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City of Byram, MS
Big Creek Sanitary Sewer Interceptor
Pickering Firm, Inc. Project 26401.00

Plans, Specifications, and Contract Documents

TO: ALL PLANHOLDERS

FROM: Jonathan McLeod, PE

DATE: Wednesday, 26 June 2024

The Plans, Specifications, and Contract Documents for this Project shall be amended as follows:

ADDENDUM #2

PLANS & SPECIFICATIONS

1. Steel Casing Installation Under Interstate 55 (Alternate 1)

   Microtunneling may be considered as an accepted method for installing the steel casing pipe beneath I-55 as depicted on Sheet C1.02A.

   ADD *Specification Section 02562 Microtunneling Construction*

   ADD *Specification Section 02563 Access Shafts*

   Specifications attached.

ITEMS IN CONFLICT WITH THIS ADDENDUM ARE HEREBY DELETED.

THIS ADDENDUM IS TO BE ACKNOWLEDGED BY THE BIDDER ON THE BID FORM.

Pickering Firm, Inc.

Jonathan McLeod, PE
26 June 2024

SECTION 02562
MICROTUNNELING CONSTRUCTION

PART 1. GENERAL

1.1 SCOPE

A. This section describes microtunneling and modified direct jack methods and minimum construction requirements to properly complete the pipeline as described in this section and/or shown on the Plans including pipe testing and post-installation closed circuit TV inspection. The pipeline diameters shown on the Plans are minimum sizes. The Contractor is permitted to substitute larger diameters to accommodate microtunneling equipment on hand. The Contractor shall furnish and install all materials and equipment, and perform all labor necessary to fulfill the requirements of the Plans and these Specifications.

B. Available information on the geological setting of the Work and available information from the subsurface investigation are described in the geotechnical report included in the Contract Documents.

C. Related Work Specified Elsewhere:

Section 02563 - Access Shafts for Microtunneling
Section 02731 – Wastewater Gravity Mains and Appurtenances

1.2 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

1. The Engineer will review submitted plans, details, and data for compliance with the requirements of this section. Such review shall not be construed to relieve the Contractor in any way of responsibilities under the Contract. The Contractor shall not commence work on any item requiring a submittal until the submittal has been reviewed and accepted by the Engineer.

2. All Contractor submittals requiring structural design shall be signed and sealed by a professional engineer registered in the State of Mississippi.

3. The Contractor shall allow thirty (30) working days for review by the Engineer considering the complexity of this Work.

4. The Contractor shall submit the following items for review and approval by the Engineer:

a. MTBM design drawings and technical specifications, including but not limited to trailing equipment, configuration of the cutterhead, size of overcut and MTBM manufacturer's operation manual.

b. Resumes detailing experience and education for the MTBM operators and Project Superintendent.

c. Pipe lubrication details.

d. Guidance system, grade and alignment control details including procedures for surveying, controlling, and checking alignment and grade.

e. Methods to control, handle, treat, and dispose of slurry/water.

f. Details of slurry system and soil separation methods including proposed slurry formulations and hydraulic calculations of the system capacity to handle flows at all distances and changes of elevation to and from the MTBM. Method and details of spoil surface storage, processing, and disposal.

g. Details of jacking system, method of operation, and thrust capacity. The Contractor ,shall include calculations of anticipated jacking forces required to advance the pipe. The Contractor shall describe procedures to prevent the maximum jacking force from being exceeded.

h. Details of method proposed to cushion and distribute jacking forces at the pipe joints, including cushion material and compression calculations.

i. Details of grouting the annulus space after pipe has been installed including injection pressure and method of controlling grout pressures.

j. Proposed plans for critical phases of microtunneling and proposed contingency plans for the potential events such as damage to pipeline structural integrity and repair; bentonite or grout spills or blowouts; loss and return to line and grade; and encountering large voids or cavities.

k. Calculations demonstrating that the pipe and pipe joints selected by the Contractor can support the external ground loads and construction forces.

l. Calculations demonstrating that the pipe class selected by the Contractor can accommodate the Contractor's planned means and methods including the anticipated longitudinal loading (jacking forces), static loading from soil and groundwater, and traffic loadings. The design calculations shall be accompanied by a

performance affidavit from the manufacturer that the pipe to be supplied is appropriate for this application.

m. Plans for storage and handling of pipe.

n. Procedures for preparing and submitting daily logs of tunneling operations, including field forms, to meet the requirements of this section.

o. A plan for testing and submittal of test results to demonstrate compliance with these Specifications and Contractor's design criteria for permanent products, materials, and installation. The plan shall identify applicable standards and procedures for testing and acceptance.

p. Design mixes for concrete and grout.

q. Method of restraining pipes and preventing the opening of pipe joints by hydrostatic pressure, near the shafts after removal of jackload, and also by soil material entering the pipe joints during microtunneling and preventing closure of the joints.

r. Details to confirm the compatibility of the pipes with the MTBM, and other microtunneling equipment.

s. Plan and procedure for physically and contractually dealing with possible obstructions.

t. Contingency measures of disposing contaminated soil and groundwater if encountered.

u. Inspection plan of post installation of pipe.

v. Damage correction measures, if any, after pipe installation.

w. Breakdown of work shifts planned and size and configuration of shifts crews.

5. The Contractor shall submit the following items for record purposes only and will not be subject to approval by the Engineer:

a. Protection against improper mechanical and hydraulic equipment operations, and for lifting and hoisting equipment and material.

b. Ventilation and lighting details.

c. Monitoring for hazardous gases.

d. Protection against flooding and means for emergency evacuation.

e. Safety supervision responsibilities. Description of complete safety

program.

6. The Contractor shall submit, to the Engineer, construction reports for each shift within twenty-four (24) hours of the operations or at least the following.

   a. Location of MTBM face by station and progress of tunnel drive during shift.

   b. Hours worked per shift, and a description of work performed.

   c. Completed pipe jacking reports to include: continuous position of the cutter head relative to the designed alignment and grade, cutter head rotation and torque, slurry chamber pressure, continuous readings of jacking pressure reported in tons, continuous monitoring of air quality, continuous record of MTBM pitch and roll, and continuous readings of external pressure.

   d. Location and brief soil descriptions of significant soil strata.

   e. Groundwater control operations.

   f. Observation of lost ground or other ground movement. In this instance, the Engineer shall be notified immediately.

   g. Indications of damaged pipe joint or pipe.

   h. Any unusual conditions or events.

   i. Operation shut-down periods or other interruptions in the work with reasons.

   j. Jacking forces.

1.3 QUALITY ASSURANCE

A. The Contractor shall supply all materials and perform all work in accordance with applicable American Society of Civil Engineers (ASCE), American Society for Testing and Materials (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI), Occupational Safety and Health Administration (OSHA), or other recognized standards. Latest revisions of all standards are applicable. If requested by the Engineer, the Contractor shall submit evidence that the manufacturer has consistently produced products of satisfactory quality and performance over a period of at least two (2) years.

1.4 DEFINITIONS

A. Microtunneling: A remotely controlled, guided, pipe-jacking process that provides continuous support to the excavation face and does not require

personnel entry into the tunnel for normal operations. This excludes guided boring or pilot tube type equipment.

B. Microtunneling Boring Machine (MTBM): A remotely-controlled, steerable, laser-guided microtunnel boring machine consisting of an articulated boring machine shield and a rotating cutting head.

C. Jacking Shaft: Excavation from which MTBM is launched for installation of a pipeline. A thrust wall may be incorporated to spread reaction loads to the ground.

D. Receiving Shaft: Excavation into which the microtunneling equipment is driven and recovered.

E. Slurry: Water, which may contain additives, that is used to transport soils and to provide continuous support to the advancing face.

F. Lubricant: Water combined with additives and applied between the pipe and soil to minimize friction and to fill the annular space.

G. Obstruction: Any object or feature that lies completely or partially within the cross-section of the microtunnel and prevents continued forward progress or causes uncontrollable change in direction beyond specified pipe line and grade tolerance.

H. Drive: The section of pipeline installed by microtunneling methods from a jacking shaft to a receiving shaft.

I. Slurry System: Transportation of excavated material in slurry flow matched to excavation rate. The slurry system balances ground water pressures and separates soil from the slurry at the end of the process. Soil separation methods are not limited to mechanical means. Soil separation method may be chemical in nature.

J. Pipe String: The succession of joined individual pipes being used to advance the excavation equipment.

K. Jacking System: A system of jacks which pushes the pipe string. The extension rate is synchronized with excavation rate of the machine.

L. Intermediate Jacking Station: Hydraulic jacks installed at intermediate locations in the pipe string to allow selective advancement of discrete segments of the total pipe string.

M. Laser: An optical system projecting a beam to a target to provide guidance reference for the excavation.

N. Guidance System: Relates the actual position of the MTBM to a design reference (e.g. by a laser beam transmitted from the jacking shaft along the centerline of the pipe to a target mounted in the shield).

O. Controls: The system which synchronizes excavation, removal of excavated material, and jacking of pipe to maintain overall balance to provide complete and adequate ground support at all times.

P. Overcut: The annular space between the excavated hole and the outside diameter of the jacking pipe.

Q. Compressed Air Construction: Application of compressed air to the pipeline and heading to maintain stability in unstable ground conditions.

1.5 WORKFORCE EXPERIENCE

A. Microtunneling is deemed to be specialty contractor work. The Project Superintendent shall have:

1. At least five (5) years of tunneling/pipe jacking experience.

2. Managed at least two (2) microtunneling projects with drive lengths exceeding five hundred (500) feet.

3. Managed at least one (1) microtunneling project with soil conditions similar to this Project, at least twenty (20) feet deep measured at the invert and under a hydrostatic head of at least ten (10) feet, using equipment similar to that intended for use on this Project.

B. The MTBM operators shall have:

1. Successfully operated a MTBM similar to the one selected by the Contractor for this Project.

2. At least two thousand (2,000) feet of microtunneling experience within the past five (5) years of which one thousand (1,000) feet have been for sizes greater than or equal to thirty (30) inches J.D.

3. Operated MTBM equipment on a project with depths greater than twenty (20) feet as measured at the invert under a hydrostatic head of at least ten (10) feet using equipment similar to that intended for use on this Project.

PART 2. PRODUCTS

2.1 GROUT

A. Grout shall be used for filling the void between the installed pipe and the surrounding ground. Cement shall conform to the requirements of ASTM CISO, Type II. Grout shall have a minimum compressive strength of one hundred (100) psi attained within twenty-four (24) hours. The grout shall be fluid enough to inject through the pipe and to fill voids, however, it shall set promptly enough to keep grout flow under control.

2.2 EQUIPMENT

A. Use of experimental equipment is at Contractor's risk. Experimental equipment is defined as any equipment which has little or no historical performance data. Experimental equipment use shall require approval by the Engineer and have been used on a minimum of three (3) projects of similar magnitude. Approval of such equipment by the Engineer does not extend to means, methods, techniques, sequences, or procedures of construction. Contractor has sale responsibility for successful use of the equipment and impact on area utilities or structures.

B. Guided boring/pilot tube type equipment and methods are not permitted on the project.

2.3 MICROTUNNELING PIPE

A. Contractor is responsible for selection of the appropriate pipe and pipe joints to carry the thrust of any jacking forces or other construction loads in combination with overburden, earth and hydrostatic loads. Design of any pipe indicated on the Contract Documents considers in-place loads only and does not take into account any construction loads. The criteria for longitudinal loading (jacking forces) on the pipe and joints shall be determined by the contractor, based on the selected method of construction.

B. The jacked pipe shall be designed to withstand the thrust from the MTBM, TBM, PTMT or shield and pipe advance without damage or distortion. The propulsion jacks shall be configured so that the thrust is uniformly distributed and will not damage or distort the pipe.

C. Use pipe that is round with a smooth, even outer surface, and has joints that allow for easy connections between pipes. Pipe ends shall be designed so that jacking loads are evenly distributed around the entire pipe joint and such that point loads will not occur when the pipe is installed. Pipe used for pipe jacking shall be capable of withstanding all forces that will be imposed by the process of installation, as well as the final in-place loading conditions. Protect the driving ends of the pipe and joints against damage

PART 2. EXECUTION

3.1 PREPARATION

A. The Contractor shall be responsible for means and methods of microtunneling operations and shall ensure the safety of the Work, the Contractor's employees, the public, and adjacent property, whether public or private.

B. The Contractor shall execute microtunneling operations so that ground loss at the surface will not occur. The completed pipe shall have full bearing against earth; no voids or pockets shall be left in any portion of the Work. The

Contractor shall fill the annular space between the pipe and ground during microtunneling operations with lubricating material.

C. The Contractor shall maintain clean working conditions inside the jacking operation area and remove spoil, debris, equipment, and other material not required for operations.

D. Intermittent entry of personnel will be permitted for maintenance and removal of equipment provided that appropriate safety precautions and procedures are taken and safety equipment is functional.

3.2 MICROTUNNEL INSTALLATION AND TESTING

A. The Contractor shall inspect all pipe prior to lowering it into the drive pit to ensure that no cracked, broken, or otherwise defective materials are being used. The Contractor shall use the pipe manufacturer's recommended method for inspection or site of the Work determination for damage. Pipe delivered with visible cracks, scars, chips, or any damage in excess of the limitations specified,shall not be used. Damaged or defective pipe shall be marked as rejected and shall be promptly removed from the site of the Work.

B. The Contractor shall use proper tools and equipment to handle pipe. Slings shall be made of rope, nonmetallic webbing, or other materials that will not damage the pipe. Lifting eyes shall be used only when approved by the pipe manufacturer.

C. The Contractor shall clean ends of pipe thoroughly. The Contractor shall remove foreign matter and dirt from pipe joints during laying. The Contractor shall lubricate joints per manufacturer's recommendations.

D. Damaged pipe shall be jacked through to the receiving shaft and be removed. Other methods of repairing the damaged conduit may be used, as recommended by the manufacturer and approved by the Engineer.

E. Air testing of individual microtunnel pipe joints using low pressure air methods in compliance with the requirements of ASTM C828 shall be completed by the Contractor.

F. Hydrostatic Testing - As an alternate test procedure.

1. The Contractor shall make all arrangements for furnishing water from the nearest hydrant or other suitable source for testing purposes. The Contractor shall perform the tests and provide all hoses, tank. trucks, plugs, and other necessary equipment to conduct the test, requirements at the Contractor's option.

2. Maximum amount allowable leakage in pipes and joints shall be 0.16 gallons per hour per inch-diameter per one hundred (100) feet when field tested by exfiltration methods over a test period or one (1) hour. The hydrostatic head for test purposes shall exceed the maximum estimated

groundwater level in the section being tested by at least six (6) feet and shall be less than six (6) feet above the inside top of the highest section of pipe in the test section, including service connections. In every case, the height of the water table at the time of the test shall be determined by the Contractor from existing monitoring wells, exploratory holes, or such other methods approved by the Engineer. The Engineer will make the final decisions regarding test height for the water in the pipe section being tested. The length of pipe tested by exfiltration shall be limited so that the pressure on the invert of the lower end of the section shall not exceed thirty (30) feet of water column.

3. The pipe test section may be filled twenty-four (24) hours, or longer at the Contractor's option, prior to time of exfiltration testing and if desired to permit normal absorption of water into the pipe walls to take pace.

G. Prior to final acceptance and formal manhole-to-manhole inspection of the sewer system by the Engineer, the Contractor shall flush and clean all parts of the system. The Contractor shall remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the sewer system at or near the closest downstream manhole. If necessary, the Contractor shall use mechanical rodding or bucketing equipment.

H. Pipe and/or joints failing the test shall be jacked through to the receiving shaft and be removed. Other methods of repairing the damaged conduit may be used, as recommended by the manufacturer and approved by the Engineer.

3.3 GROUNDWATER CONTROL

A. The Contractor shall provide the necessary ground water control measures, to provide safe working conditions, and to prevent excessive inflow of water into the excavation during jacking operations.

3.4 EQUIPMENT

A. No gasoline-powered equipment will be permitted in the tunneling operation or shafts. Diesel, electrical, or air-powered equipment is acceptable, subject to applicable Federal and State regulations. The Contractor shall use diesel engines equipped with scrubbers.

B. Microtunnel Boring Machine: The Contractor shall employ equipment that will be capable of handling the various anticipated ground conditions. In addition, the MTBM, as applicable, shall:

1. Be capable of maintaining the runnel face under wet and adverse soil conditions and preventing loss of ground through the machine. The MTBM shall provide satisfactory support of the excavated face at all times.

2. Be articulated to allow steering.

3. Incorporate a suitable seal between the MTBM and the leading pipe.

4. Provide protection to the electric and hydraulic motors and operating controls against water damage.

5. Use a bidirectional drive on the cutter head wheel, and/or adjustable fins or other means, to control roll.

C. Automated Spoil Transportation: The Contractor shall provide a MTBM which includes an automated spoil transportation slurry system which shall balance the soil and ground water pressures by the use of a slurry pressure balance system. The slurry system shall be capable of adjustments required to maintain face stability for the particular soil condition to be encountered on the Project and shall monitor and continuously balance the soil and ground water pressure to prevent loss of slurry or uncontrolled soil and ground water inflow. The Contractor shall:

1. Manage the pressure at the excavation face by use of the slurry pumps (which may be of variable speeds), pressure control valves, and a flow meter.

2. Include a slurry bypass unit in the system to allow the direction of flow to be changed and isolated, as necessary.

3. Provide a separation process when using the slurry transportation system. Design the slurry system to provide adequate separation of the spoil from the slurry so that slurry with a sediment content within the limits set by the Contractor's Work Plan can be returned to the cutting face for reuse. Appropriately contain spoil at the site of the Work prior to disposal.

4. Use the type of separation process suited to the size of microtunnel being constructed the soil type being excavated, and the work space available at each work area for operating the plant.

5. Carefully monitor the composition of the slurry to maintain the slurry weight and viscosity limits defined by the Contractor's Work Plan.

D. Pipe Jacking Equipment: The Contractor shall provide a MTBM operation which includes a pipe jacking system with the following features:

1. Main jacks mounted in a jacking frame located in the jacking shaft.

2. Jacking system which successively pushes the MTBM along with a string of connected pipes toward a receiving shaft.

3. Sufficient jacking capacity to push the MTBM and the pipe string through the ground.

4. Hydraulic cylinder extension rates which are synchronized with the excavation rate of the MTBM, as determined by the soil conditions.

5. Develops a uniform distribution of jacking forces on the end of the pipe by

use of spreader rings and packing.

6. Provides and maintains a pipe lubrication system at all times to lower the friction developed on the surface of the pipe during jacking.

E. Remote Control System: The Contractor shall provide a MTBM which includes a remote control system with the following features:

1. Allows for operation of the system without the need for personnel to enter the tunnel.

2. Have a display available to the operator, at an operation console, showing the position of the shield in relation to a design reference together with other information such as face pressure, roll, pitch, complete guidance system, valve positions, thrust force, cutter head torque, rate of advance, and installed length.

3. Integrates the system of excavation and removal of spoil and its simultaneous replacement by pipe. As each pipe section is jacked forward, the control system shall synchronize all of the operational functions of the system including spoils removal, excavation, and jacking needs.

F. Active Direction Control: The Contractor shall provide a MTBM which includes an active direction control system with the following features:

1. Controls line and grade by a guidance system,

2. Is capable of maintaining grade to within ±one and one-half (1.5) inches and line to within ± two (2) inches.

3. Provides active steering information which shall be monitored and transmitted to the operating console. As a minimum, this information shall include location of the laser beam on the target, location of the cutter head, and predicted cutter head location.

4. Provides positioning and operation information to the operator on the control console.

5. Steering connections made to the pipe string shall be carried out in such a manner that the joint to joint angle of any two adjacent pipes does not exceed 0.5 degrees.

6. The MTBM display equipment shall continuously show and automatically record the position of the head with respect to the project design line and grade.

G. The Contractor shall provide portable testing equipment at the jacking station for carbon monoxide *gas,* hydrogen sulfide gas, oxygen deficiency, and explosive gases.

H. All electrical systems utilized on the MTBM shall be equipped with

appropriate ground fault systems. The Contractor shall use electrical systems that are insulated, not permitting any bare wire exposures.

I. All equipment shall be suitably insulated so as not to exceed the noise limitations stated in the Special Conditions.

J. Necessary equipment for pipe excavation shall include signal systems, fire extinguishers, safety equipment, and other equipment required by the Contractor's method of construction. Such equipment shall be maintained in good repair.

3.5 SHAFTS

A. The Contractor shall construct shafts in accordance with the requirements of Section 02563 - Access Shafts for Microtunneling.

3.6 EXCAVATION AND JACKING OF PIPE

A. Microtunnel Excavation:

1. The Contractor shall conduct microtunneling operations in accordance with applicable safety rules and regulations and use methods which include due regard for safety of workers, and protection for adjacent structures, utilities, and the public.

2. The Contractor shall keep microtunnel excavation within the easements and rights-of-way indicated on the Plans, to the lines and grades designated on the Plans.

3. The Contractor shall locate equipment powered by combustible fuels at suitable distances from shafts and protect equipment to prevent the possibility of explosion and fire in shafts or the pipe.

4. The rate of advance of the MTBM shall be matched with the rate of spoil removed to avoid over-excavating.

5. The Contractor shall make the excavation of a minimum sufficient size to permit pipe installation by jacking with allowance for injection of the lubricant into the annular space. The overcut shall not exceed one and one-half (1.5) inches. Injection of grout shall be closely monitored in the vicinity of all brick sewer crossings.

B. Pipe Jacking:

1. For jacking, the Contractor shall use pipe that is round with a smooth, even outer surface, and has joints that allow for easy connections between pipes. Pipe ends shall be designed so that jacking loads are evenly distributed around the entire pipe joint and such that point loads will not occur when the pipe is installed. Pipe used for pipe jacking shall be capable of withstanding all forces that will be imposed by the process of installation, as well as the final in-place loading conditions. The

Contractor shall protect the driving ends of the pipe and joints against damage.

2. The Contractor shall cushion pipe joints with an approved material between joints or by other methods to transmit the jacking forces without damage to the pipe or pipe joints.

3. The Contractor shall use gaskets to make the joints watertight.

4. The Contractor shall maintain an envelope of bentonite lubricant, or other similar material, around the exterior of the pipe during the jacking and excavation operation to reduce the exterior friction and possibility of the pipe seizing in place. The Contractor shall be cognizant that excessive lubricant application pressure in the vicinity of brick sewers may cause unwanted pipe damage. Water jetting of the ground to advance the pipe is not permitted.

5. If the pipe "freezes" and the Contractor is unable to move it again, the Contractor may be permitted to construct a recovery access shaft, with the location subject to review by the Engineer. The Contractor shall be solely responsible for obtaining approvals for such a recovery shaft and shall be solely responsible for costs associated with the location and construction of the shaft and for maintaining traffic and utilities in the area.

6. A lubricant shall be injected from the rear of the MTBM and, if size allows, through ports in the pipes at regular intervals to reduce friction and fill any annular space remaining from the overcut of the cutter head.

7. In the event a section of pipe is damaged during the jacking operation, or joint failure occurs, as evidenced by visible ground water inflow or other observations, the Contractor shall use one of the following procedures to correct the damage, as directed by the Engineer, at no additional cost to the City:

    a. Slightly damaged pipe which passes leakage test and maintains pipe barrel and joint structural integrity, may, if access is possible, be repaired in place with a method approved by the pipe supplier.

    b. Severely damaged pipe, or pipe where joint failure is evident, shall be removed from the excavation by jacking it through the excavation and removing it at receiving shaft.

C. Grouting:

1. The Contractor shall completely fill voids outside the limits of the excavation created by caving or collapse of earth cover over the excavation. The Contractor shall fill voids with pressure-injected sand cement grout.

2. The Contractor shall furnish and operate suitable equipment for any required grouting operations depending on the condition of the

application.

3. The Contractor shall take care in grouting operations to prevent damage to adjacent utilities or other properties. The Contractor shall grout at a pressure that will not distort or imperil any portion of the Work or existing installation or structures.

4. Immediately after jacking has been completed and all the pipe in its final position, any remaining annulus void around the periphery of the installed pipe shall be filled under pressure with grout. The Contractor shall inject grout at a sufficient pressure to attain passage along the annulus around the pipe but shall not be greater than fifty (50) psi at the injection nozzle, until no grout is being taken or the volume of grout injected exceeds the designed volume of the annular space by a factor of three (3).

3.7 CONTROL OF LINE AND GRADE

A. Construction Control:

1. The Engineer will establish the baseline and benchmarks indicated on the Plans. The Contractor shall check baseline and benchmarks at the beginning of the work and report any errors or discrepancies to the Engineer.

2. The Contractor shall use the baseline and benchmarks established by the Engineer to furnish and provide reference control lines and grades for the pipe construction. The Contractor shall establish the exact location of the microtunne1 excavation, pipe, and structures.

3. The Contractor shall establish and be responsible for accuracy of control for the construction of the entire Project, including access shaft locations, structures, excavation, pipe alignment, and grade.

4. The Contractor shall establish control points sufficiently far from the microtunnel operation not to be affected by ground movement.

5. The Contractor shall maintain daily surveying records of alignment and grade. The Contractor shall submit three (3) copies of these records to the Engineer within twenty-four (24) hours of the operation. The Contractor, however, remains fully responsible for the accuracy of its work and the correction of it, as required.

6. The Contractor shall check the primary controls for the MTBM against an above-ground undisturbed reference at least once each week and once for each two hundred fifty (250) feet of microtunnel constructed, or more often as needed or directed by the Engineer.

B. Earth Movement: The Contractor shall be responsible for damage due to settlement from any construction-induced activities.

1. The Contractor shall take precautions to avoid damage or settlement to buildings, structures, roads, or utilities in close proximity to the Work. The Contractor shall use construction methods and equipment that minimize loss of earth at the excavation face and settlement of earth around the pipe.

2. Settlement heave tolerances of structures shall be estimated and displacement criteria shall be negotiated with respective owners or agencies.

3. In the event any movement of ground is detected, the Engineer may order the work to be stopped and secured. Before proceeding, the Contractor shall correct any problems causing or resulting from such movement.

4. The Contractor shall be aware that if settlement of the ground surface should occur during construction which will affect the accuracy of the temporary benchmarks established by the Engineer, it shall be the Contractor's responsibility to detect and report such movement. The locations of the permanent monumentation benchmarks are indicated on the Plans. The Contractor may use permanent monumentation benchmarks to verify temporary benchmark accuracy. The Contractor shall advise the Engineer of any settlement affecting the permanent monumentation benchmarks. Upon completion, the field books pertaining to the monitoring of the permanent monumentation benchmarks shall be submitted to the Engineer.

C. Line and Grade

1. The Contractor shall record the exact position of the MTBM continuously to ensure the alignment is within the specified tolerances. The Contractor shall make the survey at the MTBM to allow immediate correction of misalignment before allowable tolerances are exceeded. The microtunnel guidance system may be used, however, the Contractor shall select times to measure and record this information after the air temperatures have stabilized throughout the pipe to ensure accurate readings.

2. When the excavation is off line or grade, the Contractor shall return to the design line and/or grade at a rate of not more than one {l) inch per twenty five (25) feet.

3. The Contractor shall perform a verification survey of the installed pipe from shaft to shaft after removal of the MTBM and the modified direct jack machine. The Contractor shall document measured conformance to design line and grade of the pipe together with locations and deviation (distance and direction) of any out-of-tolerance locations.

4. Acceptance criteria for the pipe shall be ± two (2) inches in horizontal alignment from the theoretical at any point between shafts, including the receiving end, and ± one and one-half (1.5) inches in elevation from the vertical.

5. If allowable tolerances are exceeded, the Contractor shall bear full responsibility and expense for correction (redesign, reconstruction, easement acquisition, etc.). If an obstruction is encountered, the Contractor shall assume full cost and responsibility for demonstrating that an obstruction exists. If redesign is required, the Contractor shall obtain the services of a professional engineer registered in the State of Mississippi for the redesign. The installed pipe must be capable of meeting the design flow and velocities for a full pipe condition. Plans showing the changes shall be submitted to the Engineer for review.

6. Pipe installed outside tolerance or which are outside the right-of-way shall be backfilled (grouted) and reconstructed within tolerance, if directed by the Engineer.

3.8 DISPOSAL OF SPOIL MATERIAL, CONSTRUCTION WATER, AND SLURRY

A. Spoil material, construction water and slurry shall be disposed of in accordance with all applicable Federal, State, and local codes, laws, regulations, ordinances, and Sections 01355 and 01356.

3.9 SETTLEMENT MONITORING

A. Settlement monitoring shall be performed for all microtunnels and modified direct jack alignments eighteen (18) inches in diameter or larger

B. The Contractor shall perform microtunneling in a manner that will minimize the movement of the ground in front of, above, and surrounding the excavation, and minimize subsidence of the surface above and in the vicinity of the excavation.

C. Settlement shall be monitored at one hundred (100) foot intervals along the pipe centerline and a minimum of twenty (20) additional locations at the various microtunnels as defmed by the Engineer.

D. Daily readings shall be taken on all monitoring points from a period five (5) days before microtunneling is initiated to establish baseline conditions, until the overall construction period is substantially complete. Such monitoring points shall be referenced to temporary benchmarks provided by the Engineer. Benchmarks and monitoring points shall be installed in such a manner as to remain in place and undisturbed for the duration of the construction and warranty periods. All survey readings shall be recorded to the nearest one-hundredth (0.01) of a foot.

E. Operations shall be stopped when monitoring points indicate a vertical change in elevation one-half (1/2) inch or more or any surface disruption is observed. The Contractor shall propose immediate action for review and approval by the Engineer to remedy the problem at no additional cost to the City.

3.10 POST-INSTALLATION INSPECTION

Contractor shall conduct closed circuit television (CCTV) inspection of the microtunnel and modified direct jack pipe installations and submit to the Engineer for review.

END OF SECTION 02562

SECTION 02563
ACCESS SHAFTS FOR MICROTUNNELING

PART 1 - GENERAL

1.1 SCOPE

A. This section includes construction, maintenance, backfilling, and restoration of access shafts for microtunneling.

B. Related Work Specified Elsewhere:

1. Section 02220 - Dewatering
2. Section 02562 - Microtunneling Construction

1.2 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

1. The Engineer will review submitted plans, details, and data for compliance with the requirements of this section. Such review shall not be construed to relieve the Contractor in any way of responsibilities under the Contract. The Contractor shall not commence work on any item requiring a submittal until the submittal has been reviewed and accepted by the Engineer.

2. All Contractor submittals requiring structural design shall be signed and sealed by a professional engineer registered in the State of Mississippi.

3. The Contractor shall submit the following items for review and approval by the Engineer:

a. Shaft configuration and design including design criteria. Allowable surcharge loads and restrictions on surcharge capacity, including live loads, shall be clearly shown on the shaft construction drawings.

b. Reaction wall design and details of exit/entry points.

c. Method of excavation and construction sequence.

d. Shaft base design.

e. Groundwater control method.

f. Plan for monitoring deflection of shaft support system and basal heave.

g. Thrust wall reaction wall design.

4. The Contractor shall submit the following items for record purposes only and will not be subject to approval by the Engineer:

    a. Safety plan for shaft access and exit, including ladders, stairs, walkways, and hoists.

    b. Protection plan against improper mechanical and hydraulic equipment operations, and for lifting and hoisting equipment and material.

    c. Lighting details.

    d. Monitoring plan for hazardous gases.

    e. Protection plan against flooding and means for emergency evacuation.

    f. Protection plan of shaft including traffic barriers, accidental or unauthorized entry, and falling objects.

    g. Safety supervision responsibilities. Description of complete safety program, including specific requirements for working in a marine environment.

5. The Contractor shall submit, to the Engineer, construction reports for each shift within twenty-four (24) hours of the operations or at least the following:

    a. Hours worked per shift, and a description of work performed.

    b. Location and brief soil descriptions of significant soil strata.

    c. Groundwater control operations.

    d. Observation of lost ground or other ground movement.

    e. Any unusual conditions or event.

    f. Operation shut-down periods or other interruptions in the work with reasons.

1.3 QUALIFICATIONS

A. The shafts are declared to be specialty contractor work. This work shall be performed by a specialty contractor, or a Prime Contractor if it has the prerequisite experience which can demonstrate that it has the experience identified in this section.

B. Successfully completed at least five (5) jacking and receiving shafts with the same support proposed for each shaft on this project within the last ten (10) years.

PART 2. PRODUCTS

2.1 EQUIPMENT

A. The Contractor shall select equipment and materials required and submit descriptions and planned method of operation and use to the Engineer. Furthermore, the Contractor shall provide safe access to the shafts at all times.

2.2 SHAFT BACKFILL

A. Earth backfill shall be in accordance with the requirements of Section 02222 - Pipeline Excavation & Backfill.

B. The base of each jacking and receiving shaft shall be backfilled with a minimum of twelve (12) inches of No. 57 stone over a woven geotextile prior to commencing microtunneling operations. Shaft base design shall be provided by the Contractor in accordance with the requirements of this section.

2.3 PIPE THRUST BLOCKS

A. Reinforced concrete thrust blocks, anchoring and pipe support shall be in accordance with the requirements of Section 03300 - Cast-In-Place Concrete.

PART 3. EXECUTION

3.1 LOCATION OF ACCESS SHAFTS

A. The location of shafts shall be based on the capabilities of the microtunneling equipment and the manhole locations on either end of the microtunneling section, and the available land provided by the Owner for the Work**. The Owner makes no guarantee that shafts will be allowed on MDOT rights-of-way between manhole locations.**

3.2 SHAFT CONSTRUCTION

A. The shaft, including bottom protection, shall be designed and constructed to an acceptable factor of safety against yield or instability as determined by the Contractor's professional engineer, and shall withstand full potential hydrostatic head without failure. All jacking and receiving shafts shall be grouted as the shaft liner is installed and at intervals not exceeding four (4) feet.

B. Special framing, bracing or shoring and seals required around the tunnel or pipe "eyes" or other penetrations shall be in-place according to shaft construction drawings before the liner or any bracing or shoring at the penetration is cut or removed.

C. The receiving shaft shall be fully supported and be of the size required for the removal of the MTBM.

D. If laser guidance is used, a dial-a-grade laser shall be positioned and supported such that it is not affected by the jacking force.

E. Any voids or seepage paths around shafts shall be immediately grouted upon detection. If liner plate is used for shaft support it shall be installed by the underpinning method and shall be grouted as the shaft liner is installed and at intervals not exceeding four (4) feet. Secondary or "back grouting" shall be carried out at the Contractors expense if ground movement, voids, or deformation of shaft liner are detected.

F. Grout pressures, either from pumping or due to head in the grout line shall be controlled so that the liner, shoring, or bracing are not overstressed. Grouting shall be carried out uniformly around the shaft.

G. The shaft design shall incorporate thrust blocks or suitable reactions needed for jacking equipment, as applicable for tunneling or jacking method.

H. The Contractor shall provide ground water control and drainage from shafts while work is in progress and until adjacent pipe joints have been properly sealed and the shaft is properly backfilled.

I. The Contractor shall divert surface water run-off from the shaft and protect the shafts from infiltration or flooding by surface water. including discharge from any dewatering operation. The shaft lining system shall at a1llocations be extended a minimum of three (3) feet above existing, adjacent ground elevation.

J. A pump shall be prepared in the base of all shafts to remove excess water.

K. The Contractor shall construct a suitable guardrail barrier around the periphery of the shaft, meeting applicable safety standards. The Contractor shall properly maintain the barrier throughout the period the shaft remains open. The Contractor shall repair broken boards, supports, and structural members. In addition, the Contractor shall provide a full cover or other security barrier for each access shaft in which there is no construction activity or which is unattended by the Contractor's personnel.

L. Upon completion of work in shafts, the Contractor shall remove all shaft supports to a minimum of five (5) feet below finished grade.

3.3 CONTINGENT RESCUE SHAFT

A. In the event the MTBM cannot advance due to large obstruction, the Contractor may require a rescue shaft. The requirement shall be approved by the Engineer.

B. The location of the rescue shaft shall be determined by the Contractor and approved by the Engineer.

C. It is the Contractor's responsibility for adequacy of design, removal, or diversion of existing utilities, construction, traffic control and safety, and maintenance.

3.4 DISPOSAL OF EXCESS MATERIAL

A. Spoil material, construction water and slurry shall be disposed of in accordance with all applicable Federal, State, and local codes, laws, regulations, ordinances.

END OF SECTION 02306

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