Development of a Standard Specification for Horizontal Directional Drilling

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Development of a Standard Specification for Horizontal Directional Drilling

—Final Report—

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January 2013

"Prepared in cooperation with the Ohio Department of Transportation and the U.S. Department of Transportation, Federal Highway Administration."

"The contents of this report reflect the views of the author(s) who is (are) responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Ohio Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation."
Horizontal Directional Drilling (HDD) has become one of the fastest-growing trenchless technology construction methods for the installation of underground pipelines and conduits. According to the board of directors of the Ohio Horizontal Directional Drilling Association (OHDDA), there are many HDD specifications employed in Ohio, and these specifications vary significantly in their content and requirements. Consequently, inferior products may have been installed, unnecessary risks may have been taken, and the competition among contractors may have been compromised. Therefore, a HDD specification that provides for high quality installations, allocates risks appropriately, and ensures correct design and installation of product pipes without damaging the roadway is needed.

The proposed draft was based on comparison of more than 12 existing HDD specifications with the HDD Good Practice Guidelines and the collective input from professional partners representing the interest of the various entities involved in a typical HDD project. The research team along with the professional partners proposed draft specification for pressurized applications with pipe diameters in the range of 4 inches (10 cm) to 24 inches (60 cm). Installations outside this range of pipe sizes and gravity installations are beyond the scope of the specification. The implementation plan for the draft specification includes ODOT review to ensure it does not conflict with other ODOT specifications, ODOT evaluation of the proposed specification through use on an actual project, feedback from the larger interest groups across the state of Ohio, and update as needed.

Keywords: Horizontal directional drilling, Specifications, drilling fluids, drilling rigs.
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ACKNOWLEDGMENTS

The authors would like to thank the Ohio Department of Transportation (ODOT) for their guidance and funding of this research endeavor as well as the technical support offered by the ODOT Subject Matter Experts, Mr. Peter Narsavage and Mr. Robert Jessberger. The Student Study Research Program allows students the opportunity to not only develop their academic research skills in order to provide solutions to real-world problems; students are also allowed to collaborate and network with transportation industry professionals.

It is also important to acknowledge and express appreciation to the special committee that was created to collaborate and offer guidance in the writing of the Development of a Standard Specification for Horizontal Directional Drilling. The Ohio Horizontal Directional Drilling Specification Committee (OHDDSC) represented various stakeholders from the horizontal directional drilling community and the dedication of their time and expertise is deeply appreciated.

Finally, we thank the Ohio Horizontal Directional Drilling Association (OHDDA) for website and teleconferencing support and the opportunity to present the research progress and findings at their annual conferences that attracts various horizontal directional drilling professionals within Ohio.
INTRODUCTION

The Ohio Department of Transportation (ODOT) and utility owners throughout the State of Ohio are grappling with an aging infrastructure and limited funding on both the state and federal level. Ohio has the fourth largest interstate system with 6,700 lane miles and the nation’s third largest total active rail miles, surpassing California in mid-2010. ODOT has the immense task of rebuilding, protecting, and preserving the state’s infrastructure while rebuilding Ohio’s roadway system that was constructed in the 1950’s and 1970’s. (Wray, 2011).

In October 2010, the Iowa Highway Research Board released its final report on the Identification of Practices, Design, Construction, and Repair Using Trenchless Technology; the research team concluded that overall trenchless technologies, horizontal directional drilling (HDD) in particular, appear to be effective methods for installing pipelines in areas where open-trenching is not desirable (Iowa Highway Research Board, 2010).

In order for Ohio to modernize its underground infrastructure, innovative technologies need to be utilized by ODOT and utility owners to provide safe and high-quality products and installations at competitive prices. Trenchless technology construction methods have been steadily growing as an alternative to open-cut excavation projects in order to accommodate the financial needs of municipalities throughout the United States and lessen the social and environmental upheaval impacts that may occur during a typical open-cut construction method (Willoughby, 2005).

Horizontal Directional Drilling (HDD) has become one of the fastest-growing trenchless technology construction methods for the installation of underground pipelines and conduits. The majority of the rapid growth in the application of HDD occurred during the last 15 years after the Telecommunications Act of 1996 (Najafi, 2010).

According to the board of directors of the Ohio Horizontal Directional Drilling Association (OHDDA), there are many HDD specifications employed in State of Ohio, and these specifications vary significantly in their content and requirements. Consequently, inferior products have been installed and unnecessary risks have been taken on by both owners and contractors. Also, the contractors of the OHDDA indicated that the lack of consistent specifications have compromised the competitive playing field among contractors, subcontractors, and suppliers. Therefore, it is necessary to create a fair HDD specification that provides guidelines for high quality installations, allocates fairly risks associated with HDD, and ensures pipes are correctly designed and installed without damaging the roadways. This fair allocation of construction risk will allow the contractors to submit more accurate bids with reduced markup to cover risk.

Contract documents contain plans and specifications that are essential to the success or failure of a HDD project. The lack of clarity within the specifications usually leads to costly disputes between the owner and contractor (Kalin, Weygant, Rosen, & Regener, 2010 and Kelleher, Kelleher Jr., & Walters, 2009). Currently the HDD industry within the United States is guided by the Horizontal Directional Drilling Good Practices Guidelines developed by D. Bennett and S. Ariaratnam in 2001 and updated in 2008 (Bennett & Ariaratnam, 2008), however specific regulations in regards to compliance do not exist (Allouche, 2002).

It is critical that the technical specifications for HDD be evaluated properly and not taken from previous projects and simply revised for the current project. It is also important that the owner’s
representative be on site to enforce the carefully crafted specifications (Woodroffe & Ariaratnam, 2008).

Development of a standard specification for HDD provides ODOT with a specification, which if utilized, will ensure a high quality product installation that fairly allocates risks associated with horizontal directional drilling.

The potential beneficiaries of the proposed HDD specifications were:

- ODOT and other public utility owners such as municipalities, cities, and counties.
- Private/public owners of utilities such as water, wastewater, gas lines, power lines, etc.
- Design engineers who are involved in the design and supervision of construction of underground utilities.
- Contractors and subcontractors who are involved in the installation of pipelines using HDD technology.
- Suppliers of equipment, pipes, and other material needed for HDD projects.

There are many other potential beneficiaries of well designed and installed pipelines using HDD that include the consumers of the water, gas, power, data carried by these conduits. Also the users (pedestrians and drivers) of the roads under which these pipes will be installed are potential beneficiaries. We can also add to this list the owners of nearby business and their customers who would be negatively impacted by the open-cut construction or problematic HDD installation.

If the proposed specification is employed by most owners and engineers in the state of Ohio, the quality of the pipelines under our highways will improve and our pavement structures will last longer—which saves funds. It is well documented by the DOT literature that cutting the pavement via open cut reduces the life of the pavement. It is also well documented that disturbance of the soil under the pavement structure reduces the pavement life. HDD, if designed and installed properly:

- Reduces the disturbance to the soil under the pavement and avoid cutting the pavement structure.
- Enhances the safety of the construction workers, highway users, pedestrians, etc.
- Reduces risk to all the project players which reduce cost to the owners and taxpayers-in the long run-via competition among contractors.
- Reduces the overall roadway construction duration because HDD work can be done at the same time as other activities on the site.

The HDD specification will serve as a fair and consistent guide to ODOT and the HDD contractor in order to ensure the quality required for a successful HDD installation that will assist ODOT in getting a higher quality product for a lower cost by reducing the contractor’s markup for risk.

**RESEARCH OBJECTIVES**

The main objective of the research project involved developing a standard specification for horizontal directional drilling. The research objective was broken down into the following goals:

1. Collect existing HDD specifications and identify the points of agreement and disagreement among the collected specifications.
2. Compare the points of disagreement with the HDD Good Practice Guidelines.
3. Survey the HDD industry to determine the value/weight of the points of disagreement within the collected specifications.
4. Collect and analyze the survey data.
5. Draft the specification and final report.

GENERAL DESCRIPTION OF RESEARCH

The work plan for the development of a standard specification for horizontal directional drilling project was broken down into the following activities that align with the goals stated previously.

GOALS 1 & 2: COLLECTION OF HDD SPECIFICATIONS & EXPANDED LITERATURE REVIEW

The research team at Bowling Green State University (BGSU) collected existing HDD specifications from the various municipalities and agencies of Ohio and other states. Table 1 shows the collected specifications; five were from Ohio and five were from outside of Ohio. The research team compared the specifications and identified major areas of agreement/disagreement. The issues of agreement in the HDD specifications were used as the foundation for the proposed specification. The issues of disagreement were analyzed and evaluated for possible inclusion in the specification. These major areas of agreement/disagreement were then compared to the HDD Good Practices Guidelines manual to narrow down the list of points of disagreement for further research.

Table 1 List of the Collected HDD Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Source</th>
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<tbody>
<tr>
<td>1. Del-Co Water</td>
<td>Ohio</td>
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<tr>
<td>2. Ohio Horizontal Boring</td>
<td>Ohio</td>
</tr>
<tr>
<td>3. CT Consultants</td>
<td>Ohio</td>
</tr>
<tr>
<td>5. Laurel Maryland HDD Specifications</td>
<td>Laurel, MD</td>
</tr>
<tr>
<td>6. City of Stow</td>
<td>Ohio</td>
</tr>
<tr>
<td>7. Hillsborough County</td>
<td>Ohio</td>
</tr>
<tr>
<td>8. Hampton Roads Planning</td>
<td>Chesapeake, VA</td>
</tr>
<tr>
<td>9. City of Lancaster</td>
<td>South Carolina</td>
</tr>
<tr>
<td>10. JEA Water &amp; Sewer</td>
<td>Jacksonville, FL</td>
</tr>
</tbody>
</table>

GOALS 3 AND 4: SURVEYING THE HDD INDUSTRY AND ANALYZING THE SURVEY DATA

The authors were supposed to develop a questionnaire to solicit the opinions of the stakeholders regarding the weight and value of the disagreed upon issues identified in the previous step. The research team identified the issues of agreement and disagreements among the collected HDD specifications. The Ohio Horizontal Directional Drilling Specification Committee (OHDDSC) was created to oversee the narrowing down of the issues of disagreement. The committee members represented the interests of different stakeholders as shown in Appendix B; it consisted
of representatives of the following: ODOT, utility owners, contractors, engineers, designers, suppliers, manufacturers, and academia. The committee discussed the issues upon which there were disagreement among the collected specifications and unanimously agreed that surveying the industry at large was not needed because the disagreed upon issues among the specifications were mostly due the nature of the specific project and were not significant in their impact as shown in the Minute of Meeting dated June 1, 2012 in Appendix C. The comparison of the disagreed upon issues is presented and discussed in the results section of the report.

The industry participation in the development and drafting of the specifications was a critical objective in order to develop a fair and standardized specification and to increase the adaptability by the owners, engineers, and contractors. The HDD industry participation is crucial for the HDD industry’s ownership of the specification. This sense of ownership is crucial for the acceptability and the employability of the specification.

GOAL 5: DRAFTING THE SPECIFICATION AND FINAL REPORT

Based on the consensus within the OHDDSC, the BGSU team wrote the first draft of the HDD standard specification. The OHDDSC reviewed the first draft and negotiated within the committee areas of disagreement and agreement in order to produce the second draft of the HDD standard specification. The second draft of the HDD standard specification was then distributed to the OHDDSC for review and consensus was reached within the committee in order to produce the final draft of the specification to be submitted to ODOT for review.

RESULTS

ANALYSIS OF COLLECTED SPECIFICATIONS

Almost all of the specifications stated that when the owner’s approval is needed on a certain item, this approval shall not relieve the contractor of the responsibility for making a satisfactory installation meeting the needed criteria/performance. The specifications allow the contractor to determine the method and techniques of installation. The exact method and techniques for completing the directionally drilled installation will be determined by the contractor, subject to the requirements of the specification.

The Drill Rig

Almost all the collected specifications had requirements for the drill rig, but eight specifications have a section titled drill rig. The directional drilling machine shall consist of a power system to rotate, push, and pull hollow drill pipe into the ground at a variable angle (one specified eight degrees) above horizontal while delivering a pressurized fluid mixture to a guidable drill head. Four specifications stated that the power system shall be self-contained with sufficient pressure and volume to power drilling operations, and another four stated that the hydraulic system shall be free of leaks. The drill rig shall be of adequate commercial size and satisfactory working condition for safe operation, and may be subject to approval by the Owner. The HDD rig shall have sufficient strength to drill the pilot hole, ream the hole to adequate diameter, and pull the carrier pipe through the hole for the length and pipe diameter indicated. Sufficient spares shall be kept on hand for any break-downs which can be reasonably anticipated. Four specifications stated that rig shall have a system to monitor and record maximum pull-back pressure during
pull-back operations. Four specifications mentioned mud motors, and stated that it shall be of adequate power to turn the required drilling tool.

Two specifications stated that the machine must be anchored to the ground to withstand the pulling, pushing, and rotating pressure required to complete the crossing and the rig shall be grounded during drilling and pull-back operations. Five specifications addressed the electrocution and electric detection systems:

- There shall be a system to detect electrical current from the drilling string and an audible alarm which automatically sounds when an electrical current is detected. (2 specifications)
- Provide equipment to guard against electrocution and alarm system on drilling equipment capable of detecting electrical current as it approaches electric lines. (1 specification)
- The system shall have an audible alarm to warn the operator if the drill head contacts electrified cables. (1 specification)
- Equipment shall be fitted with a permanent alarm system capable of detecting an electrical current. (1 specification)

Three specifications mandated that the drill pipe shall be constructed of high quality 4130 seamless tubing, grade D or better. Some variations of the wording are:

- Drill pipe shall be API steel drill pipe, Range 2, Premium Class or higher, Grade S-135 in a diameter sufficient for the torque and longitudinal loads and fluid capacities required for the Work. (1 specification)
- Only drill pipe inspected under API's Recommended Practice Specification API RP 7G within 30 Days prior to start and certified as double white band or better shall be used. (1 specification)
- Tool joints should be hardened to 32-36 RC. (2 specifications)

The Guidance System

Eight specifications mentioned that the guidance system shall be of a proven type and setup and operated by personnel trained and experienced with the system. If a magnetic guidance system is used, the operator shall be aware of any magnetic anomalies and shall consider such influences in the operation of the guidance system. Contractor shall supply all components and materials to install, operate, and maintain the guidance system. The system must be remotely steerable and permit electronic monitoring of tunnel depth and location. The system must be able to control the depth and direction of the pipe and must be accurate to a window of + 2 inches. Four specifications directly stated that the drill head shall be steerable by changing its rotation and shall provide the necessary cutting surfaces and drilling fluid jets.

An electronic walkover tracking system or a Magnetic Guidance System (MGS) probe or proven gyroscopic probe and interface shall be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation. Two specifications stated that the MGS can be wireless or wire line with surface grid verification and shall provide real time electronic data to the inspector. All daily data and project data shall be displayed on the “As Built”. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction). The system must be remotely steerable and permit electronic monitoring of drill head depth and location. Two
specifications stated that the guidance system shall be accurate to +/- 2% of the vertical depth of the borehole and capable of sensing the drill position at depths up to one hundred feet and accurate within 1.5 meters horizontally. Another one stated that the guidance system shall be accurate and calibrated to manufacturers specifications and capable of sensing the transmitter at depths up to fifty feet and accurate to 2-feet horizontally. A few go further to include electronic monitoring of horizontal and vertical drilling head location. Obtain accuracy range within one inch of actual position of pipeline. It is required to record the position readings at maximum of 10 foot intervals (some indicated 20 foot interval) and at all obstacles or other changes in soil material that may alter the direction of the drill head.

Drilling Fluids

Nine specifications have a section titled drilling fluids; five have a section titled mixing system. Seven specifications mentioned bentonite drilling mud compatible with environment. The mixing system is a self-contained, closed, boring fluid system of sufficient size (One specification stated 500 gallons) to mix and deliver boring fluid composed of bentonite clay, potable water and appropriate additives. Mixing systems shall be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure thorough mixing. Mixing systems shall continually agitate the boring fluid during boring operations. (two specifications).

Drilling fluid shall be composed of clean water and an appropriate additive. Water shall be from a clean source with a pH of 8.5 - 10 (another variation authorized source with a minimum pH of 6.0). Water of a lower pH or with excessive calcium shall be treated with the appropriate amount of sodium carbonate or equal. The water and additives shall be mixed thoroughly and be absent of any clumps or clods. No hazardous additives may be used. Boring fluid shall be maintained at a viscosity sufficient to suspend cuttings and maintain the integrity of bore wall. Waste oil or environmentally non-compatible polymers cannot be part of composition. One specification stated that unless otherwise authorized, an environmentally safe drilling fluid that does not contain bentonite shall be used for all HDD operations where drilling will be done under any stream, river or other watercourse.

Additives to drilling fluid such as drill soap, and polymers shall be environmentally safe and approved for such usage. The drilling mud shall be bentonite slurry or polymer additives or approved equal and contained and disposed of in accordance with state/federal regulations and permit conditions with no environmental risk.

One specification stated that the bentonite shall be provided as specified in API Specifications 13A. Any modification to the basic drilling fluid involving additives must describe the type of material to be used and be included in contractor’s drilling plan and presented to the owner. The owner retains the right to sample and monitor the waste drilling mud, cuttings, and water.

Operations/Procedures/Execution

All ten specifications have a section titled operations/procedures/execution. This section covers:

- Site Preparation - pre-construction survey.
- Drill Path Survey- the entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings.
Location of Utilities - the majority of the specifications require the contactor to notify all companies with underground utilities in the work area via the state or local “one-call” to obtain utility locates and verify locations.

Pipe Handling – measures to endure that the drill pipes and the product pipes are stored and handled without gauging, scratching the pipe.

Pilot Hole - the pilot hole shall be drilled along the bore path to the following tolerance areas elevation, alignment, curve radius, entry point location, exit point location, and limitations on depth.

Reaming and Pull Back – measures to ensure that the product pipe is pulled without excessive ground movement, over stressing the product pipe, inadvertent returns of drilling fluids, preventing the transfer of the soil cuttings from the face of excavation to the launching or exit points.

Testing Pipe - the majority of specifications require pressure and leakage testing for pipes. Five specifications require hydro-testing

Site Restoration

Four specifications have a section titled site restoration. Most state that following the drilling operations, the contractor shall de-mobilize equipment and restore the work-site to original condition or better. Restoration shall include paved and unpaved surfaces, shrubbery, landscaping, trees, structures, and all else encountered. Any noticeable surface defects, due to the drilling operation, shall be repaired by the contractor. All excavations will be backfilled and compacted according to other specification requirements elsewhere.

Submittal

Seven specifications mandated the contractor to submit a work plan. Six specifications have a qualifications and personnel submittal section. Four specifications requested the contractor to submit shop drawings. Three of the specifications have material, product data, and equipment submittal sections. Two specifications have record drawings and closeout submittal sections. One specification has the following sections:

- Manufacturer’s certificate: certify products meet or exceed specified requirements.
- Bore plan
- Production and as-built drawings
- Testing and quality control and assurance documentation
- Supplemental work plan requirements
- Construction records

The findings of the comparison among these ten specifications were presented in the ASCE Pipelines Engineering Conference 2012 in Miami, FL.

DRAFTING THE SPECIFICATION

One of the early issues encountered with developing the specifications for HDD is the wide range of applications in which the HDD technology is used and their different levels of challenges and risks. The specification committee decided that creating one specification that addressed all of these challenges and risks was unwise. For example, specification to address the challenges and risks associated with the Maxi-horizontal-drilling installations, which can be
several thousand feet in length and a pipe diameter larger than 24 inches, would create undue burdens on the majority of the HDD installations which are less than 24 inches in diameter. The OHDDSC developed the draft specification for pressurized applications with pipe diameters between 4 inches and 24 inches (10 cm and 61 cm). Therefore, HDD installations outside this range of pipe sizes are beyond the scope of this specification. Also, HDD installations for gravity applications are excluded from the scope of this specification.

As stated previously, the OHDDSC discussed the issues upon which there were disagreements among the collected specifications on June 1, 2012. The committee unanimously agreed that surveying the industry at large was not needed for the following reasons:

- The committee debated the issues and arrives at consensus on the topics of disagreement.
- The disagreed upon issues among the specifications were mostly due to the nature of the specific project for which the specifications was written
- The issues were not significant in their impact
- Using the Horizontal Directional Drilling Good Practices Guidelines resolved the majority of the issues.

Several meetings took place to review several drafts of the specification. The meetings minutes are included in Appendix C. Also, numerous email communications took place among the members of the committee and the research team. There were several issues that the committee decided that the specification do not need to address for various reasons. The following list presents these issues:

1. Pre-Qualifications will be moved to the Pre-Qualification for work type-of the ODOT specifications. The following paragraph is recommended to be added to the Prequalification section for HDD work:

   Qualifications: Contractor must have successfully completed work comparable in nature and scope to the required work by this project. The contractor must furnish document(s) supporting the directional drilling Contractor’s qualifications and experience of projects of a similar nominal diameter and length to the proposed project. Contractor shall submit the following information for each referenced project:

   - Name and general description of project.
   - List of key personnel.
   - Location of project.
   - Contract start and completion date.
   - Length and diameter of completed bore(s).
   - Description of pipe material.
   - Ground conditions.
   - Type of drilling equipment and installation equipment used.

2. Preconstruction survey is part of the open cut work of which HDD is part and, it is applicable here as well. In addition, it is usually conducted by the general contractor, not the HDD contractor.

3. Installing and monitoring surface and subsurface settlement points because the specification regarding monitoring ground movement is part of the open-cut work that HDD is part of and, it is applicable here as well. In addition, it is usually conducted by the General contractor, not the HDD contractor.
4. As-Built Drawings are required for the overall project of which HDD is a part of, and it is applicable here as well. Record drawings, which are sufficient for the general contractor to produce and for the engineer to verify the As-Built drawings, are mandated in the specification.

5. Quality Assurance is covered in the General Specification for the overall project that HDD is part of, and it is applicable here as well. In addition, it is usually conducted by the general contractor, not the HDD contractor.

6. Testing is covered in the specification for the overall pipe project that the HDD is part of, and it is applicable here as well. The additional testing requirement will be limited to the tracer (detection) wire.

7. Safety requirements that are to be followed are in the ODOT 100 series in the general specifications that cover the entire project. The safety section in the proposed specification covers only the items that are specific to HDD work.

8. Specifying the size of the back-reamer compared to the product pipe as indicated in the Horizontal Directional Drilling Good Practices Guidelines was eliminated on the ground that this may impact the contractor’s means and methods. The following provide helpful guidelines for the size of the back-reamer:

<table>
<thead>
<tr>
<th>Product Diameter</th>
<th>Reamed Diameter</th>
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<tbody>
<tr>
<td>&lt; 8”</td>
<td>Diameter of product + 4”</td>
</tr>
<tr>
<td>8” – 24”</td>
<td>Diameter of product x 1.5</td>
</tr>
<tr>
<td>&gt; 24”</td>
<td>Diameter of product + 12”</td>
</tr>
</tbody>
</table>

9. Testing and payment for leakage and bacteriological, locate wiring, interior lining and exterior coating, restrained joints, retainers, glands and couplings, system connections, drainage maintenance, and traffic maintenance are outside of the scope of the proposed specification. These areas are covered in other sections in specification of the overall pipe project of which HDD is a part. In addition, these activities are usually conducted by the general contractor, not the HDD subcontractor.

10. Grouting of the annulus after completion of the bore is not needed.

The specifications from other DOTs were consulted to develop the proposed draft specification. These specifications included the Florida Department of Transportation (Florida Department of Transportation, 2010) and Illinois Department of Transportation (Hashash & Javier, 2011). The BGSU team and the OHDDSC developed a draft specification for horizontal directional drilling that addressed various issues that are unique to HDD construction projects. The committee unanimously approved the proposed draft specification which is presented in Appendix A. The specification for horizontal directional drilling was drafted to become a supplemental specification and was written according to the ODOT’s specification writing guidelines.
CONCLUSIONS AND RECOMMENDATIONS

The draft specification will provide ODOT with a specification that ensures a high quality product installation that allocates risks associated with Horizontal Directional Drilling. This allocation of construction risk allows the contractors to submit more accurate bids and reduce markup to cover risk. The intended users of the proposed HDD specifications are ODOT and utility owners, design engineers, and contractors. The suppliers of equipment, pipe, and other materials needed for HDD projects will also benefit from the proposed specifications. A standard specification will enhance communication among these project partners and provide a safer environment for all users.

IMPLEMENTATION PLAN

The following activities present an implementation plan for the draft specification:

- Review the proposed specification internally within ODOT to ensure it does not conflict with other ODOT specifications.
- Work with the Ohio Horizontal Directional Drilling Association to evaluate the proposed specification through use on an actual HDD project.
- Allow the larger different interest groups across the state of Ohio (engineers, general contractors, HDD contractors, suppliers, etc.) to review the proposed specification to ensure that it is balanced to the benefit of the Ohio tax payer.
- Update and adjust as needed.

REFERENCES


APPENDIX A: DRAFT SPECIFICATION
HORIZONTAL DIRECTIONAL DRILLING

STATE OF OHIO
DEPARTMENT OF TRANSPORTATION

11/06/2012

Description
Materials
Construction
Testing
Method of Measurement
Basis of Payment

DESCRIPTION

Use Horizontal Directional Drilling (HDD) method when the plan calls for such a method to be used, or when the engineer approves using this method via a value engineering process, to furnish and install underground utility/facility/product/pipe/conduit (referred to as product pipe in the rest of this section). The installation is according to the sizes and limits shown on the plans, and specified by these technical specifications herein. The work includes all services, equipment, materials, tools, and labor for a complete and proper installation and testing.

HDD is a trenchless method for installing a product pipe. It is a multi-stage process consisting of site preparation, equipment setup, pilot bore, product pipe pulling through the drilled bore, and site restoration. Alignment of the bore is accomplished by proper orientation of the drill bit head as it is pushed through the ground by the drill rig. Orientation and tracking of the drill bit is determined by using an acceptable tracking system from a transmitter located within the drill bit head. When necessary, enlarge the pilot borehole (back reaming) to accommodate a product pipe larger than the pilot borehole size. Back ream ahead of or at the same time pulling the product pipe through the pilot borehole.

In order to minimize friction and prevent collapse of the bore hole, introduce a soil stabilizing agent (drilling fluid) into the annular bore space from the front end of the drill bit. The rotation of the bit in the soil wetted by the drilling fluid creates slurry. The slurry stabilizes the surrounding soil, prevents the bore hole from collapsing, and provides lubrication. Select or design the drilling fluids for the site’s specific soil and ground water conditions. Confine free flowing (escaping) slurry or drilling fluids at the ground surface during pull back or drilling.
MATERIALS

Product Pipe

Select the product pipe material according to the type of product indicated on the plans. The product pipe must comply with all applicable ODOT specification sections and ASTM standards depending on the purpose and material of the product pipe. Join the pipe sections so that the joined pipe sections are installable using HDD. Ensure that the joined product pipes have adequate strength and flexibility to withstand the installation stresses, overburden pressures, and operating pressures without compromising the structural stability of the pipe wall. Ensure that the product pipe meets the bend radius required for the proposed installation. Join the pipe sections so that the inner surfaces are flush and even.

The following material standards are the minimum in place standards.

<table>
<thead>
<tr>
<th>Material Standards for HDD Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material Type</td>
</tr>
<tr>
<td>Polyethylene (PE)</td>
</tr>
<tr>
<td>High Density Polyethylene (HDPE)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Polyvinyl-Chloride (PVC)</td>
</tr>
<tr>
<td>Steel</td>
</tr>
</tbody>
</table>

(1) No hydrostatic test required
(2) Dimensional tolerances only

Detection Wire: Electronic detection material for non-conductive piping products. Select tracer wire designed for HDD to conductively locate underground utility lines according to ASTM D-1248. Use either a continuous green sheathed solid conductor copper wire line (minimum #12 AWG for external placement) or a coated conductive tape. Select a minimum 12-gauge copper clad steel wire and able to withstand the installation tension along the entire length of the line.

CONSTRUCTION

Submittals

Work Plan: Prior to beginning work, submit to the Engineer a Work Plan detailing the procedure and schedule to execute the project. The work plan will be comprehensive, realistic, and based on actual working conditions for this particular project. The work plan documents the planning required to successfully complete the project. The work plan includes complete descriptions of proposed plans, procedures, equipment, personnel, and if applicable, supporting material, for the following:

- Drilling operations: describe the pilot hole drilling procedure, the reaming operation, the pullback procedure, and illustrate the plan
- Profile of the bore plotted at a scale appropriate for the crossing and acceptable to the Engineer.
- HDD site layout including entry and exit points.
• Directional drilling equipment list includes: drilling rig, drill bit, back-reamer, mud mixing and pumping systems, down-hole tools, guidance system, and rig safety system. Provide calibration records for guidance equipment.
• Drilling fluid management plan: drilling fluid types and specifications, cleaning and recycling equipment, estimated flow rates, procedures for minimizing drilling fluid escape, and the method/location for final disposal of waste drilling fluids. Provide the MSDS for all drilling fluid additives that will be used.
• Pipe storage and handling details.
• Pipeline assembly and installation procedures.
• MSDS of any potentially hazardous substances to be used.
• Contingency plans for possible problems.

Submit supporting calculations, certifications, or material demonstrating the strength of the product pipes for acceptance before the beginning of the installation. Submit for the Engineer’s acceptance prior to construction, other product pipe material than those listed on the plans. Demonstrate that the proposed material satisfies the purpose of the utility and withstands the design and construction stresses and pressures.

If site conditions change and require modification to the work plan, resubmit revised drilling plans to achieve successful installation. Explain, in the revised submittal, the anticipated and encountered conditions that mandated the change in plans.

**Daily Reports and Operator Logs**

Submit the Daily Reports to the Engineer within 24 hours. Include, in the Daily Reports, log of boring operations and guidance system for each drill rod added or withdrawn during drilling, reaming, and pullback. The log covers downhole tools and equipment in use, drilling fluid, fluid pumping rate, drilling head location. Cover, in the report, details of and perceived reasons for any unusual events and delays greater than one hour excluding normal breaks.

**Record Drawings**

At the completion of the HDD product pipe installation, the general contractor will provide the Engineer marked up plans noting all deviations from the plans that result in change of location, material, type or size of work guided by the boring operations and guidance system log. Post, on the drawing, the x, y, and z coordinates of the starting and ending points of the line at minimum. Include in the marked up plans, the station number or reference to a permanent structure within the project right-of-way, name of person collecting data, including title, position and company name, detection method used, and elevations and offset dimensions. Certify the accuracy of the drawing to the capability of the tracking system. If the HDD contractor is the general contractor, the HDD contractor provides the Engineer with the marked up plans.

**Installation**

**Site Preparation**: Prior to any alterations to worksite, walk the area prior to the commencement of the HDD project and visually inspect the site for potential problems.

**Utility Location**: Contact the Ohio Utilities Protection Service (OUPS) at 1-800-362-2764 or 8-1-1 and contact the Oil & Gas Producers Underground Protection Service (OGPUPS) by dialing 1-800-825-0988 or 8-1-1 at least 48 hours, but no more than 10 working days (excluding weekends and legal holidays) before beginning work. Explore and locate existing underground
utilities in the areas of Work. Verify the exact physical location and depth of existing utilities by exposing as needed. If utilities are to remain in place, provide adequate means of protecting the utility during excavation operations. Should uncharted or incorrectly charted piping or other utilities be encountered during the utility exploration, contact the Owner of the utilities and the ODOT Representative in the field. Contractor is responsible for repairing damaged utilities to the satisfaction of the utility owner in accordance to the Ohio revised code 153.64 Protecting underground utility facilities during construction of public improvement and 3781.25 One-call utility protection service definitions. If the utility was accurately marked by the utility locator or on the drawing, repair it at no additional cost. If the damaged utility was not accurately marked by the utility locator or on the drawing, owner adjusts the contract value and/or time accordingly. Follow the additional instructions in section105.07 Cooperation with Utilities of the Ohio Department of Transportation Construction and Material Specifications for cooperation with utilities.

Take control of the HDD operation at all times. Have a representative who is thoroughly knowledgeable of the equipment, boring and the owner procedures, present at the job site during the entire installation and available to address immediate concerns and emergency operations. Notify the Engineer 48 hours in advance of starting work. Do not begin installation until the Engineer is present at the job site and agrees that proper preparations have been made.

**EQUIPMENT REQUIREMENTS**

Match the HDD drill rig and its auxiliary pieces of equipment to the diameter and length of product pipe being installed and ensure that the drill rod can meet the bend radius required for the proposed installation. The directional drilling machine consist of a power system to rotate, push and pull back hollow drill pipe into the ground at variable angles while delivering a pressurized fluid mixture to a guidable drill head (bit). Select/design the power system to provide sufficient pressure to power the drilling operations through a leak-free hydraulic system. Anchor the directional drilling machine to the ground to withstand the pulling, pushing, and rotating pressure required to complete the HDD installation.

Select a drilling fluid mixing system that is self-contained and closed with sufficient size to mix and deliver drilling fluid to the drill bit. The mixing system will continually agitate the drilling fluid during drilling operations. Select fluids delivery system capable of pumping drilling fluid with sufficient volume and pressure from the mixing tank through the drill rods to the drill head (bit).

Minimize potential damage from soil displacement/settlement/heave by limiting the borehole diameter compared to the product pipe. Select the back-reamer size so it creates a large enough borehole to allow cuttings to transfer from the face of excavation to the surface with a minimum soil displacement.

**Guidance System**

Unless it is specified on the plan, select an acceptable guidance system to locate and track continuously and accurately the drill head during the pilot bore. The guidance system must be capable of tracking the drill bit in the expected underground environment and at the depth shown on the plans. The acceptable methods include: walkover, wire line, Magnetic Guidance System (MGS) probe, proven (non-experimental) gyroscopic probe, or any other system as accepted by
the Engineer. Select the guidance system and the drill rig to deliver the required horizontal and vertical accuracy required for the product pipe. Use a locating and tracking system capable of ensuring that the proposed installation is executed as intended. If signal interference is encountered that significantly affects the ability to accurately track the drill bit, the Engineer may specify the use of a suitable tracking system. If the owner informs the contractor about signal interference or it is reasonable to expect interference at the site prior to bidding; select a suitable tracking system without extra cost to the owner; otherwise the owner adjusts the contract value and time accordingly. Select the locating and tracking system to provide information on: (a) Clock and pitch information (b) depth (c) transmitter temperature (d) battery status (e) position (x,y) (f) azimuth, where direct overhead readings (walkover) are not possible (i.e. subaqueous or limited access transportation facility). Ensure proper calibration of all equipment before commencing directional drilling operation. Take necessary measures to ensure accurate record drawing. Install all facilities such that their location can be readily determined by electronic designation after installation.

**Drilling Fluids**

Use a drilling fluids mixture composed of potable water and stabilizing agent - usually bentonite and/or polymer and/or appropriate additives continuously pumped to the drill bit. Design/select the drilling fluid: to transport the spoils; maintain temperatures of bits and transmitter; clean cuttings from drill bit and reamers; reduce friction, pullback, and torque on drill rods and product pipe; stabilize the borehole; control ground water pressure; and reduce migration of drilling fluids in soil. Use water with pH between 7.5 and 10 and free of chlorine with calcium < 100ppm, sodium chloride < 500ppm, and chlorine < 50ppm. Hard water may be treated with soda ash to reach the required pH. Design the quantity and the mixture of drilling fluids to perform the preceding functions in the expected soil. Vary the fluid viscosity to best fit the encountered soil conditions. Do not use any other chemicals or polymer surfactants in the drilling fluid without written consent from the Engineer. Certify to the Engineer in writing that any added chemicals are environmentally safe and not harmful or corrosive to the product pipe and the environment. Approvals and permits are required for obtaining water from such sources as streams, rivers, ponds or fire hydrants. Any water source used other than potable water requires a pH test.

**Drilling Operations**

Prior to the start of the boring operation, survey the work site with x, y, z coordinates at control point at 100/LF intervals at minimum along the planned bore path. Provide stakes at offset distances (left or right) from the centerline at these control points and at all known existing utility crossings. Submit this information to the owner at least 24 hours before the start of pilot bore operations.

Drill the pilot hole along the path shown on the plans and profile drawings within the allowable tolerance of the type of utility. Provide and maintain instrumentation necessary to accurately locate the pilot hole (both horizontal and vertical placements). Ensure adequate removal of soil cuttings and stability of the bore hole by monitoring the drilling fluids parameters such as the pumping rate, pressures, viscosity and density during the pilot bore, back reaming, and product pipe installation. Relief holes can be used as necessary to relieve excess pressure down hole. Obtain the Engineer’s approval of the location and all conditions necessary to construct relief
holes. Maintain proper disposition of drilling fluids and minimize inconvenience to other facility users.

To minimize heaving during pull back, determine the pullback rate in order to maximize the removal of soil cuttings without building excess down hole pressure. Contain excess drilling fluids at entry and exit points until the recycle, vacuum, or removal from the site during drilling operations. Ensure that entry and exit containments are of sufficient size to contain the expected return of drilling fluids and soil cuttings. Carry out excavation and backfill for entry, exit, recovery pits, connection pits, slurry sump pits, or any other excavation as specified in Section 611.

Ensure that all drilling fluids are disposed of or recycled in a manner acceptable to the appropriate local, state, or federal regulatory agencies. When drilling in contaminated ground, test the drilling fluid for contamination and appropriately dispose of it. The Engineer will adjust the contract value and/or time if the contractor was not notified about the contamination during the bidding phase. Remove any excess material upon completion of the bore. Contact the Engineer immediately if it becomes evident that the soil is contaminated in the drilling process. Do not continue drilling without the Engineer’s consent.

Install all facilities such that their location can be readily determined by electronic designation after installation. For non-conductive installations, attach a continuous conductive tracking (tracer wire) materials, either externally, internally or integral with the product. Tracking conductors must extend two feet beyond bore termini. Test conductors for continuity.

Within 48 hours of completing the installation, clean the work site of all excess slurry or spoils, de-mobilize equipment, and ensure that the site is safe and secured.

Environmental Protection. Take all necessary measures to eliminate the discharge of water, drilling mud, and cuttings to nearby waterways during the HDD work. If applicable, provide equipment and procedures to maximize the recirculation or reuse of drilling mud to minimize waste. Follow section 107.19 Environmental Protection of the Ohio Department of Transportation Construction and Material Specifications for environmental protection requirements.

Damage Restoration: Take responsibility for restoration of any damage caused by heaving, settlement, separation of pavement, escaping drilling fluid, or from the directional drilling operation. If the negligence of the contractor causes damage to any facility, restore the facility to its original conditions or better at no additional cost to the Department. Follow sections 104.04 and 107.10 of the Construction and Material Specifications for other requirements regarding clean up and restoration. When remediation plans are required by the Engineer, provide detailed and acceptable-by-the-Engineer plans showing how the damage will be remedied before any work proceeds.

TESTING

Upon completion of the directional bore, test tracer wire continuity for each bore before acceptance.
METHOD OF MEASUREMENT

The Department will measure installed product by the number of feet (meters) in place measured from center-to-center of appurtenant small structures, connection points, or between open ends inclusive of lengths of pipe bends and branches. The Department will not deduct for catch basins, inlets, or manholes that are 6 feet (2 m) or less across, measured in the direction of flow. Where the location of an appurtenance, connection point, or an open end is changed with the approval of the Engineer, the Department will measure the length placed.

BASIS OF PAYMENT

The Department will fully compensate the contractor for all work specified, including furnishing and installing product pipe, from plan point of beginning to plan point of ending at plan depth, removal of excavated materials and spoils, removal and disposal of drilling fluids, backfilling, and complete restoration of the site according to the unit prices submitted in the bid. The price covers all other related incidental work and materials including layout and reference points, fence and shrub restoration, locate wiring and testing. The cost of the bore includes the furnishing and installing detection wire or tape. No payment will be made for failed bore paths, injection of flowable fill, products taken out of service or incomplete installations due to fault of the contractor.

No payment will be made for the HDD work until the daily boring logs has been delivered to the Engineer. After the Engineer’s acceptance of the daily boring logs, payment will be made in the amount of 90% of the unit price bid for the HDD work. The remaining 10% of the unit price bid will be made after submittal of record drawings in accordance with ODOT requirements.

Payment will be made under: Item No. #### Directional Bore - per foot (meter) for each diameter and pipe material.
## APPENDIX B: OHIO HORIZONTAL DIRECTIONAL DRILLING SPECIFICATION (OHDDSC) COMMITTEE MEMBERS

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Job Description</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Alan Atalah</td>
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<td>S&amp;S directional Drilling</td>
<td>Contractor Project Manager</td>
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<td>Executive Director</td>
<td><a href="mailto:director@ohiohdd.com">director@ohiohdd.com</a></td>
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<tr>
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<td>OUPS</td>
<td>Service Coordinator</td>
<td><a href="mailto:chuckg@oups.org">chuckg@oups.org</a></td>
</tr>
<tr>
<td>Sandria Brown</td>
<td>Bowling Green State University</td>
<td>BGSU Graduate Researcher</td>
<td><a href="mailto:sandrib@bgsu.edu">sandrib@bgsu.edu</a></td>
</tr>
</tbody>
</table>
APPENDIX C: MINUTES OF MEETINGS

ODOT DISTRICT OFFICES IN CLEVELAND, OHIO JUNE 1, 2012 | 9 AM-12 PM |

Committee Members Present:
Sandria B. (BGSU- Graduate Student Research)
Dr. Atalah (BGSU-Primary Investigator)
Peter N. (ODOT- Subject Matter Expert)
Chris H. (ODOT-District Utilities Coordinator)
Brian W. (Contractor Rep. OHDDA)
Ryan S. (Designer/Engineer)
Dustin S (Contractor Rep. OHDDA) Via Telephone Conference

Friday’s Meeting Critical Update:
I will be sending out a separate email with a more detailed review of the Friday Specification Committee Meeting Minutes. The success of the three hour meeting included a major change within the methodology of the research.

➢ The original plan to distribute a survey to solicit the opinion of the stakeholders regarding the weight and value of the disagreed issues will no longer be necessary due to the committee’s ability to debate and arrive at consensus on topics of disagreement within committee. (Awesome Job Members!)

Introduction of Committee & Conference Update

✔ Dr. Atalah & Sandy will be presenting at the ASCE Pipelines 2012 Conference in Miami on Monday, August 20, 2012. The conference topic is: Analyzing Existing Specifications for Developing Horizontal Directional Drilling Specification

ODOT & BGSU Schedule of Work

The following link is an overview of the Student Study Research Project that the Ohio Department of Transportation sponsors:
http://www.dot.state.oh.us/Divisions/Planning/SPR/Research/RFP/Pages/Student-Study-Program.aspx

The ODOT Quarterly Report is due within 30 days of the June 30, 2012 deadline. This report will outline our progress and the updated research methodology.

ODOT Spec. Overview Goals & Committee Responsibilities

Brief overview of the Specifications. This information will also need to be updated now that the survey has been eliminated.

Good Practices Guidelines for HDD
Committee reviewed this section. The Committee removed the following:

1. Installing and monitoring settlement points
2. Grouting of the annulus after completion of the bore

Sandria will report back to the committee via email what the guidelines specifically mean by: Installing and removing conductor casing. She will also report back information regarding excessive ground movements.

**Our ODOT Subject Matter Expert-Peter reported back the following information regarding:**

1. Environmental protection, such as Storm Water Prevention Plans
2. Record drawings
3. Site restoration.

1) For the SWPP and other environmental protections, I would simply say the following. "Refer to 107.19 of the Construction and Material Specifications for environmental protection requirements."

2) I am still not sure we should be requiring record drawings, but if we do, I recommend the following text. "Submit record drawings which show all deviations from the plans that result in a change of location, material, type or size of work. Also show the location of subsurface features (utilities, obstructions, etc.) encountered during the work but those are not shown in the plans or are shown in a different location."

3) I recommend the following. "Restore all areas affected by the work to the condition that existed before starting the work. Perform the restoration at no expense to the Department. Refer to 104.04 and 107.10 of the Construction and Material Specifications for other requirements regarding clean up and restoration.

**As-Builts/Operator Logs**

**Agreed Areas:**

1. Contractor shall maintain a daily project log of boring operations and a guidance system log with a copy given to Engineer at completion of project. As-built drawings shall be certified as to accuracy by contractor.

2. The MGS data shall be recorded during the actual crossing operation. The Contractor shall furnish as-built plan and profile drawing based on these recordings showing the actual location horizontally and vertically of the installation, and all utility facilities found during the installation. The MGS data shall be certified accurate by the Contractor to the capability of the MGS System.

3. Daily Reports submitted within 24 hours of completion and shall include for each drill rod added or withdrawn during drilling, pre-reaming, and pullback: Downhole tools and equipment in use, description of ground conditions encountered, drilling fluid, fluid pumping rate, max and min downhole fluid pressures, drilling head location: every 50 feet along the bore path, details and perceived reason for delays greater than one hour other than normal breaks and shift changes, details of any unusual or events.
Area Removed:
Third-party verification of as-built drawings shall be completed and certified by the Ohio registered professional surveyor and mapped at Contractors expense in a form as required by Engineer.

Quality Assurance
Covered in the General Specification, will not be covered in HDD Spec.

Testing
Will compare two specifications related to tracer wire.

Contractor Experience
Depend on number of projects of similar scope.

Drill Rig
Clarification will be given for a generalized description that will go into the submittals.

Safety
ODOT would refer back to 100 series in general spec. that covers the entire project. The safety should cover items that are specific to HDD work.

Drilling Fluid Plan
Committee agreed that this section will be rewritten in specification language and placed in the submittal phase based on the Good Practices Guidelines.

The next meeting will be a review of the draft specification. I will update you on our progress and an update of the change in methodology. I will need to change the schedule as well.
OHDDSC MEETING ON SEPT. 6, 2012
9am-12pm Bowling Green State University

Meeting Attendees:
Christopher Hibbet-ODOT District 2 Utilities Coordinator
Dr. Atalah - Bowling Green State University & Ohio Horizontal Directional Drilling Association Technical Expert
Robert Jessberger-ODOT Subject Matter Expert
Brian Willis-Precision Directional Boring Lead Estimator & Ohio Horizontal Directional Drilling Association President
Ryan Schuster-URS Senior Project Engineer & Ohio Horizontal Directional Drilling Association Board Member
Sandria Brown-Student Researcher & Ohio Horizontal Directional Drilling Association Student Board Member

Meeting Overview
Committee received an email from Brian Dorwart right before the meeting with his comments. Please see the EndNotes for his comments.

ODOT Writing Style: The specification will need to reflect the Active Voice-Imperative Mood & when the Imperative Mood is not appropriate the Indicative Mood will be utilized.

Definitions: Some items will be clarified in the Draft 2 Copy

Detection Wire will be 12-gauge copper clad steel, not 10-gauge.

Materials Section: Will need to be revised and updated and reflect all material for HDD.

Contractor Qualifications:
Many of the specifications that were reviewed for this project specified Contractor Qualifications within the specifications.

Robert (ODOT Subject Matter Expert): Contractor Qualifications are not written into ODOT specifications. The Qualifications would need to become a part of the Pre-Qualification Process & a work type would be assigned to Horizontal Directional Drilling.

Sandria will be addressing this issue in committee during the week of Sept. 17-21.

The Committee discussed at length the proposed Contractor qualifications for Horizontal Directional Drilling & the process for becoming Pre-Qualified with the Ohio Department of Transportation. The proposed language will need to be readdressed at an upcoming meeting and determine if the current language is strong enough. Robert (ODOT Subject
Matter Expert) believed the wording was not strong enough and the discussion was tabled. Sandria will be addressing this issue in committee during the week of Sept. 17-21.

The term As-Builts and The Contractor shall furnish as-built plan and profile drawing based on these recordings showing the actual location horizontally and vertically of the installation, and all utility facilities found during the installation was removed from the specification.

The current wording of the Safety Requirements & Precautions and Refer to 638.19 of the Ohio Department of Transportation Construction and Material Specifications for requirements regarding method of measurement was removed from the specification.

Testing and The Basis of Payment will need to be reviewed & updated. Sandria will be addressing this issue in committee during the week of Sept. 17-21.

EndNotes:
Brian Dorwart’s Email:

- Quick comment on definitions – they use both a definition of the part and purpose of item. Suggest one format with purpose then part description.
- Drill fluid does not always need to be circulated it can be a lubrication only for small drills.
- Can use foam for drills along with air pressure and polymers but product needs to be matched to the ground.
- Need to include the minimum data base that is required for a contractor to bid and do the work to keep all bidders on the same footing.
- Need to have a clear purpose of the drill and what is considered an acceptable installation with tolerances and performance to be job specific and filled in for each project by owner/engineer.
- I will provide additional comments from me and the NTA within the next week or so.
**OHDDSC MEETING NOTES SEPT. 14 ODOT COLUMBUS, OHIO**

**Meeting Attendees:**
Christopher Hibbett-ODOT District 2 Utilities Coordinator  
Dr. Atalah-Bowling Green State University & Ohio Horizontal Directional Drilling Association Technical Expert  
Robert Jessberger-ODOT Subject Matter Expert Substitute  
Homer Suter-ODOT Subject Matter Expert Substitute  
Brian Willis-Precision Directional Boring Lead Estimator & Ohio Horizontal Directional Drilling Association President  
Ryan Schuster-URS Senior Project Engineer & Ohio Horizontal Directional Drilling Association Board Member  
Sandria Brown-Student Researcher & Ohio Horizontal Directional Drilling Association Student Board Member

**Meeting Overview**

Discussion regarding project timeline and scheduling of regular meetings.

Draft Copy 2 Spec. & Committee Meeting Notes will be shared via Google Doc.

Sandria will contact committee members on Tuesday to check schedule availability for phone conference on Friday, Sept. 21, 2012

Discussion regarding ODOT 4 month review period-Executive Draft Report and finalized spec. project.

Discussion regarding Materials & the possibility of a Material Spec. & statement regarding pipe material.


The ODOT Subject Matter Expert Robert will be on vacation for the next several weeks and his substitute is Homer (Traffic Specification Committee) and will be available for any ODOT related questions or concerns.

Discussion of 603 from Spec. Book. Identify all materials for Horizontal Directional Drilling. List of appropriate products for the materials section.

Committee will decide on material listing and it must be suitable for horizontal directional drilling application and must be able to withstand the tension and be able to deliver the function.

Detection Wire Section updated to 12-gauge.

ODOT 625.14
Drilling fluid and the composition is part of the means and methods of construction. The performance criteria should be outlined. Contractor will submit a mud plan and the drilling fluid is acceptable for the soil conditions.

ODOT does not use the terminology approve, instead the word acceptance is utilized.

Proposed Pre-Qualification & further study regarding materials will be submitted in the research project.
Greetings Again Specification Committee Members,

Teleconferencing Information is always the same that is provided by the OHDDA.

I will be Skyping (Skype Name: SandriaSays) & in the Google hangout (sandria.brown71@gmail.com) during our teleconferencing meeting for video chat as well.

I will be available starting at 8:30 am for any questions or to assist in uploading comments or suggestions prior to the meeting.

**Agenda**

- Committee Meeting Notes & Update ODOT Project by Sandria
- Newly Reformatted & Updated Draft Copy 2 by Dr. Atalah
- Final Revision Edits for Draft Copy 2 by Committee
- Schedule final meetings before Oct. 3, 2012 Deadline by Committee
- Questions & Issues for Discussion by Committee
- Adjournment

Thank you for your time and consideration and for serving on the OHDDSC.

Greetings Specification Committee Members,

We are making great progress and I am so excited about the level of participation, keep up the good work!

**AGENDA FOR OHDDSC WEDNESDAY, SEPTEMBER 26, 2012**

- Brief Update from Sandria regarding any ODOT project related issues and committee concerns
- Draft Copy 2 Revisions
  - Quick Review of Final Revisions from the last committee meeting
  - Starting Point for Revisions: Utility Locates
- Scheduling of any additional meetings

Greetings Specification Committee Members,

We are making great progress, we have reviewed roughly 90% of the Draft Copy 2.

**AGENDA FOR OHDDSC MONDAY, OCTOBER 1, 2012 9:30AM-11:30AM**

- Brief Update from Sandria regarding any ODOT project related issues and committee concerns
• Draft Copy 2 Revisions
  o Quick Review of Final Revisions from the last committee meeting
  o Starting Point for Revisions: Testing
• Adjournment
## APPENDIX D: COMPARISON OF THE TEN SPECIFICATIONS

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<td>Del-Co Water</td>
<td>1. Boring shall proceed by creating a pilot drilled hole guided by a drill head capable of being steered in the direction desired. 2. A tracking system shall allow the location and depth of the bore head by a manually operated overhead receiver. Document the locations and depth of the drill head at minimum 20-foot intervals and at all obstacles or other changes in soil material that may alter the direction of the drill head. 3. Jet fluid, mechanical cutting, or a combination of both shall be utilized in the boring operation. 4. Pullback head shall prevent soil, drilling mud or other material from entering the pipe. 5. Multiple passes of reaming and pullback may be used to gradually enlarge the size of the borehole to permit the installation of the pipe. 6. Drill the borehole to the size required to permit installation of the pipe. 7. Do not exceed maximum pipe deflection as recommended by the pipe manufacturer.</td>
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|                 | 1. Protection of Persons and Property  
|                 | a. Barricade open excavations occurring as part of this Work and post with warning lights. Operate warning lights during hours from dusk to dawn each day and as otherwise required by state or local agencies.  
|                 | b. Protect structures, utilities, sidewalks, pavements, and other properties from damages caused by settlement, vibrations, lateral movement, undermining, washout and other hazards created by excavation operations.  
|                 | c. Comply with the requirements of all agencies having traffic control authority.  
|                 | d. Protect trees and other plants from damage that are to not to be disturbed.  
|                 | e. Restore damaged improvements including drainage tile to their original condition, acceptable to parties having jurisdictional ownership. |
|                 | 2. Existing Utilities Protection  
|                 | a. Locate existing underground utilities in the areas of Work. If utilities are to remain in place, provide adequate means of protecting during excavation operations.  
|                 | b. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the Owner immediately. Cooperate with the Owner and public or private utility companies in keeping their respective services and facilities in operation. Repair damaged utilities to the satisfaction of the utility owner.  
|                 | c. Do not interrupt existing utilities occupied and used by the Owner or others, except when permitted in writing, and then only after acceptable temporary utility services have been provided. Methods and procedures shall conform to the requirements and recommendations of ASTM F1962, Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstructions, Including River Crossings and referenced standards. |

| Ohio Horizontal Boring | A. Verify existing conditions under provisions of Section 01300. PREPARATION |

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<td>A. Identify required lines, levels, contours and datum locations.</td>
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<td>B. Locate so as not to interfere with underground utility line, Identify and protect utilities that remain from damage.</td>
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<td>Notify utility company to remove and relocate utilities.</td>
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<td>Protect and/or replace plant life, and other features remaining as a portion of final landscaping.</td>
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<td>Protect and/or replace benchmarks, survey control points, existing structures, fences, sidewalks, paving and curbs from excavating equipment and vehicular traffic.</td>
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<td>Route piping in straight line.</td>
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<td>The Contractor shall install the pipelines by means of horizontal directional boring. The Contractor shall assemble, support, and pretest the pipeline prior to installation in the directional drill tunnel.</td>
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<td>Horizontal directional boring shall consist of the drilling of a small diameter pilot hole from one end of the alignment to the other, followed by enlarging the hole diameter for the pipeline insertion. The exact method and techniques for completing the directionally drilled installation will be determined by the Contractor, subject to the requirements of these Specifications.</td>
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<td>The required piping shall be assembled in a manner that does not obstruct adjacent roadways or public activities. The Contractor shall erect temporary fencing around the entry and exit pipe staging areas. If installed as a casing pipe per the Drawings, after the carrier pipe is installed void spaces between the pipes shall be completely filled with a sand and cement mixture or grout. Fill shall be placed pneumatically through a discharge pipe entered into the hole and withdrawn as the void spaces are filled.</td>
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<td>1. Casing Spacers: The Contractor shall furnish and install a Ranger II® boltless casing spacer or equivalent, on the carrier pipe. Casing spacers shall be spaced a maximum of eight feet apart along the length of the carrier pipe with one casing spacer within two (2) feet of each side of a pipe joint and the rest evenly spaced. Wood Skids are not an acceptable method of supporting the carrier pipe.</td>
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<td>2. a. Casing Spacers shall be all non-metallic (polypropylene), molded in segments for field assembly without any special tools. Spacer segments shall be secured around carrier pipe by insertion of a Slide-Lock. The casing spacer polymer shall contain ultraviolet inhibitors and shall have a minimum compressive strength of 3,000 psi, an 800 Volts/mil dielectric strength and impact strength of 1.5 ft.-lbs./inch. Each casing spacer shall have full length integrally molded skids extending beyond the bell or mechanical joint of the carrier pipe.</td>
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<td>Casing End Seals: Flexible S-shaped seals fabricated of 1/8” thick synthetic rubber with 304 stainless steel bands and clamps with worn screws. PSI Model S Standard Pull-on end seals manufactured by PSI-Pipeline Seal and Insulator, Inc. or approved equal</td>
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<td>CT Consultants INSTALLATION</td>
<td>A. The Engineer must be notified three days in advance of starting work. The Directional Bore shall not begin until the Engineer is present at the job site and agrees that proper preparations for the operation have been made. The Engineer approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract.</td>
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<td>B. The drawings show existing utilities that are believed to be near the directional drill alignment. There is no guarantee that these utilities are located as shown or that other utilities may not be present. The Contractor is to field locate existing utilities in advance of the work so as not to delay work and to avoid conflict or disruption of utility services.</td>
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<td>DRILLING PROCEDURE</td>
<td>A. The work site within right-of-way as indicated on drawings shall be graded or filled to provide a level working area. No alterations beyond what is required for operations are to be made. The Contractor shall confine all activities to designated work areas.</td>
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<td>B. The entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings. If the Contractor is using a magnetic guidance system, drill path shall be surveyed for any surface geo-magnetic variations or anomalies. C. The Contractor shall adhere to all applicable state, federal, and local safety regulations, and all operations shall be conducted in a safe manner.</td>
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<td>D. Pipe lengths shall be connected together in one length if space permits. Pipe shall be placed on pipe rollers before pulling into bore hole with rollers spaced close enough to prevent excessive sagging of pipe. E. The pilot hole shall be drilled on bore path with no deviations greater than 5% of depth over a length of 100 feet. In the event that pilot does deviate from bore path more than 5%, the Contractor shall notify Engineer and Engineer may require Contractor to pull-back and re-drill from the location along bore path before the deviation. Upon successful completion of pilot hole, the Contractor shall ream bore hole to a minimum of 25% greater than outside diameter of pipe bell for straight pulls and 50% greater for curved or radius pulls using the appropriate tools. Contractor shall have the option to pre-ream or ream and pull back pipe in one operation if conditions allow. The Contractor shall not attempt to ream at one time more than the drilling equipment and mud system are designed to safely handle. G. After successfully reaming bore hole to the required diameter, the Contractor shall</td>
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pull the pipe through the bore hole. In front of the pipe shall be a swivel. Once pull-back operations have commenced, operations must continue without interruption until pipe is completely pulled into bore hole. During pull-back operations the Contractor shall not apply more than the maximum safe pipe pull force at any time. In the event that pipe becomes stuck, the Contractor shall notify the Engineer. The Engineer and Contractor shall discuss options and then work shall proceed accordingly.

H. Excess pipe shall be removed and the bore hole associated with this excess pipe shall be filled with flowable fill or grout unless the area of the excess pipe is excavated and backfilled as part of the tie-in operations. In the event that a drilling fluid fracture, inadvertent returns, or returns loss occurs during pilot hole drilling operations, the Contractor shall cease operations and shall discuss corrective options with the Engineer; then work shall proceed accordingly.

PIPE TESTING A. Following the successful pullback of the pipe, the Contractor shall hydro-test pipe from end to end.

Directional Central Boring Specification
The Engineer must be notified 48 hours in advance of starting work. The Directional Bore shall not begin until the Engineer is present at the job site and agrees that proper preparations for the operation have been made. The Engineer approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract. It shall be the responsibility of Engineer to provide inspection personnel at such times as appropriate without causing undue hardship by reason of delay to the Contractor.

A. SITE PREPARATION: Prior to any alterations to work-site, contractor shall photograph or video tape entire work area, including entry and exit points. One copy of which shall be given to Engineer and one copy to remain with contractor for a period of one year following the completion of the project.

Work site as indicated on drawings, within right-of-way, shall be graded or filled to provide a level working area. No alterations beyond what is required for operations are to be made. Contractor shall confine all activities to designated work areas.

B. BORE PATH SURVEY: Entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings. If contractor is using a magnetic guidance system, drill path will be surveyed for any surface geo-magnetic variations or anomalies.

C. ENVIRONMENTAL PROTECTION: Contractor shall place silt fence between all boring operations and any drainage, wetland, waterway or other area designated for such protection by contract documents, state, federal and local regulations. Additional environmental protection necessary to contain
### Specification

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<td>any hydraulic or boring fluid spills shall be put in place, including berms, liners, turbidity curtains and other measures. Contractor shall adhere to all applicable environmental regulations. Fuel or oil may not be stored in bulk containers within 200’ of any water-body or wetland.</td>
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**D. UTILITY LOCATES:** Contactor shall notify all companies with underground utilities in the work area via the state or local “one-call” to obtain utility locates. Once the utilities have been located Contractor shall physically identify the exact location of the utilities by vacuum or hand excavation, when possible, in order to determine the actual location and path of any underground utilities which might be within 20 feet of the bore path. Contractor shall not commence boring operations until the location of all underground utilities within the work area have been verified.

**E. SAFETY:** Contractor shall adhere to all applicable state, federal and local safety regulations and all operations shall be conducted in a safe manner. Safety meetings shall be conducted at least weekly with a written record of attendance and topic submitted to Engineer.

**F. PIPE:** Pipe shall be connected together in one length prior to pull-back operations, if space permits. Steel pipe welds will be X-rayed prior to being placed in bore hole. Pipe will be placed on pipe rollers before pulling into bore hole with rollers spaced close enough to prevent excessive sagging of pipe.

**G. PILOT HOLE:** Pilot hole shall be drilled on bore path with no deviations greater than 5% of depth over a length of 100’. In the event that pilot does deviate from bore path more than 5% of depth in 100’, contractor will notify Engineer and Engineer may require contractor to pull-back and re-drill from the location along bore path before the deviation.

In the event that a boring fluid fracture, inadvertent returns or returns loss occurs during pilot hole boring operations, contractor shall cease boring, wait at least 30 minutes, inject a quantity of boring fluid with a viscosity exceeding 120 seconds as measured by a March funnel and then wait another 30 minutes. If mud fracture or returns loss continues, contractor will cease operations and notify Engineer. Engineer and contractor will discuss additional options and work will then proceed accordingly.

**H. REAMING:** Upon successful completion of pilot hole, contractor will ream bore hole to a minimum of 25% greater than outside diameter of pipe using the appropriate tools. Contractor will not attempt to ream at one time more than the boring equipment and mud system are designed to safely handle.

**I. PULL-BACK:** After successfully reaming bore hole to the required diameter, contractor will pull the pipe through the bore hole. In front of the pipe will be a swivel. Once pull-back operations have commenced, operations must continue without interruption until pipe is completely
pulled into bore hole. During pull-back operations contractor will not apply more than the maximum safe pipe pull pressure at any time.

In the event that pipe becomes stuck, contractor will cease pulling operations to allow any potential hydro-lock to subside and will commence pulling operations. If pipe remains stuck, contractor will notify Engineer. Engineer and contractor will discuss options and then work will proceed accordingly.

Following successful pull-back of pipe, contractor will hydro-test pipe using potable water for a period of ___ hours at a pressure of ____ psi. A calibrated pressure recorder will be used to record the pressure during the test period. This record will be presented to Engineer.

After successful completion of hydro-test, pipe will pigged dry.

Laurel Maryland HDD Specifications.

A. General. 1. Determine drilling length and equipment pull strength for type of soil encountered. 2. Provide method to control line and grade. a. Provide and maintain instrumentation that accurately locates pilot hole. b. Drill pilot hole along path following Drawings to these tolerances: 1) Vertical alignment plus or minus 0.5 foot. Vertical path of pilot hole must not establish new high points not shown on Drawings. 2) Horizontal alignment plus or minus 1.0 foot. c. Include electronic monitoring of horizontal and vertical drilling head location. Obtain accuracy range within one inch of actual position of pipeline. Record position readings at maximum of 10 foot intervals. d. At completion of pilot hole drilling, furnish tabulations of horizontal and vertical alignment to Engineer. 3. When water is encountered. a. Provide and maintain dewatering system of sufficient capacity to remove water. b. Keep excavation free of water until backfill operation is in progress. c. Perform dewatering in manner that removal of soils particles are held to minimum. d. Dewater into sediment trap following Section 01570. 4. Maintain close observation to detect settlement or displacement of surface and adjacent facilities. a. Notify Engineer immediately if settlement or displacement is detected. b. Maintain safe conditions and prevent damage.

Drilling Operation.

1. Drilling Fluids. a. Maintain drilling fluid in bore hole to increase stability of surrounding soil and reduce drag on pulled pipe. b. Dispose of drilling fluid and other spoils at location following laws, ordinances, rules, and regulations of local jurisdiction. c. Transport excess fluids and other spoils to disposal site, at no additional cost to the Commission. d. Minimize drilling fluid at locations other than entry and exit points. Immediately clean up any drilling fluids that inadvertently surface. e. Provide clean water for drilling, at no cost to the Commission, at Engineer’s requirement. a. Angle entry hole so that curvature of pilot hole does not exceed allowable bending radius of HDPE pipe. b. Be able to make a turn of up to 90 degrees and
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<td>maintain curvature not to exceed allowable bending radius of HDPE pipe. c. Alignment Adjustment and Restarts. 1) Follow pipeline alignment on Drawings within tolerances specified herein. Before adjustments, notify Engineer for approval. 2) Notify Engineer when forward motion of operation is stopped by an obstruction. a) Abandon in place with drilling fluid, unless Engineer directs otherwise. b) Upon Engineer’s approval, attempt second installation at approved location or excavate at point of difficulty and install HDPE pipe by trench method following Section 02533. 3) Withdrawals, abandonments, and restarts are at no additional cost to the Commission when HDD is provided as an option of installation of pipe. 4) Exercise caution including, but not limited to, locating utilities following Section 01150, drilling downholes (test pits) to observe drill stems or reamer assembly to clear other existing utilities at locations following Drawings. 5) Keep the number of boring pits to a minimum, no closer than following distances, unless otherwise approved by Engineer. Installing HDPE Pipe. 1. Provide a swivel to reaming assembly and pull section of pipe to minimize torsional stress on pull section after drilling pilot hole. 2. Hold reaming diameter to 1.5 times outside diameter of HDPE pipe being installed. 3. Protect pull section as it proceeds during pull back so it moves freely and is not damaged. 4. Pull detection wire along with HDPE pipe. Extend wire into locator station at each end of HDPE pipe. 5. When connecting to adjacent pulled or non-pulled section of HDPE pipe, allow pull section of pipe to extend past termination point. Make tie-ins the next day after pullback of HDPE pipe. 6. Test pit pipe installation to verify horizontal and vertical alignment at Engineer's direction. a. One test pit for every 500 feet along length of pipeline. b. Engineer may order additional test pit for each test pit that reveals pipeline installation is not in compliance with Contract Documents at no additional cost to the Commission. 7. Replace portions of pipeline not in compliance with Contract Documents at Engineer’s direction and at no additional cost to the Commission. B. Installing Locator Station. 1. Locator Stations. a. At each end of HDPE pipe. Follow Standard Details or Drawings, b. Flush mount underground locator: See Standard Details. c. When HDPE pipe is connected to another type of pipe material, continue detector wire over connecting pipe, so locator station is installed out of paved area. d. In</td>
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### Specification

areas scheduled to be improved identify and protect station locations immediately after installation. 1) Space 3 stakes equally around the station. 2) Extend at least 4 feet above existing grade. Flag with orange fluorescent wrap within 6 inches from top of stakes. e. Manhole mounted locator station: See Standard Details. 2. Detection Wire. a. Install detection wire without splices as shown on Standard Details. b. Terminate detection wire inside locator box using proper sized crimp type connectors on wire ends. c. Connect each wire to terminal maintaining at least 18 inches slack in each wire for underground flush mounted locator stations. d. Neatly coil slack wire in test station below terminal board. e. Locate wires on top and along HDPE pipe. f. Allow adequate slack and support to protect wires from damage during backfilling operations. g. Test each detection wire for continuity after backfill is completed.

1) If test for continuity is negative, repair or replace at Engineer's direction.

2) After continuity is verified, connect each detection wire to terminal block in locator station. FIELD QUALITY ASSURANCE A. Perform field testing of HDPE pipe following Section 02533.

### City of Stow

The ENGINEER must be notified 3 days in advance of starting work. The Directional Bore shall not begin until the ENGINEER is present at the job site and agrees that proper preparations for the operation have been made. The ENGINEER'S approval for beginning the installation shall in no way relieve the CONTRACTOR of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract. It shall be the responsibility of ENGINEER to provide inspection personnel at such time as appropriate without causing undue hardship by reason of delay to the CONTRACTOR.

B. All equipment used by the CONTRACTOR on Owner's property and right-of-ways may be inspected by the OWNER or the Owner's Representatives and shall not be used if considered unsatisfactory by OWNER or Owner's Representatives.

C. The Contractor shall be fully responsible for all damages arising from his failure comply with the regulations and the requirements of these Specifications.

The CONTRACTOR shall provide all material, equipment, and facilities required for directional drilling. Proper alignment and elevation of the bore hole shall be consistently maintained throughout the directional drilling operation. The method used to complete the directional drill shall conform to the requirements of all applicable permits. Copies of all permits will be supplied to the CONTRACTOR by the OWNER.

B. The entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings. If CONTRACTOR is using a magnetic guidance system, drill
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<td>path will be surveyed for any surface geo-magnetic variations or anomalies.</td>
<td>C. CONTRACTOR shall place slit fence between all drilling operations and any drainage, well-fields, wetland, waterway or other area designated for such protection necessary by documents, state, federal and local regulations. Additional environmental protection necessary to contain any hydraulic or drilling fluid spills shall be put in place, including berms, liners, turbidity curtains and other measures. CONTRACTOR shall adhere to all applicable environmental regulations. Fuel may not be stored in bulk containers within 200 feet of any water body or wetland.</td>
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<td>D. Readings shaft be recorded after advancement of each successive drill pipe, (no more than 10') and the readings plotted on a scaled drawing of 1 = 2', both vertical and horizontal. Access to all recorded readings and plan and profile information shall be made available to the ENGINEER, or his representative, at all times. At no time shall the deflection radius of the drill pipe exceed the deflection limits of the carrier pipe as specified herein.</td>
<td>E. A complete list of all drilling fluid additives and mixtures to be used in the directional operation will be submitted to the ENGINEER, along with their respective Material Safety Data Sheets. A drilling fluids and loose cuttings shall be contained in pits or holding tanks for recycling or disposal, no fluids shall be allowed to enter any unapproved areas or natural waterways. Upon completion of the directional drill project, the drilling mud and cuttings shall be disposed of by the CONTRACTOR at an approved dump site.</td>
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<td>F. The pilot hole shall be drilled on bore path with no deviations greater than 5% of depth over a length of 100 feet. In the event that pilot does deviate from the bore path more than 5-feet of depth in 100-feet, CONTRACTOR will notify ENGINEER and ENGINEER may require CONTRACTOR to pull-back and re-drill from the location along bore path before the deviation. In the event that a drilling fluid fracture, inadvertent returns or returns loss occurs during pilot hole drilling operations, CONTRACTOR shall cease drilling, wait at least 30 minutes, inject a quantity of drilling fluid with a viscosity exceeding 120 seconds as measured by a March funnel and wait another 30 minutes. If mud fracture or returns loss continues, CONTRACTOR will discuss additional options with the engineer and work will then proceed accordingly.</td>
<td>G. Upon completion of pilot hole phase of the operation, a complete set of as-built records shall be submitted in duplicate to the OWNER. These records shall include copies of the plan and profile drawing, as well as directional survey reports as recorded during the drilling operation.</td>
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<td>H. Upon approval of the pilot hole location the hole opening or enlarging phase of the installation shall begin. The bore hole diameter shall be increased to accommodate the pullback operation of the required size of</td>
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PVC pipe. The type of hole opener or back reamer to be utilized in this phase shall be determined by the types of subsurface soil conditions that have been encountered during the pilot hole drilling operation. The reamer type shall be at the CONTRACTOR'S discretion with the final hole opening being a maximum of 1.5 times larger than the outside diameter of the Certa- lok C900 1 Restrained Joint COUPLING to be installed in the bore hole.

I. The open bore hole may be stabilized by means of bentonite drilling slurry pumped through the inside diameter of the drill rod and through openings in the reamer. The drilling slurry must be in a homogenous/flowable state serving as an agent to carry the loose cuttings to the surface through the annulus of the borehole. The volume of bentonite mud required for each pullback shall be calculated based on soil conditions, largest diameter of the pipe couplings, capacity of the bentonite mud pump, and the speed of pullback as recommended by the bentonite drilling fluid manufacture. The bentonite slurry is to be contained at the exit or entry side of the directional bore in pits or holding tanks. The slurry may be recycled at this time for reuse in the hole opening operation, or shall be hauled by the CONTRACTOR to an approved dumpsite for proper disposal.

The PVC pipe shall be joined together according to manufacturer's specifications. The gaskets and the ends of pipe must be inspected and cleaned with a wet cloth prior to each joint assembly so they are free of any dirt or sand. The ends of pipe must be free of any chips, scratches, or scrapes before pipe is assembled. A pulling eye will be attached to the Certa-Lok C900/RJ pulling head on the lead stick of pipe which in turn will be attached to a swivel on the end of the drill pipe. Tracer wire (#8) solid coated copper wire shall be attached to the pulling eye and the crown of PVC pipe with duct tape @ 24" O.C. and a minimum of two full wraps around the pipe. This will allow for a straight, smooth pull of the product pipe as it enters and passes through the borehole toward the drill rig and original entrance hole of the directional bore. The product pipe will be elevated to the approximate angle of entry and supported by means of a side boom with roller arm, or similar equipment, to allow for the "free stress: situation as the pipe is pulled into the exit hole toward the drill rig. The product pullback phase of the directional operation shall be carried out in a continuous manner until the pipe reaches the original entry side of the bore. Cleaning and flushing are to be done by the CONTRACTOR in accordance with the requirements of the contract. B. Directional drilling pipe shall be tested by CONTRACTOR after pullback. The average pressure shall be maintained at 150 psi for two hours. The test pump and water supply shall be arranged to allow accurate measurements of the water required to maintain the test pressure. Any material showing seepage or the slightest leakage shall be replaced as directed by the OWNER at no additional expense to the OWNER. C. The manufacturer's recommendations on pipe
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| stretch allowances, bend radius and tensile strength. allowable make-up water, and duration of test pressure shall be observed. D. Pipeline shall be tested end to end. E. All service lines on the new main shall also be tested along with the new (size of pipe) main. | Hillsborough County Directional Drilling Operations 1. Pipe shall be handled, stored and joined in accordance with manufacturer’s specifications and these Specifications. 2. Pre-excavate pipe entry and receiving areas to provide a gradual entry of the pipe without stress to the pipe or joints and to allow free movement into the bore hole at an acceptable depth. Carefully guide pipe in such a manner as to avoid deformation of, or damage to, the pipe. 3. If unexpected subsurface conditions are encountered during the bore, the procedure shall be stopped. The installation shall not continue until approval has been given by the Engineer. 4. The drilling mud shall be bentonite slurry or approved equal and contained and disposed of in accordance with state/federal regulations and permit conditions. The Contractor shall install erosion and sedimentation control measures including, but not limited to, straw bales to prevent drilling mud from inadvertently spilling out of the entrance/exit pit and pressure relief vents. 5. The carrier pipe shall be pulled back through using the wet insertion construction technique. At the Contractor’s option, the pipe may be installed ballasted with water during installation. The limits of the directional bore construction and plan view length of pipe are shown on the construction plans. 6. Every effort shall be made to maintain pipe installation to a depth of 42 inches (min) (centerline of pipe). Where deeper installations are shown on the plans, or required by the Owner, the Contractor shall make such adjustments without additional cost to the Owner. Deviations from the plans may be made ONLY with the approval of Water Resource Services. 7. The pipe shall be installed in a manner that does not cause upheaval, settlement, cracking, movement or distortion of surface features. 8. The system must be remotely steerable and permit electronic monitoring of tunnel depth and location. The system must be able to control the depth and direction of the pipe and must be accurate to a window of + 2 inches 9. Equipment shall be fitted with a permanent alarm system capable of detecting an electrical current. The system shall have an audible alarm to warn the operator if the drill head contacts electrified cables. 10. All nonmetallic pipes shall be installed with insulated 6 gauge copper locating wires. Wires (two ) shall be attached directly to the pipe at 10:00
and 2:00, or the wires shall be installed/run in a one inch diameter PVC pipe attached directly to the carrier pipe. Wires/PVC pipe shall be attached to the carrier pipe using (minimum) 2 inch wide duct tape. Tape shall be at every joint and 4 to 5 feet spacing. Locating wires shall terminate 4 or more inches above the concrete valve paid and fold back inside a 3 inch PVC access pipe (see 02080.2, Exhibit W-13A). Wires shall be installed on terminal water lines leading to fire hydrant. Access to tracer wires at the hydrant valve, shall be provided when the hydrant is more than 10 feet from the water main.

11. Elevations of the pipe shall be shown on the Record Drawings at 50 ft. stationing. Depth changes from the plans shall be shown on the Record Drawings.

12. The annular space between the pipe and the bore hole shall be filled with an approved material (Bentonite or equal) to support and stabilize the pipe. If pressure grouting is used, caution should be exercised to insure that excess grout pressure does not distort or collapse the pipe.

13. Pipe shall be installed in a manner that will insure that external loads will not subsequently cause a decrease of more than five percent in the vertical cross-section dimension. When changes in direction are necessary, these shall be accomplished gradually such that the ratio of bend radius to nominal pipe size is not less than 300.

14. In the case of a pull-back where the bore will be abandoned, the Contractors shall inject an approved grout into the annular space. This action will be in conjunction with the removal of the bore tool to insure against collapse of the cover material.

Hampton Roads Planning

The HDD operation is to be performed in a manner to eliminate the discharge of water, drilling mud and cuttings to nearby waterways. The Contractor shall provide equipment and procedures to maximize the recirculation or reuse of drilling mud to minimize waste. The Contractor shall line all excavated pits used in the drilling operation with heavy-duty plastic sheeting with sealed joints to prevent the migration of drilling fluids and/or ground water. If inadvertent returns of drilling fluids near a structure or into a waterway occur, the Contractor shall immediately provide environmental controls and cleanup to the satisfaction of, and at no additional expense, to the Owner. When working adjacent to waterways, the general work area on the entry and exit sides of the crossing shall be enclosed by a beam to contain unplanned spills or discharge. Waste cuttings and drilling mud shall be processed through a solids control plant comprised as a minimum of sumps, pumps, tanks, desilter/desander, centrifuges, material handlers, and haulers all in a quantity sufficient to perform the cleaning/separating operation without interference with the drilling program. The cuttings and excess drilling fluids shall be dewater and dried by the
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| Contractor to the extent necessary for legal disposal in off-site landfills. Water from the dewatering process shall be treated by the Contractor to meet permit requirements and disposed of locally or hauled off-site for legal disposal. The cuttings and water for disposal are subject to being sampled and tested. The construction site and adjacent areas may be checked by the Owner for signs of unplanned leaks or seeps. Equipment and materials for cleanup and contingencies shall be provided in sufficient quantities by the Contractor and maintained at the site for use in the event of inadvertent leaks, seeps or spills. Unless otherwise indicated in the Special Provisions the Contractor shall provide water for HDD process and pipeline testing. Layout of Entry, Exit, & Staging Areas: The pipe shall be laid out as shown in the Drawings, and assembled in a manner that does not obstruct adjacent roads or activities adjacent to the layout areas except as otherwise shown. The Contractor shall confine construction activities and disturbances within the areas shown on the Drawings. If the Contractor is specifically permitted to use portions right-of-way for staging, pipe layout and joining, the Contractor shall coordinate his operations so as not to interfere with VDOT (or the City as applicable) or with the traveling public. Where the butt fusion pipe string is laid-out within the roadway right-of-way, the Contractor shall maintain access to public and private entrances and driveways at all times. Unless otherwise indicated, access may be maintained either by trenching and installing temporary culvert pipe for slip lining of the HDPE pipe, or by supporting the HDPE pipe aerially. The minimum bending radius for laying out and pulling the HDPE pipe shall be 60 times the pipe outside diameter. Contractor shall provide copies of written and signed agreements with adjacent property owners for any arrangements made by the Contractor for use of property outside of the rights-of-way and public property shown on the Drawings. Prior to the start of any Work under this section, Contractor shall photograph or video tape the entire work areas, including the entry and exit points. One copy shall be provided to the Owner. The pilot hole shall be drilled along the path shown on the construction drawings, or the Contractor's plan and profile approved by the Owner. The Contractor will provide and maintain instrumentation that will accurately locate the pilot hole and measure drilling fluid flow and pressure at all times. The Contractor shall plot the actual horizontal and vertical alignment of the pilot bore at intervals not exceeding 25 feet. This "as built" plan and profile shall be up-dated as the pilot bore is advanced. Significant deviations between the Owner-approved "design" position and the actual position and the actual position shall immediately be brought to the attention of the Owner for discussion and/or approval. At no point in the drilled profile shall the radius of curvature of the bore be less than that indicated on the Drawings. The Contractor shall maintain and provide to the Owner upon
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<td>request the data generated by the downhole survey tools in a form suitable for independent calculation of the pilot hole profile. The Contractor shall provide and use a separate, electronic, monitoring system employing a ground survey grid system. The alignment of the pilot bore must be approved by the Owner before reaming and pullback may commence. Unless directed otherwise, the pilot hole shall then be abandoned in place with the drilling fluid. With the Owner's approval, another attempt to drill the pilot hole may be made or excavation at the obstruction to alleviate the blockage may be acceptable. Withdrawal, abandonment, and restarts shall be performed at no additional cost to the Owner. The Contractor shall maintain close observations to detect settlement or displacement of surface and adjacent facilities. If settlement or displacement is detected, the Contractor is to immediately notify the Owner and act to maintain safe conditions and prevent damage. Ream &amp; Pull Back: Upon approval of the pilot hole location by the Owner, the hole opening or enlarging phase of the installation shall begin. The borehole diameter shall be increased incrementally to accommodate the pullback operation of the carrier pipe. The type of hole opener or back reamer to be utilized in the is phase shall be determined by the types of subsurface soil conditions that have been encountered during the pilot hole drilling operation. The final hole opening diameter shall be a minimum of 40% larger than the outside diameter of the carrier pipe to be installed. Once pullback operations have commenced, the Contractor shall continue without interruption until the pipe is completely pulled into the bore hole. During the pullback operation, the Contractor shall monitor roller operation and side brooms, if required, to assist the movement of the carrier pipe. Surface damage shall be repaired by the Contractor before pulling operations resume. The maximum pull (axial Tension force) exerted on the carrier pipe shall be measured continuously and limited to the maximum allowed by the pipe manufacturer to prevent the pipe and/or joints from becoming overstressed. Vertical and horizontal curves shall be limited so that wall stresses do not exceed 50% of yield stress for flexural bending of the carrier pipe. If the pipe is buckled or otherwise damaged, the damaged section shall be removed and replaced by the Contractor at his expense. A swivel shall be used to connect the pipeline to the drill pipe to prevent torsional stresses from occurring in the pipe. The pipelines shall be adequately supported during installation to prevent overstressing or buckling. The Contractor shall provide adequate support/rollers along the stringing area to support the required length of the HDPE pipe. Such support/rollers shall be spaced at a maximum of 60 feet on centers. The rollers shall be comprised of a non-abrasive material arranged in a manner to provide support to the bottom and bottom quarter points of the pipeline allowing for free movement of the pipeline during pullback. The end of the pipe shall be closed during the pullback operation. The Contractor shall pull detection</td>
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<td><strong>City of Lancaster</strong></td>
<td>wire, without splices, on top and along with the HDPE pipe. After the carrier pipe is completely pulled through the bore hole, a sufficient relaxation period as recommended by the specified pipe manufacturer shall be provided prior to the final pipe tie-in.</td>
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<td>A. Drill pilot bore with vertical and horizontal alignment as indicated on shop drawings. B. Guide drill remotely from ground surface to maintain alignment by monitoring signals transmitted from drill bit.</td>
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<td>1. Monitor depth, pitch, and position.</td>
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<td>2. Adjust drill head orientation to maintain correct alignment.</td>
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<tr>
<td>C. Inject drilling fluid into bore to stabilize hole, remove cuttings, and lubricate drill bit and pipe. D. Continuously monitor drilling fluid pumping rate, pressure, viscosity, and density while drilling pilot bore, back reaming, and installing pipe to ensure adequate removal of soil cuttings and stabilization of bore.</td>
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<td>1. Provide relief holes when required to relieve excess pressure.</td>
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<td>E. Calibrate and verify electronic monitor accuracy during first 50 feet of bore in presence of Engineer before proceeding with other drilling. Excavate minimum of four test pits spaced along first 50 feet bore to verify required accuracy. When required accuracy is not met, adjust equipment or provide new equipment capable of meeting required accuracy. F. After completing pilot bore, remove drill bit.</td>
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<td><strong>JEA Water &amp; Sewer</strong></td>
<td>DRILL PATH:</td>
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<td>Prior to drilling Contractor shall utilize all verified locate information to determine drill pathway. Marked up drawings (see Site Preparation paragraph) shall be on site at all times, and referred to during the drill operation.</td>
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<td>GUIDANCE SYSTEM:</td>
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<td>Contractor shall provide and maintain instrumentation necessary to accurately locate the pilot hole (both horizontal and vertical displacements), measure pilot string torsional and axial and measure drilling fluid discharge rate and pressure. The JEA Representative shall have access to instrumentation and readings at all times during operation.</td>
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<td>PILOT HOLE:</td>
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<td>The pilot hole shall be drilled along the path shown on the plans and profile drawings or as directed by the JEA Representative in the field. Unless approved otherwise by JEA, the pilot-hole tolerances shall be as follows:</td>
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<td>Elevation: As shown on the plans.</td>
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<td>Alignment: Five feet inside of right-of-way or easement boundary.</td>
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<td>Curve Radius: The pilot hole radius shall be no less than 80% of the maximum bending radius as recommended by the pipe manufacturer of the pipe being installed. In no case shall the bending radius be less than 30 pipe diameters, unless approved otherwise by JEA.</td>
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<td>Entry Point Location: The exact pilot hole entry point shall be within ±5 feet of the location shown on the drawing or as directed by the JEA Representative in the field.</td>
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<tr>
<td>Exit Point Location: The exit point location shall be within ±5 feet of the location shown on the drawing or as directed by the JEA Representative in the field.</td>
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<td>Limitations on Depth: If not noted on the plans, 6” HDPE pipe and smaller shall be installed with a depth of 3 to 5 feet and 8” HDPE pipe thru 12” pipe shall be installed with a depth of 3 to 6 feet unless it is required to install the pipe deeper due to utility conflicts. HDPE pipe larger than 12” shall be specifically designed by the engineer and approved by JEA. Where utilities cross under DOT roads, the depth of cover shall comply with applicable DOT permit.</td>
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<td>Water Main and Non-Water Main Separation Requirements: The minimum separation requirements between HDPE water main and a non-water main shall be as outlined in specification chapter III. 1. - Section 350 and Detail Nos. W-10 and W-11.</td>
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<td>PULL BACK:</td>
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<td>After successfully reaming bore hole to the required diameter, Contractor will pull the pipe through the bore hole. In front of the pipe will be a swivel and reamer to compact bore hole walls. Once pull-back operations have commenced, operations must continue without interruption until pipe is completely pulled into bore hole. During pull-back operations Contractor will not apply more than the maximum safe pipe pull pressure at any time. Maximum allowable tensile force imposed on the pull section shall be equal to 80% of the pipe manufacturer’s safety pull (or tensile) strength. Torsional stress shall be minimized by using a swivel to connect a pull section to the reaming assembly.</td>
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<td>The pullback section of the pipeline shall be supported during pullback operations so that it moves freely and the pipe is not damaged. External pressure shall be minimized during installation of the pullback section in the reamed hole. Damaged pipe resulting from external pressure shall be replaced at no cost to the JEA.</td>
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<td>Buoyancy modification shall be at the discretion of the Contractor and shall</td>
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<td>be approved by the JEA Representative. The Contractor shall be responsible for any damage to the pull section resulting from such modifications. In the event that pipe becomes stuck, Contractor will cease pulling operations to allow any potential hydro-lock to subside and will commence pulling operations. If pipe remains stuck, Contractor will notify JEA Representative. JEA Representative and Contractor will discuss options and then work will proceed accordingly.</td>
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