in Words)					

SECTION 01 31 14 - COORDINATION WITH PLANT OPERATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

This work shall consist of coordinating construction activities with the Owner, Engineer, and other contractors, furnishing and installing temporary facilities and services, scheduling of construction, maintaining plant roads and traffic, and utilizing construction procedures that do not interrupt treatment plant facilities or operating and maintenance activities. Contractor shall perform all construction activities so as to minimize interference with operations of the facilities and the work of others.

1.2 SCOPE

- A. Procedures and requirements set forth herein do not relieve the Contractor from any additional costs necessary to provide and maintain any or all temporary facilities and equipment that may be required to maintain adequate plant operations during the construction period. The Contractor may use procedures other than those set forth herein with prior approval of the Engineer. The approval of the Engineer shall be only for compliance with the intent of maintaining full operation of the wastewater treatment facilities.
- B. Allow full access for plant operators to all areas not under construction. Owner, Engineer, and plant operators' access shall be provided to all plant areas on an as-needed basis at no additional cost to the Owner.
- C. Owner shall have the authority to stop or prohibit work which would interfere or jeopardize the continuous and reliable operation of the facilities, without increase to the Contract cost.
- D. Connections to existing interceptors, process pipelines, and structures; temporary connection to the existing drain lines; and installation or removal of any equipment shall be accomplished with minimal interruption of flow through these facilities. Perform all work necessary to complete connections, cutovers, and tie-ins to existing facilities in an expeditious and workmanlike manner.
- E. The Contractor shall include in their bid and bear all expenses incurred, including temporary pumping and piping required to maintain wastewater treatment and conveyance if such action becomes necessary during construction activities and installation of new facilities.
- F. Should temporary facilities be required, the Contractor shall have on site or at their immediate disposal, back-up facilities in the event of failure of the temporary units.

1.3 SEQUENCING AND OPERATIONS

- A. General:

1. The Contractor shall carefully coordinate all Work and schedules with the Engineer, and shall coordinate with plant operations/engineering at least 2 weeks prior to beginning all shutdowns, interruptions, connections, or bypasses are required at plant process pipeline, interceptor sewers, plant drain sewers, and buildings.
2. Each request shall include the estimated starting time, duration, work areas, plant operations that will be affected, assistance required from plant operations, temporary facilities proposed, security measures, restrictions, and shall include the methods of accomplishing the work. Each request must be approved and signed by the Owner, or his designated representative, prior to the start of work. The maximum duration of each plant shutdown must be less than 24 consecutive hours. The maximum duration of the existing TRSL system shutdown must be less than 24 consecutive hours for each or both pipelines, or as otherwise directed by the Owner.

B. Disturbances to Operations:

1. Keep existing facilities in operation continuously during the construction period, unless otherwise specifically permitted in these Specifications or approved by the Owner.
2. Scheduled interruptions of any operations must be coordinated with, and approved by, the Owner or their designated representative. The Contractor shall minimize the frequency and duration of disturbances to plant operations.
3. Scheduled interruption of plant operations shall not occur until all materials needed for the construction of the new facilities causing the interruption have arrived on site and are ready for construction.
4. The new pipes, sewers, and other utility lines shall be installed and utility lines that are to be replaced or abandoned can be disconnected.
5. **Unscheduled interruptions resulting from construction work under the Contractor's responsibility are strictly prohibited**, and normal plant operations must be resumed at once at no additional cost to the Owner.
6. The equipment and materials to be used for temporary purposes need not be new, but shall be in serviceable condition and installed in a safe manner.
7. The temporary facilities shall be installed so as to minimize interference with plant operations, construction, the work of others, and shall meet any applicable code requirements.

8. Relocation of such temporary facilities may be required as construction progresses. The cost of all temporary facilities shall be included in the Contract cost.

1.4 PROJECT COORDINATION

- A. The Contractor shall be solely responsible for coordination of all of the work. He shall supervise, direct and cooperate fully with all subcontractors, manufacturers, suppliers, installers, testing agencies, and all others whose services, materials or equipment are required to insure completion of the work within the contract time.
- B. The Contractor shall cooperate with, and coordinate his work with, the work of any other contractor, utility service company, Owner's employees, or plant operators performing additional work at the site.**
- C. The Contractor shall not be responsible for damage done by contractors not under his jurisdiction. He will not be liable for any such loss or damage unless it is through the negligence of the Contractor. Conversely, the Contractor shall be responsible for damage done by contractors and subcontractors under his jurisdiction, and shall be liable for any such loss or damage resulting from the negligence of the Contractor and other contractors and subcontractors under his jurisdiction.
- D. The Contractor shall attend and participate in all project coordination meetings. The minutes of the meetings will be assembled by the Owner's resident project representative.

1.5 SUBMITTALS

- A. Construction Schedule: Refer to Specification Section 01 32 16 – Construction Progress Schedule.
- B. Access and Traffic Plan: In conjunction with the Construction Schedule, the Contractor shall submit an Access and Traffic Plan to the Engineer within five (5) working days following the Notice to Proceed for review and approval. The Access and Traffic Plan must be approved prior to the start of construction activities. The Access and Traffic Plan shall detail the specific routes, number of vehicles and equipment, work times, security provisions, and other related items to be used to perform construction activities, to include but not be limited to:
 1. Haul routes
 2. Constructed temporary haul roads
 3. Buildup plan at designated laydown/staging areas, if required
 4. Security measures
 5. Contractor vehicle parking areas
 6. Road cleaning equipment and procedures
 7. Dust control measures
 8. Work hours
 9. Emergency and contingency procedures
 10. Routes to be used by emergency vehicles (fire truck and ambulances)

- C. Erosion Control Plan: Refer to Specification Section 31 25 00 – Erosion and Sediment Controls, and the Storm Water Pollution Prevention Plan (SWPPP). A condensed version of the SWPPP is contained within these Specifications immediately after Specification Section 31 25 00 – Erosion and Sediment Controls.
- D. Excavation Drainage Water Disposal Plan: The plan shall detail specific procedures and locations to be used to contain and discharge water during excavation and demolition operations. Water must be filtered to remove solids prior to discharge.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. All permanently installed materials and equipment shall be in accordance with the applicable sections of these Specifications.
- B. Temporary materials and equipment shall be selected by the Contractor and shall conform to the intent of this Section.

PART 3 - EXECUTION

3.1 INSTALLATION

Materials and equipment that are to become a permanent part of the wastewater treatment plant facilities shall be installed as indicated on the drawings and in accordance with the applicable sections of these Specifications.

3.2 GENERAL PROCEDURES

- A. Prior to the start of modifications to any existing facility, the Contractor must assemble labor, materials, and equipment required to complete the modifications without interruption and/or inordinate delays.
- B. Discharge from dewatering of existing tanks and excavations shall be coordinated with the Engineer and CEG.
- C. Modification and connections to more than one of the existing facilities shall not be done simultaneously, unless directed otherwise by the Engineer within contract plan set. The modification to one existing facility or the connection to one existing pipeline shall be completed before modification or connection to another existing facility or pipe line is started.
- D. To the extent possible, connection of multiple lines shall be made during the same shutdown period to minimize the number of shutdowns.

- E. The Contractor shall maintain existing plant drives and/or construct temporary drives as necessary to provide access for plant personnel to existing facilities. Access shall be provided at all times when the Contractor is not working on the site.

- F. Road Cleaning: The Contractor shall clean the designated haul routes, by first removing large material followed by sweeping to prevent dust, dirt, and excavated material from accumulating. **Special attention shall be used at the location of the entry gates where the speed bumps can cause construction related material to fall off trucks and other vehicles.** Road cleaning shall be performed at least once per day. Additional cleaning shall be performed as necessary or as directed by the Engineer. The release of Fugitive Dust will be closely monitored as described in Section 01 00 00 Part 1.12.

END OF SECTION 01 31 14

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Project Record Documents are the records that demonstrate the actions of Contractor throughout the construction and verification/testing of the project. These documents include, but are not limited to correspondence, transmittals, submittals, Request for Information (RFIs) and responses thereto, certifications, insurance documents, training records, meeting minutes, test results, audit reports and associated documents, change documents, records of cost reimbursable work, permits and documents associated with the monitoring of those permits, documentation required for hazardous materials management, tracking logs, project record documents, operations and maintenance manuals and related documents, operator and technician training records, operations and maintenance records, and service bulletins.
- B. Construction progress documentation includes:
 - 1. Contractor's Daily Field Reports
 - 2. Construction Photographs
 - 3. Operation and Maintenance Records
 - 4. Permit Documentation
 - 5. Fabrication Records
 - 6. Document Control and Tracking
- C. In addition to normal business records, progress documentation requirements shall include documenting any existing environmental conditions, transportation coordination and emergency services.

1.2 CONTRACTOR'S DAILY FIELD REPORTS

- A. Submit one [1] copy of Contractor's Daily Field Report to the Owners Representative within three [3] working days from the date Work was performed. The Daily Field Report will include:
 - 1. Contract name and number, name of CONTRACTOR, name, signature, and title of employee completing the report.
 - 2. Report number - number each report sequentially.
 - 3. Weather conditions.
 - 4. Date Work was performed.
 - 5. Construction schedule activity number.
 - 6. Activity description including items and quantity of work performed
 - 7. Current problems and constraints.
 - 8. Potential problems and delays.
 - 9. Requests for Information (RFI).
 - 10. Site visitations to include purpose of visit.
 - 11. Daily manpower including Subcontractors: identify office, supervisory, craft

- personnel and schedule activity number.
- 12. Major construction equipment used in performing Work, and construction equipment idle for the day.
- 13. Remarks, instructions from the Owners Representative, etc.

1.3 CONSTRUCTION PHOTOGRAPHS

- A. Contractor shall, as part of the Work of this Contract, furnish a series of construction photographs to show the progress of the Work. Photographs are to be taken of major components of the Work before they are covered and of views to be determined by the Owners Representative. Photographs must be clearly labeled or referenced within an index containing the Project's name and the CEG project number, location and orientation of view, and date. All photographs are to be submitted to the Owner's Representative in electronic format at the end of each month.
- B. **Private property owners, such as IP&L, Hanson Aggregates, Inc., etc. might have restrictions for photography on their property.** Contractor is responsible for understanding these restrictions and receiving written permission from each private property owner, as required, if the limits of the photograph are to extend beyond the limits of CEG easement boundaries.
- C. No extra payment will be made for this Work, but the entire cost of the same shall be included in the prices stipulated for the Work of this Contract.

1.4 PERMIT DOCUMENTATION

- A. Maintain at the Project field office all permit drawings and permits in a manner accessible for inspection by the Owners Representative.

1.5 DOCUMENT TRACKING

- A. All correspondence shall include the Project Name and Contract number along with the specific subject of the letter. When replying to a specific letter, the letter of transmittal shall be referenced by serial number, date, and subject. Where a submittal is referenced, the application specification section number shall also be referenced. All correspondence shall be serialized and separated into incoming and outgoing correspondence logs. E-mail subject lines must include, at minimum, the project number with a description of the message contents or purpose.
- B. Contractor shall maintain a computerized document control system to monitor the generation, status, and filing of documents. Documents such as Change Orders (proposed and approved), Request for Proposals, Request for Information, Design Clarifications, Meeting Minutes, Applications for Payment, submittals, reports and transmittal letters shall be controlled using the computerized system. The control system must be totally integrated so that the generation of documents automatically prepares a log with the document recorded.

1. The system must maintain the same work flow as the Phase 1 work (by others). The Contractor must complete the following table and supply it to Tony Dargo when setting up the eCommunication system.

<u>Role</u>	<u>Company</u>	<u>Contact</u>	<u>Email</u>
General Contractor	<u>company name</u>	<u>name</u>	<u>email address</u>
General Contractor 2	<u>company name</u>	<u>name</u>	<u>email address</u>
Owner 1	CEG	Mike Latos	mlatos@citizensenergygroup.com
Owner 2	CEG	Craig Cordi	ccordi@citizensenergygroup.com
Engineer	Etica group, inc.	Sean McManus	smcmanus@eticagroup.com
Designer 1	Etica group, inc.	Mark Westphal	mwestphal@eticagroup.com
Designer 2	Etica group, inc.	Jason Doan	jdoan@eticagroup.com

1.6 CASH FLOW PROJECTIONS

- A. CONTRACTOR shall provide CEG with monthly cash flow projections for all activities on the Project, including CONTRACTOR’s work, subcontractors work, and any other ancillary costs that might be expected for the Project. The projections for activities not included in the scope of services shall be based on either a unit cost or construction cost percentage. Initial projections shall be furnished at the beginning of the Project based on the Project contract amount, and shall be updated with each pay application, whenever the construction cost is revised, and if the contract scope, schedule, cost or payment plan is revised by CEG. All projections must show, in Excel format, both the original and current projections, by month, for the entire anticipated duration of the Project.

1.7 MONTHLY PROJECT ACCRUAL

- A. CONTRACTOR shall provide CEG a monthly accrual amount for construction services provided and/or work completed but not invoiced by the 2nd business day of each month. The accrual does not need to be a pay application.

END OF SECTION 01 32 00

SECTION 01 32 16 -- CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: This section covers all work involved in the preparation and maintenance of the Contractor's Construction Schedule for the duration of the project.
- B. Related Work Specified in Other Sections
 - 1. Section 01 00 00 – General Requirements
- C. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the reference thereto.
- D. Definitions
 - 1. Activity: Any task, or portion of a project, that takes time to complete.
 - 2. Baseline Schedule: The initial CPM construction schedule representing the Contractor's original work plan, as accepted by the Engineer.
 - 3. Controlling Operation: The activity within that series of activities defined as the Critical Path, which, if delayed or prolonged, will delay the time of completion of the Contract.
 - 4. Critical Path: The series of activities that determines the earliest completion of the project (i.e., the Forecast Completion Date) in accordance with the terms and conditions of the Contract.
 - 5. Critical Path Method: A mathematical calculation that determines the earliest completion of the project in accordance with the terms and conditions of the Contract and that includes a graphic representation of the sequence of activities showing the interrelationships and interdependencies of the elements composing a project.
 - 6. Current Contract Completion Date: The date for completion of the Contract based on the total number of days, or fixed completion date as specified for full and final completion of the work in the contract documents.
 - 7. Differential Completion Time: The difference in time between the Current Contract Completion Date and the Contractor's scheduled early Forecast Completion Date as shown on the Baseline Schedule, or schedule updates and revisions thereto.

8. Float: The amount of time between the early start date and the late start date, or the early finish date and the late finish date, of any activity or group of activities in the network. See Free Float and Total Float.
9. Forecast Completion Date: The Early Finish date of the last scheduled work activity identified on the Critical Path.
10. Fragment: A section or fragment of the network diagram comprised of a group of activities.
11. Free Float: The amount of time an activity can be delayed without delaying the Early Start of a successor activity.
12. Milestone: An activity that represents a significant point in time, and may be used to indicate the start or end of a series of related activities and/or contract accomplishment. A milestone has zero original and remaining duration, and does not increase the Contract time.
13. Revision: A change in the schedule that modifies logic, revises the current contract completion date, adds or deletes activities, or alters activities, sequences, descriptions, calendars, actual dates, or durations.
14. Tabular Listing: A report showing schedule activities, their relationships, durations, scheduled and actual dates, float, resources, and all log notes where comments are inserted for an activity.
15. Total Float: The amount of time that an activity may be delayed without affecting the total duration of the project.
16. Update: The modification of the most current Contractor CPM progress schedule through a regular and periodic (at least monthly) review to incorporate actual progress to date by activity. Update shall indicate changes to the activity's percent complete, actual start and actual finish dates.

1.2 PRE-CONSTRUCTION SCHEDULING MEETING

- A. The Contractor shall schedule and conduct a Pre-Construction Scheduling Meeting within 5 working days of the issuance of Notice to Proceed. Mandatory attendees at the meeting will include the Contractor's Project Manager and Construction Scheduler, the Owner, and the Engineer.
- B. At this meeting, the requirements of the Special Provisions regarding scheduling will be reviewed with the Contractor. At the Pre-Construction Scheduling Meeting, the Contractor shall furnish a Preliminary Baseline Schedule as discussed in Section 1.3 and be prepared to discuss both its proposed methodologies for fulfilling the scheduling requirements and its sequence of operations. In this meeting, the Contractor shall also supply to the Engineer a copy of the Contractor's proposed Primavera activity code dictionary that will be

utilized in the sorting of the activities into phases of work, areas of work, types of work, etc.

- C. At the Pre-Construction Scheduling Meeting, the Contractor shall be prepared to discuss the requirements for all off-site material testing and submittals applicable to the Contract, discuss their respective preparation, and review durations.

1.3 BASELINE SCHEDULE

- A. Within 10 working days of the Notice to Proceed, the Contractor shall submit to the Engineer a Baseline Schedule, which shall incorporate any and all comments provided by the Engineer regarding the Preliminary Baseline Schedule. The Baseline Schedule shall include the effective date of the Notice to Proceed and shall not include any work prior to that date. The Baseline Schedule shall be accompanied by a Baseline Schedule Narrative as described in Section 1.6.

The Baseline Schedule shall depict how the Contractor plans to complete the work of the Contract and shall show all those activities that defines the Critical Path. The scheduled time for each activity shall be reasonable, depicting a realistic time to perform the activity. The Baseline Schedule shall provide for the adequate planning of the project, as well as the Engineer's monitoring and evaluation of progress and analysis of time impacts. The Contractor shall not attribute any negative float to any activity depicted on the Baseline Schedule. The Engineer will be allowed 5 working days to review and approve the Contractor's submittal of the Baseline Schedule. Should the Engineer reject the Contractor's submittal of the Baseline Schedule, the Contractor shall resubmit a revised schedule within 5 working days of receipt of the Engineer's review comments, at which time a new 5 working day review period by the Engineer will begin.

1.4 SCHEDULE REQUIREMENTS

- A. The Baseline Schedule and all schedules submitted thereafter by the Contractor shall comply with the following requirements.
 - 1. All schedules shall be created, updated and provided to the owner by use of an up to date, industry accepted computer software program. The schedules shall comply with:
 - a. Any and all interim target dates and/or milestones specified by the Contract;
 - b. All constraints, restraints or sequences specified by the Contract; and
 - c. The number of days set forth in the Contract for completion of the work.

2. All schedules submitted to the Engineer shall be depicted graphically by network diagrams. The Contractor's network diagrams shall be time scaled to show a continuous flow of information from left to right. The critical path shall be clearly and graphically identified on the network diagrams.
 3. All network diagrams prepared by the Contractor shall be organized in a logical fashion. The activities shown on the diagrams shall be sorted and grouped per work structure, with the work covered by each Contract Item separately designated by distinct schedule activities.
 4. The network diagrams shall indicate all submittals and off-site material testing required by the Contract, and the submittals shall be sub-grouped by category.
- B. All schedules shall identify, at a minimum, the following activities:
1. Identification of utility relocations and interfaces as separate activities, including activity description and responsibility coding that identifies the type of utility and the name of the utility company involved.
 2. Identification of all tests, submission of test reports, and approval of test results required under the Contract.
 3. Identification of Punchlist and final clean-up required by the Contractor to complete the work. The Contractor shall designate not more than 30 calendar days for the Contractor's performance of Punchlist and final clean-up activities.
 4. Identification of any manpower, material, or equipment restrictions, as well as the specific identification of any activity requiring unusual shift work, such as double shifts, 6 day weeks, specified overtime, or work at times other than regular days or hours.
- C. Float shall not be considered as time for the exclusive use of or benefit of either the Owner or the Contractor but shall be considered as a jointly owned, expiring resource available to the project and shall not be used to the financial detriment of either party. Any schedule, including the Baseline Schedule and all updates thereto, showing an early completion date shall show the time between the forecast completion date and the Contract Completion Date as "project float".
- D. In connection with the submittal of the Baseline Schedule and all updates thereto, the Contractor shall require all of its subcontractors to submit in writing a statement certifying that the subcontractor has concurred with the schedule and that the subcontractor's related schedule has been incorporated accurately, including the duration of activities.
- E. The Engineer's acceptance of a Contractor schedule shall not constitute a change of any portion of the Contract. Failure of the Contractor to include any element of work required by the Contract in its schedules shall not relieve the Contractor

from completing the work within the time limit specified for completion of the Contract. If the Contractor fails to define any element of work, activity or logic, and the omission or error is discovered by either the Contractor or the Engineer, it shall be corrected by the Contractor in the next monthly update or revision of the schedule.

- F. Should the Baseline Schedule or any update thereto show variances from the scheduling requirements of the Contract, the Contractor shall make specific mention of the variations in the letter of transmittal, in order that, if accepted, proper adjustments to the project schedule can be made. Notwithstanding the foregoing, the Contractor will not be relieved of the responsibility for completing all work required by the Contract.
- G. In the event that the Baseline Schedule, or any updates or revisions, show completion occurring prior to the Completion Date and/or interim milestones, the Contractor shall demonstrate to the Engineer that the schedule is reasonable, practical and achievable. Moreover, it is expressly understood and agreed that (1) the Contractor shall have no claim against the Owner for delay, disruption, hindrance, or other impact based on any early completion indicated in the Contractor's schedule(s); (2) a delay is critical if and only if to the extent that the delay extends the completion of the entire work to a date that is beyond the contractually specified date for full completion of the work, regardless of the Contractor's planned early completion; and (3) the contract price includes full compensation for all time related costs associated with the Contractor working at the project site for the full duration of the time set forth in the Contract, even if the Contractor represents that the Contractor plans to fully finish the work in less than the time established by the Contract for full completion of the work.
- H. The Contractor shall not incorporate any changes or delays to the work in the Baseline Schedule and in all schedules submitted thereafter without the Engineer's approval.
- I. The submittal of all schedules shall also be accompanied by computer generated mathematical analysis tabular reports for all activities included in the network diagrams. The tabular reports (on an appropriate size sheet) shall consist of a report detailing the following. The Contractor must resubmit, without delay, the tabular reports that are deemed illegible by the recipient on a larger size sheet at no additional cost.
 - 1. Activity number and description;
 - 2. Original, and remaining durations;
 - 3. Earliest start date (by calendar date);
 - 4. Earliest finish date (by calendar date);
 - 5. Actual start date (by calendar date);
 - 6. Actual finish date (by calendar date);
 - 7. Latest start date (by calendar date);
 - 8. Latest finish date (by calendar date);
 - 9. Identify activity calendar ID;
 - 10. Total Float and Free Float, in calendar days;

11. Percentage of activity complete and remaining duration for incomplete activities;
 12. Detailed Predecessor; and
 13. Detailed Successor
- J. Unless otherwise specifically noted elsewhere in this Section, network diagrams and the tabular reports shall be submitted to the Engineer in the following quantities:
1. 1 set of the network diagram, tabular report, and brief schedule narrative in PDF format on each item's appropriate sheet size.

1.5 BI-WEEKLY SCHEDULE UPDATE

- A. The Contractor shall regularly update the approved Baseline Schedule to reflect the current status of the project. At each construction progress meeting, the Contractor shall submit a Bi-Weekly Schedule Update to the Engineer. The update shall include all information available and status of the project as of the construction progress meeting, or such other date as established by the Engineer. All Bi-Weekly Schedule Updates described below shall comply with the requirements indicated in Section 1.6.
- B. All Bi-weekly Schedule Updates shall incorporate all changes previously approved by the Engineer.
- C. Each Bi-weekly Schedule Update shall reflect all as-built activities performed as of the effective date of the update schedule. The Bi-weekly Schedule Update shall include the period from the last update to the effective date and for the remainder of the project. The current period's activities shall be reported as they actually took place. In the updated schedule, the Contractor shall indicate the actual dates that activities were started, completed, or split. Ongoing activities shall have an indication of the percent complete and the remaining duration to complete such activities.
- D. The electronic submission (PDF format) of the submitted Bi-weekly Schedule Update and the related reports shall constitute a clear record of the actual progress of the work from the effective date of the Notice to Proceed to the effective date of the update, as well as the projected future work up to final completion of the project.
- E. The Bi-weekly Schedule Update, and any other relevant information available, will be used to determine the effect of any contemplated or actual changes or delays to the work.

1.6 SCHEDULE NARRATIVE REPORTS

- A. Schedule Narrative Reports. The Contractor shall also prepare Schedule Narrative Reports, which are to be submitted to the Engineer concurrently with each Construction Schedule submittal.

- B. Baseline Narrative Report. The Baseline Schedule Narrative Report shall describe, in a narrative fashion, the logic of the schedule. It shall identify the critical path and other areas of schedule delay risk. The narrative shall include a listing of all decision/approval points in the schedule.
- C. Brief Progress Narrative Reports. The Progress Narrative Report shall describe the physical progress of work performed by the Contractor during the report period. In addition, the report shall indicate the Contractor's plans for continuing the work during the forthcoming report period, actions planned to correct any negative float, and any delays or problems and their estimated impact on the contract completion date for the project. In addition, the Contractor shall include for consideration by the Engineer alternatives for possible schedule recovery to mitigate any potential delay. The report shall follow the outline set forth below:
1. Contractor's Transmittal Letter.
 2. Work completed during the report period, including the labor craft and equipment class resources employed to complete the work identified during the report period.
 3. Description of the current critical path of the schedule.
 4. List of any and all delayed activities including a complete explanation of the delay and reason for such.
 5. Status of the Contract Interim Milestone and Contract Completion Dates.
 - a. On schedule
 - b. Ahead of schedule and number of days
 - c. Behind schedule and number of days
 6. Listing of any changes to the schedule activities or logic.
 7. Recovery schedule for the proposed alternatives to restore the schedule to the approved timelines.
- D. Narrative reports containing nonfactual, subjective statements, judgments or opinions, which appear to assign responsibility or to make conclusions as to excusability, responsibility, or compensability for delays shall be cause for rejection of the narrative report.
- E. On a Bi-weekly basis, and on a date to be determined by the Engineer, the Contractor shall meet with the Engineer to review the Bi-weekly Schedule Update and the Schedule Narrative Report. The Engineer will be allowed five (5) working days after the meeting to review and accept or reject the Bi-weekly Schedule Update and the Schedule Narrative Report. The report is deemed as

accepted if the five (5) working day period expires without rejection. Rejected schedules and/or reports shall be revised and resubmitted to the Engineer within five (5) working days, at which time a new five (5) working day review period by the Engineer will begin. If the first draft of the report is rejected, all subsequent reports must be formally accepted by the Engineer. All efforts shall be made between the Engineer and the Contractor to complete the review and the approval process prior to the cutoff date for the next update schedule. To expedite the process, a second meeting between the Engineer and the Contractor shall be held, as determined to be necessary by the Engineer.

1.7 SCHEDULE REVISIONS

- A. Contractor Proposed Revisions. Once the Baseline Schedule is accepted, the Contractor shall not make any revisions to the schedule without first obtaining the approval of the Engineer.
- B. Possible revisions to the Baseline Schedule include, but are not limited to, changes to the logic and sequence of the activities depicted in the schedule; changes to the duration of a particular activity; and addition or deletion of activities to be included with the schedule.
- C. The Contractor's request to revise the approved Baseline Schedule shall be made in writing. The request shall set forth the reasons for the change and the proposed revisions to the activities, logic and duration of the approved schedule. In addition, the Contractor shall submit a schedule analysis showing the effect of the revisions on the entire project. The analysis shall include the following:
 - 1. An updated schedule that does not include the proposed revisions. The schedule shall have a data date just prior to implementing the proposed revisions, and the schedule shall indicate the current contract completion date;
 - 2. A revised schedule that includes the proposed revisions. The schedule shall have the same data date as the updated schedule, and the schedule shall indicate the current contract completion date;
 - 3. A narrative explanation of the revisions and their impact to the schedule; and
 - 4. Computer files of the updated and revised schedules, in PDF format
- D. The Engineer will be allowed five (5) working days to consider the Contractor's request for revision to the approved schedule. Should the Engineer provide his acceptance of the proposed revision, the Contractor shall incorporate the revision into the next monthly update of the schedule. However, if the Engineer does not accept the proposed revision, the Contractor shall not make any change to the schedule.
- E. The above provisions shall not be construed as a limitation on the Contractor's

obligation to accurately reflect the as-built progress of the work with respect to each Bi-weekly Schedule Update. It is expressly understood and agreed that the term "revisions", as used herein shall refer to changes to the schedule with respect to work that will be prospectively performed up to completion of the project.

- F. Engineer Required Revisions. Within five (5) working days of the Engineer's request, the Contractor shall submit a revised schedule whenever the Engineer determines that there is a significant change in the Contractor's operations that affects the Critical Path.

1.8 PAYMENT

- A. CPM Scheduling shall not be measured and paid separately, but will be considered subsidiary to other items of the work.
- B. The Owner will retain an amount equal to 25 percent of the total estimated value of the work performed during each period in which the Contractor fails to submit any of the schedules required herein, including Bi-weekly Updates and Schedule Narrative Reports, and/or fails to conform said schedule requirements of this section, as determined by the Engineer.
- C. Thereafter, on subsequent successive estimate periods the percentage the Owner will retain will be increased at the rate of 25 percent per estimate period in which the non-conformance with this specification continues. Retention due to this non-conformance shall be in addition to all other retentions provided for under the Contract. The retention for this non-conformance will be released for payment on the next monthly estimate for partial payment following the date the schedule information is brought back into compliance with this provision.

END OF SECTION 01 32 16 -

SECTION 01 32 36 - PRECONSTRUCTION VIDEO MONITORING AND DOCUMENTATION

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Work of this Section includes, but is not limited to, Preconstruction Video Photography consisting of color video recording, with audio description, of surface features along the entire line of the project and including all Work, easement, and storage areas and all access roadways, and, prior to audio-video recording, visual investigation of all areas to be inventoried with notations made to items not readily visible by recording methods including, but not limited to, size, type and condition of driveway culverts, headwalls, etc. Audio-video recording shall be performed prior to commencement of the construction or delivery of any equipment, materials, or supplies to the site of Work.
- B. The purpose of the color audio-video recording of the project is to provide the necessary information for restoration of surface features after completion of the project. This recording must, therefore, cover the project area in its entirety to assist in returning those areas affected by construction to their original condition with as little controversy as possible. Video recording shall be performed no more than seven [7] days prior to construction in the area.
- C. Work in this Section does not relieve CONTRACTOR of his contractual obligation to furnish construction photographs as defined in Section 01 32 00.

1.2 OWNERSHIP OF RECORDINGS

- A. All recordings produced will become the permanent property of OWNER. CONTRACTOR shall deliver two [2] copies of all video recordings to the OWNERS REPRESENTATIVE prior to the start of any construction.
- B. Any portion of the recorded coverage deemed unacceptable by the OWNERS REPRESENTATIVE must be re-recorded by CONTRACTOR at no additional cost to OWNER.

PART 2 - PRODUCTS

2.1 ELECTRONIC REQUIREMENTS

- A. Audio-video recording shall be DVD format.

PART 3 - EXECUTION

3.1 COVERAGE OF RECORDING

- A. The area to be recorded shall include, but not be limited to, all existing driveways, sidewalks, curbs, ditches, streets, landscaping, trees, culverts, catch basins, headwalls, retaining walls, fences, visible utilities, and all buildings located within the zone of influence of construction. Of particular concern are any existing faults, fractures, defects, or other imperfections exhibited by the above mentioned surface features. Audio description shall be made simultaneously with and support the video coverage.
 - 1. Streets: All streets adjacent to excavation sites shall be recorded for the full width of the public right-of-way and for the entire length of the excavation plus 50 feet either side of the excavation site.
 - 2. Building Exteriors: Contractor shall furnish color audio and video of all exterior surfaces of buildings specifically identified by the Owners Representative to receive such coverage. At a minimum, any structure or building shall be recorded if located within any permanent or temporary easement. Buildings so identified may include houses, apartments, factories, warehouses, retail stores and other structures. Exterior building coverage shall include, but not be limited to, walls, visible foundations, chimney, porches, and trim.

3.2 LOCATION INFORMATION

- A. All DVD discs shall be properly identified by disc number, location, date, and project name in a manner acceptable to the Owners Representative.
- B. A record of the contents of each disc shall be supplied on a run sheet identifying each segment in the disc by location (i.e., street or easement viewing side, traveling direction, sewer stationing, and all referenced by disc indexing).
- C. A brief report and inventory of all discs completed, referenced by location and disc number, shall be furnished to the Owners Representative upon completion of the Work and delivery of the discs.
- D. All video recordings shall begin with the date and time of recording, the project name, the sheet numbers or engineering stationing as shown on the Contract Drawings, the name of the street, easement or building being recorded, the direction of travel, and the viewing side.
- E. Houses and buildings shall be identified visually by house or building number, when possible, in such a manner that the progress of the recording and the proposed system may be located by reference to the houses and buildings.
- F. The engineering stationing numbers must be continuous and correspond to the project sewer stationing and include the standard engineering symbols. This information must appear in the lower half of the viewing screen. Below the engineering stationing shall appear the name of the project, name of the area

covered, direction of travel, viewing side, date, time, etc.

- G. In easements, where hand-held video equipment must be used, the engineering station cannot be automatically reproduced on the disc. Local landmarks on the route or other recognizable features off to the side of the route shall be visually and audibly noted at frequent intervals to identify the camera location.
- H. All discs are to be accompanied by a notarized statement verifying the original unedited quality of the discs.

3.3 SITE RECORDING CONDITIONS

- A. All recording shall be done during times of good visibility. No outside recording shall be done during periods of visible precipitation or when the ground area is covered with snow, leaves, or debris unless otherwise authorized by the Owners Representative.
- B. In order to produce the proper detail and perspective, adequate auxiliary lighting will be required to fill in shadow areas caused by trees, utility poles, road signs and other such objects, as well as other conditions requiring artificial illumination.
- C. The average rate of speed in the general direction of travel of the conveyance used during recording shall not exceed 48 feet per minute. Panning rates and zoom-in zoom-out rates shall be controlled sufficiently such that playback will produce adequate clarity of the objects being viewed.
- D. When conventional wheeled vehicles are used as conveyances for the recording, the distance from the camera lens to the ground shall not be less than 8 feet to insure proper perspective. In instances where coverage will be required in areas not accessible to conventional wheeled vehicles, such coverage shall be obtained by walking or by special conveyance approved by the Owners Representative, but with the same requirements for disc quality and content as specified herein except as may be specifically exempted by the Owners Representative in writing.

END OF SECTION 01 32 36

SECTION 01 33 00 – CONTRACTOR SUBMITTALS

PART 1 - GENERAL

1.1 GENERAL

- A. Electronically submit all submittals required by the Contract Documents to the RPR unless otherwise noted.
- B. Within 30 days after the commencement date as stated in the Notice to Proceed, Contractor shall submit the following items to the RPR for review:
 - 1. A preliminary schedule of Shop Drawings, Samples, and proposed Substitutes ("Or-Equal") submittals listed in the Bid.
 - 2. A list with all permits and licenses Contractor shall obtain indicating the agency required to grant the permit and the expected submittal date for the permit and required date for receiving the permit.

1.2 SUBMITTAL REQUIREMENTS

- A. Wherever called for in the Contract Documents or where required by the RPR, Contractor shall furnish to the RPR one electronic submittal.
- B. Submittals shall be accompanied by the RPR standard submittal/transmittal form, a reproducible copy of which is available from the RPR. Any submittal not accompanied by such a form, or where all applicable items on the form are not completed, shall be returned for re-submittal.
- C. Organization
 - 1. A single submittal/transmittal form shall be used for each technical specification section or item or class of material or equipment for which a submittal is required. A single submittal covering multiple sections will not be acceptable, unless the primary specification references other sections for components. Example: if a pump section references other sections for the motor, protective coating, anchor bolts, local control panel, and variable frequency drive, a single submittal would be accepted; a single submittal covering vertical turbine pumps and horizontal split case pumps would not be acceptable.
 - 2. On the transmittal form, index the components of the submittal and insert tabs in the submittal to match the components. Relate the submittal components to specification paragraph and subparagraph, Contract Drawing number, detail number, schedule title, major component, and/or bid list item as applicable.
 - 3. Unless indicated otherwise, terminology and equipment names and

numbers used in submittals shall match those used in the Contract Documents.

D. Format

1. Minimum sheet size shall be 8.5 inches by 11 inches. Maximum sheet size shall be 24 inches by 36 inches. Number every page in sequence in each submittal. Properly collate, staple, and/or bind each copy of a submittal as appropriate.
2. Where product data from a manufacturer is submitted, clearly mark which model is proposed, with all pertinent data, capacities, dimensions, clearances, diagrams, controls, connections, anchorage, and supports. Sufficient detail level shall be presented for assessing compliance with the Contract Documents.
3. Each submittal shall be assigned a unique number and shall be numbered sequentially. The submittal numbers shall be clearly noted on the transmittal. Original submittals shall be assigned a numeric submittal number. Re-submittals shall bear an alpha-numeric system, which consists of the number assigned to the original submittal for that item, followed by a letter of the alphabet to represent it is a subsequent re-submittal of the original. For example, if submittal 25 requires a re-submittal, the first re-submittal will bear the designation "25-A" and the second re-submittal will bear the designation "25-B" and so on.

E. Disorganized submittals which do not meet the requirements above will be returned without review.

F. Except as may otherwise be indicated herein, the RPR will return prints for each submittal to Contractor with comments noted thereon, within 30 calendar days following receipt by the RPR. It is considered reasonable that Contractor shall make a complete and acceptable submittal by the first re-submittal on an item. Owner reserves the right to withhold monies due to Contractor to cover additional costs for the RPR review beyond the first re-submittal. The RPR maximum review period for each submittal or re-submittal will be 30 days. Thus, for a submittal requiring two re-submittals before it is complete, the maximum review period could be 90 days.

G. If a submittal is returned to Contractor marked "APPROVED," formal revision and resubmission will not be required.

H. If a submittal is returned marked "APPROVED AS NOTED," Contractor shall make the corrections on the submittal, but formal revision and resubmission will not be required.

I. If a submittal is returned marked "REVISE & RESUBMIT," Contractor shall revise it and shall resubmit the required number of copies for review. Re-submitting portions of multi-page or multi-drawing submittals will not be

allowed. For example, if a Shop Drawing submittal consisting of 10 drawings contains one drawing noted as "REVISE & RESUBMIT," the submittal as a whole is deemed "REVISE & RESUBMIT," and all 10 drawings are required to be re-submitted even if changes are only made to one drawing.

- J. If a submittal is returned marked "REJECTED/RESUBMIT," it shall mean either the submitted material or product does not satisfy the specification, the submittal is so incomplete it cannot be reviewed, or is a substitution request not submitted in accordance with the requirements. Contractor shall prepare a new submittal and shall submit the required number of copies for review.
- K. Re-submitting rejected portions of a previous submittal shall not be allowed. Every change from a submittal to a re-submittal or from a re-submittal to a subsequent re-submittal shall be identified and flagged on the re-submittal.
- L. Fabricating an item shall be commenced only after the RPR has reviewed the pertinent submittals and returned copies to Contractor marked either "APPROVED" or "APPROVED AS NOTED." Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as changes to the contract requirements.
- M. All submittals shall be carefully reviewed by an authorized representative of Contractor, prior to submission. Each submittal shall be dated, signed, and certified by Contractor's Quality Control Engineer as being correct and in strict conformance with the Contract Documents. The RPR will only review submittals which have been so certified by Contractor. All non-certified submittals will be returned to Contractor without action taken by the RPR, and any delays caused thereby shall be the total responsibility of Contractor.
- N. The RPR review of submittals shall not relieve Contractor of the entire responsibility for the correctness of details and dimensions. Contractor shall assume all responsibility and risk for any misfits due to any errors in submittals. Contractor shall be responsible for the dimensions and the design of adequate connections and details.

1.3 SHOP DRAWINGS

- A. Wherever called for in the Contract Documents or where required by Engineer, Contractor shall furnish for review, one electronic copy for each Shop Drawing submittal. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop-prepared drawings, fabrication and installation drawings, erection drawings, lists, graphs, catalog sheets, data sheets, and similar items. Whenever Contractor is required to submit a design or design calculations as part of a submittal, such calculations shall bear the signature and seal of a Professional Engineer registered in the appropriate branch and in the State of Indiana, unless otherwise indicated.
- B. All Shop Drawings shall be carefully reviewed by an authorized representative of

Contractor, prior to submission. Each sheet of a shop drawing submittal shall be dated, signed, and certified by Contractor's Quality Control Engineer as being correct and in strict conformance with the Contract Documents.

1.4 CONTRACTOR'S SCHEDULE

- A. Contractor's CPM Construction Schedule and reports shall be prepared and submitted to the RPR in accordance with the specifications.

1.5 SAMPLES

- A. Whenever samples are required in the Contract Documents, Contractor shall submit not less than [3] samples of each item or material unless otherwise agreed upon in writing from the Engineer.
- B. Unless otherwise indicated, samples shall be submitted minimum of [30] days prior to ordering such material.
- C. Samples shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and Manufacturer's name. Upon receiving acceptance of the RPR, one set of the samples will be stamped and dated by the RPR and returned to Contractor, one set of samples will be retained by the RPR, and one set of samples shall remain at the Site until completion of the Work.
- D. Unless indicated otherwise, all colors and textures for items presented in sample submittals shall be from the manufacturer's standard colors and standard materials, products, or equipment lines. If the samples represent non-standard colors, materials, products, or equipment lines and their selection will require an increase in Contract Times or Price, Contractor shall clearly indicate same on the submittal's transmittal page.
- E. Schedule sample submittals such that:
 - 1. Sample submittals for colors and texture selection are complete so the RPR has 45 days to assemble color panels and select color and texture dependent products and materials without delay to the construction schedule, and
 - 2. After the RPR selects colors and textures, Contractor has sufficient time to provide the products or materials without delay to the construction schedule. The Contract Times will not be extended for Contractor's failure to allow enough review and approval or selection time, failure to submit all samples requiring color or texture selection, or failure to submit complete or approvable samples.

1.6 SPARE PARTS LIST

- A. Contractor shall furnish the RPR one electronic set of spare parts information for all mechanical, electrical, and instrumentation equipment for information upon Substantial Completion. The spare parts list shall include the current list price

for each spare part. The spare parts list shall include those spare parts which each manufacturer recommends be maintained by Owner in inventory. Each manufacturer or supplier shall indicate the name, address, and telephone number for its nearest outlet of spare parts to assist Owner in ordering. Contractor shall cross-reference all spare parts lists to the equipment numbers designated in the Contract Documents. The spare parts lists shall be bound in standard size, three-ring, loose-leaf, vinyl plastic hard cover binders suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches. A USB "thumb drive" containing the same sheets in PDF format shall also be provided if requested by the Owner or their representatives.

1.7 AS-BUILT AND RECORD DRAWINGS

- A. As-built drawings shall be maintained and submitted in accordance with the requirements of the specifications included herein.
- B. As-built drawings shall be accessible to Owner and the RPR at all times during the construction period.
- C. Final payment will not be acted on until the as-built drawings have been prepared and delivered to Owner in the format specified.
- D. The as-built information submitted by Contractor will be incorporated by the RPR into Project Record Drawings. In preparing the Project Record Drawings, the RPR will assume the as-built information submitted by Contractor is correct, and Contractor shall be responsible for the accuracy of such information and for any errors or omissions which may appear on the Project Record Drawings as a result.

1.8 PRE-CONSTRUCTION AUDIO-VIDEO

- A. Pre-construction video photography shall be performed and submitted in accordance with the requirements of Section 01 32 36 – Preconstruction Video Monitoring and Documentation.

1.9 WARRANTIES AND GUARANTEES

- A. Warranties and Guarantees shall be prepared in accordance with the requirements of the AGREEMENT and submitted in accordance with Section 01 33 00 – Contractor Submittals.

END OF SECTION 01 33 00

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections include the following:
 - 1. Divisions 1 through 15 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Engineer.
- C. Mockups: Full-size, physical example assemblies to illustrate finishes and materials. Mockups are used to verify selections made under Sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Mockups shall

establish the standard by which the Work will be judged.

- D. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.4 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

- 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

1.5 SUBMITTALS

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

- C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

- 1. Specification Section number and title
 - 2. Description of test and inspection.
 - 3. Identification of applicable standards.
 - 4. Identification of test and inspection methods.
 - 5. Number of tests and inspections required.
 - 6. Time schedule or time span for tests and inspections.
 - 7. Entity responsible for performing tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.

- D. Reports: Prepare and submit certified written reports that include the following:

- 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.

9. Test and inspection results and an interpretation of test results.
 10. Ambient conditions at time of sample taking and testing and inspecting.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and re-inspecting.
- E. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or products that are similar to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain sections of the Specifications may require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.
- G. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in types of tests and inspections to be performed.

- H. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Engineer.
 2. Notify Engineer seven days in advance of dates and times when mockups will be constructed.
 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 4. Obtain Engineer's approval of mockups before starting work, fabrication, or construction.
 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 6. Demolish and remove mockups when directed, unless otherwise indicated.

1.7 QUALITY CONTROL

- A. Contractor Responsibilities: Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction.
1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ the same entity engaged by Owner, unless agreed to in writing by Owner.
 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.
- C. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that revised or replaced Work that failed to comply with

requirements established by the Contract Documents.

- D. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 3. Submit a certified written report, in duplicate, of each test, inspection and similar quality-control service through Contractor.
 4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
 5. Do not perform any duties of Contractor.
- E. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field-curing of test samples.
 5. Delivery of samples to testing agency.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspection equipment of Project site.
- F. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- G. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within days

of date established for the Notice to Proceed.

1. Distribution: Distribute schedule to Owner, Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - EXECUTION

2.1 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 50 00 – MOBILIZATION AND DEMOBILIZATION

PART 1 - GENERAL

1.1 SCOPE

- A. Mobilization and Demobilization shall include the following principal items as required for the proper performance and completion of the Work.
1. Obtain all required permits and keep them active/updated throughout the course of the project.
 2. Obtain all insurance and bonds.
 3. Move on to the site all of Contractor's materials and equipment
 4. Install temporary construction utilities, including power, wiring, and lighting facilities.
 5. Establish fire protection system.
 6. Develop construction water supply.
 7. Provide and install field office trailers and/or secure local office and storage space for Contractor and the Owners Representative, complete with all furnishings and utility services including internet, telephone and copying machines. A location shall be set at the preconstruction conference. If a field office is deemed unnecessary at the preconstruction conference, a Contract deduction shall be provided to the Owner for the anticipated cost of installing such facilities.
 8. Provide all on-site communication facilities, including telephones, and radio pagers if deemed necessary at pre-construction conference.
 9. Provide on-site sanitary facilities and potable water facilities including their removal at project completion.
 10. Arrange for and erect Contractor's work and storage yard as well as necessary perimeter sediment traps.
 11. Construct and implement security features and requirements including perimeter fencing as necessary.
 12. Have all OSHA required notices, and establish safety programs.
 13. Complete initial submittal requirements.
 14. Remove all temporary utilities, field office trailer(s) and furnishings

(including any fencing, erosion control measures, and any other contractor supplied amenities or stored materials) away from project site at project completion or as directed by the Owners Representative.

15. Restore surfaces damaged as a result of construction activities, including mobilization and demobilization, which are not included under other items and as directed by the Owners Representative.

1.2 RELATED SECTIONS

- A. Section 01 33 00 – Contractor Submittals
- B. Section 01 32 36 – Preconstruction Video Monitoring and Documentation
- C. Section 01 76 01 – Protecting Existing Facilities

END OF SECTION 01 50 00

SECTION 01 74 23 – FINAL CLEANING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for final cleaning at Substantial Completion.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Special cleaning requirements for specific construction elements are included in appropriate Sections of Divisions 1 through 15.
 - 2. Burning or burying of debris, rubbish, or other waste material is not permitted.

PART 2 - PRODUCTS

2.1 MATERIALS

Cleaning Agents: Use cleaning materials and agents recommended by the manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health, property, the environment, or that might damage or mar finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Provide final-cleaning operations when indicated. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of Work to the condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
- B. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for the entire Project or a portion of the Project.
 - 1. Clean the Project Site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and foreign substances.
 - 2. Sweep paved areas broom clean. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - 3. Remove petrochemical spills, stains, and other foreign deposits.
 - 4. Remove tools, construction equipment, machinery, and surplus material from the site.
 - 5. Remove debris and surface dust from limited access spaces, including

- roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
6. Broom clean concrete floors in unoccupied spaces.
 7. Vacuum clean carpet and similar soft surfaces, removing debris and excess nap. Shampoo, if required.
 8. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 9. Remove labels that are not permanent labels.
 10. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 11. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment.
 12. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 13. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 14. Leave the Project clean and ready for occupancy.
- C. Road Cleaning: The Contractor shall clean the designated haul routes to prevent dust, dirt, and excavated material from accumulating. Special attention shall be used at the location of the entry gates where the speed bumps can cause construction related material to fall off trucks and other vehicles. Road cleaning shall be performed at least once a day. Additional cleaning shall be performed as necessary or as directed by the Engineer.
- D. Removal of Protection: Remove temporary protection and facilities installed during construction to protect previously completed installations during the remainder of the construction period.
- E. Compliances: Comply with governing regulations and safety standards for cleaning operations. Remove waste materials from the site and dispose of lawfully.
1. Where extra materials of value remain after completion of associated Work, they become the Owner's property. Dispose of these materials as directed by the Owner. The Owner may defer ownership of these materials of value to the contractor in which case a lump sum credit for the value of the materials shall be deducted from the contract.

END OF SECTION 01 74 23

SECTION 01 76 01 – PROTECTING EXISTING FACILITIES

PART 1 - GENERAL

1.1 GENERAL

- A. Contractor shall protect all existing utilities and improvements not designated for removal and shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than that prior to such damage or temporary relocation, all in accordance with the Contract Documents.

1.2 RESTORATION OF PAVEMENT

- A. Permanent Resurfacing: In order to obtain a satisfactory junction with adjacent surfaces, Contractor shall saw cut back and trim the edge so as to provide a clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement. Damaged edges of pavement along excavations and elsewhere shall be trimmed back by saw cutting in straight lines. All pavement restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed pavement.

1.3 EXISTING UTILITIES AND IMPROVEMENTS

- A. Contractor shall protect underground utilities and other improvements which may be impaired during construction operations, regardless of whether or not the utilities are indicated on the Contract Drawings. Contractor shall take all possible precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.
- B. Coordination with any applicable utility or utilities shall be the sole responsibility of Contractor. Contractor shall be responsible for the availability and accuracy of information relating to the utilities.
- C. The plans show all known utilities located within the project limits according to information and data furnished to the Owners Representative by the various utility companies. The accuracy of the plans in this respect is not guaranteed or warranted by Owner.
- D. All of the permanent and temporary utility facilities in their present or relocated positions shall have been considered in the bid. No additional compensation will be allowed for suspensions, delays, interference, hindrances, inconvenience, or damage sustained by Contractor due to said utility facilities or the operations of moving them. However, if the execution of the Work is delayed for an unreasonable period of time, Contractor may make a claim.
- E. For sewer construction within the public right of way, permanent easement, or temporary easement, Contractor shall coordinate with affected utilities to protect, relocate, shore, or replace existing utilities at no additional cost to Owner.

- F. Citizens Gas chooses to protect its own facilities and will provide Contractor a schedule of estimated costs upon request.
- G. Field tile, storm drains, and culverts encountered and affected by the Scope of Work specified within the Contract Documents shall be given a positive drainage outlet. Any field tile, storm drains, or culverts damaged by Contractor's operations shall be replaced by Contractor at his own expense.
- H. Right of Access: The right is reserved to Owner, Owners Representative and to the owners of public utilities and franchises to enter the worksite at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the Work of this Contract.
- I. On Grade and Overhead Utilities both Indicated and Not Indicated: Existing infrastructure and utility lines that are indicated or the locations of which are visible from the ground must be protected by the Contractor. All damage to visible infrastructure and utility lines caused by the Contractor must be repaired immediately to the satisfaction of the owner of the respective damaged object at no additional cost to the Owner. Foreseen conflicts with above ground or on grade infrastructure and utility lines must be communicated and coordinated with the Owner, Owners Representative, and the owner of the respective object when it is identified. No additional compensation will be allowed for suspensions, delays, interference, hindrances, inconvenience, or damage sustained by Contractor due to said utility facilities or the operations of moving them.
- J. Underground Utilities Indicated: Existing utility lines that are indicated or the locations of which are made known to Contractor prior to excavation and that are to be retained, and all utility lines that are discovered during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired or replaced by Contractor at his own expense, unless otherwise repaired by the owner of the damaged utility. If the owner of the damaged utility performs its own repairs, Contractor shall reimburse said owner for the costs of repair.
- K. Underground Utilities Not Indicated: In the event that Contractor damages existing utility lines that are not indicated or the locations of which are not made known to Contractor prior to excavation, a verbal report of such damage shall be made immediately to the Owners Representative and a written report thereof shall be made promptly thereafter. The Owners Representative will immediately notify the owner of the damaged utility. If the Owners Representative is not immediately available, Contractor shall notify the utility owner of the damage. If directed by the Owners Representative, repairs shall be made by Contractor under the provisions for changes and extra work contained in Section 01 00 00.
- L. Costs for locating and repairing damage not due to failure of Contractor to exercise reasonable care, and removing or relocating such utility facilities not indicated in the Contract Documents with reasonable accuracy, and for equipment on the project which was actually working on that portion of the Work which was interrupted or idled by removal or relocation of such utility facilities

and which was necessarily idled during such work, will be paid for as extra work in accordance with the provisions of Section 01 00 00.

- M. Approval of Repairs: All repairs to a damaged utility or improvement are subject to inspection and approval by an authorized representative of the utility or improvement owner before being concealed by backfill or other work.
- N. Maintaining in Service: Unless indicated otherwise, oil and gasoline pipelines, power, and telephone or communication ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the Work shall remain continuously in service during all the operations under this Contract unless other arrangements satisfactory to the Owners Representative are made with the owner of said pipelines, ducts, main, irrigation line, sewer, storm drain, pole, wire, or cable. Contractor shall be responsible for and shall repair all damage due to its operations, and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after the completion of backfilling and compaction. There shall be no direct payment for maintaining service of existing facilities and that cost shall be included in the payment for other items.

1.4 LAWN AREAS

- A. Lawn or landscaped areas damaged during construction shall be repaired to match the preconstruction condition to the satisfaction of the land-owner and the Owners Representative at the expense of the Contractor.

END OF SECTION 01 76 01

SECTION 01 78 23 – OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 OPERATION AND MAINTENANCE MANUALS

- A. Provide Operation and Maintenance data in the form of instructional manuals for use by the Owner’s personnel for:
 - 1. All equipment and systems
 - 2. All valves, gates, and related accessories
 - 3. All instruments, control devices, and panels
 - 4. All electrical gear
- B. Operation and Maintenance (O&M) Manual must be submitted to the Engineer before equipment can be placed into service for operation by the Owner.
- C. With each O&M Manual, include a copy of the three-page checklist included in this section. Manuals will not be reviewed without a completed checklist.
- D. All non-applicable information shall be marked as such by crossing out. Indicate actual model numbers and equipment options. Manuals not marked as indicated above will be returned to the Contractor without review.
- E. Definitions:
 - 1. Operation and Maintenance Data shall be provided.
 - a. The term “operation and maintenance data” includes all product related information and documents which are required for preparation of the plant operation and maintenance manual. It also includes all data which must accompany said manual as directed by current regulations of any participating government agency, including but not limited to, MSDS sheets for lubricants, chemicals, etc.
 - b. Required operation and maintenance data include, but are not limited to, the following:
 - (1) Complete, detailed written operating instructions for each product or piece of equipment including: equipment function; operating characteristics; limiting conditions; operating instructions for start-up, normal, and emergency conditions; regulation and control; and shutdown.
 - (2) Complete, detailed written preventive maintenance instructions as defined below.
 - (3) Complete parts list including assembly drawing, exploded view or sectional drawing with all parts

identified. Parts listing shall include part name and original equipment manufacturer's parts numbers.

- (4) Recommended spare parts lists and local sources of supply for parts.
- (5) Written explanations of all safety considerations relating to operation and maintenance procedures.
- (6) Name, address, and phone number of manufacturer, manufacturer's local service representative, and subcontractor or installer.
- (7) Copy of all approved shop drawings and copy of warranty bond and service contract as applicable.

2. Preventive Maintenance Instructions shall be provided.

- a. The term "preventive maintenance instructions" includes all information and instructions required to keep a product or piece of equipment properly lubricated, adjusted, and maintained so that the item functions economically throughout its full design life.
- b. Preventive maintenance instructions include, but are not limited to, the following:
 - (1) A written explanation with illustrations for each preventive maintenance task
 - (2) Recommended schedule for execution of preventive maintenance tasks
 - (3) Lubrication charts
 - (4) Table of alternative lubricants
 - (5) Troubleshooting instructions
 - (6) List of required maintenance tools and equipment

F. Submittals:

1. General:

- a. Contractor shall submit to the Engineer for review and approval two (2) hard copies of the operation and maintenance manual for each piece of equipment within 90 days after approval of its shop drawings.
- b. Within thirty (30) days after Engineer's approval of the two-copy submittal, Contractor shall furnish to Engineer eight (8) hard copies and three (3) electronic copies of the operation and maintenance manual.
- c. The submittals shall clearly delineate information applicable to the equipment. Unmarked manuals not clearly delineating instructions applicable to the equipment supplied are unacceptable and will be returned to the Contractor without review.

2. Letter of Transmittal: Provide a letter of transmittal with each submittal and include the following in the letter:
 - a. Date of submittal
 - b. Contract title and number
 - c. Contractor's name and address
 - d. A list of the attachments and the Specification Sections to which they relate
 - e. Reference to or explanation of related submittals already made or to be made at a future date

3. Format Requirements:
 - a. Use 8-1/2-inch by 11-inch paper.
 - b. Insert heavy clear plastic sheet at front and back of text to prevent printed material from adhering to the covers.
 - c. Drawings reduced to 11-inch by 17-inch are acceptable if they are clear and readable and are neatly and individually double-folded to 8-1/2-inch by 11-inch size. Drawing title shall be visible in lower right hand corner of the original and folded drawing. Reinforce binding edge with clear Mylar strip.
 - d. Larger drawings or illustrations are acceptable if neatly folded and individually placed in an 8-1/2-inch by 11-inch clear plastic packet which fits in the binder. Only one drawing or illustration can be placed in each packet. Drawing title shall be visible in lower right hand corner of the original and folded drawing.
 - e. All text must be legible typewritten or machine printed originals or high quality copies of same.
 - f. Each page shall have a binding margin of approximately 1- 1/2 inches and be punched for placement in a three-ring loose leaf binder. Provide heavy duty hard cover three-ring "Slant D" binders with clear vinyl overlay pocket on binder front, back, and spine, Cardinal Slant D ATA or equal. Identify each binder provided with the following inserted in the front and spine pockets:
 - (1) Title "Operating and Maintenance Instructions"
 - (2) Location of Project: Belmont AWT Plant, City of Indianapolis, Indiana
 - (3) Title of Project: Twin Transfer Sludge Lines (TRSL) Maintenance and Replacement
 - (4) Identity of building or structure, as applicable.
 - (5) Identity of general subject matter covered.
 - g. Use dividers and indexed tabs between major categories of information, such as operating instructions, preventive maintenance instructions, or other. When necessary, place each major category in a separate binder.
 - h. Provide a table of contents for each binder.

- i. Identify products by their functional names in the table of contents and at least once in each chapter or section. Thereafter, abbreviations and acronyms may be used if their meaning is explained in a table in the back of each binder. Use of model or catalog numbers or letters for identification is not acceptable.
4. Interim Maintenance Requirements: Provide a detailed explanation of the Owner's obligations required to maintain the equipment and materials during the guarantee period.
 - a. List of preventive maintenance items that are required to be performed by the Owner to keep the guarantee in force
 - b. Explanation of emergency type repairs that may be undertaken by the Owner during the guarantee period without voiding the guarantee
 - c. List of local supplier of equipment and materials and name of contact persons
 - d. List of service centers that are factory authorized to make emergency type repairs including 24-hour telephone numbers and names of contact persons
 - e. Provide two factory or service center person names including 24-hour telephone numbers and a priority list of whom to contact first, etc.
5. Information provided under this Section shall be specific to the exact type and model number of equipment item being supplied. General catalog information and/or generic descriptions are not acceptable and will be rejected.
6. Electronic Version: Every item of mechanical and electrical equipment will require an electronic set on a CD-ROM. Separate PDF files shall be submitted for every item of mechanical and electrical equipment. The PDF files shall be named using file names that do not include spaces. The file names shall be descriptive of the content, including chapter and heading names. At a minimum, chapters shall include operation and maintenance data, preventative maintenance instructions, and interim maintenance instructions. The architecture of the PDF files shall include embedded electronic links for all references within the manual. These links shall connect parts of a document, provide manufacturers' locations on the Web, and connect to photographs, graphs, tables or exhibits. The PDF files shall be indexed using Acrobat Catalog such that they will be searchable. The information stored on the CD-ROM shall be printable and able to be copied and saved to a network. Printed sets and CD-ROM covers shall bear the Item Number and Name of the Item.

CITIZENS ENERGY GROUP
TWIN TRANSFER SLUDGE LINES MAINTENANCE AND REPLACEMENT

O&M SUBMITTAL
REVIEW CHECKLIST

PREPARED BY: _____
(contractor)

DATE: _____

PREPARED BY: _____
(contractor)

DATE: _____

SUBMITTAL NO.: _____

CONTRACT NO.: _____

SPEC. SECTION: _____

ITEM DESCRIPTION: _____

<u>Required Data</u>	<u>Item Complete (Y or N)</u>	<u>Contractor Initials</u>	<u>Page Nos.</u>	<u>Reviewer Remarks*</u>
<u>O&M Data</u>				
Equipment Description				
Installation Data				
Operating Characteristics				
Start-up Procedures				
Shutdown Procedures				
Maintenance Instructions				
Parts List				
Recommended Spare Parts				
Safety Information				
Manufacturer				
Local Supplier				
Local Service Facility				
Shop Drawings				
MSDS Sheets				

CITIZENS ENERGY GROUP
TWIN TRANSFER SLUDGE LINES MAINTENANCE AND REPLACEMENT

O&M SUBMITTAL
REVIEW CHECKLIST
(continued – page 2)

SUBMITTAL NO.: _____

<u>Required Data</u>	Item Complete (Y or N)	Contractor Initials	Page Nos.	<u>Reviewer Remarks*</u>
<u>Preventive Maintenance</u>				
Tasks required				
Recommended Schedule				
Lubrication Charts				
Alternative Lubricants				
Troubleshooting Guide				
List of Maintenance Tools				
<u>Interim Maintenance Requirements</u>				
Preventative Maintenance				
Types of Permissible Repairs				
Service Centers				
Service Contact Person(s)				
Phone Numbers (24-hour)				
<u>Predictive Maintenance</u>				
Vibration Data				

CITIZENS ENERGY GROUP
TWIN TRANSFER SLUDGE LINES MAINTENANCE AND REPLACEMENT

O&M SUBMITTAL
REVIEW CHECKLIST
(continued – page 3)

SUBMITTAL NO.: _____

<u>Required Data</u>	<u>Item Complete (Y or N)</u>	<u>Contractor Initials</u>	<u>Page Nos.</u>	<u>Reviewer Remarks*</u>
General (form, format, etc.)				
Number Required				
Three-Ring Binder/Covers				
Non-applicable Information				
Dividers Provided				
Table of Contents				
Oversize Drawings				

Remarks: *Refers to remarks noted above or on attached sheets.

END OF SECTION 01 78 23

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Document Redlines and other 'as-built' information that the Contractor is required to submit to the Owners Representative. The Owners Representative, and Inspection team, is responsible for preparing and submitting final Project Record Drawings.
- B. Project Document Redlines required include the following:
 - 1. Field Marked-up copies of Contract Drawings.
 - 2. Field Marked-up copies of Shop Drawings.
 - 3. Field Marked-up copies of Specifications, Addenda, and Change Orders.
 - 4. Field Marked-up Product Data submittals.
 - 5. Field Record Samples.
 - 6. Field records for variable and concealed conditions.
 - 7. Field Record information on Work that is recorded only schematically.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Divisions 01 through 40 Sections for specifying Project Record Document requirements for specific pieces of equipment or building operating systems.
- D. Maintenance of Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition. Make documents and Samples available at all times for the Engineer's inspections.

1.3 REDLINE DRAWINGS

- A. Markup Procedure: During construction, maintain a set of prints of the Contract Drawings (half size or larger, as necessary to maintain legibility) and Shop Drawings for Project Redline Documentation purposes.
 - 1. Legibly mark these Drawings to show the actual installation where the installation varies from the installation shown originally. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later. Items required to be marked include, but are not limited to, the following:

- a. Dimensional changes to the Drawings.
 - b. Revisions to details shown on the Drawings.
 - c. Depths of foundations below the first floor.
 - d. Locations and depths of existing underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Locations of concealed internal utilities.
 - i. Details not on original Contract Drawings.
2. Legibly mark record prints of Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings location.
 3. Legibly mark redline documentation with red pen. Use other colors to distinguish between changes for different categories of the Work at the same location.
 4. Legibly mark important additional information that was either shown schematically or omitted from original Drawings.
- B. Responsibility for Markup: The individual or entity, who obtained record data, whether the individual or entity is the Installer, subcontractor, or similar entity, shall prepare the markup on redline drawings.
1. Accurately record information in a legible manner. Owners Representative has the right to require resubmission of redline documentation due to illegible markings.
 2. Record data in the field, or as soon as possible after obtaining required information. Record and check the redline markup prior to enclosing concealed installations.
 3. At time of Substantial Completion, submit the redline documentation to Owners Representative for the Owner's records. Coordinate submission requirements with the Owners Representative.

1.4 PIPELINE SURVEY REQUIREMENT

- A. The Contractor will be required to furnish a precise location of that actual installed location of each installed pipeline and fiber optic conduit to the Owner and Engineer in CAD or GIS format within two (2) weeks of the placement and backfill of the final pipe segment of this phase.
1. Minimum Precision Requirements
 - a. Horizontal: ± 1 foot
 - b. Vertical: ± 0.1 foot

1.5 RECORD SPECIFICATIONS

- A. During the construction period, maintain a copy of the Project Specifications, including addenda and modifications issued, for Project Redline Documentation purposes.
1. Legibly mark the Specifications to indicate the actual installation where the installation varies from that indicated in Specifications and modifications issued. Note related project record drawing information, where applicable. Give particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later.
 - a. In each Specification Section where products, materials, or units of equipment are specified or scheduled, mark the copy with the proprietary name and model number of the product furnished.
 - b. Record the name of the manufacturer, supplier, installer, and other information necessary to provide a record of selections made and to document coordination with record Product Data submittals and maintenance manuals.
 - c. Note related record Product Data, where applicable. For each principal product specified, indicate whether record Product Data has been submitted in maintenance manual instead of submitted as record Product Data.
 2. Upon completion of markup, submit record Specifications to the Owners Representative for inclusion with the final Project Record Drawings for the Owner's records.
 3. The Contractor is responsible for collecting marked-up record Sections from each of his subcontractors. The Contractor is also responsible for collating these Sections in proper numeric order with its own Sections to form a complete set of record Specifications.
 4. The Contractor is responsible for submitting the complete set of record Specifications to the Owners Representative as specified, above.

1.6 RECORD PRODUCT DATA

- A. During the construction period, maintain one copy of each Product Data submittal for Project Record Document purposes.
1. Legibly mark Product Data to indicate the actual product installation where the installation varies substantially from that indicated in Product Data submitted. Include significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation.
 2. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 3. Upon completion of markup, submit a complete set of record Product Data to the Owner's Representative for the Owner's records.

4. Where record Product Data is required as part of maintenance manuals, submit marked-up Product Data as an insert in the manual instead of submittal as record Product Data.
5. Each prime contractor is responsible for marking up and submitting record Product Data for its own Work.

1.7 RECORD SAMPLE SUBMITTAL

Immediately prior to date of Substantial Completion meet with the Owners Representative and the Owner's personnel at the site to determine which of the Samples maintained during the construction period shall be transmitted to the Owner for record purposes. Comply with the Owners Representative's instructions for packaging and identification marking for delivery to Owners Representative. Delivery to the Owner's Sample storage space will be performed by the Owners Representative. Dispose of other Samples in a manner specified for disposing surplus and waste materials.

1.8 MAINTENANCE MANUAL SUBMITTAL

When each construction activity that requires submittal of maintenance manuals is nominally complete, but before Substantial Completion, submit maintenance manuals specified. Additional maintenance manual requirements are contained in Section 01 78 23.

1.9 MISCELLANEOUS RECORD SUBMITTALS

- A. Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Immediately prior to Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Submit to the Owners Representative for the Owner's records.
 1. Categories of requirements resulting in miscellaneous records include, but are not limited to, the following:
 - a. Field records on excavations and foundations.
 - b. Field records on underground construction and similar work.
 - c. Survey showing locations and elevations of underground lines.
 - d. Invert elevations of drainage piping.
 - e. Surveys establishing building lines and levels.
 - f. Authorized measurements utilizing unit prices or allowances.
 - g. Records of landscaping and plant treatments.
 - h. Ambient and substrate condition tests.
 - i. Certifications received in lieu of labels on bulk products.
 - j. Batch mixing and bulk delivery records.
 - k. Testing and qualification of tradesmen.
 - l. Documented qualification of installation firms.
 - m. Load and performance testing.
 - n. Inspections and certifications by governing authorities.
 - o. Leakage and water-penetration tests.
 - p. Final inspection and correction procedures.

PART 2 - EXECUTION

2.1 RECORDING

Record redlines for changes and modifications to the Documents as they occur. **Do not wait until the end of the Project to complete redline documentation.**

END OF SECTION 01 78 39

SECTION 02 41 00 – DEMOLITION

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Demolish, wholly or in part, and dispose of structures, equipment, materials, piping, pavement, sidewalks, fences, guardrails, and do related work necessary to complete work shown or specified.
- B. Demolition shall include the salvaging of designated piping and equipment and the backfilling of trenches, holes, and pits resulting from demolition work with clean soil free from debris and foreign material.
- C. The limits of demolition shall be as indicated on the drawings or specified in this Section

1.2 QUALITY ASSURANCE

- A. Accomplish all demolition work so there is no injury to any persons and no damage to adjacent structures or property. All demolition methods shall be in full compliance with municipal, county, state, and federal ordinances. Demolition work shall comply with the requirements of the Occupational Safety & Health Administration (OSHA).
- B. The Contractor shall comply with all municipal, county, state, and federal ordinances regarding the disposal of rubble, scrap metal, and refuse.
- C. Limits: Exercise care to break concrete well for removal in reasonably small masses. Where only parts of a structure are to be removed, cut the concrete along limiting lines with a suitable saw so that damage to the remaining structure is held to a minimum.
- D. Demolition procedures shall be developed by the Contractor and submitted to the Engineer before demolition is started. The procedures shall provide for safe conduct of the work, protection of property which is to remain undisturbed, including the installation of dust barriers at occupied areas of buildings, if necessary, and coordination with other work in progress. The procedures shall include a detailed description of the methods and equipment to be used for each operation and sequence of operations.

1.3 SUBMITTALS

- A. Submittals shall be as specified in Section 01 00 00 – General Requirements.
- B. Submit proposed demolition procedures
- C. Site Inspection: Visit the site and inspect all existing structures. Observe and record any defects which may exist in buildings or structures adjacent to but not directly affected by the demolition work. Provide the Owner with a copy of this inspection record and obtain the Engineer's and Owner's approval prior to commencing the demolition.

1.4 JOB CONDITIONS

- A. General: It shall be the responsibility of the Contractor to visit the site and inspect the nature and condition of the items to be removed before submitting his bid.
- B. Asbestos: If, during the course of this work, the existence of asbestos is observed in the work area, promptly notify the Owner in writing. Do not perform any work pertinent to the asbestos material prior to receipt of special instructions from the Owner.
 - 1. Should any special measures be required, the cost thereof shall be handled by an appropriate Change Order or a separate contract or subcontract with the Owner.
- B. Dust Control: Control the amount of dust resulting from demolition to prevent the spread of dust to occupied portions of buildings and to avoid creation of a nuisance in the surrounding area. For more specific requirements, refer to Specification 01 00 00 – General Requirements – in Part 1.12. Do not use water when it will result in, or create, hazardous or objectionable conditions such as ice, flooding, and pollution.
- D. Protection of Existing Work: Protect existing work. Work damaged by the Contractor shall be repaired to match existing work.

PART 2 – PRODUCTS

2.1 TEMPORARY MATERIALS

Temporary fencing, barricades, and other items shall be neat, clean, and used for its intended purpose. All temporary materials and installation layouts must be approved by the Owners Representative prior to installation. All temporary materials will be furnished and installed by the Contractor at no additional cost to the Owner unless otherwise specifically agreed to by the Owner in writing and prior to the execution of the work.

2.2 REPAIR AND REPLACEMENT MATERIALS

Materials used in the repair or replacement of existing work to remain shall be identical or equal to the materials used in existing work when new.

PART 3 – EXECUTION

3.1 DEMOLITION REQUIREMENTS

- A. **The use of explosives is strictly prohibited. Explosive devices are strictly prohibited.**
- B. Carefully protect all mechanical and electrical equipment against dust and debris.
- C. Provide safe access to and egress from all working areas at all times with adequate protection from falling material.
- D. Provide adequate scaffolding, shoring, bracing railings, toe boards and protective covering during demolition to protect personnel and equipment against injury or damage. Cover floor openings not used for material drops with material substantial enough to

support any loads placed on it. Properly secure the covers to prevent accidental movement

- E. Provide adequate lighting at all times during demolition.
- F. Close areas below demolition work to anyone while removal is in progress.
- G. Do not drop material to any point lying outside the exterior walls of the structure unless the area is effectively protected.

3.2 STRUCTURES AND BUILDINGS

- A. Remove all slabs, piping, conduits, etc. as required after approval of the Engineer.
- B. When structures and buildings are to be partially demolished, the break between the part removed and the part remaining shall be as indicated on the drawings unless otherwise approved by the Engineer in writing prior to commencing the work.

3.3 PIPING AND UTILITIES

- A. Completely remove piping, conduit, and wiring in structures and buildings which are to be demolished. Completely remove piping, conduit, and wiring in the demolished parts of structures and buildings which are to be partially demolished. Completely remove other piping, conduit, and wiring which are designated to be removed.
- C. Underground piping, conduit, and wiring which are to be abandoned and do not interfere with new work may be left in place, unless otherwise shown on the drawings. Do not leave abandoned branches of piping and wiring "live." Isolate abandoned branches by closing branch valve at main or by disconnecting branch at main. Plug, cap, and seal active branch at isolating valve or point of disconnection.
- D. Existing sludge lines which are to be abandoned shall be flushed first with water until water discharge is clear. Plug and seal cut ends of underground piping to be abandoned.**
- E. Properly disconnect, seal, and plug utility services to structures and buildings which are completely demolished. Properly disconnect, seal, and plug utility lines within structures and buildings which are partially demolished.

3.4 REMOVAL OF EXISTING PAVEMENT, SIDEWALKS, CURBS, AND GUTTERS

- A. Completely remove pavement, sidewalks, curbs, and gutters which are designated to be removed.
- B. Use methods to remove pavement, sidewalks, curbs, and gutters that will assure breaks at pavement, sidewalks, curbs, and gutters not removed are along straight lines. The faces of the remaining pavement, sidewalk, curb, and gutter faces shall be saw cut to a neat, clean, and straight edge.

3.5 OPENINGS

Plug all openings in walk, floors, and ceilings resulting from the removal of existing equipment, piping, and conduit. Plug openings with pipe plugs, blind flanges, caps, or expansive grout. Plug openings in a manner that will result in a structurally suitable seal and a neat and presentable appearance.

3.6 SALVAGING PERIOD AND DISPOSAL

- A. Equipment, piping, and materials which are designated to remain the property of the Owner shall be carefully disassembled and moved to a location within the project site designated by the Owner.
- B. The Contractor shall disconnect all equipment, piping and materials which are designated to be evaluated and salvaged by the plant operator from all electrical and liquid sources, and shall notify the Owner when they are ready for evaluation. The plant operator's evaluation and salvaging period will generally be less than two (2) weeks after receiving the removed materials from the Contractor. After the evaluation, the unsalvageable materials shall become the property of the Contractor and shall be removed from the site.
- C. All removed equipment, piping, and materials not specifically designated to remain the property of the Owner shall become the property of the Contractor and shall be removed from the site.
- D. Do not allow debris and rubbish to accumulate on the site. Remove debris and rubbish from the site periodically or as directed by the Owner or their Representative.

3.7 FILLING

- A. Backfill excavations resulting from demolition to the original grade or to the grades indicated on the Drawings.
- B. Backfill excavations beneath new structures, buildings, piping, and other new work as specified in Section 31 23 00, Excavation and Fill.
- C. Backfill excavations which will not be beneath new structures, buildings, piping, or other new work as specified in this paragraph.
 - 1. Backfill excavations more than 3 feet deep or more than 5 cubic yards in volume as specified in Section 31 23 00, Excavation and Fill.
 - 2. Place and compact backfill in other excavations to produce an adequate foundation for seeding. The top 12 inches of backfill shall be topsoil.

3.8 CLEAN UP

- A. Clean-up in areas where other work is to be done following demolition shall be as specified in the applicable Sections
- B. Clean-up the job site in areas where no other work is to be done under this Contract following demolition. Remove all debris and rubbish, temporary facilities, and

equipment. Level surface irregularities to eliminate depressions. Leave the work in a neat and presentable condition.

- C. Road Cleaning: The Contractor shall clean the designated haul routes to prevent dust, dirt, and excavated material from accumulating. Road cleaning shall be performed at least once a day. Additional cleaning shall be performed as necessary or as directed by the Engineer.

END OF SECTION 02 41 00

SECTION 03 20 00 – CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Furnish and install steel reinforcing bars and welded wire fabric for concrete reinforcement shown or specified.
- B. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply in all cases.

1.2 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following, except as otherwise indicated:
 - 1. ACI 315 – Manual of Standard Practice for Detailing Reinforced Concrete Structures.
 - 2. ACI SP66 - ACI Detailing Manual.
 - 3. ACI 301 – Specifications for Structural Concrete.
 - 4. ACI 318 - Latest edition "Building Code Requirements for Reinforced Concrete".
 - 5. ACI 350-06 – Code Requirements for Environmental Engineering Concrete Structures and Commentary.
 - 6. ASTM A 615/A615M- Deformed and Plains Billet-Steel Bars for Concrete.
 - 7. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
 - 8. CRSI – Concrete Reinforcing Steel Institute
- B. Tolerances:
 - 1. Fabrication Tolerances
 - a. Sheared Length: ± 1 inch.
 - b. Overall dimensions of stirrups, ties and spirals: +0, -1/4 inch for concrete thickness 24 inches or less and +0, -1/2 inch for concrete thickness over 24 inches.

- c. All other bends \pm 1 inch.
- C. Welding: Do not weld reinforcement except where indicated on the Drawings for welded splices. Tack welding of reinforcement is not permitted, except where specified by the Structural Engineer.

1.3 SUBMITTALS

- A. Submittals shall be as specified in the Section 01 00 00 General Requirements.
- B. Submit the following:
 - 1. Mill test certificates identifying chemical and physical analysis of each load of reinforcing steel delivered.
 - 2. Manufacturer's literature, specifications and installation instructions for splice devices when these devices are called for on the Drawings.
 - 3. Shop Drawings: Submit checked Working Drawings, including bar lists, schedules, bending details, placing details and placing plans and elevations for fabrication and placing reinforcing steel conforming to "ACI Detailing Manual".
 - a. Do not bill wall and slab reinforcing in sections. Show complete elevations of all walls and complete plans of all slabs, except that, when more than one wall or slab are identical, only one such elevation or plan is required. These plans and elevations need not be true views of the walls or slabs shown. Bill every reinforcing bar in a slab on a plan. Bill every reinforcing bar in a wall on an elevation. Take sections to clarify the arrangement of the steel reinforcement. Identify all bars, but do not bill on such sections.
 - b. Make the reinforcing steel placing drawings complete for placing reinforcement including the location of support bars and chairs, without reference to the design drawings.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery Requirements: Have reinforcing steel delivered to the work in strongly tied bundles. Identify each group of both bent and straight bars with a metal tag giving the identifying number corresponding to the reinforcing steel placing drawings and bar lists.
- B. Storage: Carefully handle and store reinforcing steel on wood blocking above ground and over visqueen in an orderly manner. Keep bars clean after delivery to the site of the work.
- C. Promptly remove damaged products from the job site. Replace damaged products

with undamaged products.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.
 - 1. Mechanical connections - Provide mechanical connections that develop at least 125 percent of the specified yield strength of the bar in tension.
 - a. Dowel Bar Splicer/Dowel-In System and Coupler Splice System of the Richmond Screw Anchor System.
 - b. Cadweld Rebar Splice by Erico Products Inc.
 - c. Bar Grip Splice by Barsplice Products Inc.
- B. Reinforcement Bars
 - 1. Steel reinforcement shall be new, deformed billet steel, meeting ASTM A 615; Grade 60.
 - 2. Tie wire to be annealed steel, Fed Spec QQ-W-461.
 - 3. Fabrication to be in accordance with CRSI Manual of Standard Practice except for the allowable tolerances specified herein.
- C. Bar Supports
 - 1. Conform to “Bar Support Specifications,” CRSI Manual of Standard Practice.
 - 2. The portions of the supports or accessories within ½ inch of the concrete surface shall be coated with plastic at least 3/32-inch thick at points of contact with formwork. Other requirements shall be in accordance with Class 1, maximum protection, plastic protected bar supports, in Chapter 3 of the Manual of Standard Practice by CRSI.
- D. Welded Wire Reinforcement
 - 1. Welded Wire Reinforcement shall be electrically welded wire fabric of cold-drawn wire (70,000 psi yield point) of gauge and mesh size shown on the Drawings, and shall conform to “Specifications for Welded Wire Reinforcement for Concrete Reinforcement”, ASTM A 185.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove all mud, oil, loose rust or mill scale or other foreign materials that may reduce bond.
- B. Rust or mill scale, which is “tight”, will be permissible without cleaning or brushing provided weights, dimensions, cross-sectional area, and tensile properties meet requirements of ASTM A 615.

3.2 INSTALLATION

A. Bar Placement

- 1. Conform to CRSI-WCRSI “Placing Reinforcing Steel”.
- 2. Reinforcement shall be supported and wired together to prevent displacement by construction loads or the placing of concrete.
- 3. Use side form spacers against vertical or sloping forms to maintain prescribed side cover.
- 4. Maximum bar movement to avoid interference with other reinforcing steel or embedded items: one bar diameter or 1 inch, whichever is greater, or as directed by the Engineer.
- 5. Have reinforcing placement reviewed by the Engineer before concrete is placed.
- 6. A mat of steel shall be considered as two layers of reinforcing bars forming a grid. When one mat of steel is to be placed in a wall or slab, place the mat in the center of the section unless specifically accepted. When two mats of steel are to be placed in a wall or slab, place one mat in each face of the section utilizing the minimum allowable clear distance

B. Bar Supports

- 1. Provide at a minimum, the number of bar supports as required by ACI 315.
- 2. All reinforcement shall be tied to chairs to secure them from displacement during concrete placement. Reinforcement shall be secured at a maximum distance of four feet on center.

C. Concrete Cover

- 1. Except as otherwise indicated on the drawings, provide the following

minimum concrete cover for reinforcement.

- a. Concrete cast against and permanently exposed to earth: 3-inches.
 - b. Vertical formed concrete surfaces exposed to earth, weather, or fluid surfaces: 2-inches.
 - c. Horizontal formed concrete surfaces exposed to earth, water, weather and over or in contact with wastewater: 2 inches.
2. Cover for reinforcing steel shall not be less than the minimum given above (no minus tolerance) and shall not exceed the minimum by more than $\frac{1}{4}$ inch where concrete thickness is 24 inches or less, or more than $\frac{1}{2}$ inch where the concrete thickness is more than 24 inches.

D. Reinforcement Adjustment

1. Do not heat, bend or cut reinforcement without Engineer's acceptance.
2. Reinforcement shall not be bent after being partially embedded in hardened concrete.

E. Splices

1. Do not splice bars except at locations shown on the Drawings without the Engineer's acceptance.
2. Any dowel or lap shown on the drawings and not dimensioned and any splices required but not shown shall be the minimum allowable Class B tension splice according to ACI 318, based on Grade 60 steel reinforcing and 4,000 psi 28-day concrete.
3. Splices in horizontal wall reinforcement in circular tanks shall be staggered.

END OF SECTION 03 20 00

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Furnish and place plain and reinforced concrete and do related work necessary to complete work shown or specified.

See 'General Structural Notes' sheet S701 for additional exclusive specifications and testing requirements related to Pipe Junction Boxes.

- B. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply in all cases.

1. Following is a partial list of American Concrete Institute publications which are applicable to concrete construction:

- a. ACI 318 Building Code Requirements for Reinforced Concrete.
- b. ACI 301 Specifications for Structural Concrete.
- c. ACI 350 Code Requirements for Environmental Engineering Concrete Structures.
- d. ACI 211.1 Recommended Practice for Selecting Proportions for Normal Weight Concrete.
- e. ACI 347 Recommended Practice for Concrete Formwork.
- f. ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures.
- g. ACI 308 Recommended Practice for Curing Concrete.
- h. ACI 306 Recommended Practice for Cold Weather Concreting.
- i. ACI 305 Recommended Practice for Hot Weather Concreting.
- j. ACI 304 Recommended Practice for Measuring, Mixing, and Placing Concrete.
- k. ACI 503.1 Standard Specification for Bonding Hardened Concrete, Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive.

1. ACI 503.2 Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive.

1.2 QUALITY ASSURANCE

- A. Testing Laboratory Services: The Contractor shall employ and pay for the services of an independent testing laboratory to perform specific services and necessary tests as outlined below:
 1. Tests: Establish each proposed design mix prior to placing the first concrete at the job site. Make a set of four test cylinders for each proposed mix. Break one cylinder from each set at seven days. Break the remaining cylinders at 28 days. A mix will be considered satisfactory if the average strength of three 28-day breaks equals or exceeds the specified 28-day strength. Adjust the design mix and repeat the test procedure if the average strength of three 28-day breaks is less than the specified 28-day strength.
- B. Tolerances: Finish concrete shall meet the following tolerances:
 1. Variations from Plumb: $\pm 1/4$ -inch per 10 feet but not more than 1 inch.
 2. Variations from Level or Indicated Grade: $\pm 1/4$ -inch per 10 feet but not more than $1/2$ -inch.
 3. Variations from Horizontal: $\pm 1/4$ -inch per 10 feet but not more than $1/2$ -inch.
 4. Variations in Size and Locations of Openings or Sleeves: $\pm 1/4$ -inch.

1.3 SUBMITTALS

- A. Submittals shall be as specified in the General Conditions.
- B. Submit the following:
 1. Certified copies of test reports of concrete mixes required by the applicable standards.
 2. Concrete proportions shall be established on the basis of previous field experience or laboratory trial batches, or both.
 3. For concrete restoration and repair work, submit complete description of proposed method of repair, including sequence of work, dimensions, method of surface preparation, protection of existing structures and materials.
 4. Test reports of fly ash and material certification for each admixture proposed to be used in the concrete mix design.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage, and handling of products.
- B. Promptly remove damaged or unsuitable products from the job site. Replace damaged products with undamaged products. Replace unsuitable products with suitable products.

1.5 JOB CONDITIONS

- A. Follow methods outlined in ACI 306 if concrete is to be placed when the atmospheric temperature is expected to be less than 40°F.
- B. Calcium chloride will not be considered for approval as an accelerating admixture during cold weather construction.**
- C. Follow methods outlined in ACI 305 if concrete is to be placed when the atmospheric temperature is expected to exceed 90°F.
- D. Manufacturer's recommendations shall be strictly followed in regard to atmospheric temperature limitations during application of epoxy or acrylic polymer modified concrete materials.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cement shall be Portland cement and shall conform to the "Standard Specification for Portland Cement," ASTM Specification C 150. Cement shall be Type I/II. Once cement type is chosen, the type and source shall remain the same throughout the project.
- B. Aggregate
 - 1. Regular fine and coarse aggregates shall meet the requirements of ASTM Specification C 33. Aggregate shall be crushed limestone with a maximum size of 3/4 inch, except in mass concrete the maximum size may be 1-1/2 inches.
 - 2. The same source and type of aggregate shall be used throughout the project.
- C. Water shall be potable, clean, and free from injurious amounts of oils, acids, alkalis, organic materials, or other substances that may be deleterious to concrete or reinforcement.

D. Tests for Chloride Ions

1. For corrosion protection of reinforcement in concrete, maximum water soluble chloride ion concentrations in hardened concrete contributed by the ingredients including water, aggregates, cementitious materials and admixtures shall not exceed 0.10 water soluble chloride ions by weight of cement.

E. Admixtures

1. Air-entraining admixtures shall meet the requirements of ASTM Specification C 260.
2. Water-reducing and retarding admixtures shall meet the requirements of ASTM Specification C 494, Type A or Type D, except that they shall contain no chlorides, shall be non-toxic after 30 days, and shall be compatible with the air-entraining admixtures. The amount of admixture added to the concrete shall be in accordance with the manufacturer's requirements. Furnish a compliance statement that the admixture used satisfies all requirements of this specification.
3. Fly ash shall meet the chemical and physical requirements of ASTM C 618 for mineral admixture Class F, except loss on ignition shall not exceed 3%. Fly ash shall be sampled and tested in accordance with ASTM C 311 prior to use.

F. Joint Filler

1. Preformed expansion joint filler shall be chosen to suit the job requirements as follows:
 - a. Type A: Asphalt filler for unsealed expansion or isolation joints in sidewalks, driveways, floor slabs on-grade, and elsewhere as indicated on the drawings. Filler shall meet the requirements of ASTM Specification D994.
 - (1) Sealtight asphalt expansion joint filler, as manufactured by W. R. Meadows, Inc., Elgin, Illinois, or approved equal, will be acceptable.
 - b. Type B: Self-expanding cork filler for standard or waterproof sealed expansion joints in walls, slabs, and elsewhere as indicated on the drawings. Sealing shall be installed in accordance with the details shown on the drawings. Filler shall meet the requirements of ASTM Specification D1752, Type III.

- (1) Sealtight self-expanding cork expansion joint filler as manufactured by W. R. Meadows, Inc., Elgin, Illinois, or approved equal, will be acceptable.
2. Hot-poured elastic joint filler shall meet the requirements of ASTM Specification D1190.
 - a. Sealtight No. 164, as manufactured by W. R. Meadows, Inc., Elgin, Illinois, or approved equal, will be acceptable.

G. Waterstops

1. Provide PVC waterstops. The PVC waterstop shall be extruded from an elastomeric plastic material of which the basic resin is prime virgin polyvinyl chloride. The PVC compound shall not contain any scrapped or reclaimed material.
2. Waterstops shall meet the requirements of Corps of Engineers CRD-C572. Waterstops shall be of the configurations as shown on the standard detail drawings.
3. Store Waterstops out of sunlight and keep clean and free from deleterious substances.
4. Provide factory made waterstop fabrications for all changes of direction, intersections, and transitions leaving only straight butt joint splices for the field.
5. Provide hog rings or grommets spaced at 12 inches on center along length of waterstop.
6. Provide Teflon coated thermostatically controlled waterstop splicing irons for field butt splices.

H. Curing Compounds: Curing compounds shall meet the requirements of ASTM Specification C 309, Type I.

I. Epoxy Adhesive and Grout

1. Epoxy adhesive and grout shall be epoxy-resin systems meeting the requirements of ASTM C 881 and the additional requirements herein.
2. The proper type, grade, and class (ASTM C 881) shall be chosen to suit the job requirements as follows:
 - a. Type

- (1) I - For bonding hardened concrete and other materials to hardened concrete and setting anchor bolts and reinforcing bars in hardened concrete.
 - (2) II - For bonding freshly mixed concrete to hardened concrete.
 - (3) III - For bonding skid resistant materials to hardened concrete and as a binder in epoxy mortars or epoxy concrete.
- b. Grade
- (1) 1 - For crack injection and spray application, light viscosity.
 - (2) 2 - For brush application, medium viscosity.
 - (3) 3 - For trowel or caulking gun application, nonsagging heavy viscosity for filling voids and gaps.
- c. Class
- (1) A - For use below 40°F.
 - (2) B - For use between 40°F and 60°F.
 - (3) C - For use above 60°F.
- d. Color: All epoxy adhesives and grouts shall be concrete grey or clear if they will be visible on the final concrete surface.
3. The epoxy material shall consist of a two-component system conforming to the following requirements:
- a. Properties of mixed components shall meet the following requirements:
 - (1) Solids Content: 100% by weight
 - (2) Pot Life: 30 minutes (minimum) @ 75°F
 - (3) Contact Time: 2 hours @ 75°F
 - (4) Tack Free Time: 4 hours minimum @ 75°F
 - b. Properties of cured material shall meet the following requirements:

- (1) Neat Binder
 - (a) Tensile Strength ASTM D-638: 3200 psi minimum @ 14 days, 75°F cure
 - (b) Tensile Elongation ASTM D-638 (Modified): 1% minimum @ 14 days, 75°F cure
 - (c) Compressive Strength ASTM D-695: 12,000 psi minimum @ 14 days, 75°F
 - (d) Compressive Modulus: 400,000 psi minimum @ 28 days, 75°F
 - (e) Water Absorption: 1% by weight, maximum 14 days 75°F cure 24 hours immersion.
- (2) Grout: One part Binder to three-and-quarter parts Aggregate by loose volume
 - (a) Compressive Strength ASTM C-109 (Modified) (2" cubes): 12,000 psi minimum @ 28 days, 75°F cure
 - (b) Compressive Modulus (Modified): 1,250,000 psi minimum @ 28 days, 75°F cure
- c. Aggregate shall meet the requirements of the resin manufacturer.
- d. Chemical acceptance for SPI Classification -2- ('A' Component)
 - (1) The cured system shall meet the requirements of the U.S. Department of Agriculture for use in food processing plants.
 - (2) The cured system shall meet the requirements of U.S. Government regulations requiring water extractables of less than 0.5 MG per square inch of exposed surface for potable water containers. Tests for water extractables shall meet the requirements of the Environmental Control Administration of the U.S. Public Health Service.
- e. The following epoxy manufacturers' products, or equal products, will be considered for approval:

- (1) KADUR as manufactured by Sika Chemical Corp., Lyndhurst, New Jersey.
- (2) EPOTOX as manufactured by Toch Division, Carbolina, St. Louis, Missouri.
- (3) SONOBOND as manufactured by Sonneborn - Contech, Minneapolis, Minnesota.
- (4) PROBOND as manufactured by Protex Industries, Denver, Colorado.

J. Type 1 Grout

1. Type 1 grout shall be expansive grout.
2. The grout shall be composed of selected silica sands, modified cements, pozzolanic, plasticizing, and water reducing admixtures.
3. The grout shall be entirely non-metallic and shall be suitable for both interior and exterior applications.
4. The grout shall be a one-step product delivered to the job site in bags containing a premixed formulation requiring only the addition of water prior to use.
5. The physical properties of the grout shall meet the following requirements:
 - a. Initial Set (ASTM C 191) 45 min.
 - b. Final Set (ASTM C 191) 180 min.
 - c. Compressive Strength (ASTM C 109)
 - (1) 24 hours: 5,000 psi
 - (2) 3 days: 6,000 psi
 - (3) 7 days: 8,000 psi
 - (4) 28 days: 10,000 psi
 - d. Volume Change (ASTM C 827)
 - (1) 24 hours: +0.032%

- (2) 3 days: +0.033%
- (3) 7 days: +0.035%
- (4) 28 days: +0.035%

e. Tensile Strength

- (1) 24 hours: 400 psi
- (2) 3 days: 460 psi
- (3) 7 days: 550 psi
- (4) 28 days: 600 psi

6. The following grout manufacturers' products, or equal products, will be considered for approval:

- a. SONOGROUT as manufactured by Sonneborn-Contech, Minneapolis, Minnesota.
- b. FIVE STAR GROUT as manufactured by U.S. Grout Corp., Old Greenwich, Connecticut.
- c. SET NON-SHRINK GROUT as manufactured by Set Products, Macedonia, Ohio.
- d. SEALTIGHT 588 as manufactured by W. R. Meadows, Elgin, Illinois.

K. Bonding Agents: The following bonding agent manufacturers' products, or equal products, will be considered for approval:

- 1. EPOXTITE BINDER as manufactured by Construction Products Div., W. R. Grace & Co., Cambridge, Massachusetts.
- 2. SIKADUR HI-MOD EPOXIES as manufactured by Sika Chemical Corp., Lyndhurst, New Jersey.
- 3. SONOBOND as manufactured by Sonneborn-Contech, Minneapolis, Minnesota.

L. Cement Based and Acrylic Polymer Compounds: The following cement based or acrylic polymer compound manufacturers' products, or equal products, will be considered for approval:

- 1. THOROSEAL as manufactured by BASF.

2.2 CONCRETE

A. General

1. Concrete shall be Class A or B as specified in this Article. All concrete shall be assumed to be Class A, unless specifically accepted by the Engineer.
2. The slump of all concrete shall be not more than 5 inches or less than 2 inches unless specifically accepted by the Engineer in writing.
3. The air content by volume of all concrete shall be 6% plus or minus 1%.
4. Class A concrete shall contain a water-reducing and retarding admixture, unless specifically accepted. Use of a water-reducing and retarding admixture in Class B concrete is optional. Use of a retarding admixture with fly ash concrete is optional.
5. Do not exceed the water-cement ratio of the design mix which includes all water added. The water-cement ratio shall not exceed 0.42. The water-cement ratio shall be based on the total cementitious materials content.
6. The water reducing and retarding admixture shall be in accordance with the manufacturer's requirements.
7. Class A concrete shall have a minimum cementitious materials content of 580 lbs. /cubic yard.
8. An approved fly ash may be added to the cement in Class A or B concrete in an amount not to exceed 20% by weight of cement, provided all applicable requirements for these classes of concrete are met and proposed mix designs are approved.

B. Class A Concrete

1. Class A concrete shall be structural concrete with a 28-day compressive strength of 4,000 psi.
2. Proportion Class A concrete in accordance with ACI 211.1.

C. Class B Concrete

1. Class B concrete shall have a 28-day compressive strength of 3,000 psi.
2. Proportion Class B concrete in accordance with ACI 211.1.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

- A. Subgrade shall be free of sawdust, debris, water, ice, snow, frozen material, extraneous oil, mortar, or any other substances that may be deleterious to the concrete.
- B. Clean rock surfaces by air-water cutting, wet sandblasting, or wire brush scrubbing. Wet rock surfaces immediately prior to placement of concrete.
- C. Earth surfaces shall be firm and damp.
- D. Do not place Class A concrete on mud, dried earth, uncompacted fill, or frozen subgrade. Mud mats of Class B concrete will be permitted upon written approval of the Engineer.
- E. When Class A concrete is to be placed on highly pervious materials which might allow flowing groundwater to damage fresh concrete, the contact surface shall be covered with a layer of asphalt-impregnated building paper or polyvinyl sheeting prior to placement of the concrete.

3.2 FORMWORK

- A. All formwork shall be done in accordance with recommended practices contained in ACI 347.
- B. Forms shall be of wood, plywood, steel, or other approved materials and shall be mortar-tight.
- C. Construct forms and associated falsework so finished concrete conforms to the dimensions and contours shown on the drawings.
- D. Form surfaces shall be smooth and free from holes, dents, sags, or other irregularities.
- E. Coat forms with a non-staining oil before being set in place.
- F. Ties or anchorages within the forms shall be equipped with cones, she-bolts, or other devices that permit their removal to a depth of at least 1 inch without injury to the concrete.
- G. Remove forms in a manner and at such time to ensure complete safety of the structure. Do not remove supporting forms or shoring until sufficient strength has been developed in the concrete to support weight and load.

3.3 CONCRETE

- A. General: Measure and mix concrete in accordance with ACI 614.
- B. Class A Concrete.
 - 1. Concrete shall be Class A concrete, unless otherwise shown on the drawings.
 - 2. No measurable amount of water shall pass through structural concrete when a head of water equal to 12 inches of depth per inch of concrete is applied.
- C. Class B Concrete:
 - 1. Fillets shall be Class B concrete, unless fillets are constructed monolithic with walls or slabs.
 - 2. Mud mats shall be Class B concrete.
- D. Ready-Mixed Concrete
 - 1. Mix, deliver, and place ready-mixed concrete in accordance with ASTM Specification C 94.
 - 2. Discharge concrete from a truck within 1-1/2 hours after water has been added to the mix in the truck.
 - 3. The delivery ticket shall contain the cubic yards in the load, the percent of air, pounds of cement in the load, pounds of fly ash in the load – if applicable, and the total gallons of water in the load. Copy of delivery ticket shall be given to the Engineer's representative.
 - 4. Water may be added at the job site if the water-cement ratio after the addition of the water does not exceed the water-cement ratio of the applicable design mix. When water is added at the job site, there shall be a minimum of 1-1/2 minutes of mixing per each cubic yard remaining in the truck.
- E. Site-Mixed Concrete
 - 1. Thoroughly mix site-mixed concrete in an approved type batch mixer having a capacity of not less than 1/2 cubic yard. The volume of the mixed batch shall not exceed the manufacturer's rated capacity of the mixer.
 - 2. The mixing time for each batch, after addition of water to cement and aggregate, shall not be less than 1-1/2 minutes for each 1 cubic yard of materials. Operate the mixing drum at the speed for which it was designed, provided the speed is more than 14 rpm and less than 20 rpm.

3.4 WATERSTOPS

- A. Waterstop Placement and Use
 - 1. Waterstops shall be placed in all walls and floor slabs where earth or air is on one side and fluid on the other side.
 - 2. Waterstops shall be placed in all walls and floors slabs where it is possible to isolate one tank or structure from each other.
 - 3. Waterstops will not be placed in divider walls where fluid is on either side, except in the case where tank or structure can be isolated.
- B. Field butt splices shall be heat fused welded using a Teflon coated thermostatically controlled waterstop splicing iron at approximately 380 degrees F. Follow manufacturer's published instructions. Lapping of waterstop, use of adhesives, or solvents is not permitted.
- C. Secure waterstop in correct position using hog rings or grommets spaced at 12 inches on center along the length of the waterstop and wire tie to adjacent reinforcing steel.

3.5 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304. Provide chutes, drop pipes, and other placing equipment properly designed and appropriate for the intended use to prevent segregation of coarse aggregate.
- B. Remove construction debris and extraneous matter from within the forms.
- C. Remove temporary struts, stays, bracing, and blocks serving to hold the forms in correct shape and alignment until concrete is placed.
- D. Place concrete on clean, damp surfaces, free from running or standing water.
- E. Deposit concrete in approximately horizontal layers, not to exceed 18 inches.
- F. Consolidate concrete by means of mechanical vibrating. Insert and remove vibrators vertically at regular intervals to ensure uniform consolidation. Do not use vibrators to transport concrete inside the forms. Internal vibrators shall maintain a speed of not less than 7,000 impulses per minute when in operation. At least one standby vibrator shall be on hand at all times during placing.

3.6 CURING

- A. Prevent concrete from drying for a period of 7 days after it is placed.
- B. Curing may be accomplished by any of the approved methods as listed in ACI 308.

- C. Concrete with fly ash may require longer curing time. Curing shall be continuous for a minimum of 7 days or for the time necessary to attain 70% of the specified compressive strength, whichever is greater.

3.7 EPOXY ADHESIVE AND GROUT

- A. Use epoxy-resin system in accordance with ACI 503.1 when it is required to grout reinforcing bars or non-expansive anchors into existing concrete.
- B. Use epoxy-resin system in accordance with ACI 503.2 when it is required to bond fresh (plastic) concrete to hardened concrete.
- C. Joining of new and old concrete shall meet the requirements of the epoxy-resin system manufacturer.

3.8 TYPE 1 GROUT

- A. Use Type 1 grout in all areas where the grout could be expected to have some structural requirements such as under column base plates, and all equipment mounting pads.
- B. Grout storage, handling, mixing, and placing shall meet the requirements of the grout manufacturer.
- C. The clearance between foundations and base plates or equipment bases shall not be less than 1 inch for each 16 inches the grout must flow horizontally.
- D. All areas to be grouted shall be clean and free of oil, grease, dirt, and contaminants. Remove all loose material. Provide air relief openings where required to avoid entrapment of air. All metal components to be in contact shall be derusted and free of paint or oils. All concrete to come into contact with the grout shall be rough finished and shall be thoroughly saturated by dampening or soaking prior to placement of grout. Remove excess water from holes and voids.
- E. Use forming procedures that allow proper and complete placement of the fluid grout, including the use of head forms. Support elements to be grout has hardened sufficiently. Pretreat wood surfaces that can absorb moisture with forming oils. Cut back edges of concrete to be grouted which are less than 1-inch thick to form a uniform butt.
- F. Place grout in accordance with standard grouting procedures and recommendations of ACI for placing and curing of concrete. Use chains, rods, or tamping devices to compact grout tightly, completely removing all air voids. Place grout quickly and continuously, striking off exposed areas. Cure finished grout by standard methods.
- G. Grout protection shall meet the requirements of the grout manufacturer

3.9 FINISHING

- A. All concrete and grout surfaces shall be true and even, and shall be free from open or rough spaces, depressions, or projections.
- B. Accurately screed exposed surfaces of concrete to grade and then float prior to final finishing. Do not use excessive floating or trowel while concrete is soft. Do not add dry cement or water to the surface of screeded concrete to expedite finishing.
- C. After removal of forms, remove all bulges, fins, form marks, or other irregularities that may adversely affect the appearance or function of the concrete.
- D. Clean and patch all cavities left by form ties or any other device. Use expansive grout for patching.
- E. Finish concrete in accordance with the following schedule, unless specifically accepted.

Surface	Finish
All exposed vertical surfaces from 6 inches below grade or minimum operating level	Smooth rubbed finish
Exterior horizontal traveled surfaces	Brushed finish
Exterior horizontal non traveled surfaces	Smooth rubbed finish

- F. Cement based or acrylic polymer compounds will be considered for use. Surface preparation and application shall meet the requirements of cement based and acrylic polymer compound manufacturers.

3.10 TESTING

- A. The Contractor shall employ and pay for the services of an Independent Testing Laboratory to perform the following tests as specified below and as requested by the Engineer.
 - 1. Perform tests in accordance with the following ASTM Specifications:

Test	ASTM Specifications
Slump	C 143
Air Content	C 173
Test Cylinders	C 31 or C 513
Core Samples	C 42
Fly Ash	C 311

- B. The Contractor and the Engineer's representative shall measure slump each time test cylinders are to be made and at any other time requested by the Engineer. The slump limits given hereinbefore shall not be exceeded unless specifically accepted by the Engineer.

- C. Measure air content each time test cylinders are to be made and at any other time requested by the Engineer. The field test may be omitted if the air content is known prior to taking samples. The field test may not be omitted if fly ash is used in the mix.
- D. Make test cylinders in sets of four. Field cure two cylinders and break both field cured cylinders at seven days. Laboratory cure the remaining two cylinders from each set of four. Break laboratory cured cylinders at 28 days. The Contractor shall be responsible for handling and transportation of cylinders. If fly ash is used in the mix, a total set of seven cylinders shall be taken. The additional three cylinders shall be laboratory cured and two of the three cylinders broken at 56 days, if the 28 day strength does not meet specifications. Keep the seventh cylinder as a spare to be tested as directed by Engineer. The seventh, spare cylinder for each sample may be eliminated after the first several concrete placements of each type of concrete if, in the opinion of the Engineer, test results are consistent and within specifications.
- E. Make one set of test cylinders for each 28-day strength concrete used in each day of work following the table below:

Concrete Quantity	Number of Samples
50 cyds or less	One Set of Cylinders
50 to 100 cyds	Two Sets of Cylinders
100 cyds or more	Two Sets plus one set for each additional 100 cyds or portion thereof

- F. Fly ash shall be sampled and tested as specified in ASTM C 311 prior to use as an admixture in concrete.

END OF SECTION 03 30 00

SECTION 03 30 11 – GROUT

PART 1 - GENERAL

1.1 DESCRIPTION

A. WORK INCLUDED

1. Contractor shall furnish all labor, materials, equipment, and incidentals required to provide and install grout as shown and specified.
2. The types of grout include the following:
 - a. High Strength Epoxy type
 - b. Non-shrink, non-metallic type

- B. Codes, specifications and standards referred to by title or number in this specification shall be adhered to, and latest revisions shall apply in all cases.

1.2 RELATED SECTIONS

- A. Section 03 30 00 – Cast-in-Place Concrete
- B. Section 33 05 23.31 – Steel Ribs and Lagging Tunnel
- C. Section 33 05 24.31 – Tunnel Carrier Piping Systems

1.3 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
1. ASTM C 144, Aggregate for Masonry Mortar
 2. ASTM C 150, Portland Cement
 3. ASTM C 109, Comprehensive Strength of Hydraulic Cement Mortars (using 2-in. or 50 mm. Cube Specimens)
 4. ASTM C 191 Time of Setting of Hydraulic Cement by Vicat Needle.
 5. Test Method C531-00 Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
 6. ASTM C579-96, Standard Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing and Polymer Concretes
 7. CRD-C-588, Specifications for Non-Shrink Grout
 8. CRD-C-621-83, Specifications for Non-Shrink Grout

1.4 SUBMITTALS

- A. Submittals shall be as specified in the General Conditions, Section 01 00 00 – General Requirements, and Section 01 33 00 – Contractor Submittals.
- B. Submit the following:
 - 1. Shop Drawings
 - a. Submit copies of manufacturer’s specifications and installation instructions for all proprietary materials.
 - 2. Reports and Certificates
 - a. For proprietary materials, submit copies of reports on quality control tests.
 - b. For nonproprietary materials, submit certification that materials meet specification requirements.
 - c. Submit test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95% bearing under 4' x 4' base plate

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials: Grout materials from manufacturers shall be delivered in unopened containers and shall bear intact manufacturer’s labels.
- B. Storage of Materials: Grout materials shall be stored in a dry shelter and shall be protected from moisture.

PART 2 - PRODUCTS

2.1 NON-SHRINK, NON-METALLIC GROUT

- A. Pre-mixed non-staining cementitious grout requiring only the addition of water at the jobsite.
- B. Product and Manufacturer: Provide one of the following:
 - 1. Euco N-S by The Euclid Chemical Company
 - 2. Masterflow 713 by Master Builders Company
 - 3. Five Star by U.S. Grout Corporation
 - 4. Or approved equal.

2.2 NON-SHRINK CELLULAR GROUT

- A. Cellufoam or approved equal.
- B. Non-shrink cellular grout shall have a minimum compressive strength of 150 psi.

2.3 WATER

- A. Use clean, fresh, potable water free from injurious amounts of oils, acids, alkalis or organic matter.

PART 3 - EXECUTION

3.1 GENERAL

- A. Place grout as shown and in accordance with manufacturer's instructions.
- B. If manufacturer's instructions conflict with the Specifications do not proceed until Engineer provides clarification.
- C. Dry packing will not be permitted.
- D. Manufacturers of proprietary products shall make available upon 72 hours notification the services of a qualified, full time employee to aid in assuring proper use of the product under job conditions.
- E. Placing grout shall conform to temperature and weather limitations in Section 03 30 00

3.2 INSTALLATION

- A. Non-Shrink, Non-Metallic Grout shall be used in accordance with Specification 33 05 23.31, to fill void spaces as a part of the Steel Rib and Lagging Tunnel and Primary Liner Construction.
- B. Non-Shrink Cellular Grout shall be used to in accordance to Specification Sections 33 05 23.31 and 33 05 24.31, to fill the annular space between the Tunnel Carrier Piping Systems and the Primary Liner.
- C. Cost for the Grout shall be included in the construction of the tunnel as described in Specification 01 22 00 Measurement and Payment.

END OF SECTION 03 30 11

SECTION 03 40 00 – PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work of this Section includes the manufacturing and installation of precast concrete structures as detailed on the Contract Drawings and specified herein. The manufacturing and installation includes all labor, materials, tools, equipment and incidentals required to complete the work.
- B. Precast structure specifications in this Section are to include concrete structures to be used as valve vaults.
- C. Contractor is responsible for testing (when required), handling, storing, and transporting of precast structures.

1.2 SUBMITTALS

- A. Shop drawings shall be submitted in accordance with Section 01 00 00 – General Requirements. Submittals shall include information regarding structural design, size and dimensions, reinforcing, location of openings and embedded items, and catalog cuts of all associated materials including frames, hatches, steps, etc. Submit written certification from the manufacturer that all precast structures conform to the applicable standards and requirements specified in this Section. Submit manufacturer-recommended handling and storage requirements to Construction Inspector for information prior to shipment to site.
- B. Product Data: For each type of product indicated.
- C. Design Mixes: For each concrete mix.
- D. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements for:
 - 1. Concrete materials
 - 2. Reinforcing materials and prestressing tendons
 - 3. Admixtures
 - 4. Bearing pads

1.3 RELATED SECTIONS

- A. Section 03 20 00 – Concrete Reinforcement
- B. Section 03 30 00 – Cast-in Place Concrete

C. Section 31 23 00 – Excavation and Fill

1.4 DELIVERY, STORAGE AND HANDLING

- A. Precast concrete structures shall be delivered to the site complete and in structurally sound condition. Contractor shall take proper care in moving the structures to prevent cracking, breaking, or otherwise damaging the structures. Handle and store precast products in accordance with manufacturer recommendations.

PART 2 - PRODUCTS

2.1 General

- A. Precast manholes, including drop manholes, shall be as indicated in the Contract Documents.
- B. Precast reinforced concrete manholes shall be manufactured, tested, and marked in accordance with ASTM C 478. Manhole sections shall not be installed until at least five (5) days after having been cast unless permitted in writing by Owner.
- C. All joints between precast manhole elements (excluding adjusting rings) shall have a rubber gasket per ASTM C 443, and one-half (½) inch diameter butyl rubber rope sealant per ASTM C 990.
- D. No “see through” lift holes shall be allowed on precast concrete manholes.

2.2 Rejection of Damaged Manholes

- A. Manholes possessing any of the following defects shall be subject to rejection:
1. Fractures or cracks passing through the shell, except for a single end crack that does not exceed the depth of the joint;
 2. Defects that indicate imperfect proportioning, mixing and molding;
 3. Surface defects indicating honeycombed or open profile; damaged ends, when such damage would prevent making a satisfactory joint;
 4. The internal diameter of the manhole section shall not vary more than 1% from the nominal diameter;
 5. Deviations more than one-quarter (¼) inch from the straight edge at any point across the top of the manhole cone section or riser ring;
 6. Visible steel bars along the inside or outside surface of the manhole

except for reinforcement stirrups or spacers used to position the cage during manufacture, and reinforcement bars visible at the manhole structure end, provided these reinforcement bar ends are properly grouted in conformance with applicable ASTM specifications.

7. Manhole sections not clearly or completely marked with date of manufacture, trade name, size designation, part number, or ASTM number.

2.3 Manhole Flat Top Caps

- A. Precast manhole flat top caps shall be an eccentric offset type.
- B. Internal portion of manhole flat top caps must be constructed to accept an internal chimney seal.
- C. The top of manhole flat top caps must be able to accept either one precast adjusting ring or a casting frame as necessary per the requirements of each manhole location.

2.4 Monolithic (Cast-In-Place) Sanitary Sewer Structures

- A. Monolithic pour structures will be approved on a case-by-case basis provided information identifying the concrete mix, steel reinforcement details, pipe connections, and manhole dimensions are submitted by Contractor and approved by Owners Representative prior to construction.

2.5 Concrete Bases

- A. Base sections for rectangular valve vault structures shall be constructed with poured concrete base, or with the base and first riser section as one complete integral (monolithic) precast unit. The concrete base shall be as follows: a minimum of twelve (12) inch thickness for rectangular valve vault structures. Monolithic pour or precast manholes shall be constructed of 4,000 psi structural concrete using calcareous aggregate and Type II cement as defined in Section 03 30 00 – Cast in Place Concrete. Precast structures with separate base sections shall utilize a gasketed joint between the base section and first riser section. The wall and base thickness of precast concrete box inlet structures shall be as specified by the Indiana Department of Transportation Standard Specifications, and must also be constructed of 4,000 psi structural concrete using calcareous aggregate and either Type I or Type II cement.

2.6 Manhole Adjusting Rings

- A. Only concrete adjusting rings are allowed.
- B. Concrete adjusting rings shall conform to ASTM C 478 and be free from voids, cracks, and other defects. The adjusting ring shall be from the same manufacturer as the manhole cone section to assure compatibility and a watertight seal as

detailed in the Contract Documents. The minimum thickness of the concrete adjusting ring shall be four (4) inches.

2.7 Steps

- A. Steps shall conform to the requirements of ASTM C 478 and be manufactured using steel rods encased in polypropylene plastic. Steps shall be factory installed when the manhole is manufactured.

2.8 Safety Features

A. Fall Protection Grating System

1. These specifications were adapted from The BILCO Company's product sample specifications. Equal products may be submitted to the Engineer for approval per the process in section 01 33 00.
2. Furnish and install on vault access doors, where indicated on plans, fall protection grating system. Door manufacturer shall install the grating system when the door is fabricated or field installed (by others) on existing doors already in use.
3. Performance characteristics:
 - a. Grating panel(s) shall be high visibility color.
 - b. Grating panel(s) shall lock automatically in the full open position.
 - c. Grating system shall have a twenty-five year warranty.
 - d. Grating panel(s) shall have a provision for locking to prevent unauthorized opening.
4. Grating: Panels shall be aluminum with a powder coat paint finish or Fiber Reinforced Plastic (FRP) and designed to meet OSHA 29 CFR 1910.23 requirements for fall protection.
5. Hold open feature: A Type 316 stainless hold open device shall be provided to lock the cover in the fully open 90 degree position.
6. Hardware: All hardware shall be Type 316 stainless steel.

B. Ladder Safety Post

1. These specifications were adapted from The BILCO Company's LadderUP® Safety Post product sample specifications. Equal products may be submitted to the Engineer for approval per the process in section 01 33 00.

2. Furnish and install where indicated on plans ladder safety post Model LU-3. The ladder safety post shall be pre-assembled from the manufacturer.
3. Performance characteristics:
 - a. Tubular post shall lock automatically when fully extended.
 - b. Safety post shall have controlled upward and downward movement.
 - c. Release lever shall disengage the post to allow it to be returned to its lowered position.
 - d. Post shall have adjustable mounting brackets to fit ladder rung spacing up to 14" on center and clamp brackets to accommodate ladder rungs up to 1-3/4" in diameter.
4. Post: Shall be manufactured of high strength square tubing. A pull up loop shall be provided at the upper end of the post to facilitate raising the post.
5. Material of construction: Shall be Type 304 stainless steel (Model LU-3).
6. Balancing spring: A stainless steel spring balancing mechanism shall be provided to provide smooth, easy, controlled operation when raising and lowering the safety post. [For installation in highly corrosive atmospheres, Model LU-3 incorporates a special alloy spring mechanism].
7. Hardware: All mounting hardware shall be Type 316 stainless steel.
8. Finishes: Factory finish shall be mill finish stainless steel (Model LU-3).

2.9 Pipe to Manhole Connector

A. Resilient Rubber Connectors

1. All piping entrances to manholes shall be made with resilient rubber connectors manufactured in accordance with ASTM C 923 unless otherwise specified or approved by the Engineer. Connectors shall be secured to the manhole by either being cast-in or connected with an expandable stainless steel band. Connector shall be secured to the pipe with a stainless steel band. The stainless steel elements of the connector shall be totally nonmagnetic, Series 305 stainless steel. The use of other pipe to manhole connector methods and products must be approved by the Engineer.

2. The connector shall be the sole element relied upon to assure a flexible, watertight seal from the pipe to the manhole.
 3. The connectors shall be as manufactured by Kor-N-Seal, Press Seal, A-Lok, or approved equal.
- B. Doghouse manhole voids must be filled with formed class B concrete. An epoxy coated, steel sleeve with waterstops must be installed around the pipe prior to placing concrete. The pipe to sleeve interface must be sealed using Link-Seal[®], or other approved equal. Special care must be taken to not damage any corrosion protection products on or around the pipe.

2.10 Manhole Chimney Seal

- A. Internal Manhole Chimney Seals shall consist of a flexible internal rubber sleeve, interlocking extensions, and stainless steel compression bands conforming to ASTM C 923.
- B. The seal shall remain flexible throughout a 25-year design life, allowing repeated vertical movement of the frame of not less than two (2) inches and repeated horizontal movement of the frame of not less than one-half (½) inch. The sleeve portion of the seal shall be a minimum double pleated with a minimum unexpanded vertical height of 8, 10, or 13 inches, respectively. The sleeve and extension shall have a minimum thickness of three-sixteenths (3/16) inches and shall be made from a high quality rubber compound conforming to the applicable requirements of ASTM C 923, with a minimum 1500 psi tensile strength, a maximum 18% compression set, and a hardness (durometer) of 48 ± 5 .
- C. The area of the seal that compresses against the manhole frame/casting and the chimney/cone shall provide a watertight seal.
- D. The bands shall be fabricated from 16 gauge stainless steel with no welded attachments and shall have a minimum adjustment range of two (2) diameter inches. Any screws, bolts, or nuts used to lock the band in place shall be stainless steel.
- E. The internal seals shall be as manufactured by Cretex Specialty Products, NPC Specialty Products, or an approved equal.

2.11 Castings, Frames, and Covers

- A. Fiber optic handhole structures must include a 6-inch thick concrete lid with insert for removal.
- B. Neenah Model R-1646 is to be used on above grade valve vaults. Neenah models can be substituted with other manufacturers if their specifications are equal to the Neenah models listed.

- C. All casting covers shall be of Type B and have a machined bearing surface with Type F concealed pick holes.
- D. Sanitary sewer manhole covers shall be a solid lid casting for shutoff valves and vented lid castings for air release/vacuum combination valves as detailed on the Contract Drawings.
- E. Castings shall be manufactured in accordance with ASTM A 48 – Class 35B, and shall have a minimum tensile strength of 35,000 psi.
- F. Bolt down castings shall be provided in Special Flood Hazard Areas.
- G. Castings shall be uniform quality, free from blow holes, porosity, hard spots, shrinkage, distortion, or other defects. They shall be smooth and well-cleaned by shot blasting or other approved method.
- H. All castings shall be manufactured true to pattern; component parts shall fit together in a satisfactory manner. Round frames and covers shall be of nonrocking design or shall have machined horizontal bearing surfaces to prevent rocking and rattling under traffic. All castings shall be fully interchangeable.

2.12 Hatches

- A. These specifications were adapted from The BILCO Company’s product sample specifications. Equal products may be submitted to the Engineer for approval.
- B. Hatches shall be of the size and shape shown in the Contract Plan Set. The hatch shall be reinforced to support an AASHTO H-20 wheel load. The hatch must comply with the sample specification for both single (JAL H20) and double (JDAL H20) leaf doors (as applicable) from The BILCO Company.
- C. Hatches shall be preassembled and cast into the precast concrete structures prior to delivery to the job site.
- D. Performance characteristics:
 - 1. Cover: Shall be reinforced to support an AASHTO H-20 wheel load with a maximum deflection of 1/150th of the span.
 - 2. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
 - 3. Operation of the cover shall not be affected by temperature.
 - 4. Entire door, including all hardware components, shall be highly corrosion resistant.
- E. Cover: Shall be 1/4” (6.3 mm) aluminum diamond pattern.

- F. All components of the hatches shall be constructed using aluminum and stainless steel materials to reduce long term corrosion.
- G. Frame: Channel frame shall be 1/4" (6.3mm) extruded aluminum with bend down anchor tabs around the perimeter.
- H. Hinges: Shall be specifically designed for horizontal installation and shall be through bolted to the cover with tamperproof Type 316 stainless steel lock bolts and shall be through bolted to the frame with Type 316 stainless steel bolts and locknuts.
- I. Drain Coupling: Provide a 1-1/2" (38mm) drain coupling located in the right front corner of the channel frame [note: can be placed at a different location if specified].
- J. Lifting mechanisms: Manufacturer shall provide the required number and size of compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe fastened to a formed 1/4" gusset support plate.
- K. A removable exterior turn/lift handle with a spring loaded ball detent shall be provided to open the cover and the latch release shall be protected by a flush, gasketed, removable screw plug.
- L. Hardware:
1. Hinges: Heavy forged Type 316 stainless steel hinges, each having a minimum 1/4" (6.3 mm) diameter Type 316 stainless steel pin, shall be provided and shall pivot so the cover does not protrude into the channel frame.
 2. **Cover shall be equipped with a hold open arm which automatically locks the cover in the open position.**
 3. Cover shall be fitted with the required number and size of compression spring operators. Springs and spring tubes shall be Type 316 stainless steel.
 4. A Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the cover.
 5. Hardware: Shall be Type 316 stainless steel throughout.
- M. Finishes: Factory finish shall be mill finish aluminum with bituminous coating applied to the exterior of the frame.

2.13 Precast Concrete Covers

- A. Shaft covers shall be constructed with 5,000 psi concrete and as shown on the Contract Drawings.
- B. Lifting hooks shall be of the type specified on the Contract Drawings, and securely embedded into the concrete to safely support the anticipated cover load.

PART 3 - EXECUTION

3.1 Bedding

- A. The bedding for all manholes shall be a minimum of eight (8) inches of No. 8 crushed stone or No. 8 fractured-face aggregate.
- B. The stone and/or aggregate shall be placed to form a stable base.
- C. Where poor or unstable soil conditions exist, or over excavation has occurred, additional No. 8 crushed stone, No. 8 fractured faced aggregate, No. 2 stone, or lean concrete shall be used to form a stable base.

3.2 Backfilling

- A. Manhole backfilling and compaction requirements shall comply with the minimum requirements for the adjacent sanitary sewer pipe as found within these specifications.

3.3 Placement of Manhole Sections

- A. Precast manhole sections shall be placed and aligned to provide vertical sides. The completed manhole shall be rigid, true to dimensions, and watertight.
- B. The joints between manhole sections shall be properly sealed utilizing an approved rubber gasket and butyl rubber rope.
- C. Manhole cones shall be turned away from the wheel path of paved streets and the flow line of ditches. There shall be no castings located in the flow line of ditches.

3.4 Placement of Adjusting Rings

- A. Where one (1) solid riser or barrel section cannot be used, final adjustments in elevation of the casting frame and cover shall be accomplished by the use of precast concrete adjusting rings of a minimum thickness of four (4) inches as shown in the Contract Documents. The total number of adjusting rings shall not exceed three (3) and the total height of adjusting rings shall not exceed twelve (12) inches.

- B. Concrete adjustment rings less than four (4) inches thick are not allowed. A water tight seal shall be provided between the cone section of the manhole and adjusting ring, each adjoining adjusting ring, and between the adjusting ring and casting by the use of two (2) rows of one-half (1/2) inch diameter cords of extrudable preformed gasket material, non-asphaltic mastic, or trowelable grade butyl rubber, as shown on the Contract Drawings. This material shall be placed in joints and keyways and be of sufficient quantity to completely fill the joint cavity.
- C. The use of brick or block in lieu of adjustment rings is not allowed.

3.5 Butyl Rubber Backplaster

- A. A trowelable grade butyl rubber base exterior backplaster material one-quarter (1/4) inch minimum thickness when dry, shall be installed on the outside of the manhole at each joint, extending six (6) inches above and below the joint.
- B. The joint between the casting frame and cone section shall be sealed with a pliable butyl rubber sealant and coated with a coal tar epoxy coating, upon reaching its final set, to become a watertight joint. It shall be installed from two (2) inches below the bottom adjustment ring on the cone section to, and covering, the base of the casting.

3.6 Internal Manhole Chimney Seal

- A. Internal Chimney Seals shall be installed on the joints of all manholes between the casting frame and the cone section per manufacturer's recommendation.

3.7 Connections to Manholes

- A. Saw cutting and hammer taps are prohibited.
- B. All connections shall provide for a watertight seal between the pipe and the manhole.
- C. The connector shall be the sole element relied upon to assure a flexible water tight seal of the pipe to the manhole.

3.8 Leakage

- A. All manholes shall be watertight and free from leakage.
- B. Each manhole shall be visually inspected for leakage by Construction Inspector after assembly and backfilling.
- C. If the manhole shows signs of leakage, the manhole shall be repaired to the satisfaction of Owner and reinspected.

END OF SECTION 03 40 00

SECTION 07 10 00 – DAMPPROOFING AND WATERPROOFING

PART 1 - GENERAL

1.1 SCOPE

Furnish and install waterproofing and appurtenances necessary to complete work shown or specified on the plans.

1.2 CODES AND ABBREVIATIONS

Codes, specifications, and standards referred to by title or number shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply in all cases.

1.3 DESIGN PARAMETERS

A. Comply with manufacturer's recommendations and the specifications in this Section in regard to temperature and moisture limitations during storage, application, and curing of waterproofing.

B. Surface preparation for waterproofing:

1. Prior to installing each application of waterproofing, the Contractor shall provide a written certification from the waterproofing subcontractor certifying that all surfaces to be waterproofed have been properly prepared in accordance with the requirements, recommendations, and instructions of the manufacturer of the waterproofing compounds. Furthermore, the surfaces shall be ready and acceptable for applying the submitted and approved waterproofing compounds.
2. Waterproofing shall not be applied until this certification is submitted and is acceptable to the Engineer.

1.4 WARRANTY

The manufacturer shall warrant products to be free of material and workmanship defects for a period of five (5) years from the date of acceptance by the Owner.

1.5 SUBMITTALS

A. Submittals shall be as specified in the General Conditions.

B. Submit the following:

1. Certified copies of test reports of factory tests required by the applicable standards.

2. Shop drawings with performance data and physical characteristics for waterproofing systems.
3. Certificates: Submit manufacturer's recommended instructions for installation and certificates that materials meet specification requirements.
 - a. Submit manufacturer's authorization of applicators.
4. Installation instructions, details, and drawings.
5. Certification from waterproofer described in Article 1.3.

1.6 PROJECT SITE CONFERENCE

- A. Project site conference for waterproofing system required by this specification is a requirement of these Contract documents. The conference is to be scheduled and held within two weeks prior to the application of waterproofing system.
- B. The following representatives are to be present:
 1. Owner's Representative
 2. Engineer
 3. Contractor
 4. Waterproofing Subcontractor
 5. Concrete Finisher(s) – if utilized for the application of waterproofing.
 6. Technical Representative from the Manufacturer, (not subcontractor).
- C. The following will serve as an outline agenda for the technical issues of the conference but not be limited to:
 1. Substrate preparation
 2. Construction joint and shrinkage crack repair
 3. Weather Conditions
 4. Application Methods
 5. Yield
 6. Curing and Protection

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Exercise care to prevent damage to materials during loading, transportation, and unloading.
- B. Store materials off the ground.
- C. Deliver waterproofing material to job site in manufacturer's original, sealed containers with manufacturer's name and brand name legible and intact.
- D. Store materials in accordance with manufacturer's published instructions.

- E. Handle materials with care to avoid rupturing packaging.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Furnish waterproofing systems as specified in this Section.
- B. For a particular system as herein described, the products of one manufacturer shall be used.

2.2 WATERPROOFING SYSTEMS

- A. System "A" Crystalline Waterproofing: Crystalline waterproofing shall be a cementitious coating containing catalytic chemicals which, when placed in contact with the moisture and unhydrated cement in concrete, forms non-soluble crystals of dendritic fibers in the voids and capillary tracts of the concrete. Crystalline waterproofing shall be used in strict accordance with manufacturer's application instructions.
 - 1. The following products or equal are acceptable:
 - a. Xypex
 - b. Vandex

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Onsite Technical Representative (not sales rep) employed by the manufacturer of the waterproofing material is to be present on the project site immediately upon completion of wall preparation and prior to the application of waterproofing. Technical Representative is to perform the following:
 - 1. Verify that walls have been suitably prepared to receive waterproofing material
 - 2. Verify that the installation of the waterproofing system is in conformance with the manufacturers "published" instructions.
- B. The layers or thickness of waterproofing shall be in accordance with manufacturer's recommendations.
- C. Only one waterproofing system shall be used on a single area. Only one manufacturer's products shall be used for any one system.

- D. Surface preparation and waterproofing shall be in accordance with manufacturer's recommendations and as specified in this Section.
- E. Waterproofing shall be applied to areas as indicated on the drawings or in the Waterproofing List.

3.2 ENVIRONMENTAL CONDITIONS

- A. Do not apply waterproofing in wet weather or when the air temperature is below 40°F, unless vertical surfaces are heated and dried by heated dehumidification or other approved methods and surfaces meet manufacturer's requirements.
- B. The minimum ambient temperature during the curing period shall be 40°F. Provide heating when necessary to maintain specified temperature.

3.3 SURFACE PREPARATION

- A. All surfaces to which waterproofing is to be applied shall be cleaned and/or primed per the manufacturer's recommendations.
- B. Unless specifically accepted by waterproofing manufacturer, concrete and masonry surfaces shall be cured a minimum of seven days for the crystalline application and shall be surface dry. Surfaces shall be cleaned and free of voids, loose aggregate, sharp protrusions, form release agents, or other contaminants. Metal surfaces shall be free of all rust, sharp protrusions, or other contaminants.
- C. All surfaces that will receive waterproofing shall have been completed with a suitable finish and in condition ready to receive the required waterproofing treatment. Surfaces shall be dry, clean, and free of dust, debris, foreign, and loose materials.
- D. Assure that nailers, grounds, flashings, and expansion joints are installed.
- E. Provide additional surface preparation as required for the waterproofing system.
- F. Do not commence installation of waterproofing until conditions are satisfactory.

3.4 INSTALLATION

- A. System "A" Crystalline Waterproofing: Remove form ties with inserts.
 - 1. Chip back concrete approximately 1-inch where form ties are without inserts.
 - 2. Rout out all visible cracks greater than 0.01-inch and construction joints where "keyways" are not provided to a width of 1-inch and a minimum depth of 1-1/2-inches to form square cut edges.
 - 3. Honeycombed pockets and faulty concrete construction joints shall be

routed out to sound concrete but not less than 1-1/2-inches in depth and 1-inch wide.

4. Concrete surfaces that are to receive the waterproofing shall not be treated with chemical hardeners or curing agents prior to application.
5. Apply a wood float or rough finish to all concrete surfaces that are to receive slurry applications. Remove all laitance and thoroughly wet for 1 hour and remove excess water immediately prior to applying the waterproofing.
6. Pre-moisten all surfaces to receive waterproofing chemical treatment so that the concrete is suitably absorbent prior to the application of the chemicals, and damp, but not wet, at the time of application.
7. Mix material in strict accordance with concrete treatment chemical manufacturer's instructions, and no more material shall be prepared than can be applied in the time period recommended by the manufacturer. Apply material with a stiff brush or broom, or by spray, well worked into the surfaces. The material may be applied any time after removal of forms or any time the concrete has been established to have set sufficiently so that it will not be affected when wetted.
8. Apply two equal coats of the waterproofing material to all internal surfaces of concrete walls. Apply second coat when the first coat is green. Apply by dry shake to all floor surfaces where indicated on Schedule or Drawings. Application rate is to be in accordance with manufacturer's published recommendations.
Application Criteria
 - a. Vandex Super Total Amount
 - (1) Floor Slab 2.2 lbs. /seed 1 coat
 - (2) Walls 2.8 lbs. /seed 2 coats
 - b. Xypex
 - (1) Floor Slab 2.0 lbs. /seed 1 coat
 - (2) Walls 3.0 lbs. /seed 2 coat
9. Mist or fog-spray treated concrete surfaces so as to keep the surface from drying out for no less than 72 hours. Protect surface from hot sun and freezing.
10. Treat joints within 24 hours of the next pour. Cold-joints between horizontal and vertical surfaces shall have a cove area no less than 1-inch deep. Dry-pack the cove before general application. Mix dry-pack in accordance with manufacturer's instructions.

11. Form-tie holes shall be dry-packed. Any structural defects in the concrete such as cracks, honeycombing, rock pockets, or other shall be repaired prior to the general application.
12. One coat Concentrate and one coat Modified shall be applied on concrete floor (structural base mat substrate) and pneumatically placed substrate for large area applications while first coat is still "green", but after it has its initial set.
13. When structural slabs that have been treated with material are to receive a concrete or other topping or surface treatment, the crystalline waterproofing manufacturer's recommendations for this condition will be followed. Proper curing is essential.

3.5 CLEANING

Clean exposed surfaces which have been soiled with waterproofing material.

END OF SECTION 07 10 00

SECTION 09 97 00 – SPECIAL COATINGS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Furnish and apply coatings and do related work necessary to complete work shown or specified.
- B. Work Specified Elsewhere: Pipe identification markers for piping are specified in Division 33 and 40. See Section 33 05 26.13 – Identification Signs, Plaques, and Labeling, and Section 40 05 13 – Process Piping for information related to this Section.
- C. Codes, Specifications, and Standards: Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply, unless otherwise shown or specified.
- D. Definitions
 - 1. Abbreviations
 - a. ASTM - American Standard Testing Materials
 - b. OSHA - Occupational Safety & Health Administration
 - c. SSPC - Steel Structures Painting Council
 - d. TNE - Tnemec Company, Inc.
 - e. SW - The Sherwin Williams Paint Company
 - f. DFT - Dry film thickness
 - g. DMT - Dry mill thickness
 - h. NFPA - National Fire Protection Association
 - 2. Coating: The term coating includes emulsions, enamels, paints, stains, varnishes, sealers, emulsion filler, and other coating materials whether used as prime, intermediate, or finish coats.
 - 3. Spatter: Drops and droplets of coating and spilled or splashed coatings on surfaces not specified to be coated or surfaces previously finish coated.

1.2 QUALITY ASSURANCE

- A. All coating and surface preparation shall be completed by a qualified painting contractor who shall have a minimum of five (5) years of experience in applying protective coatings to industrial and municipal water and wastewater treatment facilities.
- B. Minimum requirements for materials are included in this Section. These

requirements are intended to establish standards of quality. Products of manufacturers which meet all minimum requirements as herein established shall be acceptable. Written acceptance of the materials to be used shall be obtained prior to surface preparation or application.

- C. No request for substitution will be considered which decreases the film thickness designated, or which offers a change from the generic type of coating specified. Requests for substitution shall contain the full name of each product, descriptive literature, directions for use, generic type, nonvolatile content by volume.
- D. All materials shall be brought to the job site in the original sealed and labeled containers of the manufacturer and shall be subject to inspection by the Owner's Representative.
- E. All materials shall be the product of or recommended by the coating manufacturer.
- F. All materials shall be compatible with the service intended. No products shall be used that may have ingredients which might react detrimentally with adjacent fluids or gases.

1.3 SUBMITTALS

- A. Submittals shall be as specified in Section 01 00 00 – General Requirements.
- B. Submit the following electronically, unless physically unable to do so in which case submit in writing why unable to do so:
 - 1. Shop drawings with performance data and physical characteristics.
 - 2. Color charts.
 - 3. Samples of slip-resistant adhesive tape, if used.
 - 4. List of surfaces indicating coating system and colors.
 - 5. Manufacturer's Certificate specified in Article 3.06.
 - 6. Manufacturer's application instructions.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage, and handling of products.
- B. Promptly remove damaged or deteriorated products from the job site. Replace damaged products with undamaged and undeteriorated products.
- C. All painting materials stored on the job site shall be stored in a location consistent to the manufacturer's storage requirements. The Contractor shall take all safety precautions accordance with NFPA Bulletin No. 101.

1.5 JOB CONDITIONS

A. Environmental Requirements

1. Perform coating work in strict conformance with manufacturer's printed recommendations as to environmental conditions under which coating and coating systems can be applied.
2. Do not apply finish in areas where dust is being generated.
3. During the course of the coating work, adequately ventilate the coated spaces to ensure there will be no concentration of noxious odors, hazardous fumes, or flammable vapors.
4. Unless otherwise noted, do not apply coatings in damp weather or when the temperature is below 50°F or above 95°F.
5. Provide heating and enclosure when necessary to maintain specified temperature.
6. Provide forced air circulation in enclosed areas during the curing period.
7. All costs associated with providing and/or maintaining the required environmental conditions shall be borne by the coating subcontractor.

B. Protection

1. Protect all finish work of other trades and surfaces not being coated. Furnish suitable coverings as required. Remove coating spatter from all finished surfaces and restore finishes of affected items to their original conditions at no additional cost to the Owner.
2. Post "Wet Paint" notices, as required, to protect newly coated surfaces.
3. Keep oily rags and waste in Underwriters' Laboratories labeled metal containers. Do not allow oily rags and waste to accumulate in buildings.

- C. Job Site Conference: The Contractor shall arrange and conduct a job site conference between the coating manufacturer's representative, the Owner's representative, and the personnel assigned this work prior to any field surface preparation or coating application.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Except as otherwise specified, materials shall be the products of the following manufacturers or equal:
1. Tnemec Company, Inc. (TNE)

2. The Sherwin Williams Company (SW)
 3. Carboline
- B. Materials selected for coating systems for each type surface shall be the product of a single manufacturer, unless otherwise acceptable to the Owner.

2.2 MATERIALS

- A. All field applied primers and undercoats shall be provided to ensure compatibility of total coating systems and of the same manufacturer as the finish coats for each system as specified hereafter. Provide barrier coats over incompatible primers or remove and reprime as required. No thinner or solvents other than those approved by the Coating Manufacturer shall be used.
- B. All materials shall herein be assigned a designation number for ease of reference. The minimum material requirements shall be as listed.

2.3 COATING SYSTEMS

- A. All surfaces to be coated shall be cleaned of all dirt, oil, grease, salts, mill scale and other foreign matter prior to the surface preparation and coating applications described below.
- B. Interior Exposed Metal Pipe
1. Surface Preparation: Commercial blast per SSPC-SP6, achieve 1.0 - 2.0 mil profile.
 2. Prime Coat: Polyamide Cured Epoxy, 1 coat, 4.0-6.0 mils DFT
 - a. TNE: 66 HB Epoxyline
 - b. SW: Recoatable Epoxy Primer, B67 Series
 - c. Carboline Carboguard 893 SG
 3. Finish Coat: Polymide Epoxy, 2 coats, 4.0-6.0 mils DFT per coat
 - a. TNE: 66 HB Epoxyline
 - b. SW: Heavy-Duty Epoxy, B67W300 Series
 - c. Carboline Carboguard 893 SG
 4. Minimum of 3 coats and a minimum total finished DMT of 12.0
- C. Existing Interior Exposed Pipe with Coating
1. Surface preparation: Hand tool or power tool cleaning per SSPC SP-2 or SP-3
 2. Prime Coat: Epoxy Mastic, 1 coat, 4.0-6.0 mils DFT

- a. TNE: Series 135 Chem-Build
 - b. SW: Macropoxy B58 Series
 - c. Carboline Carbomastic 615 HS
 - 3. Finish Coat: Polyamide Epoxy, 2 coats, 4.0-6.0 mils DFT per coat
 - a. TNE: 66 HB Epoxyline
 - b. SW: Heavy-Duty Epoxy, B67W300 Series
 - c. Carboline Carboguard 893 SG
 - 4. Minimum of 3 coats and a minimum total finished DMT of 12.0
- D. Non-Submerged Interior Metals & Machinery not shop coated by Manufacturer
- 1. Surface preparation: Commercial blast, per SSPC-SP6, achieve 1.0-2.0 mil profile
 - 2. Prime Coat: Polyamide Cured Epoxy, 1 coat, 4.0-6.0 mils DFT
 - a. TNE: 66 HB Epoxyline
 - b. SW: Recoatable Epoxy Primer, B67 Series
 - c. Carboline Carboguard 893 SG
 - 3. Finish Coat: Polyamide Epoxy, 2 coats, 5.0-6.0 mils DFT
 - a. TNE: 66 HB Epoxyline
 - b. SW: Heavy-Duty Epoxy, B67W300 Series
 - c. Carboline Carboguard 893 SG
 - 4. Minimum of 3 coats and a minimum total finished DMT of 14.0
- E. Existing Non-submerged Interior Metals & Machinery with Coating
- 1. Surface preparation: Hand tool or power tool clean, per SSPC-SP2 or SP3
 - 2. Prime Coat: Epoxy Mastic, 1 coat, 4.0-6.0 mils DFT
 - a. TNE: Series 135 Chem-Build
 - b. SW: Macropoxy B58 Series
 - c. Carboline Carbomastic 615 HS
 - 3. Finish Coat: Polyamide Epoxy, 2 coats, 5.0-6.0 mils DFT
 - a. TNE: 66 HB Epoxyline
 - b. SW: Heavy-Duty Epoxy, B67W300 Series
 - c. Carboline Carboguard 893 SG

4. Minimum of 3 coats and a minimum total finished DMT of 14.0
- F. Non-submerged Interior & Exterior Metals & Machinery, shop coated by manufacturer
1. Prime Coat (by manufacturer): Epoxy Mastic, 1 coat, 4.0-6.0 mils DFT
 - a. TNE: Series 135 Chem-Build
 - b. SW: Macropoxy B58 Series
 - c. Carboline Carbomastic 615 HS
 2. Finish Coat (Interior): Polyamide Epoxy, 2 coats, 5.0-6.0 mils DFT per coat
 - a. TNE: 66 HB Epoxyline
 - b. SW: Heavy-Duty Epoxy, B67W300 Series
 - c. Carboline Carboguard 893 SG
 3. Finish Coat (Exterior): Aliphatic Polyurethane, 2 coats, 2.0-5.0 mils DFT per coat
 - a. TNE: Series 73 Endura-Shield II
 - b. SW: Corothane II, B65 Series
 - c. Carboline Carbothane 133 HB
 4. Minimum of 3 coats and a minimum total finished DMT of 8.0 (exterior) or 14.0 (interior)
- G. Existing Interior Concrete Walls or Ceilings with Coating
1. Surface preparation: Abrade per ASTM D4259
 2. Prime Coat: Epoxy Mastic, 1 coat, 4.0-6.0 mils DFT
 - a. TNE: Series 135 Chem-Build
 - b. SW: Macropoxy B58 Series
 - c. Carboline Carbomastic 615 HS
 3. Finish Coat: High Build Epoxy, 2 coats, 5.0-10.0 mils DFT per coat
 4. Minimum of 3 coats and a minimum total finished DMT of 14.0 (interior)
- H. Concrete Floors (finish as noted on coating list)
1. Surface preparation: Abrade per ASTM D4259, achieve profile of 80 grit sandpaper, or per manufacturer's instructions
 2. Clear Sealer (gloss finish)

- a. Prime Coat: Polyamide Epoxy, 1 coat, 10.0-12.0 mils DFT
 - (1) TNE: Series 201 Epoxyprime
 - (2) Carboline Semstone 110

- 3. Clear Sealer (Gloss Finish)
 - a. Prime Coat: Polyamide Epoxy, 2 coats, 4.0-6.0 mils DFT per coat
 - (1) TNE: Series 285 Satinglaze
 - (2) Carboline Semstone 110

 - b. Minimum of 2 coats and a minimum total finished DMT of 8.0

- 4. Color Finish (Gloss Finish)
 - a. Prime Coat: Polyamide Epoxy, 2 coats, 4.0-6.0 mils DFT per coat
 - (1) TNE: Series 201 Epoxyline
 - (2) Carboline Semstone 110

 - b. Finish Coat: Polyamide Epoxy, 2 coats, 6.0-8.0 mils DFT per coat
 - (1) TNE: Series 280, Tnemeglaze
 - (2) Carboline Semstone 945SL

 - c. Minimum of 4 coats and a minimum total finished DMT of 20.0

I. Notes:

- 1. The total finish dry mil thickness shall be in accordance with the manufacturer's coating system's requirements.

- 2. The term submerged applies to water and wastewater. Special consideration shall be given to applications where acids or other highly corrosive materials will be present.

- 3. Minimum total dry film thickness excludes the primer.

2.4 COLORS

- A. Comply with OSHA requirements concerning color coding and safety marking.

- B. All colors should match existing, adjacent conditions.

2.5 MIXING AND TINTING

- A. Coatings, except two-part epoxies, shall be delivered to the job site premixed.
- B. Job tinting will not be acceptable, except as approved by the Engineer.
- C. All mixing shall be done in mixing pails placed in suitably sized nonferrous or oxide resistant metal pans.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect all surfaces on which paint is to be applied, and notify the Owner of any defects considered detrimental to the application of materials specified.
- B. If any dirty, rusty, scaly, greasy, damp, scuffed surfaces or conditions otherwise detrimental to the formation of a durable paint film are painted over, both the removal of paint and repainting the affected area shall be done by the Contractor without additional cost to the Owner.
- C. Provide all scaffolding, staging, and other temporary facilities required for the proper execution of the work. Scaffolding shall be placed so as not to interfere with the work of others. Should it be necessary for the progress of the work on the building in general, the Contractor shall, if so directed and without extra cost to the Owner, move, relocate, or arrange his scaffolds, ladders, or coverings to permit the Owner or other crafts to proceed with their work without delay.

3.2 SURFACE PREPARATION

- A. General
 - 1. All surfaces to be coated shall be prepared in a workman-like manner with the objective of obtaining a clean and dry surface. No coating shall be applied before the prepared surfaces are approved by the Engineer.
 - 2. All preparation and cleaning procedures shall be in strict accordance with the coating manufacturer's printed instructions and as specified in this Section for each particular substrate condition.
 - 3. Remove or otherwise protect hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be painted prior to surface preparation and painting operations. Remove items, if necessary, for the complete painting of the items and adjacent surfaces. Following completion of painting of each space, reinstall removed items. Such removal and reinstalling shall be done by workmen skilled in the trades involved.

4. Clean surfaces to be coated before applying coating or surface treatments. Remove oil and grease with clean cloths and cleaning solvents in accordance with SSPC SP-1 prior to mechanical cleaning. Clean surfaces of galvanized metals, fiberglass and PVC with water soluble detergents prior to etching. Cleaning solvents shall be low toxicity and shall have a flash point in excess of 115°F. Arrange cleaning and painting so dust and other contaminants from the cleaning process do not fall in wet, newly coated surfaces.

B. Metals

1. All ferrous metal to be primed in the shop shall have all rust, dust, and scale, as well as all other foreign substances, removed by sandblasting in accordance with SSPC SP-6 or SP-10 and achieve a profile ranging from 1.0 to 3.0 mils DFT as recommended by manufacturer. Immersion (submerged metals) exposure shall receive surface preparation SSPC SP-10 near-white blast. Nonimmersion (non-submerged metals) exposure shall receive surface preparation SSPC SP-6 commercial blast. Cleaned metal shall be primed or pretreated immediately after cleaning to prevent new rusting. Abraded or corroded spots on shop coated surfaces shall be wire brushed and touched up with primer specified in this Section.
2. Store shop coated ferrous surfaces out of contact with the ground in such manner and location as will minimize the formation of water-holding pockets, soiling, contamination, and deterioration of the coating film.
3. All ferrous metals not primed in the shop shall be sand-blasted in the field prior to application of the primer pretreatment in accordance with criteria specified above.
4. All non-ferrous metals and galvanized surfaces, whether to be shop or field primed, shall be solvent cleaned per SSPC SP-1 prior to the application of a vinyl-phosphoric wash and/or primer.
5. Any piping scheduled for a coating which is supplied with a bituminous coating shall receive two coats of titanium pigmented alcohol-soluble resin before applying primer and colored finish coat.
6. All exterior and interior electrical conduits will be coated per specification.
7. All existing coated metals and previously shop coated metals shall be free of all foreign substances and cleaned according to manufacturer's recommendations prior to application of primer and finish coats.
8. All existing pipe, pipe supports, metal structural members, and miscellaneous metal items to remain which are to be re-coated shall have all loose and poorly adhered existing coating removed with hand tool cleaning to provide a surface preparation SSPC SP-2 (hand tool cleaning)

or SP-3 (power tool cleaning). All rust, dust scale, and other foreign substances shall be removed. Bare metal exposed after cleaning shall be immediately primed to prevent new rusting. Prior to applying new coating, clean existing metals and piping with water-soluble degreasers or solvent per SSPC SP-1.

C. Concrete and Masonry

1. All concrete surfaces shall be allowed to cure a minimum of 28 days before coatings may be applied.
2. Concrete surfaces to be coated shall receive a brush-off blast per ASTM D4259 to achieve a profile equal to 80-grit sandpaper as recommended by the manufacturer to remove laitance, efflorescence, chalk, dust, dirt, grease, oil, asphalt, tar, excessive mortar and mortar droppings. Surface deposits of free iron shall be removed prior to painting. Fill holes and imperfections in finish surfaces with surface/fill as recommended by manufacturer. Do not coat over surfaces where the moisture content exceeds that permitted in the coating manufacturer's written instructions.
3. Masonry surfaces to be coated shall be free of laitance, efflorescence, dust, dirt, grease, oil, excessive mortar and mortar droppings. Fill holes and imperfections in finish surfaces with surface/filler as recommended by manufacturer.
4. Walls and ceilings to be coated shall have all specified coats applied prior to the installation of equipment or items such as panels which will result in a portion of the walls or ceilings to be inaccessible and prevent them from receiving additional coats.

3.3 APPLICATION

A. Coating Thickness

1. Each coat of material shall be applied at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. Dry film thickness shall be verified in accordance with SSPC-PA2. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with undiluted material. One gallon of unthinned material as originally furnished by the manufacturer must not cover a greater square foot area when applied by spray gun than when applied unthinned by brush. Coatings in submersible applications shall be pinhole-free.
2. Deficiencies in film thickness shall be corrected by the application of an additional coat(s) of material.

B. Application to Concrete Floors: After floor is clear and dry, prepare surface in accordance with ASTM D4259 brush-off blast to achieve a profile equal to 80-

grit sandpaper. Remove all dust and apply one coat of sealer using lambswool applicator. Let dry overnight, then burnish first coat and sweep surface thoroughly before applying second coat. Apply second coat and let dry overnight before opening to traffic.

- C. Drying Time: Drying time shall be construed to mean "under normal conditions." Where conditions are other than normal because of the weather or because coating must be done in confined spaces, longer drying times will be necessary. Additional coats of material shall not be applied, nor shall units be returned to service until coatings are thoroughly dry.

3.4 CLEANING

- A. Touch-up coatings and restore finish where damaged or defaced by construction activities.
- B. Remove coating spatter from all finished surfaces and restore affected finishes.
- C. Remove excess materials, scaffolding, staging, drop cloths, equipment, and rubbish from the job site.

3.5 CERTIFICATION

The Contractor shall submit to the Owner, immediately upon completion of the job, certification from the manufacturer indicating that the quantity of each coating purchased was sufficient to properly coat all surfaces.

3.6 COATING LIST

- A. The areas indicated by the drawings are to have the surfaces coated as tabulated by the Coating List. Colors are to be selected by the Owner and Engineer after submittal of the color chart. Color schemes are to match existing facilities unless otherwise indicated by the Engineer.
- B. While an effort has been made to include as many items as possible, particularly major items, the coating list is not a guaranteed complete listing of all items requiring coating. Any additional items requiring coating for corrosion protection, aesthetics, or for color coding that are not listed shall be coated based upon the specific application of that item.

COATING LIST

(Colors to be selected by Owner)

Site (*All Phases*)

1. New exposed piping, valves, and supports (except stainless steel).
2. New exposed piping in manholes.

3. New manhole rims and covers.
4. Other miscellaneous new metal surfaces not listed.

Miscellaneous (*All Phases*)

1. All existing items or surface with existing coating that is damaged, cut, abraded, stained, or otherwise compromised by construction activities.

NOTE:

1. The following surfaces shall NOT be coated:
 - a. Aluminum and stainless steel items.
 - b. Items that have been finish coated by the manufacturers, except as needed to repair damage to finished coating; which shall match the existing coating.
 - c. Items that are hot dip galvanized, unless specified, noted or shown otherwise.

END OF SECTION 09 97 00

SECTION 27 05 43 – UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: This section applies to all buried nonmetallic conduit ducts, fittings, and appurtenances including precast underground utility structures for communications systems. Furnish and install all conduits, fittings and appurtenances including precast underground utility structures necessary to complete work shown or specified.
- B. Codes, specifications and standards referred to by title or number in this specification shall be adhered to, and latest revisions shall apply in all cases.
- C. Definitions: The term Duct and Conduit might be used interchangeably within this specification and shall be interpreted as the same in each case except near building wall penetrations.
- D. Abbreviations
 - 1. AASHTO - American Association of State Highway and Transportation Officials
 - 2. ANSI - American National Standards Institute
 - 3. ASTM - American Society for Testing & Materials
 - 4. PFI - Conduit Fabricators Institute
- E. Referenced Standards
 - 1. ASTM 478 | Standard Specification for Precast Reinforced Concrete Manhole Sections
 - 2. ASTM C 858 | Specification for Underground Precast Concrete Utility Structures
 - 3. ASTM C1037 | Practice for Inspection of Underground Precast Concrete Utility Structures
 - 4. ASTM C 857 | Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
 - 5. AASHTO HS20 44 – Heavy Traffic
- F. All conduits, fittings and references to conduit diameter on the drawings or in specifications are intended to be nominal size or diameter and shall be interpreted as such.
- G. Conduit installed for this project is secondary to the TRSL pipeline installation. The location of the conduit shall be revised before considering the adjustment of the TRSL pipelines alignment. Contractor must coordinate all conduit realignment concerns with the Owners Representative before executing the work in question.

1.2 QUALITY ASSURANCE

- A. Mark conduit and fittings according to the applicable specification or standard.

- B. Perform factory and field tests in accordance with the applicable specification or standard.
- C. Line and Grade Requirements: The Contractor shall provide assurance to the Owner's Representative that the conduit is laid accurately to the required line and grade as shown on the drawings, plus or minus one (1) foot. Variations from the line and grade shown on the drawings or without the approval of the Owner's Representative shall be cause for the line to be rejected. In the case that the line is rejected, the Contractor must replace the line to the design line and grade without additional cost to the Owner.
- D. Test Sections
 - 1. Final Performance Testing for Acceptance: Before acceptance and final payment for all new conduit, the Contractor and the Owner's Representative shall check conduit, even if previously checked, for accurate alignment and grade. Also, the conduit shall be tested as specified in this Section for water tightness.

1.3 SUBMITTALS

- A. Submittals shall be as specified in the General Conditions, Section 01 00 00 – General Requirements, and Section 01 33 00 – Contractor Submittals.
- B. Submit the following:
 - 1. Product Data:
 - a. For each type of product
 - 2. Installation Procedure and Storage Requirements
 - a. Conduit, Elbows, Bell Ends, Bends, and Fittings
 - b. Joints and Solvent Cement
 - 3. Shop Drawings: Show fabrication and installation details for underground utility structures and include the following:
 - a. For Precast Underground Utility Structures, Shop Drawings shall be signed and sealed by a qualified professional engineer, and shall show the following:
 - (1) Construction of Individual Segments
 - (2) Joint Details
 - (3) Precast Underground Utility Structure to Conduit Interface

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage and handling of products required for this phase of this project. Refer to Section 01 64 00 – Owner-Furnished Products for more information.

- B. Load and unload all conduits, fittings and appurtenances by hoists or skids, and do not drop, skid or roll products. Pad slings, hooks and conduit tongs, and use in such a manner to prevent damage to the products. The use of chains to lift conduits, fittings, and appurtenances is prohibited.
- C. Store nonmetallic conduits on supports to prevent bending, warping, and deforming. Comply with all storage requirements of the conduit manufacturer.
- D. Stack conduits per manufacturer requirements.
- E. Store Precast Concrete Units at the project site as recommended by the manufacturer to prevent physical damage. Arrange so any identification markings are visible and product inspections can be performed in a safe manner.
- F. Lift and support precast concrete units only at designated lifting or supporting points.
- G. Promptly remove damaged products from the job site and replace with undamaged products at no cost to the owner. Damaged products to be replaced become property of the Contractor once suitable replacement has been delivered to job site.

PART 2 - PRODUCTS

2.1 GENERAL

All conduit, fittings and appurtenances will be new, unused and as shown on the drawings or as required by the manufacturer and related Specifications.

2.2 CONDUIT

- A. Underground Plastic Utilities Duct: Schedule-40-PVC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.
- B. General Requirements for Nonmetallic Ducts and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
 - 2. Comply with TIA-569-C and TIA-758-C.
- C. Solvents and Adhesives: As recommended by duct manufacturer.

2.3 PRECAST UNDERGROUND UTILITY STRUCTURES OR HANDHOLES

- A. Precast Units: As shown in the Contract Plan Set. The detail shown in the Contract Plan Set is modeled from an INDOT Standard Drawing for a storm sewer Inlet Type F structure.
- B. Design and fabricate structure according to ASTM C 858.

- C. Structure Design Loading: ASTM C 857, Class A-16 (AASHTO HS20 44 – Heavy Traffic).
- D. Joint Sealant: As specified in Section 03 40 00 – Precast Concrete Structures
- E. Inspect structures according to ASTM C1037.

PART 3 - EXECUTION

3.1 INSPECTION

A. General

- 1. The quality of all materials, the process of manufacture and the finished products shall be subject to inspection and approval by the Engineer. Such inspection may be made at the place of manufacture, after delivery to the site or at both places. The products shall be subject to rejection at any time for failure to meet any of the specifications' requirements, even though sample products may have been previously accepted as satisfactory at the place of manufacture.
 - a. Prior to being installed, each conduit and fitting shall be carefully inspected. Those not meeting the specifications shall be rejected and replaced at the Contractor's expense.

3.2 CONDUIT INSTALLATION

- A. Slope: Pitch conduits toward valve vaults to allow for proper drainage. Slope ducts from a high point in runs between two valve vaults to drain in both directions. Precast Underground Utility Structures are to be placed at high points to prevent the accumulation of water in the conduit and structure.
- B. Duct Entrances to Precast Concrete Utility Structures or Valve Vaults: Use resilient rubber connectors, as specified in Section 03 40 00 – Precast Concrete Structures, to provide watertight entrances.
- C. Direct-Buried Conduits:
 - 1. Trench Bottom: Continuous, firm, and uniform support for conduit. Prepare trench bottoms as specified in Section 40 05 13 – Process Piping.
 - 2. Backfill: Install backfill as specified in Section 40 05 13 – Process Piping. Contractor to ensure proper compaction is met.
 - 3. Install top of conduit a minimum of 36-inches below finished grade, unless otherwise indicated.
 - 4. Warning Tape: Bury warning tape approximately 12-inches above all conduit as specified in Section 33 05 26.23 – Underground Utility Line Marking.

5. Tracer Wire: Tape tracer wire to the top of all conduit as specified in Section 33 05 26.23 – Underground Utility Line Marking.

3.3 FIELD QUALITY CONTROL

- A. Testing: Demonstrate capability and compliance with requirements on completion of installation of underground conduits and precast underground utility structures.
 1. Duct Integrity: Pull an aluminum or wood test mandrel through the conduit to prove joint integrity and test for out-of-round duct. Provide a mandrel equal to 80 percent of the internal cross-sectional area of the conduit. If obstructions are indicated, remove obstructions and retest.
 - a. Correct installations if mandrel cannot pass through the entire length of the installed conduit and retest.

3.4 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of conduits. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of precast underground utility structures. Remove foreign material.

END OF SECTION 27 05 43

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping, or sealing site utilities.
7. Temporary erosion and sedimentation control.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site

1.3 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.4 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's designated premises.

C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control , applicable detours, and plant-protection measures are in place.

E. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
 - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

- A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."

- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
 - 1. Arrange with utility companies to shut off indicated utilities.
- B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.
- C. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security, and utilities sections; and in Section 024116 "Structure Demolition" and Section 024119 "Selective Demolition."

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Grind down stumps and remove roots larger than 3 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 - 2. Use only hand methods for grubbing within protection zones.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated or other backfill materials are indicated in plans.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground or as designated in plans.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to dep of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 31 23 00 – EXCAVATION AND FILL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Clear, excavate, dewater, sheet, backfill and perform related work necessary to complete work shown or specified.
- B. Codes, specifications and standards referred to by title or number in this specification shall be adhered to, and latest revisions shall apply in all cases.
- C. Definitions
 - 1. Excavation: Removal of earth and rock to form cavities for the construction of foundations and structures and to form trenches for the installation of piping.
 - 2. Earth: Unconsolidated material derived by weathering and erosion.
Earth includes:
 - a. Materials of both inorganic and organic origin;
 - b. Boulders less than 1/2 cubic yard in volume, gravel, sand, silt and clay;
 - c. Materials which can be excavated with a backhoe, trenching machine, drag line, clam shell, bulldozer, highlift or similar excavating equipment without the use of explosives, rock rippers, rock hammers or jack hammers.
 - 3. Rock: A natural aggregate of mineral particles connected by strong and permanent cohesive forces.
Rock includes:
 - a. Limestone, sandstone, dolomite, granite, marble and lava;
 - b. Boulders 1/2 cubic yard or more in volume;
 - c. Materials which cannot be excavated with a backhoe, trenching machine, drag line, clam shell, bulldozer, high-lift or similar excavating equipment without the use of explosives, rock rippers, rock hammers or jack hammers.
 - 4. Undercutting: Excavation of rock and unsuitable earth below the bottom of the pipe or conduit to be installed in the trench.
 - 5. Subgrade: Undisturbed bottom of a trench.

6. Bedding and Haunching: Material approved for placement in the bottom of the trench and to the centerline of the pipe.
7. Initial Backfill: Material approved for placement from the centerline to one foot above the pipe.
8. Backfill and Fill:
 - a. Within 5-feet from the edge of pavement or back of curb:
B-borrow for structural installations, per INDOT Standard Specifications – Section 211, material placed around structures from the top of bedding to finished grade, or to subbase of pavement. Flowable fill is permitted as a substitute to b-borrow.
 - b. Outside 5-feet from the edge of pavement or back of curb:
Excavated or clean fill material free of rocks larger than four (4) inches in diameter, frozen lumps of soil, wood, or other extraneous material placed around structures from the top of bedding to finished grade, or to subbase of pavement.
9. Topsoil: Earth containing sufficient organic materials to support the growth of grass and free from noxious weeds, seeds, and other deleterious materials.

1.2 QUALITY ASSURANCE

- A. The Contractor shall employ and pay for the services of an independent testing laboratory to perform specified services, necessary subgrade bearing tests and field density tests to ensure that proper compaction is obtained.
- B. If, based on testing service reports and inspection, subgrade or fills which have been placed are below specified density, the Contractor shall provide additional compaction and testing at no additional cost to the Owner.
- C. Blasting will not be permitted at any time during the length of this project. Both the possession of and use of explosives are strictly prohibited on all property owned, leased, or otherwise associated with the Owner.

1.3 SUBMITTALS

- A. Submittals shall be as specified in Section 01 00 00, General Requirements.
- B. Submit
 1. All materials analysis and compaction test reports that are completed.

1.4 JOB CONDITIONS

- A. Maintain bench marks, monuments and other reference points, and replace any

that are disturbed or destroyed.

- B. Selected information, including a full soils report, from subsurface investigations performed by other consultants are included at the end of this Section, if performed. Absence of subsurface information indicates no investigation has been made. Should the Contractor encounter subsurface and/or latent conditions at the site materially differing from those shown on the plans or indicated in the specifications, he shall immediately give notice to the Engineer of such conditions before they are disturbed. The Engineer will thereupon investigate the conditions; and if he finds that they materially differ from those shown on the plans or indicated in the specifications, he will make such changes in the plans and/or specifications as he may find necessary. Any increase or decrease of cost resulting from such changes can be sent to the Owner for review.

PART 2 - PRODUCTS

2.1 BEDDING, HAUNCHING AND INITIAL BACKFILL

- A. No. 8 crushed stone or No. 8 fractured face aggregate per the Owner's Sanitary Standards Manual
 - 1. The stone and/or aggregate shall be placed to form a stable base with all required profiles cut for ductile iron pipe bells, etc.
- B. Where poor or unstable soil conditions exist, or over excavation has occurred, additional No. 8 crushed stone, No. 8 fractured face aggregate, No. 2 stone, or lean concrete shall be used to form a stable base per the written approval of the Engineer.

2.2 BACKFILL

- A. Backfill shall be excavated material of such gradation and moisture content that the soil will compact to the specified density and remain stable. Unsuitable materials shall not be used.
- B. Pipe cover material, from one foot above the pipe, shall consist of durable particles ranging in size from fine to coarse (No. 200 to 1 inch) in size in a substantially uniform combination. Unwashed bank run sand and crushed bank-run gravel will be considered generally acceptable. Initial backfill material may be used for cover material.
- C. Granular, special backfill, or engineered/flowable fill shall be used when indicated on the plans or ordered by the Engineer. It shall also meet soils, GW, GP, SW and SP, classified by the Unified Soils Classification System ASTM D 2487-06. Flowable Fill must conform to the latest version of the INDOT Standard Specifications at the time of ordering the material. Extra payment for flowable fill will not be granted and shall be included in the price of the trench excavation with granular fill backfill line item(s). Excavated material from the job site that meets the specified granular or special backfill soil classifications may

be used as special backfill.

- D. Excavated material, from the trench, that is suitable for granular backfill can be used. This excavated material may be used in place of the granular backfill specified, as approved by the Engineer.
- E. Suitable excavated material shall be used when earth backfill is specified on the plans, or where granular backfill is not specified, provided that such material consists of loam, clay or other materials approved by the Engineer. Unsuitable backfill or frozen backfill material shall not be used. Suitable backfill shall be soils, GW, GP, GM, GC, SW, SP, SM, SC, ML and CL, classified by the Unified Soil Classification System, ASTM D 2487-06.
- F. Materials which are unsuitable for backfill include stones greater than 3 inches in their largest dimension, pavement, rubbish, debris, wood, metal, plastic and soils, OL, MH, CH, OH and PT, classified by the Unified Soil Classification System, ASTM D 2487-06 and must be removed from the jobsite in a legal and ethical manner. The placement of unsuitable materials within the trench is strictly prohibited.
- G. The top six (6) inches of backfill shall be topsoil suitable for seeding and restoration of preconstruction landscaping. Topsoil must be used on this project unless specifically directed otherwise by the Owner.

PART 3 - EXECUTION

3.1 UTILITIES, STRUCTURES AND PROPERTY

- A. The Contractor shall be responsible for construction means, methods, techniques and procedures, and for providing a safe place for the performance of the work by the Contractor, Subcontractors, suppliers and their employees, and for access use, work, or occupancy by all authorized persons.
- B. The Contractor shall be solely responsible for all obligations prescribed as employer obligations under Federal and State CFR 29 Parts 1900 through 1910 and 1926.
- C. Adequate supporting systems, such as sheeting, shoring, piling, cribbing and bracing shall be furnished and installed by the Contractor as required to protect personnel, existing buildings, utilities and property from damage during the progress of the work.
- D. All poles, fences, utilities, structures and property along the routes of water mains, force mains, and sewers shall be supported and protected from damage by the Contractor.
- E. The Contractor shall proceed with caution in the excavation and preparation of trenches so that the exact location of underground utilities and structures, both known and unknown may be determined. The Contractor is responsible for the

repair of utilities and structures when broken or otherwise damaged.

- F. The Contractor shall carefully explore and excavate to determine the location of underground structures when there is uncertainty about location or the Engineer believes it is necessary.
- G. Wherever sewer, gas, water or other pipes or conduits cross the trench, the Contractor shall support them without damage and without interrupting this Contract. The manner of supporting such pipes, etc., shall be subject to the written approval of the utility involved.
- H. When utility lines that have to be removed or relocated are encountered within the areas of operations, the Contractor shall notify the Engineer in ample time for the necessary measure to be taken to prevent interruption of the service and the project.
- I. The Contractor shall conduct the work so that no equipment, material, or debris will be placed or allowed to fall upon private property in the vicinity of the work unless he shall have first obtained the property owner's written consent thereto and shall have forwarded said written consent to the Engineer.
- J. All excavated material shall be piled in a manner that will avoid obstructing sidewalks and driveways. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes, or other utility controls shall be left unobstructed and accessible until the work is completed. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural watercourses shall not be obstructed.

3.2 STRIPPING AND STOCKPILING OF TOPSOIL

- A. Strip topsoil and vegetation from the excavated areas. Clean topsoil may be stockpiled for reuse as the upper 6 inches of the areas to be seeded and landscaped. Additionally, suitable excavated material may be stockpiled, in onsite locations approved by the Engineer, for filling and backfilling.
- B. Do not intermix grass, weeds, roots, root mat, brush and stones larger than 3 inches with stockpiled topsoil. Dispose of root contaminated topsoil; and, unsuitable materials, as excavated, and surplus suitable materials shall be removed from the job site as trenches are backfilled.

3.3 PAVEMENT AND WALK REMOVAL

- A. Remove existing pavement and walks from the excavated areas and the job site.
- B. All pavement and walks shall be cut along a straight line and all faces clean and vertical. When feasible, cut walks at the nearest joint.

3.4 EXCAVATING

- A. Make excavations to elevations and dimensions necessary to permit erection of

forms and inspection of foundation and to install piping.

- B. Completely remove unsuitable materials from under building and structure foundations, unless otherwise shown or specified.
- C. All hazardous encumbrances, including trees and boulders, involved in the vicinity of the excavation work shall be removed or made safe before excavating.
- D. Use diversion ditches, dikes or other suitable means to prevent surface water from entering an excavation and provide adequate drainage of the area adjacent to the excavation. Do not allow water to accumulate in an excavation.
- E. Excavations shall be inspected by a competent Contractor's representative and the Engineer's representative prior to any backfilling in areas of load bearing foundations or other such structures after every rainstorm or other hazard-increasing occurrence, and the protection against slides and cave-ins shall be increased if necessary.
- F. Do not store excavated or other material nearer than 4 feet from the edge of any excavation. Store and retain materials as to prevent materials from falling or sliding back into the excavation. Install substantial stop log or barricades when mobile equipment is utilized or allowed adjacent to excavations.
- G. Provide adequate barriers and physically protect excavations. Barricade or cover all wells, pits, shafts and similar excavations and backfill upon completion of exploration and similar operations.

3.5 DEWATERING

The Contractor shall keep excavations free from water until foundations, structures and piping are completed and will safely withstand forces generated by water. Provide sufficient dewatering equipment and make proper arrangements for the disposal of water from dewatering operation. Dewatering shall not damage property, create nuisances or interfere with other work. Do not use sanitary sewers for the disposal of water from dewatering operations.

3.6 SHEETING

- A. Supporting systems, such as piling, cribbing, shoring and bracing, shall be designed by a qualified Contractor's representative and meet all federal, state and local OSHA and accepted engineering requirements.
- B. Materials used for sheeting, sheet piling, cribbing, bracing, shoring and underpinning shall be in good, serviceable condition. Timbers shall be sound, free from large or loose knots and of proper dimensions.
- C. Take special precautions in sloping or shoring the sides of excavations adjacent to a previously backfilled excavation or a fill, particularly when the separation is less than the depth of the excavation. Pay particular attention to joints and seams of material comprising a face and to the slope of such seams and joints.

- D. If it is necessary to place or operate power shovels, derricks, trucks, materials or other heavy objects on a level above or near an excavation, sheet-pile, shore and brace the side of the excavation as necessary to resist the extra pressure due to such superimposed loads.
- E. If the stability of adjoining buildings or walls is endangered by excavations, provide shoring, bracing or underpinning as necessary to ensure the safety of adjoining buildings or walls. Such shoring, bracing or underpinning shall be inspected daily or more often, as conditions warrant, by a competent Contractor's representative and the protection effectively maintained.
- F. The Contractor shall be held responsible for the design of and for the sufficiency of all sheeting and bracing used, and for all damage to persons or property resulting from the improper quality, strength, placing, maintaining or removing of the same. This includes damage to trees, sidewalks, and other property on the project site, as well as on private grounds.
- G. Drive sheeting ahead of excavation. Do not remove sheeting until the excavation backfill has reached within 2 feet from the top of the excavation, except that the lower course of sheeting may be removed from a double sheeted excavation. When sheeting is drawn, completely fill all cavities remaining in or adjoining the excavation. When sheeting is left in place, completely fill all cavities behind such sheeting.

3.7 SUBGRADES

- A. Protect bottoms of excavations from frost.
- B. Do not construct foundations, footings, slabs, or piping on loose soil, frozen soil, mud or other unsuitable soil.
- C. When freezing temperatures are expected, do not excavate to the full depth indicated on the drawings, unless the foundation can be poured immediately after excavation has been completed, or the bottom of the excavation is adequately protected from frost.
- D. Fill excess cuts under foundations, footings and slabs with concrete, unless otherwise specified.
- E. Fill excess cuts under piping with compacted bedding as specified in this Section.
- F. For each type of soil on which footings will be placed, conduct at least three tests to verify required design bearing capacities. Subsequent verification and approval for each footing subgrade may be based upon a visual comparison of each subgrade with related tested soil type, when acceptable to the Engineer.

3.8 BACKFILLING EXCAVATIONS FOR PAVEMENTS, FOUNDATIONS AND STRUCTURES

- A. Prevent foreign matter from entering pipe while it is being installed, and remove any that should enter the piping, at no additional cost to the Owner. Close the open ends of pipe by watertight plugs when pipe laying is not in progress.
- B. The Contractor shall employ an independent testing laboratory to perform field density tests to ensure proper compaction.
- C. Remove debris, water and other unsuitable materials from excavations before backfilling is started.
- D. Backfill excavations in areas to be paved, or subjected to traffic, with Special Backfill. Place Special Backfill in lifts. Compact each lift of backfill to not less than 95% of the maximum dry density as determined in accordance with AASHTO T99, Method A (Std. Proctor). Compaction shall be by hand tamping or approved mechanical tamping devices, or in larger excavations by approved rollers. Make at least one field density test for every 500 square feet of compacted fill layer of overlying paved area, but in no case less than three tests. Do not compact backfill by puddling, unless permitted by the Engineer.
- E. Backfill excavations around and beneath footings and vertical side of structures with Special Backfill. Backfill directly over and around structures with Special Backfill. Place backfill in lifts no greater than 6 inches in loose depth. Place backfill in lifts no greater than 4 inches in loose depth where hand tampers are used. Backfill and fill shall be within +2% of optimum moisture content. Compact backfill and fill to not less than 100% of the maximum dry density, as determined by ASTM D698- 70, for backfill and fill placed beneath footings and structures and 95% of maximum dry density for backfill and fill placed over and around structures. One field density test must be performed for every 500 square feet of fill on each lift, but in no case less than three tests, to ensure that adequate compaction is being achieved. Compaction by puddling is not acceptable.
- F. Backfill non-load bearing excavations, not requiring Special Backfill, with Suitable Material. Place backfill and fill materials in lifts no greater than 8 inches in loose depth. Place backfill and fill materials in lifts no greater than 4 inches in loose depth where hand tampers are used. Backfill and fill shall be within +2% of optimum moisture content. Compact backfill and fill to not less than 95% of the maximum dry density. Tests for determination of maximum dry density shall meet the requirements of ASTM D698-70. Method is dependent on type of fill. Use compaction equipment which is suited to the soil being compacted. Make at least one field density test for every 1,000 square feet of compacted fill layer, but in no case less than three tests.
- G. Provide additional material, if required, for backfill and fill completion, at no additional cost to the Owner.
- H. Do not use the following materials for any backfilling:
 - 1. Unsuitable materials;
 - 2. Frozen materials;

3. Materials which are too wet or too dry to be compacted to the densities specified in this Article.
 - I. Do not place fill over frozen, wet or muddy subgrade.
 - J. Place backfill and fill in a manner which will not overload foundations or structures. Place backfill and fill evenly on all sides of foundations and structures. Do not use equipment that will overload foundations or structures during filling or backfilling.
 - K. Do all cutting, filling and grading necessary to bring the entire area around foundations and outside of structures to the following subgrade levels:
 1. To the underside of the respective surfacing for walks and pavement;
 2. To 6 inches below finished grade for lawns and planted areas within the project site.

3.9 BACKFILLING PIPING TRENCHES

- A. Do not backfill trenches and excavations until all utilities have been inspected by the Engineer and until all underground utilities and piping systems are installed in accordance with the requirements of the specifications and the drawings.
- B. Place and tamp bedding and haunching material in accordance with the manufacturer's recommendations, and do not damage pipe coating, wrapping or encasement.
- C. Bedding, haunching and initial backfill procedures shall be as specified in the Section for the applicable pipe material.
- D. Do not use the following materials for any backfilling:
 1. Unsuitable materials;
 2. Frozen materials;
 3. Materials which are too wet or too dry to be compacted to the densities specified in this Article.
- E. Do not place fill over frozen, wet or muddy subgrade.
- F. Backfill trenches beneath structures with Class B concrete (Section 03 30 00), unless directed otherwise by the Engineer. When concrete fill or encasement is not used, backfill trenches beneath the structure with Special Backfill. Place Special Backfill in lifts. Compact each lift of backfill to not less than 95% of the maximum dry density as determined in accordance with ASTM D698-70. Compaction shall be by hand tamping or approved mechanical tamping devices, or in larger excavations by approved rollers. Do not compact backfill by puddling.
- G. Backfill trenches not requiring Special Backfill with Suitable Material. Place and

compact backfill to produce an adequate foundation for seeding. The top 6 inches of backfill shall not contain stones or other objects larger than 1 inch in maximum dimension. Mound backfill above finish grade to allow for settlement. Fill and restore any settlement of the backfill. Grade area to be restored 6 inches below finish grade after settlement of backfill and immediately before restoration of vegetated areas.

3.10 CLEANUP AND MAINTENANCE

- A. Cleanup the affected areas around the jobsite, within a minimum of 1,000 feet of excavation, as backfilling is completed. Remove all excess materials, and restore items moved, damaged or destroyed during construction. Then, grade the area to be restored, and leave backfill mounded over trenches which are not backfilled with Special Backfill. Maintain the job site until the work has been completed and accepted. Keep dust conditions to minimum by the use of water, salt, calcium chloride, oil or other means as approved by Engineer.
- B. Restoration of grass, bushes, trees and other plants shall be as specified in Section 32 90 00, Planting.
- C. Restoration of pavement and walks shall be completed as specified in Section 32 12 16.13 Plant-Mix Asphalt Paving.
- D. Road Cleaning: The Contractor must clean the designated haul routes to prevent dust, dirt, and excavated material from accumulating. Special attention shall be used at the location of the entry gates where the speed bumps can cause construction related material to fall off trucks and other vehicles. Road cleaning shall be performed at least once a day. Additional cleaning shall be performed as necessary or as directed by the Engineer.

END OF SECTION 31 23 00

SECTION 03 30 11 – DEWATERING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Dewatering system.

1.2 SYSTEM DESCRIPTION

- A. Dewatering consists of performing work necessary to lower and control groundwater levels and hydrostatic pressures during construction to permit excavation and construction to be performed in dry conditions.
 - 1. Control of surface and sub-surface water, ice and snow are part of dewatering requirements.
- B. The contractor shall furnish standby equipment stored at Project site and ready for immediate use upon failure of dewatering equipment.
- C. The Contractor Shall review the Geotechnical Report provided within these documents to review the elevations and depths at which ground water was encountered in the area of the Construction.
- D. Dewatering is the responsibility of the contractor based on their means and methods and considers the requirements of subgrade preparation discussed in the Geotechnical Report. It may be necessary for the dewatering contractor to obtain additional subsurface information to assist with the design of their dewatering plan. The effectiveness of the subgrade preparation activities will be directly dependent on the adequacy of the contractor's dewatering efforts. No additional compensation will be considered for the contractor's failure to become thoroughly familiar with the anticipated groundwater conditions and requirements documented in the Geotechnical Report.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings:
 - 1. Indicate dewatering system layout, well depths, well screen lengths, dewatering pump locations, pipe sizes and capacities, grades, surface water control devices, valves, and water disposal method and location.
 - 2. Indicate primary and standby power system location and capacity.
 - 3. Indicate layout and depth of monitoring wells, piezometers and flow measuring devices for system performance measurement.
 - 4. Include detailed description of dewatering and monitoring system installation procedures and maintenance of equipment.
 - 5. Include description of emergency procedures to follow when problems arise.

6. Review of proposed system will only be with respect to basic principles of methods Contractor intends to employ. The Contractor is solely responsible for arrangement, location and depths of system necessary to accomplish work of dewatering.

C. Product Data: Submit data for each of the following:

1. Dewatering Pumps: Indicate sizes, capacities, priming method, & engine characteristics.
2. Pumping equipment for control of surface water within excavation.

PART 2 - PRODUCTS

2.1 DEWATERING EQUIPMENT

- A. Select dewatering equipment to meet specified performance requirements.

2.2 ACCESSORIES

- A. Valves and Fittings: Furnish valves and fittings to isolate each well from header pipe and to prevent loss of pump prime
- B. Filter Sand: ASTM C33; natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter; graded to suit well screen.
- C. Grout: Mixture of Portland cement and bentonite clay or sand suitable for sealing abandoned wells and piping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Conduct additional borings and investigations to supplement subsurface investigations

3.2 PREPARATION

- A. Protect existing adjacent buildings, structures, and improvements from damage caused by dewatering operations.

3.3 MONITORING WELLS

- A. Install monitoring wells at locations indicated on shop drawings as specified for dewatering wells.
- B. Test each monitoring well point to verify installation is performing properly.
- C. Install piezometers, calibrate, and test for proper operation.

- D. Protect monitoring well standpipes from damage by construction operations.
- E. Maintain accessibility to monitoring wells continuously during construction operations.
- F. Maintain monitoring wells until groundwater is allowed to return to normal level.

3.4 DEWATERING SYSTEM

- A. Install dewatering system in accordance with shop drawings.
- B. Provide an adequate system to lower and control groundwater in order to permit excavation of water mains and structures and placement of fill materials to be performed under dry conditions. Install sufficient dewatering equipment to pre-drain water-bearing strata above and below bottom of structure foundations, drains, sewers and other excavations.
 - 1. Reduce hydrostatic head in water-bearing strata below structure foundations, drains, sewers and other excavations to extent that water level and piezometric water levels in construction areas are below the prevailing excavation surface at all times.
 - 2. Maintain piezometric water level a minimum of 2 feet below excavations.
- C. Prior to excavation below groundwater level, place system into operation to lower water levels as required and then operate it continuously 24 hours a day, 7 days a week until lift water mains and structures have been constructed, including placement of fill materials, until dewatering is no longer required.
- D. Locate system components to allow continuous dewatering operations without interfering with installation of permanent Work and existing public rights-of-way, sidewalks, and adjacent buildings, structures, and improvements.
- E. Drill wells in sizes and to depth required. Provide temporary surface casing when required to stabilize soil while advancing well.
- F. Provide complete standby equipment, installed and available, for immediate operation as may be required, to adequately maintain dewatering on a continuous basis in event that any part of system becomes inadequate or fails. In event dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, perform such work as may be required to restore damaged structures and foundation soils at no additional expense.

3.5 SURFACE WATER CONTROL SYSTEM

- A. Provide ditches, berms, and other devices to divert and drain surface water from excavation area.
- B. Divert surface water and seepage water within excavation areas into sumps and pump water into storm drains in accordance with requirements of agencies having jurisdiction.
- C. Control and remove unanticipated water seepage into excavation.

3.6 SYSTEM OPERATION AND MAINTENANCE

- A. Operate dewatering system continuously until backfilling is complete.
- B. Provide continuous supervision of dewatering system by personnel skilled in operation, maintenance, and replacement of system components.
- C. Conduct daily observation of dewatering system and monitoring system. Make required repairs and perform scheduled maintenance.
- D. Fill fuel tanks before tanks reduce to 25 percent capacity.
- E. Start emergency generators at least twice each week to check operating condition.
- F. When dewatering system cannot control water within excavation, notify Engineer and stop excavation work.
 - 1. Supplement or modify dewatering system and provide other remedial measures to control water within excavation.
 - 2. Demonstrate dewatering system operation complies with performance requirements before resuming excavation operations.
- G. Modify dewatering and surface water control systems when operation causes or threatens to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells.
- H. Correct unanticipated pressure conditions affecting dewatering system performance.
- I. Do not discontinue dewatering operations without Engineer's approval.

3.7 WATER DISPOSAL

- A. Dispose of water removed from excavations in such a manner as not to endanger public health, property, and portions of work under construction or completed. Dispose of water in a manner that will cause no inconvenience to others engaged in work about site. Provide sumps, sedimentation tanks, and other flow control devices as required by governing authorities.

3.8 SYSTEM REMOVAL

- A. Remove dewatering and surface water control systems after dewatering operations are discontinued.
- B. Remove piezometers and monitoring wells.
- C. Fill abandoned wells with grout.
- D. Fill abandoned piping with grout.
- E. Repair damage caused by dewatering and surface water control systems or resulting from failure of systems to protect property.

END OF SECTION

SECTION 31 25 00 – EROSION AND SEDIMENT CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of temporary and permanent control measures as shown on the plans or as ordered by the Owner during the life of a contract to control water pollution, soil erosion, and siltation through the use of berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.
- B. Temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.
- C. Temporary control may include work outside the construction limits such as borrow pit operations, equipment, and material storage sites, waste areas, and temporary plant sites.
- D. Fugitive dust defined as "the generation of particulate matter to the extent that some portion of the material escapes beyond the property line or boundaries of the property, right-of-way, or easement on which the source is located." The state rules on fugitive dust, which apply to all sources of dust (particulate matter) are found in the Indiana Administrative Code under 326 IAC 6-4 and 326 IAC 6-5.

1.2 SUBMITTALS

The Contractor shall notify Marion County Soil and Water Conservation District (317-780-1765), IDEM Rule 5 Coordinator, Sue Bock (317-233-1135), Citizens Energy Group Environmental Coordinator, Kelly Davenport (317-639-7026), within 48 hours of actual construction activity start-up to inform them of the actual project start date.

PART 2 - PRODUCTS

2.1 GRASS

Grass which will not compete with the grasses sown later for permanent cover shall be a quick-growing species (such as ryegrass, Italian ryegrass, or cereal grasses) suitable to the area providing a temporary cover.

2.2 MULCHES

Mulches may be hay, straw, fiber mats, netting, bark, wood chips, or other suitable material reasonably clean and totally free of noxious weeds, seeds, and deleterious materials.

2.3 FERTILIZER

Fertilizer shall be a standard 12-12-12 commercial grade and shall conform to all federal and state

regulations and to the standards of the Association of Official Agricultural Chemists.

2.4 ROCK CHECK DAMS

Rock check dams shall be used to prevent soil erosion and excessive sediment conveyance at all stream or ditch crossings. Individual rock check dam locations are indicated, and shall be installed according to the detail provided, within the project plan set.

2.5 SLOPE DRAINS

Where construction disturbs grassy slopes equal to or steeper than 3:1 the slope shall be protected with an erosion control mat as illustrated in site plans. Slope drains may be constructed of pipe, fiber mats, rubber, Portland cement concrete, bituminous concrete or other materials that will adequately control erosion.

2.6 SILT FENCING

Silt fencing shall be used to prevent soil erosion at toe-of-slope locations as indicated on the site plans. The silt fence shall be installed as illustrated in the construction drawings.

2.7 WEIGHTED FIBER ROLLS

- A. Weighted fiber rolls are intended for placement around drainage inlets in existing pavement at the construction site to prevent sediment from entering the storm drain system.
- B. Weighted fiber rolls shall be assembled from a machined mat or blanket of shaved aspen wood curled excelsior or reticulated polyurethane and shall have a "weighted" inner core contained in a photodegradable, extruded, "high visibility" netting tube and, for ease of handling, a handle on each end.
- C. Weighted inner core shall hold the device in place, thereby eliminating the need for securing in place with either sandbags or stakes.
- D. The reticulated polyurethane, which is also available in safety orange, may be utilized to increase detection and to reduce the chances of tripping and damage from vehicles.
- E. The weighted fiber rolls shall be placed end-to-end in a circle around a construction site drainage inlet to prevent runoff and silt, sediment and debris from entering the inlet.
- F. The weighted fiber rolls shall conform to the following specifications:

Diameter (in)	Length (ft)	Weight (lb)	Sediment Retention Capacity (ft)	Functional Life (months)
8	6	50	1.5	24-36

Weighted fiber rolls must be installed perpendicular to the expected water flow (parallel to the slope contour).

1. On steeper slopes, dig small trenches across the slope for the rolls. The trench should be deep enough to contain the bottom-half of the roll.

2. Begin installation from the bottom of the slope and continue uphill.
 3. Lay the rolls in the trenches, fitting them snugly against the soil to make sure no gaps exist between the roll and the rear wall of the trench.
 4. When the rolls are placed end to end, the ends of each roll should overlap the next roll by a minimum of 4 inches and shall be secured in place with stakes and rope.
- G. Weighted fiber rolls shall be SlopeGard™ 3 as manufactured by KriStar Enterprises, Inc., Santa Rosa, CA, or Engineer approved equal.

2.8 OTHER

All other materials shall meet commercial grade standards and shall be approved by the Owner before being incorporated into the project.

PART 3 - EXECUTION

3.1 GENERAL

The Contractor shall comply with all applicable federal, state and local erosion control laws.

3.2 SCHEDULE

Prior to the start of construction, the Contractor shall submit schedules for accomplishment of temporary and permanent erosion control work, as are applicable for clearing and grubbing, grading, construction, paving, and structures at watercourses. The Contractor shall also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operations for the applicable construction have been accepted by the Engineer.

3.3 AUTHORITY OF OWNER

The Owner shall have the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, to limit the surface area of erodible earth material exposed by excavation, borrow, and fill operations, and to direct the Contractor to provide immediate permanent or temporary control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment.

3.4 CONSTRUCTION DETAILS

- A. The Contractor shall be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages as soon as substantial areas of exposed slopes can be made available. Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design state; that are needed prior to

installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices but are not associated with permanent control features on the project.

- B. Where erosion is likely to be a problem, clearing and grubbing operations should be scheduled and performed so that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise, temporary erosion control measures may be required between successive construction stages.
- C. The Owner will limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current in accordance with the accepted schedule. Should seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified.
- D. In the event that temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or are ordered by the Owner, such work shall be performed by the Contractor at their own expense.
- E. The Owner may increase or decrease the area of erodible earth material to be exposed at one time as determined by analysis of project conditions.
- F. The erosion control features installed by the Contractor shall be acceptably maintained by the Contractor during the construction period.
- G. Whenever construction equipment must cross watercourses at frequent intervals, and such crossings will adversely affect the sediment levels, temporary bridge structures should be provided at no additional expense to owner.
- H. Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into or near rivers, streams, and impoundments or into natural or manmade channels leading thereto.

3.5 MAINTENANCE INSPECTION PROCEDURES

- A. Inspections
 1. An inspection of erosion control measures in place shall be made at least once every seven days.
 2. **All erosion control measures in place shall be inspected within 24 hours after any storm event greater than 0.5 inches of rain per 24- hour period.**
 3. Qualified personnel shall conduct a weekly inspection of the construction site to identify areas contributing to stormwater discharges associated with construction activity.
 4. Disturbed areas, material storage areas, and equipment storage areas that are

exposed to precipitation shall be inspected on a regular basis for evidence of, or the potential for, pollutants exiting the site.

5. Stormwater discharge locations shall be inspected to determine if erosion control measures are effective in preventing significant impacts to receiving waters.
 6. Erosion control devices installed as specified shall be observed to ensure that they are operating properly.
 7. Haul routes and construction entrances to work areas shall be periodically inspected for evidence of off-site vehicle tracking of mud and dirt. Periodic inspections shall be performed a minimum of three (3) times per week.
 8. The Contractor's staging area shall be inspected to ensure that solid and liquid wastes are being properly disposed of and not allowed to be discharged into stormwater runoff.
 9. A source or combination of sources may be considered to be generating fugitive dust if the dust is visible crossing the property line (construction area) at or near ground level (IDEM). Fugitive dust production will be monitored closely during construction.
- B. Inspection Reports: A report shall be completed summarizing the results of each inspection. The report shall include the name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the erosion control plan, a certificate that the facility is in compliance with the plan, and identification of any incidents of non-compliance.
1. An inspection report form shall be used to record information obtained from field investigations of the erosion control measures. The record and certification shall be signed in accordance with the signatory requirements of the permit.
 2. Inspection reports shall be maintained by the Contractor for two (2) years following Owner approval of the final payment.
- C. Maintenance: All erosion control measures shall be maintained throughout the project and until such time as the disturbed area has been completely stabilized or other provisions have altered the need for these measures. The Contractor shall:
1. Replace mulch materials to their original level when the level has been substantially reduced due to decomposition of the organic mulches and displacement or disappearance of both the organic and inorganic mulches.
 2. Remove rubbish and channel obstructions from bare and vegetated channel within the project limits. The Contractor shall repair damage from scour or bank failure, rodent holes and breaching of diversion structures. Excessive wear, movement or failure of erosion control blankets shall be repaired immediately. Deposits of sediment shall be removed from the channel and placed or disposed of as directed by the Engineer.

3. Repair any damage to silt fence barriers immediately and monitor barriers daily during prolonged rainfall.
4. Repair or replace any silt fence fabric which has decomposed or become ineffective prior to its expected usable life.
5. Remove sediment deposits after each storm event. Sediment must be removed when deposits reach approximately half the height of the silt fence barrier.
6. Till and smooth to conform to the existing grade and reseed any sediment deposits remaining in place after the silt fence barrier is no longer required.
7. Maintain the construction entrances in a condition to prevent tracking or flowing of sediment onto roads. This could require periodic top dressing with additional surface materials as conditions demand. Repair and clean out any features used to trap sediment and remove all sediment spilled, dropped, washed or tracked on road and return to the point of likely origin.
8. Contractor is to clean all streets affected by construction activity, at a minimum, once per day or as directed by Owner, Owner's representative, or Engineer. Special attention shall be used at the location of the entry gates where the speed bumps can cause construction related material to fall off trucks and other vehicles. Contractor is responsible for removing all related construction material from Harding Street, Raymond Street, and all other surrounding streets without delay.
9. All temporary erosion and sediment control practices shall be removed and disposed of within 30 days after site stabilization is achieved or after the temporary practices are no longer needed. Where left in place, trapped sediment shall be permanently stabilized to prevent further erosion.

END OF SECTION 31 25 00

SECTION 32 12 16.13 – PLANT-MIX ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: This section covers all work involved in the installation of new pavement, walks, and curbs, and the repair and replacement of existing streets, roads, highways, drives, parking areas, curbs, gutters, sidewalks, and other paved areas damaged or destroyed during construction of the work.
- B. Related Work Specified in Other Sections
 - 1. Section 01 31 14 – Coordination with Plant Operations
(Within Wastewater Treatment Plants)
 - 2. Section 31 23 00 – Excavation and Fill
 - 3. Section 32 90 00 – Planting
- C. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the reference thereto. Except as specifically modified in this specification, paving and surfacing operations, materials and testing will comply with the most current revisions of applicable sections of the 2014 Indiana Department of Transportation Standard Specifications.
- D. Definitions
 - 1. Abbreviations:
 - a. INDOTSS Indiana Department of Transportation's Standard Specifications.
 - b. AASHTO American Association of State Highway & Transportation Officials.
 - c. ACI American Concrete Institute.
 - d. ASTM American Society for Testing & Materials.
 - e. NRMCA National Ready Mix Concrete Association.
 - f. ITM Indiana Test Method
 - 2. Rock: A natural aggregate of mineral particles connected by strong and permanent cohesive forces. Rock includes limestone, sandstone, dolomite, granite, marble, and lava.
 - 3. Subgrade: The prepared and compacted soil immediately below the pavement or walk system and extending to such depth as will affect the structural design.
 - 4. Subbase: The layer of specified or selected material of designed thickness placed on a subgrade to support a base course and surface course.

5. Base Course: The layer of specified or selected material of designed thickness placed on a subbase to support a binder or surface course.
6. Binder Course: The layer of specified or selected material of designed thickness placed on a base course to support a surface course.
7. Surface Course: The layer of specified or selected material of designed thickness placed on a subbase or base course to support the traffic load.

1.2 QUALITY ASSURANCE

- A. The Contractor shall employ and pay for the services of an independent testing laboratory (unless otherwise noted) to perform specific services and necessary field density tests. The Contractor shall demonstrate to the Owner that proper compaction has been obtained and proper asphalt and concrete mix designs are in compliance with the specifications.
- B. Mixing Plant: Prior to placing any hot asphalt concrete pavement or Portland cement concrete pavement, the Contractor shall provide the Owner the name and location of the bituminous mixing or concrete mixing plant and the type and composition of mixes the Contractor proposes to use in the work.
- C. Paving and surfacing shall comply with the tolerances specified in applicable sections of 402 for Bituminous and 502 for Concrete in INDOTSS.
 1. Subgrade and subbase shall be within 1/2 inch of dimensions indicated on drawings.
 2. Bituminous base shall not vary longitudinally more than 1/4 inch from a 10-foot straightedge. Bituminous and concrete surfaces shall not vary more than 1/8 inch from a 10-foot straightedge.
 3. Finished surface shall be within 1/4 inch of dimensions indicated on drawings.
- D. Asphalt and concrete pavement shall be installed by a contractor whose prime business is asphalt or concrete paving.

1.3 SUBMITTAL REQUIREMENTS

- A. Submittals shall be as specified in the General Conditions and Section 01001, General Requirements.
- B. Submit the following:
 1. Name and location of bituminous mixing plant or concrete ready-mix plant. Mixing plants and equipment shall meet the requirements of INDOTSS, Sections 402 and 502.

2. Type and composition of proposed materials and mixes. Job mix formulas shall be prepared and submitted for approval to the Engineer in accordance with INDOTSS 402 and 502. It shall include standard bituminous information including, but not limited to, aggregate gradation, binder content, maximum specific gravity, and air voids.
3. Certified copies of reports of tests specified in this Section and required by the referenced standards.

1.4 JOB CONDITIONS

- A. Do not place paving and surfacing materials on a wet surface, pumping subbase or when weather conditions would prevent the proper construction of paving and surfacing.
- B. Do not place aggregates on frozen subgrade. Do not place aggregates when air temperature is below 35°F.
- C. Unless otherwise directed in writing by the Owner or their Representative, bituminous materials are to be placed in accordance with INDOTSS 402, 405, and 406. Unless otherwise directed in writing by the Owner or their Representative, concrete materials are to be placed in accordance with INDOTSS 502.
- D. Discontinue placing concrete when a descending air temperature away from artificial heat reaches 40°F, and do not resume placing concrete until an ascending air temperature away from artificial heat reaches 42°F.
- E. Do not place paving and surfacing materials when natural light is not sufficient to properly observe work or operations.

1.5 CONTRACTOR'S ORGANIZATION

- A. The Contractor shall be a firm whose prime business is asphalt or concrete paving. The Contractor shall have a competent supervisor on the site during the progress of the work, acting for the Contractor in all matters concerning the work. He shall have the authority to receive directions and act upon them for the Owner through the Owner's authorized representative.
- B. The Contractor shall keep a set of Plans and Specifications available on the site and in good condition.

1.6 TRAFFIC CONTROL

The Contractor shall plan construction operations so that existing local traffic access can be maintained to the maximum extent possible. During the construction, they will also maintain appropriate use of barricades, lights, flagmen and other protective devices, whether specified for the project or required by the local governing authority. Traffic control devices used for maintenance of traffic shall comply with the Indiana Manual on Uniform Traffic Control Devices and applicable INDOT standard specifications.

PART 2 - PRODUCTS

2.1 AGGREGATE

- A. Fine aggregates shall consist of natural sand or manufactured sand produced by crushing rock, shells, air-cooled blast furnace slag, or wetbottom boiler slag.
 - 1. Fine aggregates used in Portland cement concrete and bituminous pavements shall be free from injurious amounts of organic impurities. When subjected to the colorimetric test for organic impurities and a color darker than the standard is produced, it shall be tested for effect of organic impurities on strength of mortar in accordance with AASHTO T 71. If the relative strength at 7 and 28 days, calculated in accordance with section 10 of T 71, is less than 95%, it shall be rejected.
- B. Coarse aggregates shall consist of clean, tough, durable fragments of crushed rock, crushed or uncrushed gravel or shells, or crushed and processed air-cooled blast furnace slag. These materials shall not contain more than 15% flat or elongated pieces and shall not contain particles with an adherent coating. Flat or elongated pieces will be described as pieces having a length in excess of four times its width.
- C. Coarse aggregates shall comply with INDOTSS, Section 904.03. Fine aggregates shall comply with INDOTSS, Section 904.02.

2.2 BITUMINOUS MATERIALS

- A. Petroleum asphalt cement shall be homogeneous, free from water, and shall not foam when heated to 347°F.
 - 1. Petroleum asphalt cement shall be PG Binder, grade PG 64-22.
 - 2. Petroleum asphalt emulsion shall be AE-60.
- B. Bituminous materials for prime coat shall consist of:
 - 1. Cut-back asphalt - MC-70; or
 - 2. Asphalt emulsion - AE-P.
 - 3. Materials shall conform to INDOTSS Section 902.01.
- C. Bituminous materials for tack coat shall consist of:
 - 1. Asphalt emulsion - AE-T.
 - 2. Materials shall conform to INDOTSS 902.01.
- D. Bituminous materials for seal coat shall consist of:
 - 1. Asphalt emulsion - RS-2, AE-90, AE-150, HFRS-2.
 - 2. Materials shall conform to INDOTSS Sections 902.01.

- E. Cover aggregate shall consist of:
 - 1. Coarse aggregates, Class A or B, size no. 8, 9, 11 or 12.
 - 2. Fine aggregate (natural sand only), size no. 23 or 24.
 - 3. Materials shall conform to INDOTSS Sections 904.03 and 904.02, respectively.

2.3 HOT MIX ASPHALT (HMA)

- A. Hot mix asphalt (HMA) shall consist of an intimate mixture of coarse aggregate, fine aggregate (including mineral filler if required), and asphalt cement or emulsion combined in proportions specified in INDOTSS Section 402.
- B. When the use of one type or source of aggregate or binder is started, the use of that same type or source shall be continued for the entire lift being constructed, unless otherwise directed by the Engineer.
- C. Preparation of HMA mixtures shall comply with the requirements of INDOTSS Section 402.
- D. Recycled materials may consist of reclaimed asphalt pavement, RAP. RAP shall be the product resulting from the cold milling or crushing of an existing HMA pavement. The RAP shall be processed so that 100% will pass the 2 in. (50 mm) sieve when entering the HMA plant. The coarse aggregate in the recycled materials shall pass the maximum size sieve for the mixture being produced.
- E. Recycled materials may be used as a substitute for a portion of the new materials required to produce HMA mixtures. RAP shall not exceed 25.0% by weight (mass) of the total mixture. The percentages of recycled materials shall be as specified on the DMF.
- F. Recycled materials shall not be used in ESAL Category 3, 4, or 5 surface mixtures or open graded mixtures.
- G. The combined aggregate properties of a mixture with recycled materials shall be determined in accordance with ITM 584 and shall be in accordance with 904. Gradations of the combined aggregates shall be in accordance with 401.05.
- H. Mixtures containing 15.0% or less RAP shall use the same grade of binder as specified. The binder for mixtures containing greater than 15.0% and up to 25.0% RAP shall be reduced by one temperature classification, 6 degrees C, for both the upper and lower temperature classifications.

2.4 PORTLAND CEMENT CONCRETE

- A. Cement shall be Portland cement and shall meet the requirements of ASTM Specification C 150, ACI 301, and ACI 318. Cement shall be Type 1 for normal use, Type 1A where air entrainment is desired, or Type III or Type IIIA where

high early strength is desired and authorized by the Engineer. Blended hydraulic cements which meet the requirements of ASTM Specification C 595 Type 1P Portland pozzolan cement may be used where a more watertight concrete is required. Fly ash may also be used as a partial cement replacement for Types 1 or 1A. Cement shall meet requirements specified in INDOTSS Section 901.

- B. Regular fine and coarse aggregates shall meet the requirements of ASTM Specification C 33. Aggregate shall be crushed limestone with a maximum size of 3/4 inch, except in mass concrete the maximum size may be 1-1/2 inches.
 - 1. Lightweight fine and coarse aggregates shall meet the requirements of ASTM Specification C 330.
 - 2. Insulating fine and coarse aggregates shall meet the requirements of ASTM Specification C 332.
- C. Water shall be potable, clean, and free from injurious amounts of oils, acids, alkalis, organic materials, or other substances that may be deleterious to concrete or steel. A maximum of 500 mg/L of chloride ion may be present in the water.
- D. Air entraining admixtures shall meet the requirements of ASTM Specification C 260.
 - 1. Water reducing and retarding admixtures shall meet the requirements of ASTM C494, Type A or Type D; however, they shall contain no chlorides, be nontoxic after 30 days and compatible with the air entraining admixtures. The amount of admixture added to the concrete shall be in accordance with the manufacturer's requirements. Furnish a compliance statement that the admixture used satisfies all requirements of this specification. Evidence that the admixture is included in the approved list of the INDOTSS Division of Materials and Tests, in accordance with INDOTSS Section 912.03, will satisfy the requirement for a compliance statement.
 - 2. Fly ash shall meet the chemical and physical requirements of ASTM C 618 for mineral admixture Class F, except loss on ignition shall not exceed 6%. Fly ash shall be sampled and tested in accordance with ASTM C 311 prior to use.
- E. Reinforcing steel shall meet the requirements of ASTM Specification A 615, Grade 60.
 - 1. Welded wire fabric or wire mesh shall meet the requirements of ASTM A 185.
 - 2. Reinforcing steel and appurtenances shall follow INDOTSS Section 910.01.
- F. Preformed expansion joint filler shall meet the requirements of ASTM

Specification D 1752, Type III.

1. Hot-poured elastic joint filler shall meet the requirements of ASTM Specification D 1190.
 2. Waterproof expansion joint filler shall meet the requirements of ASTM Specification D 1850.
 3. Joint materials specified in INDOTSS Section 906 may be used, approved by the Engineer.
- G. Concrete pavement shall be wet cured by using burlap, waterproof blankets, or ponding; or by using a membrane compound. If the membrane method is used, the compound shall be Type 2, complying with AASHTO M148 for white pigmented compound. A pressure sprayer capable of applying a continuous uniform film to the pavement surfaces will be required.
- H. Dowel bars shall be smooth, round bars of plain billetsteel conforming to ASTM A615, Grade 40, and free of any deformation or foreign material that would restrict slippage in concrete. Dowel bars shall be coated as required by INDOTSS 910.01. For expansion joints, each bar shall be provided with a metal cap, or approved plastic cap, on one end that will provide for ample movement of the slabs.
1. Dowel bars and assemblies shall conform to the requirements of INDOTSS Section 503.
- I. Concrete base shall meet the requirements of INDOTSS Section 305.
- J. Reinforced concrete pavement shall meet the requirements of INDOTSS Section 502.
- K. Reinforced concrete for sidewalks and steps shall meet the requirements of INDOTSS Section 604.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor is responsible to provide equipment, workmanship and materials required to achieve a finished product that meets these specifications.
- B. Use compaction equipment suitable to the material being placed. Compacting equipment shall include at least one piece of equipment capable of providing a smooth even surface on the pavement surface course.
- C. Prior to placing paving and surfacing materials, shape subgrade as required to produce finished pavement grades and cross-sections shown on drawings.
- D. Do not place paving and surfacing material before subgrade is reviewed and

accepted by the Engineer. Do not place paving and surfacing materials on a frozen or muddy subgrade.

- E. Compact subgrade to not less than 100% of its maximum dry density as determined in accordance with AASHTO T99.
- F. Provide adequate drainage at all times to prevent water from standing on subgrade, pavement or walks.

3.2 SUBGRADE

The subgrade material and testing shall comply with INDOTSS Section 207, before placement of subbase.

3.3 SUBBASE PREPARATION

Provide 8 inches of subbase in locations where pavement is to be placed on a material other than Special Backfill. Subbase shall meet the requirements of INDOTSS Section 302.

3.4 AGGREGATE BASE, SURFACE, OR SHOULDERS

- A. Aggregate base, surface, or shoulders shall consist of crushed rock or gravel. The aggregate type shall be suitable for the area in which the project is located. The aggregate thickness shall be as shown on the drawings and as specified herein.
- B. Aggregate shall be Type "O" mix, unless otherwise specified by the Owner.
- C. Compacted aggregate materials and construction shall conform to INDOTSS Sections 301 and 303.
- D. If the required thickness of the aggregate (Type O) exceeds 4 inches, the material shall be placed and compacted in separate lifts no less than 2 inches nor more than 4 inches of compacted depth. If Type P aggregate is used, it may be placed in individual lifts with a thickness of up to 6 inches.
- E. If spreading devices are used which will ensure proper depth and alignment, forms will not be required; otherwise, forms shall be required. Forms shall be of wood or steel, adequate in depth, straight, of uniform dimensions and equipped with positive means for holding the form ends rigidly together and in line. Segregation of material shall be avoided by any spreading method used. No payment will be made for aggregate placed beyond the dimensions shown on the drawings.
- F. Compact material in each lift after material is spread and shaped. Compact material to not less than 100% of maximum dry density as determined by AASHTO T99. Use construction procedures, including sufficient wetting and number of passes, to ensure specified density is attained.
- G. The Contractor shall employ an independent testing laboratory to perform field density tests to demonstrate proper compaction of aggregate surface pavement, if

requested by the Owner.

- H. Unless otherwise shown on the drawings, the minimum section (excluding subgrade) of reinforced concrete shall be 6 inches of compacted #53, Type "O" aggregate base and 6 inches of 4,000 psi reinforced concrete.
- I. Unless otherwise shown on the drawings, for a street with a concrete base and an asphalt surface, the replacement section shall be a new concrete base, not less than 6 inches thick with HMA Base, 25.0 mm, to within 1 inch of the existing grade and then 1 inch of HMA Surface, 9.55 mm mix.
- J. Unless otherwise shown on the drawings, for a street with a brick base and an asphalt surface, the replacement section shall be full depth asphalt from the bottom of the brick base to the top of the asphalt surface. The top 1 inch shall be HMA Surface, 9.55 mm.
- K. Unless otherwise shown on the drawings, gravel pavement shall be replaced with 6 inches of #53, Type "O" compacted stone aggregate as specified in INDOTSS Section 303.
- L. Unless otherwise shown on the drawings, chip and seal pavements shall have 8 inches of compacted aggregate base (#53, Type "O" crushed stone) and 1 inch processed bituminous coated aggregate pavement placed and rolled as specified in INDOTSS Section 404.

3.5 HOT MIX ASPHALT

- A. This work shall consist of constructing one or more courses of HMA base, intermediate, and wedge leveling or surface mixtures on a prepared foundation in accordance with these specifications and in reasonably close conformance with the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer.
 - 1. If the required finished depth of any course is to exceed four times the top size of the aggregate used as shown by actual screen analysis, the course shall be constructed in two or more lifts, as directed.
 - 2. Mix type shall be as indicated on the drawings, without exception, unless otherwise approved in writing by the Engineer.
 - a. Job mix formulas shall be prepared and submitted for approval to the Engineer in accordance with INDOTSS 402. The job mix formula shall include standard bituminous mixture information including, but not limited to, aggregate gradation, binder content, maximum specific gravity, and air voids.
 - 3. Materials and construction requirements shall comply with the requirements of INDOTSS Section 402.
- B. If the previously constructed course is granular, a prime coat will be required.

1. Apply prime coat uniformly at a rate of 0.50 to 0.75 gallon per square yard depending on condition of surface and amount of loose aggregate.
 2. Apply prime coat with a pressure distributor. Temperature of prime coat shall not exceed 150°F.
 3. Squeegee excess prime coat from the subbase surface. Correct deficient or skipped area.
 4. Prime coat shall be placed in accordance with INDOTSS Section 405.07.
- C. Place and spread bituminous base mixture with a bituminous paver. In areas inaccessible to a paving machine, place and spread bituminous base mixture by other mechanical or hand methods acceptable to the Owner or their Representative.
- D. Tack coat shall be placed on existing bituminous or concrete surfaces before a new lift of bituminous material is added. Apply tack coat uniformly at a rate of 0.03 to 0.08 gallon per square yard.
1. Patch, sweep, and clean existing surface. The surface shall be free of irregularities and provide a reasonably smooth, dry, and uniform surface to receive the tack coat. Remove and replace unstable corrugated areas with suitable patching materials.
 2. Tack coat shall be placed in accordance with INDOTSS Sections 406.03 through 406.05.
- E. Placement and compaction of hot mix asphalt (HMA) shall conform to INDOTSS Sections 402.10 through 402.16.
- F. Place binder used for wedging or leveling, approaches and feathering by mechanical methods or acceptable hand methods for placing and spreading in accordance with INDOTSS Section 402.13.

3.6 PORTLAND CEMENT CONCRETE PAVEMENT

- A. Portland cement concrete pavement shall consist of a coarse aggregate base (if required) and a reinforced or unreinforced Portland cement concrete surface, as shown on the drawings
1. Use No. 53, Type "O" coarse aggregate for subbase, unless otherwise shown or specified.
 2. Pavement cross-section shall be as shown on drawings.
- B. Where an aggregate base course is shown or specified, it shall be constructed in

accordance with Article 3.3 of this specification.

- C. Portland cement concrete pavement operations and materials shall comply with INDOTSS Section 502 unless otherwise specified by the Engineer.
 - 1. Alternate equipment to that specified in INDOTSS, Section 501 shall be allowed provided that line, grade, surface, smoothness and other requirements of the specifications are met. The equipment used shall be subject to the approval of the Engineer.
 - 2. Expansion and contraction joints shall be installed as indicated on the drawings or as required by INDOT standards. Expansion joints shall be required whenever new concrete abuts fixed objects or existing concrete surfaces, whether or not shown on the drawings.
 - 3. Keyway construction, load transfer devices, tie bars and slab and ear reinforcement shall be installed as indicated on the drawings.
 - 4. Unless otherwise shown on the drawings, the final finish of concrete pavement shall be by brooming, as set out in INDOTSS Section 502.14, to form a transverse skid-resistant finish.
 - 5. The Contractor shall always have materials available to protect the surface of concrete against rain. These materials shall consist of burlap, curing paper or plastic sheeting.
 - 6. New concrete pavement shall be protected by the Contractor until opening to traffic is approved by the Engineer. It shall not be opened to traffic until the field-cured concrete has attained a flexural strength of 550 psi, or a compressive strength of 3,500 psi. If such tests are not conducted, the pavement shall not be opened to traffic until 14 days after the concrete was placed. Before opening to traffic, the pavement shall be cleaned and permanent lane markings applied to the pavement.

3.7 WALKS

- A. Walks shall consist of a coarse aggregate subbase and a reinforced concrete surface. Use No. 24 fine aggregate for subbase, unless otherwise shown. Concrete shall be Class "A", 4,000 psi concrete, per INDOTSS 702.
- B. Subbase shall be 2 inches thick, and concrete shall be 4 inches thick, unless otherwise shown.
- C. Compact subbase to not less than 95% of maximum dry density, as determined in accordance with AASHTO T99.
- D. Proportion, mix, and place concrete as specified in INDOTSS Sections 604 and 702. Walks shall have a broom surface finish. Edge all outside edges of walk and all joints with a 1/4-inch radius edging tool.

- E. Unless otherwise shown on the drawings, walks shall be divided into sections not more than five feet in length by dummy joints formed by a jointing tool with a 1/4-inch radius.
- F. Form construction joints around all abutting structures and appurtenances such as manhole, utility poles, hatches, and hydrants. Install 1/2 inch thick pre-molded expansion joint filler in construction joints. Expansion joint material shall extend for the full depth of the walk and not more than 1/4 inch above finished surface.
- G. If existing sidewalk is to be removed and replaced with new sidewalk or new sidewalk extended from existing sidewalk, the existing sidewalk shall be removed to the nearest joint of suitable quality or as directed by the Owner's Representative.

3.8 PROTECTION

- A. Maintain compacted aggregate subbase and surface true to line and grade and required density. Maintain subbase until prime coat is placed. Maintain surface until job is complete and accepted by the Owner.
- B. Do not permit vehicular traffic of any kind on any bituminous course until the bituminous mixture has hardened sufficiently not to be distorted beyond specified tolerances. Remove any foreign material which is on the surface of any course before the course is rolled or any subsequent course is placed.
- C. Do not permit foot or equipment traffic on concrete pavement or walks until concrete has developed sufficient strength not to be marked or damaged. Do not permit vehicular traffic on concrete for at least 14 days unless it satisfies the conditions set in 3.6 part C6, above.
- D. Repair or replace damaged pavement and walks to the satisfaction of the Engineer.

3.9 COLD MILLING

- A. Clean existing paving surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement, including hot-mix asphalt and, as necessary, unbound-aggregate base course, by cold milling to grades and cross sections indicated.
 - 1. Repair or replace curbs, manholes, and other construction damaged during cold milling.

3.10 CLEANUP

- A. Clean up the job site following pavement and surfacing restoration. Remove all rubbish, excess materials, temporary structures, and equipment. Leave the work in a neat and presentable condition.

END OF SECTION 32 12 16.13

SECTION 32 90 00 – PLANTING | LANDSCAPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Furnish and install topsoil, fertilizer, seed, mulch, trees, bushes, ornamental plants, and stone, and do related work necessary to complete work shown or specified.
 - 1. The Contractor shall repair or replace lawn areas, trees, and ornamental plants, and all other landscaping currently installed that is damaged or destroyed during construction of the work included in this Contract, unless otherwise shown on the drawings.
 - 2. New plantings (trees, shrubs, etc.) shall be as shown on the drawings.
 - 3. Any areas of 100 square feet or more to be seeded will be hydroseeded.
- B. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply, unless otherwise shown or specified.
- C. Definitions: Lawn areas include grassed areas which are cut and maintained on a routine basis. Lawn areas include lawns at homes, businesses, and government facilities and grass shoulders of streets, roads, and highways.
 - 1. Replacement of underbrush in fields and woods, along farm fences and roads, and in similar areas is not required, unless otherwise shown on the drawings.

1.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage, and handling of products.
- B. Promptly remove damaged products from the job site. Replace damaged products with undamaged products at no additional cost to the owner.
- C. Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.

1.3 JOB CONDITIONS

- A. Seed between February 15 and June 1 and between August 15 and November 1. Do not sow seed during adverse weather conditions. Do not broadcast seed during high wind. Do not sow seed when the moisture content of the soil is too low or

too high for seed germination.

- B. Plant trees and ornamental plants during the proper time and under the proper conditions for the particular tree or plant.
- C. Proceed with and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.
- D. Prepare a proposed planting schedule. Schedule dates for each type of landscape work during normal seasons for such work in area of site. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. Once accepted, revise dates only as approved in writing, after documentation or reasons for delays.

PART 2 - PRODUCTS

2.1 QUALITY ASSURANCE

- A. Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.
- B. Provide trees and shrubs grown in a recognized nursery in accordance with good horticultural practice. Provide healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun-scald, injuries, abrasions, or disfigurement.
- C. Provide shrubs of sizes shown or specified. Trees and shrubs of larger size may be used if acceptable to Engineer and if sizes of roots or balls are increased proportionately.
- D. Engineer reserves right to inspect trees and shrubs either at place of growth or at site before planting, for compliance with requirements for name, variety, size, and quality.
- E. Submit vendor's certified analysis for soil amendments and fertilizer materials. Submit other data substantiating that materials comply with specified requirements.
- F. Submit seed vendor's certified statement for each grass seed mixture required, stating botanical and common name, percentage by weight, and percentages of purity, germination, and weed seed for each grass seed species.

2.2 TOPSOIL

- A. Topsoil has (or will) be stockpiled for reuse in landscape work. If quantity of stockpiled topsoil is insufficient, provide additional topsoil as required to

complete landscape work.

- B. Provide new topsoil which is fertile, friable, natural loam, surface soil, free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones and other extraneous or toxic matter harmful to plant growth.
- C. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site and approved by the Engineer. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than 4 inches; do not obtain from bogs, marshes or wetlands.

2.3 LIMESTONE

Limestone shall be agricultural grade with a minimum total neutralizing power of 90. At least 40% of the limestone shall pass a No. 100 sieve, and at least 90% shall pass a No. 8 sieve.

2.4 FERTILIZER

- A. Fertilizer used for grass shall be 12-12-12 grade.

2.5 GRASS SEED

- A. Seed shall not contain more than 5% inert matter. Seed shall not contain noxious weeds.
- B. Temporary Seeding Mix – All areas.
 - 1. Temporary Species for One Year Coverage choose one and use alone or with a perennial seed mix below:

Species	Conventional Rates (lbs/acre)	Seeding Dates
Spring Oats	96	March – May
Forage Sorghum	20	May – June
Foxtail Millet	12	May – June
Pearl Millet	10	May – June
Annual Ryegrass	15	August - October

- C. Permanent grass seed mix, along roadway not for wildlife habitat or flood plain, shall be as follows:

Species / Mixture	Conventional Rates (lbs/acre)	Seeding Dates
Kentucky 31 Fescue	20	March - October
Creeping Red Fescue	20	

- D. Permanent grass seed mix for wildlife habitat or within a flood plain.

Species Mixture /	Conventional Rates (lbs/acre)	Seeding Dates
Orchardgrass	8	March - October
Timothy	4	
Ladino-Clover	2	
Red Clover	6	

2.6 MULCH

Mulch shall be straw, grass, hay, pine needles, or wood fiber. Straw shall be threshed straw of cereal grain such as oats, wheat, barley, rye, and rice. Mulch shall not contain objectionable weed seeds or other material that might be detrimental to the planting being established.

2.7 ASPHALT ADHESIVE

Asphalt adhesive shall be emulsified asphalt. Adhesive shall meet the requirements of ASTM D977 for Grade SS1.

2.8 CRUSHED STONE

- A. Crushed stone shall consist of clean, tough, durable fragments of crushed limestone or dolomite. Crushed stone shall not contain more than 15% flat or elongated pieces and shall not contain particles with an adherent coating. Flat or elongated pieces will be described as pieces having a length in excess of four times its width. Determination of the width will be made by hand manipulating the pieces through a standard sieve. The smallest sieve opening through which the piece will pass will be considered the width of the particle. The percentage of these particles will be determined by dividing the weight of flat or elongated particles retained on the No. 4 sieve by the total weight of material retained on the No. 4 sieve.

- B. Crushed stone sizes shall be as specified in this paragraph.

1. No. 2 Stone: Percentage passing sieves having square openings shall be as follows:

Sieve Size	Percentage Passing
2-1/2"	100
2"	95-100
1"	0-20
3/4"	0-5
1/2"	0-2
No. 200	0-1

2. No. 9 Stone: Percentage passing sieves having square openings shall be as follows:

Sieve Size	Percentage Passing
3/4"	100
1/2"	65-85
3/8"	20-55
No. 4	0-10
No. 200	0-3

2.9 RIPRAP

This work shall consist of furnishing and installing of Class 1 riprap and geotextile in accordance with Section 616 of the 2016 Indiana Department of Transportation Standard Specifications and in conformance with the plans.

PART 3 - EXECUTION

3.1 PLANTING OF TREES AND SHRUBS

- A. Layout shrub locations and areas for multiple plantings. Stake locations and outline areas and secure Engineer's acceptance before start of planting work. Make minor adjustments as may be requested.
- B. Excavate pits, beds, and trenches with sloped sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.
 - 1. For balled or burlapped (B&B trees and shrubs), make excavations at least one and one half (1.5) times as wide as the ball diameter and equal to the ball depth, plus following allowance for setting of ball on a layer of compacted backfill:
 - a. Allow for 3 inch setting layer of planting soil mixture but no so much that the crown of newly planted trees may settle below grade.
 - 2. For container grown stock, excavate as specified for balled and burlapped stock, adjusted to size of container width and depth.
- C. Dispose of subsoil removed from landscape excavations. Do not mix with planting soil or use as backfill.
- D. Fill excavations for trees and shrubs with water and allow to percolate out before planting.
- E. Set balled and burlapped stock on layer of compacted planting soil mixture, plumb and in center of pit or trench with top of ball at same elevation as adjacent

finished landscape grades. Remove burlap from sides and bottoms of balls. When set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately two thirds full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill and continually as-needed based on local rainfall.

- F. Set container grown stock as specified for balled and burlapped stock, except cut cans on two sides with an approved can cutter; remove bottoms of wooden boxes after partial backfilling so as not to damage root balls.
- G. Dish top of backfill to allow for mulching.
- H. Mulch pits, trenches, and planted areas. Provide not less than 2inch thickness of mulch and work into top of backfill and finish level with adjacent finish grades.
- I. Prune, thin out, and shape shrubs in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by Engineer, do not cut tree leaders, and remove only injured or dead branches from flowering trees, if any. Prune shrubs to retain natural character and accomplish their use in the landscape design.
- J. Remove and replace excessively pruned or misformed stock resulting from improper pruning at no additional cost to the owner.

3.2 PREPARATION OF SEEDED LAWN AREAS

- A. Prior to preparation of areas to be seeded, remove existing grass, vegetation, and turf. Dispose of such material outside of Owner's property in a legal and ethical manner. Do not turn over any removed material into the soil being prepared for seeding.
- B. Loosen subgrade of areas to be seeded to a minimum depth of 4 inches. Remove stones over 1 ½ inch in any dimension and sticks, roots, rubbish, and other extraneous matter. Limit preparation to areas which will be planted promptly after preparation.
- C. Place 6 inches of topsoil over area to be seeded.
 - 1. Spread planting soil mixture to minimum depth required to meet lines, grades, and elevations shown, after light rolling and natural settlement.
 - 2. Place approximately one-half of total amount of planting soil required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil.
- D. Grade areas to be seeded to smooth, even surface with loose, uniformly fine texture. Roll and rake and remove ridges and fill depressions as required to meet finish grades. Limit fine grading to areas which can be planted immediately after

grading.

- E. Moisten prepared areas to be seeded before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.
- F. Restore areas to be seeded to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

3.3 GRASS SEEDING

- A. Seed disturbed areas with grass seed, unless otherwise shown or specified.
- B. Loosen the seed bed, if not loose, to a depth of from 1 to 2 inches below finished grade.
- C. Any areas to be seeded over 100 square feet will be hydroseeded.
 - 1. Seed and fertilizer shall be added to water and thoroughly mixed at the rates determined by a professional landscape contractor. Wood cellulose fiber mulch shall be added at the rates recommended by the manufacturer after the seed fertilizer and water have been thoroughly mixed to produce a homogeneous slurry. Slurry shall be uniformly applied under pressure over the entire area. The hydroseeded area shall not be rolled.
- D. Apply fertilizer in the amount of 20 pounds per 1,000 square feet.
- E. Sow grass seed at the rate of not less than four pounds per 1,000 square feet.
- F. Apply agricultural grade limestone in the amount of 25 pounds per 1,000 square feet.
- G. Seeds and fertilizers can be sown with standard agricultural drills. Grass seeds may be sown broadcast or with a special seeder attachment on agricultural drills, but shall not be covered with more than 1/2inch of soil, whether drilled or raked in. If not covered by the drill, all uncovered seed shall, immediately after sowing, be slightly raked or harrowed to cover the seed.

3.4 MULCHED SEEDING

- A. All disturbed areas within the construction limits shall be mulched seeded where noted on the plans and shall be in accordance with applicable articles of Section 621 of the INDOT Standard Specifications. Seeding shall be measured by the square yard.
- B. All labor, material, equipment, and supervision required to complete this work will be included in the cost of seeding per square yard.

3.5 MULCHING

- A. Apply mulching material following seeding.
- B. Apply mulching material, except wood fiber, at a rate of 46 pounds per 1,000 square feet. Apply wood fiber at a rate of 35 pounds per 1,000 square feet.
- C. Punch mulching material into the soil so the mulch is partially covered. The punching operation shall be performed longitudinally with a mulch tiller. Use proper mulch tilling equipment. Evenly distribute mulch.
- D. Hold the mulch in place with asphalt adhesive when the seeded area has a slope of less than 4 feet horizontal to 1 foot vertical. Apply adhesive immediately after the mulch is placed. Apply adhesive at a rate of 6 to 7 gallons per 1,000 square feet.

3.6 WATERING

- A. Thoroughly water seed immediately after seeding.
- B. Water seed, grass, plants and trees as necessary to establish and maintain growth until project is completed.

3.7 PLACING STONE

- A. Place stone on area indicated on drawings. Depth of stone shall be as indicated on drawings.
- B. Stone may be machined dumped on large areas. Place stone to produce a regular surface. The finished surface of No. 2 stone shall not vary more than 4 inches from a true plane. The finished surface of No. 9 stone shall not vary more than 1 inch from a true plane.

3.8 MAINTENANCE AND PROTECTION

- A. Maintain landscaped areas. Water as specified in this Section.
- B. Provide protection against traffic and construction operations by erecting barricades immediately after landscaping is completed and by placing warning signs.
- C. If landscaping is damaged or destroyed, the affected landscaping shall be repaired or replaced to the satisfaction of the Engineer at no additional cost to the owner.

3.9 CLEANUP

- A. Cleanup the job site following landscaping. Remove rubbish, excess materials, temporary structures, and equipment. Leave the work in a neat and presentable

condition.

- B. Road Cleaning: The Contractor shall clean the designated haul routes, by first removing large material followed by sweeping to prevent dust, dirt, and excavated material from accumulating. Road cleaning shall be performed at least once a day. Additional cleaning shall be performed as necessary or as directed by the Engineer. The release of Fugitive Dust will be closely monitored as described in Section 01 00 00 Part 1.12.

END OF SECTION 32 90 00

SECTION 33 05 23.31 –
STEEL RING BEAM AND LAGGING TUNNEL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Tunnel Construction with machine tunneling using a primary tunnel liner with a carrier pipe (two pass construction). Placement of utility pipe inside tunnel constructed with primary liner shall be in accordance with Section 33 05 24.31 – Tunnel Carrier Piping Systems.
- B. Various construction methods for tunneling, including tunnel boring machine (TBM), excavator shield or hand tunneling. The liner shall be steel ring beams and wood lagging.
- C. Use techniques and liner methods appropriate for prevailing ground conditions, unless otherwise indicated

1.2 MEASURE AND PAYMENT

- A. Tunnel Excavation: All tunnel excavation, liner, grouting and any other items required for the construction of the utility tunnel shall be included in the measure and payment for this work item, per Section 01 22 00.
- B. Tunnel Carrier Pipes: Spacers and Tunnel Carrier Piping, as described in Section 33 05 24.31, shall be paid under each item as described in Section 01 22 00.
- C. Tunnel Shafts: Each tunnel shaft, main bore shaft and receiving shaft, shall be paid for as described Section 01 22 00.

1.3 RELATED SECTIONS

- A. 03 30 00 Cast in Place Concrete
- B. 03 30 11 Grout
- C. 31 23 00 Excavation and Fill
- D. 31 23 19 Dewatering
- E. 33 24.31 Tunnel Carrier Piping Systems

1.4 REFERENCES

- A. Codes, specifications and standards referred to by title or number in this specification shall be adhered to, and latest revisions shall apply in all cases
- B. American Association of State Highway and Transportation Officials (AASHTO)

- C. American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering.
- D. American Society for Testing and Materials (ASTM)
 - 1. ASTM A 36/36M - Specification for Carbon Structural Steel
 - 2. ASTM A 283 - Standard Specifications for Low and Intermediate Tensile Strength Carbon Steel Plates
 - 3. ASTM A 307 - Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
- E. Occupational Safety and Health Administration (OSHA).

1.5 SUBMITTALS

- A. Submittals shall be as specified in Section 01 00 00, General Requirements.
- B. The following submittals are required:
 - 1. Sheeting and Support plans and calculations for the Main Bore Shaft and the Receiving Shaft to access the tunnel construction. The plans and calculations shall be prepared and certified by a professional engineer, licensed in Indiana.
 - 2. Tunneling Methodology: Provide a brief description of proposed tunnel methodology for review. Description should be sufficient to convey the following:
 - a. Proposed method of tunnel construction and type of face support and lining system.
 - b. Manufacturer and type of tunneling equipment proposed; type of lighting and ventilation system.
 - c. Number and duration of shifts planned to be worked each day.
 - d. Sequence of operations.
 - e. Location of access shafts and work sites.
 - f. Method of spoil transportation from face, surface storage, and disposal location.
 - g. Method of installing carrier pipe with details of blocking system.
 - h. Identification of critical utility crossings and special precaution proposed.
 - i. Manufacturer and type of grouts proposed.
 - 3. Drawings and Calculations: Submit for record purposes, drawings and calculations for tunnel support system designed by the Contractor. Drawings shall be adequate for construction, and include installation details. Documents must be signed and sealed by the Professional Engineer registered in the State of Indiana.

4. Quality Control: Submit for review brief description of quality control methods including:
 - a. Method and frequency of survey control.
 - b. Example of tunnel daily log.
 - c. Instrumentation plan showing location and frequency of monitoring relative to critical structures within zone of active excavation.
5. Groundwater Report
 - a. Provide groundwater control plan.
6. Monitoring Plans:
 - a. Surface Settlement Monitoring Plan: Submit settlement monitoring plan for review prior to construction. Identify location of settlement monitoring points, reference benchmarks, survey frequency and procedures, and reporting format.
7. Structures Assessment:
 - a. Submit preconstruction and post-construction assessment reports and critical structures, namely those located within zone of active excavation from proposed tunnel centerline. Include photographs or video of existing damage to structures in vicinity of sewer alignment in assessment reports.
8. Submit monitor readings to the Owner.
9. Daily Reports:
 - a. Maintain shift log as defined in Paragraph 3.04, Tunneling Data, and make available on request

1.6 DEFINITIONS

- A. Primary Liner: First tunnel support installed by Contractor in 2-pass method.
- B. Carrier pipe: Pipeline installed inside primary liner.
- C. Zone of Active Excavation: Area located within radial distance about surface point immediately above face of excavation equal to depth to bottom of excavation.
- D. Critical Structure: Building, structure, bridge, pier, utility or similar construction partially or entirely located within zone of active excavation.
- E. Tunnel Boring Machine (TBM): Mechanized and fully shielded excavating equipment that is steerable, guided and articulated, with man entry.
- F. Tunneling Methodology: Written description, together with supporting documentation that defines the Contractor's plans and procedures for tunneling operations.

- G. Shield: Fabricated ground support, circular in section, providing 360 degree protection to those working in it. Shield will have cutting edge, and be equipped with hydraulic rams for steering. If steel casing is not used, liner is to be erected within tail shield.
- H. Open Face: Face of heading or tunnel which is unsupported during excavation (e.g., in hand mining or shield excavation).
- I. Closed Face: Face of heading or tunnel which is supported during excavation process from TBM, where cutter head allows both partial exposure of face and full closure, by means of hydraulically operated gates.

1.7 DESIGN CRITERIA

- A. Provide primary liner designed by the Contractor's Professional Engineer for the appropriate loading conditions and deflection criteria, including but not limited to: Overburden and lateral earth pressures; handling and installation stresses; loads imposed by tunnel shield or tunnel boring machine thrust jacks; subsurface soil and water loads; grouting; and other conditions of service. Assume responsibility for design of primary liner to carry construction loads in combination with overburden, earth and hydrostatic loads.
- B. At railroad crossings conform to Cooper E-80 locomotive loading distributions in accordance with AREMA specifications for culverts. In design, account for additive loadings due to multiple tracks. Provide liner type for railroad crossings as specified or as shown on Drawings.
- C. For truck loading use HS-20 vehicle loading distributions in accordance with AASHTO.
- D. Use liner system compatible with special requirements shown on Drawings.

1.8 QUALITY ASSURANCE

- A. Tunneling operations shall be done by a qualified contractor with at least 5 years' demonstrated experience involving work of similar nature, including size of construction, materials and similar methods.
- B. Welding shall be done by skilled welders who have had adequate experience in the type of materials to be used.

PART 2 - PRODUCTS

2.1 RING BEAM AND LAGGING

- A. Provide 3-piece steel ring beam, with beam segments for assembly expansion,

conforming to ASTM A 36.

- B. Provide bolts and nuts conforming to ASTM A 307, Grade A.
- C. Provide 3" x 6" hardwood lagging.
- D. Material used for ring beam and lagging shall be in good condition.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Use methods for tunneling operations that will minimize ground settlement. Select method which will prevent loss of soil into tunnel, and provide stability of face under anticipated conditions.
- B. Conduct tunneling operations in accordance with applicable safety rules and regulations, OSHA standards, and Contractor's safety plan. Use methods which include due regard for safety of workmen, adjacent structures, utilities, and public.
- C. Maintain clean working conditions inside tunnel and shafts.
- D. For tunneling under railroad embankments, highways, or streets, perform installation so as to avoid interference with operation of railroads, highways, or streets, excepts as approved by Owner.
- E. Support ground continuously in manner to prevent loss of ground and keep perimeters and faces of tunnel stable.
- F. Completed primary tunnel lining shall have full bearing against ground. If steel liner plates are used, grouting behind the liner plates shall be performed to fill the void. Frequency of grouting shall be the responsibility of the contractor and the contractor shall be responsible for any and all settlement.
- G. Ground Conditions: If groundwater is present, the Contractor shall design a ground water control system to successfully complete each tunnel reach.
- H. Be aware that various existing soil borings, piezometers, or instrument wells, where indicated on Drawings, may coincide with proposed tunnel alignment. These may or may not have been backfilled with grout and, therefore, caution should be used in tunneling through these locations. Contractor shall take mitigating measures to counter effect these boreholes, piezometers, or instrument wells may have on tunneling operations.

3.2 DEWATERING AND GROUND WATER CONTROL

- A. The Contractor shall keep excavations free from water until foundations,

structures and piping are completed and will safely withstand forces generated by water. Provide sufficient dewatering equipment and make proper arrangements for the disposal of water from dewatering operation. Dewatering shall not damage property, create nuisances or interfere with other work. Do not use sanitary sewers for the disposal of water from dewatering operations.

- B. Provide necessary ground water control measures to perform work and to provide safe and working conditions. Comply with provisions of Section 31 23 19, Dewatering.
- C. Anticipate that portions of tunnel excavation may be below ground water table and in cohesionless soils, even when not indicated on soil borings, and in conditions, which may require ground water control system for tunneling operations. Install filter fabrics, backer rods and other means as necessary to prevent piping of fines into tunnel.
- D. When Contractor chooses pumping installations to control ground water level or installs pervious liner through water bearing layers, install and maintain instrumentation system to monitor water level and to detect movement in adjacent structures and property.
- E. Operate dewatering system for tunnels until carrier pipe has been installed and annular space is fully grouted, or until watertight liner designed for hydrostatic pressures is installed.
- F. Do not proceed with tunneling for which ground water control is necessary until monitoring data indicates that ground water control system is operating in accordance with Contractor's plan..

3.3 EQUIPMENT

- A. Assume responsibility for selection of tunneling equipment which, based on past experience, has proven to be satisfactory for excavation of soils to be encountered.
- B. Employ tunneling equipment that will be capable of handling various anticipated ground conditions and which minimizes loss of soil ahead of face and allows satisfactory support of excavated face.
- C. TBM or shield shall conform to shape of tunnel with uniform perimeter that is free of projections that could produce over excavation or voids. An appropriately sized overcut band may be provided to facilitate steering. In addition it shall
 - 1. Be capable of full direction guidance.
 - 2. Be capable of full face closure if ground conditions dictate.
 - 3. Be equipped with appropriate tail in which liner is erected.
 - 4. Be capable of correcting roll.
 - 5. Be equipped with visual display to show operator actual position of TBM or shield relative to design reference.

6. Be designed to handle adverse ground conditions including ground water ingress.
- D. Air Quality: Provide equipment to maintain proper air quality of tunnel operations during construction in accordance with OSHA requirements

3.4 TUNNELING DATA

- A. Maintain shift logs of construction events and observations. The Engineer shall have access to the Contractor's logs with regard to the following information:
1. Location of face by station and progress of tunnel drive during shift.
 2. Hours worked per shift on tunneling operations.
 3. Completed field forms for checking line and grade of tunneling operation, showing achieved tolerance relative to design alignment. Steering control logs will generally be acceptable for shield or TBM driven tunnels.
 4. Location, elevation and brief soil descriptions of soil strata and strata boundaries.
 5. Ground water control operations.
 6. Observation of lost ground or other ground movement.
 7. Unusual conditions or events.
 8. Reasons for operational shutdown in event drive are halted
- B. Clearly mark primary liner with paint every 20 feet along tunnel with distance in feet from centerline of preceding shaft

3.5 TUNNEL EXCAVATION AND PRIMARY LINER INSTALLATION

- A. Tunnel Excavation:
1. Conduct tunneling operations in accordance with applicable safety rules and regulations, and Contractor's safety plan. Use methods which include due regard for safety of workmen, adjacent structures, utilities, and public.
 2. Maintain tunnel excavation within easements and right-of-way indicated on Drawings, to lines and grades shown on Drawings. Excavation shall be of sufficient size to allow installation of carrier pipe to lines and grades indicated on Drawings.
 3. Open-face excavations:
 - a. Keep face breasted or otherwise supported and prevent falls, excessive raveling, or erosion. Maintain standby face supports for immediate use when needed.
 - b. During shut-down periods, if ground dictates, support face of excavation as required by positive means.
 4. Closed-face excavation:
 - a. Control volume of spoil removed. Determine that advance rate and excavation rate are compatible to avoid over excavation or loss of ground

- b. When cutting head is withdrawn, keep excavated face supported and stabilized.
 - c. When face of machine is open for maintenance, monitor conditions that might threaten stability of heading. Take appropriate action to prevent or limit influx of soils and water, which would threaten stability of heading.
- B. Determination of primary liner size and section shall be sole responsibility of Contractor to match construction methods and equipment described in tunneling methodology submittal. Provide tunnels of sufficient size to permit efficient excavation operations, sufficient working space for placing primary tunnel liner, and to allow for installation of sewer pipe.
- C. Primary Liner Installation
 - 1. Provide method to ensure full bearing of soil against primary liner without significant settlement or movement of surrounding soil. To fill void behind primary liner, either expandable liner (e.g., ring beams and timber lagging) or non-expandable liner (e.g., bolted steel liner plates) may be used provided grout is placed behind non-expandable liner.
 - 2. When using TBM or tunnel shield, advance equipment only far enough to permit construction of one primary liner set, entirely within equipment shield.
 - 3. Install filter fabric, as ground requires around exterior of primary liner when using steel ribs and lagging.
 - 4. After grouting, ensure deflection of liner is no more than allowable. Also ensure that the liner is not distorted by excessive pressure.
- D. Grouting: Contractor to provide grout mix design and technical data for grout used
 - 1. For filling space behind primary or temporary liner and excavation wall, shall be per sections 03 30 11.
 - 2. For filling annular space between primary liner and carrier pipes. Non-Shrink Cellular grout, such as Cellufoam or equal, may be used. Non-Shrink Cellular Grout to meet a minimum compressive strength of 150 psi.
- E. Seal blind headings with temporary bulkhead.
- F. Unforeseen Obstructions: If an obstruction such as boulders, concrete or other impassible material stops the progress of the tunneling, the CONTRACTOR shall notify the ENGINEER in writing of the difficulty and proposed procedural modification.

3.6 CONTROL OF TUNNEL LINE AND GRADE

- A. Construction Control
 - 1. Use baselines and benchmarks established by the Contractor to establish and maintain construction control points, reference lines, and grades for locating tunnel.
 - 2. Establish control points sufficiently far from face so as not be affected by

tunneling operations.

- B. Benchmark Movement
 - 1. Ensure that when settlement of ground surface occurs during construction which affects accuracy of temporary benchmarks detect and report such movement and reestablish temporary bench marks. Locations of permanent monumentation benchmarks are indicated on the Drawings. Advise the Engineer of settlement affecting permanent monumentation benchmarks
- C. Line and Grade
 - 1. Maintain means sufficient to check alignment and grade continuously.
 - 2. Check survey control for tunneling against aboveground undisturbed reference
 - a. As required; and
 - b. at least once each week and once for each 200 feet of tunnel constructed.
 - 3. When excavation is offline or grade, make alignment corrections to avoid reverse grades in gravity sewers
 - 4. Construct primary liner to such tolerances that permit installation of Tunnel Carrier Piping Systems to be completed to tolerances given in Section 03 05 24.31.
- D. Earth Movement: Assume responsibility for damages due to settlement from construction-induced activities or occurrences

3.7 MONITORING

- A. Surface Settlement Monitoring
 - 1. Establish monitoring points on all critical structures within zone of influence of tunneling operation.
 - 2. Record location of settlement monitoring points with respect to construction baselines and elevations. Records elevations to accuracy of 0.01 feet for each monitoring point location. Monitoring points should be established at locations and by methods that protect them from damage by construction operations, tampering, or other external influences.
 - 3. Ground surface elevations must be recorded:
 - a. On centerline ahead of tunneling operations at minimum of 100-foot intervals.
 - b. At a 20 foot offset to each side of the centerline at the same intervals.
 - c. Clearly mark settlement monitoring points by studs or paint for ease of locating.
 - 4. Utilities and Pipelines: Monitor ground settlement directly above and 10 feet before and after utility or pipeline intersection.
- B. Reading Frequency and Reporting
 - 1. Instrumentation monitoring results to be read at a minimum of once per week or more often if settlement is found. Start monitoring before zone of active excavation is passed and until no further detectable movement

- occurs.
2. Record surface settlement monitoring readings:
 - a. Prior to zone of active excavation reaching that point
 - b. When tunnel face reaches monitoring point (in plan)
 - c. When zone of active excavation has passed and no further movement is detected.
 3. Submit monitoring readings promptly to Engineer.
 4. Immediately report to the Owner movement, cracking, or settlement which is detected.
 5. Following substantial completion, but prior to final completion, perform final survey of monitoring points

3.8 DISPOSAL OF EXCESS MATERIALS

- A. A. Remove spoil from job site and dispose in accordance with Section 31 23 00, Trenching and Earthwork.

3.9 CARRIER PIPE INSTALLATION AND GROUTING

- A. During placement of the Tunnel Carrier Piping in the casing, the carrier pipes shall be blocked or otherwise supported with casing pipe spacers, or wood blocking to secure the proper flow line elevations throughout its full length and to ensure grouting around the pipe can be done without any displacement or floating.
- B. After the Tunnel Carrier Piping is installed, the ends of the casing shall be bulkheaded with brick and mortar and the annular space shall be filled with Cellular Non-Shrink Grout, such as Cellufoam or equal.
- C. The contractor shall be responsible for the cooling of the Tunnel Carrier Piping if necessary to prevent the potential of melting of or damage to the piping systems.

3.10 CLOSING OF PITS

- A. After tunneling equipment and excavated materials from the tunneling operations have been removed from the Main Bore and Receiving Shafts, the Contractor shall prepare the bottom of the shafts as a foundation for the pipe and related gravity structures at each end of the tunnel.
- B. Contractor shall remove loose and disturbed materials below pipe grade down to undisturbed earth and shall re-compact the material in accordance with Section 31 23 00.

3.11 SHAFT SHEETING

- A. Supporting systems, such as piling, cribbing, shoring and bracing, shall be designed by a Professional Engineer, licensed in Indiana, prepared for the Contractor's use and meet all federal, state and local OSHA and accepted

engineering requirements.

- B. Materials used for sheeting, sheet piling, cribbing, bracing, shoring and underpinning shall be in good, serviceable condition. Timbers shall be sound, free from large or loose knots and of proper dimensions.
- C. Take special precautions in sloping or shoring the sides of excavations adjacent to a previously backfilled excavation or a fill, particularly when the separation is less than the depth of the excavation. Pay particular attention to joints and seams of material comprising a face and to the slope of such seams and joints.
- D. If it is necessary to place or operate power shovels, derricks, trucks, materials or other heavy objects on a level above or near an excavation, sheet-pile, shore and brace the side of the excavation as necessary to resist the extra pressure due to such superimposed loads.
- E. If the stability of adjoining buildings or walls is endangered by excavations, provide shoring, bracing or underpinning as necessary to ensure the safety of adjoining buildings or walls. Such shoring, bracing or underpinning shall be inspected daily or more often, as conditions warrant, by a competent Contractor's representative and the protection effectively maintained.
- F. The Contractor shall be held responsible for the design of and for the sufficiency of all sheeting and bracing used, and for all damage to persons or property resulting from the improper quality, strength, placing, maintaining or removing of the same. This includes damage to trees, sidewalks, and other property on the project site, as well as on private grounds.
- G. Drive sheeting ahead of excavation. Do not remove sheeting until the excavation backfill has reached within 2 feet from the top of the excavation, except that the lower course of sheeting may be removed from a double sheeted excavation. When sheeting is drawn, completely fill all cavities remaining in or adjoining the excavation. When sheeting is left in place, completely fill all cavities behind such sheeting.

END OF SECTION 33 05 23.31

SECTION 33 05 24.31 –
TUNNEL CARRIER PIPING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: This section applies to all piping, through the Steel Rib and Lagging Tunnel; including Sludge Force-mains, Gravity Sanitary and Fiber Optic conduits. Furnish and install all pipe, fittings, spacers and levelers and other appurtenances necessary for a complete installation of the piping systems including coordination with upstream and downstream connections as identified.
- B. Codes, specifications and standards referred to by title or number in this specification shall be adhered to, and latest revisions shall apply in all cases.
- C. Abbreviations
 - a. AASHTO - American Association of State Highway and Transportation Officials
 - b. ANSI - American National Standards Institute
 - c. ASTM - American Society for Testing & Materials
 - d. AWWA - American Water Works Association
 - e. PFI - Pipe Fabricators Institute
- 2. All pipe, fittings, and references to pipe diameter on the drawings or in specifications are intended to be nominal size or diameter and shall be interpreted as such.

1.2 RELATED SECTIONS

- A. Section 03 30 00 – Cast-in-Place Concrete
- B. Section 03 30 11 – Grout
- C. Section 33 05 23.31 – Steel Ribs and Lagging Tunnel

1.3 QUALITY ASSURANCE

- A. Mark pipe and fittings according to the applicable specification or standard.
- B. Perform factory and field tests in accordance with the applicable specification or standard.
- C. Line and Grade Requirements: The Contractor shall provide assurance to the Owner's Representative that the pipe is installed accurately to the required line and grade as shown on the drawings. Variations from the line and grade shown on the drawings or without the approval of the Engineer shall be cause for the line to be rejected. In the case that the line is rejected, the Contractor must replace the line to the design line and grade without additional cost to the Owner.

D. Test Sections

1. Final Performance Testing for Acceptance: Before acceptance and final payment for all new pipe, the Contractor and the Owner's Representative shall check pipe, even if previously checked, for accurate alignment and grade. Also, the pipe shall be tested as specified in this Section for water tightness.

1.4 SUBMITTALS

A. Submittals shall be as specified in the General Conditions, Section 01 00 00 – General Requirements, and Section 01 33 00 – Contractor Submittals.

B. Submit the following:

1. Product information for all pipe, fittings, adapters, and joint systems
2. Product information for all pipe spacers, grout and ancillary , fittings, adapters, and joint systems
3. Detailed drawings of identifying fittings, fitting rotations and pipe lengths and configurations for transitions into and out of the Tunnel
4. Polyethylene encasement products and installation details for Ductile Iron Pipe
5. Installation details and instructions for CCFRPM pipes
6. Certified field test reports

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage and handling of products not furnished by the Owner.
- B. The Contractor shall be responsible for scheduling, receiving, storing, handling, and transporting all products furnished by the Owner for this phase of this project. Refer to Section 01 64 00 – Owner-Furnished Products for more information.
- C. Load and unload all pipe, fittings and appurtenances by hoists or skids, and do not drop, skid or roll products. Pad slings, hooks and pipe tongs, and use in such a manner to prevent damage to the products.
- D. Keep stored products safe from damage or deterioration. Keep the interior of pipe, fittings and appurtenances free from dirt or foreign matter. Store gaskets, plastic pipe and fittings and other products, which deteriorate by sunlight, in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products.
- E. Do not stack ductile iron pipe higher than the limits shown in ANSI/AWWA C600. Stacking of cast iron, clay, concrete, copper, plastic and steel pipe shall meet the requirements of the pipe manufacturer. Do not stack fittings.

- F. Promptly remove damaged products from the job site and replace with undamaged products at no additional cost to the owner.

PART 2 - PRODUCTS

2.1 GENERAL

All pipe, fittings and appurtenances shall be new, unused and as shown on the drawings or as required by the manufacturer and ANSI/AWWA Specifications.

Design and manufacture pipe for a working pressure of 80 psi plus a 100 psi surge pressure. Additionally, a safety factor of 2.0 shall be applied to the working pressure requirement and a depth of cover indicated on the drawings or as required by manufacturer and ANSI/AWWA specification, shall be included.

2.2 TUNNEL CARRIER PIPING SYSTEMS AND FITTINGS

A. Ductile Iron Pipe (DIP) and Fittings

- 1. DIP shall be used within the Tunnel Carrier the carrier pipe for the Twin Sludge Forcemain piping system.

- 2. Pipe

- a. Ductile iron pipe shall meet the requirements of ANSI/AWWA C151/A21.51-91.

- b. Minimum pressure and thickness class shall be as follows:

<u>Pipe Size</u>	<u>Minimum Pressure Class</u>
14" DIP	250 psi

- c. Thickness of pipe shall be as shown in Table 15.1 of ANSI/AWWA C115/A21.15 for 250 psi working pressure.

- d. The exterior of all pipe must be coated with a bituminous coating.

- e. Unless otherwise shown on the drawings, all pipe joints shall be restrained mechanical joint or restrained push-on joint types meeting the requirements of ANSI/AWWA C111/A21.11. Restrained joints for straight runs of piping are required at all push-on or mechanical joints. Restrained joints shall be Flex-Ring, Mega-Lug, Lok-Ring, Lok-Fast, Lok-Tyte or equal as approved by the Engineer. The use of restraining gaskets such as Field-Lok or Fast-Grip will be allowed for straight run pipe joints.

- 3. Fittings

- a. The exterior of all fittings must be coated with a bituminous coating.

- b. Fittings for standard size pipe shall meet the requirements of ANSI/AWWA 110/A21.10. Compact, or short body fittings shall meet the requirements of ANSI/AWWA C153/A21.53. Compact fittings may be used only with review and approval of the engineer. Standard size fittings shall be used unless otherwise specified, shown, or approved by the Engineer. Design and manufacture fittings for a pressure rating of at least 250 psi.
 - c. Fitting joints shall be restrained mechanical joints. Joints shall meet the requirements of ANSI/AWWA C111/A21.11. Restrained joints must be used instead of thrust blocking. Restrained joints shall be Flex-Ring, Mega-Lug, Lok-Ring, Lok-Fast, Lok-Tyte or equal as approved by the Engineer. The use of restraining gaskets such as Field-Lok or Fast-Grip on fitting joints will be reviewed by the Engineer on a case-by-case basis.
4. Adapters
- a. The exterior of all adapters must be coated with a bituminous coating.
 - b. Adapters from push-on or mechanical joint ductile iron pipe to flange joint valves or fittings shall be ductile iron. Adapters shall meet the requirements of ANSI/AWWA C110. Design and manufacture adapters for a pressure rating of at least 250 psi.
 - c. Adapter ends connecting to ductile iron pipe shall be one of the following: plain-end-push-on joint; mechanical joint; or restrained push-on joint. All adapters shall have restrained joints. Mechanical joints and push-on joints shall meet the requirements of ANSI/AWWA C111/A21.11.
 - d. Adapter ends connecting to flange joint valves or fittings shall have joints complying with the specifications for the applicable valves or fittings.
5. Gaskets for mechanical joints and push-on joints for water and wastewater service shall meet the requirements of ANSI/AWWA C111/A21.11. Nuts and Bolts
- a. Nuts and bolts for mechanical joints shall be high strength, heat treated, alloy steel. Nuts shall be hexagon nuts, and bolts shall be tee head bolts. Nuts and bolts shall meet the requirements of ANSI/AWWA C111/A21.11.
 - b. Nuts and bolts for restrained push-on joints shall meet the requirements of the joint manufacturer.
6. Corrosion Protection
- a. The inside surfaces of all pipes, fittings, and adapters shall be shop applied with an amine cured novalac epoxy with a nominal DFT of 40 mil. The lining shall be Induron Protecto 401 and shall be free of any

holidays and shall be spark tested. Shop coating applicator shall have a minimum of 10 years of experience applying Protecto 401.

b. High Density Cross-Laminated Polyethylene Wrap

- (1) Two (2) layers of minimum 4-mil High Density Cross-Laminated Polyethylene (HDCLPE) wrap tubes must be installed in accordance with AWWA C105.
- (2) One (1) layer of minimum 10-mil joint wrap tubes shall have installed at all restrained joint locations.
- (3) Wrap tubes must be secured with a minimum 2-inch wide polyethylene tape with a minimum thickness of 12 mil.
- (4) All HDCLPE wraps shall be by AA Thread Seal Tape, Inc. or equal as approved by the Engineer.

<u>Nominal Diameter</u>	<u>HDCLPE Wrap Tube Width</u>
10" to 14"	30"

B. Centrifugal Cast Fiber Reinforced Polymer Mortar (CCFRPM) Pipe

1. CCFRPM pipe shall be used in the Tunnel Carrier as the carrier pipe for the Gravity Sewer system.
2. Pipe:
 - a. Pipe shall be manufactured per ASTM D 3262
 - b. The interior and exterior dimensions shall be in accordance with the manufacturer's latest literature, and ASTM D3262 for appropriate sizes. The pipe shall be marked according to ASTM D3262 with at a minimum the following: manufacturer's name, tradename or trademark, nominal pipe size, pipe stiffness, production code and ASTM number.
 - c. Minimum Pipe stiffness shall be 46 PSI when tested in accordance with ASTM D 2412.
 - d. Pipe shall be supplied in twenty (20) ft lengths unless special conditions are need for construction, in which case shorter lengths maybe used.
 - e. Pipe Materials:
 - (1) Resin Systems: The manufacturer shall use only vinylester or polyester resin systems with a proven history of performance in sewage applications.

- (2) Glass Reinforcements: The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade E-glass filaments with binder and sizing compatible with impregnating resins.
- (3) Silica Sand: Sand shall be minimum 98% silica with a maximum moisture content of 0.2%.
- (4) Additives: Resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., when used, shall not detrimentally affect the performance of the product.

3. Joints and Gaskets

a. Joints shall be:

- (1) Field connected with fiberglass sleeve couplings, “no-bell-spigot joints” or “flush” that utilize elastomeric sealing gaskets as the sole means to maintain joint water tightness.
- (2) The joints must meet the performance requirements of ASTM D4161.
- (3) Joints shall be certified by the manufacturer to perform at fifty (50) feet of hydrostatic head at 5% deflection.

b. Elastomeric Gaskets:

- (1) Shall meet ASTM F477;
- (2) Shall be EDPM elastomeric membrane and shall be resistant to sewage, industrial wastes, and groundwater.
- (3) Supplied by qualified gasket manufacturers and be suitable for the service intended.

C. PVC CARRIER CONDUIT

1. PCV Carrier Conduit shall be used in the Tunnel Carrier as the carrier pipe for the Fiber Optic Communication System wiring.
2. Underground Plastic Utilities Duct: Schedule-40-PVC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.
3. General Requirements for Nonmetallic Ducts and Fittings:
 - a. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
 - b. Comply with TIA-569-C and TIA-758-C.
4. Solvents and Adhesives: As recommended by duct manufacturer.
5. Except as noted herein for Tunnel installation, PVC Conduit shall be as described in Section 27 05 43 Underground Ducts and Raceways for Communication Systems.

PART 3 - EXECUTION

3.1 INSPECTION

A. General

1. The quality of all materials, the process of manufacture and the finished products not furnished by the Owner shall be subject to inspection and approval by the Engineer. Such inspection may be made at the place of manufacture, after delivery to the site or at both places; and the products shall be subject to rejection at any time for failure to meet any of the specifications' requirements, even though sample products may have been previously accepted as satisfactory at the place of manufacture.
 - a. Prior to being installed, each pipe and fitting shall be carefully inspected. Those not meeting the specifications shall be rejected and replaced at the Contractor's expense.

B. Ductile Iron Pipe

1. In any pipe showing a distinct crack and which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portion, if so approved by the Engineer, may be cut off. Therefore, this portion may be removed before the pipe is installed, at the expense of the Contractor. This shall ensure that the pipe used is perfectly sound. The cut shall be made in the sound barrel at a point at least 12 inches from the visible limits of the crack. The cut off material becomes property of the contractor and is to be removed from the site.
2. All cutting shall be done with a machine having steel cutters or knives adapted to the purpose and all cut ends shall be examined for possible cracks caused by cutting. The exterior coating and interior lining materials must not be damaged during any field cutting.
3. Dragging the pipe on asphalt or concrete pavement and objects is strictly prohibited. Care must be taken to preserve the integrity of any exterior corrosion protection systems.
4. Chains or cable type chokers will not be permissible when lifting fused sections of coated ductile iron pipe, fittings, and adapters.

C. Centrifugal Cast Fiber Reinforced Polymer Mortar (CCFRPM) Pipe

1. All workmanship, handling, storage, etc. shall be done per the manufacturer's recommendations.
2. Pipe shall be stored on clean, level ground to prevent undue scratching or gouging. If the pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The pipe shall be handled in such a manner that it is not pulled over sharp objects or cut by chokers or lifting equipment. Care shall be exercised to minimize dragging the pipe on

asphalt or concrete pavement and objects.

3. Sections of pipe having been discovered with damage, cuts or gouges in excess of 10% of the pipe wall thickness shall be cut out and removed from the job site.

3.2 INSTALLATION OF BURIED PIPING (TO ENDS OF TUNNEL)

A. Laying Piping

1. All excavation shall be in accordance with federal, state and local OSHA requirements. Proper tools and facilities shall be provided and used by the Contractor for safe working conditions.
2. All pipe and fitting shall be cleaned of all debris, dirt and other foreign material before being laid, and it shall be kept clean until accepted in the completed work.
3. Lay and maintain pipe to the lines and grade shown on the drawings, to maintain the minimum depth specified. Install fittings in the locations shown on the drawings, as directed by the Engineer, or as necessary to maintain proper pipeline alignment.
4. When the exact location of buried utilities is unknown and piping is to be constructed parallel and close to said utilities, adjust the alignment of the piping to least interfere with these utilities. This applies unless otherwise shown on the drawings or specified by the Engineer.
5. Potable water piping shall be laid at least 10 feet horizontally from any existing sanitary sewer or sewage force main. The distance shall be measured from edge to edge of the pipe. Potable water piping crossing sanitary sewer or sewage force mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the potable water piping and the outside of the sewer or force main. The 18-inch separation shall apply whether the potable water piping is over or under the sewer or force main. Lay potable water piping at crossings of sewers and force mains so a full length of pipe is centered on the sewer or force main whenever possible. No potable water piping shall pass through or come in contact with any part of a sanitary sewer manhole.
6. Do not lay pipe in water or when the trench or weather conditions are unsuitable for proper installation per manufacturer specifications OR at the discretion of the Owner/Owner's Representative.
7. Lower pipe and fittings into the trench by hand, hoists or ropes or other suitable tools or equipment that will not damage products, coatings or linings. Do not drop or dump pipe or fittings into the trench.
8. The Contractor shall use laser beam equipment, surveying instruments or other proven techniques to maintain accurate alignment and grade.
9. Deflection of pressure pipe from a straight line or grade shall not exceed the limits specified in this Section. If the alignment requires joint deflections in excess of

the allowable deflection per joint, furnish and install fittings or a sufficient number of shorter lengths of pipe.

10. For pressure and process piping, provide mechanical restraint at horizontal and vertical deflection fittings, tees, plugs, tapping sleeves and tapping saddles as needed.
11. Laying of ductile iron piping shall meet the requirements of ANSI/AWWA C600, unless otherwise specified in this Section or as approved by the Engineer.
12. Open excavation shall be satisfactorily protected at all times. At the end of each day's work, the open ends of all pipes shall be protected against the entrance of animals, children, earth, or debris by bulkheads or stoppers. The bulkheads or stoppers shall be perforated to allow passage of water into the installed pipe line, thereby preventing flotation of the pipe line. Any earth or other material that may find entrance into the main sewer or into any lateral sewer must be removed at the Contractor's expense. The cost of all such plugs, and the labor connected therewith, must be included in the regular bid price for the pipe item.

B. Corrosion Protection for DIP

1. Install High Density Cross-Laminated Polyethylene (HDCLPE) Wrap
 - a. Install two layers of 4-mil HDCLPE wrap must be installed one at a time per the requirements of the manufacturer with the following requirements:
 - (1) Clean all dirt, cinder, etc. from the surface of the pipe.
 - (2) Cut the first layer of the tube a minimum of 4 feet longer than a standard length of pipe.
 - (3) Slip tube over the pipe and center the tube to allow for a minimum 2 feet joint overlap.
 - (4) Pull any slack in the tube to allow for a snug fit and secure with polyethylene tape. Fold over on top of pipe and secure in place every 3 feet.
 - (5) All metal appurtenances must be encased in the 4-mil HDCLPE wrap tube.
 - (6) Wrap the circumference of the pipe with polyethylene tape at a maximum interval of 3 feet.
 - (7) Repeat steps 1 through 5 to install the second layer. Stagger all joints by a minimum of 4 feet.
 - b. At material change interfaces, all 4-mil HDCLPE wrap must extend a minimum of 8 feet from the end of the ductile iron pipe and be secured with polyethylene tape to the HDPE pipe.
 - c. All rips, tears, imperfections, and other potential locations of damaged integrity must be repaired with polyethylene tape.
 - d. Install one layer of 10-mil HDCLPE joint wrap must be installed at each

restrained joint per the requirements of the manufacturer.

- e. Apply backfill carefully as to not cause any damage to the wrap.

C. Pipe Bedding, Haunching, and Initial Backfill

1. Each pipe section shall be laid in a firm foundation of bedding material, then haunched and backfilled with care, see standard detail sheet.
2. Prior to pipe installation, carefully bring bedding material to grade along the entire length of pipe to be installed. To provide adequate support for the pipe, the following bedding procedures are recommended.
3. When No. 8 crushed stone or No. 8 fractured face aggregate material is used for bedding, little or no compaction is necessary, due to the nature of the angular particles. A minimum depth of 8 inches is sufficient to provide uniform bedding. This material must also be utilized for haunching, and initial backfill, to a plane 12 inches above the pipe.
4. Beneath the pipe, bedding material shall have a minimum thickness of 4 inches, or a thickness of one-eighth of the outside diameter of the pipe, whichever is greater. This material shall also extend up the sides of the pipe to a height of one-sixth of the pipes outside diameter.
5. In yielding subsoils, No. 2 crushed stone or fractured face aggregate material shall be used unless a concrete cradle is ordered for bedding; and the trench bottom shall be undercut to the necessary depth and backfilled with graded, crushed stone to form a firm foundation. No additional payment shall be made for stabilizing yielding subsoils.
6. When excavation occurs in rock or hard shale, the trench bottom shall be undercut and a minimum of 6 inches of crushed stone bedding shall be placed prior to pipe installation. No additional payments shall be made for rock removal.
7. For pipe with bells or flanges, depressions in the bedding material shall be excavated in advance of pipe laying so the entire barrel will bear uniformly.
8. No. 8 crushed stone or No. 8 fractured face aggregate haunching material shall be utilized for haunching up to the spring line of the pipe to avoid loss of side support through migration of haunching material into the bedding. Haunch material shall be shovel sliced or otherwise carefully placed and "walked" or hand-tamped in to ensure compaction of the haunch area and complete filling of all voids. Material shall be compacted to 95% Standard Proctor AASHTO T-99, or higher.
9. Initial backfill from the pipe spring line to 12 inches above the top of the pipe shall be No. 8 crushed stone or No. 8 fractured face aggregate added in 6-inch lifts and "walked" in for compaction. Material shall be compacted to 95% standard Proctor AASHTO T-99, or higher.

D. Where the edge of the trench is within 5 feet of or crosses existing or proposed roadway

pavement, it shall be backfilled with Special Backfill. Backfill any trench specifically indicated on the drawings with Special Backfill. Place Special Backfill in lifts. Compact each lift of backfill to not less than 95% of the maximum dry density, according to AASHTO T99, Method A. In all other areas, cuts and trenches shall be backfilled with granular backfill to within 1 foot of the paved surface. The remainder of the trench is to be filled with crushed stone and compacted in place, prior to opening the street to traffic. The Contractor shall add crushed stone and grade until sufficient settlement has taken place and final restoration is made.

- E. Backfill trenches not requiring granular backfill with suitable excavated material. Fill and restore any settlement of the backfill. In unpaved areas, backfill shall be mounded above finish grade to allow for settlement. Grade unpaved area to be restored 6 inches below finish grade after settlement of backfill and immediately before restoration of vegetated areas. Place 6 inches of topsoil over area to be restored. Cost of seeding restored area to be included in lump sum erosion control payment per section 01 22 00.
- F. Concrete cradles shall be constructed of Class "B" concrete and of the design shown on the detailed drawings. When so ordered in writing, concrete cradles not shown on the drawings will installed and paid for on an individual (per "Each") basis.
- G. Jointing
 - 1. Clean the ends of the pipe satisfactorily just before laying. Subsequently, the joint shall be made in a satisfactory manner according to the manufacturer's recommendations for that specific joint and as approved by the Engineer. All joint work shall be done by experienced workmen.
 - 2. Joints shall be as specified in this Section.
 - 3. Each length of pipe shall be installed in accordance with the manufacturer's recommendations and ANSI/AWWA C600.
 - 4. Piping shall be tested as specified in this Section.
- H. Manholes and Other Structures
 - 1. Manholes and other structures shall be as specified in Section 03 40 00 – Precast Concrete Structures.

3.3 JOINTS

- A. Ductile Iron Pipe - Mechanical Joints
 - 1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.
 - 2. Evenly tighten the nuts using a torque wrench. The torque shall be within the range listed in the following table:

Pipe Size	Bolt Size	Torque Range
4" thru 24"	3/4"	75 to 90 ft.-lb.

3. Pipe Deflections at Rotated Fittings:
 - a. Shall provide for a smooth transition between pipe sections, sizes and directions.
 - b. Deflections shall be avoided if at all possible;
 - c. If a deflection is required. The amount of deflection shall not exceed the limits shown in the following table; or the limits of AWWA/ASTM standards for the types and materials used, whichever is less.

Pipe Size	Maximum Deflection Angle	Maximum Deflection Based Upon 18-foot Pipe Length
14"	3°-35°	13-1/2"

B. CCFRPM JOINTS

1. CCFRPM Gravity Sewer Pipe shall be installed in a straight linear manner between the upstream and downstream structures, through the Tunnel Primary Liner.
2. Connections between Pipe sections shall be per manufacturer's instructions.
3. Provide an appropriate pipe boot to seal the connections to the structures up- and down- stream, which complies with the manufacturer's instructions for connections to concrete structures.

C. PVC CONDUIT

1. PVC Carrier Conduit Joints shall be solvent welded joints, in compliance with manufacturer's recommendations and Specification Section 27 05 43
2. Pipe Deflections at Rotated Fittings, At Tunnel Entrance / Exit
 - a. Shall provide for a smooth transition between pipe sections, sizes and directions.
 - b. Deflections shall be avoided if at all possible;
 - c. If a deflection is required. The amount of deflection shall not exceed the limits shown in the following table; or the limits of AWWA/ASTM standards for the types and materials used, whichever is less..

3.4 RESTRAINING AND SUPPORT

- A. Thrust blocking is not permitted. All restrained joints shall be of a mechanical type

restraint method.

B. Pipe Supports

1. Furnish and install supports required to hold pipe, fittings and valves at the lines and grades indicated on the drawings, without causing strain upon pipe, fittings, and valves.
2. Support piping by suitable saddle stands, concrete piers or hangers.
3. Locate supports where necessary, at least 8 feet on center.

3.5 INSTALLATION OF TUNNEL CARRIER PIPING

A. All carrier piping and conduit shall be installed to accurate lines and grades with fittings, valves and appurtenances at the required locations. Piping shall be parallel to the tunnel and primary liner except where shown otherwise on the Drawings at the entrance and exit of the tunnel primary liner.

B. Installation

1. All piping shall be cleared of debris, dirt, etc., before being installed and be kept clean until accepted at completion of work.
2. Piping shall be installed in a neat workmanlike manner. Proper tools and facilities shall be provided and used by the Contractor for safe working conditions. All piping shall be carefully installed in such a manner as to prevent damage to piping materials, protective coatings and liners.
3. During placement of the carrier pipe in the casing, the carrier pipe shall be blocked or otherwise supported with casing pipe spacers or wood blocking to secure the proper flow line elevations throughout its full length and to ensure backfilling around the pipe can be done without any displacement or floating.
4. Piping shall be installed so no undue strain is placed upon piping joints, equipment or structures.

C. Supports and Grouting

1. The Contractor shall provide all necessary spacers and wood blocking to support the pipe and to keep the pipe and appurtenances stable at the lines and grades shown on drawings or as directed by the Engineer, and without strain upon the piping and connected equipment.
2. Cellular Non-Shrink Grout shall be used for the Annular Space in the Jacked Casing.

3.6 INFILTRATION LIMITS

Maximum infiltration/exfiltration limits for all new sewers shall not exceed 50 gallons per inch of diameter per mile of pipe per 24 hours. This standard is for the overall project and includes all

manholes and other structures. All sections of new sewer shall be tested, and any sections not meeting this infiltration standard shall be repaired and retested. The piping in this project conveys sludge that is hazardous to the public and environment. Extreme caution must be taken to ensure zero leakage in this system.

3.7 HYDROSTATIC TESTING FOR PRESSURE AND PROCESS PIPING

- A. Testing shall be performed prior to the installation of Cellular Non-Shrink Grout through the tunnel primary liner, for the entire segment through the Steel Rib and Lagging Tunnel section.
- B. Test procedures shall meet the requirements of ANSI/AWWA C600.
- C. Piping may be tested in sections between valves when there is one or more intermediary valve in a line.
- D. The piping shall be complete and shall have been in place for not less than 10 days prior to being tested.
- E. Test closed-end pressure piping as follows:
 - 1. Expel all air from the piping prior to the application of test pressure. Tap the piping at high points, if necessary, to release all air from the piping. Plug taps after the test is successfully completed. Plugs shall be watertight.
 - 2. Test piping at a static pressure of 120 pounds per square inch over a period of not less than eight consecutive hours. The test will be considered successful when the pressure drop over the test period is 5 pounds per square inch or less. If the pressure drop exceeds 5 pounds per square inch, repair the leaks and repeat the test. Repair leaks and repeat the test until the pressure drop over the test period is 5 pounds per square inch or less.
- F. Test open-end pressure piping and ductile iron sewer piping as follows:
 - 1. The ends of piping being tested shall have test plugs or caps adapted with a tap of adequate diameter to fill and pressurize the system with water.
 - 2. When a section is terminated at a manhole with a plain end (spigot), the pipe must extend into the manhole of sufficient length to accommodate a restraining cap. The bench-wall shall be formed in the manhole after the test section has been approved.
 - 3. Water shall be introduced into the section to be tested at the lower end. The upper end shall have an orifice at the top of the plug or cap to expel air when filling the system with water. All air shall be expelled from the pipe.
 - 4. The test plugs or caps shall be capable of withstanding an internal pressure of 175 psi.
 - 5. Pumped flow systems shall be subjected to an internal pressure equal to 50%

more than the maximum operating pressure, but in no case less than 50 psig or greater than 120 psig.

6. **Hydrostatic tests can be dangerous** if, because of ignorance or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed in such a way as to prevent blowouts. In as much as a force of 2,500 pounds is exerted on an 8-inch plug by an internal pipe pressure of 50 psi, it should be realized that sudden expulsion of a poorly installed plug or cap can be dangerous. **As a safety precaution, no one shall be allowed in the manholes when the pipe is pressurized.**

G. GRAVITY SEWER TESTING

1. Visual Test - At the discretion of the Engineer, a visual test may be performed by lamping the sewer to check alignment and grade. All obstructions shall be removed. Any sewer showing less than a full circle of light when a lamp is viewed between adjacent manholes shall be considered unsatisfactory and shall be repaired by the Contractor without additional compensation.
2. Air Test - Leakage testing by means of low pressure air shall be required in accordance with the procedures described in UNI-B-6. The air leak rate shall not exceed 0.0015 cfm/square foot at 4 psig (see Tables 1 and 2).
3. Individual Joint Test (for pipe larger than 30") – individual joints shall be tested with a portable tester per ASTM Standard C1103-94 Section 8.2, which summarized, state that the void volume will be pressurized with air to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Allow the air pressure and temperature to stabilize before shutting off the air supply and start of test timing. The acceptable limit is 1 psi or less drop in 5 seconds. If joint fails, it may be retested, or repaired and retested, in accordance with this standard.
4. Deflection Test - An in place deflection test will be performed on the sewer pipe. An allowable deflection of 5% internal pipe diameter will be acceptable after all backfilling has been completed. A nine-point "go, No Go" mandrel shall be used for the deflection test and a proving ring shall be provided for each size mandrel. For pipes larger than 30-inch diameter, a visual inspection as discussed above or CCTV inspection is required. In addition, at the Owner's discretion, an alternative means of measuring deflection such as a water leakage test may be considered at no additional cost. All pipes exceeding the allowable deflection shall be replaced or re-rounded. The Contractor will bear all costs for testing and testing equipment

TABLE 1
 SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG
 PRESSURE DROP
 FOR SIZE AND LENGTH OF PIPE INDICATED
 FOR Q = 0.0015

1 Pipe Diameter (in.)	2 Minimum Time (min.:sec.)	3 Length For Minimum Time (in.)	4 Time for Longer Length (sec.)	Specified Minimum for Length (L) Shown (min.: sec.)								
				100 ft.	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.	450 ft.	
4	3:46	597	0.380L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854L	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520L	7:34	7:34	7:34	7:34	7:36	9:52	10:08	11:24	
10	9:26	239	2.374L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48	
12	11:20	199	3.418L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38	
15	14:10	159	5.342L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04	
18	17:00	133	7.692L	17:00	19:14	25:38	32:03	38:27	44:52	51:16	57:41	
21	19:50	114	10.470L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31	
24	22:40	99	13.674L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33	
27	25:30	88	17.306L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48	
30	28:20	80	21.366L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15	
33	31:10	72	25.852L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53	
36	34:00	66	30.768L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46	
42	39:48	57	41.883L	69:48	104:42	139:37	174:30	209:24	244:19	279:13	314:07	
48	45:34	50	54.705L	91:10	136:45	182:21	227:55	273:31	319:06	364:42	410:17	
54	51:02	44	69.236L	115:24	173:05	230:47	288:29	346:11	403:53	461:34	519:16	
60	56:40	40	85.476L	142:28	213:41	284:55	356:09	427:23	498:37	569:50	641:04	

TABLE 2

SPECIFICATION TIME REQUIRED FOR A 0.5 PSIG
PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED
FOR Q = 0.0015

1 Pipe Diameter (in.)	2 Minimum Time (min.:sec.)	3 Length for Minimum Time (ft.)	4 Time for Longer Length (sec.)	Specified Minimum for Length (L) Shown (min:sec)								
				100 ft.	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.	450 ft.	
4	1:53	597	.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12	
8	3:47	298	.760 L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42	
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54	
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50	
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02	
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51	
21	9:55	114	5.235 L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16	
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17	
27	12:45	88	8.653 L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	46:54	
30	14:10	80	10.683 L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07	
33	15:35	72	12.916 L	21:33	31:19	43:56	53:52	64:38	75:24	86:10	96:57	
36	17:00	66	15.384 L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23	
42	19:54	57	20.942L	34:54	52:21	69:49	87:15	104:42	122:10	139:37	157:04	
48	22:47	50	27.352L	45:35	68:23	91:11	113:58	136:46	159:33	182:21	205:09	
54	25:31	44	34.618L	57:42	86:33	115:24	144:15	173:05	201:56	230:47	259:38	
60	28:20	40	42.738L	71:14	106:51	142:28	178:05	213:41	249:18	284:55	320:32	

3.8 FLUSHING

A. Water, Wastewater and Sludge Piping

1. Flush piping with a flushing velocity of at least 2.5 feet per second. Following are flows required to provide a flushing velocity of 2.5 feet per second:

Pipe Size (Inches)	Inside Diameter (Inches)	Flow at a Velocity of 2.5 Feet per Second (gpm)
14 DIP	14.55	1296

2. Flush piping until the water discharged is clear.

END OF SECTION 33 05 24.31

Section 33 05 24.35 - Reinforced Concrete HDPE Lined Gravity Sewer Pipe

1.01 Scope of Work

- A. Furnish all labor, materials, equipment and incidentals necessary to manufacture and test HDPE lined reinforced concrete gravity sewer pipe and fittings as shown on the drawings and specified herein. Manufacturer will be a current QCAST Certified Producer with the American Concrete Pipe Association.
- B. All pipe shall be manufactured specifically for this project and no pipe shall be furnished from stock unless approved by the Engineer.
- C. In the event of discrepancies between this document and the Citizens Energy Group Sanitary Standards Manual, the Citizens Energy Manual shall have precedence.

1.02 Reference Specifications

Except as modified or supplemented herein, all reinforced concrete pipe shall conform to the applicable requirements of the following specifications, latest edition.

ASTM C33	Specification for Concrete Aggregates
ASTM C76	Standard Specifications for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C150	Standard Specifications for Portland Cement
ASTM C361	Standard Specifications for Reinforced Concrete Low-Head Pressure Pipe
ASTM C618	Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C497	Standard Methods of Testing Concrete Pipe, Manhole Sections or Tile
ASTM C822	Definition of Terms Related to Concrete Pipe and Related Products
ASTM C1479	Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe using Standard Installations

- ASTM C1619 Standard Specification for Elastomeric Seals for Joining Concrete Structures
- ASTM D570 Standard Test Method for Water Absorption of Plastics
- ASTM D696 Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C with a Vitreous Silica Dilatometer
- ASTM D746 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
- ASTM D1204 Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
- ASTM D1505 Standard Test Method for Density of Plastics by the Density-Gradient Technique
- ASTM D4218 Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds By the Muffle-Furnace Technique
- ASTM D5199 Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
- ASTM D5397 Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
- ASTM D5596 Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
- ASTM D5641 Practice for Geomembrane Seam Evaluation by Vacuum Chamber
- ASTM D6365 Standard Practice for Nondestructive Testing of Geomembrane Seams Using the Spark Test
- ASTM D6392 Test Method for Determining Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-fusion Methods
- ASTM D6693 Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

ASTM D7240 Standard Practice for Electrical Leak Location Using Geomembranes with an Insulating Layer in Intimate Contact with a Conductive Layer via Electrical Capacitance Technique (Conductive-Backed Geomembrane Spark Test)

ASTM D7853 Test Method for Hydraulic Pullout Resistance of a Geomembrane with Locking Extensions Embedded in Concrete

American Concrete Pipe Association (ACPA) Design Data 9 Standard Installations and Bedding Factors for the Indirect design Method

1.03 Submittal Data

- A. The contractor shall submit to the Engineer drawings showing the principal pipe and joint dimensions, general construction and materials used in the HDPE lined reinforced concrete pipe along with pipe design calculations.
- B. Design: Reinforced Concrete pipe shall be in accordance with ASTM C76 and the American Concrete Pipe Associations Design Data 9. Testing shall be in accordance with ASTM C497. For pipe installed below the water table, an analysis shall be required checking for possible flotation.
- C. Joints: Joints shall meet the requirements of ASTM C361 Section 8 and these specifications. The joint shall consist of a rubber gasket contained in a groove formed on the spigot end of the pipe. The gasket shall be a solid circular cross section. The joint shall be designed for not less than 15% or more than 55% deformation of the gasket when out-of-roundness and off-centered position of the joint is considered and the gasket will not support the weight of the pipe.
- D. All reinforced concrete sewer pipe shall be lined with an HDPE liner. The pipe shall be lined with a full 360⁰ liner or as required by the Engineer and cast into the pipe at time of manufacture.

1.04 Acceptance Testing & Repairs

- A. At no expense to the owner, HDPE lined reinforced concrete pipe shall be inspected and tested as required below by the Engineer or a designated 3rd party firm that has been approved by the owner. Inspection is to include the manufacturing process. The Engineer will be provided copies of all test reports.
- B. The following tests shall be required. Test pipe shall be produced without liners.

Hydrostatic: The pipe barrel and pipe joint shall be subjected to an internal hydrostatic pressure of 13 psi for 10 minutes in the centered position and to 10 psi for 10 minutes in the off-centered position. The off-centered position is defined as a minimum load of 150 lbs per inch of diameter applied across the non-bulkheaded joint or concrete to concrete contact occurs. The test set up shall include a minimum of two (2) pipe sections. Moisture or beads or water appearing on the surface of the joint will not be considered as leakage. If leakage of joints should initially occur, the manufacturer shall have the option to extend the test period up to 24 hours. Test pipe shall be manufactured without the liner for hydrostatic testing of the pipe wall. After completion of the hydrostatic testing of the unlined pipe, this pipe may also be used for the load bearing test.

Load Bearing Test: One Three-Edge-Bearing Test in accordance with ASTM C497 for the load to produce the 0.01 inch crack and the ultimate load. All Three-Edge-Bearing tests shall be run on pipe manufactured without liners.

Absorption: One absorption test per lot shall be conducted in accordance with ASTM C497. Absorption shall meet the requirements of ASTM C76 Section 11 Paragraph 11.9.

Concrete Strength: The compressive strength shall be determined according to ASTM C76.

Joint Shear Test: One joint, consisting of a bell and spigot, shall be joint shear tested to a differential load of 4000 pounds times the pipe diameter in feet without any signs of distress.

HDPE Liner: Testing of the HDPE liner shall be as specified in Section 5.01.

- C. Pipe and liner may be repaired if made necessary because of occasional imperfections in manufacture or damage during handling. A repair procedure shall be submitted to the Engineer for approval prior to any repairs being made. All repaired pipe or liner will be inspected and considered acceptable if, in the opinion of the Engineer, the repairs are sound, properly finished and cured and conform to the requirements of the specifications.

2.01 Materials & Manufacture

Materials for the pipe, gaskets and other products shall conform to the applicable ASTM Standard describing the material. Submittal data shall include all materials associated with the pipe product.

- A. Except as otherwise specified herein, all pipe shall conform to the applicable ASTM Standard. The Class of the pipe shall be as specified on the Drawings.

- B. All pipe shall be manufactured using the Dri-cast or Wet Cast Method of manufacture. The manufacturing method shall be at the option of the pipe manufacturer.
- C. All joints shall meet the requirements of ASTM C361 Section 8. All gaskets shall meet the requirements of ASTM C361 Section 6.9 and ASTM C1619
- D. Portland cement conforming to ASTM C150 shall be used. Flyash conforming to ASTM C618 Class F or Class C may be used.
- E. All coarse and fine aggregates shall meet the requirements of ASTM C33 except for gradation.
- F. The application of HDPE liner to forms and other surfaces is specialized work. Personnel performing such work shall be adequately trained in the methods of liner installation prior to commencing work.
- G. To ensure adequate liner/pipe wall bond, all HDPE lined pipe shall pre-set for a minimum of two hours with the forming core left in the pipe. All pipe shall be cured in a fully enclosed curing chamber or have individual curing covers placed over each pipe.
- H. Each pipe shall be clearly marked with the strength (Class of Pipe), date of manufacture, the name or trade mark of the manufacturer and the manufacturer's Quality Assurance stamp of approval.

3.01 Performance Assurance

- A. The Contractor shall submit to the Engineer the pipe manufacturer's Quality Control Program for approval prior to any pipe being manufactured. The program and standards of manufacturing must be established and well defined.
- B. The program must include the following minimum requirements:
 - 1) A Quality Control Technician that is ACI certified.
 - 2) A Quality Control Laboratory, either on-site or third party, capable of testing and recording the requirements set forth in these specifications for concrete pipe.
 - 3) Written verification the concrete pipe manufacturer has a minimum of 5 years satisfactory performance on manufacturing reinforced concrete pipe for sanitary sewer applications.

- 4) A program to ensure the quality of the pipe manufactured complies with the requirements of this standard.
- 5) Prior to the installation of any pipe, a meeting shall be called by the owner's representative, to include the pipe installation contractor, the pipe manufacturer, joint welding contractor, the engineer and the owner's representative to review recommended procedures, to include pipe joining techniques and quality control.
- 6) Prior to the shipment of any pipe to the job site, all bells and spigots shall be checked for dimensional accuracy.

4.01 Pipe Laying

- A. Care shall be taken in loading, transporting, and unloading to prevent damage to the pipe. All pipe shall be examined and approved by the Engineer or his appointed representative before laying and no piece shall be installed which is found to be defective.
- B. Preparation of bedding and backfill shall be as specified on the Drawings and per the requirements of the American Concrete Pipe Association's Design Data 9. Pipe shall be laid with uniform bearing (loosely placed, not compacted bedding) under the full barrel of the pipe.
- C. Pipe shall be protected from lateral displacement by pipe embedment material installed as provided in the Drawings. Under no circumstances shall concrete pipe be laid in water and no pipe shall be laid in unsuitable weather or trench conditions. Pipe shall be laid with bell ends facing the direction of laying except when making closures. The pipe shall be oriented when laid so that the longitudinal liner seam is located at the invert of the pipe $\pm 10^0$.
- D. Rubber gaskets shall be installed in strict conformance with the pipe manufacturer's recommendations.
- E. Pipe shall be laid to line and grade as shown on the plans. Curves may be formed using fittings, specials, or unsymmetrical joint closure of straight pipe as required.

5.01 HDPE Liner

- A. General. The installation of all HDPE liner shall be done in accordance with Plans and Specifications.
- B. Submittals. Prior to HDPE liner installation, the Contractor shall submit the following information:
 - 1) Material safety data sheets

- 2) Complete description of HDPE liner joint welding procedures.
- 3) Certifications that the material used meets the material properties stated in these specifications.
- 4) HDPE liner welders to be fully trained by an approved training facility recommended by the liner manufacturer.

C. Liner Properties:

- 1) Liner shall demonstrate minimum pull-out strength of 14,000 psf.
- 2) Embedded liner shall demonstrate its ability to withstand back pressure hydrostatic forces as required by ASTM D7853.
- 3) Liner sheets shall be produced in thickness of 80 mils (2.0 mm).
- 4) The locking studs shall be an integral part of the liner sheet. Stud spacing shall be as required to meet testing requirements referenced in this specification.
- 5) The liner and welding cap strips shall be made from 97-98% virgin high density polyethylene and 1.5-3% carbon black or pigmentation for the purpose of an otherwise specified color.
- 6) Cap strips shall be approximately 4 inches wide but not greater than 6 inches and shall be equivalent to that of the liner.
- 7) Liner sheets shall have the physical properties as stated and when tested in accordance with Table 1.
- 8) Liner sheets shall be supplied in pre-fabricated tubes. The liner seam shall be butt fused along the entire length of the seam. The integrity of the butt fused weld shall be verified by testing sample welds prior to fabricating the tubes.

Table 1: Liner Properties

TESTED PROPERTY	TEST METHOD	FREQUENCY	NOMINAL VALUE			
Thickness, mm (mil)	ASTM D5199	Every 5th roll	2.00 (80)	3.00 (120)	4.00 (160)	5.00 (200)
Density, g/cm ³	ASTM D1505	1/1 00,000 ft ²	0.94	0.94	0.94	0.94
Tensile Properties (each direction) Strength at Yield, lb./in ² (MPa) Elongation at Break, %	ASTM D6693, Type IV Dumbbell G.L. = 2.0 in (50 mm)	1/1 00,000 ft ²	2,200 (15.2) 500	2,200 (15.2) 500	2,200 (15.2) 500	2,200 (15.2) 500
Stud Pull-Out Strength ¹ , lb./ft ² (kN/m ²)	ASTM D7853	1/product	>14,000 (669.89)	>14,000 (669.89)	>14,000 (669.89)	>14,000 (669.89)
Carbon Black Content/Pigment	ASTM D4218	1/100,000 ft ²	2-3 1.5-2.5	2-3 1.5-2.5	2-3 1.5-2.5	2-3 1.5-2.5
Carbon Black Dispersion ²	ASTM D5596	1/100,000 ft ²	Note 2	Note 2	Note 2	Note 2
Notched Constant Tensile Load, hours	ASTM D5397	1/formulation	1,000	1,000	1,000	1,000
Coefficient of Linear Thermal Expansion, per °C	ASTM D696	1/product	1 .20E-04	1 .20E-04	1 .20E-04	1 .20E-04
Low Temperature Brittleness, °C	ASTM D746	1/product	-77	-77	-77	-77
Dimensional Stability, % (each direction)	ASTM D1204	1/product	±1.0	±1.0	±1.0	±1.0
Water Absorption, %	ASTM D570	1/product	0.1	0.1	0.1	0.1

D. HDPE Liner Joint Welding Procedure

- 1) Welding procedure shall be submitted and approved as required in 5.01.B.2.
- 2) Welding procedure shall include the following:
 - A. Prior to the start of each days joint welding or if welding is stopped for more than 3 hours, sample cap strips will be welded, and coupons cut and pull tested to verify the strength of the weld. Testing shall be per ASTM D6392.
 - B. Each weld shall be visibly inspected. In addition, all joint welds shall be probed with a trowel, putty knife, or similar tool approved by the Engineer.
 - C. Each joint weld shall be fully vacuum tested or spark (holiday) tested immediately following the completion of the welding process. Any joint weld not passing the test shall be repaired and re-tested.
 - D. At the completion of each run of joint welds, a report of each weld shall be provided to the Engineer. The report shall include welder identification, weld/joint identification, and joint test results.

END OF SECTION

SECTION 33 05 26.13 – IDENTIFICATION SIGNS, PLAQUES, AND LABELING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Furnish and install signs, plaques, labels, and appurtenances necessary to complete work shown or specified. Furnish and install temporary construction delineation signs as shown or specified.
- B. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply in all cases.

1.2 SUBMITTALS

- A. Submittals shall be as specified in Section 01 00 00 – General Requirements.
- B. Submit the following:
 - 1. Shop drawings with physical characteristics of all signs, plaques, and labels.
 - 2. Installation data describing appurtenant items, installation requirements, and installation information.
 - 3. Pipe marking locations must be identified in clearly labeled sketches. Typical sketches are permissible for markings in similar structures provided the work performed at each location conforms to the submitted sketches and the Contract Documents.
 - 4. One sample of each of the following, if applicable:
 - a. valve identification disc
 - b. pipe identification plaque
 - c. equipment identification labels
 - d. pipe identification sticker

1.3 PROJECT DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage, and handling of products.
- B. Promptly remove damaged products from the job site. Replace damaged products with undamaged products at no additional cost to the Owner.
- C. Contractor is responsible for furnishing any temporary construction delineation signs not provided by the Owner from previous phases of this project. Contractor

must load, unload, place, and handle all Owner provided temporary construction delineation signs at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 SIGNS

- A. Valve identification discs shall be 1-inch diameter by 1/8-inch stainless steel discs with embossed numbers and mounting rings. Numbering system shall correspond to numbers as listed elsewhere in these specifications or as otherwise directed by the Engineer.
1. Stainless steel discs shall have holes of sufficient diameter to accommodate mounting hardware.
 - a. Discs for exposed valves shall be mechanically attached to the valve bodies or attached to the valves by a stainless steel jack chain.
 - b. Discs for buried valves shall be attached to the valve box concrete collars.
 2. Fasteners for valve identification discs shall be stainless steel. Fastener size shall be as recommended by the disc manufacturer.
- B. Pipe Markers: Pipe labels shall be painted-on stencil labels. Paint shall be weather-proof suitable for moist areas or outdoor environments and compatible with pipe coatings. Pipe labeling shall be done for all new and recoated piping unless otherwise indicated by the Engineer.
1. Pipe label colors shall be white, or as required to match existing labels.
 2. The sizing for band and markers shall have minimum sizing as follows:
- | <u>Outside Diameter of Pipe or Covering</u> | <u>Length of Label</u> | <u>Size of Label Letters</u> |
|---|------------------------|------------------------------|
| over 10" | 32" | 3-1/2" |
- C. Temporary Construction Delineation Signs: Signs are intended to protect all project stakeholders from MSHA (Mine Safety and Health Administration) inspections and any special requirements of other safety inspection agencies related to mine, quarry, or electricity generation station activity.
1. Material: Corrugated Plastic supported with Stakes
 2. Dimensions: 12" by 18"
 3. Manufacturer/Supplier: Repro Graphix, Inc. or approved equal
 4. Verbiage: At minimum, signs must declare "UTILITY SYSTEM IMPROVEMENTS", "NOT A MINING OPERATION", include the Citizen's Energy Group insignia, and jobsite foreman contact

information.

2.2 PLAQUES

- A. Pipe Identification Sticker: Furnish plastic pipe identification stickers for the purpose of identifying the underground Transfer Sludge Lines (TRSL) once it is complete.
 - 1. Manufacturer: dasManufacturing, Inc., or equal as approved by the Engineer.
 - 2. The plaque shall conform to the following specifications:
 - a. Duracast™ Style Marker, or equal as approved by the Engineer
 - b. Non-slip surface
 - c. Minimum Dimensions: 2" x 4.5" Rectangular
 - d. Mount sticker to top of the valve vault in a location shown on the valve vault detail sheet in the Contract Plan Set
 - e. Exact wording for the tablet shall be: "TRSL"
 - f. Lettering must be Tahoma font, all caps format, & centered
 - g. Height and thickness of letters shall be proportional to the wording and space available. A text height of 1.25" works well.

PART 3 - EXECUTION

3.1 GENERAL

Install signs and plaques in accordance with manufacturer's recommendations and as specified in this Section.

3.2 VALVE IDENTIFICATION DISCS

- A. All valves shall be identified by a numbered valve disc. Operating stands and valve boxes shall be similarly labeled as the valves served.
- B. The brass valve tags shall be fastened either by drilling and using a brass screw or by attachment using a brass jack chain. Drilling and tapping methods shall be such that the valve body is not structurally weakened or the pressure rating reduced.
- C. Valve identification discs to be mounted on valve box concrete collars shall be mechanically attached in such a manner that the discs will not be loosened by freezing and thawing. Discs shall be imbedded in the concrete collars so that the disc faces are flush with the concrete finish surface. Each disc shall be oriented so that the top of the lettering is toward its respective valve box.

3.3 PIPE MARKERS

After the final finishing coating of exposed pipe work within buildings, vaults, and the outdoors has been completed, the Contractor shall label each line with identification stencil labeling showing the name, direction of flow, destination of flow, and/or other identification of the pipe line as directed by the Engineer. Such identification labeling shall appear every 15-20 feet and after changes in direction, or as necessary in the judgment of the Owner, Owners Representative, or Engineer, but generally not less than two places. A typical example of pipe marking is as follows: “Twin Transfer Sludge Line - East” or “Twin Transfer Sludge Line – West”. If space is limited, “Twin Transfer Sludge Line” can be abbreviated to “TRSL” to fit in the space provided after the approval of the Engineer.

3.4 TEMPORARY CONSTRUCTION DELINEATION SIGNS

- A. Install temporary construction delineation signs with a maximum of 300 feet separation or within sightline, whichever is closer, and maintain 3 feet clearance above the ground. The direction of the signs must be coordinated with the Owner’s Representative or Engineer prior to placement.
- B. All temporary construction delineation signs must be placed along the limits of the construction project as defined by silt fence per Specification Section 31 25 00, Erosion and Sediment Controls, within the property boundaries of The Heritage Group, Martin Marietta, and Hanson Aggregates properties. Signs shall be placed inside the silt fence boundaries.
- C. Payment for Temporary construction delineation signs shall be included as part of the lump sum item for “Maintenance of Traffic” as shown in Section 01 22 00.

3.5 PIPE IDENTIFICATION STICKERS

- A. Install pipe identification sticker in the locations shown on the drawings or as designated by the Engineer.
- B. The surface must be dry and free of any loose debris and oils. Apply the adhesive following the adhesive guide on the back of the sticker. Apply pressure to the sticker forcing a bead of adhesive out around the entire edge. It is important that the entire edge of the sticker is sealed. Adhere the pipe identification sticker using das Curb Marker Adhesive #RS-22-5 / #RS-22-11, or equal, as approved by the Engineer.

3.6 CLEANING

Clean grease, oil, dirt, paint, or any other contaminants from the exterior surfaces of signs, plaques, stickers, fasteners, and parts after installation.

END OF SECTION 33 05 26.13

SECTION 33 05 26.16 – IDENTIFICATION MARKERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Install pipeline markers and tracer wire test stations as necessary to complete work shown or specified.
- B. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply in all cases.
 - 1. APWA - American Public Works Association: Utility Location and Coordination Council National Color Code shall be strictly adhered to and is as follows:
 - a. Safety Red: Electric power, distribution and transmission, and municipal electric systems.
 - b. High Visibility Safety Yellow: Gas and oil distribution and transmission, dangerous products, materials, and steam.
 - c. **Safety Alert Orange: Fiber optic** and telephone systems, police and fire communications, and cable television.
 - d. Safety Precaution Blue: Water systems and slurry pipelines.
 - e. **Safety Green: Sanitary sewer, storm sewer, force main and non-potable water.**
 - f. Precaution Brown: Influent and effluent lines.
 - g. Alert Purple: Reclaimed water lines.

1.2 SUBMITTALS

- A. Submittals shall be as specified in Section 01 00 00 – General Requirements.
- B. Submit the following:
 - 1. Proposed tracer wire test station shop drawings
 - 2. Installation requirements and installation information.

1.3 PROJECT DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage, installation, and handling of all products required for this phase of the project.

- B. Promptly notify the Owners Representative of any damaged products.

PART 2 - PRODUCTS

2.1 MARKER POSTS

- A. Contractor is required to furnish and install marker posts in conformance with the detail drawing and locations shown in the project plans.
 - 1. Marker posts shall be color-coordinated as listed below
 - a. TRSL pipeline post color: "Green"
 - b. Fiber optic conduit post color: "Orange"

2.2 TRACER WIRE TEST STATIONS

- A. Contractor is required to furnish and install tracer wire test stations at locations shown in the project plans.
 - 1. Tracer wire test stations shall be color-coordinated as listed below
 - a. TRSL pipeline post color: "Green"
 - b. Fiber optic conduit post color: "Orange"

PART 3 - EXECUTION

3.1 GENERAL

Install signs and plaques in accordance with manufacturer's recommendations. Payment will be made on a unit price basis for each marker and each test station installed.

3.2 CLEANING

Clean grease, oil, dirt, paint, or any other contaminants from the exterior surfaces of signs, plaques, stickers, fasteners, and parts after installation.

END OF SECTION 33 05 26.16

SECTION 33 05 26.22 – EXISTING UNDERGROUND UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: The Contractor shall be responsible for exercising due diligence in identification and protection of existing buried utilities through and adjacent to the project site on both public and private property and is responsible for damage to such facilities caused by negligent construction processes.
- B. Definitions: All work shall be in accordance with site requirements, details in the plans, and these specifications.
- C. Codes, Specifications, and Standards: Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply, unless otherwise specified. Where used in these specifications, the following acronyms shall represent:
 - 1. ASTM - American Society for Testing and Materials
 - 2. APWA - American Public Works Association: Utility Location and Coordination Council National Color Code shall be strictly adhered to and is as follows:
 - a. Safety Red: Electric power, distribution and transmission, and municipal electric systems.
 - b. High Visibility Safety Yellow: Gas and oil distribution and transmission, dangerous products, materials, and steam.
 - c. **Safety Alert Orange: Fiber optic** and telephone systems, police and fire communications, and cable television.
 - d. Safety Precaution Blue: Water systems and slurry pipelines.
 - e. **Safety Green: Sanitary sewer, storm sewer, force main and non-potable water.**
 - f. Precaution Brown: Influent and effluent lines.
 - g. Alert Purple: Reclaimed water lines.

1.2 QUALITY ASSURANCE

- A. In exercising due diligence, it may be necessary for the Contractor awarded the project to seek private utility locates for buried facilities not marked by 811. These services shall be paid for as a lump sum item concurrent with the parameters of

Section 01 22 00 part 1.7B. The means and methods for determining the location of buried utilities not marked by 811 shall be up to the Contractor provided they do not damage nor interrupt the service of such facilities, unless they have explicit written permission from the facility owner to do so.

1.3 SUBMITTALS

- A. Submittals shall be as specified in Section 01 00 00, General Requirements.
- B. The Contractor awarded the project is to electronically submit to the Engineer for review and recordkeeping, one (1) updated log of active 811 dig tickets and private utility locate records related to the project for each month of the project schedule.
- C. Any exceptions to this specification or associated plans must be submitted in writing and clearly stated. The exceptions would then be considered and must be approved by the Engineer and the Owner prior to proceeding with work.

END OF SECTION

SECTION 33 05 26.23 - UNDERGROUND UTILITY LINE MARKING | TRACER WIRES AND TAPE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: The Contractor shall furnish and install an underground utility line locating system along the center line of and directly affixed to the entire length of the transmission lines, plant lines, distribution lines, and individual service lines for all buried underground utility services. The underground utility line locating system shall consist of the sequential burial of a minimum of one (1) tape and two (2) or three (3) tracer wires to provide maximum protection against future dig-in damage as shown in the table in Part 3 of this specification. The tracer wires shall be taped to the top of the pipe in all locations to allow for conductive/inductive line locating. The warning tape shall be buried one foot above the top of and along the centerline of the pipe as an "early warning" device. The tracer wires shall be brought to the surface at all air release/vacuum combination valve vaults, drainage valve vaults, and tracer wire marker posts.
- B. Definitions: All work shall be in accordance with site requirements, details in the plans, these specifications and the manufacturer's recommendations.
- C. Codes, Specifications, and Standards: Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply, unless otherwise specified. Where used in these specifications, the following acronyms shall represent:
1. ASTM - American Society for Testing and Materials
 2. APWA - American Public Works Association: Utility Location and Coordination Council National Color Code shall be strictly adhered to and is as follows:
 - a. Safety Red: Electric power, distribution and transmission, and municipal electric systems.
 - b. High Visibility Safety Yellow: Gas and oil distribution and transmission, dangerous products, materials, and steam.
 - c. **Safety Alert Orange: Fiber optic** and telephone systems, police and fire communications, and cable television.
 - d. Safety Precaution Blue: Water systems and slurry pipelines.
 - e. **Safety Green: Sanitary sewer, storm sewer, force main and non-potable water.**

- f. Precaution Brown: Influent and effluent lines.
- g. Alert Purple: Reclaimed water lines.

1.2 QUALITY ASSURANCE

- A. All multiple ply composition tapes shall be manufactured utilizing co- polymer polyethylene extrusion laminate technique. Products using either water-based or solvent-based adhesive type laminate shall not be acceptable. Manufacturer's certification shall be required that the products will not delaminate under the following conditions:
 - 1. Tape can withstand immersion in a solution of Methyl Ethyl Ketone for a period of 72 hours verifying that no solvent based adhesives have been used.
 - 2. Tape can withstand immersion in boiling water (212 degrees Fahrenheit) for a period 24 hours verifying that no water based adhesives have been used.
- B. All pigments and colorants shall be 100% lead-free, heavy metal free, organic based environmentally sound and suitable for direct burial. All pigments shall be of a compounded type to enhance ultra-violet light stability. Products utilizing blended pigments shall not be acceptable. Manufacturer's certification shall be required that the pigments will not discolor or fade when immersed for 48 hours in a pH 7.1 solution of 50% H₂S₀₄ in 10% NA₂S₀₃.
- C. To achieve maximum bonding of the ink to the plastic films, the manufacturer shall utilize the Corona treatment method of electrical destabilization of the film surface. Corona treatment at the 40 dyne level shall immediately precede the printing process; the elapsed time between treatment and printing shall not exceed five minutes. Products utilizing chemical treatment of the film surface prior to printing shall not be acceptable as it could allow environmentally hazardous residue to leak into the surrounding soil.
- D. All of the underground utility line marking tapes shall be supplied by one source with local representation so as to provide undivided responsibility. Acceptable manufacturer is Empire Level Manufacturing Corporation, Mukwonago, WI, 1-800-558-0722 or Presco Marking Products, Sherman, TX, 1-800-527-3295.

1.3 SUBMITTALS

- A. Submittals shall be as specified in Section 01 00 00, General Requirements.
- B. The Contractor awarded the project is to electronically submit to the Engineer for review and approval, one (1) set of detailed specifications and performance characteristics for all of the utility marking tapes to be furnished and installed. The Engineer will review the submittal and render a decision in writing as to the acceptability of the marking tape. Without prior approval, the item of work may

not be accepted.

- C. Any exceptions to this specification or associated plans must be submitted in writing and clearly stated. The exceptions would then be considered and must be approved by the Engineer and the Owner prior to proceeding with work.
- D. The Contractor shall submit test reports of field-testing of locator wire continuity.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage, and handling of products.
- B. Load and unload all tape cartons by hand or skidding. Do not drop products.
- C. The tape furnished shall be packaged by the manufacturer in such a manner as to provide ample protection from damage during shipment, handling, and indoor storage.
- D. Promptly remove damaged products from the job site. Replace damaged product with undamaged products at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 DETECTABLE UNDERGROUND UTILITY MARKING TAPE

- A. Each utility line shall be marked by means of direct burial of the appropriate color coded detectable, reinforced underground utility marking tape (width shall be a minimum of 2 times line diameter up to a maximum of 6 inches). The burial depth of the warning tape shall be one (1) foot above the top of the pipe.
- B. The detectable underground utility marking tape shall be capable of being detected/located by either conductive or inductive location techniques. The detectable underground utility marking tape shall consist of a minimum: 5 mil (0.005") overall thickness; acid, alkali and corrosion resistant; with no less than 132 pounds of tensile break strength per 6 inch width; color code impregnated with color stable, lead-free, organic pigments suitable for direct burial. The detectable reinforced underground utility marking tape shall have a 35 gauge (0.00035") solid aluminum foil core encapsulated within two layers of plastic.
- C. All printing shall be permanent reverse printing, hollow core lettering allowing the visibility of the aluminum. No inks shall at any time extend to the edges of the tape thereby ensuring the quality of the laminate seal and the protection from corrosion of the aluminum foil core. The tape shall be inscribed with the proper warning for the utility such as "CAUTION: PRESSURIZED TRSL PIPE BELOW."
- D. The detectable, reinforced underground utility marking tape shall meet at a minimum the following test criteria and certifications stating such shall be furnished to the owner by the Contractor upon request:

Property	Method	Value
Thickness	ASTM D 2103	5.0 mils (nominal)
Tensile Strength	ASTM D 882	132# per 6" width
Elongation	ASTM D 882	50% at break > 40 dynes/cm ²
Printability	ASTM D 2578	> 40 dynes/cm ²
Message Repeat	Mfg. Specs.	Every 20-36 inches

- E. The detectable underground utility marking tape shall be spliced with a Termi-Foil Splice Clip with wire barrel. Two such clips shall be used at each splice, one on each side of the tape. The purpose of these clips is to make conductive splices in the detectable, reinforced underground utility marking tape. Splicing shall occur between the end of one roll and the beginning of the next roll to insure continuity along the entire marked utility path; and between the tape laid in place over the system and the tape installed over the service lines going to each facility.
- F. The Termi-Foil Splice Clip with wire barrel shall be utilized at each indicated location to provide access for the conductive line location devices. This shall be accomplished by attaching a #10 AWG, HMWPE insulated, solid copper wire to the wire barrel and to any indicated metal riser or running the wire through PVC carrier pipe riser to the surface.
- G. Each Termi-Foil Splice Clip shall be galvanized to resist degradation; each installed clip shall be wrapped with a waterproof rubber-based protective sealant unit to prevent corrosion. The Termi-Foil Splice Kits shall include twenty clips and twenty protective sealant units, and are available from Tyco Electronics, Part Number 53264-2, or approved equal.
- H. The detectable underground utility marking tape shall be printed with the standard warning for the protected utility line. The detectable underground utility marking tape shall be MagnaTec® manufactured by Empire Level Manufacturing Corporation or Presco Detectable Underground Warning Tape manufactured by Presco Marking Products.

2.2 LOCATOR (TRACER) WIRE

- A. Locator wire must be a #19 AWG tin clad, solid copper conductor with polyethylene insulation supplied by Trace-Safe®, or equal. The locator wire must meet the following additional requirements:
 1. Locator wire core material comprised of high-tenacity, woven polyester with water blocking yarns.
 2. Woven polyester must be encapsulated with minimum thickness of 30 mil, high molecular weight high density polyethylene (HMHDPE) insulation that is green or orange in color to meet the APWA color code of the buried utility line, or as applicable to the respective utility line installed.
 3. Locator wire must not conduct an electrical current when struck by

lightning.

4. Locator wire must be designed for direct bury and directional boring applications at 30 volts and RoHS compliant.
 5. Tracer wire shall be Trace-Safe Water Blocking Tracer Wire, manufactured by NEPTCO and produced in the United States of America, or approved equal.
- B. Locator wire must be spliced and branched with water blocking gel filled connectors designed for Trace-Safe Water Blocking Tracer Wire, manufactured by NEPTCO and produced in the United States of America, or approved equal.
- C. Locator wires must be individually terminated at the top of each test station post (Specification 33 05 26.16) with water blocking gel filled 'Locate Clips' designed for Trace-Safe Water Blocking Tracer Wire, manufactured by NEPTCO and produced in the United States of America, or approved equal, attached to the terminals in the locate plate.

PART 3 - EXECUTION

3.1 LOCATOR (TRACER) WIRE

- A. The locator wires are to be taped to the top of all HDPE piping and shall be continued across all locations of DI piping buried underground. The locator wires must be bundled together every 10 feet or as required to keep the tracer wires in one bundle along the length of the pipe.
- B. Locator wires must be routed up to and around the face of each valve vault. The locator wires for each TRSL mainline pipeline must be routed around its respective side of each valve vault. The locator wires must be kept adjacent to the outside face of each valve vault. Locator wires for drain pipes must use an approved tee connector to directly connect to the locator wire for the TRSL mainline routed around the face of the valve vault with the drain pipe location.
- C. The end of all locator wires for each respective pipe must not be exposed to soil. Exposed ends of locator wires shall be connected together using an approved splice connector. Locator wires for two different pipes must never be connected together except at tee locations for drain pipe locations.
- D. The minimum quantity of locator wires for each pipe installed can be found below:

Pipe Description	Ratios	Nominal Diameter [Inches]	Purpose/ Description	Min. Qty. Tracer Wires	Test Station Post Access
HDPE	DR 11	16	Mainline TRSL	2	Yes
Ductile Iron	Class 250	14	Mainline TRSL	2	Yes
PVC	SDR 35	8	V.V. Drain Pipe (to SW)	2	No

			Diversion)		
HDPE	DR 9	6	Fiber Optic Conduit	2	Yes
PVC	SCHD 40	4	Fiber Optic Conduit	2	Yes

- E. Each locator (tracer) wire must be tested for continuity after initial backfill placement.
 - 1. If the test fails, the failing locator wires must be replaced at no additional cost to the Owner.
 - 2. If the test passes, no additional work on the tested wires is required.
- F. Locator wire shall be installed to fire hydrants, air/vacuum valves, gate valves, and inside valve vaults along the pipe route.
- G. Additional locator wire stations will be located along the project at 400 foot intervals regardless of the presence of a valve vault is positioned within the interval. A tracer wire access marker post is specified in Section 33 05 26.16 – Identification Markers.

3.2 INSPECTION AND TESTS

Prior to burial, all tapes and locator wires shall be inspected for quality and the Contractor shall have a statement of compliance from the manufacturer acknowledging that the conditions set forth in Part 1, Section 1.2 of this specification have been met. The locator wires and marking tapes shall be free from nicks and cuts, and tapes shall be continuous and not cut. An electrical continuity test shall be performed for each run of locator wire.

3.3 GUARANTEE

The Manufacturer of the tapes shall warrant for a minimum period of fifty (50) years that all reinforced underground tape will maintain its installed width and message repeat, even after excavation, and to be free of surface area distortion. Manufacturer shall further warrant for a minimum period of ten (10) years that all reinforced tapes will maintain their strength-to-weight ratios resistance to fungi and bacteria and shall be resistant to cold and stress cracking to a temperature of - 30 degrees Fahrenheit. Finally, the manufacturer shall warrant for a minimum period of two (2) years that all reinforced tape will remain color stable and that the imprinted safety message will remain substantially intact and legible during and after the abrasive forces of installation and direct burial.

END OF SECTION 33 05 26.23

SECTION 40 05 13 – PROCESS PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: This section applies to all buried site piping, including process, sanitary drains, building drains, pressure, plant water, etc. Furnish and install all pipe, fittings and appurtenances to complete work shown or specified.
- B. Codes, specifications and standards referred to by title or number in this specification shall be adhered to, and latest revisions shall apply in all cases.
- C. Abbreviations
 - a. AASHTO - American Association of State Highway and Transportation Officials
 - b. ANSI - American National Standards Institute
 - c. ASTM - American Society for Testing & Materials
 - d. AWWA - American Water Works Association
 - e. PFI - Pipe Fabricators Institute
- 2. All pipe, fittings, and references to pipe diameter on the drawings or in specifications are intended to be nominal size or diameter and shall be interpreted as such.
- D. All storm sewers passing under paved areas shall be watertight installed with rubber gaskets.

1.2 QUALITY ASSURANCE

- A. Mark pipe and fittings according to the applicable specification or standard.
- B. Perform factory and field tests in accordance with the applicable specification or standard.
- C. Line and Grade Requirements: The Contractor shall provide assurance to the Owner's Representative that the pipe is laid accurately to the required line and grade as shown on the drawings, plus or minus one (1) foot. Variations from the line and grade shown on the drawings or without the approval of the Engineer shall be cause for the line to be rejected. In the case that the line is rejected, the Contractor must replace the line to the design line and grade without additional cost to the Owner.
- D. Test Sections
 - 1. Final Performance Testing for Acceptance: Before acceptance and final payment for all new pipe, the Contractor and the Owner's Representative shall check pipe, even if previously checked, for accurate alignment and grade. Also, the pipe shall be tested as specified in this Section for water tightness.

1.3 SUBMITTALS

Submittals shall be as specified in the General Conditions, Section 01 00 00 – General Requirements, and Section 01 33 00 – Contractor Submittals.

- A. Submit the following:
 - 1. Product information for all ductile iron pipe, fittings, adapters, and restrained joint systems
 - 2. Polyethylene encasement products and installation details
 - 3. Installation details and instructions for HDPE pipes
 - 4. Certified field test reports

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage and handling of products.
- B. The Contractor shall be responsible for scheduling, receiving, storing, handling, and transporting all products
- C. Load and unload all pipe, fittings and appurtenances by hoists or skids, and do not drop, skid or roll products. Pad slings, hooks and pipe tongs, and use in such a manner to prevent damage to the products.
- D. Keep stored products safe from damage or deterioration. Keep the interior of pipe, fittings and appurtenances free from dirt or foreign matter. Store gaskets, plastic pipe and fittings and other products, which deteriorate by sunlight, in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products.
- E. Do not stack ductile iron pipe higher than the limits shown in ANSI/AWWA C600. Stacking of cast iron, clay, concrete, copper, plastic and steel pipe shall meet the requirements of the pipe manufacturer. Do not stack fittings.
- F. Promptly remove damaged products from the job site and replace with undamaged products at no additional cost to the owner.

PART 2 - PRODUCTS

2.1 GENERAL

All pipe, fittings and appurtenances shall be new, unused and as shown on the drawings or as required by the manufacturer and ANSI/AWWA Specifications.

Design and manufacture pipe for a working pressure of 80 psi plus a 100 psi surge pressure. Additionally, a safety factor of 2.0 shall be applied to the working pressure requirement and a depth of cover indicated on the drawings or as required by manufacturer and ANSI/AWWA specification, shall be included.

2.2 BURIED PRESSURE AND PROCESS PIPE AND FITTINGS

A. Ductile Iron Pipe and Fittings

1. Pipe

- a. Ductile iron pipe shall meet the requirements of ANSI/AWWA C151/A21.51-91.
- b. Minimum pressure and thickness class shall be as follows:

<u>Pipe Size</u>	<u>Minimum Pressure Class</u>
14" DIP	250 psi
16" DIP	250 psi

- c. Thickness of pipe shall be as shown in Table 15.1 of ANSI/AWWA C115/A21.15 for 250 psi working pressure.
- d. The exterior of all pipe must be coated with a bituminous coating.
- e. Unless otherwise shown on the drawings, all pipe joints shall be push-on or mechanical joint type meeting the requirements of ANSI/AWWA C111/A21.11. Restrained joints for straight runs of piping are required at all push-on or mechanical joints. Restrained joints shall be Flex-Ring, Mega-Lug, Lok-Ring, Lok-Fast, Lok- Tyte or equal as approved by the Engineer. The use of restraining gaskets such as Field-Lok or Fast-Grip will be allowed for straight run pipe joints.
- f. Flange joints shall be screwed on ductile iron flanges or shouldered type joints. Flanges shall meet the requirements of ANSI/AWWA C115/A21.15, and shouldered type joints shall conform to ANSI/AWWA C606. Field made-up flanges will not be allowed unless approved in writing by the Engineer. Then, these shall comply with ANSI/AWWA C115/A21.15 with facing done after turning pipe through flange.

2. Fittings

- a. The exterior of all fittings must be coated with a bituminous coating.
- b. Fittings for standard size pipe shall meet the requirements of ANSI/AWWA 110/A21.10. Compact, or short body fittings, shall be used only under the direction of the engineer. Standard size fittings shall be used unless otherwise specified, shown, or approved by the Engineer. Design and manufacture fittings for a pressure rating of at least 250 psi.
- c. Fitting joints for pumped pressure lines and low-head process piping shall be restrained mechanical joints or restrained push-on joints. Joints shall meet the requirements of ANSI/AWWA C111/A21.11. Restrained

joints must be used instead of thrust blocking. Restrained joints shall be Flex-Ring, Mega-Lug, Lok-Ring, Lok-Fast, Lok-Tyte or equal as approved by the Engineer. The use of restraining gaskets such as Field-Lok or Fast-Grip on fitting joints will be reviewed by the Engineer on a case-by-case basis.

3. Adapters

- a. The exterior of all adapters must be coated with a bituminous coating.
- b. Adapters from push-on or mechanical joint ductile iron pipe to flange joint valves or fittings shall be ductile iron. Adapters shall meet the requirements of ANSI/AWWA C110. Design and manufacture adapters for a pressure rating of at least 250 psi.
- c. Adapter ends connecting to ductile iron pipe shall be one of the following: plain-end-push-on joint; mechanical joint; or restrained push-on joint. All adapters shall have restrained joints. Mechanical joints and push-on joints shall meet the requirements of ANSI/AWWA C111/A21.11.
- d. Adapter ends connecting to flange joint valves or fittings shall have joints complying with the specifications for the applicable valves or fittings.

4. Gaskets for mechanical joints and push-on joints for water and wastewater service shall meet the requirements of ANSI/AWWA C111/A21.11. Nuts and Bolts

- a. Nuts and bolts for mechanical joints shall be high strength, heat treated, alloy steel. Nuts shall be hexagon nuts, and bolts shall be tee head bolts. Nuts and bolts shall meet the requirements of ANSI/AWWA C111/A21.11.
- b. Nuts and bolts for restrained push-on joints shall meet the requirements of the joint manufacturer.

5. Corrosion Protection

- a. The inside surfaces of all pipes, fittings, and adapters shall be shop applied with an amine cured novalac epoxy with a nominal DFT of 40 mil. The lining shall be Induron Protecto 401 and shall be free of any holidays and shall be spark tested. Shop coating applicator shall have a minimum of 10 years of experience applying Protecto 401.
- b. High Density Cross-Laminated Polyethylene Wrap
 - (1) Two (2) layers of minimum 4-mil High Density Cross-Laminated Polyethylene (HDCLPE) wrap tubes must be installed in accordance with AWWA C105.

- (2) One (1) layer of minimum 10-mil joint wrap tubes shall have installed at all restrained joint locations.
- (3) Wrap tubes must be secured with a minimum 2-inch wide polyethylene tape with a minimum thickness of 12 mil.
- (4) All HDCLPE wraps shall be by AA Thread Seal Tape, Inc. or equal as approved by the Engineer.

<u>Nominal Diameter</u>	<u>HDCLPE Wrap Tube Width</u>
3" to 8"	20"
10" to 14"	30"
16" to 20"	41"
20" to 24"	54"
30"	67"
36" to 42"	81"
48"	95"
54" to 60"	108"

B. High Density Polyethylene Pipe and Fittings

- 1. The Contractor is responsible for supplying all materials required to install the HDPE pipe to contract specifications and for intended use:
 - a. Mechanical Restraint
 - (1) Mechanical restraint for HDPE may be provided by mechanical means separate from the mechanical joint gasket sealing gland. The restrainer shall provide wide, supportive contact around the full circumference of the pipe and be equal to the listed widths. Means of restraint shall be machined serrations on the inside surface of the restrainer equal to or greater than the listed serrations per inch and width. Loading of the restrainer shall be by a ductile iron follower that provides even circumferential loading over the entire restrainer. Design shall be such that restraint shall be increased with increases in line pressure.
 - (2) Serrated restrainer shall be ductile iron ASTM A 536 with a ductile iron follower; bolts and nuts shall be corrosive resistant, high strength alloy steel.
 - (3) The restrainer shall have a pressure rating of, or equal to that of the pipe on which it is used or 150 PSI, whichever is lesser. Restrainers shall be JCM Industries, Sur-Grip or pre-approved equal.
 - (4) Restrainer width and serrations shall comply with manufacturer's recommendations.

- (5) Pipe stiffeners must be used in conjunction with restrainers. The pipe stiffeners shall be designed to support the interior wall of the HDPE. The stiffeners shall support the pipe's end and control the "necking down" reaction to the pressure applied during normal installation. The pipe stiffeners shall be formed of 304 or 316 stainless steel to the HDPE manufacturers published average inside diameter of the specific size and DR of the HDPE. Stiffeners shall be by JCM Industries or pre-approved equal.

2.3 EXTERIOR EXPOSED PIPE AND FITTINGS

A. Ductile Iron Pipe and Fittings

The inside surfaces of all pipes, fittings, and adapters shall be shop applied with an amine cured novalac epoxy with a nominal DFT of 40 mil. The lining shall be Induron Protecto 401 and shall be free of any holidays and shall be spark tested. Shop coating applicator shall have a minimum of 10 years of experience applying Protecto 401.

1. Pipe

- a. Pipe shall comply with ANSI/AWWA C151/A21.51.
- b. The exterior of all pipe must be coated with a bituminous coating.
- c. Thickness of the pipe shall correspond to ANSI/AWWA C115/A21.15, for 250 psi minimum working pressure.
- d. Joints shall be flange joints with screwed on ductile iron flanges in accordance with ANSI/AWWA C115/A21.15.
- e. Field made-up flanges will not be allowed unless approved in writing by the Engineer. If approved, field made-up flanges shall comply with ANSI/AWWA C115/A21.15, with facing done after turning the pipe through the flange.
- f. Joints may be mechanical groove-and-ring type (Victaulic) where approved by the Engineer. Pipe shall conform to the requirements of ANSI/AWWA C 150/A21.51 and shall be radius grooved conforming to AWWA C606 for rigid joints.

2. Fittings

- a. The exterior of all fittings must be coated with a bituminous coating.
- b. Fittings shall meet the requirements of ANSI/AWWA C110 and be designed and manufactured for a pressure rating of at least 300 psi.
- c. Flange joints shall meet the requirements of ANSI/AWWA C110/A21.10.
- d. Victaulic fittings shall conform to the requirements of ANSI A21.10 with the exception of the end preparation. The end preparation shall be radius grooved conforming to the recommendations for rigid joints. Coupling housings shall be of ductile iron conforming to the requirements of ASTM A536. Grooves, couplings, and grooved fittings shall conform to AWWA C606.
- e. Bolts and nuts for Victaulic couplings shall be of carbon steel, heat treated and plated, conforming to ASTM A183. Gaskets shall be of the mechanical grooved coupling design with short center let to bridge pipe ends and shall have the properties designated by ASTM D2000. Such gaskets shall be suitable for the required service. Transition flanges shall be used for direct connection of flanged valves, pumps, or other equipment to grooved pipe or fittings. Transition flanges shall be ductile iron conforming to the requirements of ASTM A536.

3. Finish coat the exterior surfaces of ductile iron pipe and fittings as specified in Section 09 97 00 – Special Coatings.

4. Flange Joint Accessories

- a. Gaskets for flange joints for water and wastewater service shall meet the requirements of ANSI/AWWA C110.
- b. Gaskets shall be full face, have a 1/8-inch thickness and be rubber or another material approved by the Engineer.
- c. Nuts and bolts shall meet the requirements of ANSI/AWWA C110 and be zinc-coated alloy steel.

5. Shouldered joint accessories shall follow ANSI/AWWA C606.

2.4 FLANGED JOINT ADAPTERS AND UNION FLANGES

- A. Flange-mechanical joint adapters and union flanges shall have restrained joints designed for a pressure rating of at least 300 psi as approved by the Engineer. The use of flange adapters, such as Mega-Flange and union flanges such as Uni-Flange, are permissible with the approval of the Engineer.
- B. Flange-mechanical joint adapters and union flanges shall conform to the following

specifications:

1. Adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSI/AWWA C115/A21.15. Restraint for the adapter shall consist of multiple individually actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of the gripping wedges.
2. The adapters shall be capable of deflection during assembly or permit lengths of pipe to be field cut to allow a minimum of 0.6-inch gap between the ends of the pipe and the mating flange without affecting the integrity of the seal.

2.5 WALL SLEEVES

Wall sleeves shall be of the size and type shown on the drawings, if applicable.

2.6 COUPLINGS

- A. Expansion couplings for non-buried service shall be composed of two steel follower flanges, one steel middle ring, two molded rubber gaskets and sufficient rolled thread, track headed bolts to properly compress the gaskets.
- B. Exposed rubber expansion joints for spool-type applications shall be single-arch type with standard 125 lb. drilled flanges integral to the body and drilled to conform to the bolt holes of the applicable connecting piping. The tube and cover shall be constructed from synthetic rubber, with the tube being seamless from the outside edges of flange to flange. The shell shall be constructed of reinforced fabric of high-strength synthetic fibers. Rubber expansion joints for water and wastewater service shall be capable of operating temperatures up to 250°F and pressures of 130 psi. Rubber expansion joints shall be manufactured by General Rubber Corporation, or Owner-approved equal.

2.7 PIPE INSULATION

- A. The Contractor will be responsible for the replacement of all existing pipe insulation that is removed or damaged. The Contractor will be responsible for determining the quantities of new insulation required to replace all damaged insulation during the construction of the connection to the Pig Retrieval Station. Insulation system must match the existing insulation system and finish.
 1. Johns Manville Micro-Lok HP Fiber Glass Pipe Insulation
 - a. Insulation thickness: 2 inches
 2. Johns Manville Micro-Flex Large Diameter Pipe and Tank Wrap
 - a. Nominal Pipe Size: 10 inches, 14 inches, and 16 inches
 3. RPR Products Insul-Mate aluminum roll jacketing
 - a. Thickness: 0.020"

2.8 MANHOLES AND OTHER STRUCTURES

Refer to Section 03 40 00 – Precast Concrete Structures.

PART 3 - EXECUTION

3.1 INSPECTION

A. General

1. The quality of all materials, the process of manufacture and the finished products shall be subject to inspection and approval by the Engineer. Such inspection may be made at the place of manufacture, after delivery to the site or at both places; and the products shall be subject to rejection at any time for failure to meet any of the specifications' requirements, even though sample products may have been previously accepted as satisfactory at the place of manufacture.
 - a. Prior to being installed, each pipe and fitting shall be carefully inspected. Those not meeting the specifications shall be rejected and replaced at the Contractor's expense.

B. Ductile Iron Pipe

1. In any pipe showing a distinct crack and which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portion, if so approved by the Engineer, may be cut off. Therefore, this portion may be removed before the pipe is installed, at the expense of the Contractor. This shall ensure that the pipe used is perfectly sound. The cut shall be made in the sound barrel at a point at least 12 inches from the visible limits of the crack. The cut off material becomes property of the contractor and is to be removed from the site.
2. All cutting shall be done with a machine having steel cutters or knives adapted to the purpose and all cut ends shall be examined for possible cracks caused by cutting. The exterior coating and interior lining materials must not be damaged during any field cutting.
3. Dragging the pipe on asphalt or concrete pavement and objects is strictly prohibited. Care must be taken to preserve the integrity of any exterior corrosion protection systems.
4. **Chains or cable type chokers will not be permissible when lifting fused sections of coated ductile iron pipe, fittings, and adapters.**

C. High Density Polyethylene (HDPE) Pipe

1. All workmanship, handling, storage, etc. shall be done per the manufacturer's recommendations.

2. Pipe shall be stored on clean, level ground to prevent undue scratching or gouging. If the pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The pipe shall be handled in such a manner that it is not pulled over sharp objects or cut by chokers or lifting equipment. Care shall be exercised to minimize dragging the pipe on asphalt or concrete pavement and objects.
3. Sections of pipe having been discovered with cuts or gouges in excess of 10% of the pipe wall thickness shall be cut out and removed from the job site. The undamaged portions of the pipe shall be rejoined using the heat butt fusion joining method.
4. Fused segments of the pipe shall be handled so as to avoid damage to the pipe. **Chains or cable type chokers will not be permissible when lifting fused sections of plastic pipe.** Nylon slings are required when lifting the pipe in short fused sections. Spreader bars are recommended when lifting long fused sections.

3.2 INSTALLATION OF BURIED PIPING

A. Laying Piping

1. **All excavation shall be in accordance with federal, state and local OSHA requirements.** Proper tools and facilities shall be provided and used by the Contractor for safe working conditions.
2. All pipe and fitting shall be cleaned of all debris, dirt and other foreign material before being laid, and it shall be kept clean until accepted in the completed work.
3. Lay and maintain pipe to the lines and grade shown on the drawings, to maintain the minimum depth specified. Install fittings in the locations shown on the drawings, as directed by the Engineer, or as necessary to maintain proper pipeline alignment.
4. When the exact location of buried utilities is unknown and piping is to be constructed parallel and close to said utilities, adjust the alignment of the piping to least interfere with these utilities. This applies unless otherwise shown on the drawings or specified by the Engineer.
5. Potable water piping shall be laid at least 10 feet horizontally from any existing sanitary sewer or sewage force main. The distance shall be measured from edge to edge of the pipe. Potable water piping crossing sanitary sewer or sewage force mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the potable water piping and the outside of the sewer or force main. The 18-inch separation shall apply whether the potable water piping is over or under the sewer or force main. Lay potable water piping at crossings of sewers and force mains so a full length of pipe is centered on the sewer or force main whenever possible. No potable water piping shall pass through or come in contact with any part of a sanitary sewer manhole.

6. A strict minimum of 4'-0" of cover shall be present when the pressure piping is 12 inches or larger. This minimum depth of cover applies unless otherwise depicted on the drawings or specified by the Engineer. Furthermore, cover shall be measured as the vertical distance from the top of the pipe to the finish grade elevation.
7. Do not lay pipe in water or when the trench or weather conditions are unsuitable for proper installation per manufacturer specifications OR at the discretion of the Owner/Owner's Representative.
8. Lower pipe and fittings into the trench by hand, hoists or ropes or other suitable tools or equipment that will not damage products, coatings or linings. Do not drop or dump pipe or fittings into the trench.
9. Pipe laying shall proceed upgrade, beginning at the lower end of the pipeline.
10. The Contractor shall use laser beam equipment, surveying instruments or other proven techniques to maintain accurate alignment and grade.
11. Deflection of pressure pipe from a straight line or grade shall not exceed the limits specified in this Section. If the alignment requires joint deflections in excess of the allowable deflection per joint, furnish and install fittings or a sufficient number of shorter lengths of pipe.
12. For pressure and process piping, provide mechanical restraint at horizontal and vertical deflection fittings, tees, plugs, tapping sleeves and tapping saddles as needed.
13. Laying of ductile iron piping shall meet the requirements of ANSI/AWWA C600, unless otherwise specified in this Section or as approved by the Engineer.
14. Open excavation shall be satisfactorily protected at all times. At the end of each day's work, the open ends of all pipes shall be protected against the entrance of animals, children, earth, or debris by bulkheads or stoppers. The bulkheads or stoppers shall be perforated to allow passage of water into the installed pipe line, thereby preventing flotation of the pipe line. Any earth or other material that may find entrance into the main sewer or into any lateral sewer must be removed at the Contractor's expense. The cost of all such plugs, and the labor connected therewith, must be included in the regular bid price for the pipe item.
15. Maintain a clearance of, at minimum, 12 inches (horizontal or vertical) between the outside edge of the pipe and all nearby existing infrastructure (measured along the shortest distance between the two objects) unless otherwise approved by the Engineer in writing.
16. Where the pipe crosses below a potable water main, 18 inches of separation is required. If 18 inches of separation cannot be met, a carrier pipe extending a minimum of 10 feet on each side of the water main must be installed per 10 States Standards.

B. Corrosion Protection

1. Install High Density Cross-Laminated Polyethylene (HDCLPE) Wrap

- a. Install two layers of 4-mil HDCLPE wrap must be installed one at a time per the requirements of the manufacturer with the following requirements:
 - (1) Clean all dirt, cinder, etc. from the surface of the pipe.
 - (2) Cut the first layer of the tube a minimum of 4 feet longer than a standard length of pipe.
 - (3) Slip tube over the pipe and center the tube to allow for a minimum 2 feet joint overlap.
 - (4) Pull any slack in the tube to allow for a snug fit and secure with polyethylene tape. Fold over on top of pipe and secure in place every 3 feet.
 - (5) All metal appurtenances must be encased in the 4-mil HDCLPE wrap tube.
 - (6) Wrap the circumference of the pipe with polyethylene tape at a maximum interval of 3 feet.
 - (7) Repeat steps 1 through 5 to install the second layer. Stagger all joints by a minimum of 4 feet.
- b. At material change interfaces, all 4-mil HDCLPE wrap must extend a minimum of 8 feet from the end of the ductile iron pipe and be secured with polyethylene tape to the HDPE pipe.
- c. All rips, tears, imperfections, and other potential locations of damaged integrity must be repaired with polyethylene tape.
- d. Install one layer of 10-mil HDCLPE joint wrap must be installed at each restrained joint per the requirements of the manufacturer.
- e. Apply backfill carefully as to not cause any damage to the wrap.

C. Pipe Bedding, Haunching, and Initial Backfill

1. Each pipe section shall be laid in a firm foundation of bedding material, then haunched and backfilled with care, see standard detail sheet.
2. Prior to pipe installation, carefully bring bedding material to grade along the entire length of pipe to be installed. To provide adequate support for the pipe, the

following bedding procedures are recommended.

3. When No. 8 crushed stone or No. 8 fractured face aggregate material is used for bedding, little or no compaction is necessary, due to the nature of the angular particles. A minimum depth of 8 inches is sufficient to provide uniform bedding. This material must also be utilized for haunching, and initial backfill, to a plane 12 inches above the pipe.
 4. Beneath the pipe, bedding material shall have a minimum thickness of 4 inches, or a thickness of one-eighth of the outside diameter of the pipe, whichever is greater. This material shall also extend up the sides of the pipe to a height of one-sixth of the pipes outside diameter.
 5. In yielding subsoils, No. 2 crushed stone or fractured face aggregate material shall be used unless a concrete cradle is ordered for bedding; and the trench bottom shall be undercut to the necessary depth and backfilled with graded, crushed stone to form a firm foundation. No additional payment shall be made for stabilizing yielding subsoils.
 6. When excavation occurs in rock or hard shale, the trench bottom shall be undercut and a minimum of 6 inches of crushed stone bedding shall be placed prior to pipe installation. No additional payments shall be made for rock removal.
 7. For pipe with bells or flanges, depressions in the bedding material shall be excavated in advance of pipe laying so the entire barrel will bear uniformly.
 8. No. 8 crushed stone or No. 8 fractured face aggregate haunching material shall be utilized for haunching up to the spring line of the pipe to avoid loss of side support through migration of haunching material into the bedding. Haunch material shall be shovel sliced or otherwise carefully placed and "walked" or hand-tamped in to ensure compaction of the haunch area and complete filling of all voids. Material shall be compacted to 95% Standard Proctor AASHTO T-99, or higher.
 9. Initial backfill from the pipe spring line to 12 inches above the top of the pipe shall be No. 8 crushed stone or No. 8 fractured face aggregate added in 6-inch lifts and "walked" in for compaction. Material shall be compacted to 95% standard Proctor AASHTO T-99, or higher.
- D. Where the edge of the trench is within 5 feet of or crosses existing or proposed roadway pavement, it shall be backfilled with Special Backfill. Backfill any trench specifically indicated on the drawings with Special Backfill. Place Special Backfill in lifts. Compact each lift of backfill to not less than 95% of the maximum dry density, according to AASHTO T99, Method A. In all other areas, cuts and trenches shall be backfilled with granular backfill to within 1 foot of the paved surface. The remainder of the trench is to be filled with crushed stone and compacted in place, prior to opening the street to traffic. The Contractor shall add crushed stone and grade until sufficient settlement has taken place and final restoration is made.
- E. Backfill trenches not requiring granular backfill with suitable excavated material. Fill and

restore any settlement of the backfill. In unpaved areas, backfill shall be mounded above finish grade to allow for settlement. Grade unpaved area to be restored 6 inches below finish grade after settlement of backfill and immediately before restoration of vegetated areas. Place 6 inches of topsoil over area to be restored. Cost of seeding restored area to be included in lump sum erosion control payment per section 01 22 00.

F. Concrete cradles shall be constructed of Class "B" concrete and of the design shown on the detailed drawings. When so ordered in writing, concrete cradles not shown on the drawings will installed and paid for on an individual (per "Each") basis.

G. Jointing

1. Clean the ends of the pipe satisfactorily just before laying. Subsequently, the joint shall be made in a satisfactory manner according to the manufacturer's recommendations for that specific joint and as approved by the Engineer. All joint work shall be done by experienced workmen.
2. Joints shall be as specified in this Section.
3. Each length of pipe shall be installed in accordance with the manufacturer's recommendations and ANSI/AWWA C600.
4. Piping shall be tested as specified in this Section.

H. Manholes and Other Structures

1. Manholes and other structures shall be as specified in Section 03 40 00 – Precast Concrete Structures.

3.3 JOINTS

A. Ductile Iron Push-on Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.
2. Deflect pipe after jointing, if deflection is required. The amount of deflection shall not exceed the limits shown in the following table:

Pipe Size	Maximum Deflection Angle	Maximum Deflection Based Upon 18-foot Pipe Length
Inch	Degrees	Inches
14	4	15
16	4	15

3. For restrained push-on joints, pull the nuts to a uniform tightness by hand or with

a short wrench. Do not pull the spigot of the pipe being installed against the back of the bell of the receiving pipe. Engage at least a full nut on each bolt when joint deflection is required.

B. Mechanical Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.
2. Evenly tighten the nuts using a torque wrench. The torque shall be within the range listed in the following table:

Pipe Size	Bolt Size	Torque Range
4" thru 24"	3/4"	75 to 90 ft.-lb.

3. Deflect pipe, fittings or valves after jointing, if deflection is required. The amount of deflection shall not exceed the limits shown in the following table:

Pipe Size	Maximum Deflection Angle	Maximum Deflection Based Upon 18-foot Pipe Length
14"	3°-35'	13-1/2"
16"	3°-35'	13-1/2"

C. Threaded Joints

1. Threading of steel pipe shall be done after bending, forging, heat treating or welding operations.
2. Threads shall be concentric with the outside of the pipe and conform to ANSI 82.1.
3. Do not seal weld threaded joints; instead make leak tight using Teflon™ tape on all but the first two threads of the pipe.
4. When threading chemically cleaned pipe, use inhibited trichloroethane (methyl chloroform) as the cutting fluid.
5. Avoid over tightening of threaded joints and damaging the pipe exterior with the pipe wrench.
6. Backing off of made-up threaded joints to facilitate fit-up or alignment will not be permitted.

D. Flange Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and

ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the flange faces of each pipe.

2. Do not over torque nuts and bolts.

3.4 RESTRAINING AND SUPPORT

A. Thrust blocking is not permitted. All restrained joints shall be of a mechanical type restraint method.

B. Mechanical Joint Rod Restraint

1. Mechanical joint rod restraint shall be from fitting to fitting.

2. The number of rods shall conform to the following table:

Pipe Size (inches)	Rod Size (Inches)	Minimum No. of Rods
14	3/4	6
16	3/4	8

Restrained joint piping shall be as specified in this Section. Distance from fitting to end of restraint along upstream and downstream piping shall not be less than that indicated on the detail in the Drawings.

C. Pipe Supports

1. Furnish and install supports required to hold pipe, fittings and valves at the lines and grades indicated on the drawings, without causing strain upon pipe, fittings, and valves.
2. Support piping by suitable saddle stands, concrete piers or hangers.
3. Locate supports where necessary, at least 8 feet on center.

3.5 INSTALLATION OF INTERIOR EXPOSED PIPING - 8 INCH AND LARGER

A. All pipes shall be installed to accurate lines and grades with fittings, valves and appurtenances at the required locations. Piping shall be perpendicular to penetrated walls and parallel to floor except where shown otherwise on the Drawings or approved by the Engineer.

B. Installation

1. All piping shall be cleared of debris, dirt, etc., before being installed and be kept clean until accepted at completion of work.
2. Piping shall be installed in a neat workmanlike manner. Proper tools and facilities shall be provided and used by the Contractor for safe working

conditions. All piping shall be carefully installed in such a manner as to prevent damage to piping materials, protective coatings and liners.

3. The pipe, fittings and appurtenances shall be inspected for defects prior to installation.
4. Piping shall be installed so no undue strain is placed upon piping joints, equipment or structures.

C. Supports

1. The Contractor shall provide all necessary supports to keep the pipe and appurtenances stable at the lines and grades shown on drawings or as directed by the Engineer, and without strain upon the piping and connected equipment.
2. Piping supported from the floor or from the top of concrete walls shall be supported by suitable saddle stands, concrete piers, or suspended from steel support framing as shown on the drawings. Piping along walls shall be supported by suitable wall brackets with attached roller or saddle, or by wall brackets with hanger rods. For piping supported from the ceiling, approved rod anchors and ceiling inserts or anchorage of a type capable of supporting the pipe shall be used.

- D. Piping cast in concrete or masonry shall be accurately set with bolt holes carefully aligned so that connecting piping can be installed without undue strain at the lines and grades required.

3.6 SETTING APPURTENANCES

Install all fittings and appurtenances in the lines as indicated on the drawings or as specified by the Engineer.

A. Shouldered Type Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C60 requirements. Additionally, all lumps, blisters, and foreign material must be removed from the bell and spigot end of each pipe.
2. The tightening torque shall not exceed the limits recommended by the joint manufacturer.
3. If deflection is required, deflect pipe, fittings, adapters or valves after jointing. The amount of deflection shall not exceed the limits recommended by the joint manufacturer.

B. Threaded Joints

1. Threading of steel pipe shall be done after bending, forging, heat treating or welding operations.

2. Threads shall be concentric with the outside of the pipe and shall conform to ANSI 82.1.
3. Do not seal weld threaded joints; instead make leak-tight using Teflon tape on all but the first two threads of the pipe.
4. When threading chemically cleaned pipe, use inhibited trichloroethane (methyl chloroform) as the cutting fluid.
5. Avoid over tightening of threaded joints damaging the pipe exterior with the pipe wrench.
6. Backing off of made-up threaded joints to facilitate fit-up or alignment will not be permitted.

3.7 INFILTRATION LIMITS

Maximum infiltration/exfiltration limits for all new sewers shall not exceed 50 gallons per inch of diameter per mile of pipe per 24 hours. This standard is for the overall project and includes all manholes and other structures. All sections of new sewer shall be tested, and any sections not meeting this infiltration standard shall be repaired and retested. The piping in this project conveys sludge that is hazardous to the public and environment. Extreme caution must be taken to ensure zero leakage in this system.

3.8 HYDROSTATIC TESTING FOR PRESSURE AND PROCESS PIPING

- A. Test procedures shall meet the requirements of ANSI/AWWA C600.
- B. Piping may be tested in sections between valves when there is one or more intermediary valve in a line.
- C. The piping shall be complete and shall have been in place for not less than 10 days prior to being tested.
- D. Test closed-end pressure piping as follows:
 1. Expel all air from the piping prior to the application of test pressure. Tap the piping at high points, if necessary, to release all air from the piping. Plug taps after the test is successfully completed. Plugs shall be watertight.
 2. Test piping at a static pressure of 120 pounds per square inch over a period of not less than eight consecutive hours. The test will be considered successful when the pressure drop over the test period is 5 pounds per square inch or less. If the pressure drop exceeds 5 pounds per square inch, repair the leaks and repeat the test. Repair leaks and repeat the test until the pressure drop over the test period is 5 pounds per square inch or less.
- E. Test open-end pressure piping and ductile iron sewer piping as follows:

1. The ends of piping being tested shall have test plugs or caps adapted with a tap of adequate diameter to fill and pressurize the system with water.
2. When a section is terminated at a manhole with a plain end (spigot), the pipe must extend into the manhole of sufficient length to accommodate a restraining cap. The bench-wall shall be formed in the manhole after the test section has been approved.
3. Water shall be introduced into the section to be tested at the lower end. The upper end shall have an orifice at the top of the plug or cap to expel air when filling the system with water. All air shall be expelled from the pipe.
4. The test plugs or caps shall be capable of withstanding an internal pressure of 175 psi.
5. Pumped flow systems shall be subjected to an internal pressure equal to 50% more than the maximum operating pressure, but in no case less than 50 psig or greater than 120 psig.
6. **Hydrostatic tests can be dangerous** if, because of ignorance or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed in such a way as to prevent blowouts. In as much as a force of 2,500 pounds is exerted on an 8-inch plug by an internal pipe pressure of 50 psi, it should be realized that sudden expulsion of a poorly installed plug or cap can be dangerous. **As a safety precaution, no one shall be allowed in the manholes when the pipe is pressurized.**

3.9 FLUSHING

A. Water, Wastewater and Sludge Piping

1. Flush piping with a flushing velocity of at least 2.5 feet per second. Following are flows required to provide a flushing velocity of 2.5 feet per second:

Pipe Size (Inches)	Inside Diameter (Inches)	Flow at a Velocity of 2.5 Feet per Second (gpm)
14 DIP	14.55	1296
16 HDPE	14.047	1208

2. Flush piping until the water discharged is clear.

END OF SECTION 40 05 13

SECTION 40 05 23 – PROCESS VALVE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Install all valves and appurtenances necessary to complete work shown or specified.
- B. Codes, specifications and standards referred to by title or number in this specification shall be adhered to, and latest revisions shall apply in all cases.
- C. Definitions
 - 1. Abbreviations
 - a. ANSI - American National Standards Institute
 - b. API - American Petroleum Institute
 - c. ASTM - American Society for Testing & Materials
 - d. AWWA - American Water Works Association
 - e. MSS - Manufacturers Standardization Society
 - f. PFI - Pipe Fabricators Institute
 - 2. Valve size and all references to pipe diameter on the drawings or specifications are intended to be nominal size or diameter and shall be interpreted as such.

1.2 QUALITY ASSURANCE

- A. Mark valves according to the applicable specification or standard.
- B. Perform field tests in accordance with the applicable specification or standard.

1.3 SUBMITTALS

- A. Submittals shall be as specified in the General Conditions and Section 01 00 00, General Requirements.
- B. Submit:
 - 1. Shop drawings with performance data and physical characteristics for valves and any power units

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage, and handling of all products.
- B. The Contractor shall be responsible for scheduling, receiving, storing, and

handling of all products for this project.

- C. Load and unload all valves and appurtenances by hoists or skidding. Do not drop products. Do not skid or roll products on or against other products. Use sling, hooks and pipe tongs in such a manner to prevent damage to products. The use of chains as slings is prohibited unless otherwise approved by the manufacturer.
- D. Keep stored products safe from damage or deterioration. Keep the interior of valves and appurtenances free from dirt or foreign matter. Drain and store valves in a manner that will protect valves from damage by freezing. Store gaskets and other products which will deteriorate from sunlight in a cool location out of direct sun-light. Gaskets shall not come in contact with petroleum products.
- E. Store valves, gaskets, accessories, and appurtenances in accordance with manufacturer's recommendations.
- F. Do not stack valves, valve boxes or valve stands.
- G. Promptly remove damaged products from the job site and replace with undamaged products.

PART 2 - PRODUCTS

2.1 GENERAL

All valves and appurtenances shall be new, unused, as shown within the contract plan set, and as specified in this Section unless otherwise noted within the contract documents. Valve opening direction shall be determined by the Engineer.

2.2 VALVES

A. Air Release/Vacuum Valves (Ductile Iron)

- 1. The Contractor is responsible for supplying all materials required to connect the air release/vacuum valve to the ductile iron pipe.
 - a. All 2" diameter NPT pipe must be either 316 stainless steel or brass.
 - b. A full-ported brass ball valve shall be furnished for each air/vacuum valve to isolate the valve from the piping system.

B. Plug Valve (Ductile Iron)

- 1. The Contractor is responsible for supplying all materials required to connect the plug valve to the ductile iron pipe flanges.

C. Backwater Valves

1. The Contractor must furnish all of the Backwater Valves required for this project as shown on the Contract Plan Set.
2. Backwater valves for general wastewater service in sizes 3-inches, 4-inches, and 6-inches, shall be of the following manufacturer and model:
 - a. Rectorseal Clean Check® Backwater Valve
 - b. Contractor can propose the use of a different backwater valve only with justification as to why the substitute product is operationally superior to the Rectorseal Clean Check® product.
3. Valve body and exposed components must be PVC plastic, fusion bonded epoxy coated ductile or cast iron, or 316 stainless steel. Any exposed nuts, bolts, washers, and springs shall be 316 stainless steel.
4. When necessary, any fusion bonded epoxy coatings must be electrostatically applied internally and externally with a minimum 10 mil thickness. The coating shall meet or exceed the requirements of AWWA C550.
5. Contractor is responsible for furnishing and installing all adapters and miscellaneous accessories necessary to install each backwater valve.

D. 100% Port Gate Valves (4 Inches and Larger Ductile Iron)

1. The Contractor is responsible for supplying all materials required to connect the plug valve to the ductile iron pipe flanges.

PART 3 - EXECUTION

3.1 INSPECTION

- A. The quality of all materials, the process of manufacture, and the finished products shall be subject to inspection and approval by the Engineer. Such inspection may be made at the place of manufacture, on the work after delivery or at both places. The products shall be subject to rejection at any time on account of failure to meet any of the specifications' requirements even though sample products may have been accepted as satisfactory at the place of manufacture.
 1. Prior to being installed, each pipe, fitting, valve and hydrant shall be carefully inspected, and those not meeting the specifications shall be rejected and promptly removed from the work.

3.2 INSTALLATION OF EXPOSED VALVES

- A. Installation of valves shall be in conjunction with and in conformance with piping installation as specified in Section 40 05 13 – Process Piping.
 - 1. All valves must be cleared of debris, dirt, etc., before being installed and must be kept clean until accepted at the completion of the work. During installation, no debris, tools, clothing, lumber, or other materials shall be placed in the valves.
 - 2. Valves shall be installed in a neat workmanlike manner. Proper implements, tools, and facilities shall be provided and used by the Contractor for the **safe** and convenient prosecution of the work. All valves shall be carefully installed in such a manner as to prevent damage to valve materials, protective coatings, and liners.
 - 3. The valves and appurtenances shall be inspected for defects prior to installation.
 - 4. Valves shall be installed in such a manner that no undue strain is placed upon piping joints, equipment, or structures.
- B. The Contractor shall provide all supports necessary to support the valves and appurtenances in a firm, substantial manner at the lines and grades shown on the drawings or as directed, and without strain upon the piping and connected equipment.
 - 1. Valves shall be supported from the floor by suitable saddle stands or concrete piers. Valves along walls may be supported by suitable wall brackets. For piping supported from the ceiling, approved rod anchors of a type capable of screw adjustments after erection of the piping and valves and with suitable adjustable concrete inserts or beam clamps shall be used.

3.3 INSTALLATION OF BURIED VALVES

- A. Installation of buried valves shall be in conjunction with and in conformance with piping installation as specified in Section 40 05 13 – Process Piping.
 - 1. All valves must be cleared of debris, dirt, etc., before being installed and must be kept clean until accepted at the completion of the work. During installation, no debris, tools, clothing, lumber, or other materials shall be placed in the valves.
 - 2. Valves shall be installed in a neat workmanlike manner. Proper implements, tools, and facilities shall be provided and used by the Contractor for the **safe** and convenient prosecution of the work. All valves shall be carefully installed in such a manner as to prevent damage to valve materials, protective coatings, and liners.

3. The valves and appurtenances shall be inspected for defects prior to installation.
4. Valves shall be installed in such a manner that no undue strain is placed upon piping joints, equipment, or structures.
5. Install components in accordance with manufacturer's instructions and approved product data submittals.
6. Set plumb, level, and rigid.

3.4 SETTING APPURTENANCES

Install all valves and appurtenances in the lines as indicated on the drawings.

3.5 VALVE LEAKAGE TESTING

Test valves for leakage at the same time that the connecting pipelines are tested. See Section 40 05 13 – Process Piping for pressure testing requirements. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage, except for air release/vacuum valves in aeration systems. Repair or replace valves showing leaks and retest.

3.6 VALVE FIELD TESTING

- A. Operate manual valves through 10 full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. If valves stick or bind, repair the valve and repeat the tests. This procedure must be repeated until sticking or binding is no longer occurring.
- B. Gear operators shall operate valves from full open to full close through 10 cycles without binding or sticking. The pull required to operate handwheel or chainwheel-operated valves shall not exceed 80 pounds. The torque required to operate valves having 2-inch ANSI/AWWA nuts shall not exceed 150 ft.-lbs. If operators stick or bind or if pulling forces and torques exceed the values stated previously, repair the operators and repeat the tests. Operators shall be fully lubricated in accordance with the manufacturer's recommendations prior to operating.

3.7 VALVE SCHEDULE

Install the valves and operators per the indications and tables in the Contract Plan Sheets

END OF SECTION 40 05 23

UNIQUE SPECIAL PROVISIONS FOR PROTECTION OF RAILROAD INTERESTS Indiana Rail Road Company

The State of Indiana Standard Specifications are revised as follows:

SECTION 103, LINE 553, DELETE AND INSERT AS FOLLOWS:

103.03 Railroad Provision

This project requires work to be done on or in the vicinity of railroad property. Railroad Protective Liability Insurance shall be required. Unique insurance requirements for this contract are included in Section 107.09 and shall be complied with in addition to the requirements of Section 103.04.

SECTION 107.09, AFTER LINE 388, INSERT AS FOLLOWS:

(c) Railroad Information

All work on or in the vicinity of the railroad(s)' right-of way shall be subject to and governed by the provisions titled "PROTECTION OF RAILWAY INTEREST". The railroad information contained therein pertaining to rate of pay and additional charges applied to payment for persons performing flagging services, number of trains, and speed of trains, was furnished by the Railroad Company(s). This information shall be verified in order to determine costs for the contract.

PROTECTION OF RAILWAY INTEREST

1. AUTHORITY OF RAILROAD ENGINEER AND DEPARTMENT ENGINEER:

The authorized representative of the Railroad Company, hereinafter referred to as Railroad Engineer, shall have final authority in all matters affecting the safe maintenance of Railroad traffic of his Company including the adequacy of the foundations and structures supporting the Railroad tracks. For Public Projects impacting The Indiana Rail Road Company ("INRD"), the Vice President of Engineering will serve as the Railroad Engineer.

The authorized representative of the Department, hereinafter referred to as the Department Engineer, shall have authority over all other matters as prescribed herein and in the Project Specifications.

2. NOTICE OF STARTING WORK:

A. Department's Prime contractor shall not commence any work on railroad rights-of-way until he has complied with the following conditions:

1. Given the Railroad written notice in electronic format to the Railroad Engineer, with copy to the Department Engineer who has been designated to be in charge of the work, at least ten days in advance of the date he proposes to begin work on Railroad rights-of-way.
2. Obtained written approval from the Railroad of Railroad Protective Liability Insurance coverage as required by paragraph 14 herein. It should be noted that Railroad Company does not accept notation of Railroad Protective insurance on a certificate of liability insurance form or Binders as Railroad Company must have the full original countersigned policy. Further, please note that mere receipt of the policy is not the only issue but review for compliance. Due to the number of projects system-wide, it typically takes a minimum of 30-45 days for Railroad Company to review.
3. Obtained Railroad's Flagging Services as required by paragraph 7 herein.
4. Obtained written authorization from the Railroad to begin work on Railroad rights- of-way, such authorization to include an outline of specific conditions with which he or she must comply.
5. Furnished a schedule for all work within the Railroad rights-of-way as required by paragraph 7.B.1.

B. The Railroad's written authorization to proceed with the work shall include the names, addresses, and telephone numbers of the Railroad's representatives who are to be notified as hereinafter required. Where more than one representative is designated, the area of responsibility of each representative shall be specified.

TECHNICAL PROVISIONS – Attachment 16-1
Unique Special Provisions for Protection of Railroad Interests (Indiana Rail Road Company)

3. INTERFERENCE WITH RAILROAD OPERATIONS:

- A. The Contractor shall so arrange and conduct his work that there will be no interference with Railroad operations, including train, signal, telephone and telegraphic services, or damage to the property of the Railroad Company or to poles, wires, and other facilities of tenants on the rights-of-way of the Railroad Company. Whenever work is liable to affect the operations or safety of trains, the method of doing such work shall first be submitted to the Railroad Engineer for approval, but such approval shall not relieve the Contractor from liability. Any work to be performed by the Contractor which requires flagging service or inspection service shall be deferred by the Contractor until the flagging service or inspection service required by the Railroad is available at the job site.
- B. Whenever work within Railroad rights-of-way is of such a nature that impediment to Railroad operations such as use of runaround tracks or necessity for reduced speed is unavoidable, the Contractor shall schedule and conduct his operations so that such impediment is reduced to the absolute minimum.
- C. Should conditions arising from, or in connection with the work, require that immediate and unusual provisions be made to protect operations and property of the Railroad, the Contractor shall make such provisions. If in the judgment of the Railroad Engineer, or in his absence, the Railroad's Division Engineer, such provisions is insufficient, either may require or provide such provisions as he deems necessary. In any event, such unusual provisions shall be at the Contractor's expense and without cost to the Railroad or the Department.
- D. "One Call" Services do not locate buried railroad utilities. The contractor shall contact the railroad's representative 2 days in advance of work at those places where excavation, pile driving, or heavy loads may damage railroad underground facilities. Upon request from the contractor or agency, railroad forces will locate and paint mark or flag railroad underground facilities. The contractor shall avoid excavation or other disturbances of these facilities. If disturbance or excavation is required near a buried railroad facility, the contractor shall coordinate with the railroad to have the facility potholed manually with careful hand excavation. The facility shall be protected by the contractor during the course of the disturbance under the supervision and direction of the railroad representative.

4. TRACK CLEARANCES:

- A. The minimum track clearances to be maintained by the Contractor during construction are shown on the Project Plans. If temporary clearances are not shown on the project plans, the following criteria shall govern the use of falsework and formwork above or adjacent to operated tracks.
 - 1. A minimum vertical clearance of 23'-0" above top of highest rail shall be maintained at all times.
 - 2. A minimum horizontal clearance of 13'-0" from centerline of tangent track or 14'-0" from centerline of curved track shall be maintained at all times. Additional horizontal clearance may be required in special cases to be safe for operating conditions. This additional clearance will be as determined by the Railroad Engineer
 - 3. All proposed temporary clearances which are less than those listed above must be submitted to the Railroad Engineer for approval prior to construction and must also be authorized by the regulatory body of the State if less than the legally prescribed clearances.
 - 4. The temporary clearance requirements noted above shall also apply to all other physical obstructions including, but not limited to: stockpiled materials, park equipment, placement or driving of piles, and bracing or other construction supports.
- B. Before undertaking any work within Railroad right-of-way, and before placing any obstruction over any track, the Contractor shall:
 - 1. Notify the Railroad's representative at least 72 hours in advance of the work.
 - 2. Receive assurance from the Railroad's representative that arrangements have been made for flagging service as may be necessary.
 - 3. Receive permission from the Railroad's representative to proceed with the work.
 - 4. Ascertain that the Department Engineer has received copies of notice to the Railroad and of the Railroad's response thereto.

5. CONSTRUCTION PROCEDURES:

- A. General:
 - 1. Construction work and operations by the Contractor on Railroad property shall be:
 - a. Subject to the inspection and approval of the Railroad or their designated Construction Engineering Representative.
 - b. In accord with the Railroad's written outline of specific conditions.

TECHNICAL PROVISIONS – Attachment 16-1
Unique Special Provisions for Protection of Railroad Interests (Indiana Rail Road Company)

- c. In accord with the Railroad's general rules, regulations and requirements including those relating to safety, fall protection and personal protective equipment.
- d. In accord with these Special Provisions.

2. Submittal Requirements

- a. The contractor shall submit all construction related correspondence and submittals electronically to the Railroad Engineer.
- b. The contractor shall allow for 30 days for the Railroad's review and response.
- c. All work in the vicinity of the Railroad's property that has the potential to affect the Railroad's train operations or disturb the Railroad's Property must be submitted and approved by the Railroad prior to work being performed.
- d. All submittals and calculations must be signed and sealed by a registered engineer licensed in the state of the project work.
- e. All submittals shall first be approved by the Department Engineer and the Railroad Engineer, but such approval shall not relieve the Contractor from liability.
- f. For all construction projects, the following submittals, but not limited to those listed below, shall be provided for review and approval when applicable:
 - i. General Means and Methods
 - ii. Roadway Protection
 - iii. Construction Excavation & Shoring
 - iv. Pipe, Culvert, & Tunnel Installations
 - v. Demolition Procedure
 - vi. Erection & Hoisting Procedure
 - vii. Debris Shielding or Containment
 - viii. Blasting
 - ix. Formwork for the bridge deck, diaphragms, overhang brackets, and protective platforms
 - x. Bent Cap Falsework. A lift plan will be required if the contractor want to move the falsework over the tracks.
- g. For Undergrade Bridges (Bridges carrying the Railroad) the following submittals in addition to those listed above shall be provided for review and approval:
 - i. Shop Drawings
 - ii. Bearing Shop Drawings and Material Certifications
 - iii. Concrete Mix Design
 - iv. Structural Steel, Rebar, and/or Strand Certifications
 - v. 28 day Cylinder Test for Concrete Strength
 - vi. Waterproofing Material Certification
 - vii. Test Reports for Fracture Critical Members
 - viii. Foundation Construction Reports

Fabrication may not begin until the Railroad has approved the required shop drawings.

- h. The Contractor shall include in all submissions a detailed narrative indicating the progression of work with the anticipated timeframe to complete each task. Work will not be permitted to commence until the Contractor has provided the Railroad with a satisfactory plan that the project will be undertaken without scheduling, performance or safety related issues. Submission shall also provide a listing of the anticipated equipment to be used, the location of all equipment to be used and insure a contingency plan of action is in place should a primary piece of equipment malfunction.

B. Roadway Protection

- 1. The Contractor shall submit the proposed roadway protection system detailing the specific filter fabric and anchorage system to be used during all construction activities.
- 2. The roadway protection is to extend 25' beyond the proposed limit of work, be installed at the start of the project and be continuously maintained to prevent all contaminants from entering the ballast section of all tracks for the entire duration of the project.

C. Excavation:

TECHNICAL PROVISIONS – Attachment 16-1
Unique Special Provisions for Protection of Railroad Interests (Indiana Rail Road Company)

1. The subgrade of an operated track shall be maintained with edge of berm at least 10'-0" from centerline of track and not more than 24-inches below top of rail. Contractor will not be required to make existing section meet this specification if substandard, in which case existing section will be maintained.
2. Additionally, the Railroad will require the installation of an OSHA approved handrail and orange construction safety fencing for all excavations of the Railroad right-of-way.

D. Excavation for Structures and Shoring Protection:

1. The Contractor will be required to take special precaution and care in connection with excavating and shoring pits, and in driving piles or sheeting for footings adjacent to tracks to provide adequate lateral support for the tracks and the loads which they carry, without disturbance of track alignment and surface, and to avoid obstructing track clearances with working equipment, tools or other material.
2. All plans and calculations for shoring shall be prepared and signed by a Registered Professional Engineer, licensed in the state of the proposed project, in accordance with The American Railroad Engineering and Maintenance-of-Way ("AREMA") Guidelines. The Registered Professional Engineer will be responsible for the accuracy for all controlling dimensions as well as the selection of soil design values which will accurately reflect the actual field conditions.
3. The contractor shall provide a detailed installation and removal plan of the shoring components. Any component that will be installed via the use of a crane or any other lifting device shall be subject to the guidelines outlined in section 5.G.
4. The contractor shall be required to survey the track(s) and railroad embankment and provide a cross section of the proposed excavation in relation to the tracks.
5. Calculations for the proposed shoring should include deflection calculations. The maximum deflection for excavations within 18'-0" of the centerline of the nearest track shall be 3/8". For all other cases, the max deflection shall not exceed 1/2".
6. Additionally, the Railroad will require the installation of an OSHA approved handrail and orange construction safety fencing for all excavations of the Railroad right-of-way.

E. Pipe, Culvert, & Tunnel Installations

- a. Pipe, Culvert, & Tunnel Installations shall be in accordance with AREMA Guidelines.

F. Demolition Procedure

1. General

- a. Demolition plans are required for all spans over the track(s), for all spans adjacent to the track(s), if located on (or partially on) Railroad right-of-way; and in all situations where cranes will be situated on, over, or adjacent to Railroad right-of-way and within a distance of boom length plus 15'-0" from the centerline of track.
- b. Railroad tracks and other railroad property must be protected from damage during the procedure.
- c. A pre-demolition meeting shall be conducted with the Department, the Railroad Engineer or their representative, and the key contractor personnel prior to the start of the demolition procedure.
- d. The Railroad Engineer or his designated representative must be present at the site during the entire demolition procedure period.
- e. Existing, obsolete, bridge piers shall be removed to a sufficient depth below grade to enable restoration of the existing/proposed track ditch, but in no case less than 2'-0" below final grade.

2. Submittal Requirements

- a. In addition to the submittal requirements outlined in Section 5.A.2, the contractor shall submit the following for approval by the Railroad Engineer:
 - i. A plan showing the location of cranes, horizontally and vertically, operating radii, with delivery or disposal locations shown. The location of all tracks and other railroad facilities as well as all obstructions such as wire lines, poles, adjacent structures, etc. must also be shown.

TECHNICAL PROVISIONS – Attachment 16-1
Unique Special Provisions for Protection of Railroad Interests (Indiana Rail Road Company)

- ii. Rating sheets showing cranes or lifting devices to be adequate for 150% of the actual weight of the pick, including all rigging components. A complete set of crane charts, including crane, counterweight, and boom nomenclature is to be submitted. Safety factors that may have been “built-in” to the crane charts are not to be considered when determining the 150% factor of safety.
- iii. Plans and computations showing the weight of the pick must be submitted. Calculations shall be made from plans of the existing structure showing complete and sufficient details with supporting data for the demolition the structure. If plans do not exist, lifting weights must be calculated from field measurements. The field measurements are to be made under the supervision of the Registered Professional Engineer submitting the procedure and calculations.
 - iv. The contractor shall provide a sketch of all rigging components from the crane’s hook block to the beam. Catalog cuts or information sheets of all rigging components with their lifting capacities shall be provided. All rigging must be adequate for 150% of the actual weight of the pick. Safety factors that may have been “built-in” to the rating charts are not to be considered when determining the 150% factor of safety. All rigging components shall be clearly identified and tagged with their rated lifting capacities. The position of the rigging in the field shall not differ from what is shown on the final plan without prior review from the Department and the Railroad.
- v. A complete demolition procedure, including the order of lifts, time required for each lift, and any repositioning or re-hitching of the crane or cranes.
- vi. Design and supporting calculations for the temporary support of components, including but not limited to the stability of the superstructure during the temporary condition, temporary girder tie- downs and falsework.

3. Overhead Demolition Debris Shield

- a. The demolition debris shield shall be installed prior to the demolition of the bridge deck or other relevant portions of the superstructure over the track area to catch all falling debris.
- b. The demolition debris shield shall provide a minimum vertical clearance as specified in Section 4.A.1 or maintain the existing vertical clearance if the existing clearance is less than that specified in Section 4.A.1.
- c. The Contractor shall include the demolition debris shield installation/removal means and methods as part of the proposed Demolition procedure submission.
- d. The contractor shall submit the demolition debris shield design and supporting calculations for approval by the Railroad Engineer
- e. The demolition debris shield shall have a minimum design load of 50 pounds per square foot plus the weight of the equipment, debris, personnel, and other loads to be carried.
- f. The Contractor shall include the proposed bridge deck removal procedure in its demolition means and methods and shall verify that the size and quantity of the demolition debris generated by the procedure does not exceed the shield design loads.
- g. The contractor shall clean the demolition debris shield daily or more frequently as dictated either by the approved design parameters or as directed by the Railroad Engineer.

4. Vertical Demolition Debris Shield

- a. A vertical demolition debris shield may be required for substructure removals in close proximity to the Railroad’s track and other facilities, as determined by the Railroad Engineer.

G. Erection & Hoisting Procedures

1. General

- a. Erection plans are required for all spans over the track(s), for all spans adjacent to the track(s), if located on (or partially on) Railroad right-of-way; and in all situations where cranes will be situated on, over, or adjacent to Railroad right- of-way and within a distance of boom length plus 15’-0” from the centerline of track.
- b. Railroad tracks and other railroad property must be protected from damage during the erection procedure.
- c. A pre-erection meeting shall be conducted with the Department, the Railroad Engineer or their representative, and the key contractor personnel prior to the start of the erection procedure.

TECHNICAL PROVISIONS – Attachment 16-1
Unique Special Provisions for Protection of Railroad Interests (Indiana Rail Road Company)

- d. The Railroad Engineer or his designated representative must be present at the site during the entire erection procedure period.
- e. For field splices located over Railroad property, a minimum of 50% of the holes for each connection shall be filled with bolts or pins prior to releasing the crane. A minimum of 50% of the holes filled shall be filled with bolts. All bolts must be appropriately tightened.

2. Submittal Requirements

- a. In addition the submittal requirements outlined in Section 5.A.2, the contract shall submit the following for approval by the Railroad Engineer:
 - i. As-built beam seat elevations - All as-built bridge seats and top of rail elevations shall be furnished to the Railroad Engineer for review and verification at least 30 days in advance of the erection, to ensure that minimum vertical clearances as approved in the plans will be achieved.
 - ii. A plan showing the location of cranes, horizontally and vertically, operating radii, with delivery or staging locations shown. The location of all tracks and other railroad facilities as well as all obstructions such as wire lines, poles, adjacent structures, etc. must also be shown.
 - iii. Rating sheets showing cranes or lifting devices to be adequate for 150% of the actual weight of the pick, including all rigging components. A complete set of crane charts, including crane, counterweight, and boom nomenclature is to be submitted. Safety factors that may have been "built-in" to the crane charts are not to be considered when determining the 150% factor of safety.
 - iv. Plans and computations showing the weight of the pick must be submitted. Calculations shall be made from plans of the proposed structure showing complete and sufficient details with supporting data for the erection of the structure. If plans do not exist, lifting weights must be calculated from field measurements. The field measurements are to be made under the supervision of the Registered Professional Engineer submitting the procedure and calculations.
 - v. The contractor shall provide a sketch of all rigging components from the crane's hook block to the beam. Catalog cuts or information sheets of all rigging components with their lifting capacities shall be provided. All rigging must be adequate for 150% of the actual weight of the pick. Safety factors that may have been "built-in" to the rating charts are not to be considered when determining the 150% factor of safety. All rigging components shall be clearly identified and tagged with their rated lifting capacities. The position of the rigging in the field shall not differ from what is shown on the final plan without prior review from the Department and the Railroad.
 - vi. A complete erection procedure, including the order of lifts, time required for each lift, and any repositioning or re-hitching of the crane or cranes.
 - vii. Design and supporting calculations for the temporary support of components, including but not limited to temporary girder tie-downs and falsework.

H. Blasting:

- 1. The Contractor shall obtain advance approval of the Railroad Engineer and the Department Engineer for use of explosives on or adjacent to Railroad property. The request for permission to use explosives shall include a detailed blasting plan. If permission for use of explosives is granted, the Contractor will be required to comply with the following:
 - a. Blasting shall be done with light charges under the direct supervision of a responsible officer or employee of the Contractor and a licensed blaster.
 - b. Electric detonating fuses shall not be used because of the possibility of premature explosions resulting from operation of two-way radios.
 - c. No blasting shall be done without the presence of the Railroad Engineer or his authorized representative. At least 72 hours advance notice to the person designated in the Railroad's notice of authorization to proceed (see paragraph 5.E.2.B) will be required to arrange for the presence of an authorized Railroad representative and such flagging as the Railroad may require.
 - d. Have at the job site adequate equipment, labor and materials and allow sufficient time to clean up debris resulting from the blasting without delay to trains, as well as correcting at his expense any track misalignment or other damage to Railroad

TECHNICAL PROVISIONS – Attachment 16-1
Unique Special Provisions for Protection of Railroad Interests (Indiana Rail Road Company)

- property resulting from the blasting as directed by the Railway's authorized representative. If his actions result in delay of trains, the Contractor shall bear the entire cost thereof.
- e. The blasting contractor shall have a copy of the approved blasting plan on hand while on the site.
 - f. Explosive materials or loaded holes shall not be left unattended at the blast site.
 - g. A seismograph shall be placed on the track shoulder adjacent to each blast which will govern the peak particle velocity of two inches per second. Measurement shall also be taken on the ground adjacent to structures as designated by a qualified and independent blasting consultant. The Railroad reserves the option to direct the placement of additional seismographs at structures or other locations of concern, without regard to scaled distance.
 - h. After each blast, the blasting contractor shall provide a copy of their drill log and blast report, which includes number of holes, depth of holes, number of decks, type and pounds of explosives used per deck.
 - i. The Railroad may require top of rail elevations and track centers taken before, during and after the blasting and excavation operation to check for any track misalignment resulting from the Contractor's activities.
2. The Railroad representative will:
- a. Determine approximate location of trains and advise the Contractor the appropriate amount of time available for the blasting operation and clean up.
 - b. Have the authority to order discontinuance of blasting if, in his opinion, blasting is too hazardous or is not in accord with these special provisions.
3. The Contractor must hire, at no expense to the Railroad, a qualified and independent blasting consultant to oversee the use of explosives. The blasting consultant will:
- a. Review the Contractor's proposed drilling and loading patterns, and with the blasting consultant's personnel and instruments, monitor the blasting operations.
 - b. Confirm that the minimum amounts of explosives are used to remove the rock.
 - c. Be empowered to intercede if he concludes that the Contractor's blasting operations are endangering the Railway.
 - d. Submit a letter acknowledging that he has been engaged to oversee the entire blasting operation and that he approves of the blasting plan.
 - e. Furnish copies of all vibration readings to the Railroad representative immediately after each blast. The representative will sign and date the seismograph tapes after each shot to verify the readings are for that specific shot.
 - f. Advise the Railroad representative as to the safety of the operation and notify him of any modifications to the blasting operation as the work progresses.
4. The request for permission to use explosives on the Railroad's Right-of-Way shall include a blasting proposal providing the following details:
- a. A drawing which shows the proposed blasting area, location of nearest hole and distance to Railway structures, all with reference to the centerline of track.
 - b. Hole diameter.
 - c. Hole spacing and pattern.
 - d. Maximum depth of hole.
 - e. Maximum number of decks per hole.
 - f. Maximum pounds of explosives per hole.
 - g. Maximum pounds of explosives per delay.
 - h. Maximum number of holes per detonation.
 - i. Type of detonator and explosives to be used. (Electronic detonating devices will not be permitted). Diameter of explosives if different from hole diameter.
 - j. Approximate dates and time of day when the explosives are to be detonated.
 - k. Type of flyrock protection.
 - l. Type and patterns of audible warning and all clear signals to be used before and after each blast.
 - m. A copy of the blasting license and qualifications of the person directly in charge of the blasting operation, including their name,

TECHNICAL PROVISIONS – Attachment 16-1
Unique Special Provisions for Protection of Railroad Interests (Indiana Rail Road Company)

- address and telephone number.
- n. A copy of the Authority's permit granting permission to blast on the site.
- o. A letter from the blasting consultant acknowledging that he has been engaged to oversee the entire blasting operation and that he approves of the blasting plan.
- p. In addition to the insurance requirements outlined in Paragraph 14, a certificate of insurance from the Contractor's insurer stating the amount of coverage for XCU (Explosive Collapse and Underground Hazard) insurance and that XCU Insurance is in force for this project.
- q. A copy of the borings and Geotechnical information or report.
- I. Track Monitoring

1. At the direction of the Railroad Engineer, any activity that has the potential to disturb the Railroad track structure may require the contractor to submit a detailed track monitoring program for approval by the Railroad Engineer.
2. The program shall specify the survey locations, the distance between the location points, and frequency of monitoring before, during, and after construction. Railroad reserves the right to modify the survey locations and monitoring frequency as necessary during the project.
3. The survey data shall be collected in accordance with the approved frequency and immediately furnished to the Railroad Engineer for analysis.
4. If any movement has occurred as determined by the Railroad Engineer, the Railroad will be immediately notified. Railroad, at its sole discretion, shall have the right to immediately require all contractor operations to be ceased and determine what corrective action is required. Any corrective action required by the Railroad or performed by the Railroad including the monitoring of corrective action of the contractor will be at project expense.

J. Maintenance of Railroad Facilities:

1. The Contractor will be required to maintain all ditches and drainage structures free of silt or other obstructions which may result from his operations and provide and maintain any erosion control measures as required. The Contractor will promptly repair eroded areas within Railroad rights-of-way and repair any other damage to the property of the Railroad or its tenants.
2. If, in the course of construction, it may be necessary to block a ditch, pipe or other drainage facility, temporary pipes, ditches or other drainage facilities shall be installed to maintain adequate drainage, as approved by INRD. Upon completion of the work, the temporary facilities shall be removed and the permanent facilities restored.
3. All such maintenance and repair of damages due to the Contractor's operations shall be done at the Contractor's expense.

K. Storage of Materials and Equipment:

1. Materials and equipment shall not be stored where they will interfere with Railroad operations, nor on the rights-of-way of the Railroad Company without first having obtained permission from the Railroad Engineer, and such permission will be with the understanding that the Railroad Company will not be liable for damage to such material and equipment from any cause and that the Railroad Engineer may move or require the Contractor to move, at the Contractor's expense, such material and equipment.
2. All grading or construction machinery that is left parked near the track unattended by a watchman shall be effectively immobilized so that it cannot be moved by unauthorized persons. The Contractor shall protect, defend, indemnify and save Railroad, and any associated, controlled or affiliated corporation, harmless from and against all losses, costs, expenses, claim or liability for loss or damage to property or the loss of life or personal injury, arising out of or incident to the Contractor's failure to immobilize grading or construction machinery.

L. Cleanup:

1. Upon completion of the work, the Contractor shall remove from within the limits of the Railroad rights-of-way, all machinery, equipment, surplus materials, falsework, rubbish or temporary buildings of the Contractor, and leave said rights-of-way in a neat condition satisfactory to the Railroad Engineer or his authorized representative.

6. DAMAGES:

- A. The Contractor shall assume all liability for any and all damages to his work, employees, servants, equipment and materials caused by Railroad traffic.
- B. Any cost incurred by the Railroad for repairing damages to its property or to property of its tenants, caused by or resulting from the operations of the Contractor, shall be paid directly to the Railroad by the Contractor.

7. FLAGGING SERVICES:

- A. Requirements:

TECHNICAL PROVISIONS – Attachment 16-1
Unique Special Provisions for Protection of Railroad Interests (Indiana Rail Road Company)

1. Flagging services will not be provided until the contractor's insurance has been reviewed & approved by the Railroad.
2. Under the terms of the agreement between the Department and the Railroad, the Railroad has sole authority to determine the need for flagging required to protect its operations. In general, the requirements of such services will be whenever the Contractor's personnel or equipment are or are likely to be, working on the Railroad's right-of-way, or across, over, adjacent to, or under a track, or when such work has disturbed or is likely to disturb a railroad structure or the railroad roadbed or surface and alignment of any track to such extent that the movement of trains must be controlled by flagging.
3. Normally, the Railroad will assign one flagman to a project; but in some cases, more than one may be necessary, such as yard limits where three (3) flagmen may be required. However, if the Contractor works within distances that violate instructions given by the Railroad's authorized representative or performs work that has not been scheduled with the Railroad's authorized representative, a flagman or flagmen may be required full time until the project has been completed.

B. Scheduling and Notification:

1. The Contractor's work requiring railroad flagging should be scheduled to limit the presence of a flagman at the site to a maximum of 50 hours per week. The Contractor shall receive Railroad approval of work schedules requiring a flagman's presence in excess of 40 hours per week.
2. Not later than the time that approval is initially requested to begin work on Railroad right-of-way, Contractor shall furnish to the Railroad and the Department a schedule for all work required to complete the portion of the project within Railroad right-of-way and arrange for a job site meeting between the Contractor, the Department, and the Railroad's authorized representative. Flagman or Flagmen may not be provided until the job site meeting has been conducted and the Contractor's work scheduled.
3. The Contractor will be required to give the Railroad representative at least 10 working days of advance written notice of intent to begin work within Railroad right-of-way in accordance with this special provision. Once begun, when such work is then suspended at any time, or for any reason, the Contractor will be required to give the Railroad representative at least 3 working days of advance notice before resuming work on Railroad right-of-way. Such notices shall include sufficient details of the proposed work to enable the Railroad representative to determine if flagging will be required. If such notice is in writing, the Contractor shall furnish the Engineer a copy; if notice is given verbally, it shall be confirmed in writing with copy to the Engineer. If flagging is required, no work shall be undertaken until the flagman, or flagmen are present at the job site. It may take up to 30 days to obtain flagging initially from the Railroad. When flagging begins, the flagman is usually assigned by the Railroad to work at the project site on a continual basis until no longer needed and cannot be called for on a spot basis. If flagging becomes unnecessary and is suspended, it may take up to 30 days to again obtain from the Railroad. Due to Railroad labor agreements, it is necessary to give 5 working days notice before flagging service may be discontinued and responsibility for payment stopped.
4. If, after the flagman is assigned to the project site, an emergency arises that requires the flagman's presence elsewhere, then the Contractor shall delay work on Railroad right-of-way until such time as the flagman is again available. Any additional costs resulting from such delay shall be borne by the Contractor and not the Department or Railroad.

C. Payment:

1. The Department will be responsible for paying the Railroad directly for any and all costs of flagging which may be required to accomplish the construction.
2. The estimated cost of flagging is current rate per day based on a 10-hour work day. This cost includes the base pay for the flagman, overhead, and includes a per diem charge for travel expenses, meals and lodging. The charge to the Department by the Railroad will be the actual cost based on the rate of pay for the Railroad's employees who are available for flagging service at the time the service is required.
3. Work by a flagman in excess of 8 hours per day or 40 hours per week, but not more than 12 hours a day will result in overtime pay at 1 and 1/2 times the appropriate rate. Work by a flagman in excess of 12 hours per day will result in overtime at 2 times the appropriate rate. If work is performed on a holiday, the flagging rate is 2 and 1/2 times the normal rate.
4. Railroad work involved in preparing and handling bills will also be charged to the Department. Charges to the Department by the Railroad shall be in accordance with applicable provisions of Subchapter B, Part 140, Subpart I and Subchapter G, Part 646, Subpart B of the Federal-Aid Policy Guide issued by the Federal Highway Administration on December 9, 1991, including all current amendments. Flagging costs are subject to change. The above estimates of flagging costs are provided for information only and are not binding in any way.

D. Verification:

1. Railroad's flagman will electronically enter flagging time via Railroad's electronic billing system. Any complaints concerning

TECHNICAL PROVISIONS – Attachment 16-1
Unique Special Provisions for Protection of Railroad Interests (Indiana Rail Road Company)

flagging must be resolved in a timely manner. If the need for flagging is questioned, please contact Railroad's System Engineer - Public Improvements. All verbal complaints will be confirmed in writing by the Contractor within 5 working days with a copy to the Department's Engineer. Address all written correspondence electronically to Railroad's System Engineer - Public Improvements:

2. The Railroad flagman assigned to the project will be responsible for notifying the Department Engineer upon arrival at the job site on the first day (or as soon thereafter as possible) that flagging services begin and on the last day that he performs such services for each separate period that services are provided. The Department Engineer will document such notification in the project records. When requested, the Department Engineer will also sign the flagman's diary showing daily time spent and activity at the project site.

8. HAUL ACROSS RAILROAD:

- A. Where the plans show or imply that materials of any nature must be hauled across a Railroad, unless the plans clearly show that the Department has included arrangements for such haul in its agreement with the Railroad, the Contractor will be required to make all necessary arrangements with the Railroad regarding means of transporting such materials across the Railroad. The Contractor or Agency will be required to bear all costs incidental to such crossings whether services are performed by his own forces or by Railroad personnel.
- B. No crossing may be established for use of the Contractor for transporting materials or equipment across the tracks of the Railroad Company unless specific authority for its installation, maintenance, necessary watching and flagging thereof and removal, until a temporary private crossing agreement has been executed between the Contractor and Railroad. The approval process for an agreement normally takes 90-days.

9. WORK FOR THE BENEFIT OF THE CONTRACTOR:

- A. All temporary or permanent changes in wire lines or other facilities which are considered necessary to the project are shown on the plans; included in the force account agreement between the Department and the Railroad or will be covered by appropriate revisions to same which will be initiated and approved by the Department and/or the Railroad.
- B. Should the Contractor desire any changes in addition to the above, then he shall make separate arrangements with the Railroad for same to be accomplished at the Contractor's expense.

10. COOPERATION AND DELAYS:

- A. It shall be the Contractor's responsibility to arrange a schedule with the Railroad for accomplishing stage construction involving work by the Railroad or tenants of the Railroad. In arranging his schedule he shall ascertain, from the Railroad, the lead time required for assembling crews and materials and shall make due allowance therefore.
- B. No charge or claim of the Contractor against either the Department or the Railroad Company will be allowed for hindrance or delay on account of railway traffic; any work done by the Railway Company or other delay incident to or necessary for safe maintenance of railway traffic or for any delays due to compliance with these special provisions.

11. TRAINMAN'S WALKWAYS:

- A. Along the outer side of each exterior track of multiple operated tracks, and on each side of single operated track, an unobstructed continuous space suitable for trainman's use in walking along trains, extending to a line not less than 10 feet from centerline of track, shall be maintained. Any temporary impediments to walkways and track drainage encroachments or obstructions allowed during work hours while Railway's protective service is provided shall be removed before the close of each work day. If there is any excavation near the walkway, a handrail, with 10'-0" minimum clearance from centerline of track, shall be placed and must conform to AREMA and/or FRA standards.

12. GUIDELINES FOR PERSONNEL ON RAILROAD RIGHT-OF-WAY:

- A. The Contractor shall be fully responsible for having and implementing an "On-Track Safety" program for all employees and assuring that on-track machines used by Contractor conform with FRA requirements contained in 49 CFR 214. A copy of INRD's "On-Track Safety" program shall be furnished to Contractor upon request. Contractor must also submit documentation to Railroad Engineer evidencing that each of its employees working within track limits have been safety trained as required by the FRA and in compliance with 49 CFR 214. The Contractor and Agency's personnel must be familiar with INRD's Standard Operating Rules and Guidelines, should conduct themselves accordingly, and may be removed from the property for failure to follow these guidelines.
- B. All persons shall wear hard hats. Appropriate eye and hearing protection must be used. Working in shorts is prohibited. Shirts must cover shoulders, back and abdomen. Working in tennis or jogging shoes, sandals, boots with high heels, cowboy and other slip-on type boots is prohibited. Hard-sole, lace-up footwear, zippered boots or boots cinched up with straps which fit snugly about the ankle are adequate. Wearing of safety boots is strongly recommended. In the vicinity of at-grade crossings, it is strongly recommended that reflective vests be worn.

TECHNICAL PROVISIONS – Attachment 16-1
Unique Special Provisions for Protection of Railroad Interests (Indiana Rail Road Company)

- C. CONTRACTOR shall confine its apparatus, the storage of materials and the operations of CONTRACTOR's workers to limits indicated by laws, ordinances, permits or requests of the Railroad Engineer and shall not unreasonably encumber the premises with its material, equipment and supplies. CONTRACTOR shall not leave unattended equipment on the main track. When leaving unattended equipment on track other than the main track, CONTRACTOR will either ensure that a properly placed and locked derail is in place, or chain the lead axle of the last piece of equipment into the rail to prevent machinery from fouling the main line. All turntable mounted booms must have their booms secured parallel to the track when not working, including time waiting in a side or spur track for a mainline movement. All equipment with drop down work heads will have those work heads lowered to prevent equipment from moving. Loose tools and other light equipment will be secured. No materials, tools or equipment shall at any time be stored or maintained nearer than fifteen (15) feet from the center line of any operated track, without the express permission of the Railroad Engineer, or his authorized representative in each and every instance. All heavy equipment provided or leased by CONTRACTOR shall be equipped with audible back-up warning devices. If in the opinion of the Railroad Engineer, any of CONTRACTOR's equipment is unsafe for use on INRD's right-of-way, CONTRACTOR, at the request of Railroad Engineer, shall remove such equipment therefrom.
- D. No one is allowed within 25' of the centerline of track without specific authorization from the flagman.
- E. All persons working near track while train is passing are to lookout for dragging bands, chains and protruding or shifted cargo.
- E. No one is allowed to cross tracks without specific authorization from the flagman.
- F. All welders and cutting torches working within 25' of track must stop when train is passing.
- G. No steel tape or chain will be allowed to cross or touch rails without permission from the Railroad.

13. GUIDELINES FOR EQUIPMENT ON RAILROAD RIGHT-OF-WAY:

- A. No crane or boom equipment will be allowed to set up to work or park within boom distance plus 15' of centerline of track without specific permission from railroad official and flagman.
- B. No crane or boom equipment will be allowed to foul track or lift a load over the track without flag protection and track time.
- C. All employees will stay with their machines when crane or boom equipment is pointed toward track.
- D. All cranes and boom equipment under load will stop work while train is passing (including pile driving).
- E. Swinging loads must be secured to prevent movement while train is passing.
- F. No loads will be suspended above a moving train.
- G. No equipment will be allowed within 25' of centerline of track without specific authorization of the flagman.
- H. Trucks, tractors or any equipment will not touch ballast line without specific permission from railroad official and flagman. Orange construction fencing may be required as directed.
- I. No equipment or load movement within 25' or above a standing train or railroad equipment without specific authorization of the flagman.
- J. All operating equipment within 25' of track must halt operations when a train is passing. All other operating equipment may be halted by the flagman if the flagman views the operation to be dangerous to the passing train.
- K. All equipment, loads and cables are prohibited from touching rails.
- L. While clearing and grubbing, no vegetation will be removed from railroad embankment with heavy equipment without specific permission from the Railroad Engineer and flagman.
- M. No equipment or materials will be parked or stored on Railroad's property unless specific authorization is granted from the Railroad Engineer.
- N. All unattended equipment that is left parked on Railroad property shall be effectively immobilized so that it cannot be moved by unauthorized persons.
- O. All cranes and boom equipment will be turned away from track after each work day or whenever unattended by an operator.

TECHNICAL PROVISIONS – Attachment 16-1
Unique Special Provisions for Protection of Railroad Interests (Indiana Rail Road Company)

- P. Prior to performing any crane operations, the contractor shall establish a single point of contact for the Railroad flagman to remain in communication with at all times. Person must also be in direct contact with the individual(s) directing the crane operation(s).

14. INSURANCE:

- A. The Contractor will be required to carry insurance in accordance with 103.04 of the Standard Specifications and the Railroad's requirements. In the event this project is awarded to a "joint venture" all insurance, except workman's compensation, shall be carried in the name of the joint venture.

Evidence of insurance as required above shall be furnished to the address shown. The original policies, or certificates, shall be sent to the railroad for its' review. Copies of the transmittal letter and the policies or certificates shall be forwarded to the Department.

RAILROAD POLICY

Department:
Indiana Dept. of Transportation
Construction Contracts Manager
Government Center North
100 N. Senate Avenue
Indianapolis, IN 46204-2219

Railroads:
SEE ATTACHMENT "A"

Trains will be operated at a maximum speed of 40 mph through the improvement. The number of trains through the improvement will be 12 freight trains daily.

The named insured, description of the work and designation of the job site to be shown on the Policy are as follows:

- (a) Named Insured: SEE ATTACHMENT "A"

- (b) Description and Designation:

Indiana Department of Transportation Contract: R-41536
Replacement of the bridges carrying I-465 over INRD tracks and Right-of-Way near the city of Indianapolis, Marion County, Indiana

- B. All insurance herein before specified shall be carried until all work required to be performed under the terms of the contract has been satisfactorily completed within the limits of the rights of way of the Railroad as evidenced by the formal acceptance by the Department. Insuring Companies may cancel insurance by permission of the Department and Railroad or on thirty (30) days written notice to the Railroad and copied to the Indiana Department of Transportation at the same addresses shown in Par. A above

- a. CONTRACTOR shall, at its sole cost and expense, procure and maintain during the life of the agreement, the following insurance coverage:
- i. Commercial General Liability Insurance. CGL shall contain broad form contractual liability with a combined single limit of a minimum of \$5,000,000 each occurrence and an aggregate limit of at least \$10,000,000. Coverage must be purchased on a post-1998 ISO occurrence form or equivalent and include coverage for, but not limited to the following:
 - Bodily Injury and Property Damage
 - Personal Injury and Advertising Injury
 - Fire Legal Liability
 - Products and Completed Operations
 - Contractual Liability

The policy shall contain the following endorsements (or appropriate alternate language) on the Certificate of Insurance:

- Employer's liability or workers' compensation related exclusions in the policy shall apply only to employees of the Named Insured and shall not apply to Railroad employees.
- The definition of "insured contract" shall be amended to remove any exclusion or other limitation for work being done within 50 feet of railroad property
- A Waiver of Subrogation
- Additional Insured endorsement in favor of INRD
- Separation of Insureds
- That policy shall be primary and non-contributing with respect to any insurance carried by the Railroad
- The policy shall contain no exclusion for subcontractors

TECHNICAL PROVISIONS – Attachment 16-1
Unique Special Provisions for Protection of Railroad Interests (Indiana Rail Road Company)

- ii. Business Automobile Insurance. This insurance shall contain a combined single limit of at least \$1,000,000 per occurrence and include coverage for, but not limited to, the following:
 - Bodily Injury and Property Damage
 - Any and all vehicles owned, used or hired
- iii. Workers' Compensation and Employers' Liability Insurance including coverage for, but not limited, to the following:
 - Statutory liability (Part A) under the workers' compensation laws of the state(s) in which the work is to be performed
 - Employers' Liability (Part B) with limits of at least \$1,000,000 each accident, \$1,000,000 by disease policy limit, \$500,000 by disease each employee
- iv. Railroad Protective Liability Insurance on ISO-RIMA form or equivalent form approved by the Railroad. RPL insurance shall cover the work to be performed at the designated job site and afford protection for damages arising out of bodily injuries or death, injury to or destruction of property, including damage to the insured's own property. The limit of liability shall be at least \$3,000,000 each occurrence and \$6,000,000 annual aggregate. The policy shall name the Railroad and any other Indemnities, their officers directors and employees as the Named Insured and shall amend the definition of "physical damage of property" to mean direct and accidental loss of or damage to "all property of any Named Insured and all property in any Named Insured's care, custody or control."
- v. Other Requirements:
 - Where allowable by law, all policies listed above shall contain no exclusion for punitive damages reflected on the Certificates of Insurance.
 - CONTRACTOR shall: (i) waive its right of recovery against Railroad for all claims and suits against Railroad; (ii) require its insurers, through the terms of the policy or policy endorsement, to waive their right of subrogation against Railroad for all claims and suits and (iii) waive its right of recovery (and require its insurers to waive their right of subrogation) against Railroad for loss of its owned or leased property or property under CONTRACTOR's care, custody or control.
 - CONTRACTOR is not allowed to self insure without the prior written consent of the Railroad. If granted by Railroad, any deductible, self insured retention or other financial responsibility for claims shall be covered directly by CONTRACTOR in lieu of insurance. Any and all Railroad liabilities that would otherwise, in accordance with the provisions of the agreement, be covered by CONTRACTOR's insurance will be covered as if CONTRACTOR elected not to include a deductible, self insured retention or other financial responsibility for claims.
 - Prior to commencing work, CONTRACTOR shall furnish Railroad with an acceptable Certificate(s) of Insurance evidencing the required coverage, endorsements or amendments.
 - CONTRACTOR will notify Railroad, as soon as practical, of any changes of the insurance policy or coverage.
 - Any insurance policy shall be written by a reputable insurance company acceptable to Railroad or with a current Best's Guide Rating of A- and Class VII or better. Carriers shall be authorized to do business in the state(s) in which the work or services are to be provided.
 - If any portion of the work is to be subcontracted and if any subcontractor does not meet the insurance requirements herein, there shall be no exclusion in CONTRACTOR's General Liability coverage for work performed by its subcontractors. Subcontractor's agreement with CONTRACTOR shall name Railroad as additional insured, and requiring subcontractor to release, defend, indemnify Railroad to the same extent and under the same terms and conditions as CONTRACTOR.
 - The fact that insurance (including, without limitation, self insurance) is obtained by CONTRACTOR shall not be deemed to release or diminish CONTRACTOR's liability, including, without limitation, liability under the indemnity provisions of the agreement. Damages recoverable by Railroad shall not be limited by the amount of the required insurance coverage.
 - CONTRACTOR shall warrant that the agreement has been thoroughly reviewed by its insurance agent(s) or broker(s) who have been instructed by CONTRACTOR to procure the coverages required hereunder.

15. FAILURE TO COMPLY:

- A. In the event the Contractor violates or fails to comply with any of the requirements of these Special Provisions:

TECHNICAL PROVISIONS – Attachment 16-1
Unique Special Provisions for Protection of Railroad Interests (Indiana Rail Road Company)

1. The Railroad Engineer may require that the Contractor vacate Railroad property.
2. The Engineer may withhold all monies due the Contractor on monthly statements.

B. Any such orders shall remain in effect until the Contractor has remedied the situation to the satisfaction of the Railroad Engineer and the Engineer.

16. PAYMENT FOR COST OF COMPLIANCE:

- A. No separate payment will be made for any extra cost incurred on account of compliance with these special provisions. All such costs shall be included in prices bid for other items of the work as specified in the payment items.

17. PROJECT INFORMATION

Date:11/3/2020
INRD File No: [unknown]
INRD Milepost: [Pending Information]
INDOT Project No: 1801695

ATTACHMENT “A”

Insurance Required by The Indiana Rail Road Company

- 1) CONTRACTOR shall, at its sole cost and expense, procure and maintain during the life of the agreement, the following insurance coverage:
 - a) Commercial General Liability Insurance. CGL shall contain broad form contractual liability with a combined single limit of a minimum of \$5,000,000 each occurrence and an aggregate limit of at least \$10,000,000. Coverage must be purchased on a post-1998 ISO occurrence form or equivalent and include coverage for, but not limited to the following:
 - b) Bodily Injury and Property Damage
 - c) Personal Injury and Advertising Injury
 - d) Fire Legal Liability
 - e) Products and Completed Operations
 - f) Contractual Liability
- 2) The policy shall contain the following endorsements (or appropriate alternate language) on the Certificate of Insurance:
 - a) Employer’s liability or workers’ compensation related exclusions in the policy shall apply only to employees of the Named Insured and shall not apply to Railroad employees.
 - b) The definition of “insured contract” shall be amended to remove any exclusion or other limitation for work being done within 50 feet of railroad property
 - c) A Waiver of Subrogation
 - d) Additional Insured endorsement in favor of INRD
 - e) Separation of Insureds
 - f) That policy shall be primary and non-contributing with respect to any insurance carried by the Railroad
 - g) The policy shall contain no exclusion for subcontractors
- 3) Business Automobile Insurance. This insurance shall contain a combined single limit of at least \$1,000,000 per occurrence and include coverage for, but not limited to, the following:
 - a) Bodily Injury and Property Damage
 - b) Any and all vehicles owned, used or hired
- 4) Workers’ Compensation and Employers’ Liability Insurance including coverage for, but not limited, to the following:
 - a) Statutory liability (Part A) under the workers’ compensation laws of the state(s) in which the work is to be performed
 - b) Employers’ Liability (Part B) with limits of at least \$1,000,000 each accident, \$1,000,000 by disease policy limit, \$500,000 by disease each employee
- 5) Railroad Protective Liability Insurance on ISO-RIMA form or equivalent form approved by the Railroad. RPL insurance shall cover the work to be performed at the designated job site and afford protection for damages arising out of bodily injuries or death, injury to or destruction of property, including damage to the insured’s own property. The limit of liability shall be at least \$3,000,000 each occurrence and \$6,000,000 annual aggregate. The policy shall name the Railroad and any other Indemnities, their officers directors and employees as the Named Insured and shall amend the definition of “physical damage of property” to mean direct and accidental loss of or damage to “all property of any Named Insured and all property in any Named Insured’s care, custody or control.”
- 6) Other Requirements:
 - a) Where allowable by law, all policies listed above shall contain no exclusion for punitive damages reflected on the Certificates of Insurance.
 - b) CONTRACTOR shall:
 - i) waive its right of recovery against Railroad for all claims and suits against Railroad;

- ii) require its insurers, through the terms of the policy or policy endorsement, to waive their right of subrogation against Railroad for all claims and suits and
 - iii) waive its right of recovery (and require its insurers to waive their right of subrogation) against Railroad for loss of its owned or leased property or property under CONTRACTOR's care, custody or control.
- c) CONTRACTOR is not allowed to self insure without the prior written consent of the Railroad. If granted by Railroad, any deductible, self insured retention or other financial responsibility for claims shall be covered directly by CONTRACTOR in lieu of insurance. Any and all Railroad liabilities that would otherwise, in accordance with the provisions of the agreement, be covered by CONTRACTOR's insurance will be covered as if CONTRACTOR elected not to include a deductible, self insured retention or other financial responsibility for claims.
- d) Prior to commencing work, CONTRACTOR shall furnish Railroad with an acceptable Certificate(s) of Insurance evidencing the required coverage, endorsements or amendments.
- e) CONTRACTOR will notify Railroad, as soon as practical, of any changes of the insurance policy or coverage.
- f) Any insurance policy shall be written by a reputable insurance company acceptable to Railroad or with a current Best's Guide Rating of A- and Class VII or better. Carriers shall be authorized to do business in the state(s) in which the work or services are to be provided.
- g) If any portion of the work is to be subcontracted and if any subcontractor does not meet the insurance requirements herein, there shall be no exclusion in CONTRACTOR's General Liability coverage for work performed by its subcontractors. Subcontractor's agreement with CONTRACTOR shall name Railroad as additional insured, and requiring subcontractor to release, defend, indemnify Railroad to the same extent and under the same terms and conditions as CONTRACTOR.
- h) The fact that insurance (including, without limitation, self insurance) is obtained by CONTRACTOR shall not be deemed to release or diminish CONTRACTOR's liability, including, without limitation, liability under the indemnity provisions of the agreement. Damages recoverable by Railroad shall not be limited by the amount of the required insurance coverage.
- i) CONTRACTOR shall warrant that the agreement has been thoroughly reviewed by its insurance agent(s) or broker(s) who have been instructed by CONTRACTOR to procure the coverages required hereunder.

<Remainder of page intentionally left blank>

INSURANCE APPROVAL REQUEST - To be sent with required evidence of insurance.

TO: _____ Date: _____.

The Indiana Rail Road Company
Attn: Peter Ray
1500 South Senate Avenue
Indianapolis, IN 46225

CSXT Agreement With: State of Indiana
(Name of Public Authority, Private Entity, etc)

Name of Contractor:

Project Description: INDOT Contract: **R-41536** - Bridge replacement of I-465 structures over INRD tracks and Right-of-Way

(Provide both INRD and Contract Project Description using INRD and Contract File Nos. when available)

Anticipated Starting Date: _____ Completion Date _____

City: Indianapolis County: Marion State: IN

Division: n/a Sub-Division: [Pending] RR M.P.: [Pending]

Attached are Original Railroad Protective Insurance Policy, in duplicate, required to be furnished to INRD. Please advise if the attached evidence of insurance is satisfactory and complies with the insurance requirements of the agreement.

Public Authority, Private Entity, Contractor

(Public Authority, Private Entity or Contractor must show address below and attach self-addressed, stamped envelope)

TO: _____ Date: _____

File: _____

- Approved - this is not authority to proceed with work, entry arrangements must be made with our Division Manager.
- Not Approved. Reason:
 - General Liability limits inadequate (\$ _____ required).
 - No evidence of Contractual Liability Insurance.
 - No unconditional 30-day notice of cancellation.
 - Other:
- Returned for your further handling.
- Insufficient information provided Returned without approval.

The Indiana Rail Road Company

Authorized Signature

cc: INDOT Contracts Services Manager/Document Control Manager

ATTACHMENT 17-1

UNIQUE SPECIAL PROVISIONS for ITS

ATMS DOCUMENTATION AND SUBMITTALS3
ATMS ELECTRICAL IDENTIFICATION8
ATMS GENERAL ELECTRICAL REQUIREMENTS11
ATMS GENERAL REQUIREMENTS12
ATMS GROUNDING18
ATMS POWER SERVICE DROP22
ATMS TRACER WIRE24
CABLE DUCT MARKER26
CCTV ASSEMBLY28
DYNAMIC MESSAGE SIGN, FULL-COLOR38
FENCE AND SLIDING GATE FOR TOWER SITES57
FIBER OPTIC BACKBONE CABLE58
FIBER OPTIC CABLE SPLICE64
FIBER OPTIC DROP CABLE68
FIBER OPTIC LOCATOR POST69
FIBER OPTIC PATCH PANEL ASSEMBLY71
HANDHOLES74
ITS, CELLULAR MODEM ASSEMBLY76
ITS COMMUNICATION SHELTER AND GENERATOR78
ITS CORE SWITCH86
ITS FIELD SWITCH89
ITS FOLDING POLE, CCTV91
ITS POLE STRUCTURE96
FOUNDATION, ITS POLE STRUCTURE101
PADLOCKS105
REMOTE POWER SWITCH106
SURGE PROTECTION DEVICES FOR ATMS COMMUNICATIONS, VIDEO, AND 24V108
VAULT, ATMS110
WIRELESS VEHICLE DETECTION SYSTEM113

ATMS DOCUMENTATION AND SUBMITTALS

Description

The Design-Build Contractor shall provide four types of documentation and Submittals for this contract: wiring diagrams and system schematics, submittal data, as-built documentation, and manuals and maintenance documentation. The Design-Build Contractor shall submit Working Drawings in accordance with 105.02 and the following additional requirements.

All documentation, except as approved by IFA, shall be no smaller than 8.5 inches by 11 inches or no larger than 24 inches by 36 inches. Standard bound manuals shall be exempted from this requirement. IFA will maintain the right to reproduce unlimited copies of any documentation for exclusive use on this contract.

All documentation shall also be provided in electronic format and delivered on CD-ROM or flash drive as practical. All electronic files shall be readable using standard Microsoft Office products. Drawings shall be provided as CAD files in data exchange (.DXF) file format compatible with MicroStation and in Acrobat Reader (.PDF) file format.

All 8.5 inch by 11 inch documentation, except standard bound manuals, shall be bound in logical groupings in three ring loose-leaf binders. Binders may also include 11 inch by 17 inch documentation, if Z-folded. Three copies of each bound grouping of documentation shall be provided labeled in a legible and permanent manner.

Three copies of all 24 inch by 36 inch documentation and a single reduced set no smaller than 11 inches by 17 inches shall be provided.

All documentation submitted shall be of reproducible quality as determined by IFA. All unsatisfactory items will be returned to the Design-Build Contractor who shall make the submittal again in satisfactory reproducible form as determined by IFA.

All literature from manufacturers shall be original documents provided by the manufacturers. Black and white copies of color originals are not acceptable. No facsimile reproductions of any type shall be accepted.

Wiring Diagrams

Wiring diagrams and system schematics shall be prepared and meet the following requirements:

1. Include wire designations by color or labels for every piece of field equipment in every cable segment between the equipment.
2. Include appropriate designations for every cable and Conduit segment. All Conduits carrying electrical cables shall be marked or labeled at all maintenance points and points of access. Designations shall include terminology such as, "Power Distribution - 480 VAC", "Video Coax", etc. All designations shall be submitted to IFA for approval prior to submittal.
3. Show locations of all cable splices.
4. Show connections to all communications equipment at the remote sites, CDP sites, and at the Traffic Management Center.
5. All radio equipment documentation packages shall include system diagrams, interconnection drawings, parameter lists and optimization procedures.

Submittal Data

Submittal data shall be prepared and meet the following requirements:

Prior to the purchase or fabrication of any equipment or material proposed for use on this Project, the Design-Build Contractor shall submit for review by IFA catalog cut sheets and specifications for all standard, off-the-shelf items; Working Drawings shall be submitted for all non-catalog or custom items. An electronic copy of all Submittals and Working Drawings shall be provided in .pdf format. Every Submittal shall be accompanied by transmittal letter providing following information:

1. Submittal number
2. Pay item number
3. Manufacturer and model number
4. Description

Submittals and Working Drawings will be approved or rejected in writing, and a memorandum stating the disposition will be returned to the Design-Build Contractor. Certain items will require verification of performance, which shall be provided with the catalog cut sheets, Working Drawings, and specifications. See individual equipment specifications for requirements.

The purpose of the Submittal and Working Drawing data is to show specifically and in detail how the Design-Build Contractor intends to satisfy the requirements of these specification and the Plans. If preprinted literature is utilized to satisfy some or all of these requirements, there shall be no statements on the literature which conflict with these specifications or Plans. Any such statements will be crossed off and initialed by the Design-Build Contractor and an appropriate statement be attached indicating how the requirements of these specification or the Plans will be fulfilled.

The Design-Build Contractor shall label each item of Submittal and Working Drawing data with the bid item number or other description of the items to which it applies. Each Submittal of catalog cut sheets, specifications, or Working Drawings, shall contain sufficient information and details to allow IFA to evaluate the particular component.

Copies of the catalog cut sheets, specifications, and Working Drawings shall be submitted by the Design-Build Contractor to IFA and the INDOT ITS Field Engineer, whom will be introduced at the preconstruction meeting. All catalog cut sheets and specification Submittal data shall be submitted within 30 calendar days following issuance of the Notice to Proceed. All Working Drawings shall be submitted within 90 calendar days following issuance of the Notice to Proceed.

All Submittals will be returned to the Design-Build Contractor within 30 days of submission. All Submittals returned to the Design-Build Contractor as rejected shall be resubmitted for approval within 14 calendar days from the notice of rejection.

The Design-Build Contractor may submit alternatives to the Plans and Special Provisions to IFA for consideration. Any alternative submitted shall be identified with benefits stated and documented.

The Design-Build Contractor shall submit the following items at a minimum. Any item included in this list that is not a deliverable of the contract may be removed from the requirements with approval by IFA. This list

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

does not preclude the submittal of other items as required in the specifications. The submittal requirement items are as follows;

1. Fiber optic cable
2. Fiber optic drop cable assemblies
3. Fiber optic patch panels
4. Fiber optic patch cables
5. Fiber optic break out kit and connectors
6. Fusion splice protection kit
7. Fusion splice enclosure
8. Small Form-Factor Pluggable Transceivers (SFPs)
9. Vaults
10. Handholes
11. Handhole and vault rings & lids
12. Cable duct markers, concrete
13. Cable duct markers, flexible (including decal design)
14. All conduits
15. All electrical and grounding cables
16. Cell Modems
17. Conduit splicing methods and materials
18. Dynamic Message Sign Structure
19. Dynamic Message Sign Structure Foundation
20. DMS Panels and Signs
21. ITS Cabinet
22. Wireless Vehicle Detection System
23. Monopole
24. Monopole Foundation
25. Camera Assemblies
26. Computers

As-Built Documentation

Documentation of the Work, as-built, shall be provided by the Design-Build Contractor prior to acceptance of the Work. The Design-Build Contractor will be provided with base files containing the proposed locations for Conduit, cabinets, and devices. On a level containing no proposed information, the Design-Build Contractor shall draw in the final as-built locations for the cabinets, poles, Conduits including burial depth, and device locations. These drawings shall be returned in both electronic and paper format.

As part of the final as-built documentation the Design-Build Contractor shall provide GPS coordinates accurate within 3 feet of a CCTV, DMS, cabinet, or service point location. The coordinates shall be noted on the Plans and in a single spreadsheet form provided to IFA on a compact disk, CD or flash drive.

As part of the final as-built documentation the Design-Build Contractor shall provide GPS coordinates accurate within 3 feet of all handhole and vault locations. The coordinates shall be noted on the Plans and in a single comma separated value, CSV, file provided to IFA. The CSV file shall be supplied on a CD or flash drive to IFA including the latitude and longitude of all handhole and vault locations in decimal degree format. Each record shall include the type of object, latitude, longitude, road name, direction of roadway travel, and nearest mile marker to the nearest tenth of a mile. The following is an example of the record format:

Example record: Vault, 39.40247778, -86.44611111, I-69, NB, 136.7

This would be the location record for a vault placed along I-69, on the

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

NB side of the road, at the 136.7 mile marker near the interchange with SR 39.

Component and wiring diagrams shall be provided for all custom manufactured equipment as well as a complete parts listing indicating the manufacturer and model of all electronic components.

In addition to the documentation specified elsewhere, prints of schematic diagrams applicable to the equipment contained in cabinets or the communication shelters shall be provided by the Design-Build Contractor. An 11-inch by 17-inch laminated wiring diagram, and an 11-inch by 17-inch laminated site drawing shall also be supplied in a weatherproof holder and mounted at each new cabinet and communication shelter.

Manuals and Maintenance Documentation

Two manuals shall be supplied for each individual component of the system. A reproducible form of the manual shall also be provided. The manuals supplied for the off-the-shelf items shall be those supplied by the equipment manufacturer.

Manuals shall include, at a minimum, the following material:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and schedules.

The Design-Build Contractor shall provide a maintenance history for each piece of electronic equipment provided on this contract. This history shall include the equipment type, model and serial numbers, date of manufacture, date and location of installation, date of all associated tests required by these specifications and the performance of the equipment during these tests.

Any maintenance activity performed on the unit because of a failure shall be documented, and shall include: an explanation of all failures, date that the equipment was removed from a cabinet, the repairs that were made, the date and nature of any tests made to check the correct operation of the unit, and the date and the location where the unit was reinstalled in the field.

After each repair conducted, prior to acceptance, the Warranty period shall be renewed. No more than one repair shall be allowed prior to acceptance. If a second repair is required, the equipment shall be replaced in kind with a new Warranty period.

Basis of Item

ATMS documentation and Submittals will not be measured.

System documentation shall be considered incidental to the ITS equipment being provided on this contract.

ATMS ELECTRICAL IDENTIFICATION

Description

The Design-Build Contractor shall provide labeling and signing to clearly identify all new electrical equipment and Conduits installed for ATMS equipment on this Project. This section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including but not limited to the following:

1. Buried electrical line warnings.
2. Identification labeling for Conduits, cables, and conductors.
3. Operational instruction signs.
4. Warning and caution signs.
5. Equipment labels and signs.

Electrical Component Standard:
Components and installation shall comply with NFPA 70 of the NEC.

ANSI Compliance:

Comply with requirements of ANSI Standard A13.1, Scheme for the Identification of Piping Systems, with regard to type and size of lettering for raceway and cable labels.

Materials

Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, or a manufacturer with equal products, the following:

1. American Labelmark Co.
2. Ideal Industries, Inc.
3. National Band and Tag Co.
4. Panduit Corp.
5. Seton Name Plate Co.
6. Standard Signs, Inc.
7. W.H.Brady, Co.

Adhesive Marking Labels for Raceway and Metal-clad Cable: *Pre-printed, flexible, self-adhesive labels with legend indicating voltage and service (Power, ATMS).*

Label Size for conduits larger than 1 inch: 1.10 inches high by 7.87 inches long. Color: Black legend on orange background.

Colored Adhesive Marking Tape for Conduits, Wires, and Cables: Self-adhesive vinyl tape not less than 0.003 inches thick by 0.98 inches to 1.96 inches wide.

Underground Line Marking Tape: Permanent, bright-colored, continuous-printed, plastic tape compounded for direct-burial service not less than 5.88 inches wide by 0.004 inches thick. Printed legend indicative of general type of underground line below.

Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.

Engraved, Plastic-Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 0.059 inches minimum thick for signs up to 20.0 square inches, or 7.87 inches in length; 0.118 inches thick for larger sizes. Engraved legend in white letters on black face and punched for mechanical

fasteners.

Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.177 inch minimum width, 48.5 pound minimum tensile strength, and suitable for a temperature range from minus 50° F to 348.8° F. Provide ties in specified colors when used for color coding.

Construction Requirements

Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification Work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in Submittals and as required by code. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.

Underground Electrical Line Identification:

During trench backfilling, for exterior underground power, signal, and communications lines, install continuous underground plastic line marker, located above line at 6 inches to 8 inches below finished grade.

Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.

Conductor Color Coding:

Provide color coding for secondary service, feeder, and branch circuit conductors throughout the project secondary electrical system as follows:

Table 1: Conductor Color Coding Convention

<u>Phase</u>	<u>120/240 Volts</u>	<u>240/480 Volts</u>
A	Black	Brown
B	Red	Orange
Neutral	White	White
Ground	Green	Green

For phase conductors:

1. At a weatherhead: Identify conductors with pressure sensitive plastic tape applied in half-lapped turns for a distance of 6 inches from the terminal points and in boxes where splices are made.
2. All other locations: Identify conductors with color factory applied the entire length of the conductors or pressure sensitive plastic tape applied in half-lapped turns for a distance of 6 inches. from the terminal points and in boxes where splices are made.

For Neutral and Ground conductors: Use conductors with color factory-applied the entire length of the conductors except as follows:

The following field-applied color-coding methods may be used for receptacle phase conductors on sizes larger than No. 6 AWG.

1. Pressure-sensitive plastic tape shall be applied in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. The last two laps of tape shall be applied with no tension to prevent possible unwinding. Use 1-inch wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

2. In lieu of pressure-sensitive tape, cable ties may be used for color identification. Three ties of specified color shall be applied to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. A special tool or pliers shall be used to, tighten for a snug fit, and cut off excess length.

Tag or label conductors as follows:

1. Where multiple branch circuits are present in the same Conduit, box or enclosure, label each conductor or cable, including each neutral.
2. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring in each panel.
3. Phase and voltage of branch circuit wiring may be indicated by means of coded color of conductor insulation.
4. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.

Warning, caution, and instruction signs and stencils shall be applied as follows:

1. Install warning, caution, or instruction signs where required by NEC or OSHA, where indicated, or where required to assure safe operation and maintenance of electrical systems and of the items to which they connect.
2. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation.
3. Install butyrate signs with metal backing for outdoor items.

Basis of Item

Electrical Identification will not be measured.

The following shall be considered incidental to this item:

Electrical Identifications will be considered incidental to all electrical equipment furnishings and installations. The materials, equipment, and installation of identification, warning tags and labels shall be considered incidental.

ATMS GENERAL ELECTRICAL REQUIREMENTS

Description

This Section includes general administrative and procedural requirements for electrical installations. The following sections of the Standard Specifications relate specifically to electrical Work 807, Highway Illumination; 805, Traffic Signals; 809, ITS; and 920.01(g), Working Drawings. Required material and product certifications shall be in accordance with 916.

Construction Requirements

Electrical Installation:

Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate electrical systems, equipment, and materials installation with other roadway components.
2. Verify all dimensions by field measurements.
3. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work.
4. Coordinate connection of electrical systems with exterior underground and overhead Utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
5. Install systems, materials, and equipment to conform with approved Submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to IFA.
6. Install systems, materials, and equipment level and plumb, unless otherwise specified.
7. All Work and materials shall comply with the NEC, NFPA 70, as adopted by the State.

Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

Basis of Item

ATMS General Electrical Requirements will not be measured.

The following shall be considered incidental to this item:

ATMS General Electrical Requirements will be considered incidental to the equipment being provided on this contract.

ATMS GENERAL REQUIREMENTS

Description

The Work and methods described herein are general and applicable to all equipment, components, and software to be furnished and installed. Unless otherwise specified, all equipment, components, and software shall conform to these requirements.

Materials

All procurement shall be made on new materials and equipment. The procurement shall be in accordance with the current applicable standards of the following; National Electrical Manufacturers Association, NEMA; Electronics Industries Association, EIA; National Electrical Code, NEC; Underwriters Laboratory, UL. All equipment shall be obtained from qualified vendors approved by IFA.

All controls, indicators, and connectors shall be labeled in a clear and permanent manner approved by IFA.

All electronic and electrical components assemblies or digital control devices that are connected to commercial power shall be UL (Underwriters Laboratories) or ETL (Electronics Testing Laboratories) listed or, if not listed, shall first be approved by IFA. This includes, but is not limited to: power supplies, relays, video monitors, wiring, and wiring accessories. Copies of UL or ETL product cards shall be provided to IFA to document the listings. All data and low power connections shall be accomplished via positive locking mechanisms.

Delivery

The Design-Build Contractor shall deliver products to a location as determined by IFA each identified with name, model number, type, grade, compliance labels, and other information needed for identification.

Rough-In

All final locations for rough-ins shall be verified with field measurements per the requirements of the actual equipment to be connected.

Installation

Connectors, terminals, bus joints, and mountings shall be checked for tightness by the Design-Build Contractor. Field-connected connectors and terminals, including screws and bolts, shall be tightened in accordance with equipment manufacturers' published torque tightening values. Where manufacturers' torque requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A. Scratches and mars of finish shall be touched up to match original finish. Remove paint splatters and other spots, dirt, and debris.

Outdoor Equipment

All conductive connectors, pins (except pins connected by soldering), and socket contacts shall be gold plated. Except for integrated circuits containing custom firmware, all components shall be soldered to the printed circuit board.

Custom Equipment

Equipment that is not part of a manufacturer's or vendor's standard product line, or that is made or modified for this Project, shall conform to the following:

1. Design specifications and drawings for custom equipment shall first be submitted to IFA for review and approval. IFA reserves all rights

to use any custom equipment throughout the State of Indiana at their convenience without restriction or license. Agreements of non-disclosure or product rights will be considered by IFA upon written request.

2. Where practical, electronics shall be modular plug-in assemblies to facilitate maintenance. Such assemblies shall be keyed to prevent incorrect insertion of modules into sockets.
3. All components shall be available from multiple manufacturers as part of the manufacturers' standard product lines. All custom components will be labeled with the value, part number, tolerance, or other information sufficient to enable a technician to order an exact replacement part.
4. Lamps used for indicator purposes shall be light-emitting diodes.
5. The printed circuit boards shall be composed of two-ounce copper on 0.063 inch thick fiberglass epoxy or equivalent type construction. Holes, which carry electrical connections from one side of the board to the other, shall be plated through. Multilayer printed circuit boards shall not be used. The name or reference number used for the board in the drawings and maintenance manuals supplied to IFA shall be permanently affixed to each board. Alternatives may be submitted for approval of IFA. Each circuit board shall be labeled with a unique serial number and part number that identifies the part to the manufacturer's revision and quality control documentation.
6. All components shall be mounted so that the identifying markings are visible without moving or removing any part, if practical.

All equipment requiring FCC type approval, acceptance or certification shall have such approval, acceptance and certification at time of shipment.

All electronic equipment shall be solid state and reflect the latest advances in state-of-the-art design. All equipment and materials shall be new and free of corrosion, scratches and other defects. All equipment shall meet or exceed the applicable standards of the EIA.

Lightning/surge protection will be provided for all installed hardware in accordance with Motorola R-56.

Environmental Conditions

ATMS equipment shall continue to operate as specified under the ranges of environmental conditions specified by NEMA TS-2, except as noted for individual pieces of equipment.

Vibration and Shock

The equipment, when packaged in its normal shipping container, shall not be damaged, nor shall the operational performance be degraded after exposure to vibrations of 1g, 15 Hz to 500 Hz, or shocks of 5g, 10 ±1 milliseconds in each of three mutually perpendicular planes.

Camera assemblies, vehicle detection assemblies, and communications radios and antennas, and any other equipment mounted atop poles or structures shall not be impaired by the continuous vibration caused by winds and traffic.

Duty Cycle

The duty cycle of all equipment shall be continuous.

Electromagnetic Radiation

The equipment shall not be impaired by ambient electrical or magnetic fields, such as those caused by power lines, transformers, and motors. ATMS equipment supplied under this contract shall not conduct or radiate signals which will adversely affect other electrical or electronic equipment including, but not limited to, other control systems, data processing equipment, audio, radio, industrial, and medical equipment.

Electrical Power

The electrical power requirements shall be in accordance with the following:

1. Operating Power: The equipment shall operate on single phase, 3 wire 120/240 VAC, 60 Hz, unless otherwise specified. It shall conform to its specified performance requirements when the input voltage varies from 89 to 135 volts and the frequency varies ± 3 Hz.
2. High Frequency Interference: The equipment operation shall be unaffected by power supply voltage spikes of up to 150 volts in amplitude and ten microseconds duration.
3. Line Voltage Transients: The equipment operation shall be unaffected by voltage transients of plus or minus 20 percent of nominal line voltage for a maximum duration of 50 milliseconds. Equipment in the field shall meet the power service transient requirements of NEMA Standard TS-1 when connected to the surge protectors in the cabinets.
4. Protection: All equipment shall use readily accessible, manually resettable or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection.
5. Brownouts: The equipment shall not be damaged when the main power drops to 95 VAC for a period of eight hours. If the equipment does not operate normally at 95 Volts, the equipment shall automatically resume normal operation within five seconds after normal power returns.

Temperature and Humidity:

The temperature and humidity requirements shall be in accordance with the following:

1. Field Equipment: Equipment in the field shall meet the temperature and humidity requirements of NEMA Standard TS-1. Liquid crystal displays shall be undamaged by temperatures as high as 165° F, and shall produce a usable display at temperatures up to 122° F.
2. Central Equipment: Central equipment shall operate normally at any combination of temperatures between 50° F and 104° F, and humidity between five percent and 90 percent, non-condensing, and with a temperature gradient of 41° F, per hour.

Wiring

The wiring requirements shall be in accordance with the following:

Every conductor, except a conductor contained within a single piece of equipment, shall terminate either in a connector or on a terminal block. The Design-Build Contractor shall provide and install the connectors and terminal blocks where needed. Approved splice kits shall be used instead of connectors.

Connectors shall be labeled and keyed to preclude improper connection.

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

The permanent labeling methods shall be approved by IFA prior to use.

Appropriate designations shall be used for every Conduit and cable segment. All Conduits carrying electrical cables shall be marked or labeled at all maintenance points and points of access. Designations shall include terminology such as, "Power Distribution 480 VAC", "RF Coax", "Video Coax", "Video Fiber". All designations shall be approved by IFA. Labels shall be done in accordance with these Special Provisions.

Terminal blocks shall be affixed to panels that identify the block and what wire connects to each terminal. This may be accomplished by silk screening or by installing a laminated printed card under the terminal block, with the labels on portions of the card that extend beyond the block. Installation of terminal blocks by drilling holes in the exterior wall of the cabinet is not acceptable.

Personnel shall be protected from accidental contact with all dangerous voltages.

Conductors carrying AC power shall not be installed in the same wiring harness as conductors carrying DC control or communication or video signals.

Wiring shall be arranged so that any removable assembly can be removed without disturbing wiring that is not associated with the assembly being removed.

All splices, excluding permissible fiber optic cable, shall be in equipment cabinets. Fiber optic splices shall be in ATMS vaults. All splices shall be watertight and capable of satisfactory operation under continuous submersion in water. Splicing materials, insulation, and techniques shall be approved by IFA.

Electrical cables shall have at least 10 feet of slack in all handholes and 6 feet of slack in all cabinets, unless otherwise approved by IFA.

Unless otherwise stated herein or shown on the Plans, hot dipped galvanized steel shall be used for all exposed metal surfaces. Corrosion protection shall be provided between dissimilar metals.

Software

Controller Software: The Design-Build Contractor shall deliver the most current versions of software working, tested, and complete with all necessary data files. For all software, except for commonly used, commercial software packages that are not supplied by an equipment manufacturer and that have not been modified for this project, the Design-Build Contractor shall furnish well documented protocol, interface documentation and technical support as required to integrate the intended application and hardware into the system. A non-disclosure affidavit will be signed by IFA or an approved representative if required. Delivery of the software shall be made in all of the following ways:

1. Installed on the hard disk or, for controller software on a PROM integrated circuit, executable code and data files only.
2. On two identical sets of portable storage media approved by IFA.
3. As printouts, 2 copies of data files and source code.

In order for the software to be accepted, the Design-Build Contractor shall demonstrate that the source code and other items on the portable storage media

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

are sufficient to create the working software provided by the Design-Build Contractor. The Design-Build Contractor shall demonstrate that the working executable program delivered on the hard disk or PROM is identical to the one produced in the demonstration.

Department's Rights: The Design-Build Contractor shall provide licensed copies to IFA of any Commercial Off-the-Shelf Software (COTS) purchased from a third-party. Adequate licensed copies of the software shall be provided as specified herein.

Serviceable Parts

The Design-Build Contractor shall certify that all serviceable parts are commercially available or readily available from the system vendors and Suppliers. The system vendors and Suppliers shall provide a letter to IFA stating that all current and future models of serviceable parts for all ATMS equipment components shall be backwards compatible. Components that shall be backwards compatible include, but are not limited to: vehicle detectors, closed circuit television cameras, pan-tilt-zoom mechanisms, all video control equipment, component software, and all communication equipment including fiber optic equipment, radios, antennas, and cables.

Parts shall be shipped within five Business Days of receiving an order from INDOT. These parts, at a minimum, shall be easily serviceable by INDOT maintenance personnel using standard tools or tools provided to INDOT by the Design-Build Contractor. IFA will not agree to any implied or written arrangement to purchase any part from an exclusive source.

INDOT shall have unlimited rights to software licenses. All source code shall be held in escrow by the Design-Build Contractor.

Basis of Item

ATMS General Requirements will not be measured.

The following shall be considered incidental to this item:

ATMS General Requirements will be considered incidental to the equipment being provided on this contract. Tools provided by the Design-Build Contractor shall become the property of INDOT and shall be considered incidental.

ATMS GROUNDING

Description

This Work includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified herein may be supplemented in other sections of these specifications. All ground wires shall be tinned copper.

The Design-Build Contractor shall design a ground system for each type of remote site and submit Plans in the form of a design drawing for approval by IFA. The design shall be certified by a Registered Professional Engineer.

The Work shall be completed in accordance with 807 and 922.07. This Work shall also comply with Motorola R-56, Motorola Standards and Guidelines for Communications Sites 2000, Chapter 6, External Grounding. Where conflicts exist between Motorola R-56 and specifications, the more stringent requirement shall prevail.

Materials

Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, or manufacturers with equal products, the following:

1. O-Z/Gedney Co.
2. Alltec Corporation
3. American Electric/Blackburn
4. Thomas & Betts Corp.

Grounding and Bonding Products:

Products of types indicated and of sizes and ratings to comply with the NEC. Where types, sizes, ratings, and quantities indicated in these specifications, Plans, Motorola R-56, or 807 are in excess of the NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern. Conductor materials shall be copper.

Wire and Cable Conductors:

1. Aluminum wire and cable shall not be used.
2. In general, conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.
3. Equipment Grounding Conductor shall be green insulated.
4. Grounding Electrode Conductor shall be solid copper wire.
5. Bare Copper Conductors shall be solid copper wire: ASTM B-3.
6. Assembly of Stranded Conductors in accordance with ASTM B-8.
7. Tinned Conductors in accordance with ASTM B-33.

Miscellaneous Conductors:

1. Ground Bus shall be bare annealed copper bars of rectangular cross section.

Connector Products:

1. In general shall be listed and labeled as grounding connectors for the materials used.
2. Pressure Connectors shall be high-conductivity-plated units.
3. Bolted Clamps shall be heavy-duty units listed for the application.
4. Exothermic Welded Connections shall be provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.

Grounding Electrodes:

Ground Rods shall be copper-clad steel with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core. Electrolytic ground rods maybe used, if required by soil conditions, with the approval of IFA. Ground rods shall be 5/8 inches by 10 feet.

Construction Requirements

Electrical systems and equipment shall be grounded in accordance with Motorola R-56 and NEC requirements except where exceed by the plans or the specifications.

Listing and Labeling:

Products provided shall be listed and labeled. The terms "listed" and "labeled" shall be in accordance with NEC, Article 100.

Electrical Component Standard:

Components and installation shall comply with NFPA 70 of the NEC.

UL Standard:

Grounding and bonding equipment shall comply with UL 467, Grounding and Bonding Equipment.

Equipment Grounding Conductor Application:

Equipment grounding conductors shall comply with NEC Article 250 for size and quantity, except where larger sizes or more conductors are indicated on the plans or by Motorola R-56.

Connections:

In general, make connections in such a manner as to minimize galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be compatible and prevent galvanic action. The following requirements shall also apply:

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and make contact points closer in order of galvanic series.
2. Make connections with clean bare metal at points of contact.
3. Aluminum to steel connections shall be with stainless steel separators and mechanical clamps.
4. Aluminum to galvanized steel connections shall be with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to the contact surfaces.

Exothermic Welded Connections:

Use for connections to structural steel, for all underground connections, and for all connections to ground rods and plate electrodes. Comply with manufacturer's written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic Conduits terminate at metallic housings without mechanical and electrical connection to the housing, terminate each Conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Non-continuous, metallic Conduits shall be bonded, in an electrical manner, at one

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

end with grounding bushings and bare grounding conductors.

Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque-tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A.

Ground Rod Installations:

Ground rods shall be driven into the earth. The top of the ground rod shall be a minimum of 12 inches below finished grade. Conductor terminations to the ground rod shall be made by exothermic welds, rated for underground installation.

Compression-Type Connections:

Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

Moisture Protection:

Where insulated ground conductors terminated underground insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

Field Quality Control:

The procedures for performing resistance testing of the site grounding electrode system shall comply with the following:

The resistance of a grounding electrode system shall be measured after its installation and before it is bonded to the power company neutral wire or any other utility, such as the telephone ground or metallic pipes.

Resistance testing shall be done using the Three-Point/Fall-of-Potential method. The Three-Point/Fall-of-Potential test is the most widely accepted and recommended test method. This procedure is documented in ANSI/IEEE STD 81 and shall be referred to for more details. The testing shall be done in accordance with Motorola R-56. An instrument designed specifically to measure the resistance of a point to each ground shall be used and the instructions provided with the instrument shall be followed for proper measurement method. All measurements shall be recorded along with the location of each ground rod and submitted to IFA.

Upon completion of all grounding requirements outlined in these Special Provisions and other applicable documents, the ground resistance for Configuration G sites shall be 4 Ohms or less, all Configuration J shall be 25 Ohms or less, and all other sites shall be 10 Ohms or less.

Deficiencies:

Where ground resistances exceed specified values, the Design-Build Contractor shall modify the grounding system to reduce resistance values. Additional costs for materials and labor used in these modifications will be considered incidental to the cost of the grounding system.

Reporting:

Prepare test reports of the ground resistance at each test location. Include observations of weather and other phenomena that may affect test

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

results. Describe measures taken to improve test results.

Cleaning and Adjusting:

Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated.

Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other Work to their original condition. Include necessary topsoil, fertilizing, liming, seeding, sodding, sprigging, or mulching. Maintain disturbed surfaces, restore vegetation, and restore disturbed paving.

Inspection:

The grounding system will be inspected by IFA using the checklist from Motorola R-56 Appendix F pages 601 through 643, as applicable.

Basis of Item

Grounding will not be measured.

The following shall be considered incidental to this item:

Grounding will be considered incidental to electrical equipment, cabinets, and ATMS equipment.

ATMS POWER SERVICE DROP

Description

Work under this item shall include furnishing and installing all equipment necessary to provide a complete service point power entry for ATMS equipment. Electrical service, where required, shall be provided by power Utility which services the location of the service point. Provide a 100 Amp, 120/240 VAC, 1-phase, 3-wire service or a 100 Amp and 480 VAC 1-phase, 2-wire service or as indicated on the Plans.

Materials

The service drops shall be sized and equipped as shown on the Plans. Meter sockets shall be installed in accordance with the requirements of the Utility. Grounding shall be in accordance with Standard Specification 807.12 and shall be part of the service installation.

The service drop or metered panel shall be a Service Entrance rated, NEMA 3R Load Center with integral meter base rated 120/240VAC similar to the GE TSM1610CSCU, Square D RC1624M100S, or Siemens MC2040B1150, or with a separate meter base when rated at 480VAC as indicated in the Plans. The panel shall be equipped with a Main Circuit Breaker sized as indicated on the Plans or sized for the service provided. Provide a minimum of sixteen, 1-inch, 1-pole circuit breaker spaces in the panel for branch circuits. The enclosure shall be padlockable.

Circuit breakers shall be single or two-pole as required by the branch circuit. Circuit breakers shall have a minimum 10,000 AIC for 240V circuit breakers, and 65,000 AIC for 480V circuit breakers. Panels shall be fully rated; series rated shall not be allowed.

Construction Requirements

The service point shall be installed at locations as indicated in the Plans and shall also be closely coordinated with the Utility's requirements. Work under this item includes overhead and underground service power drops. The Design-Build Contractor shall pay for all costs required by the Utility for service installation.

After coordination with the electric Utility's representative, the Design-Build Contractor shall submit a "Connection Request" form to IFA. IFA will forward this form to the electric Utility and IFA will be responsible for paying bills after service is connected and the Design-Build Contractor pays the Utility bills for all construction costs. The Service drops shall be in accordance with these Special Provisions and with 807.15.

All electrical Work associated with the service power drop installations shall be in accordance with the Plans, Standard Specifications, and the manufacturer's written instructions and applicable requirements of NEC standards. As identified in the Plans or per IFA request, where the proposed service point is more than 500 feet from the ATMS remote site, a separate, lockable, subpanel shall be provided at the ATMS site.

All subpanels shall have their own ground rod which is also connected to the site's grounding system. The grounding conductors and ground rod shall be bonded to all non-current carrying metal on the subpanel.

Any location that incurs a new customer set-up charge from the power Utility shall be considered as part of the installation. The installation is not complete until power is available at the service point site.

Basis of Item

Service points will be measured per unit each. Circuit Breakers when identified as the method for power service connection to an existing ITS service point shall be measured per unit each.

The items list shall include the following:

Item Description	Unit Symbol
Service Point, ATMS, Circuit Breaker	EACH
Service Point, ATMS, 120/240V, Overhead	EACH
Service Point, ATMS, 120/240V, Underground	EACH
Service Point, ATMS, Subpanel.....	EACH
Service Point, ATMS, Metered Panel.....	EACH

The following shall be considered incidental to this item:

Terminations, connections, service conductors, circuit breakers when not identified as the power source to an existing ITS Service Point, ground rods, ground wires, fittings, switches, service cabinets, utility current transformer cabinets, PT cabinets, CT cabinets, weather-heads, meter sockets, cables, Conduits down to first below grade bend, poles, aluminum channels, braces, and mounting surfaces, and other miscellaneous items shall be incidental to this Work. Utility charges that are a standard fee for new service installations are incidental to this Work, except as provided below. Ground rod for a subpanel location shall be considered incidental.

ATMS TRACER WIRE

Description

Work under this item shall include furnishing and installing tracer wire in Conduits as shown on the Plans and as described in these specifications to assist with Conduit locates.

Materials

Tracer wires shall be a single conductor, high strength copper clad steel, orange color jacket, high molecular weight and high-density polyethylene (HMWPE) insulation, #12 AWG wire. The HMWPE jacket shall be a minimum of 30 millimeters in thickness. The wire shall have a minimum break load of 425 pounds and made of fully annealed, high carbon 1055 grade steel. Tracer wires shall be rated for use at 30 volts. Wire connectors shall be waterproof.

Construction Requirements

As determined by IFA, new continuous tracer wire shall be placed into each run of fiber optic cable, fiber optic trunk cable, fiber optic lateral cable and fiber optic extension cable from handhole to handhole or vault. A minimum of 3 feet of tracer wire shall be securely tied off inside of a terminating handhole.

As determined by IFA, a new continuous tracer wire shall be provided in the same Conduit with all fiber optic cables. Tracer wire is not required to be installed in above-ground Conduits and empty Conduits that are part of a duct bank that contains a non-dielectric (conductive) cable. When multiple cables are to be installed in a Conduit, all cables shall be pulled simultaneously to prevent friction damage to the cable insulation. Spare and empty Conduits shall not be utilized to install the tracer wire.

The tracer wire shall be securely fastened inside of the handhole or vault. A waterproof wire nut or direct burial connector shall be connected to each end of the tracer wire to prevent corrosion. At vaults with splice enclosures the tracer wire shall be connected to the enclosure and connect to the wire lead for the Fiber Optic, Locator Post.

Basis of Item

ITS, Tracer Wire will be measured per linear feet of materials provided complete and in place.

The items list shall include the following:

Item Description	Unit Symbol
ITS, Tracer Wire.....	LFT

The following shall be considered incidental to this item:

Materials, labor, equipment, and necessary incidentals. ITS, Tracer Wire shall include fasteners, waterproof wire nuts, waterproof direct burial rated connectors and all other incidentals necessary for installation. Waterproof wire nuts or connectors shall be considered incidental.

CABLE DUCT MARKER

Description

This Work shall consist of providing ATMS cable duct markers as shown on the Plans and as directed by IFA.

Materials

Concrete Markers:

Concrete cable duct markers shall be manufactured and installed according to the Standard Specifications 807.08 except as revised herein. Concrete cable duct markers shall be marked "ATMS" with field-cut arrows identifying the direction of the underground conduits.

Flexible Markers:

Flexible cable duct markers shall be manufactured of an integrally colored orange, single piece, two-sided, UV resistant, fiberglass reinforced composite, constructed of adequate strength and rigidity to enable installation into compacted soil.

Markers shall be capable of returning to vertical and remaining functional after being subjected to a head-on vehicle impact. At a minimum, markers shall be 3.75 inches wide by 66 inches long with raised and reinforced ribs along each side to protect the decal. Decals shall be provided on both sides of the markers. Decal shall consist of a standard fiber optic warning message, visible from a distance, such as "Warning Fiber Optic Cable". In addition, the decal shall include the message "Call INDOT Technology Deployment Technicians Supervisor before Digging 317899-8606" along with INDOT symbol (digital image is available on the INDOT's website):



Figure A: INDOT's Logo

All markers and decals shall be from a single manufacturer. Decals shall be considered incidental to the cost of the flexible markers.

Markers shall be installed according to the manufacturer's recommendations, or to a depth suitable to resist the impact of wind or an errant vehicle without pulling free. Location of marker installations shall be shown on Plans or as determined by INDOT.

Basis of Item

The completed Work as described for cable duct marker will be measured by the unit of EACH and includes furnishing and installing of a cable duct marker with all accessories necessary for a complete installation.

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

The items list shall include the following:

Item Description	Unit Symbol
Cable-Duct Marker, Concrete.....	EACH
Cable-Duct Marker, Flexible.....	EACH

The following shall be considered incidental to this item:

The cost of materials, labor, equipment, transportation, placement, and other necessary incidentals.

CCTV ASSEMBLY

Description

This work shall consist of furnishing and installing closed circuit television cameras and camera lowering systems.

The CCTV assembly shall have the following components:

1. One camera with pan-tilt-zoom (PTZ)
2. One camera lowering system

Materials

Camera shall, at a minimum, meet the following characteristics:

CAMERA

- Sensor 1/2.8" CMOS
- Scanning Progressive
- Resolution 1,920 x 1,080
640 x 360 @ 3x dig. Zoom
- Digital Formats YUV 4:2:2 SMPTE 274M, BT.709,
BT.1120, 1080p,1080i, 720p
- Frame Rate 30 fps
- Camera Format Day/Night (IR Cut Filter)
- Day/Night Modes Auto, Color, B/W
- S/N Ratio >50 db
- Motion Detection Off/On [Area of Detection]

SENSITIVITY

- Standard (f1.4, 1/30, 30 IRE)
 - o Color 0.25 lux (0.025 fc)
 - o B/W 0.024 lux (0.0024 fc)
- Digital Slow Shutter (f1.4, 1/2, 30 IRE)
 - o Color 0.015 lux (0.0015 fc)
 - o B/W 0.0015 lux (0.00015 fc)

OPTICS

- Zoom Lens 30x, 4.4 to 132mm
effective 264mm with 2x digital
zoom
- Aperture f1.4 -> f4.6
- HAFOV 63.4° to 2.1° @ 1920x1080
63.4° to 0.7° @ 640 x 360
- Focus Auto/Manual [Near, Far]
- Focus Search Normal, Bright, Point Source
- Focus Sensitivity Low, Normal, High
- Iris Auto/Manual [Open/Close]
- Lens Speed Three [Slow, Medium, Fast]
- Digital Zoom 12x, Off/On [Depth]

IMAGE PROCESSING

- Defog Mode Off/Auto/Manual [3 Levels,
Strength and Color Adj.]
- Image Stabilization Off/On

TECHNICAL PROVISIONS – Attachment 17-1
 Unique Special Provisions for ITS

- Enhanced Intensity Off, Enhanced, Whiteout Reduction
- Dynamic Range >90dB Off/On [3 Levels, Normal, Combo, Contrast]
- Back Light Comp Off/On [Level Setting]
- Shutter (AES) Auto/Manual [1/2 -> 1/30,000]
- Slow Shutter Off/On [1/15->1/2] with Limit Setting
- White Balance Auto/Manual [Red/Blue Adjustment]
- (WB) Modes Normal, Mercury, Sodium Vapor
- AGC 1 to 48db, Adjustable
- Sharpness Soft, Normal, Sharp, Sharpest
- Noise Reduction Normal, Medium, Strong, Fixed

IP STREAM

- Video Streams 5 or more video streams dependent on available processing budget
- Video Codec H.264 Base, Main and High Profiles, MJPEG
- Video Protocols RTSP/RTP
RTSP Interleave
HTTP Tunneling
RTP Multicast
- Video Resolution 1080p, 720p, D1, VGA, CIF
- Video Frame Rate 1 to 30 fps, 30 fps default
- Video Data Rate 256Kbs to 8Mbs
- Video Rate Cntrl Variable or Constant
- Video GOV 1 to 600, 30 default
- Video Latency Four frames (0.133 sec.)
- Video Trans. 99.999% error free

NETWORK INTERFACE

- Network Format 802.3u 100Base-T, MDI-X auto-sensing, full duplex
- Network Protocol TCP, UDP, IPv4, ICMP, DNS, IGMPv2/v3, DHCP, RTP, RTSP, RTCP, NTP, HTTP, SOAP, HTTPS ARP, FTP, SMTP, SNMP/NTCIP, Telnet. ONVIF Profile S
- Media Players VLC, Quick Time or any media player compliant with RFC 2326, 3984, 3550, 2435, ISO/IEC 13818-1
- ONVIF Profile S
- Camera Protocols ONVIF, NTCIP 1205, CoHuT, CoHuHD legacy
- Security 4 Levels: Admin, Operator, User, Anonymous [User Name + Password], Digest Authentication
- Updates File upload over network using camera web server Interface
- Configurations Stored in Non-Volitiale Memory
- Browsers IE11, Firefox, Chrome

DIGITAL I/O INTERFACE

- Digital Circuits Four digital I/O circuits, user defined as either input or output

ANALOG INTERFACE

- Video Format NTSC or PAL
- Serial PTZ RS422, full/half duplex, 1,200 to 115k baud adjustment, data, stop and parity bit configuration.
- Protocols CohuHD Legacy, PelcoD, Ultrak, NTCIP 1205, A/D, FAST, Javelin

COMMAND CORE ACTION ENGINE

- Input Triggers Digital Input(s), Timer, Scheduler, Preset reached, PTZ move, Maintenance, User command
- Output Actions Activate digital output(s), FTP image, Send Email, Send Text, Activate Preset or Tour, Display OSD Message
- Trigger Queuing User selectable mode. Processes output actions by trigger priority, first in, or last in.
- Servers Multiple FTP and EMAIL servers can be configured for use by camera system

ON SCREEN DISPLAY (OSD)

- OSD Capacity Up to 7 OSD Elements can be selected for display on video
- OSD Elements Text, Preset, Position, Compass, Date/Time, Sector, Maintenance, Action Event
- OSD Characters Up to 40 characters per text element
- OSD Size 20 to 90 point, Increment of 10
- OSD Color White, Black, Green, Red, Blue
- OSD Background Transparent, Black
- OSD Location Upper Right/Left, Lower Right/Left, Center, Custom
- Banner Display On/Off, Top/Bottom, 4 OSD elements
- Logo Display BMP, PNG, GIF Format, [x,y] position, Transparency

PRIVACY MASKS

- Capacity Up to 8 Rectangular Masks.
- Color Red, orange, green, blue, purple, grey
- Blur Solid, fine, medium or coarse pixelated
- Opacity 25, 50 or 75%
- Brightness 4 levels of adjustment

POSITIONING DRIVE

- Pan Range 360° continuous rotation
- Tilt Range 360°
- Preset Speed Peak speed of 120°/sec
180° movement < 3 seconds
- Manual Speed 0.1° to 45°/second
- Speed Resolution > 64 Variable speed levels
- Repeatability +/- 0.05°
- Resolution +/- 0.05°
- Presets Up to 256, Includes pan, tilt, zoom, focus, preset ID, I/O output state
- Tours Up to 256, Includes presets with dwell, speed, direction and recurrence properties
- Auto Park Returns to a preset or tour after timer expires, Timer Value [Off, 1 Minute to 999 Hours]
- Features Auto focus/iris on PTZ
Proportional PTZ, Video freeze on preset, High wind/vibration mode, Set north calibration, Inverted mounting mode

ELECTRICAL

- Input Voltage PoE++, 24Vac or 120Vac, model dependent
- Power 30w, up to 60w with heaters ON
- Voltage Range NEMA standard TS 2-2003 section 2.2.7 tests C to H
- Transient/Surge Certified to CISPR 24 levels
- Emissions Certified to CISPR 22 levels
- Pigtail Cable(s) Approx. 24"

MECHANICAL

- Weight 21.5 pounds (9.75 kg maximum)
- Dimensions Refer to dim. diagram
- Construction Powder Coated aluminum
- Faceplate Optically Correct Glass
- Faceplate Wiper Model Dependent, [On/Off, Dwell, Time Out Settings]
- Sunshield Included as standard
- Inverted Mounting Yes. Software selectable
- Connectors RJ45, AMP, MS, Model dependent
- Color Light Gray Cardinal Coating T241-GR142

ENVIRONMENTAL

- Protection Rating Camera - IP68, Pressurized with Dry Nitrogen, 3.5 psi.
Positioner Body - IP66
- Operating Temp -40°F to 167°F (-40°C to 75°C) Per

- | | |
|-----------------|---|
| | NEMA TS2 2.2.7 |
| • Heaters | Heaters are software controlled for managing proper internal temperature of camera system. The faceplate heater is ITO coated glass designed to maintain outer faceplate surface temperature above 32° (0°C) down to -4° (-20C) |
| • Humidity | Up to 100% |
| • Vibration | Per NEMA TS2 para. 2.2.8. 5-30Hz sweep @ 0.5g applied in each of 3 mutually perpendicular planes. |
| • Shock | Per NEMA TS2 para. 2.2.9. 10g applied in each of 3 mutually perpendicular planes |
| • Corrosion | MIL-STD-810G, Method 509.5, Paragraph 4.5.2, ANSI NCSL Z540-1, ISO 17025:2005 |
| • Impact Rating | IK10 |

EMC CERTIFICATIONS

- CE, FCC Part 15B, RoHS
- AS/NZS CISPR 22:2009+A1:2010
- CAN/CSA-CISPR 22-10
- EN 55022:2010+AC: 2011
- EN 55024:2010
- EN 61000-3-2:2006+A1:2009+A2:2009
- EN 61000-3-3:2013
- EN 61000-4-2: 2009
- EN 61000-4-3: 2006 +A1:2008 +A2:2010
- EN 61000-4-4: 2004
- EN 61000-4-5: 2006
- EN 61000-4-6: 2009
- EN 61000-4-8: 2010
- EN 61000-4-11: 2004

Construction Requirements

All installation services shall comply with all manufacturer's instructions and Warranty provisions and Warranty contract maintenance services and Department electrical codes. All wiring entry to the camera dome shall use watertight fittings. All materials shall be installed in a neat and professional manner. All wiring entry and exits shall be made at the side or underneath components; no exposed top entry or exits are permitted. This requirement extends to all enclosures, junction boxes, support arms, or any other externally exposed devices.

The camera lowering system shall be designed to support and lower a standard closed-circuit television camera, lens, housing, PTZ mechanism, cabling, connectors, and other supporting components without damage or causing degradation of camera operations. The camera lowering device and the tower are interdependent upon each other and thus, must be considered a single unit or system. The

lowering system shall consist of a coax contact unit, self-aligning divided support arm, an adapter for attachment to a tower, and a camera connection box. The divided support arm and receiver brackets shall be designed to self-align the contact unit during installation and ensure the contact unit cannot twist under high wind conditions. The camera-lowering device shall withstand wind forces of 100 mph with a 30 percent gust factor using a 1.65 safety factor. The lowering device shall effectively operate within a temperature range of -40 to 191°F. The lowering device manufacturer shall furnish independent laboratory testing documents certifying adherence to the stated wind force criteria utilizing, as a minimum effective projected area (EPA), the actual EPA or an EPA greater than that of the camera system to be attached. If the camera-lowering device is not from INDOT's Approved Materials List, the camera-lowering device to be furnished shall be the product of manufacturers with a minimum of 2 years of experience in the successful manufacturing of such systems. The lowering device provider shall be able to identify a minimum of 3 previous projects where the purposed system has been installed successfully.

All pulleys for the camera lowering tool shall have sealed, self-lubricated bearings, oil tight bronze bearing, or sintered bronze bushings. The lowering cable shall be a minimum 1/8-inch-diameter stainless steel aircraft cable with a minimum breaking strength of 1,740 pounds with seven strands of 19 gauge wire each.

The camera lowering system shall be capable of lowering the camera to the ground without contacting the pole/tower structure or anything attached to the tower structure. A guide cable shall be provided to prevent interference with the tower structure. The guide cable shall be 5/32 inch diameter stainless steel and shall be a manufacturer provided component. The cable guide shall be installed per manufacturer's recommendations. The guide cable shall be mounted to minimize the impact on the camera's view of the roadway, and shall have the ability to be disconnected from the ground mounting point to maximize the camera's view.

All electrical and video coaxial connections between the fixed and lowerable portion of the contact block shall be protected from exposure to the weather by a waterproof seal to prevent degradation of the electrical contacts. The electrical connections between the fixed and movable lowering device components shall be designed to conduct 56,000 bps RS422/485 or RS-232 data and one volt peak-to-peak video signals as well as the power requirements for operation of dome environmental controls.

The interface and locking components shall be made of stainless steel and/or aluminum. All external components of the lowering device shall be made of corrosion-resistant materials, powder coated, galvanized, or otherwise protected from the environment by industry-accepted coatings to withstand exposure to a corrosive environment. A weep hole with screen shall be included on the underside of the weight box.

The lowering system shall include the following basic components:

- Coaxial contact unit
- Self-aligning divided support arm

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

- Adapter for attachment to tower
- CCTV control cable junction box at the top of the tower
- Permanent mount lowering tool

The suspension contact unit shall have a load capacity 200 pounds with a 4 to 1 safety factor. There shall be a locking mechanism between the fixed and movable components of the lowering device. The movable assembly shall have a minimum of two latches. This latching mechanism shall securely hold the device and its mounted equipment. The latching mechanism shall operate by alternately raising and lowering the assembly using the winch and lowering cable. When latched, all weight shall be removed from the lowering cable. The fixed unit shall have a heavy-duty cast tracking guide and means to allow latching in the same position each time. The contact unit housing shall be weatherproof, with a gasket provided to seal the interior from dust and moisture.

The prefabricated components of the lift unit support system shall be designed to preclude the lifting cable from contacting the power or video cabling. Design-Build Contractor shall supply a means of separating the power and video cabling from the lowering cable if required by the Design Documents or IFA. The only cable permitted to move during lowering or raising shall be the stainless-steel lowering cable. All other cables shall remain stable and secure during lowering and raising operations.

The coax connector block consists of DIN Housing containing thermoplastic insulation bodies that hold the individual contacts. Guide pins and guide bushings shall prevent misconnections and provide accurate mating without relying on the contact pins to provide alignment. There shall be a minimum of 12 -.06-in. contacts and 1-75 Ohm contact. The max current rating for each pin shall be at least 13 amps. The signal and power wires shall be crimped using an industry standard 8-point crimp tool. The video cable shall be 75 ohm coax not to exceed a length of 1,000 feet. The cable loss with the connectors shall not exceed 0.8 decibels per 100 feet at 5 megahertz. The camera cable shall be made up with the coax connector block in the factory and sealed with electrical insulating. The entire coax connector block shall be sealed from external dust and moisture when in the mated condition by means of a gasket.

The divided support arm and receiver brackets shall be designed to self-align the contact unit during installation and ensure the contact unit cannot twist under high wind conditions.

The camera-lowering device shall be operated by use of a permanent mount lowering tool. The lowering tool shall be provided with an adapter for operating the lowering device by a portable drill using a clutch mechanism. The clutch mechanism, but not the portable drill, shall be provided for each site. The lowering tool shall be equipped with a positive locking mechanism to secure the cable reel during raising and lowering operations. The lowering tool shall be made of durable and corrosion-resistant materials, powder coated, galvanized, or otherwise protected from the environment by industry-accepted coating to withstand exposure to a corrosive environment. Lowering

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

tool shall be installed in the stainless steel, or aluminum enclosure, rated 3R, mounted to the tower.

The Camera Lowering System shall be installed in accordance with the manufacturer's instructions. All materials shall be installed in a neat and professional manner. All installation services shall comply with all Warranty provisions and Warranty contract maintenance services. All installation services shall comply with all local and State electrical codes, and Motorola R-56 requirements. Installation of the Camera Lowering System shall be coordinated with IFA to determine actual mounting height and azimuth. Typically, the camera lowering system azimuth will be perpendicular to the mainline lanes.

Prior to the delivery of the camera lowering system, the manufacturer will test for the following:

- Electrical continuity
- Direct connectivity to ground for an open circuit of 120 volts

The results of these tests will be supplied to IFA with each camera lowering system upon delivery.

Design-Build Contractor shall provide a 916.02(c) Type C certification from the vendor verifying the CCTV control cable was properly installed and tested before delivery to Design-Build Contractor.

Design-Build Contractor shall provide a manufacturer's Warranty against defects in material and workmanship for a period of three years after Final Acceptance of each complete installation. Design-Build Contractor shall include labor for removal and reinstallation of a failed unit. Warranty shall include lifetime Warranty on water ingress into camera head enclosure.

Basis of Item

CCTV Assembly will be measured by the number of units installed.

The items list shall include the following:

Item Description

Unit Symbol

CCTV Assembly.....EACH

The following shall be considered incidental to this item:

Labor, materials, design, vendor support, and items necessary to provide a complete and functioning CCTV assembly shall be incidental.

DYNAMIC MESSAGE SIGN, FULL-COLOR

Description

The Work shall consist of furnishing, installing, and testing all equipment and components necessary to provide full and complete ITS functionality of Dynamic Message Signs (DMS).

Materials

The overhead DMSs are LED (light emitting diode) displayed, full-matrix, 20 mm pixel pitch signs capable of displaying three lines of at least 20 characters each. The sign display shall have a minimum width of 127 pixels and a minimum height of 27 pixels.

The DMS shall be a full matrix, full color LED sign with a walk-in enclosure housing using all modular, controller, electrical, and communication equipment. The DMS shall include the following basic components:

1. DMS
2. Walk-in enclosure
3. DMS controller, firmware, and software
4. Electrical end-equipment
5. Mounting hardware

The Design-Build Contractor shall furnish one controller as an integral part of each DMS. The DMS controller is to be mounted inside the DMS and connected to the cellular modem for communications back to the TMC. The DMS shall be NTCIP compliant as currently defined by the NTCIP *Object Definitions for Dynamic Message Signs Publication 1203* (including subsequent revisions). The manufacturer shall provide all MIB definitions (Public and Proprietary) that the sign supports as well as associated data types supported. Methods for setting these values shall conform to NTCIP 1203v3 or newer. Manufacturer shall allow department to change without firmware, hardware changes, or third-party assistance the authentication values for SNMPv2c or SNMP3. Sample code for basic message manipulation shall be provided. Basic message manipulation includes:

- Defining Font
- Defining font size
- Defining a custom message
- Defining a schedule for the custom message
- Terminating custom message
- Viewing all stored messages
- Viewing all stored schedules

Construction Requirements

Dynamic Message Sign Manufacturing and Design Standards

DMS manufacturers shall comply with the Project Standards including the most current version, as of the Setting Date, of the following standards:

6. High-voltage wiring: High-voltage components and circuits (120 volts alternating current) shall be wired and color-coded per the NEC.
7. Environmental: The display and all display components shall conform to NEMA TS 4 Section 2 Environmental Standards.
8. Shock/Vibration: The display and all display components shall
9. conform to NEMA TS 4 Section 2 shock/vibration tests.

- 10.NTCIP: Publication 1203, most current version.
- 11.NEMA TS 4 Hardware Standards for DMS with NTCIP Requirements.
- 12.FCC: All equipment must be designed in accordance with FCC Part 15, Subpart B.

Materials

All electrical equipment shall operate within the range of environmental conditions specified herein and come with Warranties. The Warranties shall receive the approval of INDOT prior to the use of the respective equipment.

Weight and Dimensions

The maximum static weight of the DMS, including all internal and external components and mounting devices and members shall not exceed 4,500 pounds. In addition to the static weight, a live load of 600 pounds for maintenance personnel and equipment is to be accounted for in the structural analysis. The approximate outside dimension of the DMS enclosure shall not exceed 30 feet wide by 8 feet 10 inches high by 4 feet 1 inch deep.

Display Characteristics

The DMS shall consist of interchangeable LED modules arranged to provide a full matrix display. The full matrix display shall provide three-character lines each at least 20 characters long, separated vertically by six blank pixels. Horizontal spacing between characters shall be a minimum of four pixels. Pixel pitch shall be a maximum of 20 mm. Each display module shall consist of one or more-pixel matrices. Each pixel matrix shall form characters that are 18 inches in height.

The sign display shall have a minimum width of 127 pixels and a minimum height of 27 pixels.

The width of the borders on the display shall be equal and not less than 12 inches. Legibility of displays shall include daylight hours with direct sunlight on the face and behind the DMS.

Minimum clear visibility and legibility distance for the sign shall be 900 feet at an eye height of 3.5 feet within a 30° cone of vision about the optical axis under all weather conditions, except heavy rain, fog, or snow.

The display shall not perceivably brighten due to stray headlights shining on the photocells at night.

Basic Dynamic Message Sign Functions

A character set shall be provided and shall consist of at least the following:

1. All 26 capital letters of the alphabet
2. All digits 0 through 9
3. Arrows pointing to the eight primary compass points
4. Punctuation marks (\$ □ - + = . , ' & / \ () * ! ; : " " % # ? < > @ ~ ^ [] |)
5. Sequential arrow
6. Standard font (7x5 pixels per character)
7. Double stroke font (7x7 pixels per character)
8. Condensed font (7x4 pixels per character)
9. Expanded font (7x6 pixels per character)
10. Two additional user-defined fonts for a total of six fonts (standard, double stroke, condensed, expanded, two user defined)

11. Images in the format of SVG, GIF and JPEG
12. Minimum 32 bit color mapping.

Each sign shall be able to display static, multi-frame, or flashing messages:

1. Static Message: The chosen message shall be displayed constantly on the sign face until the sign controller is instructed to do otherwise.
2. Multi-frame Message: The chosen message shall display up to four different frames alternately at durations separately controllable in 0.1-second increments from 0.1 seconds to 25.5 seconds.
3. Flashing Message: A flashing capability shall be possible by blanking the LEDs. The parameters controlling the flashing rate shall be operator-selectable from 0.1 seconds to 9.9 seconds, in increments of 0.1 seconds.

Display Modules

The sign display shall be created by interconnecting several individual and interchangeable display modules. Each display module shall be capable of displaying a minimum of one 18-inch character, but not more than three 18-inch characters. The replacement of a complete display module shall be possible from the interior of the sign enclosure without the use of any special tools. Display modules shall be identical and interchangeable in all signs provided for this Project. Interconnection of modules shall be through connectors only. Each pixel shall have its optic axis oriented perpendicular to the sign face. Pixels shall be attached to the display module with a secure fastening system.

Pixels

Pixel columns and rows shall be perpendicular. The horizontal and vertical spacing (the pitch) of the pixels on center shall be identical on each display module and between all display modules in the DMS.

Each LED module shall contain a minimum of one each of red, green, and blue surface-mounted LED for each pixel.

Each pixel shall have a total brightness of 40 candelas per pixel at 20 milliampere as the sum from all LEDs in each individual pixel. The total on-axis (0 degrees horizontal, 0 degrees vertical) luminance intensity of the sign will be a minimum of 12,000 candelas per square meter. All pixels shall have equal color and on-axis intensity. The method used to provide the brightness, equal color, and intensity shall be included in the shop drawing submittals and approved by INDOT. Pixel brightness shall be tested and documented by a third-party lab. This documentation shall be submitted to IFA for approval prior to shipping the sign

Each pixel shall have a device attached to the printed circuit board (PCB) to hold and protect the LEDs. These devices shall do the following:

1. Hold the LEDs to within 0.5 degrees of being perpendicular to the display modules.
2. Prevent the LEDs from being crushed or bent during handling.
3. The LEDs shall be protected such that there is no contact with them when the display module is handled or dropped.
4. Protect the LEDs from damage when the display module is laid on the front surface (the side on which the LED lamps are located).
5. Be easily removable from the display module PCB without any

- specialized tools.
6. Not put any stress on the LEDs due to differentials of expansion and contraction between the device and the LEDs over the temperature range herein specified.
 7. Not become loose or fall off during handling or due to vibration.
 8. Not block airflow over the leads of the LEDs.
 9. Not block the light output of the LEDs at the required viewing angle.
 10. Be black in color to maximize contrast.

LEDs

The LED display module shall consist of pixels created by utilizing one LED of each of the following colors: Red, Green, and Blue. All LED display modules shall be manufactured by Avago Technologies, Nichia Corporation, Sander, Agilent, or Toshiba Corporation, and shall be of the same make and model and all traceable to the manufacturer. LEDs will have a 30-degree viewing angle. LEDs shall have a typical luminous intensity of 4.2 to 7.2 candelas per individual discrete LED when driven at 20 milliamperes. The light emitted by the LED display shall be full color, with individual LED features as follows:

- Red LEDs shall utilize AlInGaP semiconductor technology with a peak wavelength centered at approximately 625 nanometers ± 10 nanometers.
- Green LEDs shall utilize InGaN semiconductor technology with a peak wavelength centered at approximately 530 nanometers ± 10 nanometers.
- Blue LEDs shall utilize InGaN semiconductor technology with a peak wavelength centered at approximately 470 nanometers ± 10 nanometers.

LEDs in an individual sign will be from no more than two consecutive "bins" for either color or light intensity levels. The DMS manufacturer will perform the color/intensity sorting of individual LEDs, and they will be distributed consistently from pixel to pixel. The luminous intensity of the highest- and lowest- appearing pixels will be measured, and the intensity ratio ($L1/L2$ where $L1 > L2$) between the two shall be less than 3:1. LEDs shall have no less than 50 percent of the normalized intensity at their respective 30 degree viewing angle.

LED package style shall be surface-mount LEDs. Through-hole flush mount and through-hole standoff LEDs will not be allowed.

LEDs shall be nominally rated for 100,000 hours of operation under NEMA TS-4 environmental conditions.

The brightness of each LED shall be measured in accordance with the International Lighting Commission (CIE) Test Method A, as described with the CIE 127-2007, Technical Report: Measurement of LEDs. The LED brightness and color bins that are used in each pixel shall be provided to IFA for approval.

Certification shall be provided with the shop drawing Submittals from the LED manufacturer that demonstrates the LEDs were tested and binned in accordance with CIE Test Method A. This certification shall be provided to IFA prior to site delivery.

Optical Performance

Operating contrast values between 6 and 25 shall be demonstrated for each

lighting condition given the following definitions:

Luminance =	The luminous intensity of the 35 pixels The area of the block containing the 35 pixels including the background
Daytime Contrast =	(Luminance On - Luminance Off)/Luminance Off
Where the ambient light is simulated by a solar source simulator placed 10 degrees off the horizontal axis in front of the sign when measured on-axis to the center of the sign face giving a luminance of 40,000 lux on the sign face.	

Electronics

All DMS electronics shall be solid state technology and, with the exception of the PCBs, shall be commercially available, easily accessible, replaceable, and removable using conventional electronic repair methods. Moving parts shall be minimized where practical. All electronic and electrical components used in the LED display or DMS controller or other digital control devices shall be UL or Electronic Testing Laboratories (ETL) listed. This includes power supplies, wiring, and wiring accessories. Copies of UL or ETL product cards shall be provided to IFA prior to site delivery to document the listings. All data and low power connections will be accomplished via positive locking devices.

All workmanship shall comply with ANSI/IPC A-610D Class 2 titled, "Acceptability of Electronic Assemblies," and ANSI/IPC-7711/21B titled, "Rework Modification and Repair Electronic Assemblies."

All PCBs, except for the LED motherboard, power supply PCBs, and controller PCBs, shall be completely conformal coated with 0.010-inch minimum thickness silicone resin. The LED motherboard shall be completely conformal coated, except at the pixels on the front of the PCBs, with 0.010-inch minimum thickness silicone resin. The material used for the PCB coating shall meet the military specification MIL-I-46058C Type SR.

The LED pixels shall be directly driven using pulse width modulation (PWM) of the drive current to control the display intensity. This LED driver circuitry shall vary the current pulse width to achieve the proper display intensity levels for all ambient light conditions. The drive current pulse shall be modulated at a frequency high enough to provide flicker-free operation and a minimum of 200 brightness levels. The power supplies shall be designed such that one supply may fail and the sign display will still be supplied with sufficient power to run 100 percent of the pixels at 100 percent duty at 60 degrees Celsius. The power distribution system shall connect each display module to all power supplies and shall minimize voltage drop over the face of the sign. Multiplexing drive circuits shall not be used. The LED display manufacturer shall supply the schematic of the display to document the LED drive mode used.

The current provided at maximum brightness shall be easily adjustable between 15 milliamperes and 30 milliamperes in 1 percent increments. This adjustment will be altered occasionally over the life of the sign to offset the dimming of the LEDs as they age. LED brightness shall be controlled or adjusted in three ways: locally using the sign controller, remotely from the ATMS using the sign controller's serial communications port, and automatically via a closed-loop ambient light monitoring circuit. Once the LED brightness is set or adjusted, intensity shall not fluctuate or flicker due to sudden ambient light

level changes caused by weather (i.e., moving cloud cover) or vehicle headlights. It is not necessary that maximum brightness be remotely controlled. Upon installation, Design-Build Contractor shall set the maximum brightness current to 20 milliampere.

The sign controller shall continuously measure all LED module power supply voltages. The sign controller shall provide these voltage readings to the ATMS or remote laptop when polled.

Maintenance

All DMS equipment components, modular assemblies, and other materials located in the DMS housing shall be removable, transportable, and capable of being installed by a single technician accessing the sign from inside the walk-in enclosure.

Miscellaneous Requirements

The presence of ambient magnetic or electromagnetic fields, including those created by any components of the DMS subsystem, shall not interfere with the performance of the signs.

The rated life of all components, except LEDs, fans, filters, and equipment not normally furnished with the DMS, shall be a minimum of 20 years under 24-hour-a-day operation.

Equipment and accessories shall be, essentially, the standard cataloged products and of the latest design of manufacturers regularly engaged in production of such equipment and accessories for at least five years.

Differential expansion of the sign enclosure, sign face, and the display panel shall not cause damage to any of the components.

Walk-In Enclosure

The DMS walk-in enclosure (housing) shall be furnished and installed in this Project and be designed integral to the DMS. The DMS housing, including its front-face panels, shall be a NEMA type 3R, as described in the latest edition of the NEMA Standards Publication 250. The bottom of the sign shall be horizontal, and all sides shall be vertical. The top shall slope to the rear to completely drain rainwater from the roof. Sign housings shall be constructed of aluminum alloy 3003-H14 or 5052-H32, and shall not be less than 1.90 inches thick. Seams shall be continuously welded. Framing structural shapes shall be constructed of aluminum alloy 6061-T6 or 6063-T52. Non-corrosive materials shall be used where possible and corrosion protection shall be provided between dissimilar metals. Sign housings shall be cleaned and de-oxidized after welding.

To allow for the vacuum effect of the passage of large trucks, the sign face shall be designed for and shall withstand a negative (outward) pressure of 50 percent of the design inward wind pressure. Gasket material, where needed, shall be impervious to moisture, smog, and salt spray. If neoprene is used, the mating surface shall be covered with a silicon lubricant to prevent sticking to the mating metal surface.

The walk-in enclosure shall be designed such that the top of the display face (the surface that faces approaching traffic) is tilted 3 degrees toward traffic. The top plane of the housing shall be sloped 0.5 degrees toward the back of the housing. The rear plane of the housing shall remain vertical, and the interior walkway surface shall remain level (horizontal).

The manufacturer's name, month, and year of manufacture shall appear on the inside of the DMS housing. No logos or names of manufacturers shall appear on the outside of the housing.

Painting

The front of the sign enclosure will be coated with a semi-gloss black polyvinylidene fluoride (PVDF) protective coating. This coating will be designed to have a minimum of 10-year color retention and chalk resistance. All finish coatings shall be resistant to chipping, impacts, weather, scuffs, corrosion, and bacteria for a minimum of 10 years. All other surfaces shall be left their natural finish or unfinished aluminum.

Environmental

The sign shall be constructed to present a clean, neat appearance, and the equipment located therein shall be protected from moisture, dust, dirt, and corrosion. Sign enclosures shall contain small weep holes for draining moisture that accumulates in the signs from condensation. Weep holes shall be designed to prevent the entrance of insects and shall have snap-in drain filter plug inserts. The filter plug inserts shall be replaceable.

Sign Attachment Members

The sign shall be attached to the sign structure with I-beams or Z-bar extrusions. The number of I-beams or Z-bars needed and the method of attaching the I-beams or Z-bars to the sign housing and sign structure shall be as required to conform to the Project Standards. The housing shall be designed to accommodate mounting on the rear vertical plane. All structural hardware and mounting bracket hardware shall be stainless steel or galvanized high-strength steel and appropriately sized for the application. Mounting brackets shall be attached to the DMS using direct-tension indicators to verify that mounting hardware is tightened with the proper amount of force.

Lifting eyes or the equivalent shall be provided for moving and mounting signs. The DMS housing shall be designed such that the DMS can be shipped and temporarily stored without damage or undue stresses prior to installation on the overhead support structure.

Maintenance and Repair

Design and construct the walk-in housing so that all maintenance and repair is performed from within the DMS housing, with the exception of structural members and components thereof. The minimum clear distance from the interior rear wall of the DMS housing to the closest display components shall be 2 feet. This free space shall be maintained across the entire interior of the sign housing. Structural members shall be designed and positioned so as to not be an obstruction to free movement of maintenance technicians throughout the interior of the housing.

Include in the housing an internal incandescent lighting system of at least six fixtures to provide maintenance personnel with a minimum of 35 foot-candles of light measured at the floor, evenly distributed, provided by ceiling or top of wall mounted incandescent or compact fluorescent lights utilizing a cold-weather ballast within each sign housing. Locate two 3-circuit control switches inside the DMS housing for the lighting system, within easy reach from outside the DMS housing through the entryway. The sign housing and display panel shall be designed to be sufficiently "light tight," such that during night-time maintenance activities, no internal lighting shall be visible or distracting to motorists.

The DMS housing shall include a minimum of three 15 Amp, 120 volt alternating current duplex electrical outlets, with ground fault circuit interrupters, for use by maintenance personnel. The duplex outlets are to be mounted on the back wall of the DMS, distributed evenly within the housing. All power runs inside the housing shall be protected in intermediate metallic Conduits attached to the inside of the sign case.

Interior Walkway

The interior of the walk-in enclosure shall provide a minimum clear width of 2 feet and a minimum clear height of 6 feet through the length of the walkway to allow maintenance personnel free movement and working space. The interior walkway of the DMS shall be non-slip and able to support a minimum of a 500-pound load per linear foot and shall be constructed of multiple removable panels. The walkway's top surface shall be free of obstructions that would present a tripping hazard to maintenance personnel.

Personnel Access

The DMS housing shall have two vertically hinged doors, one on each end of the sign. The DMS housing doors shall be rain-tight/dust-tight. Doorway openings shall be a minimum of 6.5 feet in height and a minimum of 2 feet in width. The doors shall use a Corbin Lock Number 2 and shall be furnished with a minimum of one number 2 key. The DMS doors shall open to the exterior of the DMS and have a stop to retain the door in its fully open position while workers are inside the sign.

The latching/locking mechanism shall include two handles: one on the interior of the housing such that a person with no key and no tools cannot become entrapped inside the housing and another on the exterior of the housing with a key lock.

Cable Access

Provide a cable entrance for AC power as described herein. Conduit shall enter the rear exterior wall (facing away from traffic) of the sign case through a 90-degree bend in the Conduit. The attachment point between the Conduit and sign case shall be sealed on both sides of the sign case with a neoprene gasket or other approved material such that no moisture, condensation, or light can penetrate the seal.

Attach two junction boxes to the interior wall of the sign case: one to receive the AC power and one the communications cables. The junction box for the communications cable shall be 6 inches by 6 inches by 2 inches and labeled on the outside "COMM." The junction box for the power cable shall be labeled on the outside "AC POWER." All entries and exits from the junction boxes will be made via Conduit. Approximately 2 feet of cable slack shall be coiled in the junction boxes. Conduits leading from the junction boxes to the lighting panel and the ITS field processor shall also be provided.

Sign Display Cover

The sign display cover is attached to the front of each sign case and is a weatherproof assembly that presents an unobstructed view of the sign display.

The DMS shop drawings submitted by Design-Build Contractor shall demonstrate the technique employed to minimize glare, reduce solar heat gain on the LEDs, and increase sign contrast in all ambient lighting conditions.

Compose the sign display cover of a series of clear-formed segments that,

when placed side by side, form a complete face. Each display cover segment shall be of a size and weight that can easily be handled by maintenance personnel for replacement or cleaning. The sign display covers and display modules shall be constructed to allow all service operations from inside the sign case. The cover shall not be damaged by sign vibration or the positive and negative pressures resulting from changes in atmospheric conditions or the passing of large trucks. This includes cleaning the outside of the window by tipping the modules and sign face inward. The removal of any combination of windows shall not alter the structural integrity of the sign case.

The clear lens panels shall be made of polycarbonate. Polycarbonate shall contain an ultraviolet (UV) light inhibitor, which protects the LED display matrix from the effects of UV light exposure and prevents premature aging of the polycarbonate itself. Polycarbonate sheets shall have the following characteristics:

1. Tensile Strength, Ultimate: 9,000 pounds per square inch
2. Tensile Strength, Yield: 9,300 pounds per square inch
3. Tensile Strain at Break: 125 percent
4. Tensile Modulus: 330,000 pounds per square inch
5. Flexural Modulus: 330,000 pounds per square inch
6. Impact Strength, Izod (1/8 inch, notched): 17 foot-pounds per inch of notch
7. Rockwell Hardness: M75, R118
8. Heat Deflection Temperature Under Load: 264 pounds per square inch at 270 degrees Fahrenheit and 66 pounds per square inch at 288 degrees Fahrenheit
9. Coefficient of Thermal Expansion: 3.9×10^{-5} in/in/F
10. Specific Heat: 0.30 British thermal unit per pound per degree Fahrenheit
11. Initial Light Transmittance: 85 percent minimum
12. Change in Light Transmittance, 5 years' exposure in a southern latitude: less than 5 percent
13. Change in Yellowness Index, 5 years' exposure in southern latitude: less than 5 percent

The display cover and all associated parts, such as fasteners, shall be captive so that they cannot fall to the roadway. The windows shall be dust-proof and shall not leak when sprayed with water from any angle by a garden hose at a pressure equivalent to rain in a 90-mile-per-hour wind. The window frame(s) shall have a continuous closed-cell neoprene gasket around the entire perimeter. Horizontal portions of the gasket shall be supported by a channel. The gasket shall be at least 1 inch wide and 0.375 inches thick. The mating surface of the gasket shall be treated with silicone lubricant so that it does not stick. The sign face display cover shall be designed to minimize bowing.

Heaters and Fans

Signs shall contain thermostatically controlled fans and electric heating elements to prevent condensation on the inside of the display windows. A humidistat and thermostat shall also be included to activate the fans and electric heaters at user-selectable settings to control temperature and humidity for the display window and sign case. The defogging system shall be capable of substantially removing condensation from a completely fogged window within five minutes.

Vented thermostatically controlled fans shall be used to circulate the air inside the enclosures for cooling. Cooling fans shall turn on when the

internal DMS air temperature reaches 30 degrees Celsius. Fans shall keep the back side of the display modules below 60 degrees Celsius when the outdoor temperature is 40 degrees Celsius, the face of the sign is in full sun, and 50 percent of the pixels are illuminated, drawing 20 milliamperes of current. The ventilation system shall achieve this performance despite the failure of any single fan. The fans shall be installed so as to either "blow" air into or out of the sign case. Air inlets shall have louvers to keep out rain, rustproof screens to keep out insects, and replaceable 2-inch air filters to keep out dust. The filters shall be available from multiple manufacturers and shall be located to facilitate replacement. Exhaust vents shall be screened and have movable louvers that are closed when the fans are not running.

The LED modules and electric equipment shall be protected by a fail- safe, back-up fan control system in the event of an electronic fan control failure or shutdown of the DMS controller.

Heaters shall operate from a 240-volt, 60-hertz, single-phase AC power. Fans shall operate from 120-volt, 60-hertz, single-phase AC power.

Fire Extinguisher

Furnish and install a 5-pound standard BC powder fire extinguisher by the rear door. The fire extinguisher shall have squeeze grip operation. The fire extinguisher shall be supplied complete with a wall bracket and shall be mounted on the internal wall of the sign enclosure within easy reach of the door opening.

The fire extinguisher shall include positive on/off operation, pull-pin safety locks, a waterproof stainless-steel gauge, and an anodized aluminum valve.

Interference

The dimming circuit and DMS power system shall have electrical devices installed to minimize radio frequency interference (RFI) noise generated by the DMS both on the power line and radiated by sign circuitry. Equipment shall be in compliance with FCC Part 15, Subpart B.

DMS Controller, Firmware, and Software

Furnish, test, and install a DMS controller, firmware, and software compatible with the communications protocol provided by INDOT, at each DMS site shown on the Plans. Furnish, test, and install the auxiliary equipment and wiring required to complete the system testing. The DMS shall be capable of receiving communications from the server located at one of INDOT TMCs and displaying messages by illuminating the LEDs to form legible words and graphics. Provide all equipment and materials needed to interconnect and interface the controller to the sign, including cables and connectors. Provide controller software that is consistent with the operational requirements and communications protocols.

DMS controllers shall have the following features:

1. Communications Ports. The DMS controller shall be able to receive instructions from and provide information to the ATMS network. There shall be ports available for both local and remote operation of the DMS. Including minimally 1000 Base-T Ethernet.

The DMS sign controller shall contain a minimum of one 1000Base-T Ethernet communication port. This port shall be available for optional use for communicating from the ATMS to the DMS sign controller when an Ethernet network is available. The Ethernet port shall have a standard RJ45 connector.

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

The DMS sign controller shall contain a minimum of two NTCIP- compatible RS-232 communications ports. These ports shall support multiple communication interfaces, including direct null-modem (for local laptop control), dial-up and leased-line modems, radio systems, cellular modems, and fiber-optic modems. The RS232 ports shall all have standard DB9M connectors.

1. Microprocessor. The DMS controller shall be a solid state microprocessor.
2. Internal Clock. The controller shall have an internal clock that will satisfy the following minimum requirements:

The internal clock shall obtain its timing reference either from a crystal or from the 60-hertz frequency of the power input line. For internal clocks obtaining its timing reference from the 60- hertz power line frequency, the timing reference shall be crystal controlled in the absence of AC power. In either case, the clock shall be accurate to within 15 seconds per month.

The internal clock shall have both permanent and changeable memory. The permanent memory shall be in the form of plug-in programmable read-only memory (PROM) integrated circuits. It shall contain the software for performing the required timing functions. The changeable memory shall be in the form of random access memory (RAM) integrated circuits with a lithium battery back-up that retains the data in memory for a minimum of one year following a power failure.

The changeable memory shall contain the current time in the form of year, month, day of month, hour of day, minute of hour, and second of minute.

The correct time shall be entered into changeable memory as a function of the year, month, day of month, hour of day, minute of hour, and second of minute. Hours of the day shall be entered in 24-hour (military) format.

The internal clock shall automatically compensate for leap years. The dates and times on which daylight-savings-time changes take place shall be user-programmable. The programming for daylight-savings-time changes shall be accomplished in such a manner that reprogramming each year is not necessary. Once set, the internal clock shall automatically adjust the hour of the day for daylight-savings-time changes.

1. Stored Messages. The DMS controller shall be capable of storing a minimum of 100 messages in non-volatile memory, each message consisting of up to three phrases and each phrase consisting of up to three full lines of text.
2. Default Message. The DMS controller shall be designed to blank out the sign in the event of a power failure.
3. Message Speed. The LED display shall update instantaneously with no shifting, scrolling, or other visual disturbance apparent to the motorist.
4. Controller Failures and Loss of Power. In the event of a controller failure, any displayed message shall be blanked out. The controller's operating system shall reside in non-volatile memory and shall reinitialize automatically at power-up and run without operator intervention. In the event of power outage, the clock shall re-start with the correct time (e.g., GPS or crystal clock) on the restoration of power. During the period of time that the controller is attempting to automatically recover from a controller failure, and until such time that the initialization process is complete, no messages shall

- be displayed on the sign.
5. Pixel Failures. The controller shall determine how many pixels are not turning on, how many pixels are not turning off, and the number of modules that have failed. This information shall be reported to the DMS controller.
 6. LED Temperature Monitor. The sign controller shall monitor the temperature of the LED circuit board and shall reduce light output (DC forward current) when the temperature exceeds unacceptable thresholds. At least three temperature levels, set via the system interface, shall be supported, which will result in increasingly lower output to the LEDs. The sign controller shall perform an automatic sign shutdown when the temperature exceeds an absolute threshold. The sign controller shall use an analog to digital converter to capture the current LED temperature. Current temperature shall be reportable to the ATMS or portable computer via the sign controller interface. The temperature sensors shall be equally spaced to cover each end and the middle of the sign.

The DMS controller shall continuously measure all LED module power supply voltages and be able to report those voltages both locally and remotely to the ATMS.

Physical

The DMS controller and all of its associated equipment, cables, connectors, and materials shall be designed, constructed, and positioned so that all maintenance and repair is performed from inside the walk-in enclosure.

All DMS controller equipment, components, modular assemblies, and other materials located in the walk-in enclosure shall be removable, transportable, and installable by a single technician.

Space shall be provided inside the walk-in enclosure for the installation of the ITS field processor and junction boxes. The area provided for the installation of this auxiliary equipment shall clearly be shown in Design-Build Contractor's Submittal of the DMS shop drawings. Conduits shall be provided between the DMS controller and equipment racks to the ITS field processor and cabinet interface panel as necessary for a neat and orderly installation of cables and connectors.

The DMS equipment, components, and housing shall be designed and constructed for ease of maintenance. A single technician shall be able to remove and replace any modular assembly under adverse conditions in under 15 minutes. All electronic subassemblies shall be accessible and easily replaced by using plug-in or connector-based subassemblies. Any required configuration jumpers shall be clearly marked.

DMS controller circuit breakers, fuses, switches, and indicators shall be readily visible inside the walk-in enclosure.

All assemblies and panels shall allow air circulation through the top and bottom, unless specifically called out otherwise. Assemblies shall be fabricated of a 0.0625-inch-minimum-thickness aluminum or stainless-steel sheet. The metal surface shall be treated with clear chromate.

Software

The application software shall be supplied for local operation of the DMS controller, and it shall be NTCIP (current version) compliant. Design-Build

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

Contractor shall provide a licensing agreement that facilitates unlimited use within INDOT or authorized maintenance contracts. Provide software with the following minimum capabilities:

1. Verify, set, and change the time on the internal clock.
2. Verify, enter, change, and delete dates and times for daylight savings time changes.
3. View, enter new, edit existing, and delete entries in the event schedule.
4. Verify, enter, modify, and delete password protection codes.
5. Diagnostic routines capable of testing full sign operation.

Display tests shall include but not be limited to the following:

1. All pixels on
2. All pixels off
3. All pixels on and off alternately
4. Sequence through each column
5. Sequence through each row
6. Sequence through the entire character set
7. Display immediate messages on the DMS entered through the portable field control computer's keyboard.
8. Mimic both diagnostic and operator-generated messages sent to the DMS display on the portable field control computer's display in pixel matrix format identical to that of the sign being controlled.
9. Operator selection of dimming levels.

Exerciser

The manufacturer shall supply two compiled, latest versions of the FHWA, NTCIP exerciser with the manufacturer's MIB. One copy shall be sent prior to approval with a test application to mock sign interface to ITS Engineering Director, Traffic Maintenance Division, Indiana Department of Transportation, and one to the manufacturer's representative.

Dimming System

The DMS controller shall incorporate a means of changing the lighting level provided by the LEDs automatically in response to ambient lighting conditions at each sign location as detected by the photocell system, and remotely in response to commands received from the software. A light sensing system shall be used to detect lighting conditions between ranges of 2 to 20,000 lux. Design-Build Contractor shall provide photoelectric cells integral to the DMS. These devices shall direct the DMS controller to modify the intensity of the light produced by the pixel elements. Locate the photoelectric cells such that they are easily accessible for maintenance. Seal photoelectric cells using twist-lock-type receptacles or other approved receptacles suitable for this application. Two replaceable photocells shall be located on the DMS enclosure and positioned to sense the ambient light on the front and rear face of the DMS in such a manner to provide the information necessary to allow the controller to adjust the light levels of the DMS to maintain optimum visibility at sunrise, sunset, and other abnormal lighting conditions.

Provide all wiring and equipment necessary for the operation and interconnection of the photocell system and the light level output control circuit. Incorporate the light level output control circuit in the DMS controller. The circuit shall consist of solid state or other approved methods for control of the photoelectric system. The system shall provide a minimum of eight settings that are both locally and remotely settable.

Electrical End-Equipment

Design-Build Contractor shall establish electric service accounts in INDOT's name, as appropriate. Each DMS sign shall have a lighting panel mounted within the sign case.

Each circuit shall be over-current protected. Each circuit breaker shall be UL or ETL, or an approved equal, switching duty type. The service personnel lighting and convenience receptacle outlets shall be provided with ground fault circuit interrupters.

Power supplies shall operate from 120 or 240-volts-alternating-current power. The LED displays shall be operated at low internal DC voltage not exceeding 24 volts direct current. Power supplies shall be solid state electronic switching regulated output. The display shall be powered with two or more supplies wired in a redundant parallel configuration such that the supplies provide equal amounts of current to the display. When a power supply fails, the remaining supplies shall be capable of providing sufficient power to the sign display (20 milliampere to every LED on the line when the air around the power supply is at 60 degrees Celsius) and electronics.

Power supplies shall operate from -34 degrees Celsius to +74 degrees Celsius. Power supplies shall be short-circuit protected by DC power off and shall reset automatically after 5 seconds of AC power off. Power supplies shall also be protected by a minimum overload allowance of 105 percent and have an efficiency rating of at least 80 percent. The power supply shall be UL or ETL listed. Power supplies may be mounted either above or below the interior walkway of the housing. Units mounted above shall not encroach on the 2-foot-wide, 6-foot-high clear space above the walkway. Units placed beneath the walkway shall be mounted above the bottom surface of the housing with a chair bracket to provide protection against water damage.

All signs shall be unaffected by surges or transient voltages normally experienced on commercial and industrial power lines. Signs will be protected from surges and transient voltages by the incorporation of metal-oxide varistor (MOV) devices at the AC line circuit input utilization of a multi-section L-C filter ahead of the sign electronics power supply. Protection against abnormally low and high voltages shall be provided by an electronic voltage detection circuit controlling the AC input power with a suitably selected contact relay.

An AC line monitor shall be provided to monitor the AC signal entering the sign. If three consecutive positive pulses are not detected, the AC line monitor will relay a signal to the DMS controller indicating power has failed. The DMS controller will then send a signal to the drivers to blank the sign or display the default message.

All signs shall be equipped with lightning protection, including electrical service and telephone service, as appropriate. Protection from lightning shall include gas discharge devices followed by zener diodes for data entry connections to the sign. Proper grounding of the sign housing shall be the responsibility of Design-Build Contractor.

Mounting Hardware

Mounting hardware shall be supplied with the DMS. The mounting hardware shall include those devices shown on the Plans and all other appurtenant hardware, connectors, bolts, structural stiffening members, etc., necessary to attach the DMS to the structural supports.

Installation

Upon delivery to a storage location or to the site of installation, place the DMS in a manufacturer-approved manner, including supports that keep the sign off the ground and in a stable position. Supply all mounting bracket and required hardware for the permanent mounting of the DMS. Supply bolts if the lifting eyebolts are removed from the DMS after installation, to plug and seal the holes to prevent water from entering the DMS housing. If the lifting bolts are to be removed, provide compatible lifting bolts to Department for possible future use.

DMS Testing and Acceptance Requirements

Conduct such tests as necessary to ensure each DMS meets the requirements and specifications. IFA reserves the right to witness and verify, or to appoint a representative to witness, all product testing during manufacture of the DMS. If the FAT is performed at a location more than 100 miles from the Site, the Design-Build Contractor shall reimburse travel costs for up to four Engineer(s).

Factory Acceptance Testing (FAT)

The FAT shall be performed at the DMS vendor's manufacturing facility. FAT is required prior to shipping of any DMS and shall include the following, at a minimum:

Passage of the NEMA 250 Water Spray Test with no visible signs of water leakage through any of the sign housing seams.

Proof of the 48 hours of continuous operation of the FAT DMS at each of two test conditions: 25 degrees Fahrenheit (first test) and 125 degrees Fahrenheit (second test).

Post-FAT, IFA will audit and approve all burn-in test logs for each DMS prior to that DMS shipping from the factory.

The physical verification through inspection by IFA that the DMS meets the special provision and the approved Submittal and shop drawings.

Post-Delivery Testing and Operation

Prior to delivery of the DMS, the site shall have all lightning and surge suppression and grounding and bonding performed and accepted. Upon the delivery of each DMS provide permanent power for demonstration of the DMS' functions in accordance with the requirements and specifications and for proof that the DMS has not been damaged during shipment. Maintain the DMS power feed from the day of delivery to Final Acceptance, thereby protecting the interior electronics within the DMS from environmental degradation.

Post-Delivery Test Plan

Develop and submit to IFA a DMS Post-Delivery Test Plan with the Working Drawings. The test plan shall demonstrate the complete functionality and integrity of the DMS after shipment and post-delivery. The plan shall describe test procedures, detail the features being tested, and the detail the expected values that demonstrate DMS compliance.

Testing Schedule

All DMSs will be tested in accordance with the IFA-approved Post- Delivery Test Plan. Schedule and conduct the post-delivery tests at a time approved by INDOT.

Reporting Requirements

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

Submit vendor and third-party reports verifying testing procedures, testing dates, and testing results to IFA. The report will document the comparison of test results to the specifications detailed herein. The report will clearly identify any failure to conform to the specifications.

Failure to conform to testing procedures will be considered a defect of the equipment and will thereby be subject to rejection by IFA. Rejected equipment may be offered again for a retest. The retest shall fully comply with the test procedure, and the DMS is retested by the vendor or third-party. Evidence of conformance of the test shall be submitted to IFA.

Failure of any DMS to conform to the Design Documents, Construction Documents, or the PPA Documents will be considered a Defect, and the DMS is thereby subject to rejection by IFA. Rejected equipment may be offered again for a retest, provided that all nonconformances have been corrected and retested by the vendor and evidence thereof has been submitted to IFA.

Final FAT and product test reports showing complete compliance with specifications shall be submitted for review and comment by INDOT before Design-Build Contractor releases the DMS for shipment.

Conduct final inspection and acceptance of the DMS after:

1. Approval of the product testing report
2. Approval of the FAT report
3. Delivery of the DMS to a site designated by IFA
4. Proof and verification of the DMS continuous operation post-delivery
5. Approval of the reports documenting the results of the post-delivery test

Warranty

The DMS device and all ancillary equipment shall be covered under full manufacture Warranty for parts for two years after Final Acceptance. The mounting of a cellular antenna, radio antenna, and/or pole to the DMS shall not void this Warranty. The manufacturer shall submit Warranty information on company letterhead to IFA with the authorizing company representative's signature. Warranty information shall include shipping and replacement part procedures that allow IFA to obtain a Warranty replacement of defective parts in a timely manner. Standard Warranties shall be issued in IFA's name.

Supply a DMS factory-trained technician to observe and oversee the DMS and ACP installation process for each sign. The technician shall verify that the installation practices follow the DMS vendor's standard operating procedure and that DMS vendor's warranty was not in any way voided or limited during the installation.

Once accepted by IFA and upon Design-Build Contractor's request, the DMS Warranty will begin.

Warrant that:

1. All Work furnished pursuant to the contract documents will conform to all professional engineering principles generally accepted as standards of the industry in the state.
2. The DMS will be free of defects.
3. Materials and equipment furnished under the PPA Documents will be of good quality and, when installed, will be new.
4. The Work will meet all of the requirements of the PPA Documents.

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

The Design Documents and construction documents for the DMS devices and ancillary equipment selected and prepared for use during Construction Work are appropriate for their intended use.

The Design-Build Contractor shall document all installation activities, including the quantity, brand, model/part numbers, and test results of all materials used. Provide an installer-signed list of the materials installed with the required documentation.

Basis of Item

The DMS shall be measured per the number of units furnished and installed complete and in place and after passing component and subsystem testing.

The items list shall include the following:

Item Description	Unit Symbol
Dynamic Message Sign, Full-Color.....	EACH

The following shall be considered incidental to this item:

Labor, materials, design, vendor support, and items necessary to provide a complete and functioning DMS shall be incidental.

FENCE AND SLIDING GATE FOR TOWER SITES

SECTION 603, BEGIN LINE 18, INSERT AS FOLLOWS:

Cantilever slide gates shall be manufactured to the minimum dimensions shown on the Plans. The gate post and gate post foundations shall be sized per the manufacturer's recommendations, but no smaller than the posts and foundations shown in the Plans. Gates shall be provided with a gate latch capable of being padlocked with the ITS, PADLOCK.

SECTION 603, BEGIN LINE 46, INSERT AS FOLLOWS:

The fence and gate shall be grounded in accordance with the Plans and grounding specification.

The camera lowering device down guide cables shall be securely attached to the fence posts at the locations indicated in the Plans, or as approved by IFA.

Gate installation shall be in accordance with the manufacturer's instructions.

SECTION 603, BEGIN LINE 154, INSERT AS FOLLOWS:

*FENCE CHAIN LINK 96 IN., MODIFIEDLFT
FENCE GATE CHAIN LINK, 96 IN x 15 FT, CANTILEVERED.....EACH*

FIBER OPTIC BACKBONE CABLE

Description

The Design-Build Contractor shall provide outdoor-rated, single-mode, armored, fiber optic cable of the number of fibers specified as directed by IFA. Other ancillary components required to complete the fiber optic cable plant, including but not limited to, moisture and water sealants, cable caps, fan-out kits, etc., shall be incidental to the fiber optic cable item and will not be paid for separately.

Materials

The single-mode, fiber optic cable shall incorporate a single tube, 12-fiber ribbon design or a loose, buffer tube design. The cable shall conform to the requirements of Rural Utility Service (RUS) 7 CFR 1755.900 (PE-90) for a single sheathed, armored cable, and shall be new, unused, and of current design and manufacture. The number of fibers in each cable shall be as specified on the Plans.

Minimum Bending Radius:

The cable shall be capable of withstanding a minimum-bending radius of fifteen (15) times its outer diameter during operation and ten (10) times its outer diameter during installation without changing the characteristics of the optical fibers.

Environmental Requirements:

The cable shall meet all of the specified requirements under the following conditions:

1. Shipping/storage temperature: -40°F to +158°F (-50°C to +70°C)
2. Installation temperature: -30°F to +158°F (-30°C to +70°C)
3. Operating temperature: -40°F to +158°F (-40°C to +70°C)
4. Relative humidity from 0% to 95%, non-condensing

All backbone cables shall be suitable for installation in outdoor handholes, manholes, or vaults subject to immersion in water and ice.

Construction Requirements

Experience Requirements:

Personnel involved in the installation, splicing, and testing of the fiber optic cables shall meet the following requirements:

1. Shall have installed two systems where fiber optic cables are outdoors in Conduit and where the systems have been in continuous satisfactory operation for at least two years. The Design-Build Contractor shall submit as proof, photographs or other supporting documents, and the names, addresses, and telephone numbers of the operating personnel who can be contacted regarding the installed fiber optic systems.
2. A minimum of three years of experience in the installation of fiber optic cables, including fusion splicing, terminating, and testing single mode fibers.
3. Shall have installed one fiber optic cable system (which may be one of the two in the preceding paragraph), which the Design-Build Contractor can arrange for demonstration to IFA representatives, if requested.
4. Installers shall be familiar with the cable manufacturer's recommended procedures for installing the cable. This shall include

knowledge of splicing procedures for the fusion splicer being used on this Project and knowledge of all hardware such as breakout (furcation) kits and splice closures. The Design-Build Contractor shall submit documented procedures to IFA for approval and to be used by construction inspectors.

5. Personnel involved in testing shall have been trained by the manufacturer of the fiber optic cable test equipment to be used in fiber optic cable testing procedures. Proof of this training shall be submitted to IFA for approval. In addition, the Design-Build Contractor shall submit documentation of the testing procedures for approval by IFA.

Installation in Conduit:

The Design-Build Contractor shall provide a cable-pulling plan, identifying where the cable will enter the underground system and the direction of pull. This plan shall address locations where the cable is pulled out of a handhole, coiled in a figure eight, and pulled back into the handhole. The plan shall address the physical protection of the cable during installation and during periods of downtime. The cable-pulling plan shall be provided to IFA for approval a minimum of 10 Business Days prior to the start of installation. IFA's approval shall be for the installation operation on the freeway and does not include an endorsement of the proposed procedures. The Design-Build Contractor is responsible for the technical adequacy of the proposed procedures.

During cable pulling operations, the Design-Build Contractor shall ensure that the minimum bending of the cable is maintained during the unreeling and pulling operations. Entry guide chutes shall be used and the ends of the Conduit shall be fitted with bells to protect and guide the cable into the handhole Conduit ports. Bells shall be removed after installation of the cable. Lubricating compound shall be used to minimize friction. Corner rollers (wheels), if used, shall not have radii less than the minimum installation-bending radius of the cable. A series array of smaller wheels can be used for accomplishing the bend if the cable manufacturers specifically approve the array.

The pulling tension shall be continuously measured and shall not be allowed to exceed the maximum tension specified by the manufacturer of the cable. Fuse links and breaks can be used to ensure that the cable tensile strength is not exceeded. The pulling system shall have an audible alarm that sounds whenever a pre-selected tension level is reached. Tension levels shall be recorded continuously and shall be given to IFA upon request.

The number of handholes/manholes/vaults and their locations shall be as shown on the Plans, or as requested by IFA.

The cable shall be pulled into the Conduit as a single component, absorbing the pulling force in all tension elements.

The steel strength member(s) and Aramid yarn shall be attached directly to the pulling eye during cable pulling. "Basket grip" or "Chinese-finger type" attachments, which only attach to the cable's outer jacket, shall not be permitted. A breakaway swivel, rated at 95 percent of the cable manufacturer's approved maximum tensile loading, shall be used on all pulls. When simultaneously pulling fiber optic cable with other cables, separate grooved rollers shall be used for each cable.

300 feet of slack fiber shall be installed at all location where splices

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

are being made, 150 feet on each side of the splice enclosure and tie-wrapped and coiled as indicated on the plans. 50 feet of slack fiber shall be included at all other handholes or vaults not containing splices. Slack cable shall be pulled from the adjacent cabinet or shelter after installation and secured inside of the vault.

Construction Documentation Requirements:

Installation Practices for Outdoor Fiber Optic Cable Systems: The Design-Build Contractor shall examine the proposed cable plant design. At least one month prior to starting installation of the fiber optic cable plant, the Design-Build Contractor shall prepare and submit to IFA for review and approval, digital submission of the Design-Build Contractor's "Installation Practices for Outdoor Fiber Optic Cable Systems" manual, or as required by IFA. This manual shall address the Design-Build Contractor's proposed practices covering all aspects of the fiber optic cable plant. This submittal shall include all proposed procedures, list of installation equipment, and splicing and test equipment. Test and quality control procedures shall be detailed as well as procedures for corrective action.

Operation and Maintenance Documentation: After the fiber optic cable plant has been installed, digital submission of the Operation and Maintenance Documentation shall be provided, or as required by IFA. The documentation shall, as a minimum, include the following:

1. Complete and accurate as-built diagrams showing the entire fiber optic cable plant including locations of all splices.
2. Final copies of all approved test procedures.
3. Complete performance data of the cable plant showing the losses at each splice location and each terminal connector.
4. Complete parts list including names of vendors.

Testing Requirements: The Design-Build Contractor shall submit detailed test procedures for approval by IFA. All fibers shall be tested bi-directionally at both 1310 nm and 1550 nm with both an Optical Time Domain Reflectometer (OTDR) and a power meter and optical source. Any discrepancies between the measured results and these specifications shall be resolved to the satisfaction of IFA.

A Certified Technician utilizing an Optical Time Domain Reflectometer (OTDR) and Optical Source/Power Meter shall conduct the installation test. The Technician is directed to conduct the test using the standard operating procedures defined by the manufacturer of the test equipment. All fibers installed shall be tested in both directions.

The Design-Build Contractor shall provide the date, time, and location of any tests required by this specification to IFA at least 5 days before performing the test. Upon completion of the cable installation, splicing, and termination, the Design-Build Contractor shall test all fibers for continuity, events above 0.1 dB, and total attenuation of the cable. The test procedure shall be as follows:

Optical Time Domain Reflectometer: The method of connectivity between the OTDR and the cable shall be a factory patch cord or launch cable of a length equal to the "dead zone" of the OTDR. Optionally, the technician can use a factory "fiber box" of 328 ft (100 m) minimum with no splices within the box. The tests shall be conducted at 1310 nm and 1550 nm for all fibers.

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

At the completion of the test, the Design-Build Contractor shall provide two copies of documentation of the test results along with a Comma Separated File(CSV) to the Project Engineer. The test documentation shall be bound and shall include the following:

1. Cable & Fiber Identification:
 - a. Cable ID
 - b. Cable Location beginning point
 - c. Cable Location end point
 - d. Fiber ID
 - e. Rube/Ribbon Color
 - f. Fiber color
2. Operator Name
3. Date & Time
4. Setup Parameters
5. Wavelength
6. Pulse width (OTDR)
7. Refractory index (OTDR)
8. Range (OTDR)
9. Scale (OTDR)
10. Setup Option chosen to pass OTDR "dead zone"
11. Test Results:
 - a. OTDR Test
 - b. Total Fiber Trace
 - c. Splice Loss/Gain
 - d. Events > 0.10 dB
12. Physical Length (Cable Marking)
13. Fiber Length (OTDR)
14. Test results and traces shall also be provided on a CD or flash drive
15. Optical Source/Power Meter
16. Total Attenuation

These results shall be provided in tabular form. The following shall be the criteria for the acceptance of the cable:

1. The test results shall show that the dB/km loss does not exceed +3 percent of the factory test or 1 percent of the cable's published production loss.
2. However, no event shall exceed 0.10 dB. If any event is detected above 0.10 dB, the Design-Build Contractor shall replace or repair the fiber including that event point.

The total dB loss of the cable, less events, shall not exceed the manufacturer's production specifications as follows:

1. 0.5 dB/km at 1310 nm
2. 0.4 dB/km at 1550 nm

If the total loss exceeds these specifications, the Design-Build Contractor shall replace or repair that cable run at the Design-Build Contractor's expense, both labor and materials. Elevated attenuation due to exceeding the pulling tension during installation shall require the replacement of the cable run at the Design-Build Contractor's expense, including labor and materials.

The aforementioned tests shall be completed on the reel before installation and completed after the complete installation.

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

Splicing Requirements: Splices shall be made at locations shown on the Plans. Any other splices shall be permitted only with the written approval of IFA.

All optical fibers shall be spliced as indicated on the Plans. If no information is provided, mainline splices shall concatenate the fibers from the two cable segments, that is, the colors of the buffer tubes and fibers shall be the same across the splice. For splices that breakout the individual fibers, the fibers shall be spliced in accordance with the Plans.

Slack Storage of Fiber Optic Cables: As part of this item, slack fiber shall be supplied as necessary to allow splicing of the fiber optic cables to occur in a controlled environment, such as a splicing van or tent. After splicing has been completed, the slack fiber shall be stored underground in vaults.

Where identified on the Plans or as directed by IFA, additional lengths of fiber shall be stored as maintenance coils. The aggregate lengths of the maintenance coils and the slack fiber shall be used to repair and maintain the fiber optic cable.

Label the destination of each cable in each handhole, vault. Label the destination of each cable at a fiber distribution panel (FDP) located in cabinets, DMSs, and shelters. As a minimum, FDP face plate shall indicate the destination (i.e. dms-465-022-0-nb).

Fiber optic cable shall be tagged inside handholes with a vinyl label containing the text: "CAUTION - FIBER OPTIC CABLE."

Identification of installed Fiber Optic Cables: The backbone fiber optic cable shall be labeled as "Destination (i.e. CDP-S2)" - "Route (i.e. 465)" - "Destination (i.e. CDP-S3" and "Count" - "Fiber Type (SM or MM)" depending on the location of the fiber and type of fiber. Labels shall be permanent wrap-around type, machine printed and shall be installed within 2 feet from each installed splice enclosure, termination shelf, or conduit penetration into a handhole, cabinet or other structure.

Basis of Item

Fiber optic cable will be measured per foot of cable provided in conduit, handhole, vault, cabinet, or shelter.

The items list shall include the following:

Item Description	Unit Symbol
Fiber Optic Cable, Armored, 24F Single Mode.....	LFT
Fiber Optic Cable, Armored, 96F Single Mode.....	LFT
Fiber Optic Cable, Armored, 192F Single Mode.....	LFT

The following shall be considered incidental to this item:

Material, labor, equipment, transportation, placement, and other necessary incidentals.

All necessary preparation work, pulling equipment and materials, testing, labor, and other necessary incidentals to complete the Work.

FIBER OPTIC CABLE SPLICE

Description

The Design-Build Contractor shall splice optical fibers from different cable sheaths and protect them with a splice enclosure and splice trays at the locations shown on the Plans. Fiber splicing consists of in-line fusion splices for all fibers described in the cable plan at the particular location.

Materials

Splice Enclosures: Splice Enclosures shall be designed for use under the most severe conditions such as moisture, vibration, impact, cable stress, and flex temperature extremes as demonstrated by successfully passing the factory test procedures and minimum specifications listed below:

Physical Requirements: The enclosures shall provide ingress for up to four cables in a butt configuration. The closure shall prevent the intrusion of water without the use of encapsulates.

The enclosure shall be capable of accommodating splice organizer trays that accept mechanical or fusion splices. The splice enclosure shall have provisions for storing fiber splices in an orderly manner, mountings for splice organizer assemblies, and space for excess or un-spliced fiber. Splice organizers shall be re-enterable. The splice case shall be UL rated.

Enclosure re-entry and subsequent reassembly shall not require specialized tools or equipment. Further, these operations shall not require the use of additional parts.

The splice enclosure shall have provisions for controlling the bend radius of individual fibers to a minimum of 1.5 in (38 mm).

For splices in armored cables, the splice closure shall provide a method of bonding the armor from all sheaths entering the closure. It shall also provide a means of grounding the armor and closure at the splice location.

Factory Testing:

Factory Testing shall conform to the following testing;

Compression Test:

The closure shall not deform more than 10 percent in its largest cross-sectional dimension when subjected to a uniformly distributed load of 1335 N at a temperature of 0° F and 100° F (-18°C and 38°C). The test shall be performed after stabilizing at the required temperature for a minimum of two hours. It shall consist of placing an assembled closure between two flat parallel surfaces, with the longest closure dimension parallel to the surfaces. The weight shall be placed on the upper surface for a minimum of 15 minutes. The measurement shall then be taken with weight in place.

Impact Test:

The assembled closure shall be capable of withstanding an impact of 28 N-M at temperatures of 0° F and 100° F (-18° C and 38° C). The test shall be performed after stabilizing the closure at the required temperature for a minimum of 2 hours. The test fixture shall consist of 20 pound (9 kg) cylindrical steel impacting head with a 2 inch (5 cm) spherical radius at the point where it contacts the closure. It shall be dropped from a height of 12 inches (30 cm). The closure shall not exhibit any cracks or fractures to the housing that would preclude it from passing the water immersion test. There

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

shall be no permanent deformation to the original diameter or characteristic vertical dimension by more than 5 percent.

Cable Gripping and Sealing Testing:

The cable gripping and sealing hardware shall not cause an increase in fiber attenuation in excess of 0.05 dB/fiber @ 1550 nm when attached to the cables and the closure assembly. The test shall consist of measurements from six fibers, one from each buffer tube or channel, or randomly selected in the case of a single fiber bundle. The measurements shall be taken from the test fibers before and after assembly to determine the effects of the cable gripping and sealing hardware on the optical transmission of the fibers.

Vibration Test:

The splice organizers shall securely hold the fiber splices and store the excess fiber. The fiber splice organizers and splice retaining hardware shall be tested per EIA Standard FOTP-II, Test Condition I. The individual fibers shall not show an increase in attenuation in excess of 0.1 dB/fiber.

Water Immersion Test:

The closure shall be capable of preventing a 10 foot water head from intruding into the splice compartment for a period of seven days. Testing of the splice closure shall be accomplished by placing the closure into a pressure vessel and filling the vessel with tap water to cover the closure. Continuous pressure shall be applied to the vessel to maintain a hydrostatic head equivalent to 10 feet on the closure and cable. This process shall be continued for 30 days. Remove the closure and open to check for the presence of water. Any intrusion of water in the compartment containing the splices constitutes a failure.

Certification:

It is the responsibility of the Design-Build Contractor to ensure that either the manufacturer, or an independent testing laboratory has performed all of the above tests, and the appropriate documentation has been submitted to the Department. Manufacturer certification is required for the model of closure supplied. It is not necessary to subject each supplied closure to the actual tests described herein.

Construction Requirements

Installation: Underground splice enclosures shall be installed in ATMS Vaults at locations shown on the Plans. After all necessary splices are made and the enclosure is sealed, the Design-Build Contractor shall install the enclosure in the vault such that it is supported at least one foot above the aggregate bottom of the vault. The Design-Build Contractor shall use appropriate hardware for mounting. The Design-Build Contractor shall seal the splice closure and pressure test it following the manufacturer's instructions. Dry water-blocking compound shall be placed in the closure during this process.

The Design-Build Contractor shall secure the Splice Closure to the side of the splice facility using cable support brackets or similar methods. All cables shall be properly dressed and secured to rails or racks within the vault. No cables or enclosures will be allowed to lie on the floor of the splice facility. Cables that are spliced inside a building shall be secured to the equipment racks or walls as appropriate and indicated on the Plans.

The enclosure shall be installed according to the manufacturer's recommended guidelines.

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

The Design-Build Contractor shall prepare the cables and fibers in accordance with the enclosure and cable manufacturers' installation practices. A copy of these practices shall be provided to IFA 21 days prior to splicing operations.

Using a fusion splicer, the Design-Build Contractor shall optimize the alignment of the fibers and fuse them together. The Design-Build Contractor shall recoat the fused fibers and install mechanical protection over them.

Upon completing all splicing operations for a cable run, the Design-Build Contractor shall measure the mean bi-directional loss at each splice using an Optical Time Domain Reflectometer. This loss shall not exceed 0.1 dB.

The Design-Build Contractor shall measure the end-to-end attenuation of each fiber, from connector to connector, using an optical power meter and source. This loss shall be measured from both directions and shall not exceed 0.5 dB per installed kilometer of single mode cable, measured at 1310 nm.

The test results shall be supplied to IFA in hard copy and electronic versions.

The cable installation shall satisfy the requirements of both the National Electric Code (NFPA-70-2008) and the National Electric Safety Code (IEEE C2-2007). The standards require that the armor be bonded and grounded any time that the armor is interrupted or exposed by opening the sheath. These documents also provide minimum separations from foreign Utilities.

For splices in armored cables, the Design-Build Contractor shall ground the splice closure using a #6 AWG conductor or equivalent.

As directed by IFA, the Design-Build Contractor at no additional cost to IFA shall replace any cable splice not satisfying the required objectives.

Basis of Item

Fiber optic fusion splices shall be measured per each spliced fiber strand, furnished, installed and tested.

Splice enclosures shall be measured per each enclosure furnished, installed and secured to the wall of the splice facility.

The items list shall include the following:

Item Description	Unit Symbol
Fiber Optic, Fusion Splice.....	EACH
Fiber Optic, Splice Enclosure	EACH

The following shall be considered incidental to this item:

Pulling slack fiber optic cable from nearby vaults, as required to complete a fiber optic splice shall be incidental.

All testing and performance verification, and any incidentals necessary to complete the Work.

FIBER OPTIC DROP CABLE

Description

The fiber optic drop cable is used for installing fiber optic cable into Intelligent Transportation System (ITS) control cabinets and relay shelters. This ITS Drop Cable is used for connectivity between a primary fiber trunk, or feeder cable, and various field devices such as closed circuit television cameras at field locations as shown on the Plans.

Material requirements

The Fiber Optic ITS Drop Cable shall include a pre-terminated, pre-tested connector module with pigtails that splice into the primary fiber trunk. This connector module mounts into the ITS field cabinet enclosure or on a standard 19-inch rack rail. The fiber optic ITS drop cable shall have the following specifications: 1. Single mode 2. Fiber count - six fiber 3. Connector #1 - SC (pre-terminated) 4. Connector #2 - Pigtail length of 150 feet 5. mounting plate for cabinet rack 6. Insertion Loss - .2 dB typical 7. Return Loss - > -40 dB SPC 8. Tensile Strength - 50lbs. (220N) <.20 dB change 9. Temperature Cycling - -40°C + 70°C, 40 cycles <.20 dB change 10. Ferrule material- Ceramic 11. Housing material - Acrylic, UL94V0 INSTALLATION REQUIREMENTS. Coordinate layout and installation of fiber optic drop cable with other installations. Revise locations and elevations from those indicated as required to suit field conditions and as approved by IFA.

All fiber optic drop cables will be measured per unit each delivered and after demonstration of performance.

The items list shall include the following:

Item Description	Unit Symbol
Fiber Optic ITS Drop Cable Assembly, 6 Fiber.....	EACH

FIBER OPTIC LOCATOR POST

Description

The Design-Build Contractor shall furnish Fiber Optic Locator Post for identifying locations of fiber optic cable as shown on the Plans or as directed by IFA.

Material

The Fiber Optic Locator Post shall be made of a non-conductive, high-density polymer, and shall be integrally white in color with an orange cap with black graphic and lettering on two sides. All colors shall be stabilized against ultraviolet light such that they will not fade under continuous exposure to direct sunlight. The marker shall retain dimensional stability in temperatures ranging between -40° F and 175° F. Each post shall be able to withstand a single vehicle impact at 45 MPH and return to within 10 degrees of vertical within 60 seconds.

Installation

A Locator Post shall be installed at fiber optic splice locations. At splice points, posts shall be connected to the fiber splice cases and the armored cable with a #12 ITS, Tracer Wire in innerduct as indicated on the Plans.

Locator Posts shall be installed in accordance with the manufacturer specifications and details.

Locator Posts shall be installed at the same time or immediately after the installation of underground Conduits and vaults for identification of underground infrastructure.

Basis of Item

This Work will be measured in units of each for the number of markers that are placed and accepted.

The items list shall include the following:

Item Description	Unit Symbol
Fiber Optic, Locator Post.....	EACH

The following shall be considered incidental to this item:

Materials, #12 tracer wire between the vault and post, labor, equipment, transportation, placement, and other necessary incidentals.

FIBER OPTIC PATCH PANEL ASSEMBLY

Description

This Work shall consist of furnishing and installing patch panels for terminations inside of the communications shelter or ITS Cabinet.

Materials

The patch panel shall have brackets and all other hardware required for rack mounting in an EIA standard 19-inch equipment rack, or wall mounted if required as shown on the Plans. The enclosure shall take up no more than four rack units for 96 fiber panels and no more than one rack unit for 12 fiber panels. The patch panel shall be made of powder-coated aluminum.

The enclosure shall include routing guides for jumpers, strain relief for pigtailed coming from a splice enclosure, and labels for every connector. The panel shall route fiber optic patch cables between any two connectors without reaching the patch cables' minimum bending radius.

Twelve Port Panels

The enclosure shall include a 12 port patch panel cassette module with a male connection MPO, Type A, IP 69k and 68 for connection to the trunk cable and SC connectors on the front panel. The patch panel cassette shall be pre-terminated from the factory between the SC connectors and the MPO connector. Each MPO connector shall not cause in excess of 0.65dB optical signal loss when tested at 1310nm with a typical loss of 0.35dB. Each SC connector shall not cause in excess of 0.3dB optical signal loss when tested at 1310nm. The enclosure shall be designed to hold cassettes totaling at least 36 connectors or as shown on the plans. Provide enough cassettes for every fiber that terminates in the enclosure. Provide blank panels for panel positions that are not equipped with cassettes or patch panels.

Ninety-six Port Panels

The enclosure shall include patch panel modules with SC connectors. Each SC connector on the panel shall not cause in excess of 0.3dB optical signal loss when tested at 1310nm. The enclosure shall be designed to hold modules totaling at least 96 connectors in a vertical array mountable in a 19 inch rack. Provide enough modules for every fiber that terminates in the enclosure. Provide blank panels for panel positions that are not equipped with patch panels.

Construction Requirements

Design-Build Contractor shall provide all equipment for fusion splices, pig tails, trays for organizing equipment, break out kits, connectors, labels, and other accessories required to make a complete system. All fibers shall be terminated into the patch panel assembly in either a communications shelter or cabinet location. The cost of terminations shall be included in the patch panel assembly price.

Basis of Item

Fiber optic patch panels shall be measured per each unit furnished and installed, which shall include the patch panel, appropriate mounting hardware, labor, and any other incidental materials necessary to complete the Work.

The items list shall include the following:

Item Description	Unit Symbol
Fiber Optic, Patch Panel Assembly, 96 Port.....EACH	EACH
Fiber Optic, Patch Panel Assembly, 12 Port, 1U.....EACH	EACH

The following shall be considered incidental to this item:

Materials, labor, equipment, transportation, placement, and other necessary incidentals.

HANDHOLES

SECTION 805.03, BEGIN LINE 30, INSERT AS FOLLOWS:

ATMS Handholes shall be as shown on the Plans. The handhole covers shall be bolted into place with stainless steel bolts and washers. The cover frame shall be installed in the handhole with a butyl rubber sealant in tape/coil form for a proper seal between the handhole and frame and to prevent it from moving out of place. The sealant shall comply with ASTM C990 for butyl rubber sealants.

The cover for the ATMS handhole shall be marked with logo imprints of "Traffic Management System" or "Traffic Management Power" horizontally across the cover.

Covers labeled "Traffic Management Power" shall be provided whenever the handhole is used for power distribution cables.

Covers labeled "Traffic Management System" shall be provided in all other handholes.

Item Description	Unit Symbol
Handhole, ATMS	EACH

ITS, CELLULAR MODEM ASSEMBLY

Description

The modem shall provide communication between the ITS Controller and the TMC.

Materials

The ITS, Cellular Modem shall consist of the following components:

1. One cellular modem gateway
 - CRADLEPOINT COR SERIES ROUTER MODEL # IBR900-1200
 - Direct wire GPIO cable
 - COR Extensibility Dock
 - Power cables
 - 5 year Warranty & licensing
2. One, five-in-one antenna
 - AG60 SERIES W/CABLE (2 X CELLULAR 3G/4G/LTE/GPS/2 X WiFi 2.4GHZ FOR CRADLEPOINT IBR900)

The ITS, Cellular Modem shall provide all the needed features and components to provide data communications between the ITS field cabinet and INDOT's Traffic Management Centers.

Construction Requirements

The ITS, Cellular Modem shall be installed in accordance with the manufacturer's instructions. All materials shall be installed in a neat and professional manner. All installation services will comply with all Warranty provisions and Warranty contract maintenance services in accordance with these specifications. All installation services shall comply with all local and state electrical codes, and Motorola R-56 requirements. All wiring entry and exits shall be made at the side or underneath components; no exposed top entry or exits are permitted. This requirement extends to all enclosures, junction boxes, support arms, or any other externally exposed devices. Cable termination shall be in accordance with the manufacturer's recommendations. Connectors outside of cabinets shall be sealed in accordance with the manufacturer's recommendations. The Design-Build Contractor shall de-burr all holes made in metal poles or cabinets and install grommets for cable protection.

Basis of Item

The ITS, Cellular Modem will be measured per the number of units furnished and installed complete and in place and after passing component and subsystem testing.

The items list shall include the following:

Item Description	Unit Symbol
ITS, Cellular Modem Assembly	EACH

The following shall be considered incidental to this item:

Cellular gateway modem, cellular gateway modem power supply, antenna, cables, environmental enclosure, housing, mount, all mounting hardware, support arms, connections, Ethernet cables, and other incidentals necessary to complete the Work.

ITS COMMUNICATION SHELTER AND GENERATOR

DESCRIPTION

This Work shall consist of furnishing and installing a concrete shelter building as shown on the Plans. The shelter shall include a UPS and a diesel generator. The UPS, transfer switch, and generator shall be compatible and tested prior to shipping from the manufacturer. The Field Communication Shelter shall be a prefabricated, reinforced, modular, concrete building. The building dimensions and foundation shall be as indicated in the Plans. The concrete inside clear height shall be a 9 feet. The building shall be at a minimum 12 feet wide by 10 feet long. Electrical equipment shall be installed along the "long" walls to allow for spacing between equipment in the center of the "wide" wall. The building shall be designed so that the walls and roof are monolithic at manufacture. The floor shall be connected to the walls by a secondary pour. The building shall have no seams or joints. The building shall be designed to be handled and off-loaded with standard pickups in the roof of the structure. The building shall be designed to meet the following minimum loading:

1. Roof Live Load	60 PSF
2. Floor Live Load	100 PSF
3. Floor Dead Load	75 PSF
4. Wall Wind Load	140 MPH
5. Earthquake	Zone 4

The building shall be professionally engineered to meet the requirements of INDOT stating the building system meets design load requirements. The building shall be designed to meet the requirements of loading of the following:

1. American National Standards (A.N.S.) "Building Code Requirement for Minimum Design Loads in Buildings and Other Structures."
2. American Concrete Institute (A.C.I.-318R-83) "Building Code Requirements for Reinforced Concrete."
3. Concrete Reinforcing Institute "Manual of Standard Practice."
4. Motorola R-56, Motorola Standards and Guidelines for Communications Sites 2000

The vendor shall be regularly engaged in the construction and erection of precast concrete buildings. The manufacturing plants shall be "National Precast Certified Plants."

MATERIALS

The materials furnished shall include the precast concrete structure, fasteners, anchors, sealants, flashing, doors, and other parts necessary for a complete building system as shown on the Plans. The concrete shall be steel-reinforced (ASTMA615 Grade 60 & ASTMA-185 Welded Wire Fabric), 5000 PSI minimum, 28 day compressive strength, air-entrained (ASTM C260). Doors and frames shall meet the following requirements:

1. 3070 18 gauge galvanized steel door with weather stripping, sweep, threshold, closer, and hook and keeper.
2. Mortise-Lever lockset x three 4.5 inch door hinges with vandal resistant non-removable hinge pins.
3. Aluminum door hood x Schlage extra heavy duty lock-set (keyed to match the existing shelters)
4. Right hand swing

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

Doors and Frames shall comply with the Steel Door Institute "Recommended Specifications for Standard Steel Door Frames" (SDI-100).

The exterior finish shall be a washed aggregate finish with a cantilever strip type extension at the roof line. The exterior color shall be a brown earth tone. The interior finish shall be FRP with 2 inches of insulation. The floors shall be finished with white floor tile with cove base. Additionally, the building shall be constructed to meet the following requirements:

1. Fire Resistant - The building shall have at a minimum a two hour fireproof rating.
2. Bullet Resistant - The building shall be designed to be maintenance free and highly vandal resistant. The building shall meet the Bullet Resistant specification of ANSI/UL threat levels 1 - 4. The building envelope shall be bullet proof to a 308 rifle and steel bullet at 25 feet.
3. Attack Resistant - Attack Resistant specification shall be two minutes DODAA.
4. Water Resistant - The building shall be entirely assembled at the plant, sealed, waterproofed, and tested for water tightness.
5. Ice Resistant - The building shall not require any ice shields and be fully protected from ice falling from the collocated tower. The building roof shall be capable of withstanding a 50-pound block of ice dropping 250 feet from a tower and is capable of handling the load without damage to the exterior roof system.

The building shall include the following mechanical and electrical features:

- 1) Two 1-ton A/C with 1PH-2.2K heat
- 2) Commstat 3 controller
- 3) 20-pound fire extinguisher
- 4) First aid kit
- 5) Wall mounted desk
- 6) White board/bulletin board 36 inches x 24 inches
- 7) Two Interior, 2-lamp x 4-foot T8 LED lamps with RFI filters and switches. Lumen output per lamp shall be a minimum of 1800. Color Rendering Index shall be a minimum of 85 and a minimum color temperature of 4000K.
- 8) One Exterior LED lamp with a minimum 1600 lumen output with motion detector and switch
- 9) Four Duplex receptacles
- 10) One Exterior GFI WR Duplex receptacle, with extra-duty, cast metal, in-use cover.
- 11) Door Contact intrusion alarm
- 12) Hi and Low temperature alarm
- 13) Power fail alarm
- 14) 100A 120/240V Integrated panel board
- 15) Eleven Circuit breakers 1 pole 20A
- 16) Two Circuit breakers 2 pole 20A
- 17) One Circuit breaker 2 pole 40A
- 18) Automatic Transfer Switch
 - a. Shall be 2-pole, 3-wire, open transition with solid neutral
 - b. Minimum Amp load rating shall be 100A at 250V
 - c. Minimum AIC rating shall be 10,000 AIC or the maximum generator fault current, whichever is greater.
- 19) Appleton ADJA6034-150RS, 60A 3P4W NEMA 4x reverse service

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

- 20) Three 8-inch X 8-inch cable rack
- 21) Halo ground ring Single Point Ground - #2 Green Stranded Copper Wire - with 6-inch separation at mid-point of ground ring
- 22) Interior and exterior 0.25-inch X 4-inch X 24-inch ground bars
- 23) Four 42-Rack Unit (U/Unit/RU) 19-inch racks. Square holes to accept cage nuts at standard spacing on front and rear to accommodate rack mount equipment. They shall be adjustable from 600 mm (23.62 inches), 800 mm (31.50 inches) or 1,010 mm (39.76 inches) deep and installed at 800MM depth. They shall not have any doors.
- 24) Three rackmount shelf at least 20 inches in depth
- 25) Three sets of stamped drawings
- 26) Type 1 Surge protection
- 27) Type 3 Surge protection

The generator shall have the following characteristics:

1. Shall be fully integrated power generation systems providing stationary standby and prime power
2. Shall include a 24-hour sub-base tank (dual wall)
3. Shall have outdoor weather enclosure
4. Shall have a 100A circuit breaker for overcurrent protection
5. Shall have integrated control system with alarm and status message display and an auto shutdown on fault detection
6. Standby rating of 25 KW
7. Generator set specifications
 - a. Voltage regulation, no load to full load - $\pm 1\%$
 - b. Frequency regulation - Isochronous
 - c. Random frequency variation - $\pm 0.25\%$
8. Engine specifications
 - a. Configuration - Cast iron, in-line, 4 cylinders
 - b. Battery capacity - 450 amps minimum at ambient temperature of - 18 °C to 0 °C (0 °F to 32 °F)
 - c. Battery charging alternator - 45 amps
 - d. Starting voltage - 12-volt, negative ground
 - e. Fuel system - indirect injection: fuel filter, automatic electric fuel shutoff
 - f. Fuel filter - Single element, 5-micron filtration, spin-on fuel filter
 - g. Air cleaner type - Dry replaceable element
 - h. Lube oil filter type(s) - Spin-on, full flow x Standard cooling system - High ambient radiator x
9. Alternator specifications
 - a. Design - Brushless, 4 pole, drip proof revolving field
 - b. Stator - 2/3 pitch
 - c. Voltage: 120/240 single phase 3 wire 60Hz
 - d. Insulation system - Class H
 - e. Standard temperature rise- 150 °C standby at 40 °C ambient
 - f. AC waveform total harmonic distortion - < 5% no load to full linear load, < 3% for any single harmonic
10. Control System
 - a. Operator/display panel
 - i. Off/manual/auto mode switch
 - ii. Manual run/stop switch
 - iii. Panel lamp test switch
 - iv. Emergency stop switch
 - v. Alpha-numeric display with pushbutton access for viewing engine and alternator data and providing setup

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

- controls and adjustments
- vi. LED indicating lamps: generator running, not in auto, common warning, common shutdown
- vii. Configurable LED lamps (5)
- b. Engine protection
 - i. Overspeed shut down
 - ii. Low oil pressure warning and shut down
 - iii. High coolant temperature warning and shut down
 - iv. High oil temperature warning (some models)
 - v. Low coolant level warning or shut down
 - vi. Low coolant temperature warning
 - vii. High and low battery voltage warning
 - viii. Weak battery warning
 - ix. Dead battery shut down
 - x. Fail to start (overcrank) shut down Fail to crank shut down
 - xi. Redundant start disconnect
 - xii. Cranking lockout
 - xiii. Sensor failure indication
- c. Engine Data
 - i. DC voltage
 - ii. Lube oil pressure
 - iii. Coolant temperature
 - iv. Engine speed
- d. AC protection
 - i. Over current and short-circuit shut down
 - ii. Over current warning
 - iii. Single and three phase fault regulation
 - iv. Over and under voltage shut down
 - v. Over and under frequency shut down
 - vi. Overload warning with alarm contact
 - vii. Reverse power and reverse VAR shut down
 - viii. Excitation fault
- e. Alternator data
 - i. Line-to-line and line-to-neutral AC volts
 - ii. Single phase AC current
 - iii. Frequency
 - iv. Total and individual phase power factor, kW and kVA
- f. Other data
 - i. Genset model data
 - ii. Start attempts, starts, running hours
 - iii. kW hours (total and since reset)
 - iv. Fault history
 - v. Load profile (hours less than 30% and hours more than 90% load)
 - vi. System data display (optional with network and other Power Command gensets or transfer switches)

The UPS shall consist of the following:

- 1.3000VA/2700-Watt Output at 240V, 7200VA/5600W at 208V, Uninterruptible Power Supply
- 2.2-post rack mounting kit for UPS & transformer
- 3.One, 208V to 120V step-down transformer, L6-30 input, (12) NEMA 5-20R receptacles
- 4.One, 15A, 120V rack PDU with 10 5-20R outlets

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

The UPS shall include the following features:

1. Power factor shall be 0.7
2. Crest factor shall be 3:1
3. Nominal output voltages supported shall be 120V, 208V and 240V
4. Frequency Compatibility shall be 60 Hz
5. Output Voltage Regulation in Line or Battery Mode shall be +/-3%
6. Four, 20A branch rated breakers each protecting 1 5-15/20R outlet
7. Two, 20A double pole breakers each protecting one L6-20R outlet
8. Two, L6-30R outlets, unbreakered
9. Shall have (2) L6-20R, (1) L6-30R, and (12) 5-20R receptacles
10. No more than 4U rack space
11. Output AC Waveform in AC Mode shall be Pure Sine wave
12. Output AC Waveform in Battery Mode shall be Pure Sine wave
13. Input maximum rated input current shall be 34A
14. UPS input connection type shall be hardwire, four wire split-phase input; L1, L2, N, and G
15. Input phase shall be single-phase
16. Full load battery operation runtime shall be a minimum of 5 minutes @ 2700 W
17. Half load battery operation runtime shall be a minimum of 12 minutes @ 1400 W
18. USP shall be capable of accepting external expanded battery packs
19. Battery replacement shall be hot-swappable capable
20. Pre-installed network communications card with environmental monitoring, and temperature sensor included
21. Efficiency of 89% at 100% load
22. Voltage regulation shall be online, double-conversion power conditioning
23. Overvoltage correction shall be capable up to 140V measured L1-N : L-2-N
24. Undervoltage correction shall be capable down to 65V measured L1-N : L-2-N
25. UPS Certification shall be tested to UL1778 and shall meet FCC Part 15 Category A

The generator shall be filled with diesel fuel, as recommended by the manufacturer, prior to final acceptance of the site.

Construction Requirements

The building and generator shall be shipped upon drop deck equipment with air suspension to minimize the stresses applied during shipment. The building shall be provided with hooks for lifting without damage to walls or roof.

This Work shall consist of furnishing, assembling, and installing signage at each Communication Shelter. Each Communication Shelter shall be posted with signs identifying the site and providing notices and warnings. The types of site signage shall be in accordance with FCC, FAA, and Indiana State regulations. Signs containing general required notices, along with spaces for custom information, are commercially available and shall be used. Warning signs containing the appropriate information and symbols are also commercially available and shall be used.

The site shall have conspicuous signage that identifies INDOT as the

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

site operator and provides appropriate contact information. Permit and/or licensing information (as required by the FCC) shall also be included. The sign shall be conspicuously posted on the exterior of the door of the communication shelter. Lettering shall be large enough to be readable from outside the fence. Design-Build Contractor shall deliver proposed wording to IFA ITS Engineer for approval.

For sites with radio communication, RF Exposure: The Design-Build Contractor shall evaluate RF exposure levels for each Communication tower Site based on the FCC Office of Engineering & Technology Bulletin 65. The Design-Build Contractor shall provide the required FCC RF Environment documentation for each site. The Design-Build Contractor shall notify IFA if a Communication Shelter is not in compliance with 47 CFR 1.1307(b)(5) and provide recommend corrective action. The Design-Build Contractor shall install RF Hazard warning signs in compliance with ANSI C95.1.

Basis of Item

Field Communication Shelter will be measured per the number of units furnished and installed, complete and in place.

The items list shall include the following:

Item Description	Unit Symbol
ITS COMMUNICATION SHELTER AND GENERATOR.....	EACH

The following shall be considered incidental to this item:

Building, foundation, penetrations, service drop, specified equipment, all signage (except for "Authorized Vehicles Only sign") with all required hardware, HVAC equipment, cable trays, network racks, Conduit entries, generator fuel, and other incidentals necessary to complete the work.

ITS CORE SWITCH

Description

The Design-Build Contractor shall furnish and install ITS Core Switch as described herein. ITS Core Switch is used to connect the fiber backbone of the ITS field equipment to the shelter sites. This switch shall be located in a conditioned shelter or building. The switch shall be provided with all specified modules/cards, CPU modules, power supplies, and power cables required for connection to all field devices. ITS Core Switches will have the appropriate firmware and software components for a mixed-use data and multicast video application as shown on the plans.

Materials

The Design-Build Contractor shall provide ITS Core switch using the model and modules listed herein:

1. VSP 8400 Series Chassis
 - a. One - Extreme Networks VSP 8400 Chassis part number EC8400-A02-E6
 - b. Two Power supply shall be included - part number EC8005A01-E6
 - c. One - Rack mount kit - part number EC8011002-E6
 - d. One - VSP 8000 Series Premier Software License: enables L3 VSN and MACsec - part number 3801777
 - e. Two 8424XT 24- Port 10GBASE-SFP+ Ethernet Switch Module - part number EC8404001-E6
 - f. Four fan modules shall be included - part number EC8011004-E6

Construction Requirements

The ITS Core Switch shall be delivered to the ITS Technology Deployment Division for configuration at the Indianapolis Traffic Management Center for custom configuration and programming. Upon programming, the Design-Build Contractor will be notified and shall pick up the devices.

Upon configuration and programming, the Design-Build Contractor shall install the ITS Core Switch in accordance with the plans and the manufacturer's instructions. Installation shall include all cables, mounting hardware, power supplies and associated equipment required to mount and interface the communications subsystem. Installation activities are to be documented, including the output from show sys-info quantity, brand, model/part numbers, test results of all materials and devices used. Provide installer signed list of the materials installed with the required documentation. All cabling is to be labeled and dressed using hook & loop to secure cables in cable management.

Basis of Item

The ITS Core Switch will be measured per the number of units furnished and installed, complete and in place and after passing component and subsystem testing. This includes the mounting hardware, rack mount kit, all cabling, power supplies, and incidentals necessary to complete the work.

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

The items list shall include the following:

Item Description	Unit Symbol
ITS, Core Switch.....	EACH

The following shall be considered incidental to this item:

Materials, labor, equipment, transportation, placement, and other necessary incidentals.

ITS FIELD SWITCH

Description

The Design-Build Contractor shall provide and install the ITS field switch as described herein. The ITS field switch is used to connect communications equipment and the Aries Field Processor at ATMS sites and other sites as show on the Plans. These switches must be compatible with the existing ATMS system architecture. Each switch shall be rack mountable. If the unit requires a rack mount kit or adapter which is not paid for elsewhere in these specifications, the kit shall be included with the ITS field switch at no additional cost to IFA.

Materials

The Design-Build Contractor shall provide the ITS field switch and rack mount kit conforming to the following specifications:

1. Extreme Networks ERS 3626GTS-PWR+

Construction Requirements

The Design-Build Contractor shall provide and install the ITS Field switch in accordance with the manufacturer's instructions. Installation shall include all cables, mounting hardware, rack mount kit, power supplies with north American power cords and associated equipment required to mount and interface the communications subsystem. Installation activities are to be documented, including the output from show sys-info quantity, brand, model/part numbers, test results of all materials and devices used. Provide installer signed list of the materials installed with the required documentation. The Design-Build Contractor will follow IFA's direction for configuration information of IP addresses VLAN settings naming convention port security SNMP settings. All cabling is to be labeled and dressed using hook & loop style straps to secure cables in cable management.

Basis of Item

The ITS Field switch and rack mount kits shall be measured per the number of units furnished and installed, complete and in place and after passing component and subsystem testing. This includes the mounting hardware, rack mount kit, all cabling, power supplies, and incidentals necessary to complete the Work.

The items list shall include the following:

Item Description	Unit Symbol
ITS, Field Switch, 3626GT-PWR+.....	EACH

The following shall be considered incidental to this item:

Materials, labor, equipment, transportation, placement, and other necessary incidentals.

ITS FOLDING POLE, CCTV

Description

This Work shall consist of furnishing and installing folding intelligent transportation system, ITS, poles for closed circuit television, CCTV, cameras at the locations shown on the Plans or as directed.

Materials

Materials shall be in accordance with 807.02 and as follows:

Concrete, Class A	702
Conduit	922.19
Reinforcing Bars	910.01

The ITS pole structure material shall be in accordance with ASTM A 572, Gr 55. The base plate materials shall be in accordance with ASTM A36. Anchor bolt material for ITS pole structure shall be in accordance with ASTM F1554, Gr 55. Each anchor bolt shall be provided with two hex nuts and two washers with minimum 15 inches threaded end galvanized in accordance with ASTM A153. Structure shall be galvanized after fabrication in accordance with ASTM A123 or AASHTO M111. All connection hardware for the one upper sections shall be in accordance with ASTM A325. All other ITS pole shaft hardware, including hardware for the latch mechanism, shall be stainless steel in accordance with ASTM F593 or A594, type 304 or 305, except where otherwise specified.

(a) Design and Fabrication

The ITS folding poles shall be selected from the following manufacturers:

1. Valmont Industries, Inc.
Omaha, NE 68154
2. Approved Equal

The ITS folding pole shall be designed and fabricated in accordance with the following criteria.

ITS approved equal pole shall be designed by a Registered Professional Engineer. The Design-Build Contractor shall submit two copies of signed and stamped Plans and design calculations to IFA for approval. Working Drawings for approved designs shall be in accordance with 105.02.

The folding poles shall be design in accordance with the 2015 edition of the AASHTO *LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals* with interim revisions through 2018. Other general material requirements include:

1. Number of Cameras. The folding poles with an effective mounting height of 55 feet shall have a maximum of three cameras installed at a maximum 2 feet from the pole center.
2. Foundations. The foundations for the folding poles shall be designed for the structure.

(b) Design Load

The folding poles shall be capable of supporting the following loadings:

1. Dead Load.

The folding poles shall be capable of supporting the following dead loads.

Pole Height 55 ft		
Description of Load	Weight	Effective Projected Area
CCTV Cameras	285 lbs	7.5 sft
Lightning rod located at top of the pole top cover plate, located not to obstruct camera extension arm rotation.		
Self-Weight of the pole		

2. Wind Load.

The folding poles shall be capable of supporting the following wind loads.

Wind Load Requirements	
Mean Recurrence Interval Risk Category	High
Wind Speed (1700 Year MRI Basic Wind Speed)	120 mph
Wind Speed (10 Year MRI Gust Wind Speed)	76 mph
Height and Exposure Factor, K_z for height less than or equal to 33 ft	1.0
Gust Effect Factor, G	1.14
Design Service Life	50 years

3. Ice Load.

The folding poles shall be capable of supporting an ice load of 3 lbs/sft applied to the full perimeter of all members and applied to one face of the signs. The folding poles shall be capable of supporting the specific load combination in the table below adapted from Table 3.4-1 in the 2015 edition of the AASHTO *LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*.

Specific Load Combination Requirements				
Load Combination Limit State	Description	Dead Components (DC)	Wind (W)	Ice (IC)
Extreme II	Ice	Max 1.10/ Min 0.90	0.50*	1.0
*The wind load shall be based on the 120 mph basic wind speed.				

4. Fatigue Load.

The folding poles shall be capable of supporting a fatigue load in accordance with Article 11.5 of the 2015 edition of the AASHTO *LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals* with a Fatigue Importance Factor, I_F , of 1.0.

5. Deflection Design Criteria:

ITS folding poles shall be designed for 3-inch maximum pole top deflection at wind velocity of 30 mph with no gust.

ITS pole structure supports shall be an anchor base type pole structure and shall include a handholes and a pole top cover plate. The ITS pole shall be either multisided, round or combination of multisided and round tubular members. Shroud handhole shall be located at 42 inches, outside dimensions shall be 5.19 inches X 9 inches. Winch handhole shall be located at 51 inches, outside dimensions of the handhole shall be 7.5 inches X 26.5 inches. Opening for the handholes shall be reinforced to maintain the design strength of the pole. The

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

handhole shall have a weatherproof gasket made of neoprene or silicone rubber. The gasket shall be formed for a fit around the handhole or be attached by mechanical means. The door and hinge shall be the same type of steel as the poles. The hinge pins and other securing hardware shall be stainless steel and tamperproof. The door shall be fabricated to allow for a padlock, which is not included in the hardware. The hasp used for padlocking shall be fabricated from stainless steel. The door shall be bolted shut and the padlock and key shall be provided to IFA. The door shall include a bug proof aperture with a minimum opening of 4 square inches. Two bonding plates shall be furnished which are accessible through the pole handhole for connecting the ground wires. A connection shall be furnished for an additional ground wire on the outside of the pole near the base plate.

After fabrication, the pole shall be cleaned and galvanized. Galvanized steel pole, including the handhole, handhole door, base plate mounting plates, and all other elements welded to the shaft shall be hot dip galvanized in accordance with ASTM A123 or AASHTO M 111.

Base Plate:

A one piece base plate shall be secured to the base of the pole and shall develop full strength of the pole. The base plate material shall be in accordance with ASTM A36. The 20-inch square baseplate shall be 2 inches thick. The diameter of bolt circle shall be 20 inches. The base plate shall have four anchor bolt holes of size 1.75-inch diameter X 54 inches X 6 inches (hook).

Anchor Bolts:

Ten anchor bolts, each fitted with two hex nuts and two flat washers, shall be furnished with each pole. The top 12 inches of each anchor bolt, nut and washer shall be galvanized in accordance with the coating thickness, adherence, and quality requirements of ASTM A 153, class C. Anchor bolt shall have diameter of 1.50 inches, straight length of 54 inches, and a 6-inch hook length.

Perforated Aluminum Skirt:

A perforated aluminum skirt in accordance with 910.19(b) and Standard drawings 807-LTHI-010 shall be provided.

Ground Rod and Connections:

Ground rod and connections shall be provided in accordance with 922.16 and Standard drawings 807-LTLR-01 & 02, and E 807-LTFD-07.

Construction Requirements

Working Drawings shall be submitted in accordance with 105.02 for folding poles. The Working Drawings shall include the pole height, number of sections, the pole shaft data for each section, camera assembly, handhole details, material required, and complete anchor bolt details including bolt circle projection and hardware.

The Working Drawings shall include the design calculations and data for approval prior to fabrication in accordance with 807.03.

Basis of Item

Folding poles shall be measured by the number of units installed. ITS folding pole foundation, concrete, with grounding shall be measured per each for the size specified. Conduit and wire shall be measured in accordance with

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

807.18. Cameras and CCTV assembly shall be measured by the number of units installed.

The items list shall include the following:

Item Description	Unit Symbol
Camera	EACH
CCTV Assembly	EACH
ITS Pole, Folding, _____ ft.	EACH
ITS Pole Foundation, Concrete, with Grounding, _____ in. x _____ in. x _____ in.	EACH

The following shall be considered incidental to this item:

Pole; power cable and support cable; anchor bolts and nuts; lightning rod assembly; grounding system; and other incidental materials necessary to complete the installation shall be included in ITS folding pole. The cost of excavation, concrete, sleeves for cable-duct, non-metal pipe, reinforcing bars, backfill, finish grading, and sodding shall be included in ITS pole foundation.

ITS POLE STRUCTURE

Description

This Work shall consist of the design and installation of ITS pole structure in accordance with 105.03.

Materials

Materials shall be in accordance with 807.02 and as follows:

The ITS pole structure material shall be in accordance with ASTM A595 or A 572, Gr 55. The base plate materials shall be in accordance with ASTM A36. Anchor bolt material for ITS pole structure shall be in accordance with ASTM F1554, Gr 55. Each anchor bolt shall be provided with two hex nuts and two washers with minimum 15 inches threaded end galvanized in accordance with ASTM A153. Structure shall be galvanized after fabrication in accordance with ASTM A123 or AASHTO M111. All connection hardware for the two upper sections shall be in accordance with ASTM A325. All other ITS pole shaft hardware, including hardware for the handhole door and the latch mechanism, shall be stainless steel in accordance with ASTM F593 or A594, type 304 or 305, except where otherwise specified.

The Camera Lowering Device Raise/lower cable terminator material shall be hot dip galvanized or stainless steel. All safety cable attachment hardware shall be as listed below:

- Turnbuckles, Crosby HG-225 Hook & Eye, 3/8-inch, Part # 1030672, or Approved Equal
- Round Pin Shackles, 5/16-inch, Crosby G-213 / S-213 or G-215 / S-215, Part #'s 1018035 or 1018838, respectively, or Approved Equal
- Clevis Link Chain, Crosby Grade 80 Alloy, 5/16-inch, WLL-4500lbs, Part # 273536 or Approved Equal
- A316 Stainless Steel Quick Links, Peerless, 3/8-inch, Part # H8224-0640 or Approved Equal
- Wire Rope Thimble, Crosby HDG, 5/16-inch, Part # 1037318 or Approved Equal
- Wire Rope, Stainless Steel, 5/16-inch, Type 305/316, Loos or Approved Equal
- Wire Rope Clamps to Secure Safety Cable to Pole Only, Crosby G-40, 5/16-inch, Part #1010079 or Approve Equal. Use swage connectors to connect wire rope to turnbuckle
- Pad Eyes for Welding to inside of pole for attaching/securing safety chains, Crosby S-264, Size #2, Part # 1090786 or Approved Equal

Design and Fabrication

ITS poles shall be either the preapproved Valmont ITS pole, Millerbernd ITS pole, Ameron ITS pole or an approved equal designed and fabricated in accordance with the following criteria.

ITS approved equal pole shall be designed by a Registered Professional Engineer. The Design-Build Contractor shall submit two copies of signed and stamped Plans and design calculations to IFA for approval. Working Drawings for approved designs shall be in accordance with 105.02.

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

ITS pole structure supports shall be analyzed and designed in accordance with the 2013 edition of the AASHTO Standard Specifications for Highway Signs, Luminaries, and Traffic Signals. The design recommendations in Article 2.6 of the AASHTO specification shall be followed.

ITS pole structures shall be designed for 60-foot, 80-foot and 100-foot heights as follows.

1. Dead Loads:
 - a. Self-Weight of ITS pole
 - b. Camera and Camera lowering device - 95 lbs. each, total of 285 lbs. minimum.
 - c. Equivalent Projected Area of 2.5 square feet for each camera, total of 7.5 square feet minimum.
 - d. Lightning rod located at top of the pole top cover plate, located not to obstruct camera extension arm rotation.
2. Wind Loads:
 - a. Basic speed - 90 mph
 - b. Wind Importance Factor, $I_r = 1$
 - c. Height and Exposure Factor, $K_z = 1.265$, for 60 feet, 80 feet & 100 feet height.
 - d. Gust Effect Factor, $G = 1.14$
3. Ice Load:
 - a. Included in accordance with article 3.7 of the AASHTO specifications for full wind analysis.
 - b. Not included for deflection design criteria.
 - c. Assume ice forms on one side only. Use 3 lbs /sq ft.
4. Fatigue:
 - a. Applied to all components, mechanical fasteners and weld details of support structures in accordance with article 11.5 of the AASHTO specification.
 - b. Fatigue Category, IF - I.
5. Deflection Design Criteria:
 - a. 60 foot and 80 foot ITS poles shall be designed for 1 inch maximum pole top deflection at wind velocity of 30 mph with no gust.
 - b. 100 foot ITS poles shall be designed for 3-inch maximum pole top deflection at wind velocity of 30 mph with no gust.

ITS pole structure supports shall be an anchor base type pole structure and shall include a handhole and a pole top cover plate. The ITS pole shall be either multisided, round or combination of multisided and round tubular members. Handhole shall be located at 45 inches for poles up to 80 foot heights and at 48 feet for 100 foot pole heights, outside dimensions of the handhole shall be 28 inches X 9 inches. Opening for the handholes shall be reinforced to maintain the design strength of the pole. The handhole shall have a weatherproof gasket made of neoprene or silicone rubber. The gasket shall be formed for a fit around the handhole or be attached by mechanical means. The door and hinge shall be the same type steel as poles. The hinge pins and other securing hardware shall be stainless steel and tamperproof. The door shall be fabricated to allow for a padlock, which is not included in the hardware. The hasp used for padlocking shall be fabricated from stainless steel. Provisions shall be made to bolt the door securely shut. The door shall include a bug proof aperture with a minimum opening of 4 square inches. Two bonding plates shall be furnished which are accessible through the pole handhole for connecting the ground wires. A

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

connection shall be furnished for an additional ground wire on the outside of the pole near the base plate.

The upper camera mounting extension section shall be designed and fabricated per listed below details:

- This section shall be 40 inches long, measured from top of the top mounting flange plate to the bottom of bottom mounting flange plate.
- Design for one camera mounting with camera lowering device and shall have a lightning rod mounting.
- Bottom mounting plate shall have 12-13/16-inch X 3-inch slotted holes centered radially at 30 degrees.
- Top mounting plate shall have 12 7/8-inch holes. Pole top cover plate shall have 12 7/8-inch holes and provision for attaching 0.5 inch threaded lightning rod.
- One camera mounting plate shall be located at centered 30 inches up from the bottom of the bottom mounting flange plate.
- It shall have a handhole with cover, minimum inner diameter size of 4 inches X 6.5 inches located at 90 degrees from camera mounting plate and centered on camera mounting plate.
- Lightning rod can be mounted above camera arm and/or may be mounted on pole top cover plate.
- This section shall be provided with an integral wire support hook for all cables.

The lower camera mounting extension section shall be design for and fabricated per listed below details:

- This section shall be 40 inches, measured from top of the top mounting flange plate to the bottom of bottom mounting flange plate.
- Design for mounting two cameras & camera lowering devices oriented at 180 degree apart positions.
- Bottom mounting plate shall have 12 13/16-inch X 3-inch slotted holes centered radially at 30 degrees.
- Top mounting plate shall have 12 7/8-inch holes.
- Two camera mounting plates shall be located at centered 30 inches down from the top of the top mounting flange plate.
- Shall have a handhole with cover, minimum inner diameter size of 4 inches X 6.5 inches located at 90 degrees from camera mounting plates and centered on camera mounting plate.
- This section shall be provided with an integral wire support hook for all cables.

Pole sections which are slip fitted shall have slip joints with a minimum overlap of 1.5 times the diameter of the bottom of the upper section of the slip joint. ITS pole having slip joint construction shall be match marked at the factory and shall be shipped disassembled at the work site. Slip joint shall be marked to ensure that the 1.5 times diameter insertion is provided.

After fabrication, the pole shall be cleaned and galvanized. Galvanized steel pole, including the handhole, handhole door, base plate mounting plates, and all other elements welded to the shaft shall be hot dip galvanized in accordance with ASTM A123 or AASHTO M 111.

Base Plate

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

A one-piece base plate shall be secured to the base of the pole and shall develop full strength of the pole. The base plate material shall be in accordance with ASTM A36. The outside diameter shall be 37 inches. The bolt circle shall have a 33 inch diameter. It shall have 10 anchor bolt holes of size 1.75 inch diameter X 54 inches X 6inches(hook).

Camera Lowering Device Raise/Lower Cable Terminator

The individual camera raise/lower cables will terminate approximately 4 inches to 6 inches below the top of the handhole frame and be secured by a safety chain or cable when the camera is secured at the top of the pole and being lowered. The camera raise/lowering cable will terminate in a loop utilizing a thimble to prevent cable abrasions and a quick link that the safety chain hook of a 0.5 inches x 6 inches. Hook and eye turnbuckle can hook to the quick link of the camera raise/lower cable quick link. The anchor end of the safety chain will be secured to a plate, an oval eye, or forged steel pad eye welded to the pole face opposite the handhole opening and the two adjacent faces. They will be placed near the bottom of the handhole opening. The safety chain overall length shall be field adjustable by use of a Hook & Eye Turnbuckle, Round Pin Shackles or Chain Quick Links, and Chain sized to fit Shackles and Quick Links.

Anchor Bolts

Ten anchor bolts, each fitted with two hex nuts and two flat washers, shall be furnished with each pole. The top 12 inches of each anchor bolt, nut and washer shall be galvanized in accordance with the coating thickness, adherence, and quality requirements of ASTM A 153, class C. Anchor bolt shall have diameter of 1.75 inches, straight length of 54 inches, and a hook length of 6 inches.

Perforated Aluminum Skirt

A perforated aluminum skirt in accordance with 922.16 and Standard Drawing 807-LTHI-010 shall be provided.

Ground Rod and Connections

Ground rod and connections shall be provided in accordance with 922.16 and Standard Drawings 807-LTLR-01 & 02, and E 807-LTFD-07.

Construction Requirements

All Work shall be in accordance with 807.

Basis of Item

ITS pole structure will be measured by the number of units installed.

The items list shall include the following:

Item Description	Unit Symbol
ITS Pole Structure, _____ height.....	EACH

The following shall be considered incidental to this item:

Design, Working Drawings, fabrication, installation, and other necessary incidentals shall be included in this item.

FOUNDATION, ITS POLE STRUCTURE

Description

The Work shall consist of the design and construction of foundations for ITS monopole structures in accordance with 105.03.

Materials

Materials shall be in accordance with the following:

Concrete, Class A.....	702
Reinforcing Bars.....	910.01

Reinforcing bars shall be epoxy coated.

Construction Requirements

The foundations for proposed ITS Pole Structures shall be designed to accommodate the loading as shown on the Plans and shall adhere to current AASHTO guidance. Specifically, the foundations shall be designed to accommodate both of the following design loads:

Design Loads at the base for pole heights up to 100 feet

Axial Loads	5827.5 lbs
Bending Moment	163,281.8 ft-lbs
Torque	154.8 Ft-lbs
Shear	3157.1 lbs

Design Loads at the base for pole heights up to 100 feet

Axial Loads	7934 lbs
Bending Moment	134,573 ft-lbs
Torque	517 Ft-lbs
Shear	2524 lbs

The foundation shall be designed by a Registered Professional Engineer. The Design-Build Contractor shall submit two copies of signed and stamped Plans and design calculations to IFA for approval. Working Drawings for approved designs shall be in accordance with 105.02.

Each foundation shall have a tooled line, imprinted arrow, or other type of permanent marking on the top of the foundation to indicate the direction of the conduits.

During excavation of the foundation, all material shall be removed to the full depth as shown on the foundation Working Drawings, except if class X material is encountered, the Work shall be performed in accordance with 206.02 (b).

If the sidewalls of the excavated areas remain firm and stable, concrete may be poured directly against the dirt below the level of the top 6 inch form. Otherwise, the concrete foundation shall be fully formed by means of a paper preformed liner or other approved means. However, the foundation shall be formed to the proper size for the top 6 inches before concrete is poured. If a paper liner is used, it may be withdrawn as the concrete is placed or it may be left in place permanently. If the liner is left in place, all voids between the excavation walls and the form shall be filled and compacted using coarse aggregate No. 53. If the liner is withdrawn, the top 12 inches of the foundation shall remain formed until the concrete has obtained initial set.

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

Basis of Item

Foundation, ITS pole structure will be measured by the number of units installed.

The items list shall include the following:

Item Description	Unit Symbol
Foundation, ITS Pole Structure.....	EACH

The following shall be considered incidental to this item:

Design, Working Drawings, excavation, installation, and other necessary incidentals shall be included in this item.

PADLOCKS

Description

This Work shall consist of furnishing and installing padlocks for all cabinets, fence gates, and enclosures specified in these Special Provisions.

Materials

The padlock shall be classified as a high security padlock with hardened shackle, laminated body, 4 pin cylinder (minimum) and come complete with a weather cover to protect the lock body and cylinder from sand, dirt, water and ice. A wafer cylinder shall not be used.

NO keys shall be provided to INDOT with each padlock supplied. All padlocks shall be keyed alike and be identical to the keys currently in use by INDOT. The main body width of the padlock shall not exceed 3 inches and have a shackle length of 2.25 inches to 3.75 inches and a shackle diameter of 5/16 inch.

For padlock information, contact,

ITS Engineering Director,
Traffic Maintenance Division
Indiana Department of Transportation
(317) 690-5534
bstoner1@indot.in.gov

Basis of Item

The Padlocks will be measured per item provided by the unit of EACH.

The items list shall include the following:

Item Description	Unit Symbol
ITS, Padlock.....	EACH

REMOTE POWER SWITCH

Description

The remote network power switch unit provides continuous auto-fault detection. When IP connectivity failure is detected, it shall automatically reboot some or all of the connected devices. In addition, it provides web based troubleshoot and monitoring capabilities. This device shall be furnished and installed in a cabinet, shelter, or DMS.

Materials

The Remote power switch shall conform to the minimum following specifications:

- Operating temperature: 30° F to 170° F
- Power Outlets: Min.(8) NEMA 5-15R
- Protocols Supported, Minimum: HTTPS, TCP/IP, UDP, SNMP, Telnet, SSH, BOOTP, DHCP
- Connections: RJ-45 10/100 Mbps Ethernet
- Surface mount
- Optional 19-inch Rack Brackets Included
- Power Control & Management: Remote individual or group outlet switching, Plug naming, grouping & access control, Scheduled outlet On/Off/Reboot switching, Ping watchdog with auto reboot

Construction Requirements

A remote power switch shall be furnished and installed at each location per the manufacturer specifications. The switch and AFP shall be connected to the device.

Basis of Item

The remote power switches will be measured by the unit EACH complete and in place.

The items list shall include the following:

Item Description	Unit Symbol
Vault, ATMS	EACH

The following shall be considered incidental to this item:

The cost of materials, labor, equipment, transportation, placement and other necessary incidentals. Test and performance verification and incidentals necessary to complete the Work.

SURGE PROTECTION DEVICES FOR ATMS COMMUNICATIONS, VIDEO, AND 24V

Description

This Section includes Surge Protection Devices (SPDs) for data, communications, 24V power, and video equipment. Surge Protective Devices shall be used for the protection of all data, communications, video circuits, and low voltage power at 24V or less including POE cables from the effects of lightning induced currents and other transients.

Materials

Data and Communications Cables:

Plug-in jack or terminal connected SPDs shall protect all low-voltage signal pairs. The SPDs shall meet or exceed the following minimum requirements:

1. The SPDs shall be UL Listed 497B.
2. The protectors shall suppress a peak surge current of up to 10K amps.
3. The protectors shall have a response time less than 5 nanoseconds.
4. The protector shall clamp the voltage between the two wires at 8 volts and clamp the voltage between each wire and ground at 50 volts.
5. The first stage of protection shall be a three-element gas discharge tube, and the second stage shall consist of silicon clamping devices.
6. It shall be possible to replace the protector using standard tools.
7. The SPD housing shall be metallic and be grounded.

Coaxial Video Cables:

Cables carrying video signals shall be equipped with surge protectors that shall meet or exceed the following minimum characteristics:

1. The clamping voltage shall be 11 volts between the shield and center conductor signal line.
2. The response time shall be five nanoseconds or less.
3. Bipolar silicon avalanche diode technology shall be used in a single stage device.
4. The module shall dissipate a minimum of 50 Joules.
5. The module shall have BNC connectors.
6. The housing shall be metallic and grounded.
7. The module shall pass signals from DC to 80 MHz with less than 0.5 dB insertion loss.

24V Power Cables:

Cables carrying 24V power shall be equipped with surge protectors that shall meet or exceed the following minimum characteristics:

1. The clamping voltage shall be 50V.
2. The response time shall be five nanoseconds or less.
3. Bipolar silicon avalanche diode technology shall be used in a single stage device.
4. The module shall dissipate a minimum of 50 Joules.
5. The module shall pass signals from DC to 80 MHz with less than 0.5 dB insertion loss.

Construction Requirements

Examine conditions for compliance with requirements for installation tolerances, characteristics, and other conditions affecting performance of

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

transient voltage surge suppressors. Do not proceed with installation until unsatisfactory conditions have been corrected.

Conductors between the SPD and the point of attachment shall be kept as straight and short as possible.

The SPDs ground shall be bonded to the cabinet's grounding bar. Ground each SPD's enclosure.

Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

Install an appropriate SPD at all data, communication, video, and low voltage connections or termination.

Basis of Item

Transient voltage surge suppressors for data, communications, 24V and video will not be measured.

The following shall be considered incidental to this item:

Transient Voltage Surge Suppressors for data, communications, 24V and video will be considered incidental.

VAULT, ATMS

Description

This Work consists of furnishing and installing ATMS vaults for communications cable access as shown on the Plans.

Materials

Materials for the ATMS vault shall be as shown in the Plans and in accordance with 807.03. All vault covers are required to be bolted into place to prevent accidental removal by mowing crews or other unintentional means. The cover frame shall be installed in the vault with a butyl rubber sealant in tape/coil form for a proper seal and to prevent the frame from moving out of place. The sealant shall comply with ASTM C990 for butyl rubber sealants.

The vault rings and covers shall be as shown on the Plans and in accordance with 807.09 except the message displayed on the lid shall read "TRAFFIC MANAGEMENT SYSTEM". Fabrication of these vault covers shall not commence until Working Drawings that the Design-Build Contractor shall have submitted have been approved by IFA.

Construction Requirements

ATMS vaults shall be installed at all planned and potential future fiber optic cable splicing locations and at additional locations as shown on the Plans.

Material surrounding the buried Conduit splices and ATMS vaults shall be tamped and added in such a manner so that there are no voids or depressions formed. Conduit entrance and exit points in the new ATMS vaults shall be sealed watertight.

ATMS vaults shall be precast. The top of the vault shall be flat and level with the surrounding ground. The vault shall be placed such that final grading will provide a minimum of 4 inches of soil over the concrete box. Clean applicable surfaces before installing butyl sealant on the cover frame prior to installation in the vault. Adhesive primer shall be used when moisture is present on surfaces. Follow manufacturer's instructions for proper installation. When the installation is completed, all disturbed portions of the construction area shall be cleaned, and any excess excavation or other materials shall be properly disposed of as soon as possible.

Basis of Item

The completed Work as described for ATMS vault shall be measured by the unit of each and shall include furnishing and installation of a new vault, a bolt down cover, butyl sealant, excavation, and all other accessories, grading, and re-seeding necessary for a complete installation.

The items list shall include the following:

Item Description	Unit Symbol
Vault, ATMS	EACH

The following shall be considered incidental to this item:

Materials, labor, equipment, transportation, placement, and other necessary incidentals. All earthwork preparation and grading necessary for installation of the vault shall be considered incidental to this Work. All final clean-up and disposal of excess excavation shall be considered incidental to this Work.

WIRELESS VEHICLE DETECTION SYSTEM

Description

This Work shall consist of furnishing and installing wireless vehicle detection systems for vehicle detection at traffic signals.

Materials

The wireless vehicle detection system, WVDS, is comprised of wireless magnetometer detectors, contact closure cards, receiver processors, and wireless repeaters installed for a signalized intersection. The system shall be capable of monitoring vehicles on a roadway via detection of changes in inductance caused by the presence or passage of a vehicle and shall provide detector outputs to a traffic signal controller.

The WVDS shall include magnetometer detectors, a minimum of two receiver processors, the required mounting equipment, cables, rack mounted cards, set-up and operating software, all connectors, and miscellaneous equipment necessary for the installation and operation of the system. If required, the WVDS shall also include wireless repeaters.

Only models from INDOT's approved materials list for traffic signal control equipment shall be used.

Ethernet cable for wireless vehicle detectors shall be outdoor rated and UV shielded.

Construction Requirements

Prior to the installation, the Design-Build Contractor shall test all wireless magnetometer detectors and demonstrate proper operation and communication between the wireless magnetometer detectors and the receiver processor and wireless repeater, if required.

Prior to the installation, the Design-Build Contractor shall demonstrate that each wireless magnetometer detector is within range of its corresponding receiver processor, using wireless repeaters as necessary. All wireless magnetometer detectors assigned to either a receiver processor or wireless repeater shall be located within a 120° arc measured from the receiver processor or wireless repeater.

The Design-Build Contractor shall install each wireless magnetometer detector in the roadway according to the manufacturer's recommendations with one wireless magnetometer detector programmed to count vehicles for each through travel lane. Holes cored in the pavement shall be cleaned and dried before installing wireless magnetometer detectors. The cored pavement shall be backfilled according to the manufacturer's recommendations.

Receiver processors and wireless repeaters shall be mounted on traffic signal steel strain, pedestal, cantilever poles, or square steel sign posts. If a square steel sign post is used, it shall have a length of no more than 24 feet and a Type 3 object marker shall be installed on the post, with a mounting height of 4 feet, measured from the edge of the traveled way to the bottom of the object marker. The mounting height of receiver processors above the pavement surface shall be between 20 feet and 35 feet. The mounting height of wireless repeaters above the pavement surface shall be between 13 feet and 35 feet.

The minimum distance between a receiver processor and wireless repeater mounted on the same structure shall be 2 feet. This distance may be increased

TECHNICAL PROVISIONS – Attachment 17-1
Unique Special Provisions for ITS

to enable better communication between the devices.

After installation, the Design-Build Contractor shall demonstrate successful communication between each wireless magnetometer detector, receiver processor, and wireless repeater to IFA.

Basis of Item

Wireless magnetometer detectors contact closure cards, receiver processors and wireless repeaters shall be measured by the number of units installed.

The items list shall include the following:

Item Description	Unit Symbol
Contact Closure Card	EACH
Receiver Processor	EACH
Wireless Magnetometer Detector	EACH
Wireless Repeater	EACH

The following shall be considered incidental to this item:

Coring the pavement, sealant, and all Work necessary for proper installation and operation of the wireless magnetometer detectors shall be included in the item wireless magnetometer detector.

Cables, connectors, set-up and operating software, access boxes, rack mounted expansion cards, and all hardware necessary to complete the installation shall be included in the item contact closure cards.

Required mounting equipment, cables, connectors, and miscellaneous equipment necessary for proper installation and operation of the receiver processors shall be included in the item receiver processors.

Required mounting equipment, connectors, and miscellaneous equipment necessary for proper installation and operation of the wireless repeaters shall be included in the item wireless repeaters.

INDOT BROADBAND CORRIDOR - CABLE DUCT MARKER2

INDOT BROADBAND CORRIDOR - CONDUIT.....4

INDOT BROADBAND CORRIDORS - DOCUMENTATION AND SUBMITTALS.....10

INDOT BROADBAND CORRIDOR - FIBER OPTIC LOCATOR POST13

INDOT BROADBAND CORRIDOR - HANDHOLES14

INDOT BROADBAND CORRIDOR - TRACER WIRE15

INDOT BROADBAND CORRIDOR – CABLE DUCT MARKER

Description

This Work shall consist of providing INDOT Broadband Corridor cable duct markers..

Materials

Concrete Markers: Concrete cable duct markers shall be manufactured and installed according to the Standard Specifications 807.08 except as revised herein. Concrete cable duct markers shall be marked "INDOT Broadband Corridors" with field-cut arrows identifying the direction of the underground conduits.

Flexible Markers: Flexible cable duct markers shall be manufactured of an integrally colored orange, single piece, two-sided, UV resistant, fiberglass reinforced composite, constructed of adequate strength and rigidity to enable installation into compacted soil. Markers shall be capable of returning to vertical and remaining functional after being subjected to a head-on vehicle impact. At a minimum, markers shall be 3.75 inches wide by 66 inches long with raised and reinforced ribs along each side to protect the decal.

Decals shall be provided on both sides of the markers. Decal shall consist of a standard fiber optic warning message, visible from a distance, such as "Warning Fiber Optic Cable and Conduit". In addition, the decal shall include the message "Call INDOT Broadband Corridor Director before digging 317-232-5174" along with the INDOT symbol (digital image is available on INDOT's website):



Figure A: INDOT's Logo

All markers and decals shall be from a single manufacturer. Decals shall be considered incidental to the cost of the flexible markers.

Markers shall be installed according to the manufacturer's recommendations, or to a depth suitable to resist the impact of wind or an errant vehicle without pulling free. Location of marker installations shall be as shown on plans or as determined by the Department.

Basis of Item

The completed Work as described for cable duct marker will be measured by the unit of EACH and includes furnishing and installing of a cable duct marker with all accessories necessary for a complete installation.

TECHNICAL PROVISIONS – Attachment 17-2
Unique Special Provisions for ITS Broadband Corridor

The items list shall include the following:

Item Description	Unit Symbol
Cable-Duct Marker, Concrete.....	EACH
Cable-Duct Marker, Flexible.....	EACH

The following shall be considered incidental to this item:

Materials, labor, equipment, transportation, placement, and other necessary incidentals.

INDOT BROADBAND CORRIDOR - CONDUIT

Description

Work under this item shall include furnishing and installing conduit described in these specifications to provide raceways for fiber-optic cable.

Materials

HDPE conduits shall meet or exceed the requirements of section 922.19. Schedule 80, coilable, HDPE conduit shall be 2 inches in diameter and color coded yellow, red, white and slate. The HDPE shall meet or exceed the properties listed in ASTM D-3350 for minimum cell classification of Class E Colored with UV Stabilizer. The properties and dimensions shall be in accordance with ASTM F 2160 standard specification for "Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD)".

Fiberglass conduit shall be manufactured to NEMA TC-14 2002 standards and listed by Underwriters Laboratories (UL) standard 1684 "Above Ground and Below Ground". Carbon black shall be used as an ultraviolet inhibitor. All fiberglass conduit shall be Iron Pipe Size (IPS), "Standard Wall" with a minimum 0.07-inch wall thickness, and a minimum impact resistance per the following table and in accordance with ASTM D2444.

Table: Fiberglass Conduit Impact Resistance

CONDUIT SIZE	STANDARD WALL IMPACT RESISTANCE
2-inch	40 lbs ft
3-inch	60 lbs ft
4-inch	70 lbs ft
5-inch	100 lbs ft
6-inch	100 lbs ft

Construction Requirements

The Design-Build Contractor shall comply with Section 807.06, except as noted in this special provision. The Design-Build Contractor shall install conduits underground by means of trenching or directional drilling. Except as noted, the plans depict conduit routing and schematic form only. The Design-Build Contractor shall determine final routing based on actual field conditions at each site, including utility locator service markings, to assure no conflicts with existing utilities. In addition to notifying the IUPPS "Call Before You Dig" service, the Design-Build Contractor shall notify the INDOT ITS Division, the INDOT Broadband Corridor Group, the INDOT District to request the ITS locates, and highway lighting locates 48 hours in advance of excavation Work.

The cost of notifying IUPPS, shall be considered incidental to the contract. All conduits shall be placed a minimum of 4 feet longitudinally below existing grade, and 10 feet from the flow line of the ditch for any transverse crossing of a designated broadband corridor (US 31, US 30, Any Interstate). All conduit shall be stubbed out a minimum of 6 inches into each handhole.

TECHNICAL PROVISIONS – Attachment 17-2
Unique Special Provisions for ITS Broadband Corridor

Construction limits shall be restored by grading soil smooth and seeding as necessary to prevent erosion on steep grades. Restoring construction limits will be considered incidental to the conduit installation.

Warning tape shall be furnished and installed in all the trenches containing conduit, as depicted in the plan details.

Trenching

Conduit identified to be installed in a trench may be trenched or plowed at the Design-Build Contractor's discretion and as permitted by the site conditions. Except as revised herein, conduit trenches shall be in accordance with the INDOT Standard Specifications Section 807.04. Common trenches shall be used for multiple conduits as shown on the plans.

In a common open trench, INDOT ITS conduit shall be placed at the bottom of the trench, INDOT BBC conduit shall be located at the top and any privately-owned entity placing conduit shall be in the middle.

Conduit may be installed by directional drilling at locations called out to be as trenched on the plans with no additional compensation.

Conduit pushes as shown on the plan shall be in accordance with standard specification section 805.11 and 807.06. The Design-Build Contractor shall verify the existing pavement conditions prior to construction to avoid cracking the pavement.

All flexible roadside delineators disturbed during trenching operations shall be restored or replaced at no additional cost to the contract.

Hand Trenching

Conduit identified as Hand Trench is located in areas where sensitive existing crossing utilities or broadband have been identified and will likely require positive identification of the existing utility or broadband prior to trenching above or below the existing utility line or where surface features such as riprap would inhibit trenching. The method of positive identification of the existing utility line is at the discretion of the Design-Build Contractor and shall be accomplished with no additional compensation. Any material that is removed to accomplish Hand Trenching shall be restored or replaced in kind by the Design-Build Contractor without additional compensation.

Conduit type, number, and size shall be as identified on the plans.

Conduit identified as Hand Trench may be trenched or plowed at the Design-Build Contractor's discretion and as permitted by site conditions. Except as revised herein, conduit trenches shall be in accordance with 807.04. Common trenches shall be used for multiple conduits, as shown on the plans.

Conduit may be installed by directional drilling at locations called out to be as hand trenched on the plans with no additional compensation.

All flexible roadside delineators disturbed during hand trenching operation shall be restored or replaced at no additional cost to the contract.

Offset Trenching

TECHNICAL PROVISIONS – Attachment 17-2
Unique Special Provisions for ITS Broadband Corridor

Conduit identified as Offset Trench is in areas where the trench is located behind obstructions. This type of trenching shall utilize a long reach hydraulic driven trenching machine to reach over and beyond the obstruction and complete trench as the same as TRENCH. This trenching machine is typically attached to and powered by an excavator.

Conduit may be installed by directional drilling at locations called out to be offset trench on the plans with no additional compensation.

Directional Drilling

The Design-Build Contractor shall determine all utility locations near the path of the proposed drill, including depth. The Design-Build Contractor shall use this information to avoid damage to utilities and/or facilities within the Work area. The Design-Build Contractor shall provide this information, including the sources, to IFA a minimum of five Working days prior to drilling. The Design-Build Contractor shall not drill until IFA approves that submittal.

Prior to drilling, the Design-Build Contractor shall expose all underground fiber and utilities for which it is customary and safe to do so.

The diameter of the drilled hole shall conform to the outside diameter of the conduit or conduits as closely as practical. The Design-Build Contractor shall pressure grout as directed by IFA, to fill any voids, which develop during the installation operation. The Design-Build Contractor shall remove and replace any conduit damaged in the directional drilling operations at no expense to the project.

The use of water and other fluids in connection with the drilling operation will be permitted only to the extent necessary to lubricate cuttings. Jetting shall not be permitted, and the use of water alone as a drilling fluid shall not be permitted. The Design-Build Contractor shall use a drilling fluid/slurry consisting of at least 10% high grade, processed Bentonite to consolidate excavated material, seal the walls of the hole, and furnish lubrication for the subsequent removal of material and immediate installation of the conduit.

The Design-Build Contractor shall provide a means of collecting and containing drilling fluid/slurry that returns to the surface, such as slurry pit, or a method approved by the Engineer. The Design-Build Contractor shall include the following procedures: Provide measures to prevent drilling fluids from entering storm sewer systems. Prevent drilling fluid/slurry from accumulating on or flowing onto sidewalks, other pedestrian walkways, driveways, or streets. Immediately remove any slurry that is inadvertently deposited on pedestrian walkways. Transport waste drilling slurry from the site and dispose of it. Do not allow slurry to enter wetlands. Protect wetlands from slurry using appropriate soil erosion control measures approved by IFA.

The Design-Build Contractor shall use a digital walkover locating system to track the drill head during the bore. At minimum, the locating system shall be capable of determining the pitch, roll, heading, depth, and horizontal position of the drill head at any point along the bore. During each drilling operation, the Design-Build Contractor shall locate the drill head every 10 feet along the bore and prior to crossing any underground utility or structure. Upon completion of the drilling operation and conduit installation, the Design-Build Contractor shall furnish FIA with an as-built profile drawing and plan drawing for the

TECHNICAL PROVISIONS – Attachment 17-2
Unique Special Provisions for ITS Broadband Corridor

drilled conduit showing the horizontal and vertical locations of the installed conduit.

Conduit identified to be installed between 1,000 feet and 1,500 feet indicates a long continuous bore. Equipment required to directional drill at this distance may be different from other types of directional drilling equipment needed on shorter distance directional drills. These areas of directional drilling are inaccessible to equipment that cannot drill between the handholes and vaults shown on the plans in a single set-up. Alternate means of accomplishing the directional drill may be proposed by the Design-Build Contractor and shall require approval of IFA.

Nothing may be attached to any bridge or structure that reduces the under-bridge clearance for vehicles or vessels passing under the bridge or structure. Areas not permissible for vehicles or vessels passing under may be reduced in clearance for the purpose of extending the conduit from under the structure to the outside of the structure as shown on the plans. These locations are typically under the slope wall and at the beginning and end points of the structure where the conduit transitions from underground to under structure. Drilling or welding of the steel girders will not be permitted. Attaching conduit or hangers to the bridge barrier wall or bridge railing will not be permitted.

HDPE Conduit Splicing

All HDPE conduit splices shall be fusion splices, unless mechanical splices are approved in writing by the INDOT Broadband Corridor Director.

For all empty HDPE conduit installed under this contract and designated for future use or cable installation by others, the Design-Build Contractor shall proof the conduit system with a mandrel, as per Table below, to remove any obstruction or debris. The Design-Build Contractor shall perform the conduit proofing in the presence of INDOT. The Design-Build Contractor shall apply a pressure of 100-110 PSI to the conduit, close to the air output valve and stop compressor, and measure air pressure loss. The maximum allowable air pressure loss within 2 minutes of pressurization is 20 psi. The Design-Build Contractor shall record the Conduit Test form attached to this special provision.

Conduit Size (in)	Mandrel Diameter (in)	Minimum Mandrel Length (in)	Maximum Mandrel Length (in)	Proof (%)
1	0.60	1.0	4	80
1 ¼	0.86	1.5	4	80
1 ½	1.12	1.8	4	80
2	1.62	2.4	6	80
3	2.5	3.25	8	80
4	3.5	4.25	8	85
6	5.5	6.25	10	85
8	7.5	8.25	12	85

Conduit Testing Form

Date: _____ Route: _____ Direction: _____

Starting Station: _____ Ending Station: _____

TECHNICAL PROVISIONS – Attachment 17-2
 Unique Special Provisions for ITS Broadband Corridor

Starting Mile Post: _____

Ending Mile Post: _____

Conduit #	Conduit Color Marking Color/Stripe)	Conduit Size inches)	Cleaned (Rodded and Swabbed) (Check Mark)	Pressure Test Starting Pressure (PSI)	Pressure Test End Pressure (PSI) (2 Mins)	Capped (Check Mark)
1						
2						
3						
4						
5						
6						

Design-Build Contractor: _____

INDOT: _____

Basis of Item

Conduits of the type, size, and installation method specified shall be measured per linear foot of conduit provided complete and in place.

The items list shall include the following:

Item Description	Unit Symbol
Conduit, 3 HDPE, 1 ¼ in., SCH 80, Trench.....	LFT
Conduit, 3 HDPE, 1 ¼ IN., SCH 80, Hand Trench.....	LFT
Conduit, 3 HDPE, 1 ¼ IN., SCH 80, Offset Trench.....	LFT
Conduit, 3 HDPE, 1 ¼ IN., SCH 80, Bore.....	LFT
Conduit, 3 HDPE, 1 ¼ IN., SCH 80, Bore, 1,000 FT. - 1,500 FT.....	LFT
Conduit, 3 HDPE, 2 IN., SCH 80, Bore.....	LFT
Conduit, 3 HDPE, 2 IN., SCH 80, Trench.....	LFT
Conduit, 3 HDPE, 2 IN., SCH 80, Bore.....	LFT
Conduit, 2 PVC, 2 IN., Trench.....	LFT
Conduit, PVC, 3 IN., Bore.....	LFT
Conduit, PVC, 4 IN., Trench.....	LFT
Conduit, 1 Steel, Galvanized, 2 IN., Trench.....	LFT
Conduit, Steel, Galvanized, 3 IN., Trench.....	LFT

TECHNICAL PROVISIONS – Attachment 17-2
Unique Special Provisions for ITS Broadband Corridor

Conduit, Transition, 3 IN.....LFT
Conduit, 1 Flexible, 2 IN., Overhead Sign Structure.....LFT
Conduit, 4 HDPE, 1 ¼ IN., SCH 80, Trench.....LFT
Conduit, 4 HDPE, 1 ¼ IN., SCH 80, Offset Trench.....LFT
Conduit, 4 HDPE, 1 ¼ IN., SCH 80, Bore.....LFT

The following shall be considered incidental to this item:

Materials, labor, equipment, transportation, placement, and other necessary incidentals.

All fittings, caps, bends, sweeps, expansion joints, split stop rings, anchor brackets, installation equipment, trenching, backfilling, epoxy adhesive kits, fusion splices, couplers, connectors, conduit brackets/hangers, anchor bolts, lag screws, lag screw holes, epoxy patch for concrete holes, attachment hardware, warning tape, erosion control, restoring disturbed areas, other supporting equipment, and other necessary incidentals.

Locate, expose, and document the existing utilities.

Rodding, swabbing, mandrel and pressure testing conduits.

Containing and removing drilling fluid/slurry and protecting wetlands from drilling fluid/slurry.

INDOT BROADBAND CORRIDORS - DOCUMENTATION AND SUBMITTALS

Description

The Design-Build Contractor shall provide four types of documentation and submittals for this contract: a system schematic, submittal data, as-built documentation, and manuals and maintenance documentation. The Design-Build Contractor shall submit Working drawings in accordance with 105.02 and the following additional requirements.

All documentation, except as approved by IFA, shall be no smaller than 8.5 inches by 11 inches or no larger than 24 inches by 36 inches. Standard bound manuals shall be exempted from this requirement. IFA shall maintain the right to reproduce unlimited copies of any documentation for exclusive use on this contract.

All documentation shall also be provided in electronic format and delivered on CD-ROM or flash drive as practical. All electronic files shall be readable using standard Microsoft Office products. Drawings shall be provided as CAD files in data exchange (.DXF) file format compatible with MicroStation and in Acrobat Reader (.PDF) file format.

All 8.5 inch by 11 inch documentation, except standard bound manuals, shall be bound in logical groupings in three ring loose-leaf binders. Binders may also include 11 inch by 17 inch documentation, if Z-folded. Three copies of each bound grouping of documentation shall be provided labeled in a legible and permanent manner.

Three copies of all 24 inch by 36 inch documentation and a single reduced set no smaller than 11 in. by 17 in. shall be provided.

All documentation submitted shall be of reproducible quality as determined by IFA. All unsatisfactory items will be returned to the Design-Build Contractor who shall make the submittal again in satisfactory reproducible form as determined by IFA.

All literature from manufacturers shall be original documents provided by the manufacturers. Black and white copies of color originals are not acceptable. No facsimile reproductions of any type shall be accepted.

Submittal Data

Submittal Data shall be prepared and meet the following requirements:

Prior to the purchase or fabrication of any equipment or material proposed for use on this project, the Design-Build Contractor shall submit for review by IFA catalog cut sheets and specifications for all standard, off-the-shelf items; Working drawings shall be submitted for all non-catalog or custom items. An electronic copy of all submittals and Working drawings shall be provided in.pdf format. Every submittal shall be accompanied by transmittal letter providing following information:

1. Submittal number
2. Pay item number

TECHNICAL PROVISIONS – Attachment 17-2
Unique Special Provisions for ITS Broadband Corridor

3. Manufacturer and model number
4. Description

Submittals and Working drawings will be approved or rejected in writing, and a memorandum stating the disposition will be returned to the Design-Build Contractor. Certain items will require verification of performance, which shall be provided with the catalog cut sheets, Working drawings, and specifications. See individual equipment specifications for requirements.

The purpose of the submittal and Working drawing data is to show specifically and in detail how the Design-Build Contractor intends to satisfy the requirements of these specification and the plans. If preprinted literature is utilized to satisfy some or all of these requirements, there shall be no statements on the literature which conflict with these specifications or plans. Any such statements will be crossed off and initialed by the Design-Build Contractor and an appropriate statement be attached indicating how the requirements of these specification or the plans will be fulfilled.

The Design-Build Contractor shall label each item of submittal and Working drawing data with the bid item number or other description of the items to which it applies. Each submittal of catalog cut sheets, specifications, or Working drawings, shall contain sufficient information and details to allow IFA to evaluate the particular component.

All submittals will be returned to the Design-Build Contractor within 30 days of submission. All submittals returned to the Design-Build Contractor as rejected shall be resubmitted for approval within 14 calendar days from the notice of rejection.

The Design-Build Contractor may submit alternatives to the Plans and Special Provisions to IFA for consideration. Any alternative submitted shall be identified with benefits stated and documented.

The Design-Build Contractor shall submit the following items at a minimum. Any item included in this list that is not a deliverable of the contract may be removed from the requirements with approval by IFA. This list does not preclude the submittal of other items as required in the specifications. The submittal requirement items are as follows;

1. Fiber optic cable
2. Fiber optic drop cable assemblies
3. Fiber optic patch panels
4. Fiber optic patch cables
5. Fiber optic break out kit and connectors
6. Fusion splice protection kit
7. Fusion splice enclosure
8. Vaults
9. Handholes
10. Handhole and vault rings & lids
11. Cable duct markers, concrete
12. Cable duct markers, flexible (including decal design)

TECHNICAL PROVISIONS – Attachment 17-2
Unique Special Provisions for ITS Broadband Corridor

13. All conduits
14. All electrical and grounding cables
15. Conduit splicing methods and materials

As-Built Documentation

Documentation of the Work, as built, shall be provided by the Design-Build Contractor prior to acceptance of the Work. The Design-Build Contractor will be provided with base files containing the proposed locations for conduit, cabinets, and devices. On a level containing no proposed information, the Design-Build Contractor shall draw in the final as-built locations for the cabinets, poles, conduits including burial depth, and device locations. These drawings shall be returned in both electronic and paper format. Acceptable formats would be ESRI file geodatabase, ESRI shapefile, ASCII file and require as-builts to include X, Y, Z coordinates. Elevations must be a record of actual elevations on site and not copied from the design plan (mean sea level) elevations.

As part of the final as-built documentation the Design-Build Contractor shall provide GPS coordinates accurate within less than 2 feet of all handhole and vault locations and for conduit must be no more than 6 inches. Measurements must be made approximately every 50 feet. The coordinates shall be noted on the plans and in a single comma separated value, CSV, file provided to the Department. The CSV file shall be supplied on a CD to the IFA including the Latitude and Longitude of all handhole and vault locations in decimal degree format. Each record shall include the type of object, Latitude, Longitude, Road Name, direction of roadway travel, and Nearest Mile Marker to the nearest tenth of a mile. The following is an example of the record format.

Example record: Vault, 39.40247778, -86.44611111, I-69, NB, 136.7

This would be the location record for a vault placed along I-69, on the NB side of the road, at the 136.7-mile marker near the interchange with SR 39.

Component and wiring diagrams shall be provided for all custom manufactured equipment as well as a complete parts listing indicating the manufacturer and model of all electronic components.

In addition to the documentation specified elsewhere, prints of schematic diagrams applicable to the equipment contained in cabinets or the communication shelters shall be provided by the Design-Build Contractor. An 11 inch by 17 inch laminated wiring diagram, and an 11 inch by 17 inch laminated site drawing shall also be supplied in a weatherproof holder and mounted at each new cabinet and communication shelter.

INDOT BROADBAND CORRIDOR - FIBER OPTIC LOCATOR POST

Description

The Design-Build Contractor shall furnish Fiber Optic Locator Post for identifying locations of fiber optic cable.

Material

The Fiber Optic Locator Post shall be made of a non-conductive, high-density polymer, and shall be integrally white in color with an orange cap with black graphic and lettering on two sides. All colors shall be stabilized against ultraviolet light such that they will not fade under continuous exposure to direct sunlight. The marker shall retain dimensional stability in temperatures ranging between -40° F and 175° F. Each post shall be able to withstand a single vehicle impact at 45 MPH and return to within 10 degrees of vertical within 60 seconds.

Installation

A Locator Post shall be installed at fiber optic splice locations. At splice points, posts shall be connected to the fiber splice cases and the armored cable with a #12 tracer wire in innerduct as indicated on the plans.

Locator Posts shall be installed in accordance with the manufacturer specifications and details.

Locator Posts shall be installed at the same time or immediately after the installation of underground conduits and vaults for identification of underground infrastructure.

Basis of Item

This Work will be measured in units of each for the number of markers that are placed and accepted.

The items list shall include the following:

Item Description

Unit Symbol

Fiber Optic, Locator Post.....EACH

The following shall be considered incidental to this item:

Materials, #12 tracer wire between the vault and post, labor, equipment, transportation, placement, and other necessary incidentals.

INDOT BROADBAND CORRIDOR - HANDHOLES

SECTION 805.03, BEGIN LINE 30, INSERT AS FOLLOWS:

The handhole covers shall be bolted into place with stainless steel bolts and washers. The cover frame shall be installed in the handhole with a butyl rubber sealant in tape/coil form for a proper seal between the handhole and frame and to prevent it from moving out of place. The sealant shall comply with ASTM C990 for butyl rubber sealants.

The cover for the INDOT Broadband Corridor handhole shall be marked with logo imprints of "INDOT BROADBAND CORRIDOR" horizontally across the cover.

Item Description

Unit Symbol

Handhole, INDOT Broadband Corridor.....EACH

INDOT BROADBAND CORRIDOR - TRACER WIRE

Description

Work under this item shall include furnishing and installing tracer wire in conduits as described in these specifications to assist with conduit locates.

Materials

Tracer wires shall be a single conductor, high strength copper clad steel, orange color jacket, high molecular weight and high-density polyethylene (HMWPE) insulation, #12 AWG wire. The HMWPE jacket shall be a minimum of 30 millimeters in thickness. The wire shall have a minimum break load of 425 pounds and made of fully annealed, high carbon 1055 grade steel. Tracer wires shall be rated for use at 30 volts. Wire connectors shall be waterproof.

Construction Requirements

As determined by IFA, new continuous tracer wire shall be placed into each run of fiber optic cable, fiber optic trunk cable, fiber optic lateral cable and fiber optic extension cable from handhole to handhole or vault. A minimum of 3 feet of tracer wire shall be securely tied off inside of a terminating handhole.

As determined by IFA, a new continuous tracer wire shall be provided in the same conduit with all fiber optic cables. Tracer wire is not required to be installed in above-ground conduits and empty conduits that are part of a duct bank that contains a non-dielectric (conductive) cable. When multiple cables are to be installed in a conduit, all cables shall be pulled simultaneously to prevent friction damage to the cable insulation. Spare and empty conduits shall not be utilized to install the tracer wire.

The tracer wire shall be securely fastened inside of the handhole or vault. A waterproof wire nut or direct burial connector shall be connected to each end of the tracer wire to prevent corrosion. At vaults with splice enclosures the tracer wire shall be connected to the enclosure and also connect to the wire lead for the Fiber Optic, Locator Post.

Basis of Item

INDOT Broadband Corridor tracer wire will be measured per linear feet of materials provided complete and in place

The items list shall include the following:

Item Description	Unit Symbol
-------------------------	--------------------

INDOT Broadband Corridor, Tracer Wire.....	LFT
--	-----

The following shall be considered incidental to this item:

Materials, labor, equipment, fasteners, waterproof wire nuts, waterproof direct burial rated connectors and all other necessary incidentals.