

STATE OF DELAWARE  
DEPARTMENT OF NATURAL RESOURCES  
AND ENVIRONMENTAL CONTROL (DNREC)  
DIVISION OF FISH AND WILDLIFE

CONTRACT #NAT-201503/LITTLE.CREEK

SPECIFICATIONS  
FOR

LITTLE CREEK WILDLIFE MANAGEMENT AREA  
WATER CONTROL STRUCTURE INSTALLATION  
PROJECT

IN

DOVER, DE

PREPARED  
BY

MOFFATT & NICHOL

ISSUED FOR BID  
APRIL 18, 2016



BIDS WILL BE RECEIVED AT THE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL UNTIL 2:00 P.M. June 6, 2016 AND WILL BE PUBLICLY OPENED AND READ ALOUD AT THAT TIME. PROPOSALS RECEIVED AFTER THAT DATE AND TIME SET FOR THE OPENING WILL BE RETURNED UNOPENED.



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**INVITATION TO BID**

Sealed bids for OMB/DFM Contract No. NAT-201503/LITTLE CREEK, will be received by the State of Delaware, Department of Natural Resources and Environmental Control, Division of Fish and Wildlife, at Room B172, Richardson & Robbins Building, 89 Kings Highway, Dover, Delaware 19901, until 2:00 pm local time on June 6, 2016, at which time they will be publicly opened and read aloud in the Conference Room. Bidder bears the risk of late delivery. Any bids received after the stated time will be returned unopened.

Project involves includes installation of new Water Control Structures within the levee and performing earthwork to raise the elevation of the existing levee at two locations to improve management of the water elevations within the Little Creek Wildlife Management Area.

A **MANDATORY** Pre-Bid Meeting will be held at 10:00 AM on May 23, 2016, at the Little Creek Wildlife Management Area (WMA), 3010 Bayside Drive followed by a visit to the project's site for the purpose of establishing the listing of subcontractors and to answer questions. Representatives of each party to any Joint Venture must attend this meeting. **ATTENDANCE OF THIS MEETING IS A PREREQUISITE FOR BIDDING ON THIS CONTRACT.**

Sealed bids shall be addressed to the Department of Natural Resources And Environmental Control, Division of Fish & Wildlife, 89 Kings Highway, Dover, DE 19901, attn.: Mr. Jeremy Ashe. The outer envelope should clearly indicate: "**CONTRACT NO. NAT-201503/LITTLE CREEK- SEALED BID - DO NOT OPEN.**"

Contract documents may be obtained at the office of the Department of Natural Resources And Environmental Control, Division of Fish & Wildlife, 89 Kings Highway, Dover, DE 19901.

Construction documents will be available for review at the following locations: Delaware Contractors Association; Associated Builders and Contractors.

Bidders will not be subject to discrimination on the basis of race, creed, color, sex, sexual orientation, gender identity or national origin in consideration of this award, and Minority Business Enterprises, Disadvantaged Business Enterprises, Women-Owned Business Enterprises and Veteran-Owned Business Enterprises will be afforded full opportunity to submit bids on this contract. Each bid must be accompanied by a bid security equivalent to ten percent of the bid amount and all additive alternates. The successful bidder must post a performance bond and payment bond in a sum equal to 100 percent of the contract price upon execution of the contract. The Owner reserves the right to reject any or all bids and to waive any informalities therein. The Owner may extend the time and place for the opening of the bids from that described in the advertisement, with not less than two calendar days notice by certified delivery, facsimile machine or other electronic means to those bidders receiving plans.

**END OF ADVERTISEMENT FOR BIDS**





## **INSTRUCTIONS TO BIDDERS**

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8. FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

**ARTICLE 1: GENERAL****1.1 DEFINITIONS**

1.1.1 Whenever the following terms are used, their intent and meaning shall be interpreted as follows:

1.2 STATE: The State of Delaware.

1.3 AGENCY: Contracting State Agency as noted on cover sheet.

1.4 DESIGNATED OFFICIAL: The agent authorized to act for the Agency.

1.5 BIDDING DOCUMENTS: Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement for Bid, Invitation to Bid, Instructions to Bidders, Supplementary Instructions to Bidders (if any), General Conditions, Supplementary General Conditions, General Requirements, Special Provisions (if any), the Bid Form (including the Non-collusion Statement), and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, as well as the Drawings, Specifications (Project Manual) and all Addenda issued prior to execution of the Contract.

1.6 CONTRACT DOCUMENTS: The Contract Documents consist of the, Instructions to Bidders, Supplementary Instructions to Bidders (if any), General Conditions, Supplementary General Conditions, General Requirements, Special Provisions (if any), the form of agreement between the Owner and the Contractor, Drawings (if any), Specifications (Project Manual), and all addenda.

1.7 AGREEMENT: The Agreement shall be the DNREC Contract Document contained in these specifications.

1.8 GENERAL REQUIREMENTS (or CONDITIONS): General Requirements (or conditions) are instructions pertaining to the Bidding Documents and to contracts in general. They contain, in summary, requirements of laws of the State; policies of the Agency and instructions to bidders.

1.9 SPECIAL PROVISIONS: Special Provisions are specific conditions or requirements peculiar to the bidding documents and to the contract under consideration and are supplemental to the General Requirements. Should the Special Provisions conflict with the General Requirements, the Special Provisions shall prevail.

1.10 ADDENDA: Written or graphic instruments issued by the Owner/Architect prior to the execution of the contract which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.

1.11 BIDDER OR VENDOR: A person or entity who formally submits a Bid for the material or Work contemplated, acting directly or through a duly authorized representative who meets the requirements set forth in the Bidding Documents.

1.12 SUB-BIDDER: A person or entity who submits a Bid to a Bidder for materials or labor, or both for a portion of the Work.

1.13 BID: A complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

- 1.14 BASE BID: The sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids (if any are required to be stated in the bid).
- 1.15 ALTERNATE BID (or ALTERNATE): An amount stated in the Bid, where applicable, to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents is accepted.
- 1.16 UNIT PRICE: An amount stated in the Bid, where applicable, as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.
- 1.17 SURETY: The corporate body which is bound with and for the Contract, or which is liable, and which engages to be responsible for the Contractor's payments of all debts pertaining to and for his acceptable performance of the Work for which he has contracted.
- 1.18 BIDDER'S DEPOSIT: The security designated in the Bid to be furnished by the Bidder as a guaranty of good faith to enter into a contract with the Agency if the Work to be performed or the material or equipment to be furnished is awarded to him.
- 1.19 CONTRACT: The written agreement covering the furnishing and delivery of material or work to be performed.
- 1.20 CONTRACTOR: Any individual, firm, or corporation with whom a contract is made by the Agency.
- 1.21 SUBCONTRACTOR: An individual, partnership, or corporation which has a direct contract with a contractor to furnish labor and materials at the job site, or to perform construction labor and furnish material in connection with such labor at the job site.
- 1.22 CONTRACT BOND: The approved form of security furnished by the contractor and his surety as a guaranty of good faith on the part of the contractor to execute the work in accordance with the terms of the contract.

## **ARTICLE 2: BIDDER'S REPRESENTATIONS**

- 2.1 PRE-BID MEETING
- 2.1.1 A pre-bid meeting for this project will be held at the time and place designated. Attendance at this meeting is a pre-requisite for submitting a Bid, unless this requirement is specifically waived elsewhere in the Bid Documents.
- 2.2 By submitting a Bid, the Bidder represents that:
- 2.2.1 The Bidder has read and understands the Bidding Documents and that the Bid is made in accordance therewith.
- 2.2.2 The Bidder has visited the site, become familiar with existing conditions under which the Work is to be performed, and has correlated the Bidder's his personal observations with the requirements of the proposed Contract Documents.
- 2.2.3 The Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception.

**2.3 JOINT VENTURE REQUIREMENTS**

- 2.3.1 For Public Works Contracts, each Joint Venturer shall be qualified and capable to complete the Work with their own forces.
- 2.3.2 Included with the Bid submission, and as a requirement to bid, a copy of the executed Joint Venture Agreement shall be submitted and signed by all Joint Venturers involved.
- 2.3.3 All required Bid Bonds, Performance Bonds, Material and Labor Payment Bonds must be executed by both Joint Venturers and be placed in both of their names.
- 2.3.4 All required insurance certificates shall name both Joint Venturers.
- 2.3.5 Both Joint Venturers shall sign the Bid Form and shall submit a copy of a valid Delaware Business License with their Bid.
- 2.3.6 Both Joint Venturers shall include their Federal E.I. Number with the Bid.
- 2.3.7 In the event of a mandatory Pre-bid Meeting, each Joint Venturer shall have a representative in attendance.
- 2.3.8 Due to exceptional circumstances and for good cause shown, one or more of these provisions may be waived at the discretion of the State.

**2.4 ASSIGNMENT OF ANTITRUST CLAIMS**

- 2.4.1 As consideration for the award and execution by the Owner of this contract, the Contractor hereby grants, conveys, sells, assigns and transfers to the State of Delaware all of its right, title and interests in and to all known or unknown causes of action it presently has or may now or hereafter acquire under the antitrust laws of the United States and the State of Delaware, relating to the particular goods or services purchased or acquired by the Owner pursuant to this contract.

**ARTICLE 3: BIDDING DOCUMENTS****3.1 COPIES OF BID DOCUMENTS**

- 3.1.1 Bidders may obtain complete sets of the Bidding Documents from the Architectural/Engineering firm designated in the Advertisement or Invitation to Bid in the number and for the deposit sum, if any, stated therein.
- 3.1.2 Bidders shall use complete sets of Bidding Documents for preparation of Bids. The issuing Agency nor the Architect assumes no responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- 3.1.3 Any errors, inconsistencies or omissions discovered shall be reported to the Architect immediately.
- 3.1.4 The Agency and Architect may make copies of the Bidding Documents available on the above terms for the purpose of obtaining Bids on the Work. No license or grant of use is conferred by issuance of copies of the Bidding Documents.

**3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS**

- 3.2.1 The Bidder shall carefully study and compare the Bidding Documents with each other, and with other work being bid concurrently or presently under construction to the extent that it relates to the Work for which the Bid is submitted, shall examine the site and local

conditions, and shall report any errors, inconsistencies, or ambiguities discovered to the Architect.

3.2.2 Bidders or Sub-bidders requiring clarification or interpretation of the Bidding Documents shall make a written request to the Architect at least seven days prior to the date for receipt of Bids. Interpretations, corrections, and changes to the Bidding Documents will be made by written Addendum. Interpretations, corrections, or changes to the Bidding Documents made in any other manner shall not be binding.

3.2.3 The apparent silence of the specifications as to any detail, or the apparent omission from it of detailed description concerning any point, shall be regarded as meaning that only the best commercial practice is to prevail and only material and workmanship of the first quality are to be used. Proof of specification compliance will be the responsibility of the Bidder.

3.2.4 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for all permits, labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work.

3.2.5 The Owner will bear the costs for all impact and user fees associated with the project.

### 3.3 SUBSTITUTIONS

3.3.1 The materials, products and equipment described in the Bidding Documents establish a standard of quality, required function, dimension, and appearance to be met by any proposed substitution. The specification of a particular manufacturer or model number is not intended to be proprietary in any way. Substitutions of products for those named will be considered, providing that the Vendor certifies that the function, quality, and performance characteristics of the material offered is equal or superior to that specified. It shall be the Bidder's responsibility to assure that the proposed substitution will not affect the intent of the design, and to make any installation modifications required to accommodate the substitution.

3.3.2 Requests for substitutions shall be made in writing to the Architect at least ten days prior to the date of the Bid Opening. Such requests shall include a complete description of the proposed substitution, drawings, performance and test data, explanation of required installation modifications due the substitution, and any other information necessary for an evaluation. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval shall be final. The Architect is to notify Owner prior to any approvals.

3.3.3 If the Architect approves a substitution prior to the receipt of Bids, such approval shall be set forth in an Addendum. Approvals made in any other manner shall not be binding.

3.3.4 The Architect shall have no obligation to consider any substitutions after the Contract award.

### 3.4 ADDENDA

3.4.1 Addenda will be mailed or delivered to all who are known by the Architect to have received a complete set of the Bidding Documents.

3.4.2 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

3.4.3 No Addenda will be issued later than 4 days prior to the date for receipt of Bids except an Addendum withdrawing the request for Bids or one which extends the time or changes the location for the opening of bids.

- 3.4.4 Each bidder shall ascertain prior to submitting his Bid that they have received all Addenda issued, and shall acknowledge their receipt in their Bid in the appropriate space. Not acknowledging an issued Addenda could be grounds for determining a bid to be non-responsive.

#### **ARTICLE 4: BIDDING PROCEDURES**

##### **4.1 PREPARATION OF BIDS**

- 4.1.1 Submit the bids on the Bid Forms included with the Bidding Documents.
- 4.1.2 Submit the original Bid Form for each bid. Bid Forms may be removed from the project manual for this purpose.
- 4.1.3 Execute all blanks on the Bid Form in a non-erasable medium (typewriter or manually in ink).
- 4.1.4 Where so indicated by the makeup on the Bid Form, express sums in both words and figures, in case of discrepancy between the two, the written amount shall govern.
- 4.1.5 Interlineations, alterations or erasures must be initialed by the signer of the Bid.
- 4.1.6 BID ALL REQUESTED ALTERNATES AND UNIT PRICES, IF ANY. If there is no change in the Base Bid for an Alternate, enter "No Change". The Contractor is responsible for verifying that they have received all addenda issued during the bidding period. Work required by Addenda shall automatically become part of the Contract.
- 4.1.7 Make no additional stipulations on the Bid Form and do not qualify the Bid in any other manner.
- 4.1.8 Each copy of the Bid shall include the legal name of the Bidder and a statement whether the Bidder is a sole proprietor, a partnership, a corporation, or any legal entity, and each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current Power of Attorney attached, certifying agent's authority to bind the Bidder.
- 4.1.9 Bidder shall complete the Non-Collusion Statement form included with the Bid Forms and include it with their Bid.
- 4.1.10 In the construction of all Public Works projects for the State of Delaware or any agency thereof, preference in employment of laborers, workers or mechanics shall be given to bona fide legal citizens of the State who have established citizenship by residence of at least 90 days in the State.
- 4.1.11 Each bidder shall include in their bid a copy of a valid Delaware Business License.'
- 4.1.12 Each bidder shall include signed Affidavit(s) for the Bidder and each listed Subcontractor certifying compliance with OMB Regulation 4104- "Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on "Large Public Works Projects." "Large Public Works" is based upon the current threshold required for bidding Public Works as set by the Purchasing and Contracting Advisory Council.
- ##### **4.2 BID SECURITY**
- 4.2.1 All bids shall be accompanied by a deposit of either a good and sufficient bond to the agency for the benefit of the agency, with corporate surety authorized to do business in this State, the form of the bond and the surety to be approved by the agency, or a security of the

bidder assigned to the agency, for a sum equal to at least 10% of the bid plus all add alternates, or in lieu of the bid bond a security deposit in the form of a certified check, bank treasurer's check, cashier's check, money order, or other prior approved secured deposit assigned to the State. The bid bond need not be for a specific sum, but may be stated to be for a sum equal to 10% of the bid plus all add alternates to which it relates and not to exceed a certain stated sum, if said sum is equal to at least 10% of the bid. The Bid Bond form used shall be the standard OMB form (attached).

4.2.2 The Agency has the right to retain the bid security of Bidders to whom an award is being considered until either a formal contract has been executed and bonds have been furnished or the specified time has elapsed so the Bids may be withdrawn or all Bids have been rejected.

4.2.3 In the event of any successful Bidder refusing or neglecting to execute a formal contract and bond within 20 days of the awarding of the contract, the bid bond or security deposited by the successful bidder shall be forfeited.

#### 4.3 SUBCONTRACTOR LIST

4.3.1 As required by Delaware Code, Title 29, section 6962(d)(10)b, each Bidder shall submit with their Bid a completed List of Sub-Contractors included with the Bid Form. NAME ONLY ONE SUBCONTRACTOR FOR EACH TRADE. A Bid will be considered non-responsive unless the completed list is included.

4.3.2 Provide the Name and Address for each listed subcontractor. Addresses by City, Town or Locality, plus State, will be acceptable.

4.3.3 It is the responsibility of the Contractor to ensure that their Subcontractors are in compliance with the provisions of this law. Also, if a Contractor elects to list themselves as a Subcontractor for any category, they must specifically name themselves on the Bid Form and be able to document their capability to act as Subcontractor in that category in accordance with this law.

#### 4.4 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

4.4.1 During the performance of this contract, the contractor agrees as follows:

- A. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, sex, color, sexual orientation, gender identity or national origin. The Contractor will take affirmative action to ensure the applicants are employed, and that employees are treated during employment, without regard to their race, creed, sex, color, sexual orientation, gender identity or national origin. Such action shall include, but not be limited to, the following: Employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places available to employees and applicants for employment notices to be provided by the contracting agency setting forth this nondiscrimination clause.
- B. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, sex, color, sexual orientation, gender identity or national origin."

#### 4.5 PREVAILING WAGE REQUIREMENT

4.5.1 Wage Provisions: For renovation and new construction projects whose costs exceed the thresholds contained in Delaware Code, Title 29, Section 6960, the minimum wage rates for

various classes of laborers and mechanics shall be as determined by the Department of Labor, Division of Industrial Affairs of the State of Delaware.

4.5.2 The employer shall pay all mechanics and labors employed directly upon the site of work, unconditionally and not less often than once a week and without subsequent deduction or rebate on any account, the full amounts accrued at time of payment, computed at wage rates not less than those stated in the specifications, regardless of any contractual relationship which may be alleged to exist between the employer and such laborers and mechanics.

4.5.3 The scale of the wages to be paid shall be posted by the employer in a prominent and easily accessible place at the site of the work.

4.5.4 Every contract based upon these specifications shall contain a stipulation that sworn payroll information, as required by the Department of Labor, be furnished weekly. The Department of Labor shall keep and maintain the sworn payroll information for a period of 6 months from the last day of the work week covered by the payroll.

#### 4.6 SUBMISSION OF BIDS

4.6.1 Enclose the Bid, the Bid Security, and any other documents required to be submitted with the Bid in a sealed opaque envelope. Address the envelope to the party receiving the Bids. Identify with the project name, project number, and the Bidder's name and address. If the Bid is sent by mail, enclose the sealed envelope in a separate mailing envelope with the notation "BID ENCLOSED" on the face thereof. The State is not responsible for the opening of bids prior to bid opening date and time that are not properly marked.

4.6.2 Deposit Bids at the designated location prior to the time and date for receipt of bids indicated in the Advertisement for Bids. Bids received after the time and date for receipt of bids will be marked "LATE BID" and returned.

4.6.3 Bidder assumes full responsibility for timely delivery at location designated for receipt of bids.

4.6.4 Oral, telephonic or telegraphic bids are invalid and will not receive consideration.

4.6.5 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids, provided that they are then fully in compliance with these Instructions to Bidders.

#### 4.7 MODIFICATION OR WITHDRAW OF BIDS

4.7.1 Prior to the closing date for receipt of Bids, a Bidder may withdraw a Bid by personal request and by showing proper identification to the Architect. A request for withdraw by letter or fax, if the Architect is notified in writing prior to receipt of fax, is acceptable. A fax directing a modification in the bid price will render the Bid informal, causing it to be ineligible for consideration of award. Telephone directives for modification of the bid price shall not be permitted and will have no bearing on the submitted proposal in any manner.

4.7.2 Bidders submitting Bids that are late shall be notified as soon as practicable and the bid shall be returned.

4.7.3 A Bid may not be modified, withdrawn or canceled by the Bidder during a thirty (30) day period following the time and date designated for the receipt and opening of Bids, and Bidder so agrees in submitting their Bid. Bids shall be binding for 30 days after the date of the Bid opening.



**ARTICLE 5: CONSIDERATION OF BIDS****5.1 OPENING/REJECTION OF BIDS**

5.1.1 Unless otherwise stated, Bids received on time will be publicly opened and will be read aloud. An abstract of the Bids will be made available to Bidders.

5.1.2 The Agency shall have the right to reject any and all Bids. A Bid not accompanied by a required Bid Security or by other data required by the Bidding Documents, or a Bid which is in any way incomplete or irregular is subject to rejection.

5.1.3 If the Bids are rejected, it will be done within thirty (30) calendar day of the Bid opening.

**5.2 COMPARISON OF BIDS**

5.2.1 After the Bids have been opened and read, the bid prices will be compared and the result of such comparisons will be made available to the public. Comparisons of the Bids may be based on the Base Bid plus desired Alternates. The Agency shall have the right to accept Alternates in any order or combination.

5.2.2 The Agency reserves the right to waive technicalities, to reject any or all Bids, or any portion thereof, to advertise for new Bids, to proceed to do the Work otherwise, or to abandon the Work, if in the judgment of the Agency or its agent(s), it is in the best interest of the State.

5.2.3 An increase or decrease in the quantity for any item is not sufficient grounds for an increase or decrease in the Unit Price.

5.2.4 The prices quoted are to be those for which the material will be furnished F.O.B. Job Site and include all charges that may be imposed during the period of the Contract.

5.2.5 No qualifying letter or statements in or attached to the Bid, or separate discounts will be considered in determining the low Bid except as may be otherwise herein noted. Cash or separate discounts should be computed and incorporated into Unit Bid Price(s).

**5.3 DISQUALIFICATION OF BIDDERS**

5.3.1 An agency shall determine that each Bidder on any Public Works Contract is responsible before awarding the Contract. Factors to be considered in determining the responsibility of a Bidder include:

- A. The Bidder's financial, physical, personnel or other resources including Subcontracts;
- B. The Bidder's record of performance on past public or private construction projects, including, but not limited to, defaults and/or final adjudication or admission of violations of the Prevailing Wage Laws in Delaware or any other state;
- C. The Bidder's written safety plan;
- D. Whether the Bidder is qualified legally to contract with the State;
- E. Whether the Bidder supplied all necessary information concerning its responsibility; and,

- F. Any other specific criteria for a particular procurement, which an agency may establish; provided however, that, the criteria be set forth in the Invitation to Bid and is otherwise in conformity with State and/or Federal law.
- 5.3.2 If an agency determines that a Bidder is nonresponsive and/or nonresponsible, the determination shall be in writing and set forth the basis for the determination. A copy of the determination shall be sent to the affected Bidder within five (5) working days of said determination.
- 5.3.3 In addition, any one or more of the following causes may be considered as sufficient for the disqualification of a Bidder and the rejection of their Bid or Bids.
- 5.3.3.1 More than one Bid for the same Contract from an individual, firm or corporation under the same or different names.
- 5.3.3.2 Evidence of collusion among Bidders.
- 5.3.3.3 Unsatisfactory performance record as evidenced by past experience.
- 5.3.3.4 If the Unit Prices are obviously unbalanced either in excess or below reasonable cost analysis values.
- 5.3.3.5 If there are any unauthorized additions, interlineation, conditional, or alternate bids or irregularities of any kind which may tend to make the Bid incomplete, indefinite, or ambiguous as to its meaning.
- 5.3.3.6 If the Bid is not accompanied by the required Bid Security and other data required by the Bidding Documents.
- 5.3.3.7 If any exceptions or qualifications of the Bid are noted on the Bid Form.
- 5.4 ACCEPTANCE OF BID AND AWARD OF CONTRACT
- 5.4.1 A formal Contract shall be executed with the successful Bidder within twenty (20) calendar days after the award of the Contract.
- 5.4.2 Per Section 6962(d)(13) a., Title 29, Delaware Code, "The contracting agency shall award any public works contract within thirty (30) days of the bid opening to the lowest responsive and responsible Bidder, unless the Agency elects to award on the basis of best value, in which case the election to award on the basis of best value shall be stated in the Invitation To Bid."
- 5.4.3 Each Bid on any Public Works Contract must be deemed responsive by the Agency to be considered for award. A responsive Bid shall conform in all material respects to the requirements and criteria set forth in the Contract Documents and specifications.
- 5.4.4 The Agency shall have the right to accept Alternates in any order or combination, and to determine the low Bidder on the basis of the sum of the Base Bid, plus accepted Alternates.
- 5.4.5 The successful Bidder shall execute a formal contract, submit the required Insurance Certificate, and furnish good and sufficient bonds, unless specifically waived in the General Requirements, in accordance with the General Requirement, within twenty (20) days of official notice of contract award. The successful Bidder shall provide two business days prior to contract execution, copies of the Employee Drug Testing Program for the Bidder and all listed Subcontractors. Bonds shall be for the benefit of the Agency with surety in the amount of 100% of the total contract award. Said Bonds shall be conditioned upon the faithful performance of the contract. Bonds shall remain in affect for period of one year after the date of substantial completion.

- 5.4.6 If the successful Bidder fails to execute the required Contract, Bond and all required information, as aforesaid, within twenty (20) calendar days after the date of official Notice of the Award of the Contract, their Bid guaranty shall immediately be taken and become the property of the State for the benefit of the Agency as liquidated damages, and not as a forfeiture or as a penalty. Award will then be made to the next lowest qualified Bidder of the Work or readvertised, as the Agency may decide.
- 5.4.7 Each bidder shall supply with its bid its taxpayer identification number (i.e., federal employer identification number or social security number) and a copy of its Delaware business license, and should the vendor be awarded a contract, such vendor shall provide to the agency the taxpayer identification license numbers of such subcontractors. Such numbers shall be provided on the later of the date on which such subcontractor is required to be identified or the time the contract is executed. The successful Bidder shall provide to the agency to which it is contracting, within 30 days of entering into such public works contract, copies of all Delaware Business licenses of subcontractors and/or independent contractors that will perform work for such public works contract. However, if a subcontractor or independent contractor is hired or contracted more than 20 days after the Bidder entered the public works contract the Delaware Business license of such subcontractor or independent contractor shall be provided to the agency within 10 days of being contracted or hired.
- 5.4.8 The Bid Security shall be returned to the successful Bidder upon the execution of the formal contract. The Bid Securities of unsuccessful bidders shall be returned within thirty (30) calendar days after the opening of the Bids.

**ARTICLE 6: POST-BID INFORMATION**

- 6.1 CONTRACTOR'S QUALIFICATION STATEMENT
- 6.1.1 Bidders to whom award of a Contract is under consideration shall, if requested by the Agency, submit a properly executed Contractor's Qualification Statement, unless such a statement has been previously required and submitted.
- 6.2 BUSINESS DESIGNATION FORM
- 6.2.1 Successful bidder shall be required to accurately complete an Office of Management and Budget Business Designation Form for Subcontractors.

**ARTICLE 7: PERFORMANCE BOND AND PAYMENT BOND**

- 7.1 BOND REQUIREMENTS
- 7.1.1 The cost of furnishing the required Bonds, that are stipulated in the Bidding Documents, shall be included in the Bid.
- 7.1.2 If the Bidder is required by the Agency to secure a bond from other than the Bidder's usual sources, changes in cost will be adjusted as provide in the Contract Documents.
- 7.1.3 The Performance and Payment Bond forms used shall be the standard OMB forms (attached).
- 7.2 TIME OF DELIVERY AND FORM OF BONDS
- 7.2.1 The bonds shall be dated on or after the date of the Contract.

- 7.2.2 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix a certified and current copy of the power of attorney.

**ARTICLE 8: FORM OF AGREEMENT BETWEEN AGENCY AND CONTRACTOR**

- 8.1 The Agreement for the Work will be DNREC Contract Document contained in these specifications.

END OF INSTRUCTIONS TO BIDDERS

LITTLE CREEK WILDLIFE MANAGEMENT AREA  
DOVER, DE  
CONTRACT NO. NAT-201503/LITTLE CREEK

**BID FORM**

**For Bids Due:** June 6, 2016

**To:** DEPARTMENT OF NATURAL RESOURCES AND  
ENVIRONMENTAL CONTROL (DNREC)  
DIVISION OF FISH AND WILDLIFE  
89 KINGS HIGHWAY  
DOVER, DE 19901

**Name of Bidder:** \_\_\_\_\_

**Delaware Business License No.:** \_\_\_\_\_ **Taxpayer ID No.:** \_\_\_\_\_  
**(A copy of Bidder's Delaware Business License must be attached to this form.)**

**(Other License Nos.):** \_\_\_\_\_

**Phone No.:** (        ) \_\_\_\_\_ - \_\_\_\_\_ **Fax No.:** (        ) \_\_\_\_\_ - \_\_\_\_\_

The undersigned, representing that he has read and understands the Bidding Documents and that this bid is made in accordance therewith, that he has visited the site and has familiarized himself with the local conditions under which the Work is to be performed, and that his bid is based upon the materials, systems and equipment described in the Bidding Documents without exception, hereby proposes and agrees to provide all labor, materials, plant, equipment, supplies, transport and other facilities required to execute the work described by the aforesaid documents for the lump sum base bid to install the North Water Control Structure itemized below:

\$ \_\_\_\_\_  
(\$ \_\_\_\_\_ )

**ALTERNATES**

Alternate Prices conform to applicable project specification section. Refer to specifications for a complete description of the following Alternates. To be added to the lump sum base bid, in any combination.

ALTERNATE No. 1: Construct South Water Control Structure

\$ \_\_\_\_\_



LITTLE CREEK WILDLIFE MANAGEMENT AREA  
DOVER, DE  
CONTRACT NO. NAT-201503/LITTLE CREEK

**BID FORM**

**BASE BID QUANTITIES**

Bid quantities to be used for the lump sum base bid above are as follows:

BID ITEM No. 1 – Mobilization & Demobilization (1 Lump Sum)

BID ITEM No. 2 – 48” HDPE Pipe (120 Linear Feet)

BID ITEM No. 3 – Demolition of North Water Control Structures (1 Lump Sum)

BID ITEM No. 4 – Temporary Outboard Cofferdam System – Little River Location (1 Each)

BID ITEM No. 5 – CIP Concrete Pile Caps (31 Cubic Yards)

BID ITEM No. 6 – 48-in Pipe Steel Superstructure (2 Each)

BID ITEM No. 7 – Concrete Riser Fixtures (1 Each)

BID ITEM No. 8 – Geotextile (135 Square Yards)

BID ITEM No. 9 – DELDOT R-6 (85 Tons)

BID ITEM No. 10 – Furnish HP 12 x 74 Piles (1,332 Vertical Linear Feet)

BID ITEM No. 11 – Handling and Driving HP 12 x 74 Piles (16 Each)

BID ITEM No. 12 – Re-Strike HP 12 x 74 Piles (1 Each)

BID ITEM No. 13 – Field Splicing HP 12 x 74 Piles (16 Each)

BID ITEM No. 14 – Dynamic Pile Test HP 12 x 74 Piles (2 Each)

BID ITEM No. 15 – Dynamic Pile Test Re-Strike HP 12 x 74 Piles (2 Each)

BID ITEM No. 16 – Seeding (5,000 Square Feet)

BID ITEM No. 17 – Metal Handrails (35 Linear Feet)

BID ITEM No. 18 – Chain Link Fence (70 Linear Feet)

BID ITEM No. 19 – Chain Link Personnel Gate (2 Each)

LITTLE CREEK WILDLIFE MANAGEMENT AREA  
DOVER, DE  
CONTRACT NO. NAT-201503/LITTLE CREEK

**BID FORM**

**BID QUANTITIES – ALTERNATE NO. 1 – CONSTRUCT SOUTH WATER CONTROL STRUCTURE**

Bid quantities to be used for the ALTERNATE bid above are as follows:

BID ITEM No. 1.1 – 24” HDPE Pipe (65 Linear Foot)

BID ITEM No. 2.1 – Demolition of South Water Control Structures (1 Lump Sum)

BID ITEM No. 3.1 – CIP Concrete Pile Caps (19 Cubic Yards)

BID ITEM No. 4.1 – 24-in Pipe Steel Superstructure (2 Each)

BID ITEM No. 5.1 – Geotextile (110 Square Yards)

BID ITEM No. 6.1 – DELDOT R-6 Riprap (65 Tons)

BID ITEM No. 7.1 – Furnish HP12x74 Piles (564 Vertical Linear Feet)

BID ITEM No. 8.1 – Handling and Driving HP 12x74 Piles (8 Each)

BID ITEM No. 9.1 – Re-Strike HP 12x74 Piles (1 Each)

BID ITEM No. 10.1 – Field Splicing HP 12x74 Piles (8 Each)

BID ITEM No. 11.1 – Dynamic Pile Test HP 12x74 Piles (2 Each)

BID ITEM No. 12.1 – Dynamic Pile Test Re-Strike HP 12x74 Piles (2 Each)

BID ITEM No. 13.1 – Seeding (5,000 Square Feet)

BID ITEM No. 14.1 – Metal Handrails (17 Linear Feet)

BID ITEM No. 15.1 – Chain Link Fence (52 Linear Feet)

BID ITEM No. 16.1 – Chain Link Personnel Gate (2 Each)



LITTLE CREEK WILDLIFE MANAGEMENT AREA  
DOVER, DE  
CONTRACT NO. NAT-201503/LITTLE CREEK

**BID FORM**

**UNIT PRICES**

Unit prices conform to applicable project specification section. Refer to the specifications for a complete description of the following Unit Prices:

BASE BID

	<b><u>ADD</u></b>	<b><u>DEDUCT</u></b>
UNIT PRICE BID ITEM No. 2 – 48” HDPE Pipe per Linear Foot	\$ _____	\$ _____
UNIT PRICE BID ITEM No. 5 – CIP Concrete Pile Caps per Cubic Yard	\$ _____	\$ _____
UNIT PRICE BID ITEM No. 8 – Geotextile per Square Yard	\$ _____	\$ _____
UNIT PRICE BID ITEM No. 9 – DELDOT R-6 per Ton	\$ _____	\$ _____
UNIT PRICE BID ITEM No. 10 – Furnish HP 12 x 74 Piles per Vertical Linear Foot	\$ _____	\$ _____
UNIT PRICE BID ITEM No. 11 – Handling and Driving HP 12 x 74 Piles per Each	\$ _____	\$ _____
UNIT PRICE BID ITEM No. 12 – Re-Strike HP 12 x 74 Piles per Each	\$ _____	\$ _____
UNIT PRICE BID ITEM No. 13 – Field Splicing HP 12 x 74 Piles per Each	\$ _____	\$ _____
UNIT PRICE BID ITEM No. 14 – Dynamic Pile Test HP 12 x 74 Piles per Each	\$ _____	\$ _____
UNIT PRICE BID ITEM No. 15 – Dynamic Pile Test Re-Strike HP 12 x 74 Piles per Each	\$ _____	\$ _____
UNIT PRICE BID ITEM No. 16 – Seeding per Square Foot	\$ _____	\$ _____
UNIT PRICE BID ITEM No. 17 – Metal Handrails per Linear Foot	\$ _____	\$ _____
UNIT PRICE BID ITEM No. 18 – Chain Link Fence per Linear Foot	\$ _____	\$ _____
UNIT PRICE BID ITEM No. 19 – Chain Link Personnel Gate per Each	\$ _____	\$ _____



LITTLE CREEK WILDLIFE MANAGEMENT AREA  
DOVER, DE  
CONTRACT NO. NAT-201503/LITTLE CREEK

**BID FORM**

**UNIT PRICES**

Unit prices conform to applicable project specification section. Refer to the specifications for a complete description of the following Unit Prices:

ALTERNATE 1

	<b><u>ADD</u></b>	<b><u>DEDUCT</u></b>
BID ITEM No. 1.1 – 24” HDPE Pipe per Linear Foot	\$ _____	\$ _____
BID ITEM No. 3.1 – CIP Concrete Pile Caps per Cubic Yard	\$ _____	\$ _____
BID ITEM No. 5.1 – Geotextile per Square Yard	\$ _____	\$ _____
BID ITEM No. 6.1 – DELDOT R-6 Riprap per Ton	\$ _____	\$ _____
BID ITEM No. 7.1 – Furnish HP12x74 Piles per Vertical Linear Foot	\$ _____	\$ _____
BID ITEM No. 8.1 – Handling and Driving HP 12x74 Piles per Each	\$ _____	\$ _____
BID ITEM No. 9.1 – Re-Strike HP 12x74 Piles per Each	\$ _____	\$ _____
BID ITEM No. 10.1 – Field Splicing HP 12x74 Piles per Each	\$ _____	\$ _____
BID ITEM No. 11.1 – Dynamic Pile Test HP 12x74 Piles per Each	\$ _____	\$ _____
BID ITEM No. 12.1 – Dynamic Pile Test Re-Strike HP 12x74 Piles per Each	\$ _____	\$ _____
BID ITEM No. 13.1 – Seeding per Square Foot	\$ _____	\$ _____
BID ITEM No. 14.1 – Metal Handrails per Linear Foot	\$ _____	\$ _____
BID ITEM No. 15.1 – Chain Link Fence per Linear Foot	\$ _____	\$ _____
BID ITEM No. 16.1 – Chain Link Personnel Gate per Each	\$ _____	\$ _____



LITTLE CREEK WILDLIFE MANAGEMENT AREA  
DOVER, DE  
CONTRACT NO. NAT-201503/LITTLE CREEK

**BID FORM**

I/We acknowledge Addendums numbered \_\_\_\_\_ and the price(s) submitted include any cost/schedule impact they may have.

This bid shall remain valid and cannot be withdrawn for thirty (30) days from the date of opening of bids (60 days for School Districts and Department of Education), and the undersigned shall abide by the Bid Security forfeiture provisions. Bid Security is attached to this Bid.

The Owner shall have the right to reject any or all bids, and to waive any informality or irregularity in any bid received.

This bid is based upon work being accomplished by the Sub-Contractors named on the list attached to this bid.

Should I/We be awarded this contract, I/We pledge to achieve substantial completion of all the work within \_\_\_\_\_ calendar days of the Notice to Proceed.

The undersigned represents and warrants that he has complied and shall comply with all requirements of local, state, and national laws; that no legal requirement has been or shall be violated in making or accepting this bid, in awarding the contract to him or in the prosecution of the work required; that the bid is legal and firm; that he has not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken action in restraint of free competitive bidding.

Upon receipt of written notice of the acceptance of this Bid, the Bidder shall, within twenty (20) calendar days, execute the agreement in the required form and deliver the Contract Bonds, and Insurance Certificates, required by the Contract Documents.

I am / We are an Individual / a Partnership / a Corporation

By \_\_\_\_\_ Trading as \_\_\_\_\_  
(Individual's / General Partner's / Corporate Name)

\_\_\_\_\_  
(State of Corporation)

Business Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Witness: \_\_\_\_\_ By: \_\_\_\_\_

(SEAL)

(Authorized Signature)

(Title)

Date: \_\_\_\_\_

**ATTACHMENTS**

Sub-Contractor List  
Non-Collusion Statement  
Affidavit(s) of Employee Drug Testing Program  
Bid Security  
(Others as Required by Project Manuals)



LITTLE CREEK WILDLIFE MANAGEMENT AREA  
DOVER, DE  
CONTRACT NO. NAT-201503/LITTLE CREEK

**BID FORM**

**SUBCONTRACTOR LIST**

In accordance with Title 29, Chapter 6962 (d)(10)b Delaware Code, the following sub-contractor listing must accompany the bid submittal. The name and address of the sub-contractor **must be listed for each category** where the bidder intends to use a sub-contractor to perform that category of work. In order to provide full disclosure and acceptance of the bid by the Department of Natural Resources and Environmental Control, Division of Fish and Wildlife, **it is required that bidders list themselves as being the sub-contractor for all categories where he/she is qualified and intends to perform such work.** This form must be filled out completely with no additions or deletions. **Note that all subcontractors listed below must have a signed Affidavit of Employee Drug Testing Program included with this bid.**

<u>Subcontractor Category</u>	<u>Subcontractor</u>	<u>Address (City &amp; State)</u>	<u>Subcontractors tax payer ID # or Delaware Business license #</u>
1. Earthwork	<hr/>	<hr/>	<hr/>
2. Pile Driving	<hr/>	<hr/>	<hr/>
3. Dynamic Pile Testing	<hr/>	<hr/>	<hr/>
4. Surveying	<hr/>	<hr/>	<hr/>
5. Geotechnical Testing	<hr/>	<hr/>	<hr/>
6. Steel Fabrication	<hr/>	<hr/>	<hr/>
7. Concrete	<hr/>	<hr/>	<hr/>
8. Seeding	<hr/>	<hr/>	<hr/>





LITTLE CREEK WILDLIFE MANAGEMENT AREA  
DOVER, DE  
CONTRACT NO. NAT-201503/LITTLE CREEK

**BID FORM**

**NON-COLLUSION STATEMENT**

This is to certify that the undersigned bidder has neither directly nor indirectly, entered into any agreement, participated in any collusion or otherwise taken any action in restraint of free competitive bidding in connection with this proposal submitted this date Department of Natural Resources and Environmental Control, Division of Fish and Wildlife.

All the terms and conditions of Contract No. NAT-201503/LITTLE CREEK have been thoroughly examined and are understood.

**NAME OF BIDDER:** \_\_\_\_\_

**AUTHORIZED REPRESENTATIVE  
(TYPED):** \_\_\_\_\_

**AUTHORIZED REPRESENTATIVE  
(SIGNATURE):** \_\_\_\_\_

**TITLE:** \_\_\_\_\_

**ADDRESS OF BIDDER:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**E-MAIL:** \_\_\_\_\_

**PHONE NUMBER:** \_\_\_\_\_

Sworn to and Subscribed before me this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_.

My Commission expires \_\_\_\_\_. NOTARY PUBLIC \_\_\_\_\_.

**THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED.**



LITTLE CREEK WILDLIFE MANAGEMENT AREA  
DOVER, DE  
CONTRACT NO. NAT-201503/LITTLE CREEK

**AFFIDAVIT  
OF  
EMPLOYEE DRUG TESTING PROGRAM**

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors implement a program of mandatory drug testing for Employees who work on Large Public Works Contracts funded all or in part with public funds.

We hereby certify that we have in place or will implement during the entire term of the contract a Mandatory Drug Testing Program for our employees on the jobsite that complies with this regulation:

**Contractor/Subcontractor Name:** \_\_\_\_\_

**Contractor/Subcontractor Address:** \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

**Authorized Representative (typed or printed):** \_\_\_\_\_

**Authorized Representative (signature):** \_\_\_\_\_

**Title:** \_\_\_\_\_

Sworn to and Subscribed before me this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_.

My Commission expires \_\_\_\_\_. NOTARY PUBLIC \_\_\_\_\_.

**THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED.**



STATE OF DELAWARE  
DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL (DNREC)  
DIVISION OF FISH AND WILDLIFE

**BID BOND**

TO ACCOMPANY PROPOSAL  
(Not necessary if security is used)

KNOW ALL MEN BY THESE PRESENTS That: \_\_\_\_\_  
\_\_\_\_\_ of \_\_\_\_\_ in the County of \_\_\_\_\_  
\_\_\_\_\_ and State of \_\_\_\_\_ as **Principal**, and \_\_\_\_\_  
\_\_\_\_\_ of \_\_\_\_\_ in the County of \_\_\_\_\_  
and State of \_\_\_\_\_ as **Surety**, legally authorized to do business in the State of Delaware  
("State"), are held and firmly unto the **State** in the sum of \_\_\_\_\_  
\_\_\_\_\_ Dollars (\$ \_\_\_\_\_), or \_\_\_\_\_ percent not to exceed \_\_\_\_\_  
\_\_\_\_\_ Dollars (\$ \_\_\_\_\_)  
of amount of bid on Contract No. NAT201503/LITTLE CREEK, to be paid to the **State** for the use and  
benefit of **Department of Natural Resources and Environmental Control, Division of Fish and Wildlife**  
for which payment well and truly to be made, we do bind ourselves, our and each of our heirs, executors,  
administrators, and successors, jointly and severally for and in the whole firmly by these presents.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH That if the above bonded **Principal**  
who has submitted to the **Department of Natural Resources and Environmental Control, Division of  
Fish and Wildlife** a certain proposal to enter into this contract for the furnishing of certain material and/or  
services within the **State**, shall be awarded this Contract, and if said **Principal** shall well and truly enter into  
and execute this Contract as may be required by the terms of this Contract and approved by the **Department  
of Natural Resources and Environmental Control, Division of Fish and Wildlife** this Contract to be  
entered into within twenty days after the date of official notice of the award thereof in accordance with the  
terms of said proposal, then this obligation shall be void or else to be and remain in full force and virtue.

Sealed with \_\_\_\_\_ seal and dated this \_\_\_\_\_ day of \_\_\_\_\_ in the year of our Lord two  
thousand and \_\_\_\_\_ (20\_\_\_\_).

SEALED, AND DELIVERED IN THE  
Presence of

\_\_\_\_\_  
Name of Bidder (Organization)

Corporate  
Seal

By:

\_\_\_\_\_  
Authorized Signature

Attest \_\_\_\_\_

\_\_\_\_\_  
Title

\_\_\_\_\_  
Name of Surety

Witness: \_\_\_\_\_

By:

\_\_\_\_\_  
Title



**00 73 46 PREVAILING WAGE RATE DETERMINATION**





STATE OF DELAWARE  
DEPARTMENT OF LABOR  
DIVISION OF INDUSTRIAL AFFAIRS  
OFFICE OF LABOR LAW ENFORCEMENT  
PHONE: (302) 451-3423

Mailing Address:  
225 CORPORATE BOULEVARD  
SUITE 104  
NEWARK, DE 19702

Located at:  
225 CORPORATE BOULEVARD  
SUITE 104  
NEWARK, DE 19702

PREVAILING WAGES FOR HEAVY CONSTRUCTION EFFECTIVE MARCH 15, 2016

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
ASBESTOS WORKERS	21.82	19.20	41.74
BOILERMAKERS	75.62	31.72	58.19
BRICKLAYERS	46.43	22.91	24.60
CARPENTERS	52.81	52.81	41.97
CEMENT FINISHERS	43.05	24.05	17.91
ELECTRICAL LINE WORKERS	72.73	27.89	63.84
ELECTRICIANS	65.10	65.10	65.10
GLAZIERS	20.17	17.51	11.85
INSULATORS	54.38	54.38	54.38
IRON WORKERS	60.19	60.19	57.58
LABORERS	43.60	43.60	43.60
MILLWRIGHTS	66.83	66.83	53.40
PAINTERS	75.26	75.26	75.26
PILEDRIVERS	72.97	38.86	30.25
PLASTERERS	18.99	16.49	11.15
PLUMBERS/PIPEFITTERS/STEAMFITTERS	82.03	76.87	17.67
POWER EQUIPMENT OPERATORS	61.36	61.36	61.36
SHEET METAL WORKERS	30.35	18.82	17.68
SPRINKLER FITTERS	32.70	12.38	10.25
TRUCK DRIVERS	31.56	20.36	21.99

CERTIFIED: 4/7/16

BY: 

ADMINISTRATOR, OFFICE OF LABOR LAW ENFORCEMENT

**NOTE:** THESE RATES ARE PROMULGATED AND ENFORCED PURSUANT TO THE PREVAILING WAGE REGULATIONS ADOPTED BY THE DEPARTMENT OF LABOR ON APRIL 3, 1992.

CLASSIFICATIONS OF WORKERS ARE DETERMINED BY THE DEPARTMENT OF LABOR. FOR ASSISTANCE IN CLASSIFYING WORKERS, OR FOR A COPY OF THE REGULATIONS OR CLASSIFICATIONS, PHONE (302) 451-3423.

NON-REGISTERED APPRENTICES MUST BE PAID THE MECHANIC'S RATE.

**PROJECT:** Nat201503LittleCreek Little Creek Wildlife Management Area Water Control Structure Installation, Kent County



**DEPARTMENT OF NATURAL RESOURCES & ENVIRONMENTAL CONTROL**

**89 KINGS HIGHWAY**

**DOVER, DE 19901**

**CONTRACT DOCUMENT**

FOR

**LITTLE CREEK WILDLIFE MANAGEMENT AREA**  
**WATER CONTROL STRUCTURE INSTALLATION PROJECT**  
**CONTRACT NO. NAT201503/LITTLE.CREEK**

THIS AGREEMENT, made and executed this \_\_\_\_\_ day of \_\_\_\_\_, 2016, by and between \_\_\_\_\_ (Hereinafter designated as Contractor) party of the first part, and the Department of Natural Resources and Environmental Control, a Department created under the laws of the State of Delaware (hereinafter designated as Department) party of the second part.

WITNESSETH that the Contractor, in consideration of the covenants and agreements herein contained and made by the Department, agrees to the following:

ARTICLE ONE. The Contractor shall provide and furnish all the material, supplies, machinery, implements, appliances, tools and labor required to complete this contract in Kent County, State of Delaware, as shown and specified in the specifications, proposals, drawings or plans as indicated in the project manual issued for the Department, with specifications, proposals, drawings or plans entitled **LITTLE CREEK WILDLIFE MANAGEMENT AREA, WATER CONTROL STRUCTURE INSTALLATION PROJECT NO. NAT201503/LITTLE.CREEK** is hereby incorporated by reference as part of this contract. This contract will be binding on both parties upon receipt by the Contractor of an approved State of Delaware Purchase Order. The Contractor must prosecute the work in such order as to complete the fill placement and rock protection structures no later than October 1, 2016 or between June 8, 2017 and October 1, 2017.



***CONTRACT DOCUMENT (CONTINUED)***

IN WITNESS WHEREOF, the said parties have duly executed this agreement in triplicate the day and year first above written.

IN WITNESS WHEREOF, the parties below have hereunto set their hands on the \_\_\_\_\_ day of \_\_\_\_\_, 2016.

\_\_\_\_\_  
Contractor

\_\_\_\_\_  
Witness

By: \_\_\_\_\_  
Title

State of \_\_\_\_\_  
County of \_\_\_\_\_

Sworn and subscribed before me this \_\_\_\_\_ day of \_\_\_\_\_, 2016.

\_\_\_\_\_  
Notary Public

IN WITNESS WHEREOF, the parties below have hereunto set their hands on the \_\_\_\_\_ day of \_\_\_\_\_, 2016.

\_\_\_\_\_  
Witness

\_\_\_\_\_  
Project Manager  
Division of Fish and Wildlife

State of \_\_\_\_\_  
County of \_\_\_\_\_

Sworn and subscribed before me this \_\_\_\_\_ day of \_\_\_\_\_, 2016.

\_\_\_\_\_  
Notary Public



***CONTRACT DOCUMENT (CONTINUED)***

IN WITNESS WHEREOF, the parties below have hereunto set their hands on the \_\_\_\_\_ day of \_\_\_\_\_, 2016.

\_\_\_\_\_  
Witness

\_\_\_\_\_  
Director, Division of Fish and Wildlife

State of \_\_\_\_\_  
County of \_\_\_\_\_

Sworn and subscribed before me this \_\_\_\_\_ day of \_\_\_\_\_, 2016.

\_\_\_\_\_  
Notary Public

\_\_\_\_\_  
Witness

\_\_\_\_\_  
Secretary, Department of  
Natural Resources &  
Environmental Control

State of \_\_\_\_\_  
County of \_\_\_\_\_

Sworn and subscribed before me this \_\_\_\_\_ day of \_\_\_\_\_, 2016.

\_\_\_\_\_  
Notary Public





STATE OF DELAWARE  
DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL (DNREC)  
DIVISION OF FISH AND WILDLIFE

**PERFORMANCE BOND**

Bond Number: \_\_\_\_\_

KNOW ALL PERSONS BY THESE PRESENTS, that we, \_\_\_\_\_, as principal (**"Principal"**), and \_\_\_\_\_, a \_\_\_\_\_ corporation, legally authorized to do business in the State of Delaware, as surety (**"Surety"**), are held and firmly bound unto the **State ("Owner") Department of Natural Resources and Environmental Control, Division of Fish and Wildlife**, in the amount of \_\_\_\_\_ (\$\_\_\_\_\_), to be paid to **Owner**, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrations, successors and assigns, jointly and severally, for and in the whole, firmly by these presents.

Sealed with our seals and dated this \_\_\_\_\_ day of \_\_\_\_\_, 2016.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH, that if **Principal**, who has been awarded by **Owner** that certain contract known as Contract No. NAT-201503/LITTLE CREEK dated the \_\_\_\_\_ day of \_\_\_\_\_, 2016 (the "Contract"), which Contract is incorporated herein by reference, shall well and truly provide and furnish all materials, appliances and tools and perform all the work required under and pursuant to the terms and conditions of the Contract and the Contract Documents (as defined in the Contract) or any changes or modifications thereto made as therein provided, shall make good and reimburse **Owner** sufficient funds to pay the costs of completing the Contract that **Owner** may sustain by reason of any failure or default on the part of **Principal**, and shall also indemnify and save harmless **Owner** from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

**Surety**, for value received, hereby stipulates and agrees, if requested to do so by **Owner**, to fully perform and complete the work to be performed under the Contract pursuant to the terms, conditions and covenants thereof, if for any cause **Principal** fails or neglects to so fully perform and complete such work.

**Surety**, for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of **Surety** and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition or change in or to the Contract or the work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subletting or other transfer thereof or of any work to be performed or any monies due or to become due thereunder; and **Surety** hereby waives notice of any and all such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers and hereby expressly stipulates and agrees that any and all things done and omitted to be done by and in relation to assignees, subcontractors, and other



transferees shall have the same effect as to **Surety** as though done or omitted to be done by or in relation to **Principal**.

**Surety** hereby stipulates and agrees that no modifications, omissions or additions in or to the terms of the Contract shall in any way whatsoever affect the obligation of **Surety** and its bond.

Any proceeding, legal or equitable, under this Bond may be brought in any court of competent jurisdiction in the State of Delaware. Notices to **Surety** or Contractor may be mailed or delivered to them at their respective addresses shown below.

IN WITNESS WHEREOF, **Principal** and **Surety** have hereunto set their hand and seals, and such of them as are corporations have caused their corporate seal to be hereto affixed and these presents to be signed by their duly authorized officers, the day and year first above written.

PRINCIPAL

Name: \_\_\_\_\_

Witness or Attest: Address: \_\_\_\_\_

_____	By: _____ (SEAL)
Name:	Name:
	Title:
(Corporate Seal)	

SURETY

Name: \_\_\_\_\_

Witness or Attest: Address: \_\_\_\_\_

_____	By: _____ (SEAL)
Name:	Name:
	Title:
(Corporate Seal)	



STATE OF DELAWARE  
DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL (DNREC)  
DIVISION OF FISH AND WILDLIFE

**PAYMENT BOND**

Bond Number: \_\_\_\_\_

KNOW ALL PERSONS BY THESE PRESENTS, that we, \_\_\_\_\_, as principal (“**Principal**”), and \_\_\_\_\_, a \_\_\_\_\_ corporation, legally authorized to do business in the State of Delaware, as surety (“**Surety**”), are held and firmly bound unto the **State (“Owner”) Department of Natural Resources and Environmental Control, Division of Fish and Wildlife**, in the amount of \_\_\_\_\_ (\$\_\_\_\_\_), to be paid to **Owner**, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrations, successors and assigns, jointly and severally, for and in the whole firmly by these presents.

Sealed with our seals and dated this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH, that if **Principal**, who has been awarded by **Owner** that certain contract known as Contract No. NAT-201503/LITTLE CREEK dated the \_\_\_\_\_ day of \_\_\_\_\_, 2016 (the “Contract”), which Contract is incorporated herein by reference, shall well and truly pay all and every person furnishing materials or performing labor or service in and about the performance of the work under the Contract, all and every sums of money due him, her, them or any of them, for all such materials, labor and service for which **Principal** is liable, shall make good and reimburse **Owner** sufficient funds to pay such costs in the completion of the Contract as **Owner** may sustain by reason of any failure or default on the part of **Principal**, and shall also indemnify and save harmless **Owner** from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

**Surety**, for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of **Surety** and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition or change in or to the Contract or the work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subletting or other transfer thereof or of any work to be performed or any monies due or to become due thereunder; and **Surety** hereby waives notice of any and all such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers and hereby expressly stipulates and agrees that any and all things done and omitted to be done by and in relation to assignees, subcontractors, and other transferees shall have the same effect as to **Surety** as though done or omitted to be done by or in relation to **Principal**.



**Surety** hereby stipulates and agrees that no modifications, omission or additions in or to the terms of the Contract shall in any way whatsoever affect the obligation of **Surety** and its bond.

Any proceeding, legal or equitable, under this Bond may be brought in any court of competent jurisdiction in the State of Delaware. Notices to **Surety** or Contractor may be mailed or delivered to them at their respective addresses shown below.

IN WITNESS WHEREOF, **Principal** and **Surety** have hereunto set their hand and seals, and such of them as are corporations have caused their corporate seal to be hereto affixed and these presents to be signed by their duly authorized officers, the day and year first above written.

PRINCIPAL

Name: \_\_\_\_\_

Witness or Attest: Address: \_\_\_\_\_

\_\_\_\_\_  
Name:

(Corporate Seal)

By: \_\_\_\_\_(SEAL)  
Name:  
Title:

SURETY

Name: \_\_\_\_\_

Witness or Attest: Address: \_\_\_\_\_

\_\_\_\_\_  
Name:

(Corporate Seal)

By: \_\_\_\_\_(SEAL)  
Name:  
Title:





## **GENERAL REQUIREMENTS**

### **TABLE OF ARTICLES**

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**ARTICLE 1: GENERAL****1.1 CONTRACT DOCUMENTS**

1.1.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary and what is required by one shall be as binding as if required by all. Performance by the Contractor shall be required to an extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results.

1.1.2 Work including material purchases shall not begin until the Contractor is in receipt of a bonafide State of Delaware Purchase Order. Any work performed or material purchases prior to the issuance of the Purchase Order is done at the Contractor's own risk and cost.

**1.2 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS**

1.2.1 For Public Works Projects financed in whole or in part by state appropriation the Contractor agrees that during the performance of this contract:

1. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, sex, color, sexual orientation, gender identity or national origin. The Contractor will take positive steps to ensure that applicants are employed and that employees are treated during employment without regard to their race, creed, sex, color, sexual orientation, gender identity or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places available to employees and applicants for employment notices to be provided by the contracting agency setting forth this nondiscrimination clause.
2. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, sex, color, sexual orientation, gender identity or national origin."

**ARTICLE 2: OWNER**

(NO ADDITIONAL GENERAL REQUIREMENTS – SEE SUPPLEMENTARY GENERAL CONDITIONS)

**ARTICLE 3: CONTRACTOR**

3.1 Schedule of Values: The successful Bidder shall within twenty (20) days after receiving notice to proceed with the work, furnish to the Owner a complete schedule of values on the various items comprising the work.

3.2 Subcontracts: Upon approval of Subcontractors, the Contractor shall award their Subcontracts as soon as possible after the signing of their own contract and see that all material, their own and those of their Subcontractors, are promptly ordered so that the work will not be delayed by failure of materials to arrive on time.

3.3 Before commencing any work or construction, the General Contractor is to consult with the Owner as to matters in connection with access to the site and the allocation of Ground Areas for the various features of hauling, storage, etc.

- 3.4 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions.
- 3.5 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.
- 3.6 The Contractor warrants to the Owner that materials and equipment furnished will be new and of good quality, unless otherwise permitted, and that the work will be free from defects and in conformance with the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved, may be considered defective. If required by the Owner, the Contractor shall furnish evidence as to the kind and quality of materials and equipment provided.
- 3.7 Unless otherwise provided, the Contractor shall pay all sales, consumer, use and other similar taxes, and shall secure and pay for required permits, fees, licenses, and inspections necessary for proper execution of the Work.
- 3.8 The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on performance of the Work. The Contractor shall promptly notify the Owner if the Drawings and Specifications are observed to be at variance therewith.
- 3.9 The Contractor shall be responsible to the Owner for the acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons performing portions of the Work under contract with the Contractor.
- 3.10 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work the Contractor shall remove from and about the Project all waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials. The Contractor shall be responsible for returning all damaged areas to their original conditions.
- 3.11 STATE LICENSE AND TAX REQUIREMENTS
- 3.11.1 Each Contractor and Subcontractor shall be licensed to do business in the State of Delaware and shall pay all fees and taxes due under State laws. In conformance with Section 2503, Chapter 25, Title 30, Delaware Code, "the Contractor shall furnish the Delaware Department of Finance within ten (10) days after entering into any contract with a contractor or subcontractor not a resident of this State, a statement of total value of such contract or contracts together with the names and addresses of the contracting parties."
- 3.12 The Contractor shall comply with all requirements set forth in Section 6962, Chapter 69, Title 29 of the Delaware Code.
- 3.13 During the contract Work, the Contractor and each listed Subcontractor, shall implement an Employee Drug Testing Program in accordance with OMB Regulation 4104- "Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on "Large Public Works Projects". "Large Public Works" is based upon the current threshold required for bidding Public Works as set by the Purchasing and Contracting Advisory Council.

**ARTICLE 4: ADMINISTRATION OF THE CONTRACT****4.1 CONTRACT SURETY****4.1.1 PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND**

4.1.2 All bonds will be required as follows unless specifically waived elsewhere in the Bidding Documents.

4.1.3 Contents of Performance Bonds – The bond shall be in the form approved by the Office of Management and Budget. The bond shall be conditioned upon the faithful compliance and performance by the successful bidder of each and every term and condition of the contract and the proposal, plans, specifications, and bid documents thereof. Each term and condition shall be met at the time and in the manner prescribed by the Contract, Bid documents and the specifications, including the payment in full to every person furnishing material or performing labor in the performance of the Contract, of all sums of money due the person for such labor and material. (The bond shall also contain the successful bidder's guarantee to indemnify and save harmless the State and the agency from all costs, damages and expenses growing out of or by reason of the Contract in accordance with the Contract.)

4.1.4 Invoking a Performance Bond – The agency may, when it considers that the interest of the State so require, cause judgement to be confessed upon the bond.

4.1.5 Within twenty (20) days after the date of notice of award of contract, the Bidder to whom the award is made shall furnish a Performance Bond and Labor and Material Payment Bond, each equal to the full amount of the Contract price to guarantee the faithful performance of all terms, covenants and conditions of the same. The bonds are to be issued by an acceptable Bonding Company licensed to do business in the State of Delaware and shall be issued in duplicate.

4.1.6 Performance and Payment Bonds shall be maintained in full force (warranty bond) for a period of two (2) years after the date of the Certificate for Final Payment. The Performance Bond shall guarantee the satisfactory completion of the Project and that the Contractor will make good any faults or defects in his work which may develop during the period of said guarantees as a result of improper or defective workmanship, material or apparatus, whether furnished by themselves or their Sub-Contractors. The Payment Bond shall guarantee that the Contractor shall pay in full all persons, firms or corporations who furnish labor or material or both labor and material for, or on account of, the work included herein. The bonds shall be paid for by this Contractor. The Owner shall have the right to demand that the proof parties signing the bonds are duly authorized to do so.

**4.2 FAILURE TO COMPLY WITH CONTRACT**

4.2.1 If any firm entering into a contract with the State, or Agency that neglects or refuses to perform or fails to comply with the terms thereof, the Agency which signed the Contract may terminate the Contract and proceed to award a new contract in accordance with this Chapter 69, Title 29 of the Delaware Code or may require the Surety on the Performance Bond to complete the Contract in accordance with the terms of the Performance Bond. Nothing herein shall preclude the Agency from pursuing additional remedies as otherwise provided by law.

**4.3 CONTRACT INSURANCE AND CONTRACT LIABILITY**

4.3.1 In addition to the bond requirements stated in the Bid Documents, each successful Bidder shall purchase adequate insurance for the performance of the Contract and, by submission of a Bid, agrees to indemnify and save harmless and to defend all legal or equitable actions brought against the State, any Agency, officer and/or employee of the

State, for and from all claims of liability which is or may be the result of the successful Bidder's actions during the performance of the Contract.

- 4.3.2 The purchase or nonpurchase of such insurance or the involvement of the successful Bidder in any legal or equitable defense of any action brought against the successful Bidder based upon work performed pursuant to the Contract will not waive any defense which the State, its agencies and their respective officers, employees and agents might otherwise have against such claims, specifically including the defense of sovereign immunity, where applicable, and by the terms of this section, the State and all agencies, officers and employees thereof shall not be financially responsible for the consequences of work performed, pursuant to said contract.

#### 4.4 RIGHT TO AUDIT RECORDS

- 4.4.1 The Owner shall have the right to audit the books and records of a Contractor or any Subcontractor under any Contract or Subcontract to the extent that the books and records relate to the performance of the Contract or Subcontract.
- 4.4.2 Said books and records shall be maintained by the Contractor for a period of seven (7) years from the date of final payment under the Prime Contract and by the Subcontractor for a period of seven (7) years from the date of final payment under the Subcontract.

### ARTICLE 5: SUBCONTRACTORS

#### 5.1 SUBCONTRACTING REQUIREMENTS

- 5.1.1 All contracts for the construction, reconstruction, alteration or repair of any public building (not a road, street or highway) shall be subject to the following provisions:
1. A contract shall be awarded only to a Bidder whose Bid is accompanied by a statement containing, for each Subcontractor category, the name and address (city or town and State only – street number and P.O. Box addresses not required) of the subcontractor whose services the Bidder intends to use in performing the Work and providing the material for such Subcontractor category.
  2. A Bid will not be accepted nor will an award of any Contract be made to any Bidder which, as the Prime Contractor, has listed itself as the Subcontractor for any Subcontractor unless:
    - A. It has been established to the satisfaction of the awarding Agency that the Bidder has customarily performed the specialty work of such Subcontractor category by artisans regularly employed by the Bidder's firm;
    - B. That the Bidder is duly licensed by the State to engage in such specialty work, if the State requires licenses; and
    - C. That the Bidder is recognized in the industry as a bona fide Subcontractor or Contractor in such specialty work and Subcontractor category.
- 5.1.2 The decision of the awarding Agency as to whether a Bidder who list itself as the Subcontractor for a Subcontractor category shall be final and binding upon all Bidders, and no action of any nature shall lie against any awarding agency or its employees or officers because of its decision in this regard.
- 5.1.3 After such a Contract has been awarded, the successful Bidder shall not substitute another Subcontractor for any Subcontractor whose name was set forth in the statement which accompanied the Bid without the written consent of the awarding Agency.

5.1.4 No Agency shall consent to any substitution of Subcontractors unless the Agency is satisfied that the Subcontractor whose name is on the Bidders accompanying statement:

- A. Is unqualified to perform the work required;
- B. Has failed to execute a timely reasonable Subcontract;
- C. Has defaulted in the performance on the portion of the work covered by the Subcontract; or
- D. Is no longer engaged in such business.

5.1.5 Should a Bidder be awarded a contract, such successful Bidder shall provide to the agency the taxpayer identification license numbers of such subcontractors. Such numbers shall be provided on the later of the date on which such subcontractor is required to be identified or the time the contract is executed. The successful Bidder shall provide to the agency to which it is contracting, within 30 days of entering into such public works contract, copies of all Delaware Business licenses of subcontractors and/or independent contractors that will perform work for such public works contract. However, if a subcontractor or independent contractor is hired or contracted more than 20 days after the Bidder entered the public works contract the Delaware Business license of such subcontractor or independent contractor shall be provided to the agency within 10 days of being contracted or hired.

## 5.2 PENALTY FOR SUBSTITUTION OF SUBCONTRACTORS

5.2.1 Should the Contractor fail to utilize any or all of the Subcontractors in the Contractor's Bid statement in the performance of the Work on the public bidding, the Contractor shall be penalized in the amount of (project specific amount\*). The Agency may determine to deduct payments of the penalty from the Contractor or have the amount paid directly to the Agency. Any penalty amount assessed against the Contractor may be remitted or refunded, in whole or in part, by the Agency awarding the Contract, only if it is established to the satisfaction of the Agency that the Subcontractor in question has defaulted or is no longer engaged in such business. No claim for the remission or refund of any penalty shall be granted unless an application is filed within one year after the liability of the successful Bidder accrues. All penalty amounts assessed and not refunded or remitted to the contractor shall be reverted to the State.

\*one (1) percent of contract amount not to exceed \$10,000

## 5.3 ASBESTOS ABATEMENT

5.3.1 The selection of any Contractor to perform asbestos abatement for State-funded projects shall be approved by the Office of Management and Budget, Division of Facilities Management pursuant to Chapter 78 of Title 16.

## 5.4 STANDARDS OF CONSTRUCTION FOR THE PROTECTION OF THE PHYSICALLY HANDICAPPED

5.4.1 All Contracts shall conform with the standard established by the Delaware Architectural Accessibility Board unless otherwise exempted by the Board.

## 5.5 CONTRACT PERFORMANCE

5.5.1 Any firm entering into a Public Works Contract that neglects or refuses to perform or fails to comply with its terms, the Agency may terminate the Contract and proceed to award a new Contract or may require the Surety on the Performance Bond to complete the Contract in accordance with the terms of the Performance Bond.

**ARTICLE 6: CONSTRUCTION BY OWNER OR SEPARATE CONTRACTORS**

- 6.1 The Owner reserves the right to simultaneously perform other construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other Projects at the same site.
- 6.2 The Contractor shall afford the Owner and other Contractors reasonable opportunity for access and storage of materials and equipment, and for the performance of their activities, and shall connect and coordinate their activities with other forces as required by the Contract Documents.

**ARTICLE 7: CHANGES IN THE WORK**

- 7.1 The Owner, without invalidating the Contract, may order changes in the Work consisting of Additions, Deletions, Modifications or Substitutions, with the Contract Sum and Contract completion date being adjusted accordingly. Such changes in the Work shall be authorized by written Change Order signed by the Professional, as the duly authorized agent, the Contractor and the Owner.
- 7.2 The Contract Sum and Contract Completion Date shall be adjusted only by a fully executed Change Order.
- 7.3 The additional cost, or credit to the Owner resulting from a change in the Work shall be by mutual agreement of the Owner, Contractor and the Architect. In all cases, this cost or credit shall be based on the 'DPE' wages required and the "invoice price" of the materials/equipment needed.
- 7.3.1 "DPE" shall be defined to mean "direct personnel expense". Direct payroll expense includes direct salary plus customary fringe benefits (prevailing wage rates) and documented statutory costs such as workman's compensation insurance, Social Security/Medicare, and unemployment insurance (a maximum multiplier of 1.35 times DPE).
- 7.3.2 "Invoice price" of materials/equipment shall be defined to mean the actual cost of materials and/or equipment that is paid by the Contractor, (or subcontractor), to a material distributor, direct factory vendor, store, material provider, or equipment leasing entity. Rates for equipment that is leased and/or owned by the Contractor or subcontractor(s) shall not exceed those listed in the latest version of the "Means Building Construction Cost Data" publication.
- 7.3.3 In addition to the above, the General Contractor is allowed a fifteen percent (15%) markup for overhead and profit for additional work performed by the General Contractor's own forces. For additional subcontractor work, the Subcontractor is allowed a fifteen (15) percent overhead and profit on change order work above and beyond the direct costs stated previously. To this amount, the General Contractor will be allowed a mark-up not exceeding seven and one half percent (7.5%) on the subcontractors work. These mark-ups shall include all costs including, but not limited to: overhead, profit, bonds, insurance, supervision, etc. No markup is permitted on the work of the subcontractors subcontractor. No additional costs shall be allowed for changes related to the Contractor's onsite superintendent/staff, or project manager, unless a change in the work changes the project duration and is identified by the CPM schedule. There will be no other costs associated with the change order.

**ARTICLE 8: TIME**

- 8.1 Time limits, if any, are as stated in the Project Manual. By executing the Agreement, the Contractor confirms that the stipulated limits are reasonable, and that the Work will be completed within the anticipated time frame.
- 8.2 If progress of the Work is delayed at any time by changes ordered by the Owner, by labor disputes, fire, unusual delay in deliveries, abnormal adverse weather conditions, unavoidable casualties or other causes beyond the Contractor's control, the Contract Time shall be extended for such reasonable time as the Owner may determine.
- 8.3 Any extension of time beyond the date fixed for completion of the construction and acceptance of any part of the Work called for by the Contract, or the occupancy of the building by the Owner, in whole or in part, previous to the completion shall not be deemed a waiver by the Owner of his right to annul or terminate the Contract for abandonment or delay in the matter provided for, nor relieve the Contractor of full responsibility.
- 8.4 **SUSPENSION AND DEBARMENT**
- 8.4.1 Per Section 6962(d)(14), Title 29, Delaware Code, "Any Contractor who fails to perform a public works contract or complete a public works project within the time schedule established by the Agency in the Invitation To Bid, may be subject to Suspension or Debarment for one or more of the following reasons: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the Project."
- 8.4.2 "Upon such failure for any of the above stated reasons, the Agency that contracted for the public works project may petition the Director of the Office of Management and Budget for Suspension or Debarment of the Contractor. The Agency shall send a copy of the petition to the Contractor within three (3) working days of filing with the Director. If the Director concludes that the petition has merit, the Director shall schedule and hold a hearing to determine whether to suspend the Contractor, debar the Contractor or deny the petition. The Agency shall have the burden of proving, by a preponderance of the evidence, that the Contractor failed to perform or complete the public works project within the time schedule established by the Agency and failed to do so for one or more of the following reasons: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the project. Upon a finding in favor of the Agency, the Director may suspend a Contractor from Bidding on any project funded, in whole or in part, with public funds for up to 1 year for a first offense, up to 3 years for a second offense and permanently debar the Contractor for a third offense. The Director shall issue a written decision and shall send a copy to the Contractor and the Agency. Such decision may be appealed to the Superior Court within thirty (30) days for a review on the record."
- 8.5 **RETAINAGE**
- 8.5.1 Per Section 6962(d)(5) a.3, Title 29, Delaware Code: The Agency may at the beginning of each public works project establish a time schedule for the completion of the project. If the project is delayed beyond the completion date due to the Contractor's failure to meet their responsibilities, the Agency may forfeit, at its discretion, all or part of the Contractor's retainage.
- 8.5.2 This forfeiture of retainage also applies to the timely completion of the punchlist. A punchlist will only be prepared upon the mutual agreement of the Owner, Architect and Contractor. Once the punchlist is prepared, all three parties will by mutual agreement, establish a schedule for its completion. Should completion of the punchlist be delayed beyond the established date due to the Contractor's failure to meet their responsibilities,



the Agency may hold permanently, at its discretion, all or part of the Contractor's retainage.

**ARTICLE 9: PAYMENTS AND COMPLETION****9.1 APPLICATION FOR PAYMENT**

9.1.1 Applications for payment shall be made to Department of Natural Resources and Environmental Control Division of Fish & Wildlife, at Room B172, Richardson & Robbins Building, 89 Kings Highway, Dover, DE 19901 and marked Contract Contract No. NAT201501/MISPILLION; Attention: Jeremy Ashe. There will be a five percent (5%) retainage on all Contractor's monthly invoices until completion of the project. This retainage may become payable upon receipt of all required closeout documentation, provided all other requirements of the Contract Documents have been met.

9.1.2 A date will be fixed for the taking of the monthly account of work done. Upon receipt of Contractor's itemized application for payment, such application will be audited, modified, if found necessary, and approved for the amount. Statement shall be submitted to the Owner.

9.1.3 Section 6516, Title 29 of the Delaware Code annualized interest is not to exceed 12% per annum beginning thirty (30) days after the "presentment" (as opposed to the date) of the invoice.

**9.2 PARTIAL PAYMENTS**

9.2.1 Any public works Contract executed by any Agency may provide for partial payments at the option of the Owner with respect to materials placed along or upon the sites or stored at secured locations, which are suitable for use in the performance of the contract.

9.2.2 When approved by the agency, partial payment may include the values of tested and acceptable materials of a nonperishable or noncontaminative nature which have been produced or furnished for incorporation as a permanent part of the work yet to be completed, provided acceptable provisions have been made for storage.

9.2.2.1 Any allowance made for materials on hand will not exceed the delivered cost of the materials as verified by invoices furnished by the Contractor, nor will it exceed the contract bid price for the material complete in place.

9.2.3 If requested by the Agency, receipted bills from all Contractors, Subcontractors, and material, men, etc., for the previous payment must accompany each application for payment. Following such a request, no payment will be made until these receipted bills have been received by the Owner.

**9.3 SUBSTANTIAL COMPLETION**

9.3.1 When the building has been made suitable for occupancy, but still requires small items of miscellaneous work, the Owner will determine the date when the project has been substantially completed.

9.3.2 If, after the Work has been substantially completed, full completion thereof is materially delayed through no fault of the Contractor, and without terminating the Contract, the Owner may make payment of the balance due for the portion of the Work fully completed and accepted. Such payment shall be made under the terms and conditions governing final payment that it shall not constitute a waiver of claims.

9.3.3 On projects where commissioning is included, the commissioning work as defined in the specifications must be complete prior to the issuance of substantial completion.

## 9.4 FINAL PAYMENT

- 9.4.1 Final payment, including the five percent (5%) retainage if determined appropriate, shall be made within thirty (30) days after the Work is fully completed and the Contract fully performed and provided that the Contractor has submitted the following closeout documentation (in addition to any other documentation required elsewhere in the Contract Documents):
- 9.4.1.1 Evidence satisfactory to the Owner that all payrolls, material bills, and other indebtedness connected with the work have been paid,
- 9.4.1.2 An acceptable RELEASE OF LIENS,
- 9.4.1.3 Copies of all applicable warranties,
- 9.4.1.4 As-built drawings,
- 9.4.1.5 Operations and Maintenance Manuals,
- 9.4.1.6 Instruction Manuals,
- 9.4.1.7 Consent of Surety to final payment.
- 9.4.1.8 The Owner reserves the right to retain payments, or parts thereof, for its protection until the foregoing conditions have been complied with, defective work corrected and all unsatisfactory conditions remedied.

**ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY**

- 10.1 The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall take all reasonable precautions to prevent damage, injury or loss to: workers, persons nearby who may be affected, the Work, materials and equipment to be incorporated, and existing property at the site or adjacent thereto. The Contractor shall give notices and comply with applicable laws ordinances, rules regulations, and lawful orders of public authorities bearing on the safety of persons and property and their protection from injury, damage, or loss. The Contractor shall promptly remedy damage and loss to property at the site caused in whole or in part by the Contractor, a Subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable.
- 10.2 The Contractor shall notify the Owner in the event any existing hazardous material such as lead, PCBs, asbestos, etc. is encountered on the project. The Owner will arrange with a qualified specialist for the identification, testing, removal, handling and protection against exposure or environmental pollution, to comply with applicable regulation laws and ordinances. The Contractor and Architect will not be required to participate in or to perform this operation. Upon completion of this work, the Owner will notify the Contractor and Architect in writing the area has been cleared and approved by the authorities in order for the work to proceed. The Contractor shall attach documentation from the authorities of said approval.
- 10.3 As required in the Hazardous Chemical Information Act of June 1984, all vendors supplying any materials that may be defined as hazardous, must provide Material Safety Data Sheets for those products. Any chemical product should be considered hazardous if it has a warning caution on the label relating to a potential physical or health hazard, if it is known to be present in the work place, and if employees may be exposed under normal conditions or in any foreseeable emergency situation. Material Safety Data Sheets must be provided directly to the Owner along with the shipping slips that include those products.

- 10.4 The Contractor shall certify to the Owner that materials incorporated into the Work are free of all asbestos. This certification may be in the form of Material Safety Data Sheet (MSDS) provided by the product manufacturer for the materials used in construction, as specified or as provided by the Contractor.

#### ARTICLE 11: INSURANCE AND BONDS

- 11.1 The Contractor shall carry all insurance required by law, such as Unemployment Insurance, etc. The Contractor shall carry such insurance coverage as they desire on their own property such as a field office, storage sheds or other structures erected upon the project site that belong to them and for their own use. The Subcontractors involved with this project shall carry whatever insurance protection they consider necessary to cover the loss of any of their personal property, etc.
- 11.2 Upon being awarded the Contract, the Contractor shall obtain a minimum of two (2) copies of all required insurance certificates called for herein, and submit one (1) copy of each certificate, to the Owner, within 20 days of contract award.
- 11.3 Bodily Injury Liability and Property Damage Liability Insurance shall, in addition to the coverage included herein, include coverage for injury to or destruction of any property arising out of the collapse of or structural injury to any building or structure due to demolition work and evidence of these coverages shall be filed with and approved by the Owner.
- 11.4 The Contractor's Property Damage Liability Insurance shall, in addition to the coverage noted herein, include coverage on all real and personal property in their care, custody and control damaged in any way by the Contractor or their Subcontractors during the entire construction period on this project.
- 11.5 Builders Risk (including Standard Extended Coverage Insurance) on the existing building during the entire construction period, shall not be provided by the Contractor under this contract. The Owner shall insure the existing building and all of its contents and all this new alteration work under this contract during entire construction period for the full insurable value of the entire work at the site. Note, however, that the Contractor and their Subcontractors shall be responsible for insuring building materials (installed and stored) and their tools and equipment whenever in use on the project, against fire damage, theft, vandalism, etc.
- 11.6 Certificates of the insurance company or companies stating the amount and type of coverage, terms of policies, etc., shall be furnished to the Owner, within 20 days of contract award.
- 11.7 The Contractor shall, at their own expense, (in addition to the above) carry the following forms of insurance:

11.7.1 Contractor's Contractual Liability Insurance

Minimum coverage to be:

Bodily Injury	\$500,000 \$1,000,000 \$1,000,000	for each person for each occurrence aggregate
Property Damage	\$500,000 \$1,000,000	for each occurrence aggregate

11.7.2 Contractor's Protective Liability Insurance

Minimum coverage to be:

Bodily Injury	\$500,000	for each person
	\$1,000,000	for each occurrence
	\$1,000,000	aggregate
Property Damage	\$500,000	for each occurrence
	\$500,000	aggregate

### 11.7.3 Automobile Liability Insurance

Minimum coverage to be:

Bodily Injury	\$1,000,000	for each person
	\$1,000,000	for each occurrence
Property Damage	\$500,000	per accident

11.7.4 Prime Contractor's and Subcontractors' policies shall include contingent and contractual liability coverage in the same minimum amounts as 11.7.1 above.

11.7.5 Workmen's Compensation (including Employer's Liability):

11.7.5.1 Minimum Limit on employer's liability to be as required by law.

11.7.5.2 Minimum Limit for all employees working at one site.

11.7.6 Certificates of Insurance must be filed with the Owner guaranteeing fifteen (15) days prior notice of cancellation, non-renewal, or any change in coverages and limits of liability shown as included on certificates.

### 11.7.7 Social Security Liability

11.7.7.1 With respect to all persons at any time employed by or on the payroll of the Contractor or performing any work for or on their behalf, or in connection with or arising out of the Contractor's business, the Contractor shall accept full and exclusive liability for the payment of any and all contributions or taxes or unemployment insurance, or old age retirement benefits, pensions or annuities now or hereafter imposed by the Government of the United States and the State or political subdivision thereof, whether the same be measured by wages, salaries or other remuneration paid to such persons or otherwise.

11.7.7.2 Upon request, the Contractor shall furnish Owner such information on payrolls or employment records as may be necessary to enable it to fully comply with the law imposing the aforesaid contributions or taxes.

11.7.7.3 If the Owner is required by law to and does pay any and/or all of the aforesaid contributions or taxes, the Contractor shall forthwith reimburse the Owner for the entire amount so paid by the Owner.

## ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

12.1 The Contractor shall promptly correct Work rejected by the Owner or failing to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed, and shall correct any Work found to be not in accordance with the requirements of the Contract Documents within a period of two years from the date of Substantial Completion, or by terms of an applicable special warranty required by the Contract Documents. The provisions of this Article apply to work done by Subcontractors as well as to Work done by direct employees of the Contractor.

- 12.2 At any time during the progress of the work, or in any case where the nature of the defects shall be such that it is not expedient to have them corrected, the Owner, at their option, shall have the right to deduct such sum, or sums, of money from the amount of the contract as they consider justified to adjust the difference in value between the defective work and that required under contract including any damage to the structure.

#### **ARTICLE 13: MISCELLANEOUS PROVISIONS**

##### **13.1 CUTTING AND PATCHING**

- 13.1.1 The Contractor shall be responsible for all cutting and patching. The Contractor shall coordinate the work of the various trades involved.

##### **13.2 DIMENSIONS**

- 13.2.1 All dimensions shown shall be verified by the Contractor by actual measurements at the project site. Any discrepancies between the drawings and specifications and the existing conditions shall be referred to the Owner for adjustment before any work affected thereby has been performed.

##### **13.3 LABORATORY TESTS**

- 13.3.1 Any specified laboratory tests of material and finished articles to be incorporated in the work shall be made by bureaus, laboratories or agencies approved by the Owner and reports of such tests shall be submitted to the Owner. The cost of the testing shall be paid for by the Contractor.

- 13.3.2 The Contractor shall furnish all sample materials required for these tests and shall deliver same without charge to the testing laboratory or other designated agency when and where directed by the Owner.

##### **13.4 ARCHAEOLOGICAL EVIDENCE**

- 13.4.1 Whenever, in the course of construction, any archaeological evidence is encountered on the surface or below the surface of the ground, the Contractor shall notify the authorities of the Delaware Archaeological Board and suspend work in the immediate area for a reasonable time to permit those authorities, or persons designated by them, to examine the area and ensure the proper removal of the archaeological evidence for suitable preservation in the State Museum.

##### **13.5 GLASS REPLACEMENT AND CLEANING**

- 13.5.1 The General Contractor shall replace without expense to the Owner all glass broken during the construction of the project. If job conditions warrant, at completion of the job the General Contractor shall have all glass cleaned and polished.

##### **13.6 WARRANTY**

- 13.6.1 For a period of two (2) years from the date of substantial completion, as evidenced by the date of final acceptance of the work, the contractor warrants that work performed under this contract conforms to the contract requirements and is free of any defect of equipment, material or workmanship performed by the contractor or any of his subcontractors or suppliers. However, manufacturer's warranties and guarantees, if for a period longer than two (2) years, shall take precedence over the above warranties. The contractor shall remedy, at his own expense, any such failure to conform or any such defect. The protection of this warranty shall be included in the Contractor's Performance Bond.

**ARTICLE 14: TERMINATION OF CONTRACT**

- 14.1 If the Contractor defaults or persistently fails or neglects to carry out the Work in accordance with the Contract Documents or fails to perform a provision of the Contract, the Owner, after seven days written notice to the Contractor, may make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor. Alternatively, at the Owner's option, and the Owner may terminate the Contract and take possession of the site and of all materials, equipment, tools, and machinery thereon owned by the Contractor and may finish the Work by whatever method the Owner may deem expedient. If the costs of finishing the Work exceed any unpaid compensation due the Contractor, the Contractor shall pay the difference to the Owner.
- 14.2 "If the continuation of this Agreement is contingent upon the appropriation of adequate state, or federal funds, this Agreement may be terminated on the date beginning on the first fiscal year for which funds are not appropriated or at the exhaustion of the appropriation. The Owner may terminate this Agreement by providing written notice to the parties of such non-appropriation. All payment obligations of the Owner will cease upon the date of termination. Notwithstanding the foregoing, the Owner agrees that it will use its best efforts to obtain approval of necessary funds to continue the Agreement by taking appropriate action to request adequate funds to continue the Agreement."

END OF GENERAL REQUIREMENTS

## EMPLOYEE DRUG TESTING REPORT FORM

Period Ending: \_\_\_\_\_

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors who work on Large Public Works Contracts funded all or in part with public funds submit Testing Report Forms to the Owner no less than quarterly.

Project Number: \_\_\_\_\_

Project Name: \_\_\_\_\_

Contractor/Subcontractor Name: \_\_\_\_\_

Contractor/Subcontractor Address: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Number of employees who worked on the jobsite during the report period: \_\_\_\_\_

Number of employees subject to random testing during the report period: \_\_\_\_\_

Number of Negative Results \_\_\_\_\_ Number of Positive Results \_\_\_\_\_

Action taken on employee(s) in response to a failed or positive random test:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Authorized Representative of Contractor/Subcontractor: \_\_\_\_\_  
(typed or printed)

Authorized Representative of Contractor/Subcontractor: \_\_\_\_\_  
(signature)

Date: \_\_\_\_\_





**EMPLOYEE DRUG TESTING  
REPORT OF POSITIVE RESULTS**

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors who work on Large Public Works Contracts funded all or in part with public funds to notify the Owner in writing of a positive random drug test.

Project Number: \_\_\_\_\_

Project Name: \_\_\_\_\_

Contractor/Subcontractor Name: \_\_\_\_\_

Contractor/Subcontractor Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Name of employee with positive test result: \_\_\_\_\_

Last 4 digits of employee SSN: \_\_\_\_\_

Date test results received: \_\_\_\_\_

Action taken on employee in response to a positive test result:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Authorized Representative of Contractor/Subcontractor: \_\_\_\_\_  
(typed or printed)

Authorized Representative of Contractor/Subcontractor: \_\_\_\_\_  
(signature)

Date: \_\_\_\_\_

**This form shall be sent by mail to the Owner within 24 hours of receipt of test results.**

**Enclose this test results form in a sealed envelope with the notation "Drug Testing Form – DO NOT OPEN" on the face thereof and place in a separate mailing envelope.**



**CONTRACT NO. NAT-201503/LITTLE CREEK**

**SECTION 2  
TECHNICAL SPECIFICATIONS**



## **SECTION 02 41 00 – DEMOLITION OF WATER CONTROL STRUCTURES**

### **PART 1 - GENERAL**

#### **1.01 UNIT PRICES**

##### **A. Demolition of North Water Control Structures – Base Bid**

1. Payment for “Demolition of North Water Control Structures” shall include all site and structural demolition work required to remove the existing North Water Control Structures shown on the Contract Drawings. This shall include, but is not limited to: all required excavation, removal of existing water control structures, removal of debris, removal of fasteners, selective demolition of existing timber retaining wall, and offsite disposal of all removed elements shown in the Contract Drawings.
2. Measurement: The quantity to be paid shall be the lump sum unit price quoted on the bid form for “Demolition of North Water Control Structures”.
3. Unit of Measure: Lump Sum (LS)

##### **B. Demolition of South Water Control Structures – Alternate No. 1**

1. Payment for “Demolition of South Water Control Structures” shall include all site and structural demolition work required to remove the existing South Water Control Structures shown on the Contract Drawings. This shall include, but is not limited to: all required excavation, removal of existing water control structures, removal of debris, removal of fasteners, selective demolition of existing timber retaining wall, and offsite disposal of all removed elements shown in the Contract Drawings.
2. Measurement: The quantity to be paid shall be the lump sum unit price quoted on the bid form for “Demolition of South Water Control Structures”.
3. Unit of Measure: Lump Sum (LS)

#### **1.02 REFERENCES**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO)
  1. AASHTO M 145 - Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
  2. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

- C. American Society of Safety Engineers (ASSE/SAFE)
  - 1. ASSE/SAFE A10.6 - Safety Requirements for Demolition Operations
- D. U.S. Army Corps of Engineers (USACE)
  - 1. USACE EM 385-1-1 - Safety and Health Requirements Manual

#### 1.03 PROJECT DESCRIPTION

- A. Demolition/Deconstruction Plan: Prepare a Schedule and submit proposed demolition and removal procedures for approval before work is started. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress. Plan shall be approved by Engineer prior to work beginning.
- B. General Requirements: Do not begin demolition or deconstruction until authorization is received from the Engineer. Remove rubbish and debris from Owner property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the Engineer. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

#### 1.04 ITEMS TO REMAIN IN PLACE

- A. Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Owner. Repair or replace damaged items as approved by the Engineer. Provide new supports and reinforcement for existing construction weakened by demolition, deconstruction, or removal work.
- B. Existing Construction Limits and Protection: Do not disturb beyond the extent indicated or necessary for installation of new construction.

#### 1.05 SUBMITTALS

- A. General: Submit the following to the Design Engineer for approval. Note that approval of submittals by the Engineer shall not be construed as relieving the Contractor from responsibility for compliance with the Specifications nor from responsibility of errors of any sort in the submittals.
  - 1. Preconstruction Submittals
    - a. Existing Conditions
    - b. Demolition Plan
  - 2. Closeout Submittals
    - a. Receipts

## 1.06 QUALITY ASSURANCE

- A. Notification: Submit timely notification to the client and the Engineer in writing 10 working days prior to the commencement of work. Comply with federal, state, and local hauling and disposal regulations. Use of explosives will not be permitted.

## 1.07 PROTECTION

- A. Perform the removal as indicated with workmen skilled in the trades involved. Repair or replace items which are damaged by the Contractor with new undamaged items as approved by the Engineer.

## 1.08 EXISTING CONDITIONS

- A. Before beginning any demolition or deconstruction work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Engineer showing the condition of facilities adjacent to areas of alteration or removal. Submit survey results.

## PART 2 - PRODUCTS

### 2.01 FILL MATERIAL

- A. Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to fill voids, depressions or excavations resulting from demolition or deconstruction of structures.
- B. Fill material shall conform to the definition of satisfactory soil material as defined in Specification Section 31 00 00 Earthwork. In addition, fill material shall be free from roots and other organic matter, trash, debris, frozen materials, and stones larger than 2 inches in any dimension.

## PART 3 - EXECUTION

### 3.01 CONCURRENT EARTH-MOVING OPERATIONS

- A. Do not begin excavation, filling, and other earth-moving operations that are sequential to demolition or deconstruction work in areas to be demolished or deconstructed until all demolition and deconstruction in the area has been completed and debris removed.

### 3.02 DISPOSITION OF MATERIAL

- A. Title to Materials: Except for salvaged items, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from Owner property. Title to materials resulting from demolition and deconstruction, and materials and equipment to be removed, is vested in the Contractor upon approval by the Engineer of the Contractor's demolition, deconstruction, and removal procedures, and authorization by the Engineer to begin demolition and deconstruction. The

Owner will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

### 3.03 CLEANUP

- A. Remove debris and rubbish from excavations. Remove and transport the debris in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

### 3.04 DISPOSAL OF REMOVED MATERIALS

- A. Regulation of Removed Materials: Dispose of debris, rubbish, scrap, and other non-salvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified. Storage of removed materials on the project site is prohibited.
- B. Burning on Owner Property: Burning of materials removed from demolished and deconstructed structures will not be permitted on Owner property.
- C. Removal from Owner Property: Transport waste materials removed from demolished and deconstructed structures, except waste soil, from Owner property for legal disposal. Dispose of waste soil as directed.

### 3.05 REUSE OF SALVAGED ITEMS

- A. Salvaged materials may be reused as approved by the Engineer.

END OF SECTION



## **02 46 00 – STEEL H-PILES**

### **PART 1 - GENERAL**

#### **1.01 UNIT PRICES**

##### **A. Furnish HP12x74 Piles – Base Bid and Alternate No.1**

1. **Payment:** Payment for “Furnish HP12x74 Piles” shall include furnishing the coated H-piles, transporting them to the project site, and storing them at the project site.
2. **Measurement:** The quantity to be paid shall be the number of feet of each pile size indicated, as ordered by the Contractor and reviewed by the Engineer. Unless otherwise specified, order lengths shall be based on the distance from the pile cut-off elevation to the minimum tip elevation established by the Contract Drawings. If a pile has to be lengthened during driving to achieve the required bearing capacity and/or penetration, then the additional length shall be measured on a vertical linear foot basis.
3. **Unit of Measure:** Vertical Linear Foot (VLF).

##### **B. Handling and Driving HP12x74 Piles – Base Bid and Alternate No. 1**

1. **Payment:** Payment for “Handling and Driving HP12x74 Piles” include handling, driving to required bearing and depth specified, cutting off excess pile top and disposing of cut-offs offsite.
2. **Measurement:** Handling and driving HP12x74 steel piles, including indicator piles, shall be measured on a per each basis.
3. **Unit of Measure:** Per Each (EA).

##### **C. Re-Strike HP12x74 Piles – Base Bid and Alternate No. 1**

1. **Payment:** Payment for “Re-Strike HP12x74 Piles” shall include moving the driving rig (as necessary), re-driving the pile, and recording the results of re-strike. No payment shall be made for re-striking piles up to one hour after initial drive or re-striking heaved piles.
2. **Measurement:** Re-striking steel H-piles shall be measured on a per each basis.
3. **Unit of Measure:** Per Each (EA).

##### **D. Field Splicing HP12x74 Piles – Base Bid and Alternate No. 1**

1. **Payment:** Payment for “Field Splicing HP12x74 Piles” shall include all materials, labor, and equipment associated with providing the pile splice detail shown in the Contract Drawings.

2. Measurement: Field Splicing HP12x74 Piles shall be measured on a per each basis.
3. Unit of Measure: Per Each (EA).

## 1.02 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. ASTM International (ASTM)
  1. ASTM A 572 (2015) – High-Strength Low-Alloy Columbium-Vanadium Structural Steel
  2. ASTM A 690 (2013a) – High-Strength Low-Alloy Nickel, Copper, Phosphorus Steel H-Piles and Sheet Piling with Atmospheric Corrosion Resistance for Use in Marine Environments
- C. American Welding Society, Inc. (AWS)
  1. AWS D1.1 - (2015) Structural Welding Code – Steel
  2. AWS D1.5 - (2010) Bridge Welding Code

## 1.03 SYSTEM DESCRIPTION

- A. The work covered by this Section includes the furnishing of all materials and equipment and the performing of all labor necessary to install steel H-piles as shown on the Contract Drawings and as herein specified or directed by the Engineer.

## 1.04 DEFINITIONS

- A. An indicator or test pile is a pile driven prior to production piles, that based upon driving resistance and load tests, is used to determine the ordering length and driving resistance of production piles.

## 1.05 SUBMITTALS

- A. General: Submit the following to the Design Engineer for approval. Note that approval of submittals by the Engineer shall not be construed as relieving the Contractor from responsibility for compliance with the Specifications nor from responsibility of errors of any sort in the submittals.
- B. Certifications, test procedures, and other submittals shall show the appropriate ASTM test(s) for each material.
- C. Statement of Contractor Qualifications

- D. Submit manufacturer's certified test reports, for each heat, indicating that materials have been tested and certified to meet the specified chemical, mechanical, and section properties prior to delivery at the site. Certifications shall be submitted for all materials, including but not limited to:
  - 1. Steel H-Piling (for each heat)
- E. Driving Equipment
  - 1. Pile hammer
    - a. Hammer classification (i.e. diesel, air/steam, etc.)
    - b. Hammer type (single acting, double acting, etc.)
    - c. Energy range
    - d. Weight of striking part
    - e. Total weight
    - f. Total length
    - g. Maximum stroke, if applicable.
  - 2. Driving helmets
  - 3. Capblocks
  - 4. Pile cushions
  - 5. Pile centering guide
  - 6. Leads
  - 7. Special driving shoes or points (if used)
  - 8. Vibratory hammer (if used)
  - 9. Driving template, gate, and other temporary structures for maintaining alignment and position of piling during installation
- F. Splices
  - 1. The Contractor shall submit the method of field splicing, including welding rod type, for approval by the Engineer.
  - 2. Welding procedures, qualifications, and testing shall be submitted in conformance with the requirements of Section 05 50 00, "Metal Fabrications."
- G. Qualifications
  - 1. Inspector
- H. Pile Driving Records
- I. Work Plan
  - 1. Submit work plan for steel H-pile installation, including but not limited to, proposed sequence of construction, equipment descriptions, anticipated production rates, equipment placement, template configurations, handling, cutoff and disposal plan, and other relevant installation information. Work plan shall be approved before ordering materials.

## 1.06 PROJECT SITE CONDITIONS

- A. Subsurface Data: Subsurface soil boring logs are included in Appendix 2 of these specifications. These data represent subsurface information at the boring locations; however, variations may exist in the subsurface between boring locations. Groundwater levels indicated on the soil boring logs were levels found at the time of exploration. The groundwater table can vary significantly depending on time of year, variation from normal precipitation, and river stage or tide level.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Materials delivered to the site shall be new and undamaged and shall be accompanied by certified test reports. The manufacturer's logo and mill identification mark shall be provided on the piling as required by the referenced specifications.
- B. H-piles shall be stacked during delivery and storage so that each pile is maintained in a straight position and is supported every 10 feet or less along its length (ends inclusive) to prevent exceeding the maximum permissible camber or sweep. Supports between multiple lifts shall be in a vertical plane. Piles shall not be stacked more than 5 feet high.
- C. Piles shall be lifted using a cradle or multiple point pick-up to ensure that the maximum permissible camber or sweep is not exceeded due to insufficient support, except that a one-point pick-up may be used for lifting piles that are not extremely long into the driving leads. Point pick-up devices for the piles shall be of the type that clamp to both pile flanges at each pick-up point. Holes may be burned in the flanges or webs of piles above the cutoff length for lifting piles into the leads. Piles shall not be dragged across the ground. The Contractor shall inspect piles for excessive camber and sweep and for damage before transporting them from the storage area to the driving area and immediately prior to placement in the driving leads. Camber, curvature in the pile in the direction normal to the pile flanges, shall be measured with the pile flange base laying on a flat surface and shall be the distance between the flange base at the mid-length of the pile and the flat surface. Sweep, curvature in the pile in the direction parallel to the pile flanges, shall be measured with the pile flange tips laying on a flat surface and shall be the distance between the flange tips at the mid-length of the pile and the flat surface. The maximum permissible camber or sweep shall be 2 inches over the length of the pile. Piles having excessive camber or sweep will be rejected. Camber and sweep for casings shall be as required for achieving the specified tolerances for piling.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Steel H-Piles: ASTM A 572, Grade 50 or ASTM A 690.
- B. Welding materials: AWS D1.5

## 2.02 STEEL COATING SYSTEM

- A. Steel H-Piles shall be coated in accordance with Section 09 97 00, "Coating of Steel Waterfront Structures."

## 2.03 EQUIPMENT

### A. Pile Driving Hammer

1. Furnish a hammer capable of developing the indicated ultimate pile capacity considering the hammer impact velocity; ram weight; stiffness of hammer and pile cushions; cross section, length, and total weight of pile; and character of subsurface material to be encountered. Use the same type pile hammer, operating at the same rate and in the same manner, as that used for driving test piles. The striking part of the hammer shall in all cases be of sufficient and proper size to drive the pile to the required depth and/or penetration resistance and load capacity, without damage to the pile.
2. H-piles may be driven with air, steam, diesel, or hydraulic hammers.
  - a. The plant and equipment furnished for air/steam hammers shall have sufficient capacity to maintain at the hammer, under working conditions, the volume and pressure specified by the manufacturer. The plant and equipment shall be equipped with accurate pressure gauges which are easily accessible to the Engineer. The weight of the striking parts of air and steam hammers shall not be less than 1/3 the weight of helmet and pile being driven, and in no case shall the striking parts weigh less than 2750 pounds.
  - b. Open-end (single acting) diesel hammers shall be equipped with a device such as a jump stick to permit the Engineer to visually determine hammer stroke at all times during pile driving operations. Also, the Contractor shall provide the Engineer a chart from the hammer manufacturer equating stroke and blows per minute for the open-end diesel hammer being used.
  - c. Closed-end (double acting) diesel hammers shall be equipped with a bounce chamber pressure gauge, in good working order, mounted near ground level so as to be easily read by the Engineer. Also, the Contractor shall provide the Engineer a chart, calibrated to actual hammer performance within 90 days of use, equating bounce chamber pressure to either equivalent energy or stroke for the closed-end diesel hammer to be used.
  - d. The power plant for hydraulic hammers shall have sufficient capacity to maintain at the hammer, under working conditions, the volume and pressure specified by the manufacturer. The power plant and equipment shall be equipped with accurate pressure gauges which are easily accessible to the Engineer.

B. Approval of Pile Driving Equipment

1. All pile driving equipment furnished by the Contractor shall be subject to the approval of the Engineer. It is the intent of this Specification that all pile driving equipment is sized in such a way that the project piles can be driven with reasonable effort without damage.

C. Drive System Components and Accessories

1. Hammer Cushion: Impact pile driving equipment designed to be used with a hammer cushion shall be equipped with a suitable thickness or hammer cushion material to prevent damage to the hammer or pile and to insure uniform driving behavior. Hammer cushions shall be made of durable manufactured materials, provided in accordance with the hammer manufacturer's guidelines. Wood, wire rope, and asbestos hammer cushions are specifically disallowed and shall not be used. A striker plate as recommended by the hammer manufacturer shall be placed on the hammer cushion to insure uniform compression of the cushion in the presence of the Engineer after each 100 hours of pile driving. Any reduction of hammer cushion thickness exceeding 25% of the original thickness shall be replaced by the Contractor before driving is permitted to continue.
2. Helmet: Piles driven with impact hammers require an adequate helmet or drive head to distribute the hammer blow to the pile head. The helmet shall be axially aligned with the hammer and pile. The helmet shall be guided by the leads and not be free-swinging. The helmet shall fit around the pile head in such a manner as to prevent transfer of torsional forces during driving, while maintaining proper alignment of hammer and pile.
3. Leads: Piles shall be supported in line and position with leads while being driven. Pile driver leads shall be constructed in a manner that affords freedom of movement of the hammer while maintaining alignment of the hammer and the pile to insure concentric impact for each blow. Leads may be either fixed or swinging type. Swinging leads, when used, shall be fitted with a pile gate at the bottom of the leads and, in the case of batter piles, a horizontal brace may be required between the crane and the leads. The pile section being driven shall not extend above the leads. The leads shall be adequately embedded in the ground or the pile constrained in a structural frame such as a template to maintain alignment. The leads shall be of sufficient length to make the use of a follower unnecessary, and shall be so designed as to permit proper alignment of batter piles.
4. Template: Use a system of structural framing sufficiently rigid to resist lateral and driving forces and to adequately support the piling until design pile capacity and/or minimum tip elevation is achieved. Use templates or guide structures of a spacing and configuration that is appropriate for the length and batter of piling being installed. Templates and other guide structures shall not move when supporting piling. The template configuration is the responsibility of the Contractor.
5. Followers: Followers may be used for underwater pile installation.
6. Skirt: If a diesel hammer is used, it must be equipped with a skirt or sleeve to prevent fuel spray.

## PART 3 - EXECUTION

### 3.01 EXAMINATION AND PREPARATION

- A. Inspect piles when delivered and when in the leads immediately before driving. Where cut off is below existing ground or mudline elevation, complete excavation, sheeting, dewatering, and backfilling before pile is driven to cut off elevation.
- B. Prior to driving, the pile shall be marked continuously at 1 foot intervals with paint or keel beginning at an appropriate length above water level to allow delineation of pile length during installation.
- C. The heads of all piles shall be plane and perpendicular to the longitudinal axis of the pile before the helmet is attached.

### 3.02 TEST PILE PROGRAM

- A. Drive indicator piles at the locations shown on the Contract Drawings.
- B. Drive H-piles to the penetration criteria established by the wave equation analysis to achieve the ultimate pile capacities shown on the Contract Drawings. See Section 02 46 80, "High-Strain Dynamic Pile Testing," for wave equation analysis requirements.
- C. Restrike the indicator piles after a minimum waiting period of seven (7) days.
- D. Monitor both initial drive and restrike using the Pile Driving Analyzer (PDA) as specified in Section 02 46 80, "High-Strain Dynamic Pile Testing."
- E. Upon completion of the indicator pile program, the Dynamic Testing Consultant will review the available data and establish a recommended pile driving criteria for installation of production piles, subject to approval by the Engineer. Pile driving criteria shall be established based on revised WEAP criteria developed considering restrike and load test data.
- F. The actual tip elevations for the indicator piles shall be used in conjunction with the estimated tip elevations and soil profiles given in the Contract Drawings to determine order lengths for the piling. After driving of the indicator piles in the respective east and west water control structure tandems is complete, the Contractor shall submit his proposed pile order lengths for that area to the Engineer for approval.

### 3.03 PRODUCTION PILE INSTALLATION

- A. Proposed use of a vibratory hammer to provide initial advancement of H-Piles shall only be permitted by way of written approval from the Engineer. The Engineer reserves the right to evaluate use of vibratory installation on a per case basis, and shall consider the specific subsurface condition at the respective water control structure locations. Vibratory installation shall be limited or shall

not be used where, in the opinion of the Engineer; it adversely affects driving installation or other components or areas of the work.

- B. The Contractor is responsible for providing a temporary outboard cofferdam configuration that accommodates the clear passage of all permanent steel H-Piles during driving. The Contractor is solely responsible for resolving any conflicts or obstructions resulting from the location of his embedded temporary shoring. At no additional cost to DENREC, the Contractor shall extract and replace any and all damaged piles resulting from conflicts with his temporary shoring systems.
- C. Take care to avoid damaging piles during handling, placing in the leads, and driving. Square the heads and tips of piles to the driving axis. Laterally support piles during driving, but do not unduly restrain piles from rotation in the leads. Where pile or projecting reinforcement orientation is essential, take measures to maintain the orientation during driving. Carefully support battered piles to prevent excessive bending stresses in the pile.
- D. Drive production piles in accordance with the established driving criteria. Drive piles with the same hammer, cushion, or cap block, and use the same operating conditions as the test piles. If a pile fails to reach the tip elevation or if the required driving resistance is reached before the pile tip elevation, notify the Engineer; the Engineer will determine the procedure to be followed.
- E. If upon reaching the estimated tip elevation, the pile has not attained the specified penetration resistance, the Contractor shall stop driving. After a period of at least 48 hours, the Contractor shall restrike the pile with or without performing dynamic analysis, as directed by the Engineer. If the pile has still not attained the specified bearing capacity, then the Engineer shall direct the Contractor to what corrective measures are required, such as splicing or driving additional piles.
- F. If an obstruction is encountered during driving, the Contractor shall extract the pile and then determine the depth and lateral extent of the obstruction by probing. The Engineer shall then determine whether the obstruction should be removed, the pile offset, or additional piles driven.
- G. Splicing
  - 1. Splicing, when anticipated, shall be done prior to the start of driving so that there is no interruption during driving operations; provide piles for their full anticipated length.
  - 2. Splicing of H-piles shall be a full penetration butt for the full periphery in accordance with Section 05 50 00, "Metal Fabrications" and as indicated on the Contract Drawings. Splices shall develop the full strength of the pile in compression, tension, and bending.
  - 3. The number of splices permitted shall be compatible with driving conditions at the site and the standard lengths of piling recommended by manufacturers.
  - 4. Pile lengths spliced shall be in proper alignment so that no eccentricity exists between the axes of the two spliced lengths.



- H. Jetting of piles is not permitted.
- I. Pre-drilling of piles is not permitted.
- J. Cut-offs
  - 1. The tops of all piles shall be cut off at the elevations specified on the Contract Drawings and on a true plane parallel with the foundation slab surface unless otherwise specified.
  - 2. The Contractor shall dispose of cut-offs offsite.

#### 3.04 TOLERANCES

- A. Tolerances specified are not mutually exclusive. All piles shall be driven within all of the specified tolerances. Manipulation of driven piles is not allowed.
- B. At cut off elevation, butts shall be within 4 inches of the horizontal location shown on the Contract Drawings.
- C. Top of pile after cut-off shall be within 1/2-inch of the cut-off elevation indicated on the Contract Drawings.
- D. A maximum variation of 0.25 inch per foot of pile length from the vertical for plumb piles or 0.50 inch per foot of pile length from the required angle for batter piles is permitted.
- E. Plumb piles may be rotated from the as-planned axis. Batter piles may not be rotated from the as-planned axis.
- F. The clear distance between the heads of piles and the edges of concrete foundation mats shall be at least 4 inches. If approved in advance by the Engineer, the Contractor may provide additional concrete and reinforcement to maintain the required minimum clear distance. Redesign of concrete foundation mat or additional work required due to improper location of piles is the Contractor's responsibility.
- G. Heaved piles which have been forced up by more than 0.25-inches by any cause shall be redriven. Inspect piles for heave after all piles within a 50-foot radius have been driven.

#### 3.05 PILE DRIVING RECORDS

- A. The Contractor shall employ the services of a third party inspector to monitor pile installation and keep all records as required below. The Engineer may also have a representative observing pile driving operations and keeping records as noted below. All direction as required by the pile driving operation shall be the sole responsibility of the Contractor. The Engineer's representative is only an observer.

- B. The inspector shall keep a complete and accurate record of each pile driven. Indicate the pile location, deviation from indicated location, cross section shape and dimensions, original length, ground elevation, tip elevation, cut off elevation, penetration in blows per foot for the entire length of penetration, penetration in inches per blow for the last ten blows, hammer data including rate of operation, make, and size, and all unusual pile behavior or circumstances experienced during driving such as re-driving, heaving, weaving, obstructions, jetting, predrilling, and unanticipated interruptions. Make pile driving records available to the Engineer at the site within 24 hours of completion of driving each pile. Submit complete records of installed piles to Engineer within 15 calendar days after completion of the pile driving.
- C. Notify the Engineer immediately of any unusual pile behavior or problems during driving.
- D. Provide actual tip elevations in digital format for the Pile Schedule on the As-Built Contract Drawings.

END OF SECTION

## **02 46 40 – STEEL SHEET PILING**

### **PART 1 - GENERAL**

#### **1.01 UNIT PRICES**

##### **A. STEEL SHEET PILES**

1. Payment: Payment for steel sheet piling associated with the water control structures shall be included under the unit prices bid for the following items: “48 in Pipe Steel Superstructure” and “24 in Pipe Steel Superstructure”. The price shall include furnishing coated steel sheet piling, transporting them to the project site, storing them at the site, handling, driving to required tip elevation, splicing, cutting off excess pile top, disposing of cutoffs offsite, sheet pile location surveys, and all work incidental thereto.
2. Measurement: Steel sheet piling is not measured.
3. Unit of Measure: N/A

#### **1.02 REFERENCES**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM)
  1. ASTM A 6 – (2014) General Requirements for Rolled Structural Steel Bars, Plates, Shapes and Sheet Piling
  2. ASTM A 325 – (2014) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
  3. ASTM A 572 – (2015) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
  4. ASTM A 690 – (2013a) High-Strength Low-Alloy Nickel, Copper Phosphorous Steel H-Piles and Sheet Piling with Atmospheric Corrosion Resistance for Use in Marine Environments
- C. American Welding Society (AWS)
  1. AWS D1.1 – (2015) Structural Welding Code – Steel

#### **1.03 SYSTEM DESCRIPTION**

- A. The work covered by this Section includes the furnishing of all materials and equipment and the performing of all labor necessary to construct permanent hot-rolled steel sheet pile walls as shown on the Contract Drawings and as herein specified or directed by the Engineer. Work includes, but is not limited to,

preparation, line clearing, templates, metal fabrications, driving, cutting splicing, inspecting, recording, and all other associated work.

#### 1.04 SUBMITTALS

- A. General: Submit the following to the Design Engineer for approval. Note that approval of submittals by the Engineer shall not be construed as relieving the Contractor from responsibility for compliance with the Specifications nor from responsibility of errors of any sort in the submittals.
- B. Certifications, test procedures, and other submittals shall show the appropriate ASTM test(s) for each material.
- C. Submit manufacturer's certified test reports, for each heat, indicating that materials have been tested and certified to meet the specified chemical, mechanical, and section properties prior to delivery at the site. Certifications shall be submitted for all materials, including but not limited to:
  - 1. Steel sheet piling
  - 2. Structural steel plate and shapes
  - 3. Bolting materials
- D. Welding procedures, qualifications, and testing shall be submitted in conformance with the requirements of Section 05 50 00, "Metal Fabrications."
- E. Shop Drawings: Submit drawings for approval prior to start of work or ordering materials. Drawings for sheet piling shall include complete dimensions, minimum section properties, fabricated sections, and an overall layout including interface with the water control structure foundation and steel superstructure. Include details of top protection, special reinforcing tips, tip protection, lagging, splices, fabricated additions to plain piles, and corrosion protection.
- F. Work Plans
  - 1. The Contractor shall submit to the Engineer details of equipment, materials, methods, and procedures for the following items:
    - a. Sheet Pile Installation: Plan shall include methods for handling piling, driving, and cut-off methods, details and dimensions of templates and other temporary guide structures for installing the piling.
    - b. Pulling piling
    - c. Clearing obstructions
    - d. The work plans shall provide details of the method of handling piling to prevent permanent deflection, distortion, or damage to piling interlocks.
  - 2. Approval by the Engineer will not relieve the Contractor of his responsibility to perform work in accordance with the contract documents and Specifications.
- G. Driving Equipment
  - 1. Pile hammer
  - 2. Hammer classification (i.e. diesel, air/steam, vibratory, etc.)

3. Hammer type (single acting, double acting, etc.)
  4. Energy range
  5. Weight of striking part, if applicable
  6. Total weight
  7. Total length
  8. Maximum stroke, if applicable
  9. Driving helmets
  10. Capblocks
  11. Pile centering guide
- H. Pile Driving Records: Submit pile driving records in accordance with the requirements herein.
- I. As Built Drawings: Submit marked up drawings showing all deviations from planned arrangement or details that occurred during construction.

#### 1.05 QUALITY ASSURANCE

- A. The Contractor shall be fully experienced in all aspects of steel sheet pile installation. The firm shall be thoroughly experienced in similar installations under like subsurface conditions. The Contractor shall submit a list of similar installations performed in the last five (5) years.
- B. Before beginning work, the Contractor shall submit details of the piling to be furnished, the pile driving equipment and a description of the proposed method of installation including pile splicing; all shall be subject to the approval of the Engineer.

#### 1.06 PROJECT SITE CONDITIONS

- A. Subsurface Data: Subsurface soil boring logs are included in Appendix 2 of these specifications. These data represent subsurface information at the boring locations; however, variations may exist in the subsurface between boring locations. Groundwater levels indicated on the soil boring logs were levels found at the time of exploration. The groundwater table can vary significantly depending on time of year, variation from normal precipitation, and river stage or tide level.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Materials delivered to the site shall be new and undamaged and shall be accompanied by certified test reports. The manufacturer's logo and mill identification mark shall be provided on the sheet piling as required by the referenced specifications.
- B. Steel sheet piling shall be stored and handled in the manner recommended by the manufacturer to prevent permanent deflection, distortion, or damage to the interlocks. Support on level blocks or racks spaced not more than 10 feet apart and not more than 2 feet from the ends. Supports between multiple lifts shall be in a vertical plane. Storage of sheet piling should also facilitate required inspection activities.

- C. Protect piling to prevent damage to coatings and to prevent corrosion prior to installation.
- D. Sheet piling over 80 feet in length shall be handled using a minimum of two pickup points.

## PART 2 - PRODUCTS

### 2.01 STEEL SHEET PILING

- A. Provide heavy gage, hot-rolled steel sheet pile conforming to ASTM A 572, Grade 50 or ASTM A 690.
- B. Cutoff and closure walls shown on the Contract Drawings is based on a PZ 22 steel sheet piling with a minimum elastic section modulus of 18.1 cubic inches per foot width.
- C. Testing of steel sheet piling shall meet the requirements of ASTM A 6.
- D. The interlocks of sheet piling shall be hot-rolled and free-sliding, provide a swing angle suitable for the intended installation, but not less than five (5) degrees.
- E. Corners may be hot-rolled shapes or fabricated from ASTM A 572, Grade 50 structural steel. Fabricated units shall be bolted using bolts, washers, and nuts conforming to ASTM A 325.
- F. Sheet piling including special fabricated sections and hot-rolled interlock shapes, shall be full-length sections of the dimensions shown on the Contract Drawings.

### 2.02 STEEL PLATES

- A. Structural steel plates for splices and other fabrication appurtenances shall conform to ASTM A 572, Grade 50.

### 2.03 BOLTS, NUTS, AND WASHERS

- A. ASTM A 325, Type 1 or 2.

### 2.04 STEEL COATING SYSTEM

- A. Steel H-Piles shall be coated in accordance with Section 09 97 00, "Coating of Steel Waterfront Structures."

## PART 3 - EXECUTION

### 3.01 ORDER LENGTHS

- A. Base bids on the number, size, and length of piles from cut-off to the estimated tip elevations shown on the Contract Drawings.

- B. Submit pile type, material grade, and order lengths for review by Engineer prior to placing order.

### 3.02 STEEL SHEET PILING INSTALLATION

- A. For steel sheet piling not requiring a driven embedment, the elements shall be handled, placed, and connected in accordance with the requirements specified by the manufacturer and the Contract Documents. Piling shall be handled in a manner to prevent permanent deflection, distortion, or damage to the interlocks.
- B. For steel sheet piling specified to be driven in the Contract Drawings, furnish a hammer capable of providing sufficient force or energy to achieve the required pile penetration considering the cross section, length, and total weight of pile; and character of subsurface material to be encountered. Operate at the rate(s) recommended by the manufacturer throughout the entire driving period. Repair damage to piling caused by use of a pile hammer with excess delivered force or energy. In the event a diesel hammer is employed, it shall be equipped with a skirt to prevent fuel spray.
- C. Place driving helmet, or cap and cushion block combination, capable of protecting the head of the pile between top of pile and the ram to prevent impact damage to pile. The helmet or block shall uniformly transmit energy to pile with a minimum loss of energy.
- D. Prior to driving, the pile shall be marked continuously at 1 foot intervals with paint or keel beginning at an appropriate length above ground (or water) level to allow delineation of pile length during installation.
- E. Provide a template or driving frame suitable for aligning, supporting, and maintaining piling in the correct position during setting and driving. Use a system of structural framing sufficiently rigid to resist lateral and driving forces and to adequately support the piling until design tip elevation is achieved.
- F. Pile Driving: Steel sheet pile system shall be carefully and accurately located as shown on the plans. Maintain piling vertical during driving. Drive piles in such a manner as to prevent damage to the piles and to provide a continuous closure. Coordinate driving of steel sheet piling with the installation of steel H-piles as stipulated in Section 02 46 00, "Steel H-Piles". Where possible, drive pile with the ball end leading. If an open socket is leading, a bolt or similar object placed in the bottom of the interlock will minimize packing material into it and ease driving for the next sheet. Incrementally sequence driving of individual piles such that the tip of any sheet pile shall not be more than 4 feet below that of any adjacent sheet pile. When the penetration resistance exceeds five blows per inch, the tip of any pile shall not be more than 2 feet below any adjacent sheet pile.
- G. Obstructions: If obstructions restrict driving a piling to the specified elevation the obstruction shall be removed or penetrated with a chisel beam at no additional cost to DENREC. If the Contractor demonstrates that removal or penetration is impractical, the Engineer shall modify the alignment of the piling to maintain the integrity of the structure.

- H. Jetting: Jetting of piles is not permitted.
- I. Splicing
  1. Piles driven below the required top elevation and piles damaged by driving and cut off to permit further driving shall be extended as required to reach the top elevation by splicing when directed by the Engineer.
  2. If splices are required in adjoining piles the splices must be spaced at least 2 feet apart in elevation.
  3. Splicing of sheet piles shall be performed using a full penetration weld. Welding of splices shall conform to the requirements of AWS D1.1 and Section 05 50 00, "Metal Fabrications." Ends of piles to be spliced shall be squared before splicing to eliminate dips or camber. Splice piles with concentric alignment of the interlocks so that there are no discontinuities, dips or camber at the abutting interlocks.
  4. Spliced piles shall be free-sliding and able to obtain the maximum swing with contiguous piles.
  5. Repair coating on and around patches in accordance with Section 09 97 00, "Coating of Steel Waterfront Structures."
- J. Patching: Holes in sheet piles not embedded in concrete caps shall be made watertight by welding steel plates over the holes after the pile installation is complete. Repair coating on and around patches in accordance with Section 09 97 00, "Coating of Steel Waterfront Structures."

### 3.03 INSTALLATION RECORDS

- A. Maintain a pile driving record for each sheet pile.
- B. Indicate on the installation record installation dates and times, type and size of hammer, rate of operation, total driving time, dimensions of driving helmet and cap used, blows or time for vibratory hammer required per foot for the final 5 feet of penetration, final driving resistance or time for vibratory hammer in blows for final 6 inches, pile locations, tip elevations, ground elevations, cut-off elevations, and any reheading or cutting of piles.
- C. Record any unusual pile driving problems during driving. Notify the Engineer of any such occurrences.

### 3.04 POST SHEET PILE INSTALLATION SURVEY

- A. Within seven (7) days of the sheet pile installation, provide an independent third party surveyor to survey the horizontal and vertical position of the top of the sheet piling. The horizontal position of the pile shall be recorded in terms of station and offset relative to the appropriate centerline of construction. Upon completion of the survey, the third party surveyor shall submit a spreadsheet summarizing the as driven location of the sheet piling and any deviation from the plan position.

### 3.05 PILE TIP ELEVATIONS

- A. Piles shall be driven to the tip elevations indicated on the Contract Drawings.



### 3.06 TOLERANCES

- A. At cut off elevation, the top of sheet pile shall be within 3 inches of the location shown on the Contract Drawings.
- B. A maximum variation of 0.25 inch per foot of pile length from the vertical is allowed.
- C. The clear distance between the heads of sheet piles and the edges of concrete pile caps shall be at least 4 inches. If approved in advance by the Engineer, the Contractor may provide additional concrete and reinforcement to maintain the required minimum clear distance. Redesign of pile caps or additional work required due to improper location of piles is the Contractor's responsibility.
- D. Manipulation of sheet piles to achieve the specified tolerances is not permitted.

### 3.07 PILE CUT-OFFS

- A. The tops of all piles shall be cut off at the elevations specified on the Contract Drawings and on a true plane perpendicular to the axis of the pile unless otherwise specified.
- B. Pile cut-offs shall become the property of the Contractor and shall be disposed of offsite.
- C. Trim the tops of piles excessively battered during driving, when directed, at no additional cost. Use a straight edge in cutting by burning to avoid abrupt nicks. Do not use explosives for cutting.

### 3.08 FIELD REPAIR OF COATING DAMAGE

- A. Repair coating in accordance with Section 09 97 00, "Coating of Steel Waterfront Structures."

END OF SECTION

## **02 46 80 – HIGH-STRAIN DYNAMIC PILE TESTING**

### **PART 1 - GENERAL**

#### **1.01 UNIT PRICES**

- A. Dynamic Pile Test HP12x74 Piles – Base Bid and Alternate No. 1
  - 1. Payment for “Dynamic Pile Test HP12x74 Piles” shall include providing the wave equation analysis, furnishing the pile driving analyzer equipment, monitoring the driving, and preparing dynamic testing report. This work shall be performed during initial driving and shall include the cost of restriking the pile up to one (1) hour after initial drive.
  - 2. Measurement: The quantity to be paid shall be the number of high strain dynamic pile tests actually conducted.
  - 3. Unit of Measure: Per Each (EA).
- B. Dynamic Pile Test Re-Strike HP12x74 Piles – Base Bid and Alternate No. 1
  - 1. Payment for “Dynamic Pile Test Re-Strike HP12x74 Piles” shall include furnishing the pile driving analyzer equipment, monitoring the driving, and preparing dynamic testing report.
  - 2. Measurement: Restrikes for high-strain dynamic pile testing shall be measured on a per each basis for each pile tested.
  - 3. Unit of Measure: Per Each (EA).

#### **1.02 REFERENCES**

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. Unless otherwise indicated, the most recent edition of the publication, including any revisions, shall be used.
- C. American Society for Testing and Materials (ASTM)  
ASTM D 4945 - (2012) High-Strain Dynamic Testing of Deep Foundations

#### **1.03 SUBMITTALS**

- A. General: Submit the following to the Design Engineer for approval. Note that approval of submittals by the Engineer shall not be construed as relieving the Contractor from responsibility for compliance with the Specifications nor from responsibility of errors of any sort in the submittals.
- B. Dynamic Testing Consultant Qualifications
- C. Wave Equation Analysis

1. Submit wave equation analysis as described in paragraph entitled "Preconstruction Wave Equation Analyses" of this Section to support selection of driving equipment.
2. Analysis shall be submitted for each type, size, and batter configuration of piles specified.
3. Submittal should summarize the required driving resistance, maximum compressive stress, and maximum tensile stress anticipated based on the analysis.
4. Submit at least two (2) weeks prior to pile installation.
5. Should the proposed driving equipment for any pile type be changed at any time during the term of the Contract the wave equation analysis shall be resubmitted for that equipment.

D. Dynamic Testing Reports

E. Refined Wave Equation Analysis

1. Following completion of the test pile program, submit refined wave equation analysis as described in this Specification.
2. Analysis shall be submitted for each type, size, and batter configuration of piles specified. Submittal shall summarize the required driving resistance, maximum compressive stress, and maximum tensile stress anticipated based on the analysis.
3. Recommended pile driving criteria.

1.04 QUALITY ASSURANCE

- A. The Contractor shall retain the services of a Dynamic Testing Consultant (DTC) with at least three (3) years experience performing PDA testing services. The DTC shall be in charge of PDA operation and of result interpretation, either on site or by remote connection (PAL-R).
- B. The Dynamic Testing Consultant shall be a third-party Professional Engineer licensed in the State of Delaware and hired by the Contractor. The qualifications of the third-party Engineer shall be submitted to the Engineer for approval.

1.05 DEFINITIONS

- A. An indicator pile is a pile driven prior to production piles that, based upon driving resistance and load tests, is used to determine the ordering length and driving resistance of production piles.
- B. Minimum Steel Yield Strength ( $F_y$ )

## 1.06 SUBSURFACE INFORMATION

- A. Subsurface Data: Subsurface soil boring logs are included in Appendix 2 of these specifications. These data represent subsurface information at the boring locations; however, variations may exist in the subsurface between boring locations. Groundwater levels indicated on the soil boring logs were levels found at the time of exploration. The groundwater table can vary significantly depending on time of year, variation from normal precipitation, and river stage or tide level.

## 1.07 EQUIPMENT AND PERSONNEL

- A. The dynamic monitoring shall be performed using a Pile Driving Analyzer Model PAK or PAL. The Dynamic Testing Consultant shall furnish all equipment necessary for the dynamic monitoring such as gages, cables, etc. The equipment shall conform to the requirements of ASTM D 4945. The approved Dynamic Testing Consultant shall operate the Pile Driving Analyzer in the field.
- B. The Contractor shall provide power capable of operating an electric drill or a DC drill to prepare the pile for transducer attachment.
- C. The Contractor shall provide a 12 to 24 volt D.C. power source (e.g. car battery) for operating the Pile Driving Analyzer.

## PART 2 - EXECUTION

### 2.01 CONSTRUCTION ACCESS

- A. Prior to lifting the pile to be dynamically tested, the Contractor shall provide a minimum of 3 feet of clear access to 180 degree opposite faces of the pile for pile preparation. The Dynamic Testing Consultant or the Contractor's personnel shall then drill and prepare holes in the pile for attachment of sensors.
- B. The Contractor's personnel shall fasten a pair of transducers and a pair of accelerometers to the pile after the pile has been lightly seated in position for driving. Driving shall then continue using routine pile installation procedures. When the sensors approach the ground surface, water surface, or a pile template, driving shall be halted to remove the sensors from the pile to prevent damage to the sensors.

### 2.02 TESTING PROCEDURES

- A. Preconstruction Wave Equation Analyses
  - 1. Two (2) weeks prior to driving the piles, the Contractor shall submit the pile and complete driving equipment data form to the Engineer. The Dynamic Testing Consultant shall use the submitted information to perform wave equation analyses and shall prepare a summary report of the wave equation results. The wave equation analyses shall be used to assess the ability of the proposed driving system to install the pile to the required capacity and desired penetration depth within the allowable

driving stresses. Drivability to the estimated tip elevation indicated on the Contract Drawings shall be evaluated.

2. Wave equation analysis (GRLWEAP version 2005 or newer) shall consider at least the following:
  - a. Hammer impact velocity
  - b. Hammer energy
  - c. Hammer ram weight
  - d. Hammer ram stroke
  - e. Driving helmet and cushion
  - f. Hammer cushion or capblock
  - g. Pile size, weight and length
  - h. Character of subsurface material to be encountered
  - i. Effective pile prestress
  - j. Pile stresses during driving (compression and tension)
  - k. Pile design load
  - l. Ultimate pile capacity
  - m. Pile penetration
3. Approval of the proposed driving system by the Engineer shall be based upon the wave equation analyses indicating that the proposed driving system can develop the required ultimate pile capacity (and minimum tip elevation, when applicable), indicated on the Contract Drawings, at an acceptable driving resistance not greater than 12 blows per inch within allowable driving stress limits. The hammer shall also be sized such that the penetration per blow at the required ultimate capacity does not exceed 1/2-inches.
4. The Dynamic Testing Consultant shall recommend preliminary driving criteria based on this wave equation analysis and anticipated soil strength changes after driving, subject to further dynamic testing results. A new pile driving system, modifications to existing system, or new pile installation procedures shall be proposed by the Contractor if the pile installation stresses predicted by wave equation analysis or calculated by the Pile Driving Analyzer exceed the following maximum values:
  - a. Steel Piles  
Compression Stresses:  $0.9(F_y)$   
Tension Stresses:  $0.9(F_y)$

B. Indicator Pile Program

1. Indicator piles shall be driven to the required ultimate capacity based upon the preliminary driving resistance indicated by wave equation results. Adjustments to the preliminary driving criteria may be made by the Engineer based upon the dynamic testing results of both initial driving and restrike tests.
2. All indicator piles shall be redriven with dynamic testing after a minimum waiting period of seven (7) days. The restrike shall be performed with a warmed up hammer and shall consist of striking the piles for 20 blows or until the pile penetrates an additional three inches, whichever occurs first.

In the event the pile movement is less than 1/2-inch during the restrike, the restrike may be terminated after 10 blows.

3. A new pile driving system, modifications to existing system, or new pile installation procedures shall be proposed by the Contractor if the pile installation stresses calculated by the Pile Driving Analyzer exceed the maximum values discussed above.

C. Production Pile Testing

1. Dynamic pile testing (PDA and CAPWAP) shall be performed on approximately 2% of the piles during restrike over the duration of the production pile installation.
2. The Engineer may request additional piles to be dynamically tested if the hammer and/or driving system is replaced or modified, the pile type or installation procedures are modified, the pile capacity requirements are changed, unusual blow counts or penetrations are observed, or if any piling behavior differs from normal installation.

## 2.03 DYNAMIC TESTING REPORTS

A. Test Pile Program

1. The Dynamic Testing Consultant shall prepare a written report of the test pile program in accordance with ASTM D 4945. This report shall include a discussion of the pile capacity results obtained from the dynamic testing and comparison with static testing results, if performed. The report shall also discuss hammer and driving system performance, driving stress levels, and pile integrity.
2. The Dynamic Testing Consultant shall perform rigorous laboratory wave analysis of the measured data using the Case Pile Wave Analysis Program (CAPWAP) on data obtained from the end of initial driving and the beginning of restrike of all the test piles. The Engineer may request additional analyses at selected pile penetration depths to investigate potential alternate bearing layers.
3. The Dynamic Testing Consultant shall perform a refined wave equation analysis or analyses based upon the variations in the subsurface conditions and/or drive system performance observed in the indicator pile program results.

B. Production Piles

1. Within one (1) day of production pile testing, the Dynamic Testing Consultant shall prepare a hand written daily field report summarizing the dynamic testing results. As a minimum, the daily reports shall included the calculated driving stresses, transferred energy, and estimated pile capacity at the time of testing. Variations from previous dynamic pile tests shall also be noted.
2. CAPWAP analyses shall be performed on all of the production piles dynamically tested.

3. Not more than ten (10) working days following testing, the Dynamic Testing Consultant shall prepare a written report in accordance with ASTM D 4945 summarizing the dynamic testing results.

#### 2.04 PRODUCTION PILE DRIVING

- A. Upon completion of the test pile program the Dynamic Testing Consultant will review the available data and establish a recommended pile driving criteria for installation of production piles. Pile driving criteria shall be established based on revised WEAP criteria developed after considering restrike and load test data.

END OF SECTION

## **02 54 00 – CHAIN LINK FENCES AND GATES**

### **PART 1 - GENERAL**

#### **1.01 UNIT PRICES**

- A. Chain Link Fence – Base Bid and Alternate No. 1
  - 1. Payment for “Chain Link Fence,” shall include supply and placement of posts, base plate connections, fabric, and fittings to the satisfaction of the Engineer.
  - 2. Measurement: Chain Link Fence shall be measured on a per linear foot basis. This quantity shall be the total length in linear feet of fence.
  - 3. Unit of Measure: Linear Foot (LF)
- B. Chain Link Personnel Gate – Base Bid and Alternate No. 1
  - 1. Payment for “Chain Link Personnel Gate” shall include supply and placement of posts, base plate connections, fabric, and fittings to the satisfaction of the Engineer.
  - 2. Measurement: The quantity to be paid shall be the number of chain link personnel gates to be erected.
  - 3. Unit of Measure: Per Each (EA).

#### **1.02 SUMMARY**

- A. The work covered by this Section shall include the furnishing of all material and equipment and the performing of all labor to install the security fence and gates as shown on the Contract Drawings and as herein specified or directed by the Engineer.
- B. This work shall include but is not limited to: Installation of 8' Chain-Link Security Fence and Gates.

#### **1.03 REFERENCES**

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. Unless otherwise indicated, the most recent edition of the publication, including any revisions, shall be used.
- C. American Association of State Highway and Transportation Officials
  - 1. AASHTO M181 - (2010) Chain-Link Fence



- D. American Society for Testing and Materials (ASTM)
1. ASTM A 47 – (2009) Ferritic Malleable Iron Castings
  2. ASTM A 53 – (2007) Pipe, steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
  3. ASTM A 121 – (2007) Metallic-Coated Carbon Steel Barbed Wire
  4. ASTM A 123 – (2009) Zinc (Hot-Dip Galvanized Coatings on Iron and Steel Products
  5. ASTM A 153/A 153M – (2009) Zinc Coated Steel Chain-Link Fence Fabric
  6. ASTM A 307 - (2010) Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
  7. ASTM A 392 - (2011) Zinc-Coated Steel Chain-Link Fence Fabric
  8. ASTM A 641 - (2009a) Zinc-Coated (Galvanized) Carbon Steel Wire
  9. ASTM A 780/A 780M (2009) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

#### 1.04 SUBMITTALS

- A. General: Submit the following to the Design Engineer for approval. Note that approval of submittals by the Engineer shall not be construed as relieving the Contractor from responsibility for compliance with the Specifications nor from responsibility of errors of any sort in the submittals.
- B. Fencing Materials
1. Manufacturer's certification(s).
  2. Drawings showing plan layout, grid, spacing of components, accessories, fittings, and anchorages.
- C. Certifications shall show the appropriate AASHTO/ASTM test(s) for each material and a statement that the material meets the Specification requirement.

### PART 2 - PRODUCTS

#### 2.01 FENCING MATERIALS

- A. Post Frames
1. Post frames shall be cylindrical, no circumferential welds, galvanized steel pipe conforming to ASTM A 53.

2. Galvanize material per ASTM A 123, (1.8 ounces per square foot)
  3. Posts shall be sized as follows:
    - a. Terminal, corner and pull posts - 2.875 inch OD (5.79 lb/ft)
    - b. Line posts - 2.375 inch OD (3.65 lb/ft)
- B. Fabric
1. Fabric shall be 2 inch mesh woven from number 9 gauge wire conforming to AASHTO M181.
  2. The ends of the fabric shall have a knuckle selvage at the bottom and a barbed selvage at the top.
  3. Galvanize material per ASTM A 392, Class 2, galvanized coating after weaving (2 ounces per square foot).
- C. Tension Wire
1. The wire shall be number 7 gauge coil spring steel.
  2. Galvanize material per ASTM A 641, Class 3 coating (0.9 ounces per square foot).
- D. Hog Rings
1. Hog rings shall be number 12 gauge steel wire.
  2. Galvanize material per ASTM A 641, Class 3 (0.9 ounces per square foot).
- E. Wire Fabric Ties
1. Ties shall be number 9 gauge steel wire.
  2. Galvanize material per ASTM A 641, Class B3 (0.8 ounces per square foot.)
- F. Flat Band Fabric Ties
1. Ties shall be ½ inch by 0.06 inch steel.
  2. Galvanize material per ASTM A 153, Class B3 (1.3 ounces per square foot).
- G. Stretcher Bars
1. Stretcher bars shall be 3/16 inch by ¾-inch high carbon steel.
  2. Galvanize material per ASTM A 153, Class B1 (2 ounces per square foot).

H. Truss and Brace Rods

1. Truss and Brace rods shall be 3/8 inch steel.
2. Galvanize material per ASTM A 153, Class B1 (2 ounces per square foot).

I. Turnbuckles

1. Turnbuckles shall be wrought iron per ASTM A 47 drop forged steel.
2. Galvanize material per ASTM A 153, Class A (2 ounces per square foot).

J. Stretcher Bands

1. Stretcher bands shall be 1/8 inch by 1 inch ASTM A 123, Class A steel with beveled edges.
2. Galvanize material per ASTM A 153, Class B1 (2 ounces per square foot).

K. Nuts and Bolts

1. Nuts and bolts shall be ASTM A 307 steel.
2. Galvanize material per ASTM A 153, Class C (1.25 ounces per square foot).

L. Sleeves

1. Sleeves shall be 1.695-inch I.D. by 0.078-inch wall, drawn tube, 6 inches long. Sleeve shall be self-centering type per ASTM A 53.
2. Galvanize material per ASTM A 153, Class B2 (1.8 ounces per square foot).

M. Top Rails and Brace Rails

1. Rails shall be 1 ¼-inch ASTM A 53, American Standard Schedule 40 pipe.
2. Galvanize material per ASTM A 153, Class B1 (1.8 ounces per square foot).

N. Rail, Brace Ends, and Post Caps

1. Rail, brace ends, and posts caps shall be permanent mold casting, sand casting, galvanized malleable iron per ASTM A 47.
2. Galvanize material per ASTM A 153, Class A (2 ounces per square foot).

- O. Rail, Brace Ends, and Post Caps
  - 1. Post tops shall be permanent mold, sand mold, die castings, malleable iron per ASTM A 47.
  - 2. Galvanize material per ASTM A 153, Class A (2 ounces per square foot).
- P. Repair of Zinc-Coated Surfaces: Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A 780 or by the application of stick or thick paste material specifically designed for repair of galvanizing, as approved by the Engineer. Clean areas to be repaired and remove the slag from the welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread the molten material uniformly over surfaces to be coated and wipe the excess material off.

## 2.02 CONCRETE

- A. All concrete for footings and ground anchors shall be in accordance with Section 800 of the DelDOT Standard Specifications.

## PART 3 - PRODUCTS

### 3.01 CHAIN LINK FENCE INSTALLATION

- A. Install new fence posts. All posts shall be installed and connected to the steel superstructures as shown on the Contract Drawings. Each post shall be placed erected plumb and the posts shall line up horizontally as shown on the plans.
- B. A brace rail shall be installed between each terminal post and each adjacent line post along with a truss rod and turn buckle attachment.
- C. Tension wire shall be provided along the top and bottom of the fence.
- D. Attach new chain link fence fabric in place by securing one end to an end post corner, pull or gate post and applying sufficient tension to remove all slack before making other attachments.
  - 1. Secure fabric to end, corner pull and gate post including vertical gate frame members using stretcher bars attached to posts with tension bands at a maximum spacing of 14 inches.
  - 2. Secure fabric to all line posts and horizontal gate frame members with a double wrap and triple twist of tie wire at maximum spacing of 14 inches.
  - 3. Secure fabric to tension wires with hog rings at a maximum spacing of 2 feet.
- E. The chain link fence shall be erected at the locations shown on the Contract Drawings and approved by the Engineer to the elevations and locations shown on the drawings. The fence shall be true to line, taut and shall comply with the

best practice for chain link fence construction. The bottom of the fabric shall be placed a normal distance of 1 inch above the channel cap.

END OF SECTION

## **SECTION 03 30 00 – CAST-IN-PLACE CONCRETE**

### **PART 1 - GENERAL**

#### **1.01 UNIT PRICES**

- A. Cast-In-Place (CIP) Concrete Pile Caps – Base Bid and Alternate No. 1
  - 1. Payment: Payment for “CIP Concrete Pile Caps” associated with the water control structures shall include all of the material, labor, and equipment associated with providing, placing, consolidating, curing, and protecting the cast-in-place concrete, as well as all required reinforcing steel, subbase fill, joint detailing, laboratory testing, and field testing as specified herein.
  - 2. Measurement: The quantity to be paid shall be the Cubic Yard unit price quoted on the bid form for “CIP Concrete Pile Caps” for placed and cured concrete to the limits shown in the Contract Drawings.
  - 3. Unit of Measure: Cubic Yard (CY).
- B. Concrete Riser Fixture – Base Bid
  - 1. Payment: Payment for “Concrete Riser Fixture” shall include all of the material, labor, and equipment associated with providing, casting, curing, transporting and installing Concrete Riser fixtures in accordance with the configuration and performance criteria specified in the Contract Documents. The cost includes the Concrete Riser, all required reinforcing steel, joint detailing, laboratory testing, and field testing, the transport of all materials to the project site, temporary storage and protection of materials at the project site, and all material, labor, and equipment associated with safe handling and installation of the Precast Concrete Riser.
  - 2. Measurement: “Precast Concrete Riser shall be measured on a Per Each basis.
  - 3. Unit of Measure: Per Each (EA).

#### **1.02 REFERENCES**

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. Unless otherwise indicated the most recent edition of the publication, including any revisions, shall be used.
- C. Except as modified or otherwise required herein, the Delaware Department of Transportation (DelDOT) “Standard Specifications for Road and Bridge Construction,” August 2001, with all latest addenda are to be used for this Section.

- D. American Association of State Highway and Transportation Officials (AASHTO)
1. AASHTO M182 - (2012) Burlap Cloth Made from Jute or Kenaf and Cotton Mats
  2. AASHTO M194 - (2013) Chemical Admixtures for Concrete
  3. AASHTO T259 - (2012) Resistance of Concrete to Chloride Ion Penetration
- E. American Concrete Institute (ACI)
1. ACI 117 - (2010) Tolerances for Concrete Construction and Materials
  2. ACI 211.1 - (2009) Selecting Proportions for Normal, Heavyweight, and Mass Concrete
  3. ACI 214R – (2002) Evaluation of Strength Test Results of Concrete
  4. ACI 301 - (2010) Specifications for Structural Concrete for Buildings
  5. ACI 302.1R - (2004) Guide for Concrete Floor and Slab Construction
  6. ACI 304R - (2009) Measuring, Mixing, Transporting, and Placing Concrete
  7. ACI 304.2R - (2008) Placing Concrete by Pumping Methods
  8. ACI 305R - (2010) Hot Weather Concreting
  9. ACI 306.1 - (2002) Cold Weather Concreting
  10. ACI 308 - (2011) Curing Concrete
  11. ACI 309R – (2005) Guide for Consolidation of Concrete
  12. ACI 318 - (2011) Building Code Requirements for Structural Concrete
  13. ACI SP-66 - (2004) Detailing Manual
- F. American Society for Testing and Materials (ASTM)
1. ASTM A 184 - (2011) Welded Deformed Steel Bar Mats for Concrete Reinforcement
  2. ASTM A 615 - (2015) Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
  3. ASTM A 706 - (2014) Deformed and Plain Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

4. ASTM A 1064 - (2015) Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
5. ASTM C 31 - (2012) Making and Curing Concrete Test Specimens in the Field
6. ASTM C 33 - (2013) Concrete Aggregates
7. ASTM C 39 - (2014) Compressive Strength of Cylindrical Concrete Specimens
8. ASTM C 78 - (2015) Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
9. ASTM C 88 - (2013) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
10. ASTM C 94 - (2015) Ready-Mixed Concrete
11. ASTM C 143 - (2012) Slump of Hydraulic-Cement Concrete
12. ASTM C 150 - (2015) Portland Cement
13. ASTM C 171 - (2007) Sheet Materials for Curing Concrete
14. ASTM C 172 - (2014) Sampling Freshly Mixed Concrete
15. ASTM C 227 - (2010) Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
16. ASTM C 231 - (2010) Air Content of Freshly Mixed Concrete by the Pressure Method
17. ASTM C 260 - (2010a) Air-Entraining Admixtures for Concrete
18. ASTM C 309 - (2011) Liquid Membrane-Forming Compounds for Curing Concrete
19. ASTM C 494 - (2013) Chemical Admixtures for Concrete
20. ASTM C 595 - (2015) Blended Hydraulic Cements
21. ASTM C 666 - (2015) Resistance of Concrete to Rapid Freezing and Thawing
22. ASTM C 881 - (2014) Epoxy-Resin-Base Bonding Systems for Concrete
23. ASTM C 920 - (2014) Elastomeric Joint Sealants
24. ASTM C 989 - (2014) Slag Cement for Use in Concrete and Mortars



25. ASTM C 1077 - (2015) Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
  26. ASTM C 1218 - (2008) Water-Soluble Chloride in Mortar and Concrete
  27. ASTM D 1751 - (2013)e1 Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
  28. ASTM D 1752 - (2013) Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
  29. ASTM D 6690 - (2012) Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
  30. ASTM G 61 - (2009) Conducting Cyclic Potentiodynamic Polarization Measurements for Localized Corrosion Susceptibility of Iron-, Nickel-, or Cobalt-Based Alloys
  31. ASTM G 109 - (2013) Determining Effects of Chemical Admixtures on Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments
- G. American Welding Society (AWS)
1. AWS D1.4 - (2011) Structural Welding Code – Reinforcing Steel
- H. Concrete Reinforcing Steel Institute (CRSI)
1. CRSI MSP-1 - Manual of Standard Practice
- I. Department of Commerce (DOC)
1. DOC PS 1 - Voluntary Product Standard – Construction and Industrial Plywood
- J. British Standards Institution (BS)
1. BS 8443 - (2005) Specification for Establishing the Suitability of Special Purpose Concrete Admixtures
- K. Federal Highway Administration (FHWA)
1. FHWA/RD-83/012 - Time-to-Corrosion of Reinforcing Steel in Concretes, Vol. 5: Calcium Nitrite Admixture or Epoxy-Coated Reinforcing Bars as Corrosion Protection Systems

### 1.03 PROJECT DESCRIPTION

- A. Reinforced cast-in-place concrete shall be used to construct the lower pile-supported foundation slab for the water control structures at the locations shown in the Contract Drawings.
- B. Concrete water control fixtures that shall be installed as shown in the Contract Drawings and as herein specified or directed by the Engineer.

#### 1.04 DEFINITIONS

- A. "Cementitious material" as used herein shall include all Portland cement, pozzolan, fly ash, silica fume, and ground iron blast-furnace slag.
- B. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the project. A public location is accessible to persons not responsible for maintenance of the project.
- C. "Mass Concrete" is a concrete element with a minimum dimension greater than 3

#### 1.05 SUBMITTALS

- A. General: Submit the following to the Design Engineer for approval. Note that approval of submittals by the Engineer shall not be construed as relieving the Contractor from responsibility for compliance with the Specifications nor from responsibility of errors of any sort in the submittals.
- B. Certifications, test reports and other submittals shall show the appropriate ASTM or AWWA standard(s) for each material.
- C. Submit the following shop drawings for approval:
  - 1. Reinforcing drawings, prior to fabrication, showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes, and spacing.
  - 2. Form drawings showing details of formwork, joints supports, studding and shoring, and sequence of form and shoring removal.
  - 3. Lift drawings showing all dimensions, pour locations and designations, location of horizontal and vertical construction joints, concrete volumes, and locations of embedded items.
- D. Work Plans
  - 1. The Contractor shall submit to the Engineer details of the equipment, materials, methods and procedures for the following items:
    - a. Concrete Pumping (if used)
    - b. Cold Weather Concreting (if used)
    - c. Hot Weather Concreting (if used)
    - d. Concrete Finishing
    - e. Concrete Curing
    - f. Equipment for tremie placement

2. Approval by the Engineer will not relieve the Contractor of his responsibility to perform work in accordance with these Specifications.

E. Drawings

1. Drawings of Precast Members: Submit drawings indicating complete information for the fabrication, handling, and erection of the precast member. Drawings shall not be reproductions of Contract Drawings. Design calculations and drawings of precast members (including connections) shall be prepared and sealed by a registered Professional Engineer licensed in the State of Maryland, and submitted for approval prior to fabrication. The drawings shall indicate, as a minimum, the following information:
  - a. Marking of members for erection
  - b. Connections for work of other trades
  - c. Connections between members, and connections between members and other construction
  - d. Location and size of openings
  - e. Headers for openings
  - f. Joints between members, and joints between members and other construction
  - g. Reinforcing details
  - h. Material properties of steel and concrete used
  - i. Lifting and erection inserts
  - j. Dimensions and surface finishes of each member
  - k. Erection sequence and handling requirements
  - l. All loads used in design, for handling, transport, and erection
  - m. Bracing/shoring required
  - n. Areas to receive toppings, topping thickness
  - o. Location and placement of embedded items, including thermocouples
  - p. Methods for storage and transportation

F. Concrete Mix Design

1. Sixty (60) days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Certify, using an independent commercial testing laboratory, that proportioning of mix is in accordance with ACI 211.1 for the specified strength and is based on data, which has been determined by laboratory testing during the last six (6) months.
2. Submit a complete list of materials including type, brand, source and amount of cement, fly ash, silica fume, ground slag, and admixtures, and applicable reference Specifications.
3. All materials used in the trial mix design shall be identical to those used in production and the trial batch shall include all stipulated admixtures. In case the source, brand or characteristic properties of the ingredients are

varied during the term of the Contract, submit revised mix design and all related submittals.

4. Submit independent laboratory test reports on laboratory letterhead in-lieu of manufacturer's certificates for all mix ingredients demonstrating conformance of the ingredient with all cited standards and these specifications. Mix water is excepted from this provision unless otherwise stipulated by the Engineer.
5. For all aggregate sources, submit ASTM C 227 test results dated within the last 6 months. Aggregates shall show expansions less than 0.10% at six months when tested in accordance with ASTM C 227 using cement with alkali content above 0.8% (expressed as sodium oxide). Aggregates demonstrating expansions in excess of this limit shall not be accepted.
6. Submitted admixture data shall include full catalog information and manufacturer's certificates stating that each admixture is compatible with all other materials in the mix design.
7. Each mix design shall be submitted under separate cover and submittal number, and shall clearly indicate all portions of the construction where the mix is proposed for use.
8. Submit manufacturer's catalog data and mixing instructions for all admixtures.
9. Submit calcium nitrate retention test results which validate proposed dosing with the trial batch strength test results for each mix design for which the admixture is stipulated.

G. Design Data

1. Design Calculations: Structural design for precast units and any embedded items utilized to resist all stresses encountered during casting, transport, handling, and erection shall be prepared by a registered Professional Engineer licensed in the State of Delaware for the precast concrete manufacturer.

H. Quality Control Procedures

1. Submit proposed fabrication standards and quality control procedures. Additionally, PCI Certified Manufacturers shall submit current certification in the PCI "Certification Program for Quality Control."

I. Submit manufacturer's data, test reports, certifications, and installation instructions for all materials, including but not limited to:

1. Concrete repair materials
2. Curing Compounds
3. Epoxy Bonding Compound

4. Epoxy Coating Materials
5. Joint Backing Rod
6. Joint Filler
7. Joint Sealer
8. Form materials and location of use
9. Form accessories
10. Form release agents
11. Mechanical bar splicers/inserts
12. Mechanical terminators
13. Mill test reports for reinforcing (tests on each heat, showing chemical and physical analysis)
14. Nonshrink Grout
15. Cement
16. Aggregates
17. Chemical Admixtures
18. Slag
19. Fly Ash
20. Silica Fume

J. Batch Tickets: Submit a delivery ticket from the concrete supplier with each batch delivered to the site setting forth the following information:

1. Name of supplier
2. Name of batching plant and location
3. Serial number of ticket
4. Date
5. Truck number and batch number
6. Specific job designation
7. Volume of concrete (cubic yards)
8. Specific class of concrete
9. Time loaded and amount of water added
10. Type and brand of cement
11. Weight of cement
12. Maximum size of aggregates
13. Weights of coarse and fine aggregates, respectively
14. Type and amount of admixtures
15. Mix design designation

K. Concrete Test Reports

1. Air content
2. Compressive strength tests
3. Corrosion Inhibitor Content Test (when used)
4. Slump
5. Temperature

L. Finish Samples

M. Qualifications

1. Calcium Nitrite Testing Laboratory

2. Concrete Field Technician
3. Independent Concrete Testing Laboratory

#### 1.06 QUALITY ASSURANCE

- A. Concrete admixtures shall be manufactured by a firm with a minimum of five (5) year's experience in the production of similar admixtures. Responsible contact person for the firm shall have a minimum of five year's experience in the production of similar admixtures.
- B. Formwork and falsework design calculations and associated shop drawings shall be prepared and sealed by a Professional Engineer registered in the State of Delaware.
- C. Welding Procedures and Qualifications
  1. Welders and procedures shall be qualified in accordance with Section 05 50 00 "Metal Fabrications".
- D. Independent Concrete Testing Laboratory
  1. Contractor shall furnish and pay for an independent testing laboratory to conduct the concrete laboratory testing for trial batching and field quality control described herein.
  2. Independent Tasting laboratory shall meet the requirements of ASTM C 1077. The testing laboratory shall be accepted by the Engineer before performing any work.
  3. Laboratory's representative performing field quality control testing and preparing test samples shall, as a minimum, possess current certification as an ACI Concrete Field Technician – Grade I.
- E. Structural design for precast units to resist all stresses encountered during casting, transport, handling and erection shall be prepared by a registered Professional Engineer licensed in the State of Delaware for the precast concrete manufacturer. Manufacturer shall be responsible for any additional reinforcing and lifting inserts required for lifting, handling, and erecting the units.
- F. Precast concrete work shall be supplied by a firm with a minimum of three years of continuous operations and which has performed at least three representative jobs, three years or older, comparable to the precast work to be provided for this project. Design precast members for handling without cracking in accordance with the PCI MNL-120.
- G. When precast products are manufactured by PCI Certified Manufacturers, plants shall be certified by the PCI Plant Certification Program for Product Category C1 or C2, as applicable. Non-PCI certified manufacturers shall be subject to approval of the Engineer, based on fabrication and quality control requirements outlined herein.

## 1.07 MODIFICATION OF REFERENCES

- A. Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory, as though the word “shall” had been substituted for the words “should” or “could” or “may,” wherever they appear. Interpret reference to the “Building Official,” the “Structural Engineer,” and the “Architect/Engineer” to mean Engineer.

## 1.08 DELIVERY, HANDLING, AND STORAGE

- A. Do not deliver concrete until forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. ACI 301 for job site storage of materials. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials are clearly identified.
- B. Transportation of Precast Members
  - 1. Transporting Members: In transporting members by truck, railroad car, or barge, provision shall be made for supporting the members as previously described; except battens can be continuous over more than one stack of units, with adequate bracing to ensure their maintaining the vertical position and damping of dangerous vibrations. Trucks with double bolsters are satisfactory provided the members are fully seated on the outer bolsters at not more than 3 feet or the depth of the member from the end and the inner bolster is not more than 8 feet from the end of the member or the designated pickup point. Adequate padding material shall be provide between tie chains or cables to preclude chipping of concrete.
  - 2. Lateral Deflection or Vibration: Any noticeable indication of lateral deflection or vibration during transportation shall be corrected by rigid bracing between members or by means of lateral trussing.
- C. Storage
  - 1. Storage Area: Storage areas for precast members shall be stabilized, and suitable foundations shall be provided, so differential settlement or twisting of members will not occur. Protect precast members from weather, marring, damage, and overload.
  - 2. Stacked Members: Stacked members shall be separated and supported by battens placed across the full width of each bearing point. Battens shall be arranged in vertical planes at a distance not greater than the depth of the member from designated pickup points. Battens shall not be continuous over more than one stack of precast units. Stacking of members shall be such that lifting devices will be accessible and undamaged. The upper members of a stacked tier shall not be used as storage areas for shorter members or equipment.
- D. Handling of Members

1. The location of pickup points for handling of the members and details of the pickup devices shall be shown on the shop drawings. Members shall be handled only by means of approved devices at designated locations.

#### 1.09 FACTORY INSPECTION

- A. At the option of the Engineer, precast units may be inspected by the Engineer prior to being transported to the job site. The Contractor shall give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the DNREC's right to enforce contractual provisions after units are transported or erected.

#### 1.10 EQUIPMENT

- A. Conveying equipment shall have a capacity of at least 75 cubic yards per hour. Concrete shall be conveyed from mixer to point of placement as rapidly as practicable and within the time interval specified by methods that will prevent segregation or loss of ingredients. Any concrete transferred from one conveying device to another shall be passed through a hopper that is conical in shape and shall not be dropped vertically more than 5 feet, except where suitable equipment is provided to prevent segregation and where specifically authorized.
- B. Buckets: The interior hopper slope shall be not less than 58 degrees from the horizontal; the minimum dimension of the clear gate opening shall be at least five times the nominal maximum-size aggregate; and the area of the gate opening shall be not less than 2 square feet. The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than 2 cubic yards shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.
- C. Trucks: Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94. Nonagitating equipment shall not be used for transporting concrete.
- D. Chutes: When concrete can be placed directly from a truck mixer or agitator, the chutes attached to this equipment by the manufacturer may be used. A discharge deflector shall be used when required by the Engineer. Separate chutes and other similar equipment will not be permitted for conveying concrete.
- E. Concrete Pumps: Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least three times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped, but not less than 4 inches. Aluminum pipe shall not be used. The nominal maximum-size coarse aggregate shall not be reduced to accommodate the pumps. The distance to be pumped shall not exceed limits recommended by the pump manufacturer. The concrete shall be supplied to the concrete pump continuously. When pumping is



completed, concrete remaining the pipeline shall be ejected without contamination of concrete in place. After each operation, equipment shall be thoroughly cleaned, and flushing water shall be wasted outside of the forms. Clean-up of wasted concrete is the Contractor's responsibility.

## PART 2 - PRODUCTS

### 2.01 CONCRETE MATERIALS

- A. All materials shall conform to Section 800 of the DeIDOT "Standard Specifications for Road and Bridge Construction," except as modified herein. Materials and requirements shown below apply to all concrete used in the project.
- B. All Cement: ASTM C 595, Type IS (MS) blended cement except as modified herein:
  - 1. The blended cement shall consist of a mixture of ASTM C 150 Type II cement and ground iron blast-furnace slag. Type I, Type III, and Type V cements shall not be accepted.
  - 2. Ground Iron Blast-Furnace Slag: ASTM C 989, Grade 120. Testing shall be performed no more than six months prior to submittal date.
  - 3. The ground iron blast-furnace slag shall comprise 25% by weight of total cementitious material.
  - 4. For exposed concrete, use one manufacturer for each type of cement and ground slag.
  - 5. The tricalcium aluminate content of the blended cement shall be less than 8% by weight.
- C. For mass concrete and steam cured precast items; the following shall be met in addition to the requirements above:
  - 1. The maximum percent of sulfur reported as sulfate (SO<sub>3</sub>) in the blended cement shall be less than 3.0%.
  - 2. The alkali content of the blended cement shall be less than 0.7%
  - 3. The molar ratio of sulfate to tricalcium aluminate in the blended cement shall be less than 0.3.
- D. Aggregates
  - 1. Fine aggregate shall conform to the quality and gradation requirements of ASTM C 33.
  - 2. Coarse aggregate shall conform to ASTM C 33, Class 5S, size as specified herein.

3. Aggregates shall not contain any substance that may be deleteriously reactive with the alkalies in the cement in an amount sufficient to cause excessive expansion of the concrete.
4. Aggregate, when subjected to five cycles of the soundness test in accordance with ASTM C 88, shall not have a loss greater than 10% when sodium sulfate is used.
5. Aggregates shall show expansions less than 0.10% at six months when tested in accordance with ASTM C 227 using cement with alkali content above 0.8% (expressed as sodium oxide). Aggregates showing expansion greater than 0.10% shall not be accepted. Where aggregates are deemed to possess properties or constituents that are known to have specific unfavorable effects in concrete, these aggregates shall not be accepted.
6. Furnish aggregates for exposed concrete surfaces from one source.

E. Admixtures

1. Calcium chloride or any other admixtures containing chloride salts shall not be used.
2. Six month and one year compressive and flexural strength tests are not required for admixtures.
3. Accelerating: ASTM C 494, Type C.
4. Air Entraining: ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions.
5. Anti-washout admixture shall be Master Builders "Rheomac UW450", Sika Corporation "Sikament 100SC", or Fox Industries "Segnot", or other approved equal in compliance with Army Corps of Engineers Standard CDR-C61. Anti-washout admixture shall be included in all concrete deposited underwater (tremie). Admixture shall be applied in strict accordance with the manufacture's written instructions. Submit CDR-C61 certification laboratory results on laboratory letterhead as follows:
  - a. Initial Compliance results shall meet or exceed the performance limits in Table 1 for control mixes that are similarly proportioned to all mixes subject to washout as identified in this specification. Submit the control mix design(s) with the Initial Compliance results. Include in this documentation all deviation of the setting time for dosed mixtures from the set time for the control mix(es).
  - b. Limited Retesting to confirm current compliance of the admixture is required if Initial Compliance test results are outdated by more than 2 years.
  - c. Uniformity and Equivalence Testing shall be established by both oven drying and specific gravity among concrete lots of 10,000 cubic yards.

- d. Anti-washout admixtures that have met or exceeded BS 8443:2005 standards for similar mix designs shall be considered to have met the requirements of CDR-C61. Submit BS 8443 mixtures and results for approval.
6. Corrosion Inhibiting:
- a. Test results which meet or exceed the Physical Requirements (Table 1) of ASTM C 494 for any Type of admixture. Water content (water reduction) may not be applicable.
  - b. Criteria to meet from Table 1 include:
    - i. Time of setting: between 3½ hours earlier to 3½ hours later than control
    - ii. Compressive strength: minimum 90% of the control at any time period
    - iii. Flexural strength: minimum 90% of the control at any time period
    - iv. Length change, shrinkage: maximum 135% of the control
    - v. Relative durability factor: minimum 80
  - c. Testing conforming to FHWA/RD-83/012. After one year of testing the corrosion current measured in microamps for the corrosion inhibitor-protected specimen must be approximately 10% of the control when a minimum of five and maximum of ten pounds of chloride ion is admixed into the concrete.
  - d. Test results of ASTM G 109. Run the test for three complete cycles after the control specimens have failed according to Section 8 Period of Testing. The average corrosion current of the corrosion inhibitor-protected specimens must be less than two microamps.
  - e. Test results of ASTM G 61. The test medium shall be modified to contain a calcium hydroxide solution with a pH similar to concrete of 12.5, and sodium chloride content equivalent to approximately 0.5 molar solution. Protection potentials (Ep) must be more positive than -280 mV versus SCE.
  - f. Test results conforming to ASTM G 109 modified with a 1 inch of concrete cover over the reinforcement and a maximum water-to-cement ratio of 0.40. After five years of testing, the corrosion inhibitor-protected test specimens must have a corrosion current in microamps of less than 105 of the control.
  - g. Corrosion inhibiting admixture shall contain a minimum of 30% calcium nitrite by mass.
  - h. Concentration of corrosion inhibitor shall not be less than 5.1 pounds per cubic yard in the hardened concrete.
7. High Range Water Reducing (Superplasticizer): ASTM C 494, Type F or G. The admixture shall contain no chlorides, amines, sugar, urea, foaming agents, or air entraining agents and shall meet the requirements of AASHTO M194, with the following exceptions:
- a. The water content shall be a maximum of 85% of that of the control, and the durability factor shall be a minimum of 90 when

tested in accordance with ASTM C 666, Procedure B. Air entrained concrete containing the admixture shall have no more than 1½ % weight loss after 300 freeze-thaw cycles.

- b. Chloride permeability within a depth of ½ inch to 1 inch shall be a maximum of 226 ppm after 200 days ponding when tested in accordance with AASHTO T259.
- c. The admixture shall be added at the job site in liquid form as recommended by the manufacturer.

8. Retarding: ASTM C 494, Type D

9. Water Reducing: ASTM C 494, Type A.

F. Water shall conform to Section 803 of the DelDOT Standard Specifications for Road and Bridge Construction.

## 2.02 REINFORCING STEEL

A. Reinforcing steel for the cast-in-place concrete foundation slab shall be deformed billet-steel and shall conform to ASTM A 615, Grade 60.

B. Spirals shall conform to ASTM A 1064

C. All reinforcing steel to be welded shall conform to ASTM A 706.

## 2.03 DOWELS

A. Reinforcing steel for the H-Pile head anchorage shall be headed reinforcement meeting ACI 318-14 anchorage requirements, and conforming to ASTM A 706.

## 2.04 FABRICATED BAR MATS

A. Fabricated bar mats shall conform to ASTM A 184.

## 2.05 ACCESSORIES

A. Accessories shall conform to the ACI Detailing Manual SP-66.

B. Wire ties shall be 16 gauge or heavier black annealed steel wire.

C. Bearing Pads: Asphaltic ¼-inch thick expansion material conforming to ASTM D 1751.

D. Grout:

- 1. Non-Shrink, Non-Metallic Grout: If required, non-shrink, non-metallic grout shall conform to ASTM C 1107, salt and seawater resistant with a compressive strength of 8000 psi at 7 days in accordance with ASTM C 109 and a bond strength of 2000 psi per ASTM C 882. Non-shrink, non-metallic grout shall be a commercial formulation suitable for the application proposed.

2. Cementitious Grout: Cementitious grout shall be a mixture of Portland cement, sand, and water. Proportion one-part cement to approximately 2.5 parts sand, with the amount of water based on placement method. Provide air entrainment for grout exposed to the weather.

## 2.06 FABRICATION

### A. PCI MNL-116 unless specified otherwise.

1. Forms: Brace forms to prevent deformation. Forms shall produce a smooth, dense surface. Chamfer exposed edges 3/4-inch, unless otherwise indicated. Provide threaded or snap-off type form ties.
2. Reinforcement Placement: ACI 301 for placement and splicing. Reinforcement may be preassembled before placement in forms. Provide exposed connecting bars, or other approved connection methods, between precast and cast-in-place construction. Remove any excess mortar that adheres to the exposed connections. Placement of galvanized reinforcement shall conform to the requirements of Contract Specification Section 03300 2.6.E herein.
3. Concrete
  - a. Concrete Mixing: ASTM C 94. Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.
  - b. Concrete Placing: ACI 304R, ACI 305R for hot weather concreting, ACI 306.1 for cold weather concreting, and ACI 309R, unless otherwise specified.
  - c. Concrete Curing: Commence curing immediately following the initial set and completion of surface finishing. Provide curing procedures to keep the temperature of the concrete between 50 and 190 degrees F. Cure using one of the methods described below or by a method approved by the Engineer.
  - d. Accelerated Steam Curing:
    - i. Immediately after each item has been cast and finished, it shall be placed in a curing chamber, curing box, or under a tight enclosure which will protect the precast member from wind and drafts. Such chambers and enclosures shall be sized to allow full circulation of steam around exposed surfaces of the member.
    - ii. Instrumentation:
      - i. Install exterior recording thermometers and interior temperature probes with enclosures and power source along with wiring. All thermometers and probes shall record continuously and automatically. Each 200 feet of length of fabrication bed shall be instrumented with both one exterior thermometer and one thermocouple interior probe. Exterior thermometers and interior probes shall be installed in an alternating sequence. Parallel casting beds shall have the instrumentation placed

- in a staggered and alternating pattern along the member(s). The thermometer and the probe shall be installed at 1/3 points along the 200 feet, close to the middle of the unit, and not closer than 5 feet and not farther than 10 feet from the orifice where the steam is introduced. The exterior thermometer shall be located at the side where the steam is introduced. The interior probe shall be located at center of member thickness. Do not commence concrete placement until temperature recording devices have been checked to the satisfaction of the Q/C personnel. A uniform distribution of steam and curing temperature shall be maintained throughout the entire length of the member(s). Submit prints of the automatic readout daily if requested by Engineer.
- ii. For the purpose of checking the Contractor's recording thermometer, the Engineer may install his own recorders. In this case, Contractor shall furnish the power source and wires at locations designated by the Engineer.
  - iii. After placement and finishing of concrete, moist cure for a period of four hours.
  - iv. Commencing four hours after completion of concrete placement, the precast member(s) shall be subjected to the continuous action of steam. Care shall be exercised to see that heat is introduced gradually to avoid thermal shock to the concrete. During the heating, the temperature rise shall not exceed 25 to 35 degrees F per hour. The interior temperature of the members shall be held at a target temperature of 140 degrees F with an upward tolerance of 10 degrees F. A single precast member reaching an interior temperature of 150 degrees F may be accepted at the option of the Engineer. A run of several members with an interior exceeding 150 degrees F will be rejected.
  - v. Cooling shall follow the steaming cycle. Care shall be exercised to protect the precast members from rapid drops in temperature, mechanical injury, and other conditions likely to cause damage or loss of strength. During the cooling, the temperature drop shall not exceed 35 degrees F per hour. The cool down procedures shall be as follows:
    - i. Steam will be turned off following the steam cycle.
    - ii. The sides of the tarps will be folded to the top of the form.
    - iii. The tarps will be completely removed, and the top doors will be opened.
  - vi. After steam curing, moist curing shall be applied using either water or membrane curing compound until a total steam and moist curing time of seven (7) days is achieved.

- e. Standard Curing: High air content and low water-to-cementitious ratio used in corrosion inhibitor concrete will result in less bleed water than in normal concrete. To reduce plastic or drying shrinkage cracks, comply with ACI 302.1R, ACI 305R, ACI 306.1, and ACI 308R.
    - i. Use water cure for corrosion inhibitor treated concrete. When weather conditions are dry and windy, continue fogging above surface of concrete after the finishing operation until prewetted burlap can be placed over the flatwork surface. Use prewetted burlap to cover all flatwork and keep wet for a minimum of seven days and until 70 percent of the specified compressive strength, as recommended by ACI 308R Section 3.1.3, has been attained.
    - ii. Freestanding water is not acceptable before concrete set has occurred.
  - f. Forms may be removed after concrete in place has developed a minimum compressive strength of 3,000 psi.
  - g. Precast concrete members may be moved from the casting bed to nearby storage after the member has reached the design compressive strength. Movement from the plant storage to the project site will be permitted only after the curing period has been completed and with the approval of the Engineer. The Engineer shall approve the method of handling the members including the location of pick-up points and arrangements of the slings.
4. Surface Finish: Repairs located in a bearing area shall be approved by the Engineer prior to repairs. Precast members containing hairline cracks, which are visible and are greater than 0.005 inches in width for surfaces exposed to the weather, shall be repaired. Precast members which contain cracks greater than 0.02 inches in width shall be approved by the Engineer, prior to being repaired. Any precast member that is structurally impaired or contains honeycombed section deep enough to expose reinforcing shall be rejected.
- a. Unformed Surfaces: Provide a steel troweled finish except use raked or equivalent surface with ¼ inch amplitude for areas adjacent to cast-in-place concrete.
  - b. Formed Surfaces: PCI MNL-116 (Appendix A - Commentary), Chapter 3, for grades of surface finishes.
    - i. Unexposed Surfaces: Provide a standard grade surface finish.
    - ii. Exposed Surfaces: Provide a standard grade surface finish. The combined area of acceptable defective areas shall not exceed 0.2 percent of the exposed to view surface area, and patches shall be indistinguishable from the surrounding surfaces when dry.
5. Acceptance/Rejection of Defects
- a. Minor Defects: All honeycombed areas, chipped corners, air pockets over ¼ inch in diameter, and other minor defects that involve less than 36 square inches of concrete shall be repaired. Form offsets of fins over 1/8 inch shall be ground smooth. All

unsound concrete shall be removed from defective areas prior to repairing.

- B. Major Defects: Major defects are those which involve more than 36 square inches of concrete or exposed reinforcing steel. If one or more major defects appear in a member, it shall be rejected. Cracks of a width of more than 0.02 inch shall be cause for rejection of the member.

## 2.07 PRODUCT QUALITY CONTROL

- A. Where members are manufactured in a plant with an established quality control program as attested to by a current certification in the PCI "Certification Program for Quality Control," perform product quality control in accordance with PCI MNL-116. PCI certified manufacturers shall use an independent commercial testing laboratory, approved by the Engineer, to perform the following:
  - 1. Corrosion Inhibitor Content Testing: The Contractor shall furnish and have tested one concrete cylinder for every 100 cubic yards of concrete requiring corrosion inhibiting admixture. Hardened concrete shall be tested in accordance with NCDOT Chem. Proc. C-20.0 and shall indicate a minimum test recovery of 5.1 pounds per cubic yard of nitrite. If three consecutive tests indicate the nitrite content is less than the specified minimum recovery, the materials represented by the failing lots may be subject to rejection. Contractor shall revise the quantity and/or type of corrosion inhibitor added to satisfy these Specifications. Additional testing may be performed at the Contractor's expense to dispute failing test results.
- B. Where members are manufactured by specialists or in plants not currently enrolled in the PCI "Certification Program for Quality Control," set up a product quality control system in accordance with PCI MNL-116 and perform concrete and aggregate quality control testing using an independent commercial testing laboratory approved by the Engineer in accordance with the following.
  - 1. Aggregate Tests: Take samples of fine and coarse aggregate at concrete batch plant and test. Perform mechanical analysis (one test for each aggregate size) in accordance with ASTM C 136. Tabulate results of tests in accordance with ASTM C 33.
  - 2. Strength Tests: Sample concrete in accordance with ASTM C 172 at time concrete is deposited for each production line. Perform slump tests in accordance with ASTM C 143. Mold cylinders in accordance with ASTM C 31. Mold at least six cylinders per day or one for every 60 cubic yards of concrete placed, whichever is greater. Cure cylinders in same manner as precast units and, for accelerated curing, place at coolest point in casting bed. Perform strength tests in accordance with ASTM C 39. Test two cylinders of each set at 7 days or 14 days, and removal of units from forms. Test remaining cylinders of each set 28 days after molding.
  - 3. Slump Tests: The Contractor shall check the consistency of concrete by means of slump tests conducted in accordance with ASTM C 143. The maximum slump may be increased as specified with the addition of an approved admixture provided the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch of concrete.



4. Air Content Test: The Contractor shall test the air content in accordance with ASTM C 231. The air content test shall be made at the same time as specified for slump tests.
5. Temperature: Concrete temperature shall be taken and recorded at the same time as specified for slump tests.
6. Corrosion Inhibitor Content Testing: The Contractor shall furnish and have tested one concrete cylinder for every 100 cubic yards of concrete requiring corrosion inhibiting admixture. Hardened concrete shall be tested in accordance with NCDOT Chem. Proc. C-20.0 and shall indicate a minimum test recovery of 5.1 pounds per cubic yard of nitrite. If three consecutive tests indicate the nitrite content is less than the specified minimum recovery, the materials represented by the failing lots may be subject to rejection. Contractor shall revise the quantity and/or type of corrosion inhibitor added to satisfy these Specifications. Additional testing may be performed at the Contractor's expense to dispute failing test results.
7. Changes in Proportions: If, after evaluation of strength test results, compressive strength is less than specified compressive strength, make adjustments in proportions and water content and changes in temperature, moisture, and curing procedures as necessary to secure specified strength. Submit changes in mix design to Engineer in writing.
8. Compressive Strength Test Results: Evaluate compressive strength test results at 28 days in accordance with ACI 214R using a coefficient of variation of 10 percent. Evaluate strength of concrete by averaging test results of each set of standard cylinders tested at 28 days. Not more than 10 percent of individual cylinders tested shall have a compressive strength less than specified average compressive strength.
9. The Contractor shall obtain the services of a certified, third-party testing agency to perform sampling and testing.

## 2.08 SUPPORTS

- A. Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI MSP-1 and shall be steel or precast concrete blocks.
- B. Precast concrete blocks shall not be less than 3 inches square when supporting reinforcement on the ground. Precast concrete blocks shall have compressive strength equal to that of the surrounding concrete.
- C. When concrete formed surfaces will be exposed to the weather or where surfaces are to be painted, steel supports within 1 inch of the concrete surface shall be galvanized, plastic protected, or stainless steel.
- D. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface.
- E. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

- F. Provide commercially available reinforcing cage centralizers for composite steel H-piles.

## 2.09 CONCRETE MIX

- A. Concrete mixes shall be proportioned in accordance with ACI 211.1 except as modified herein.
- B. The water soluble chloride ion concentrations in hardened concrete between 28 and 42 days shall not exceed 0.15 when tested in accordance with ASTM C 1218.
- C. The properties of the concrete for each portion of the structure(s) shall be as indicated on the Contract Drawings and specified in the following table:

PROPERTY	<sup>3</sup> Pile-Supported Concrete Cap & Waterside Structures	Concrete Flashboard Riser
28-Day Compressive Strength, ASTM C 39 (psi)	<sup>1</sup> 5,000	<sup>1</sup> 5,000
28-Day Flexural Strength, ASTM C 78 (psi)	--	--
Coarse Aggregate Size No. ASTM C 33	57 or 67	57 or 67
Water-Cement Ratio (by weight)	0.40	0.40
Design Slump (inch)	<sup>2</sup> 4	<sup>2</sup> 4
Air Entrainment, % (ASTM C 231)	5±1.5	5±1.5
Calcium Nitrite Corrosion Inhibitor	YES	YES
<sup>4</sup> Water Reducing Admixture Required	YES	YES
<sup>5</sup> Anti-Washout Admixture	YES	NO

<sup>1</sup> Required Average Strength of Mix Design: The selected mixture shall produce an average compressive strength exceeding the specified strength by the amount indicated on ACI 301. When a concrete production facility has a record of at least 15 consecutive tests, the standard deviation shall be calculated and the required average compressive strength shall be determined in accordance with ACI 301. When a concrete production facility does not have a suitable record of tests to establish a standard deviation, the required average strength shall be as follows: For f'c between 3,000 and 5,000 psi, required compressive strength (f'cr) shall be 1,200 psi plus f'c; for f'c over 5,000 and under 10,000 psi, required compressive strength (f'cr) shall be 1,400 psi plus f'c.

<sup>2</sup> When superplasticizers are used, final slump may be increased to 8 inches. Design slump shall be 2 to 4 inches before the superplasticizer is added.

<sup>3</sup> Pile-Supported Concrete Cap & Waterside Structures shall include any cast-in-place concrete associated with the water control structures.

<sup>4</sup> If required, mix shall contain a water reducing admixture conforming to ASTM C 494, Type A. Should the Contractor wish to modify other mix properties in addition to water reduction, ASTM C 494 - Type D, E, F, or G admixtures may be used in addition to or in lieu of Type A.

<sup>5</sup> Only for concrete deposited underwater (tremie)

## 2.10 EPOXY BONDING COMPOUND

- A. Epoxy bonding compounds shall conform to ASTM C 881.
- B. Provide Type I for bonding hardened concrete to hardened concrete; Type II for bonding freshly mixed concrete to hardened concrete; and Type III as a binder in epoxy mortar or concrete, or for use in bonding skid-resistant materials to hardened concrete. Provide Grade 1 or 2 for horizontal surfaces and Grade 3 for vertical surfaces. Provide Class A if placement temperature is below 40 degrees F; Class B if placement temperature is between 40 and 60 degrees F; or Class C if placement temperature is above 60 degrees F.

## 2.11 MATERIALS FOR CURING CONCRETE

- A. Surfaces exposed to public view:
  - 1. Burlap: AASHTO M182, Class 1, 2, or 3.
  - 2. Impervious Sheeting: ASTM C 171, except that polyethylene sheeting shall not be used.
- B. Other Surfaces: Membrane forming curing compounds shall conform to ASTM C 309, Type 1-D or 2.

## 2.12 JOINT FILLERS AND SEALANTS

- A. Expansion/Contraction/Isolation Joint Filler: ASTM D 1751 or ASTM D 1752, 1/2 inch thick, unless otherwise indicated.
- B. Joint Sealants
  - 1. Horizontal Surfaces (3% maximum slope): ASTM D 6690 or ASTM C 920, Type M, Class 25, Use T.
  - 2. Vertical Surfaces (greater than 3% slope): ASTM C 920, Type M, Class 25, Use T.

## 2.13 FORM MATERIALS

- A. Forms
  - 1. Forms for surfaces exposed to view shall be plywood panels conforming to DOC PS 1, Grade B-B concrete form panels, Class I or II. Other form materials or liners may be used provided the smoothness and appearance of concrete produced will be equivalent to that produced by the plywood concrete form panels.

2. Forms for unexposed surfaces shall be wood, steel or other approved concrete form material.
  3. Retain-in-place or stay-in-place metal forms are not permitted.
- B. Form Ties
1. Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal.
  2. Solid backing shall be provided for each tie.
  3. Except where removable tie rods are used, ties shall not leave holes in the concrete surfaces less than 1/4-inch or more than 1 inch deep and not more than 1 inch in diameter.
  4. Removable tie rods shall not be more than 1½-inches in diameter.
- C. Form Releasing Agents
1. Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces.
  2. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water.

## PART 3 - EXECUTION

### 3.01 PRE-CONSTRUCTION CONFERENCE

- A. A pre-construction conference shall be held two weeks prior to commencement of operations to manufacture and install the specified product in order to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include formwork, concrete and admixture handling, placing, finishing, curing concrete, storing, and transporting products.
- B. A manufacturer's representative for the concrete admixture(s) shall be present for the pre-construction conference. The Engineer may waive requirement for manufacturer's representative if the Contractor provides sufficient evidence that producer and finisher have adequate experience with admixtures required,

### 3.02 PLACEMENT OF FORMS

- A. Formwork shall conform to Section 602.08 of the DeIDOT Standard Specifications for Road and Bridge Construction with the following additions:
1. Forms shall conform to the shape, lines, grades and dimensions of the concrete as called for on the Contract Drawings. They shall be mortar tight, and sufficiently rigid to maintain the desired position and shape

during and after placing concrete. Surfaces of metal forms shall be free from irregularities, dents, and sags. Lumber used in forms for exposed surfaces shall be evenly matched and free from loose knots and other imperfections that would produce defects on the finished concrete surfaces. Used lumber may be used if it conforms to the above.

2. Forms shall be capable of producing a surface that meets the requirements of the type of finish specified herein.
3. All formwork shall be provided with adequate cleanout openings to permit inspection and easy cleaning after reinforcing steel has been placed. Where possible, these openings shall be on the side of the unexposed surfaces.
4. Form ties shall be of a type that will conform to the reinforcing steel clearance requirements given in the Contract Drawings. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker. Wire ties shall not be permitted.
5. Forms shall not be reused if there is any evidence of surface wear and tear or defects, which would impair the quality of the surface. Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and of all other foreign material before reuse.
6. Except as otherwise shown, external corners that will be exposed shall be chamfered by moldings placed in the forms.
7. During periods of high tide, portions of the formwork may be immersed in water.

### 3.03 PREPARATION

- A. When bonding lifts or pours, apply a thin coat of compound to dry, clean surfaces. Scrub compound into the surface with a stiff-bristle brush. Place concrete while compound is stringy. Do not permit compound to harden prior to concrete placement. Follow manufacturer's instructions regarding safety and health precautions when working with epoxy resins.
- B. The inside of the forms shall be coated with non-staining mineral oil or other approved material. Where oil is used, it shall be applied before the reinforcing steel is placed. All excess oil or other approved material shall be removed before placing concrete.
- C. Before depositing concrete, all debris, ice and water shall be removed from the spaces to be occupied by the concrete. Any flow or water into such spaces shall be diverted through proper side drains to a sump, or be removed by other approved methods, which will avoid washing the freshly placed concrete.
- D. Before placing any concrete, the Contractor shall ascertain that all the work under the other Sections of the Contract which pass through the concrete, such as fittings, pipes, sleeves, anchors, frames, bolts, plates, expansion joint angles,

inserts, conduits and any other items normally required but not shown, have been set in place. Plumb anchor bolts, check location, and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

### 3.04 JOINTS

- A. Construction Joints: Locate joints to least impair strength. Continue reinforcement across joints unless otherwise indicated.
- B. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
  - 1. Radius: 1/4-inch.
  - 2. Sawn Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
- C. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to the following radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
- D. Expansion/Isolation Joints: Provide joint at edges of slabs on grade abutting vertical surfaces, and as indicated. Make joints 1/2-inch wide unless indicated otherwise. Fill expansion joints not exposed to weather with preformed joint filler material. Completely fill joints exposed to weather with joint filler material and joint sealant. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint unless an expansion sleeve is used.

### 3.05 BATCHING, MEASURING, MIXING AND TRANSPORTING CONCRETE

- A. Batching, measuring, mixing, and transporting concrete shall conform to ASTM C 94, ACI 301, ACI 302.1R, and ACI 304R, except as modified herein.
- B. Batching equipment shall be such that the concrete ingredients are consistently measured within the following tolerances: 1% for cement and water, 2% for aggregate, and 3% for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.
- C. Measuring: Make measurements at intervals as specified in Paragraph 3.17.
- D. Mixing: Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 85 degrees F. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 85

degrees F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and water-cement ratio are not exceeded. When additional water is added, additional 30 revolutions of the mixer at mixing speed is required. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch.

- E. Transporting: Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete that has segregated in transporting, and dispose of as directed by the Engineer.

### 3.06 PLACING REINFORCING STEEL

- A. All reinforcing steel shall be placed accurately in the positions shown on the Contract Drawings or as directed by the Engineer. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits, or other embedded items, the resulting arrangement of the bars, including additional bars required to meet structural requirements, shall be approved by the Engineer before concrete is placed. Cutting and bending shall be in accordance with ACI 318.
- B. All reinforcing steel shall be secured in place true to the lines and grades indicated by the use of metal or concrete supports, spacers, ties and centralizers as approved by the Engineer. Supports shall be of sufficient strength to maintain the reinforcing steel in place throughout the concreting operation. Supports shall be used in such a manner that they will not be exposed on the face of nor in any way discolor or be noticeable in the surface of the finished concrete.
- C. Substitution of different size bars will be permitted only when approved by the Engineer. No additional compensation will be allowed for substituting larger size bars in lieu of the bars indicated on the Contract Drawings.
- D. Splices of reinforcement shall conform to ACI 318 and shall be made only as required or indicated.
  - 1. All lap splices be Class 'B' tension lap splices in accordance with ACI 318. Lapped bars shall not be spaced farther apart than one-fifth the required lap length or 6 inches, whichever is less. Lap splices shall not be used for bars larger than No. 11.
  - 2. Welded butt splices shall be full penetration butt welds in accordance with AWS D1.4. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars in a straight line.

3. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the splicing device.
  4. Butt splices shall develop 125% of the specified minimum yield strength, in compression and tension, of the spliced bars or the smaller bar in transition splices.
- E. All main reinforcing steel shall have the following minimum cover except as noted otherwise on the Contract Drawings:
1. Concrete cast against and permanently exposed to earth.....3"
  2. Concrete exposed to water or earth:
    - a. Bottom of beams or slabs.....3"
    - b. Top of beams or slabs.....2"
    - c. Sides of beams or slabs.....2"
  3. The above dimensions shall be measured from the face of the reinforcing steel to the face of the forms.
- F. All reinforcing steel shall be secured in place true to the lines and grades indicated by the use of metal or concrete supports, spacers, ties, and centralizers as approved by the Engineer. Supports shall be of sufficient strength to maintain the reinforcing steel in place throughout the concreting operation. Supports shall be used in such a manner that they will not be exposed on the face of nor in any way discolor or be noticeable in the surface of the finished concrete. Metal accessories for exposed concrete surfaces shall be galvanized.
- G. All reinforcing steel shall be fully placed, secured and approved by the Engineer before any concrete is placed.

### 3.07 PLACING DOWELS

- A. Dowels shall be installed in slabs on grade at locations indicated on the Contract Drawings and at right angles to the joint being doweled.
- B. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement.
- C. Dowels shall be rigidly supported during concrete placement.

### 3.08 PLACING CONCRETE

- A. When all the other provisions of this Section have been met and the Contractor is ready to place concrete, the Engineer shall be notified. No concrete shall be deposited before the Inspector has inspected and approved the reinforcing steel and other work in place and given permission in writing on a prepared form to proceed. Do not place concrete when weather conditions prevent proper



placement and consolidation in uncovered areas during periods of precipitation or in standing water.

- B. The concrete shall be conveyed from the mixer and placed in the following manner so that there shall be no separation of the various ingredients. Concrete discharging from the mixer shall not be chuted directly into the hopper, bucket or concrete cart. The concrete shall be discharged down a chute into a baffled downpipe, dropping vertically the minimum distance necessary to fill the hopper, bucket, or concrete cart. Concrete being chuted into a form shall discharge into a baffled downpipe and then drop vertically the minimum clear distance necessary to avoid clogging the downpipe. Concrete discharging from a conveyor belt or side opening hopper or bucket shall drop vertically through a baffled downpipe or a vertical hopper or bucket opening. Chuting of concrete for distances greater than 20-feet will not be allowed.
- C. Concrete shall be deposited as nearly as possible in its final position to avoid segregation due to rehandling or flowing. Concrete shall be placed in the form by dumping against the face of concrete already in place and not by dumping away from concrete already in place. Concrete placed in forms deeper than 3-feet shall be dumped into a hopper feeding into a vertical drop chute and then falling free only the minimum clear distance necessary to avoid stopping the downpipe. The Contractor shall submit to the Engineer any method of placing and conveying concrete that deviates in any manner from the preceding specification for approval before any such methods are used to place concrete on the job.
- D. At the discretion of the Engineer, the provisions specified above for conveying and placing concrete may be modified to suit conditions encountered in the field.
- E. All concrete (other than tremie concrete) shall be placed with the aid of approved mechanical vibrating equipment. Vibration, unless otherwise approved, shall be transmitted directly through the concrete and in no case through the forms, or through the reinforcing. The duration of vibration at any location shall be the minimum required to produce thorough compaction. Vibration shall be supplemented by forking or spading by hand adjacent to the forms on exposed faces, or as required. Furnish a spare vibrator on the job site whenever concrete is placed.
- F. Tremie Placement
  - 1. Tremie concrete placement will not be permitted when, in the opinion of the Engineer, weather conditions prevent proper placement. Concrete shall be deposited in the tremie hopper and in so depositing there shall be no vertical drop greater than 5 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Sufficient placing capacity shall be provided so that concrete placement can be kept plastic and free of horizontal cold joints while concrete is being placed.
  - 2. Tremie concrete shall be deposited by a tremie or by a valved tremie. The methods and equipment used shall be subject to approval. Concrete buckets will not be permitted for placement of tremie concrete, although

they may be used to transport concrete to the tremie hoppers. The tremie shall be watertight and sufficiently large to permit a free flow of concrete, but it shall not be less than 8 inches in diameter. A funnel-shaped hopper of at least 2 cubic yards in volume shall be required at the top of the tremie. Neither the tremie pipe nor the hopper shall be constructed of aluminum. Hoisting equipment for raising and lowering the tremie pipe as the concrete is placed and tools for connecting the tremie pipe sections shall be continuously available and on hand. In lieu of use of a tremie, concrete may be placed using a positive displacement pump and pump line provided the entire operation is approved in writing after a demonstration of its use.

3. Tremie pipe sections shall be suitably secured together and a gasket used at each joint to prevent leakage. A retrievable traveling plug (go-devil) or a dry pipe with a plate and gasket wired to the bottom to prevent contact of the concrete and the slurry in the tremie shall be required to start each placement. The tremie assembly shall be lowered to rest within 6 inches of the bottom of the excavated casing prior to beginning placement. During placement of the concrete, any unnecessary movement of the pipe shall be avoided. The bottom of the tremie pipe shall remain submerged in fresh concrete at all times. Batches of concrete shall be supplied to the tremie pipe at a uniform rate for a continuous flow. The tremie pipe shall be lifted during placement at a rate that will maintain the bottom of the pipe embedded in fresh concrete. It may be necessary to reduce the amount of embedment as the differential head decreases between the concrete in the tremie pipe and the concrete in the casing. The repeated raising and lowering of the tremie pipe in the fresh concrete to facilitate placement shall be minimized. Placement shall proceed without interruption until the concrete has been brought to the required height. The Contractor shall continuously measure and record the flow during placement with the use of a sounding line. The tremie shall not be moved horizontally during a placing operation except that as the required is reached. Special care shall be taken to ensure that the bottom of the tremie pipe is not lifted out of the fresh concrete. If this occurs, the Contractor shall remove the tremie pipe, insert a dry pipe with a temporary bottom plug, and restart the placement. Also, as soon as practical, the Contractor shall drill a NX-size core boring through concrete input to a depth of at least 10 feet below the depth where the bottom of the tremie pipe was lifted out of the fresh concrete. Unacceptable zones of concrete such as honeycombed, segregated, or uncemented zones found within the core boring shall immediately be repaired or removed and replaced by an appropriate means. All cost incurred because of this failure, including the initial core boring and as many additional core borings as may be required to delineate the limits of the unacceptable concrete and the repair of the pile shall be borne by the Contractor.
4. Required height of tremie concrete. Concrete that is free of laitance, scum, or other contaminants shall be placed at the top of the formwork or casing. All scum, laitance, and contaminated concrete shall be removed from the top of the concrete as the placement is nearing completion and

shall be disposed of properly. The top surface shall be finished to grade by screeding.

### 3.09 REMOVAL OF FORMS

- A. Forms shall be removed preventing injury to the concrete and ensuring the complete safety of the structure. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement.
- B. Supporting forms and shores shall not be removed from beams, floors and wall until the structural units are strong enough to carry their own weight and any other construction or natural loads. Supporting forms or shores shall not be removed before the concrete strength has reached 70% of the 28-day design strength, as determined by field-cured cylinders or other approved methods. This strength shall be demonstrated by job-cured test specimens and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.
- C. The Engineer may order the forms to remain in place for a longer period than that considered to be sufficient in the judgment of the Contractor. However, should the Engineer acquiesce in the removal of forms by the Contractor, the Engineer assumes no responsibility and the Contractor is in no manner relieved of his responsibility of such removal. All formwork shall be removed before completion of this Contract.

### 3.10 FINISHING

- A. The Contractor shall notify the Engineer upon removal of forms. The Engineer shall inspect newly stripped surfaces, any portion of which, in the judgment of the Engineer, is damaged beyond repair shall be removed and recast at no additional cost to DENREC. Those surfaces to be repaired shall be repaired in a manner approved by the Engineer.
- B. Horizontal Surfaces
  - 1. Finish types shall be as defined in ACI 301.
  - 2. Slabs on grade, including concrete slope protection: Screed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a straightedge to check slope and flatness; correct and refloat as necessary. Obtain final finish by belting. Lay belt flat on the concrete surface and advance with a sawing motion; continue until a uniform but gritty nonslip surface is obtained.

Drag a strip of clean, wet burlap from 3 to 10 feet wide and 2 feet longer than the pavement width across the slab. Produce a fine, granular, sandy textured surface without disfiguring marks. Round edges and joints with an edger having a radius of 1/8-inch.

3. Surfaces exposed to public view shall receive a troweled finish.
4. Surfaces not exposed to public view shall receive a float finish.
5. Surfaces receiving subsequent bonded overlays or lifts shall be given a raked scratch surface.

C. Vertical Surfaces

1. Finish types shall be as defined in ACI 301.
2. Surfaces exposed to public view shall receive a grout cleaned finish.
3. Surfaces not exposed to public view shall receive a smooth-form finish. Surfaces shall be produced in forms that impart a texture to the concrete. All faces shall have a true well defined surface. Fill all air pockets and tie holes over 1/4-inch in diameter with nonshrink grout. All form offsets or fins over 1/8-inch shall be ground smooth.
4. Utility structures not exposed to public view shall receive a rough-form finish.

3.11 CURING AND PROTECTION

- A. Concrete curing shall be in accordance with ACI 301 and ACI 308 unless otherwise specified.
- B. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer-hardener or epoxy coating.
- C. Membrane Curing Compound: Do not use membrane curing compounds on surfaces exposed to public view, corrosion inhibitor treated concrete, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded.
- D. High air content and low water-to-cementitious ratio used in corrosion inhibitor concrete will result in less bleed water than in normal concrete. To reduce plastic or drying shrinkage cracks, comply with ACI 302.1R, ACI 308, and ACI 305R.

1. Use moist curing for corrosion inhibitor treated concrete. When weather conditions are dry and windy, continue fogging above surface of concrete after the finishing operation until prewetted burlap can be placed over the flatwork surface. Use prewetted burlap to cover all flatwork and keep wet for a minimum of seven days or until the time necessary to attain 85% of the specified compressive strength, as recommended by ACI 308 Section 3.1.3.
- E. Moist Curing: Remove water without erosion or damage to the structure.
1. Ponding or Immersion: Continually immerse the concrete throughout the curing period. Water shall not be more than 20 degrees F less than the temperature of the concrete. For temperatures between 40 and 50 degrees F, increase the curing period by 50%.
  2. Fog Spraying or Sprinkling: Apply water uniformly and continuously throughout the curing period. For temperatures between 40 and 50 degrees F, increase the curing period by 50%.
  3. Pervious Sheeting: Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6 inches over adjacent sheeting. Sheeting shall be at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete or over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.
  4. Protection of Treated Surfaces: Prohibit pedestrian and vehicular traffic and other sources of abrasion at least 72 hours
- F. Curing Periods: ACI 301 except 10 days for retaining walls or slabs on grade. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing shall be subject to approval by the Engineer.

### 3.12 TOLERANCES

- A. Comply with tolerances of ACI 117.
- B. Tolerances for slabs on grade shall be as modified herein:
1. Elevation: 1/4-inch.
  2. Thickness: Plus 3/8-inch, minus 1/4-inch.
  3. Surface: Gap below 10-foot long, unleveled straightedge not to exceed 1/4-inch.
  4. Joint Spacing: 3-inches.

5. Contraction Joint Depth: Plus 1/4-inch, no minus

### 3.13 PUMPING CONCRETE

- A. Pumping of concrete shall conform to the requirements of ACI 304R and ACI 304.2R.
- B. Pumping shall not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment shall not exceed 2 inches. Concrete shall not be conveyed through pipe made of aluminum or aluminum alloy. Rapid changes in pipe sizes shall be avoided. Maximum size of coarse aggregate shall be limited to 33% of the diameter of the pipe. Maximum size of well rounded aggregate shall be limited to 40% of the pipe diameter. Samples for testing shall be taken at both the point of delivery to the pump and at the discharge end.

### 3.14 COLD WEATHER CONCRETING

- A. Cold weather concreting shall conform to the requirements of ACI 306.1
- B. Adequate protection of concrete against damage by frost during the making and early curing period is absolutely essential whenever the atmospheric temperature is below 40 degrees F or whenever the temperature may fall below 40 degrees F within 24 hours after placement.
- C. The Contractor shall provide and have on the job ready to install, adequate facilities for enclosing the freshly placed concrete and heating the enclosure for the period November 1 to April 1.
- D. The mixing water and aggregates shall be heated by steam coils or other devices so that the concrete during mixing is kept above a minimum temperature of 65 degrees F.
- E. Concrete when placed in the forms shall have a minimum temperature of 55 degrees F. Freshly laid concrete and the surrounding atmosphere shall be maintained at a temperature of 50 degrees F or greater for a period of 48 hours after placement.
- F. A permanent temperature record shall be kept for the days on which protection is required as specified in Paragraph B above, showing the date, hour, outside temperature and temperature within the enclosure to show the most favorable or unfavorable conditions to which the concrete is subjected. The Contractor shall furnish maximum and minimum thermometers or recording thermometers for this purpose. A copy of the temperature record shall be sent to the Engineer at the close of each day's work.
- G. Tarpaulins supported on sawhorses or other framework shall follow closely the placing of the concrete so that only a few feet of the finished work is exposed to the outside atmosphere at any one time. Tarpaulins shall be arranged so that

heated air can circulate freely in the space between the tarpaulin and the freshly placed concrete.

- H. Within the enclosure, means for artificial heating shall be provided as well as maintain the temperatures specified continuously and with a reasonable degree of uniformity in all parts of the enclosure.
  - 1. The Contractor shall provide adequate fire protection accessible at all times where heating is in progress and shall maintain watchmen or other attendants to keep the heating units in continuous operation. All heating appliances shall be vented.
  - 2. Heating appliances shall not be placed in a manner as to endanger formwork or centering or expose any area of concrete to drying out or other injury due to excessive temperatures.
- I. The use of salts, chemicals or other foreign material in the mix to lower the freezing point of the concrete is prohibited.

### 3.15 HOT WEATHER CONCRETING

- A. Hot weather concreting shall conform to the requirements of ACI 305R.
- B. Concrete shall be protected during placement, finishing and curing in hot weather to minimize the formation of plastic shrinkage cracks.
- C. Concrete, when placed in the forms, shall have a maximum temperature of 90 degrees F. Mixing water shall be chilled as required to maintain the temperature of the concrete below this unit.
- D. Forms shall be wetted prior to placement of concrete. Fog spraying may be used to cool the air, cool the forms and reinforcing steel ahead of placement and to lessen the amount of evaporation from the concrete surface before and after finishing.

### 3.16 DEPOSITING CONCRETE UNDER WATER

- A. Methods and equipment used shall prevent the washing of the cement from the mixture, minimize the formation of laitance, prevent the flow of water through the concrete before it has hardened, and minimize disturbance to the preciously placed concrete. Do not deposit concrete in running water or in water temperatures below 35 degrees F. Deposit fresh concrete so concrete enters the mass of the previously placed concrete from within, displacing water with a minimum disturbance to the surface of the concrete. Place concrete without interruption until the top of the fresh concrete is at the required height.
- B. A tremie shall consist of a watertight tube having a diameter of not less than 10 inches with a hopper at the top. When a batch is dumped into the hopper, the flow of the concrete shall be induced by slightly raising the discharge end, always keeping the discharge end in the deposited concrete.

- C. Concrete pump discharge tubes and tremie tubes used to deposit concrete under water shall be equipped with a device that will prevent water from entering the tube while charging the tube with concrete. The tubes shall be supported so as to permit free movement of the discharge end over the entire top surface of the work and to permit rapid lowering, when necessary, to retard or stop the flow of concrete. The tubes shall be filled by a method that will prevent washing of the concrete. The discharge end shall be completely submerged in concrete at all times and the tube shall contain sufficient concrete to prevent any water entry. The flow shall be continuous until the work is completed, and the resulting concrete seal shall be monolithic and homogeneous.
- D. Before dewatering, the concrete in the seal shall be allowed to cure for not less than five days after placing.
- E. If a concrete seal designed to withstand hydrostatic pressure is placed in water having a temperature below 45 degrees F, the curing time before dewatering shall be increased. Periods of time during which the temperature of the water has been continuously below 38 degrees F shall not be considered as curing time. After sufficient time has elapsed to ensure adequate strength in the concrete seal, the cofferdam shall be dewatered and the top of the concrete cleaned of all scum, laitance, and sediment. Before fresh concrete is deposited, local high spots shall be removed as necessary to provide proper clearance for reinforcing steel.

### 3.17 EXAMINATION OF PRECAST CONCRETE MEMBERS

- A. Prior to erection, and again after installation, precast members shall be checked for damage, such as cracking, spalling, and honeycombing. As directed by the Engineer, precast members that do not meet the surface finish requirements specified in the previous paragraph "Surface Finish" shall be repaired, or removed and replaced with new precast members.

### 3.18 ERECTION OF PRECAST MEMBERS

- A. Precast members shall be erected after the concrete has attained the specified compressive strength, unless otherwise approved by the Engineer and the precast manufacturer. Erect precast members in accordance with the approved shop drawings. Tolerances shall be in accordance with PCI MNL-116 and PCI MNL-120, Chapter 8. Provide a 1:500 tolerance if no tolerance is specified. Brace precast members, unless design calculations submitted with the shop drawings indicate bracing is not required. Follow the manufacturer's recommendations for maximum construction loads. Place precast members level, plumb, square, and true within tolerances. Align member ends.

### 3.19 BEARING SURFACES

- A. Shall be flat, free of irregularities, and sized as indicated on the Contract Drawings. Size bearing surfaces to provide for the indicated clearances between the precast member and adjacent precast members or adjoining field placed surfaces. Correct bearing surface irregularities with grinding or nonshrink grout. Provide bearing pads where indicated or required. Place precast members at



right angles to the bearing surface, unless indicated otherwise, and draw-up tight without forcing or distortion, with sides plumb.

### 3.20 ANCHORAGE

- A. Provide anchorage for fastening work in place as indicated on the Contract Drawings. Conceal fasteners where practicable. Make threaded connections up tight and nick threads to prevent loosening.

### 3.21 WELDING

- A. Welding of uncoated reinforcing bars is not permitted without approval of the Engineer. When permitted, welding of uncoated reinforcing shall conform to AWS D1.4 for welding connections and reinforcing splices. Protect the concrete and other reinforcing from heat during welding. Weld continuously along the entire area of contact. Grind smooth visible welds in the finished installation.
- B. Welding of miscellaneous steel embedments shall be in accordance with AWS D 1.1.

### 3.22 OPENINGS

- A. Holes or cuts requiring reinforcing to be cut, which are not indicated on the approved shop drawing, shall only be made with the approval of the Engineer and the precast manufacturer. Drill holes less than 12-inches in diameter with a diamond tipped core drill.

### 3.23 SHEAR KEYS

- A. Clean and fill indicated shear keys between precast members and other indicated areas solidly with shear key grout as specified in Section 03300, "Cast-In-Place Concrete" before placement of reinforcement for cast-in-place concrete topping slab. Remove excess grout before hardening. Install a continuous foam backer rod in shear key, as indicated on the Contract Drawings, prior to placement of shear key fill.

### 3.24 CONSTRUCTION RECORDS

- A. Complete construction records shall be kept of the manufacturing, handling, and erection of the precast structural concrete members. Records shall be kept for, but not limited to, the following items:
  - 1. Specifications of material used in the manufacture of the members
  - 2. Records of the inspection of the members each time they are moved
  - 3. Records of any defects in the member and any corrective measures taken

### 3.25 FIELD QUALITY CONTROL AND CONCRETE TESTING

- A. Concrete Testing: The making of all concrete specimens, slump, temperature, and air content tests shall be performed by an ACI Certified Field Technician and witnessed by the Engineer. Laboratory testing of cast-in-place concrete shall be

done by a qualified independent testing laboratory paid for by the Contractor. Samples shall be taken by the Field Technician and delivered to the Independent Testing Laboratory.

- B. Test Specimens: The Contractor shall supply all concrete, compression test molds, tamping rods, trowel, metal or glass covers, slump cone, storage box and sand necessary for making test specimens as outlined herein. The Contractor shall make, cure, and remove from molds and transport to the testing laboratory, five specimens for each sample in accordance with ASTM C 31 and ASTM C 172.
- C. Compressive Strength Tests: Make five test cylinders for each set of tests in accordance with ASTM C 31. Precautions shall be taken to prevent evaporation and loss of water from the specimen. Samples for strength tests of each mix design of concrete placed each day shall be taken not less than once a day, nor less than once for each 100 cubic yards of concrete, nor less than once for each 5000 square feet of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result shall be the average of two cylinders from the same concrete sample tested at 28 days.
- D. Corrosion Inhibitor Content Testing: The Contractor shall furnish and have tested one concrete cylinder for every 100 cubic yards of concrete requiring corrosion inhibiting admixture. Hardened concrete shall be tested in accordance with NCDOT Chem. Proc. C-20.0. The minimum nitrite recovery shall be not less than 5.1 pounds of nitrate per cubic yard. If three consecutive tests indicate a nitrite content is less than the specified minimum recovery, the materials represented by the failing lots may be subject to rejection. Contractor shall revise the quantity and/or type of corrosion inhibitor added to satisfy these Specifications. Additional testing may be performed at the Contractor's expense to dispute failing test results.
- E. Air Content Test: The Contractor shall test the air content in accordance with ASTM C 231. The air content test shall be made and recorded at the same time as specified for slump tests.
- F. Slump Tests: The Contractor shall check the consistency of concrete by means of slump tests conducted in accordance with ASTM C 143. The maximum slump may be increased as specified with the addition of an approved admixture provided the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch of concrete.
- G. Temperature: Concrete temperature shall be taken and recorded at the same time as specified for slump tests.
- H. Test Reports: Field Technician shall fill in data on concrete test sample form and forward same with test specimens to the Independent Testing Laboratory. When tests have been conducted, the Contractor shall furnish the results of the tests with all pertinent data to the Engineer.

- I. Deficiencies and Remedial Action: In the event that concrete strength test results do not meet the acceptance criteria specified in ACI 301, additional tests of concrete in place as specified in DelDOT Specifications shall be performed at the sole expense of the Contractor. In the event that tests of concrete in place do not meet the acceptance criteria specified, those portions of the structure affected as determined by the Engineer shall be removed and replaced in a manner acceptable to the Engineer at no additional expense to the DENREC.

END OF SECTION

## **05 50 00 – METAL FABRICATIONS**

### **PART 1 - GENERAL**

#### **1.01 UNIT PRICES**

##### **A. 48-in Pipe Steel Superstructure – Base Bid**

1. Payment: Payment for “48-in Pipe Steel Superstructure” shall include all of the material, labor, and equipment associated with fabricating, transporting and erecting the structural steel trusses, wales and assemblies, coated steel sheet pile retaining walls, floor grating, as well as all miscellaneous metal fabrications, welding, all connection hardware such as anchor rods, framing bolts, hex nuts, washers, providing hot-dipped galvanized coating for all exposed steel framing, safe handling and installation of the DNREC-furnished 48-inch combination gate fixtures, and field testing as specified herein.
2. Measurement: The quantity to be paid shall be the number of steel superstructure to be erected.
3. Unit of Measure: Per Each (EA).

##### **B. 24-in Pipe Steel Superstructure – Alternate No. 1**

1. Payment: Payment for “24-in Pipe Steel Superstructure” shall include all of the material, labor, and equipment associated with fabricating, transporting and erecting the structural steel trusses, wales and assemblies, coated steel sheet pile retaining walls, floor grating, as well as all miscellaneous metal fabrications, welding, all connection hardware such as anchor rods, framing bolts, hex nuts, washers, providing hot-dipped galvanized coating for all exposed steel framing, safe handling and installation of the DNREC-furnished 24-inch flap gate and HDPE flashboard riser fixtures, and field testing as specified herein.
2. Measurement: The quantity to be paid shall be the number of steel superstructure to be erected.
3. Unit of Measure: Per Each (EA).

##### **C. Metal Handrail – Base Bid and Alternate No. 1**

1. Payment: Payment for “Metal Handrails” shall include all of the material, labor, and equipment associated with fabricating, transporting and erecting the metal handrails and posts, as well as all welding, connection hardware, bolts, hex nuts, washers, permanent safety chains at all temporary ladder locations, and providing hot-dipped galvanized coating for all exposed steel framing.

2. Measurement: "Metal Handrails" shall be measured on a Linear Foot basis.
3. Unit of Measure: Linear Foot (LF).

## 1.02 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. Unless otherwise indicated the most recent edition of the publication, including any revisions, shall be used.
- C. Except as modified or otherwise required herein, the Delaware Department of Transportation (DelDOT) "Standard Specifications for Road and Bridge Construction," August 2001, with all the latest addenda are to be used for this Section.
- D. American National Standards Institute (ANSI)
  1. ANSI A10.3 (2006) – Safety Requirements for Powder-Actuated Fastening Systems
  2. ANSI B18.2.1 (2010) – Square, Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head and Lag Screws (Inch Series)
  3. ANSI B18.2.2 (2010) – Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
  4. ANSI B18.6.2 (1998; R2010) – Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws
  5. ANSI B18.6.3 (2010) – Machine Screws, Tapping Screws, and Metallic Drive Screws (Inch Series)
  6. ANSI B18.21.1 (2009) – Washers: Helical Spring-Lock, Tooth Lock and Plain Washers (Inch Series)
  7. ANSI B18.22.1 (2009) – Washers: Helical Spring-Lock, and Plain Washers (Inch Series)
- E. American Society of Mechanical Engineers (ASME)
  1. ASME BPVC SEC II-C (2010) – Boiler and Pressure Vessel Code: Section II Material Specifications Part C - Welding Rods, Electrodes, and Filler Metals
- F. American Society for Testing and Materials (ASTM)
  1. ASTM A 27 - (2013) Steel Castings, Carbon, for General Application
  2. ASTM A 36 - (2014) Carbon Structural Steel

3. ASTM A 48 - (2012) Gray Iron Castings
4. ASTM A 53 - (2012) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
5. ASTM A 123 - (2015) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
6. ASTM A 153 - (2009) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
7. ASTM A 240 - (2015a) Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
8. ASTM A 276 - (2015) Stainless Steel Bars and Shapes
9. ASTM A 320 - (2015) Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service
10. ASTM A 325 - (2014) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
11. ASTM A 480 - (2015) General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
12. ASTM A 514 - (2014) High-Yield-Strength Quenched and Tempered Alloy Steel Plate, Suitable for Welding
13. ASTM A 536 - (2014) Ductile Iron Castings
14. ASTM A 563 - (2015) Carbon and Alloy Steel Nuts
15. ASTM A 572 - (2015) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
16. ASTM A 575 - (2013) Steel Bars, Carbon, Merchant Quality, M-Grades
17. ASTM A 653 - (2015) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
18. ASTM A 780 - (2015) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
19. ASTM A 992 – (2015) Specification for Structural Steel Shapes
20. ASTM C 881 - (2014) Epoxy-Resin-Base Bonding Systems for Concrete
21. ASTM D 1187 - (2011e1) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
22. ASTM D 2000 - (2012) Standard Classification System for Rubber Products in Automotive Applications

- 23. ASTM F 436 - (2011) Hardened Steel Washers
- 24. ASTM F 593 - (2013) Stainless Steel Bolts, Hex Cap Screws, and Studs
- 25. ASTM F 594 - (2015) Stainless Steel Nuts
- 26. ASTM F 1554 – (2015) Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
- G. American Water Works Association (AWWA)
  - 1. AWWA C 561 - (2014) Fabricated Stainless Steel Slide Gates
- H. American Welding Society, Inc. (AWS)
  - 1. AWS D1.1 - (2010) Structural Welding Code – Steel
  - 2. AWS D1.5 - (2010) Bridge Welding Code
  - 3. AWS D3.6 - (2010) Underwater Welding
  - 4. AWS QC1 - (2006) AWS Certification of Welding Inspectors
- I. Federal Specifications (FS)
  - 1. FS TT-P-664 (Rev. D) – Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant
- L. Military Specifications and Standards
  - 1. MIL-PRF-907 - (2004) High Temperature Antisieze Thread Compound
- M. National Association of Architectural Metal Manufacturers (NAAMM)
  - 1. NAAMM AMP 521 (2001) – Pipe Railing Systems Manual
  - 2. NAAMM MBG 531 (2001) – Metal Bar Grating Manual
- N. Steel Structures Painting Council (SSPC)
  - 1. SSPC-SP 1 (2004) – Solvent Cleaning
  - 2. SSPC-SP 6 (2007) – Commercial Blast Cleaning

### 1.03 SYSTEM DESCRIPTION

- A. The work covered by this Section includes the furnishing of all materials and equipment and the performing of all labor necessary to complete fabrications as shown on the Contract Drawings and as herein specified or directed by the Engineer.

#### 1.04 SUBMITTALS

- A. General: Submit the following to the Design Engineer for approval. Note that approval of submittals by the Engineer shall not be construed as relieving the Contractor from responsibility for compliance with the Specifications nor from responsibility of errors of any sort in the submittals.
- B. Certifications, test procedures, and other submittals shall show the appropriate ASTM test(s) for each material.
- C. Product Data
  - 1. Adhesive anchors
  - 2. Anchor bolts
  - 3. Storm drainage combo gate
- D. Submit manufacturer's certified test reports, for each heat, indicating that materials have been tested and certified to meet the specified chemical, mechanical, and section properties prior to delivery at the site. Certifications shall be submitted for all materials, including but not limited to:
  - 1. Adhesive anchors
  - 2. Anchor bolts
  - 3. Cast steel
  - 4. Cast iron
  - 5. Ductile iron
  - 6. High strength structural steel
  - 7. Stainless steel plates and sheet
  - 8. Structural carbon steel
- E. Shop Drawings
  - 1. Embedded angles, plates, and edge armor
  - 2. Storm drainage combo gate
  - 3. Storm drainage riser structure
  - 4. Storm drainage flap gate
  - 5. Pipe sleeves and supports
  - 6. Truss fabricated assemblies
  - 7. Wale fabricated assemblies
  - 8. Handrails
- F. Instructions
  - 1. Adhesive anchors
  - 2. Manufacturer's operation and maintenance manuals and information for storm drainage combo gate
- G. Certification Statements
  - 1. Welding procedure qualifications
  - 2. Nondestructive examination (NDE) procedures
  - 3. NDE personnel certification procedures
  - 4. Inspector certification
  - 5. Submit inspector certification and NDE personnel certification for record
  - 6. Manufacturer's equipment warranty for storm drainage combo gate



- H. Certified Welding Inspector, Welding Procedures, Welder, and Welding Operator Qualifications
  - 1. Certified Welding Inspector: Submit qualifications of third party AWS Certified Welding Inspectors (CWI) proposed for welder qualifications and visual/NDE inspections. Inspectors shall be qualified and certified in accordance with the provisions of AWS QC1, Standard for Qualification and Certification of Welding Inspectors. Do not proceed with welder or welding operator qualifications prior to approval of CWI qualifications.
  - 2. Specifications and Test Results: Submit copies of the welding procedure specifications, procedure qualifications, welder and welding operator qualifications test results for each type of welding required. Approval of any procedure does not relieve the Contractor of the responsibility for producing acceptable welds.
  - 3. Certification: Before assigning welders or welding operators to the work, submit their names, together with certification that each individual is performance qualified as specified in paragraph 1.05.C. Do not start welding work prior to procedure, welder and welding operator qualification approval. The certification shall state the type of welding and positions for which each welding procedure welder and welding operator is qualified, the code and procedure under which each is qualified, date qualified, and the firm and individual certifying the qualification tests.
- I. Records
  - 1. Weld Identifications: Submit a list of the welder's names and symbol for each welder. To identify welds, submit written records indicating the location of welds made by each welder or welding operator.
- J. Work Plan
  - 1. Submit work plan for steel fabrication installation and erection, including but not limited to, proposed sequence of construction, equipment descriptions, anticipated production rates, equipment placement, template configurations, handling, and other relevant installation information. Work plan shall be approved before ordering materials.

#### 1.05 QUALIFICATION OF WELDERS

- A. Qualify welders in accordance with AWS D1.1 or AWS D3.6 in accordance with these specifications where applicable, using procedures, materials, and equipment of the type required for the work.

#### 1.06 QUALITY ASSURANCE

- A. Welding Procedures, Welders and Welder Qualifications
  - 1. Develop and qualify procedures for welding metals included in the work. Do not start welding until welding procedures, welders, and welding operators have been qualified. Perform qualification testing by a Certified Weld Inspector (CWI) or testing laboratory approved by the Engineer. Notify the Engineer at least 24 hours in advance of the time and place of the tests. When practicable, perform the qualification tests at or near the work site. Maintain current records of the test results obtained in welding procedure, welder and welding operator performance qualifications, and

nondestructive examination (NDE) procedures. These records shall be readily available at the site for examination by the Engineer. Qualify the procedures for making transition welds between different materials or between plates or pipes of different wall thicknesses. The choice of welding process shall be the responsibility of the Contractor.

B. Previous Welding Qualifications

1. Welding procedures, welders, and welding operators previously qualified by test may be accepted for the work without requalification provided that the following conditions are fulfilled:
  - a. Copies of welding procedures, procedures qualification test records, and welder and welding operator performance qualification test records are submitted and approved in accordance with the paragraph entitled "Submittals."
  - b. Testing was performed by an approved testing laboratory or technical consultant or by the Contractor's approved quality control organization. The welding procedures, welders, and welding operators were qualified in accordance with AWS D1.1, or AWS D3.6 where applicable, and base materials, filler materials, electrodes, equipment, and processes conformed to the applicable requirements of this Specification.
  - c. The requirements of paragraph entitled "Welder and Welding Operator Performance Qualification" for renewal of qualification were met, and records showing name of employer and period of employment using the process for which qualified are submitted as evidence of conformance.

C. Performance

1. The Contractor shall be responsible for the quality of joint preparation, welding, and examination. Clearly identify and record materials used in the welding operations. The examination and testing defined in this Specification are minimum requirements. Provide additional examination and testing as necessary to achieve the quality required.
  - a. Welding Procedures Qualification: Qualification of the welding procedures for each group of materials to be welded is required as indicated in AWS D1.1. Qualification of the underwater welding procedures for each group of materials to be welded is required as indicated in AWS D3.6. Record in detail and qualify the "Welding Procedure Specification" for every welding procedure proposed. Qualification for each welding procedure shall conform to the requirements of AWS Standards and to this Specification. The welding procedures shall specify end preparation for weld, including cleaning, alignments, and root openings. Preheat, interpass temperature control, and postheat treatment of welds shall be as required by AWS, unless otherwise indicated or specified. Welding procedure qualifications shall be identified individually and referenced on the shop drawings or suitably keyed to the contract drawings.
  - b. Welder and Welding Operator Performance Qualification: Qualify each welder and welding operator assigned to work covered by this Specification by performance tests using equipment, positions,

procedures, base metals, and electrodes or bare filler wires from the same specification, classification, or group number that will be encountered on his assignment. Welders or welding operators who make acceptable procedure qualification tests will be considered performance-qualified for the welding procedure used. Determine performance qualification in accordance with AWS D1.1 and as specified. Determine performance qualification for underwater welding in accordance with AWS D3.6 and as specified.

- c. Renewal of Qualification: Requalification of a welder or welding operator shall be required under one or any combination of the following conditions:
  - i. When a welder or welding operator has not used the specific welding process for a period of three (3) months. The period may be extended to six (6) months if the welder has been employed on another welding process.
  - ii. There is specific reason to question the welder's ability to make welds that will meet the requirements of the Specifications.
  - iii. The welder or welding operator was qualified by an employer other than those firms performing work under this contract and a qualification test has not been taken within the preceding 12 months. Renewal of qualification under this condition need be made on only a single test joint of any thickness, position, or material to reestablish qualification for any thickness, position, or material for which the welder or welding operator had qualified previously.

D. Qualification of Inspection and Nondestructive Examination (NDE) Personnel.

E. Qualify Inspection and nondestructive examination personnel in accordance with the following requirements:

- 1. Inspector Certification: Qualify welding inspectors in accordance with AWS QC1.
- 2. NDE Personnel Certification Procedures: Certify NDE personnel and establish a written procedure for the control and administration of NDE personnel training, examination, and certification. Base procedures on appropriate specific and general guidelines of training and experience recommended by ASNT SNT-TC-1A, Supplement C-Ultrasonic.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Materials delivered to the site shall be new and undamaged and shall be accompanied by certified test reports. The manufacturer's logo and mill identification mark shall be provided on the piling as required by the referenced specifications.
- B. Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

- C. Weld Material: Deliver filler metals, electrodes, fluxes, and other welding materials to the site in manufacturer's original packages and store in a dry space until used. Label and design packages properly to give maximum protection from moisture and to assure safe handling.

## 1.08 ENVIRONMENT

- A. Do not perform welding when the quality of the completed weld could be impaired by the prevailing work or weather conditions per AWS D1.1. The Engineer will determine when the weather or working conditions are unsuitable for welding.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Anchor Bolts, Nuts and Washers
  - 1. Stainless Steel Bolts
    - a. 1/4" to 5/8" nominal diameter bolts, inclusive, shall conform to ASTM F 593, Alloy 316, Condition CW1. Nuts shall conform to ASTM F 594, Alloy 316, Condition CW1.
    - b. 3/4" to 1 1/2" nominal diameter bolts, inclusive, shall conform to ASTM F 593, Alloy 316, Condition CW2. Nuts shall conform to ASTM F 594, Alloy 316, Condition CW2.
    - c. Washers shall be Alloy 316 meeting the dimensional requirements of ANSI B18.22.1, Type A Plain.
  - 2. Adhesive Anchor Bolts: Adhesive formula shall conform to the requirements of paragraph 2.01.N. Minimum pull out and shear capacity of the adhesive system shall exceed the ultimate capacity of the anchor.
  - 3. Anchor Bolts and Threaded Rods
    - a. Anchor bolts and rods shall conform to ASTM F1554, Grade 105, galvanized
    - b. Nuts shall conform to ASTM A 563, Grade DH, galvanized
    - c. Washers shall conform to ASTM F 436, galvanized
  - 4. Bolts, Nuts, Studs and Rivets: ASMC/ANSI B18.2.2 or ASTM A 325, galvanized, as noted
  - 5. Powder Driven Fasteners: Follow safety provisions of ANSI A10.3
  - 6. Screws: ANSI B18.2.1, ANSI B18.6.2, and ANSI B18.6.3
  - 7. Washers: Provide plain washers to conform to ANSI B18.22.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ANSI B18.21.1
- B. Cast Iron Castings: ASTM A 48, Grade as required by design
- C. Cast Steel: ASTM A 27, Grade 65/35 or better as required by design
- D. Ductile Iron Castings: ASTM A 536, Grade as required by design
- E. High Strength Structural Steel and Plate Stiffeners: ASTM A 572, Grade 50

- F. Hot-rolled Carbon Steel Bars and Bar-shapes: ASTM A 575, Grade as selected by the fabricator
- G. Stainless Steel Sheet and Plate: ASTM A 240 and ASTM A 480, Alloy 316L
- H. Steel Pipe: ASTM A 53, Type E or S, Grade B and AWS D1.1
- I. Structural Carbon Steel and Plate: ASTM A 36 – Unless otherwise noted
- J. Rolled Structural W-Shapes: ASTM A 992
- K. H-Piles: ASTM A 572 Grade 50
- L. Welded Studs: AWS D1.1, Section 7 and AWS D1.5
- M. Plate Washers: ASTM A 514, Grade 100, galvanized
- N. Adhesive Formula
  - 1. Adhesive Formula: Minimum pull out and shear capacity of the adhesive system shall exceed the ultimate capacity of the anchor.
  - 2. The adhesive formula shall be suitable for installation and performance as an applicable overhead anchorage, and shall be conformed to by the current ICC-ES report or approved equivalent.
  - 3. The adhesive formula shall be suitable for installation and performance as an applicable post-installed reinforcing steel connection, and shall be conformed to by the current ICC-ES report or approved equivalent.
  - 4. The adhesive formula shall be suitable for installation and performance as an applicable water saturated anchorage, and shall be conformed to by the current ICC-ES report or approved equivalent.
  - 5. The adhesive formula shall be suitable for post-installed anchorages and meet one of the following adhesive types:
    - a. Epoxy Adhesives: Adhesives shall be a cartridge type, two-component, solid epoxy based system dispensed and mixed through a static mixing nozzle supplied by the manufacturer. The adhesive shall meet the minimum requirements of ASTM C 881 Type IV and V, Grade 2 and 3, Class A, B and C, except gel times. Acceptable installation and performance temperature ranges shall be verified with manufacturer's literature prior to installation. Epoxy adhesives shall have an evaluation report issued by ICC-ES and be tested in accordance with ICC-ES's Acceptance Criteria for Adhesive Anchors in Concrete and Masonry Elements (AC 58) for the following:
      - i. Seismic and wind loading
      - ii. Long term creep at elevated temperatures
      - iii. Static loading at elevated temperatures
      - iv. Damp and water-filled holes
      - v. Freeze-thaw conditions
      - vi. Critical and minimum edge distance and spacing
    - b. Encapsulated Adhesives: Capsule shall be a two-component, vinylester based adhesive capsule-within-a-capsule system

supplied in manufacturer's standard packaging. The capsule is placed in the hole and the resin and initiator components are combined when the rod or rebar is driven to the bottom of the hole through the capsule. No spinning or insert end preparation shall be required for proper installation. Acceptable installation and performance temperature ranges shall be verified with manufacturer's literature prior to installation. Capsule adhesives shall be tested in accordance with ICC-ES's Acceptance Criteria for Adhesive Anchors in Concrete and Masonry Elements (AC 58) for the following:

- i. Long term creep at elevated temperatures
- ii. Critical and minimum edge distance and spacing
- c. Adhesive Limitations:
  - i. Installation Temperature: When the base material temperature drops below 40 degrees F, only Acrylic Adhesives shall be used for adhesive installations. See manufacturer's instructions for additional minimum temperature requirements.
  - ii. Hollow Substrates: The adhesive manufacturer's screen tubes shall be used for adhesive installations into hollow substrate. Encapsulated Adhesives shall not be used in hollow substrate applications.
  - iii. Moisture: Encapsulated Adhesives shall not be used when moisture is present in or around hole.
  - iv. Oversized Holes: Refer to manufacturer's information if drilled hole size is larger than what is recommended.
  - v. Core-drilled holes: Refer to manufacturer's information if holes are drilled with a core-drill bit.

## 2.02 FABRICATION FINISHES

- A. Steel Galvanize: Anchor bolts, washers, frames, structural shapes, and parts or devices and all other items indicated or specified for galvanizing and as necessary for proper installation, unless indicated otherwise.
- B. Galvanizing
  - 1. Bolts, Nuts, and Washers: ASTM A 153, Class C or D as applicable
  - 2. Plates and Structural Shapes: ASTM A 123, Thickness Grade 100
  - 3. Steel Sheet: ASTM A 653, Coating Designation G210
  - 4. Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable
- C. Surface Preparation: Blast clean surfaces in accordance with SSPC-SP6. Clean surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents in accordance with SSPC-SP1. Steel to be embedded in concrete shall be free of dirt and grease. Do not galvanize bearing surfaces, including contact surfaces within friction-type joints, but coat with rust preventative applied in the shop.
- D. Repair of Zinc-Coated Surfaces: Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A 780 or by the application of stick or thick

paste material specifically designed for repair of galvanizing, as approved by the Engineer / Service. Clean areas to be repaired and remove the slag from the welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metal in stick or paste; spread the molten material uniformly over surfaces to be coated and wipe the excess material off.

- E. Nonferrous Metal Surfaces: Protect by plating, anodic, or organic coatings.

## 2.03 MISCELLANEOUS PLATES AND SHAPES

- A. Provide for items that do not form a part of the structural steel framework, such as miscellaneous mountings, frames, and connections. Provide with connections and fastener welds as indicated.
- B. Mounting plates and plate washers shall conform to ASTM A 514, Grade 100, galvanized.

## 2.04 STORM DRAINAGE COMBO GATES

- A. General
  - 1. The gates shall be self-contained with yoke and bench stand operators in accordance with the requirements of these specifications.
  - 2. This gate is in compliance with the latest version of AWWA C 561.
  - 3. Specific configurations shall be as noted on the gate schedule or as shown on the plans.
  - 4. Materials:
    - a. Frame, Cover Slides, Yokes Stainless steel: ASTM A 276 and/or ASTM A 240, AISI Type 304, 316, or 2205 Duplex, as specified
    - b. Stems Stainless Steel: ASTM A 276, AISI Type 304, 316, or 2205 Duplex, as specified
    - c. Fasteners and Anchor Bolts Stainless Steel: ASTM A 320, Type 316 CW.
    - d. Seals Rubber (J-Bulb): EPDM or Neoprene ASTM D 2000 BC 615/625 Grade BE 625
    - e. Guides: Ribbed Ultra High Molecular Weight Polyethylene (UHMW)
    - f. Finish: Mill finish on all stainless steel surfaces.
- B. Frame and Guides
  - 1. The gate frame shall be composed of stainless steel guide rails with UHMW guides upstream and downstream. The seat/seals shall form a tight seal between the frame and the slide (disc). Gate shall be designed where all seals are replaceable without removing the frame from the wall or wall thimble.
    - a. The continuous J-Bulb neoprene or EPDM seal will perform the function of a seal between the frame and the slide (disc).
    - b. This tight seal shall provide an allowable leakage rate of no more than .10 gallons per minute (GPM) per peripheral foot of perimeter opening for seating head.

2. Stainless steel retainer bars, cross bars and head rails (for self-contained gates only) shall be provided. The clear opening shall be the same size as the waterway, unless otherwise specified.
- C. Slide Cover (DISC)
1. The slide cover (disc) shall be stainless steel plate reinforced with structural shapes welded to the plate.
    - a. The slide cover shall not deflect more than 1/720th of the span, or 1/16" at the sealing surface of the gate under maximum specified head.
    - b. The stem connection shall be either the clevis type, with structural members welded to the slide and a bolt or bolts to act as a pivot pin, or a threaded and bolted (or keyed) thrust nut supported in a welded nut pocket.
    - c. The clevis or pocket and yoke of the gate shall be capable of taking, without damage, at least twice the rated thrust output of the operator at 40 pounds of pull on a hand wheel or hand crank.
- D. Slide Cover Anchor Bolts
1. Anchor hardware shall be provided by the slide gate manufacturer.
    - a. The size, quantity and location of the anchor hardware will be determined by the slide gate manufacturer.
    - b. Anchor hardware consisting of studs, nuts and washers shall be provided by the manufacturer.

## 2.05 STORM DRAINAGE FLAP GATES

- A. General
1. The gate shall be a stainless steel, spigot back design according to the requirements of these specifications.
  2. The stainless steel cover shall be attached to the frame in such a manner as to allow proper seating and full opening of the cover. Built-in stops shall be provided to prevent the cover from rotating sufficiently to become wedged in an open position.
  3. A resilient neoprene seal shall be attached to the inside of the frame opening and shall act as a seat for the cover to seal against. The seal shall be retained by a stainless steel ring bolted to the frame.
  4. The linkage system shall be of the single or double pivoted type, attached to fixed pivot points on the cover and frame. Hinge links shall be of structural stainless steel shapes. The hinge arm shall ensure positive seating at all times regardless of the angle of tidal or flow hydraulics.
  5. Specific configurations shall be as noted on the gate schedule or as shown on the plans.
  6. Materials:
    - a. Frame, Flap Gate Assembly: Stainless steel, ASTM A 276, AISI Type 316.
    - b. Flange, Cover: Stainless Steel: ASTM A 276, AISI Type 316.
    - c. Hinge Pin: Commercial Bronze
    - d. Roll Pin, Cross Member and Lift Tab: Stainless Steel, ASTM A 276, AISI Type 316.
    - e. J-Bulb Seal: Neoprene Rubber, ASTM D 2000



- f. Finish: Mill finish on all stainless steel surfaces.
- B. Flap Gate Connecting Hardware
  - 1. Connecting/ mounting hardware shall be provided by the flap gate manufacturer.
    - a. The size, quantity and location of the connection hardware will be determined by the slide gate manufacturer.
    - b. Connection hardware consisting of studs, nuts and washers shall be provided by the manufacturer.

## 2.06 WELDING MATERIALS

- A. Comply with ASME BPVC SEC II-C. Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator using qualified welding procedures.

## 2.07 STEEL RAILINGS AND HANDRAILS

- A. NAAMM AMP 521, provide the same size rail and post. Provide pipe collars of the same material and finish as the handrail and posts.
- B. Provide steel handrails, including connections to steel superstructure, steel pipe conforming to ASTM A 53/A 53M. Provide steel railings of 1 ½ inches nominal size, hot-dip galvanized and painted after galvanizing in accordance with Section 09 97 00, "Coating of Steel Waterfront Structures."
  - 1. Fabrication: Joint posts, rail, and corners by one of the following methods:
    - a. All vertical posts shall be 1 ½ inch nominal diameter, SCH 80.
    - b. All horizontal railing shall be 1 ½ inch nominal diameter, SCH 40.
    - c. Flush-type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 3/8 inch hexagonal-recessed-head setscrews.
    - d. Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Butt railing splices and reinforce them by a tight fitting interior sleeve not less than 6 inches long.
    - e. Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.
- C. Galvanize exterior railings, including pipe, fittings, brackets, fasteners, and other ferrous metal components.

## PART 3 - EXECUTION

### 3.01 QUALITY CONTROL

- A. Fabrication: Prior to shipment, all miscellaneous metal fabrications shall be examined by the fabricator and/or manufacturer for compliance with the appropriate requirements of this Specification. Noncompliance with any specified requirement or presence of any defects preventing or lessening maximum efficiency shall constitute cause for rejection

- B. Contractor Inspection: The Contractor shall examine each miscellaneous metal fabrication prior to installation and note any damage or defects. Any rejected material shall be segregated and removed from the project site. Any material damaged during Contractor handling and installation shall be repaired in accordance with manufacturer's recommendations or replaced at no additional cost to the Owner.

### 3.02 INSTALLATION

- A. Install items at locations indicated, according to manufacturer's instructions. Items listed below require additional procedures.

### 3.03 ANCHORAGE, FASTENINGS, AND CONNECTIONS

- A. Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated: expansion shields or adhesive anchors for concrete; machine and carriage bolts for steel. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

### 3.04 BUILT-IN WORK

- A. Form for anchorage metal work built-in with concrete, or provide with suitable anchoring devices as indicated or as required. Furnish metal work in ample time for securing in place as the work progresses.

### 3.05 FINISHES

- A. Galvanize and paint items as indicated on the Contract Drawings and as specified herein. Surfaces shall be cleaned per the coating manufacturer's recommendations. Paint shall be applied at a thickness as recommended by the manufacturer for exposure to a marine environment.
- B. Field Preparation: Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, shall be free of rust, grease, dirt and other foreign matter.
- C. Environmental Conditions: Do not clean or paint surfaces when damp or exposed to inclement weather, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Engineer / Service.
- D. Dissimilar Materials: Where dissimilar metals are in contact, protect surfaces with a coat conforming to FS TT-P-664 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, mortar, or absorptive materials subject to wetting, protect with ASTM D 1187, asphalt-base emulsion.

### 3.06 BOLTED CONSTRUCTION

- A. Field treat damaged galvanized finish with two coats of high zinc dust oxide paint, cold galvanizing compounds or approved equal conforming to the requirements of ASTM A 780. In addition, all exposed threaded surfaces shall be painted with two coats of high zinc dust oxide paint after installation of unit.
- B. Anti-Seize Compound: The Contractor shall coat threads of all attachment bolts with an anti-seize compound, conforming to MIL-PRF-907, prior to applying washers and nuts. Recoat any bolt thread projection beyond nut after final tightening

### 3.07 WELDING

- A. Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1 unless noted below. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.
- B. Welding: Do not deviate from applicable codes, approved procedures and approved shop drawings without prior written approval from the Engineer / Service. Materials or components with welds made off the site will not be accepted if the welding does not conform to the requirements of this Specification unless otherwise specified. Assign each welder or welding operator an identifying number, letter, or symbol that shall be used to identify his welds. Each welder or welding operator shall apply his mark adjacent to his weld using an approved rubber stamp or felt-tipped marker with permanent, weatherproof ink or other approved methods that do not deform the metal. For seam welds, place identification marks adjacent to the welds at 3-foot intervals. Confine identification by die stamps or electric etchers to the weld reinforcing crown, preferably in the finished crater.
- C. Welding Operators: Perform welding in accordance with qualified procedures using qualified welders and welding operators.
- D. Examinations and Tests
  - 1. Visual and nondestructive examinations shall be performed by a third party AWS Certified Welding Inspector (CWI) qualified and certified in accordance with the provisions of AWS QC1, Standard for Qualification and Certification of Welding Inspectors to detect surface and internal discontinuities in completed welds. The CWI shall be approved by the Engineer / Service prior to the start of welding operations. Visual and ultrasonic examination shall be required as specified. When examination and testing indicates defects in a weld joint, a qualified welder shall repair the weld in accordance with the Paragraph "Corrections and Repairs" of this Section.
  - 2. Visual Examination: Visually examine 100% of welds as follows:
    - a. Before Welding: For compliance with requirements for joint preparation, placement of backing rings or consumable inserts, alignment and fit-up, and cleanliness.
    - b. During Welding: For conformance to the qualified welding procedure.
    - c. After Welding: For cracks, contour and finish, bead reinforcement, undercutting, overlap, and size of fillet welds.

3. Nondestructive Examination (NDE): NDE shall be in accordance with written procedures. Procedures for ultrasonic tests and methods shall conform to AWS D1.1 and for underwater welding procedures for ultrasonic tests and methods shall conform to AWS 3.6. The approved procedure shall be demonstrated to the satisfaction of the Engineer's / Service's QA personnel. In addition to the information required in AWS, the written procedures shall include:
  - a. Timing of the nondestructive examination in relation to the welding operations
  - b. Safety precautions
4. 10 Percent NDE: All steel welding shall be subjected to 10 percent NDE unless noted otherwise. Additional testing may be required if unsatisfactory results are obtained.

E. Acceptable Standards

1. Visual: The following indications are unacceptable:
  - a. Cracks – external surface
  - b. Undercut on surface which is greater than 1/32 inch deep
  - c. Lack of fusion on surface
  - d. Convexity of fillet weld surface greater than 10 percent of longest leg plus 1/32 inch
  - e. Concavity in fillet welds greater than 1/16 inch
  - f. Fillet weld size less than indicated or greater than 1-1/4 times the minimum specified fillet leg length
2. Ultrasonic Examination: Linear type discontinuities are unacceptable if the amplitude exceeds the reference level and discontinuities have lengths which exceed 3/4-inch. Discontinuities interpreted to be cracks, lack of fusion, or incomplete penetration are unacceptable regardless of length.

F. Corrections and Repairs

1. Remove defects and replace welds as specified. Repair defects discovered between weld passes before additional weld material is deposited. Wherever a defect is removed, a repair by welding is required, and the affected area shall be blended into the surrounding surface eliminating sharp notches, crevices, or corners. After defect removal is complete and before rewelding, reexamine the area by the same test methods which first revealed the defect to ensure that the defect has been eliminated. After rewelding, reexamine the repaired area by the same test methods originally used for that area. For repairs to base material, the minimum examination shall be the same as required for butt welds. Indication of a defect shall be regarded as a defect unless reevaluation by NDE or by surface conditioning shows that no unacceptable indications are present. The use of foreign material to mask, fill in, seal, or disguise welding defects will not be permitted

### 3.08 FIELD QUALITY CONTROL

- A. Perform field tests, and provide labor, equipment, and incidentals required for testing. The Engineer / Service shall be notified in writing of defective welds within 7 working days of the date of the weld inspection.

- B. Welds
  - 1. Visual Inspection: AWS D1.1. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet welds and returns.
  - 2. Non Destructive Testing: AWS D1.1 Test locations shall be as indicated. If more than 20% of welds made by a welder contain defects identified by testing, then all welds made by that welder shall be tested by radiographic or ultrasonic testing, as approved by the Engineer / Service. When all welds made by an individual welder are required to be tested, magnetic particle testing shall be used only in areas inaccessible to either radiographic or ultrasonic testing. Retest defective areas after repair.

### 3.09 STORM DRAINAGE COMBO GATE INSTALLATION

- A. Installation of the slide gates shall be done in a workmanlike manner. It shall be the responsibility of the Contractor to handle, store, and install the equipment specified in this Section in strict accordance with the Manufacturer's recommendations.
- B. The Contractor shall review the installation drawings and installation instructions prior to installing the slide gates.
- C. The slide gate frames shall be installed in a true vertical plane, square and plumb, with no twist, convergence or divergence between the vertical legs of the guide frame.

### 3.10 STORM DRAINAGE COMBO GATE FIELD TESTING

- A. After installation, all slide gates will be field tested in the presence of the Engineer and Owner to ensure that all items of equipment are in full compliance with this Section. Each slide gate assembly shall be water tested by the Contractor at the discretion of the Engineer and Owner, to confirm that leakage does not exceed the specified allowed leakage.

END OF SECTION

## **SECTION 06 60 00 - FRP PRODUCTS AND FABRICATIONS**

### **PART 1 – GENERAL**

#### **1.01 UNIT PRICES**

##### **A. FRP GRATING**

1. Payment: Payment for FRP (Fiberglass Reinforced Polymer) grating associated with the water control structures shall be included under the unit prices bid for the following items: “48-in Pipe Steel Superstructure” – Base Bid and “24-in Pipe Steel Superstructure” – Alternate No. 1. The price shall include all material, labor, and equipment required to provide the FRP Grating deck surface at the locations of the water control structures shown in the Contract Drawings.
2. Measurement: FRP Grating is not measured.
3. Unit of Measure: N/A

#### **1.02 REFERENCES**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. ANSI/ACMA/FGMC FRP Composites Grating Manual for Pultruded and Molded Grating and Stair Treads.
- C. American Society of Civil Engineers (ASCE)
  1. ASCE/SEI 7 – Minimum Design Loads for Buildings and Other Structures
- D. American Society For Testing and Materials (ASTM)
  1. ASTM D 635 – (2014) Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
  2. ASTM D 4060 – (2014) Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
  3. ASTM D 4329 - (2013) Standard Practice for Fluorescent Ultraviolet (UV) Lamp Apparatus Exposure of Plastics
  4. ASTM D 4385 – (2013) Standard Practice for Classifying Visual Defects in Thermosetting Reinforced Plastic Pultruded Products
  5. ASTM E 84 – (2015) Test Method for Surface Burning Characteristics of Building Material

#### **1.03 SUMMARY**

- A. This section includes FRP Products & Fabrications for FRP Pultruded Gratings and Stair Treads.

#### 1.04 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals governed by this section necessary to install the fiberglass reinforced polymer (FRP) products as specified herein.

#### 1.05 DESIGN CRITERIA

- A. The design criteria of the FRP pultruded grating, including connections, shall be in accordance with Contract Documents.
- B. Gratings: Design live loads of FRP gratings for walkway applications shall be 100 psf uniformly distributed load per ASCE 7 as required by the Contract Documents. The maximum combined vertical deflection resulting from the uniformly distributed live load and dead loads associated with the FRP grating and steel framing elements shall not exceed 0.25" at any given location of the upper deck surface.
- C. Stair Treads: Stair treads shall be designed for a uniform load of 100 psf per ASCE 7 or a concentrated load of 300 lbs on an area of 4 sq. inches located in the center of the tread, whichever produces greater stress and deflect less than 0.25". The two loads do not act concurrently.
- D. Structural support members shall not deflect more than  $L/180$  of span for structural members unless specifically stated otherwise in the Contract Documents. Connections shall be designed to transfer the design loads.
- E. Temperature exposure is limited to a range of -25 – 110°F unless specifically stated otherwise in drawings and/or supplementary conditions.

#### 1.06 SUBMITTALS

- A. Shop drawings of all fabricated pultruded gratings and treads shall be submitted to the Design Engineer for approval.
- B. Design computations demonstrating conformance to the loading and deflection criteria specified herein. Computations shall be signed and sealed by Professional Engineer, licensed in the State of Delaware.
- C. Manufacturer's catalog data showing:
  - 1. Materials of construction
  - 2. Dimensions, spacings, and construction of grating, handrails and building panels.
- D. Detail shop drawings showing:
  - 1. Dimensions
  - 2. Sectional assembly
  - 3. Location and identification mark
  - 4. Size and type of supporting frames required

- E. Samples of each type of product shall be submitted for approval in accordance with the requirements of Section.

#### 1.07 SHIPPING AND STORAGE INSTRUCTIONS

- A. All gratings and components shall be shop fabricated and assembled into the largest practical size suitable for transporting.
- B. All materials and equipment necessary for the fabrication and installation of pultruded gratings and treads and appurtenances shall be stored before, during, and after shipment in a manner to prevent cracking, twisting, bending, breaking, chipping or damage of any kind to the materials or equipment, including damage due to over exposure to the sun. Any material which, in the opinion of the Design Engineer, has become damaged as to be unfit for use, shall be promptly removed from the site of work, and the Contractor shall receive no compensation for the damaged material or its removal.
- C. Identify and match-mark all materials, items and fabrications for installation and field assembly.

#### 1.08 QUALITY ASSURANCE

- A. The material covered by these specifications shall be furnished by an ISO-9001:2008 certified manufacturer of proven ability who is regularly engaged in the manufacture, fabrication and installation of FRP systems.
- B. Substitution of any component or modification of system shall be made only when approved by the Engineer.
- C. Fabricator Qualifications: Firm experienced in successfully producing FRP fabrications similar to that indicated for this project, with sufficient production capacity to produce required units without causing delay in the work.
- D. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

### PART 2 – PRODUCTS

#### 2.01 GENERAL

- A. Materials used in the manufacture of the FRP products shall be raw materials in conformance with the specification and certified as meeting the manufacturer's approved list of raw materials.
- B. All raw materials shall be as specified by the contract.
- C. The visual quality of the pultruded shapes shall conform to ASTM D 4385.
- D. FRP pultruded grating and treads shall be manufactured using a pultruded process utilizing polyester, vinylester or phenolic resin with flame retardant and ultraviolet (UV) inhibitor additives. Unless a phenolic resin system is utilized, a



synthetic surface veil fabric shall encase the glass reinforcement. FRP shapes shall achieve a flame spread rating of 25 or less in accordance with ASTM E 84, the flammability characteristics of UL 94 V0 and the self-extinguishing requirements of ASTM D 635.

- E. If required, after fabrication, all cut ends, holes and abrasions of FRP shapes shall be sealed with a compatible resin coating.
- F. FRP products exposed to weather shall contain an ultraviolet inhibitor. Should additional ultraviolet protection be required, a UV coating can be applied.
- G. The materials covered by these specifications shall be furnished by an ISO-9001:2008 certified manufacturer.

## 2.02 PULTRUDED GRATINGS AND TREADS

- A. General
  - 1. Grating shall be shipped from the manufacturer, palletized and banded with exposed edges protected to prevent damage in shipment.
  - 2. Each piece shall be clearly marked showing manufacturer's applicable drawing number.
- B. Design
  - 1. Walkway and platform grating panels shall be 1.50 inches deep.
  - 2. Design live loads of FRP gratings for walkway applications shall be 100 psf uniformly distributed load per ASCE 7 as required by the Contract Documents. The maximum combined vertical deflection resulting from the uniformly distributed live load and dead loads associated with the FRP grating and steel framing elements shall not exceed 0.25" at any given location of the upper deck surface.
  - 3. The bearing bars shall be joined into panels by passing continuous length fiberglass pultruded cross rods through the web of each bearing bar. A continuous fiberglass pultruded bar shaped section shall be wedged between the two cross rod spacers mechanically locking the notches in the cross rod spacers to the web of the bearing bars. Continuous adhesive bonding shall be achieved between the cross rod spacers and the bearing web and between the bar shaped wedge and the two cross rod spacers locking the entire panel together to give a panel that resists twist and prevents internal movement of the bearing bars. Each stair tread shall utilize a box-shaped nosing on its lead edge to enclose cross rods and ensure a smooth vertical edge.
  - 4. The top surface of all panels shall have a non-skid grit affixed to the surface by an epoxy resin followed by a baked-on top coat of epoxy resin.
  - 5. Surface should have a Wear Index of less than 1.0 when tested to ASTM D 4060 (Before and after 750 hours of UV exposure per ASTM D 4329 cycle A).

6. Panels shall be fabricated to the sizes shown on the drawings.
7. Hold down clamps shall be type 316L stainless steel clips or type 316 L stainless steel insert hold downs. Use 2 at each support with a minimum of 4 per panel.
8. Color shall be gray.
9. All bearing bars that are to be exposed to UV shall be coated with polyurethane coating to provide additional UV protection.

C. Products

1. The Pultruded FRP grating and stair treads shall be fabricated from bearing bars and cross rods manufactured by the pultrusion process. The glass fiber reinforcement for the bearing bars shall be a core of continuous glass strand rovings wrapped with continuous strand glass mat. With the exception of grating and stair treads manufactured using phenolic resin, a synthetic surface veil fabric shall encase the glass reinforcement.
2. Fiberglass Grating and Stair Treads
  - a) Fiberglass grating and stair treads shall be made from a chemical resistant, fire retardant polyester, vinyl ester, or phenolic resin system to meet the flame spread rating of 25 or less in accordance with ASTM E 84 testing, the flammability characteristics of UL 94 V0 and satisfies the self-extinguishing requirements of ASTM D 635. UV inhibitors are added to the resin to reduce UV attack.
3. If required, all cut and machined edges, holes and abrasions shall be sealed with a resin or compatible coating with the resin matrix used in the bearing bars and cross rods.
4. All panels shall be fabricated to the sizes shown on the approved shop drawings.

PART 3 – EXECUTION

- 1.
- 2.
- 3.

3.01 PREPARATION

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction.
- B. Coordinate delivery of such items to project site.

### 3.02 INSPECTION AND TESTING

- A. The Engineer shall have the right to inspect and test all materials to be furnished under these specifications prior to their shipment from the point of manufacture.
- B. All labor, power, materials, equipment, and appurtenances required for testing shall be furnished by the Contractor at no cost to the Owner.

### 3.03 INSTALLATION, GENERAL

- A. Fastening to in-place construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous FRP fabrications to in-place construction.
- B. Cutting, fitting and placement: Perform cutting, drilling and fitting required for installation of miscellaneous FRP fabrications. Set FRP fabrication accurately in location, alignment and elevation; with edges and surfaces level, plumb, true and free of rack; measured from established lines and levels.
- C. Provide temporary bracing or anchors in form work for items that are to be built into concrete masonry or similar construction.
- D. Penetrations through grating may require additional supports in order to meet design criteria. The Contractor shall engage the grating manufacturer for all proposed grating and associated fastener modifications. All proposed grating modifications shall be signed and sealed by a Professional Engineer, licensed in the State of Delaware. All proposed grating modifications are subject to approval in writing by the Engineer of Record.

### 3.04 ALL FRP INSTALLATION

- A. If required, all field cut and drilled edges, holes and abrasions shall be sealed with a catalyzed resin compatible with the original resin as recommended by the manufacturer. Submit all proposed field touch-up measures to the Engineer of Record for written Approval.
- B. Install items specified as indicated and in accordance with manufacturer instructions, and as approved by the Engineer of Record.

END OF SECTION

## **SECTION 09 97 00 – COATING OF STEEL WATERFRONT STRUCTURES**

### **PART 1 - GENERAL**

#### **1.01 UNIT PRICES**

##### **A. COATING OF STEEL WATERFRONT STRUCTURES**

1. Payment: Payment for coating of steel waterfront structures associated with the water control structures shall be included under the unit prices bid for the following items: “48-in Pipe Steel Superstructure” – Base Bid and “24-in Pipe Steel Superstructure”. The price shall include the furnishing of all materials and equipment and the performing of all labor necessary to complete application of corrosion protection coatings for steel waterfront structures as shown on the Contract Drawings and as herein specified or directed by the Engineer.
2. Measurement: Coating of steel waterfront structures is not measured.
3. Unit of Measure: N/A

#### **1.02 REFERENCES**

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. Unless otherwise indicated, the most recent edition of the publication, including any revisions, shall be used.
- C. American Institute of Steel Construction (AISC)
  1. AISC SPE Sophisticated Paint Endorsement
- D. American Society for Testing and Materials (ASTM)
  1. ASTM D 7091 - (2013) Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nondestructive Coatings Applied to Non-Ferrous Metals
  2. ASTM E 376 - (2011) Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods
- E. National Association of Corrosion Engineers (NACE)
  1. NACE RP0188 - (2006) Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
- F. Society for Protective Coatings (SSPC)
  1. SSPC-PS 11.01 - (1982; E2004) Black (or Dark Red) Coal Tar Epoxy Polyamide Painting System
  2. SSPC-QP 3 - (2010) Shop Application of Complex Protective Coating Systems

3. SSPC-SP 1 - (1982; E2004) Surface Preparation Standard No. 1: Solvent Cleaning
4. SSPC-SP 10 - (2010) Joint Surface Preparation Standard: Near-White Blast Cleaning
5. SSPC-Paint 16 - (2015) Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint

#### 1.03 PROJECT DESCRIPTION

- A. The work covered by this Section includes the furnishing of all materials and equipment and the performing of all labor necessary to complete application of corrosion protection coatings for the permanent steel sheet pile elements associated with the water control structures at the locations shown on the Contract Drawings.

#### 1.04 SUBMITTALS

- A. General: Submit the following to the Design Engineer for approval. Note that approval of submittals by the Engineer shall not be construed as relieving the Contractor from responsibility for compliance with the Specifications nor from responsibility of errors of any sort in the submittals.
- B. Certifications, test procedures, and other submittals shall show the appropriate ASTM test(s) for each material.
- C. Coating Materials
  1. Manufacturer's data
  2. Manufacturer's application instructions
- D. Quality Control Procedures
  1. Submit proposed application standards and quality control procedures
  2. Current AISC SPE or SSPC-QP 3 certification
- E. Coating Inspection Reports
  1. Dry film thickness measurements
  2. Holiday test results
- F. Coating Repair Procedures
- G. Qualifications
  1. Shop coating contractor
  2. Shop coating inspector
  3. Third-party coating inspector

## 1.05 QUALITY ASSURANCE

- A. Shop coating contractor shall possess a current SSPC-QP 3 or AISC SPE certification.
- B. Coating Control: Application of coating in the shop and in the field shall be done under the supervision of an experienced coating inspector. Low voltage electrical inspection shall be performed prior to installation by a third-party inspector experienced in holiday testing of coatings.

## 1.06 ENVIRONMENTAL CONDITIONS

- A. Start work only when ambient and curing temperatures and humidity are within limits of coating manufacturer's recommendations and at least 5 degrees F above dew point temperature.
- B. Do not clean or apply exterior coatings when damp or exposed to foggy, rainy, or snowy weather, when relative humidity is outside the humidity ranges required by the coating manufacturer, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Engineer.

## 1.07 HEALTH AND SAFETY PRECAUTIONS

- A. Materials listed in this Section contain coal tar pitch volatiles, which are toxic. Follow safety and health procedures as recommended by the manufacturer. Work in well ventilated areas. Provide and require workers to use impervious clothing, gloves, face shields (8-inch minimum), and other appropriate protective clothing necessary to prevent eye and skin contact with coating materials. Keep coatings away from heat, sparks, and flame.

## PART 2 - PRODUCTS

### 2.01 COATING SYSTEM

- A. Coal Tar Epoxy-Polyamide Coating
  - 1. System: SSPC-PS 11.01
  - 2. Paint: SSPC-Paint 16 Black
- B. Provide catalyst component for coating specific for resin component. Where allowed, use thinners that are compatible with the coating.

## PART 3 - EXECUTION

### 3.01 CLEANING AND PREPARATION OF SURFACES

- A. Solvent Cleaning: SSPC-SP 1. Remove visible oil, grease, and drawing and cutting compounds by solvent cleaning.

- B. Near-White Blast Cleaning: SSPC-SP 10. After solvent cleaning, complete surface preparation by near-white blast cleaning. Grit shall be selected to avoid soluble salt contamination during abrasive blasting. Remove residual dust from blasted surface by blowing with dry, oil-free air, vacuuming, or sweeping. Provide surface profile of at least 2.5 mil thickness.
- C. Additional Preparation: After blast cleaning, surface imperfections that remain shall be removed as necessary to provide for a holiday free coating.
- D. After blast cleaning and any additional preparation, remove visible oil, grease, and drawing and cutting compounds by solvent cleaning in accordance with SSPC-SP 1.

### 3.02 PROPORTIONING AND MIXING OF COATING SYSTEM

- A. Proportioning of Coal Tar Epoxy-Polyamide System: Coal tar epoxy-polyamide consists of a two-component system. Component A contains a refined coal tar pitch, polyamide resin, and a polyamine promoter to accelerate curing rate. Component B is an epoxy resin. Mix both components in a ratio of 4 parts of Component A to 1 part of Component B by volume. Do not thin coatings when doing so will result in total volatile organic compounds exceeding limits enacted by local air pollution control districts. When thinning is allowed and is necessary for proper application, use xylene or the coating manufacturer's recommended thinner, to a maximum of 1/2 gallon to a 5 gallon batch.
- B. Mixing of Coal Tar Epoxy-Polyamide System: Power stir components to a smooth, uniform consistency. Stir coating periodically during induction period. Follow coating manufacturer's requirements for induction time and pot life of mixed batches.

### 3.03 COATING APPLICATION

- A. General: Apply primer coating to dry surfaces not more than four (4) hours after near-white blast cleaning. Apply coats of each system so that finished surfaces are free from runs, sags, brush marks and variations in color.
- B. Application Method for Coal Tar Epoxy-Polyamide System: Unless otherwise specified by manufacturer's recommendations, do not allow drying time between coats to exceed 72 hours. Under conditions of direct sunlight or elevated ambient temperatures of 90 degrees F or greater, limit inter-coat drying period to a maximum of 24 hours.
- C. Repair of Defects: Repair detected coating holidays, thin areas, and exposed areas damaged prior to or during installation by surface treatment and application of additional coating or by manufacturer's recommendations. Allow a period of at least 72 hours to pass following final coat before placing in immersion service.
- D. Coal Tar Epoxy-Polyamide System: Apply a minimum of two (2) coats, each coat at a dry film thickness (DFT) of not less than 8 mils.
- E. Dry Film Thickness: Provide total system minimum dry film thickness of 16 mils. Measure using a magnetic gage.

### 3.04 SURFACES TO BE COATED

- A. Items to be coated include:
  - 1. Permanent Steel Sheet Piling – 10 feet below mudline to pile cut-off elevation on all faces of piling.
  - 2. Steel H-Piles – 10 feet below mudline to pile cut-off elevation, all faces of piling.

### 3.05 FIELD TESTING

- A. Provide a minimum of 48 hours advance notice to the Engineer of testing.
- B. Conduct the following in the presence of the Engineer:
  - 1. Holiday Testing: Prior to installation, test 100% of coated surfaces for holidays in total coating system in accordance with NACE RP0188. All coated surfaces shall be holiday free immediately prior to installation.
  - 2. Dry Film Thickness: After repair of holidays, measure coating thickness for all coated surfaces with a magnetic-type dry film thickness gage in accordance with ASTM D 7091 and ASTM E 376. If any region of coated surface has insufficient coating thickness or holidays, the coating on that region shall be repaired with an approved coal tar epoxy product. Re-measure after an additional coat is applied, if necessary to meet minimum coating thickness requirements.
- C. Submit report of coating test results. Note defective areas and corrective measures taken.
- D. Field touch up all damaged surfaces following manufacturer's instructions. Inspect piles when delivered and when in the leads immediately before driving.

END OF SECTION



## **SECTION 31 00 00 – EARTHWORK**

### **PART 1 - GENERAL**

#### **1.01 UNIT PRICES**

##### **A. Temporary Outboard Cofferdam System – Little River Location – Base Bid**

1. **Payment:** Payment for “Temporary Outboard Cofferdam System – Little River Location” shall include designing and providing the temporary shoring and dewatering systems required to construct the north water control structure located outside of the Little Creek Wildlife Management Area along the Little River as shown on the Contract Drawings. This price shall also include transporting all temporary shoring and dewatering components to and from the project site, storing the components on-site, construction engineering costs associated with outboard shoring and dewatering systems, and extraction of all temporary outboard components.
2. **Measurement:** The quantity to be paid shall be the per each unit price quoted on the bid form for “Temporary Outboard Cofferdam System – Little River Location”.
3. **Unit of Measure:** Each (EA).

##### **B. Seeding – Base Bid and Alternate No. 1**

1. **Payment:** Payment for “Seeding” shall include all fertilizer, mulch and seed.
2. **Measurement:** The quantity to be paid shall be the Square Foot unit price quoted on the bid form for “Seeding”.
3. **Unit of Measure:** Square Foot (SF).

#### **1.02 CRITERIA FOR BIDDING**

##### **A. Base bids on the following criteria:**

1. Surface elevations are as indicated.
2. Pipes or other artificial obstructions, except those indicated, will not be encountered.
3. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction. See Geotechnical Reports in Appendix 2 for further information.
4. Material character is indicated by the boring logs. See Geotechnical Reports in Appendix 2 for further information.

#### **1.03 REFERENCES**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. American Association of State Highway And Transportation Officials (AASHTO)
  - AASHTO T 180      Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
  - AASHTO T 224      Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test
- C. American Welding Society (AWS)
  - AWS D1.1/D1.1M      Structural Welding Code - Steel
- D. ASTM International (ASTM)
  - ASTM C33/C33M      (2013) Standard Specification for Concrete Aggregates
  - ASTM C136/C136M      (2014) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
  - ASTM D422      (2007)e2 Particle-Size Analysis of Soils
  - ASTM D698      (2012e2) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
  - ASTM D1140      (2014) Standard Test Methods for Determining the Amount of Material Finer than No. 200 (75-micrometer) Sieve in Soils by Washing
  - ASTM D1556      (2015) Density and Unit Weight of Soil in Place by the Sand-Cone Method
  - ASTM D1557      (2012e1) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup>) (2700 kN-m/m<sup>3</sup>)
  - ASTM D2167      (2015) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
  - ASTM D2487      (2011) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
  - ASTM D2937      (2010) Density of Soil in Place by the Drive-Cylinder Method

- |            |                                                                                                                                  |
|------------|----------------------------------------------------------------------------------------------------------------------------------|
| ASTM D4318 | (2010e1) Liquid Limit, Plastic Limit, and Plasticity Index of Soils                                                              |
| ASTM D6938 | (2015) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth) |
- E. State of Delaware Department of Transportation
- Standard Specifications for Road and Bridge Construction August 2001
- F. U.S. Army Corps of Engineers (USACE)
- USACE EM 385-1-1 (2014) Safety and Health Requirements Manual
- G. U.S. Environmental Protection Agency (EPA)
- |                  |                                                                    |
|------------------|--------------------------------------------------------------------|
| EPA 600/4-79/020 | Methods for Chemical Analysis of Water and Wastes                  |
| EPA SW-846.3-3   | Test Methods for Evaluating Solid Waste: Physical/Chemical Methods |
- H. U.S. General Services Administration (GSA)
- |             |                         |
|-------------|-------------------------|
| CID A-A-203 | Paper, Kraft, Untreated |
|-------------|-------------------------|

#### 1.04 DEFINITIONS

- A. Satisfactory Materials: Satisfactory materials comprise any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP,. Satisfactory materials for grading comprise stones less than 8 inches
- B. Unsatisfactory Materials: Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the Engineer when encountering any contaminated materials.
- C. Cohesionless and Cohesive Materials: Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, in accordance with ASTM D4318, ASTM C136/C136M, ASTM D422, and ASTM D1140.
- D. Degree of Compaction: Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557 abbreviated as a percent of laboratory maximum density. Since ASTM D1557 applies only to soils

that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve as a percentage of the maximum density in accordance with AASHTO T 180 and corrected with AASHTO T 224. To maintain the same percentage of coarse material, use the "remove and replace" procedure as described in NOTE 8 of Paragraph 7.2 in AASHTO T 180.

- E. Topsoil: Material suitable for topsoils obtained from offsite areas is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.
- F. Unstable Material: Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.
- G. Select Granular Material:
  - 1. General Requirements: Select granular material consist of materials classified as GW, GP, GM, SW, SP, SM by ASTM D2487 where indicated. The liquid limit of such material must not exceed 40 percent when tested in accordance with ASTM D4318. The plasticity index must not be greater than 12 percent when tested in accordance with ASTM D4318, and not more than 30 percent by weight may be finer than No. 200 sieve when tested in accordance with ASTM D1140

Sieve Size	Percent Passing by Weight
2-1/2 inches	100
No. 4	40 - 85
No. 10	20 - 80
No. 40	10 - 60
No. 200	5 - 25

- H. Initial Backfill Material: Initial backfill consists of select granular material or satisfactory materials free from rocks 8 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, free the initial backfill material of stones larger than 2 inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.
- I. Pile Supported Structure: As used herein, a structure where both the foundation and floor slab are pile supported.

#### 1.05 SYSTEM DESCRIPTION

- A. Subsurface soil boring logs are included in the Geotechnical Report in Appendix 2. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.
- B. Classification of Excavation: No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.
  - 1. Common Excavation: Include common excavation with the satisfactory removal and disposal of all materials not classified as rock excavation.
- C. Dewatering Work Plan: Submit procedures for accomplishing dewatering work.

#### 1.06 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Preconstruction Submittals

Shoring  
Dewatering Work Plan

Test Reports

Testing

#### PART 2 - PRODUCTS

##### 2.01 REQUIREMENTS FOR OFFSITE SOILS

- A. Test offsite soils brought in for use as backfill for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and full Toxicity Characteristic Leaching Procedure (TCLP) including ignitability, corrosivity and reactivity. Backfill shall contain a maximum of 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and a maximum of 10ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall pass the TCPL test. Determine TPH concentrations by using EPA 600/4-79/020 Method 418.1. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5030/8020. Perform TCLP in accordance with EPA SW-846.3-3 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Do not bring material onsite until tests have been approved by the Engineer.

##### 2.02 BURIED WARNING AND IDENTIFICATION TAPE

- A. Provide polyethylene plastic metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inches minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED STORM DRAIN

LINE BELOW" or similar wording. Provide permanent color and printing, unaffected by moisture or soil.

Warning Tape Color Codes	
Red	Electric
Yellow	Gas, Oil; Dangerous Materials
Orange	Telephone and Other Communications
Blue	Water Systems
Green	Sewer Systems
White	Steam Systems
Gray	Compressed Air

- B. Detectable Warning Tape for Non-Metallic Piping: Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.004 inch, and a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

## 2.03 DETECTION WIRE FOR NON-METALLIC PIPING

- A. Insulate a single strand, solid copper detection wire with a minimum of 12 AWG.

## 2.04 MATERIAL FOR RIP-RAP

- A. Provide bedding material, filter fabric and rock conforming to DelDOT State Standard for construction indicated.
- B. Bedding Material: Provide bedding material consisting of sand, gravel, or crushed rock, well graded, with a maximum particle size of 2 inches. Compose material of tough, durable particles. Allow fines passing the No. 200 standard sieve with a plasticity index less than six.
- C. Rock: Provide rock in accordance with Specification Section 35 43 37 Riprap Scour Protection.

## 2.05 SEEDING

- A. Seeding shall conform to DelDOT Standard Specifications for Road and Bridge Construction Section 734. Seed shall be the mix specified for Permanent Grass Seeding – Dry Ground.

## PART 3 - EXECUTION

### 3.01 STRIPPING OF TOPSOIL

- A. Where indicated or directed, strip topsoil to a depth of 4 inches. Spread topsoil on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations.

### 3.02 GENERAL EXCAVATION

- A. Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Perform the grading in accordance with the typical sections shown and the tolerances specified in paragraph FINISHING. Transport satisfactory excavated materials and place in fill or embankment within the limits of the work. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose surplus satisfactory excavated material not required for fill or embankment in areas approved for surplus material storage or designated waste areas. Dispose unsatisfactory excavated material in designated waste or spoil areas. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times. Excavate material required for fill or embankment in excess of that produced by excavation within the grading limits from the borrow areas indicated or from other approved areas selected by the Contractor as specified.
- B. Drainage Structures: Make excavations to the lines, grades, and elevations shown, or as directed. Provide trenches and foundation pits of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or other hard foundation material of loose debris and cut to a firm, level, stepped, or serrated surface. Remove loose disintegrated rock and thin strata. Do not disturb the bottom of the excavation when concrete or masonry is to be placed in an excavated area. Do not excavate to the final grade level until just before the concrete or masonry is to be placed. Where pile foundations are to be used, stop the excavation of each pit at an elevation 1 foot above the base of the footing, as specified, before piles are driven. After the pile driving has been completed, remove loose and displaced material and complete excavation, leaving a smooth, solid, undisturbed surface to receive the concrete or masonry.
- C. Drainage: Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity [and] [or] provide temporary ditches, swales, and other drainage features and equipment as required to

maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

- D. Dewatering: Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. Do not permit French drains, sumps, ditches or trenches within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Take control measures by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, maintain the water level continuously, at least one foot below the working level.
- E. Trench Excavation Requirements: Excavate the trench as recommended by the manufacturer of the pipe to be installed. Slope trench walls below the top of the pipe, or make vertical, and of such width as recommended in the manufacturer's printed installation manual. Provide vertical trench walls where no manufacturer's printed installation manual is available. Shore trench walls more than four feet high, cut back to a stable slope, or provide with equivalent means of protection for employees who may be exposed to moving ground or cave in. Shore vertical trench walls more than four feet high. Excavate trench walls which are cut back to at least the angle of repose of the soil. Give special attention to slopes which may be adversely affected by weather or moisture content. Do not exceed the trench width below the pipe top of 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter, and do not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, provide redesign, stronger pipe, or special installation procedures by the Contractor. The Contractor is responsible for the cost of redesign, stronger pipe, or special installation procedures without any additional cost to the Owner.
  - 1. Bottom Preparation: Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing. Remove stones of two inch or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, to avoid point bearing.
  - 2. Removal of Unyielding Material: Where unyielding material is encountered in the bottom of the trench, remove such material six inch below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.
  - 3. Removal of Unstable Material: Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in



performing the work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the Owner.

4. Jacking, Boring, and Tunneling: Unless otherwise indicated, provide excavation by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Engineer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.
- F. Underground Utilities: The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. Excavation made with power-driven equipment is not permitted within two feet of known Owner-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Engineer. Report damage to utility lines or subsurface construction immediately to the Engineer.
- G. Structural Excavation: Ensure that footing subgrades have been inspected and approved by the Engineer prior to concrete placement. Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the Engineer. Backfill and compact over excavations and changes in grade due to pile driving operations to 95 percent of ASTM D698 maximum density.

### 3.03 SELECTION OF BORROW MATERIAL

- A. Select borrow material to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Obtain borrow material from approved private sources. Unless otherwise provided in the contract, the Contractor is responsible for obtaining the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling from the owners. Borrow material from approved sources on Owner-controlled land may be obtained without payment of royalties. Unless specifically provided, do not obtain borrow within the limits of the project site without prior written approval. Consider necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon related operations to the borrow excavation.

### 3.04 SHORING

- A. General Requirements: Submit a Shoring and Sheet piling plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheet piling of excavations. Finish shoring, including sheet piling, and install as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Remove shoring, bracing, and sheet piling as excavations are backfilled, in a manner to prevent caving.

- B. Geotechnical Engineer: Hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer is responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer is responsible for updating the excavation, sheeting and dewatering plans as construction progresses to reflect changing conditions and submit an updated plan if necessary. Submit a monthly written report, informing the Contractor and Engineer of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Engineer is responsible for arranging meetings with the Geotechnical Engineer at any time throughout the contract duration.

### 3.05 GRADING AREAS

- A. Where indicated, divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills. Do not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Place and grade stockpiles of satisfactory [and unsatisfactory] [and wasted materials] as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

### 3.06 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

- A. Do not excavate to final grade until just before concrete is to be placed. For pile foundations, stop the excavation at an elevation of from 6 to 12 inches above the bottom of the footing before driving piles. After pile driving has been completed, complete the remainder of the excavation to the elevations shown. Only use excavation methods that will leave the foundation rock in a solid and unshattered condition. Roughen the level surfaces, and cut the sloped surfaces, as indicated, into rough steps or benches to provide a satisfactory bond. Protect shales from slaking and all surfaces from erosion resulting from ponding or water flow.

### 3.07 GROUND SURFACE PREPARATION

- A. General Requirements: Remove and replace unsatisfactory material with satisfactory materials, as directed by the Engineer, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of 6 inches before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 6 inches, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inches and compact it as specified for the adjacent fill.

- B. Frozen Material: Do not place material on surfaces that are muddy, frozen, or contain frost. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary 14 percent of optimum moisture to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

### 3.08 UTILIZATION OF EXCAVATED MATERIALS

- A. Dispose unsatisfactory materials removing from excavations into designated waste disposal or spoil areas. Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. Submit procedure and location for disposal of unused satisfactory material. Submit proposed source of borrow material. Do not waste any satisfactory excavated material without specific written authorization. Dispose of satisfactory material, authorized to be wasted, in designated areas approved for surplus material storage or designated waste areas as directed. Clear and grub newly designated waste areas on Owner-controlled land before disposal of waste material thereon. Stockpile and use coarse rock from excavations for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. Do not dispose excavated material to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

### 3.09 BURIED TAPE AND DETECTION WIRE

- A. Buried Warning and Identification Tape: Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.
- B. Buried Detection Wire: Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. Extend the wire continuously and unbroken, from manhole to manhole. Terminate the ends of the wire inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. Furnish insulated wire over its entire length. Install wires at manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, terminate the wire in the valve pit at the pump station end of the pipe.

### 3.10 BACKFILLING AND COMPACTION

- A. Place backfill adjacent to any and all types of structures, and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials, to prevent wedging action or eccentric loading upon or against the structure. Prepare ground surface on which backfill is to be placed and provide compaction requirements for backfill materials in conformance with the applicable portions of paragraphs GROUND SURFACE PREPARATION. Finish compaction by sheepsfoot rollers,

pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

- B. Trench Backfill: Backfill trenches to the grade shown.
  - 1. Replacement of Unyielding Material: Replace unyielding material removed from the bottom of the trench with select granular material or initial backfill material.
  - 2. Replacement of Unstable Material: Replace unstable material removed from the bottom of the trench or excavation with select granular material placed in layers not exceeding 6 inches loose thickness.
  - 3. Bedding and Initial Backfill: Place initial backfill material and compact it with approved tampers to a height of at least one foot above the utility pipe or conduit. Bring up the backfill evenly on both sides of the pipe for the full length of the pipe. Take care to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Compact backfill to top of pipe to 95 percent of ASTM D698 maximum density. Provide plastic piping with bedding to spring line of pipe. Provide materials as follows:
    - a. Class I: Angular, 0.25 to 1.5 inch, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
    - b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inch, including various graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D2487.
  - 4. Final Backfill: Fill the remainder of the trench, except for special materials for roadways, railroads and airfields, with satisfactory material. Place backfill material and compact as follows:
    - a. Roadways: Place backfill up to the required elevation as specified. Do not permit water flooding or jetting methods of compaction.
- C. Backfill for Appurtenances: After the structure has been constructed [and the concrete has been allowed to cure for 3 days, place backfill in such a manner that the structure is not be damaged by the shock of falling earth. Deposit the backfill material, compact it as specified for final backfill, and bring up the backfill evenly on all sides of the structure to prevent eccentric loading and excessive stress.

### 3.11 SPECIAL REQUIREMENTS

- A. Special requirements for both excavation and backfill relating to the specific utilities are as follows:
- B. Rip-Rap Construction: Construct rip-rap on bedding material on filter fabric in accordance with DOT State Standard, in the areas indicated. Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 0.1 foot.

1. Bedding Placement: Spread filter fabric on prepared subgrade as indicated. Finish bedding to present even surface free from mounds and windrows.
2. Stone Placement: Place rock for rip-rap on prepared bedding material to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments, with dimensions extending the full depth of the rip-rap throughout the entire mass and eliminate "pockets" of small rock fragments. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above.

### 3.12 EMBANKMENTS

- A. Earth Embankments: Construct earth embankments from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. Place the material in successive horizontal layers of loose material not more than 12 inches in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise break up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements are identical with those requirements specified in paragraph SUBGRADE PREPARATION. Finish compaction by sheepfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

### 3.13 FINISHING

- A. Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turving materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.
- B. Subgrade and Embankments: During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

- C. Grading Around Structures: Construct areas within 5 feet outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until final inspection has been completed and the work has been accepted.

### 3.14 PLACING TOPSOIL

- A. On areas to receive topsoil, prepare the compacted subgrade soil to a 2 inches depth for bonding of topsoil with subsoil. Spread topsoil evenly to a thickness of 6 inch and grade to the elevations and slopes shown. Do not spread topsoil when frozen or excessively wet or dry. Obtain material required for topsoil in excess of that produced by excavation within the grading limits from offsite areas.

### 3.15 TESTING

- A. Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. Submit qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Corps validated and approved by the Engineer.
  - 1. Determine field in-place density in accordance with [ASTM D1556] [ASTM D2167] [ASTM D6938]. [When ASTM D6938 is used, check the calibration curves and adjust using only the sand cone method as described in ASTM D1556. ASTM D6938 results in a wet unit weight of soil in determining the moisture content of the soil when using this method.
  - 2. Check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D6938; check the calibration of both the density and moisture gauges at the beginning of a job on each different type of material encountered and at intervals as directed by the Engineer.] [ASTM D2937, use the Drive Cylinder Method only for soft, fine-grained, cohesive soils.] When test results indicate, as determined by the Engineer, that compaction is not as specified, remove the material, replace and recompact to meet specification requirements.
  - 3. Perform tests on recompact areas to determine conformance with specification requirements. Appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.
- B. Fill and Backfill Material Gradation: One test per 100 cubic yards stockpiled or in-place source material. Determine gradation of fill and backfill material in accordance with ASTM C136/C136M.
- C. In-Place Densities

1. One test per 1,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.
  2. One test per 1,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.
- D. Moisture Contents: In the stockpile, excavation, or borrow areas, perform a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, perform tests as dictated by local conditions and approved by the Engineer.
- E. Optimum Moisture and Laboratory Maximum Density: Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 1,000 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.
- F. Tolerance Tests for Subgrades: Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.
- G. Displacement of Sewers: After other required tests have been performed and the trench backfill compacted to 2, feet above the top of the pipe, inspect the pipe to determine whether significant displacement has occurred. Conduct this inspection in the presence of the Engineer. Inspect pipe sizes larger than 36 inches, while inspecting smaller diameter pipe by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgment of the Engineer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, replace or repair the defects as directed at no additional cost to the Owner.

### 3.16 DISPOSITION OF SURPLUS MATERIAL

- A. Remove surplus material or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and to an approved licensed/permitted facility approved by the Engineer.

### 3.17 MEASUREMENT PROCEDURES

- A. Excavation: The unit of measurement for excavation and borrow will be the cubic yard, computed by the average end area method from cross sections taken before and after the excavation and borrow operations, including the excavation for ditches, gutters, and channel changes, when the material is acceptably utilized or disposed of as herein specified. The measurements will include authorized excavation of rock (except for piping trenches that is covered below), authorized excavation of unsatisfactory subgrade soil, and the volume of loose, scattered rocks and boulders collected within the limits of the work; allowance will be made on the same basis for selected backfill ordered as replacement. The measurement will not include the volume of subgrade material or other material that is scarified or plowed and reused in-place, and will not include the volume

excavated without authorization or the volume of any material used for purposes other than directed. The volume of overburden stripped from borrow pits and the volume of excavation for ditches to drain borrow pits, unless used as borrow material, will not be measured for payment. The measurement will not include the volume of any excavation performed prior to the taking of elevations and measurements of the undisturbed grade.

- B. Piping Trench Excavation: Measure trench excavation by the number of linear feet along the centerline of the trench and excavate to the depths and widths specified for the particular size of pipe. Replace unstable trench bottoms with a selected granular material. Include the additional width at manholes and similar structures, the furnishing, placing and removal of sheeting and bracing, pumping and bailing, and all incidentals necessary to complete the work required by this section.
- C. Topsoil Requirements: Separate excavation, hauling, and spreading or piling of topsoil and related miscellaneous operations will be considered subsidiary obligations of the Contractor, covered under the contract unit price for excavation.
- D. Overhaul Requirements: Allow the unit of measurement for overhaul to be the station-yard. The overhaul distance will be the distance in stations between the center of volume of the overhaul material in its original position and the center of volume after placing, minus the free-haul distance in stations. The haul distance will be measured along the shortest route determined by the Engineer as feasible and satisfactory. Do not measure or waste unsatisfactory materials for overhaul where the length of haul for borrow is within the free-haul limits.
- E. Select Granular Material: Measure select granular material in place as the actual cubic yards replacing wet or unstable material in trench bottoms within the limits shown. Provide unit prices which include furnishing and placing the granular material, excavation and disposal of unsatisfactory material, and additional requirements for sheeting and bracing, pumping, bailing, cleaning, and other incidentals necessary to complete the work.

### 3.18 PAYMENT PROCEDURES

- A. Payment will constitute full compensation for all labor, equipment, tools, supplies, and incidentals necessary to complete the work.
- B. Classified Excavation: Classified excavation will be paid for at the contract unit prices per cubic yard for common or rock excavation.
- C. Piping Trench Excavation: Payment for trench excavation will constitute full payment for excavation and backfilling, [including specified overdepth] except in rock or unstable trench bottoms.
- D. Unclassified Excavation: Unclassified excavation will be paid for at the contract unit price per cubic yard for unclassified excavation.



- E. Classified Borrow: Classified borrow will be paid for at the contract unit prices per cubic yard for common or rock borrow.
- F. Unclassified Borrow: Unclassified borrow will be paid for at the contract unit price per cubic yard for unclassified borrow.
- G. Authorized Overhaul: The number of station-yards of overhaul to be paid for will be the product of number of cubic yards of overhaul material measured in the original position, multiplied by the overhaul distance measured in stations of 100 feet and will be paid for at the contract unit price per station-yard for overhaul in excess of the free-haul limit as designated in paragraph DEFINITIONS.
- H. Sheeting and Bracing: Sheeting and bracing, when shown or authorized by the Engineer to be left in place, will be paid for as follows:
  - 1. Timber Sheeting: Timber sheeting will be paid for as the number of board feet of lumber below finish grade measured in place prior to backfilling. Include in the measurement sheeting wasted when cut off between the finished grade and 1 foot below the finished grade.
  - 2. Steel Sheeting and Soldier Piles: Steel sheeting, soldier piles, and steel bracing will be paid for according to the number of pounds of steel calculated. Calculate the steel by multiplying the measured in-place length in feet below finish grade by the unit weight of the section in pounds per foot. Obtain unit weight of rolled steel sections from recognized steel manuals

END OF SECTION

## SECTION 31 05 19 - GEOTEXTILE

### PART 1 - GENERAL

#### 1.01 Unit Prices

##### A. Geotextile – Base Bid and Alternate No. 1

1. Payment for “Geotextile” shall include the cost of materials, equipment, installation, testing, and other costs associated with placement of the geotextile.
2. Measurement: The quantity to be paid shall be the square yard unit price quoted on the bid form for “Geotextile”.
3. Unit of Measure: Square Yard (SY).

#### 1.02 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

B. American Society for Testing and Materials (ASTM)

ASTM D 3786	(2009) Bursting Strength of Textile Fabrics – Diaphragm Bursting Strength Tester Method
ASTM D 4354	(2009) Sampling of Geosynthetics for Testing
ASTM D 4355	(2007) Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
ASTM D 4491	(2009) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(2009) Trapezoid Tearing Strength of Geotextiles
ASTM D 4595	(2009) Tensile Properties of Geotextiles by the Wide-Width Strip Method
ASTM D 4632	(2008) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D 4833	(2007) Index Puncture Resistance of Geomembranes and Related Products
ASTM D 4873	(2009) Identification, Storage, and Handling of Geosynthetic Rolls and Samples
ASTM D 5261	(2010) Measuring Mass per Unit Area of Geotextiles

### 1.03 SUBMITTALS

- A. General: Submit the following in accordance with the Special Provision SP-16, "Submittals," of these Specifications.
- B. Prior to delivery of Geotextile to the job site, the Contractor shall submit the following certified test reports to the Engineer for approval:
  - 1. AASHTO Survivability Class (AASHTO M288)
  - 2. Apparent Opening Size (ASTM D 4751)
  - 3. Grab Tensile Strength and Elongation (ASTM D 4632)
  - 4. Mullen Burst Strength (ASTM D 3786)
  - 5. Permittivity (ASTM D 4491)
  - 6. Puncture Strength (ASTM D 4833)
  - 7. Sewn Seam Strength, if used (ASTM D 4632)
  - 8. Trapezoidal Tear Strength (ASTM D 4533)
  - 9. U.V. Resistance (ASTM D 4355)
  - 10. Wide Width Tensile Strength – Machine Direction (ASTM D 4595)
  - 11. Wide Width Tensile Strength – Cross-Machine Direction (ASTM D 4595)
- C. Manufacturer's recommendations for seaming and/or lapping joints.
- D. Samples: Representative sample of each type of geotextile showing the name of the manufacturer, brand name, type of fiber shall be submitted.
- E. The certification(s) shall show the appropriate ASTM test(s) for each material, the test results, and a statement that the material meets the specifications.

### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Geotextile labeling, shipment, and storage shall follow ASTM D 4873. Product labels shall clearly show the manufacturer or supplier name, style name, roll number, length and width of the roll.
- B. Each geotextile roll shall be wrapped with a material that will protect the geotextile from damage due to shipment, water, sunlight, and contaminants.
- C. Geotextile shall be stored in areas where water cannot accumulate, elevated off the ground, and protected from conditions that will affect the properties or performance. Outdoor storage shall not be for periods that exceed the manufacturer's recommendations, or for two months, whichever is less.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. All materials specified shall be applied as per the Manufacturer's printed instructions and recommendations or as directed by the Engineer.

- B. Any work in which unapproved materials are used shall be performed at the Contractor's risk and will be considered unacceptable, unauthorized, and will not be paid for and may require removal.

## 2.02 GEOTEXTILE

- A. The geotextile shall be manufactured with fibers consisting of long-chain synthetic polymers composed of at least 95% by weight polyolefins or polyesters. They shall form a stable network such that filaments or yarns retain their dimensional stability relative to each other, including selvages. The geotextile shall be free of any chemical treatment or coating which reduces permeability and shall be inert to chemicals commonly found in soil.
- B. Woven slit film geotextiles will not be allowed.
- C. The geotextile materials shall equal or exceed the minimum (or maximum, if noted) average roll values (MARVs) specified below:

Physical Property	Test Value	Test Method
Survivability Class	Class 1 (nonwoven) Class 2 (woven monofilament)	AASHTO M288
Mass Per Unit Area (Nonwoven Geotextiles Only)	8 oz/sy	ASTM D 5261
Apparent Opening Size (max.)	0.425mm	ASTM D 4751
Permittivity	0.7 sec-1	ASTM D 4491
Percent Open Area (woven geotextile only)	4%	CWO-22125
Porosity (nonwoven geotextiles only)	50%	
UV Resistance	70% strength retained for all classes @ 500 hours	ASTM D 4355

- D. Geotextile shall have a minimum roll width of 12 feet.
- E. The geotextile shall be delivered to the job site in its original manufacturer's container(s). Each roll shall be individually wrapped in a protective wrapping which shall protect the fabric from ultraviolet radiation and from abrasion due to shipping and handling and to avoid moisture pick up. Materials exhibiting wetness, disintegration, decomposition, and/or abrasion due to shipping and handling will be rejected and shall be removed from the job site immediately, at the Contractor's cost.
- F. Installation, handling and storage of geotextile fabric shall be in accordance with the manufacturer's recommendations and the Engineer's direction.

## 2.03 ANCHORS

- A. Geotextile anchors shall be either:

1. Commercially available or manufactured 12-inch long by 1/8-inch diameter galvanized steel pins placed through the center of 1-inch diameter by 1/8-inch thick galvanized steel washers.
2. Sand bags or rock placed on top of the geotextile to secure it in place prior to rock placement.

## PART 3 - EXECUTION

### 3.01 GEOTEXTILE PLACEMENT

- A. Surface to receive the geotextile shall be prepared in accordance with the requirements of Section 02315, "Earthwork," of these Specifications and shall be accepted by the Engineer prior to geotextile placement.
- B. Surface to receive the geotextile shall be prepared to a relatively smooth condition free of obstructions, sharp objects, stumps, and debris that could damage the geotextile during installation. When directed by the Engineer, rolling shall be used for surface preparation at no cost to the Administration.
- C. Fabric shall be placed with the warp direction roll length oriented parallel to the fill direction.
- D. Geotextile joints shall be made by either overlapping or seaming:
  1. Overlap: The geotextile shall be overlapped at all longitudinal and transverse joints a minimum of 3 feet. The geotextile shall be placed so that the preceding roll overlaps the following roll in the direction the fill material is being spread and upslope geotextile sheets shall be overlapped over downslope sheets.
  2. Seams: Seams shall develop of 90% of the specified grab tensile strength when tested in accordance with ASTM D 4632. All seams shall be subject to the approval of the Engineer.
- E. No mechanical equipment shall be permitted on the fabric surface.

END OF SECTION

## **SECTION 33 42 13 – PIPE CULVERTS**

### **PART 1 - GENERAL**

#### **1.01 UNIT PRICES**

##### **A. 48" HDPE Pipe – Base Bid**

1. Payment: Payment for "48" HDPE Pipe" shall include the HPDE Pipe, transport of all materials to the project site, temporary storage and protection of materials at the project site, all excavation, utility trench shoring, handling, stockpiling, replacement and compaction of soil material, all piping connections, gaskets, flanges, connection hardware, and all material, labor, and equipment associated with safe handling and installation of the HDPE pipe.
2. Measurement: "48" HDPE Pipe" shall be measured on a Linear Foot basis.
3. Unit of Measure: Linear Foot (LF)

##### **B. 24" HDPE Pipe – Alternate No. 1**

1. Payment: Payment for "24" HDPE Pipe" shall include the 24" HPDE Pipe, transport of all materials to the project site, temporary storage and protection of materials at the project site, all excavation, utility trench shoring, handling, stockpiling, replacement and compaction of soil material, all piping connections, gaskets, flanges, connection hardware, and all material, labor, and equipment associated with safe handling and installation of the 24" HDPE pipe.
2. Measurement: "24" HDPE Pipe" shall be measured on a Linear Foot basis.
3. Unit of Measure: Linear Foot (LF)

#### **1.02 SUMMARY**

- A. Section Includes:
  1. Pipe culverts.
  2. Joints and accessories.
  3. Bedding.
- B. Related Sections:
  1. Section 31 00 00 - Earthwork.

#### **1.03 REFERENCES**

- A. ASTM International (ASTM)
  1. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

2. ASTM F2160 - Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD)
3. ASTM D 2657 - Heat Fusion Joining of Polyolefin Pipe and Fittings
4. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
5. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

#### 1.04 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on pipe, fittings and accessories.
- C. Manufacturer's Installation Instructions: Submit special procedures required to install Products specified.
- D. HDPE Flashboard Riser
  1. Shop Drawings detailing fabrication of HDPE Flashboard Riser, and conformance to all required material and fabrication standards denoted herein.
  2. Design Computations demonstrating conformance to the specified criteria herein.
  3. Design computations shall be signed and sealed by a Professional Engineer, licensed in the State of Delaware.
  4. Handling and Installation plan of the HDPE Flashboard Riser and associated anchorage and piping connections.

#### 1.05 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents:
  1. Accurately record actual locations of pipe runs, connections, and invert elevations.
  2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
- C. Operation and Maintenance Data: Procedures for submittals.

### PART 2 - PRODUCTS

#### 2.01 STORM DRAINAGE PIPING

- A. HDPE Polyethylene Pipe conforming to ASTM F714:
  1. HDPE Iron Pipe Size (IPS): As indicated on the Contract Drawings

2. Diameter Ratio: DR 32.5
3. Joints: ASTM D2657 Heat fusion

## 2.02 HDPE FLASHBOARD RISER

- A. General: The HDPE Flashboard Riser Body, structural steel frame, and timber weir boards shall conform to the configuration shown in the Contract Drawings.
- B. HDPE Flashboard Riser Body
  1. The flashboard riser body shall be comprised of HDPE material conforming to ASTM F2160.
  2. The flashboard riser body shall be between ¼-inch to 3/8-inch in thick.
  3. The flashboard riser body shall be fused to the structural steel frame in accordance with ASTM D2657.
- C. Structural Steel Framing
  1. The flashboard riser frame elements shall consist of standard 'L' shapes conforming to ASTM A 276, Type 316 Stainless Steel.
  2. All stainless steel framing connections shall be shop-welded in accordance with AWS D.1.6.
  3. All corner junctions shall be mitered, and free of burrs and other similar surface imperfections.
- D. Steel Anchorage to Concrete Foundation
  1. As a minimum design standard, the localized anchorage to the concrete foundation cap shall consist of the following, or as required by design:
    - a. ¾" diameter ASTM F1554 anchor rods
    - b. A prequalified adhesive epoxy formula, conformed to current ICC testing data.
    - c. Bent steel plate straps conforming to ASTM A 36, or as required by design.
    - d. All steel plates and shapes shall be HDG in accordance with ASTM A123.
    - e. All steel anchor rods, bolts, hex nuts, and washers shall be HDG in accordance with ASMT A153.
  2. The manufacturer shall provide dielectric isolation between Stainless Steel and HDG finished in accordance with the following:
    - a. Where dissimilar metals are in contact, protect surfaces with a coat conforming to FS TT-P-664 to prevent galvanic or corrosive action.

## 2.03 TIMBER WEIR BOARDS

- A. Timber weir boards shall conform to the following:
  1. All timber construction shall conform to the recommendations of the national design specification for wood construction (NDS-2005) & the American Institute of Timber Construction.
  2. All timber components shall be treated with ACZA or CCA in accordance with AWWA (Use category system U1-06 commodity specification G) for timber subject to saltwater immersion. Preservative retention shall be 2.50 pounds per cubic foot for all components.



3. Field test cuts, bevels, notches, refacing, and abrasions made in accordance with AWPA M4-06. Wood preservatives are restricted use pesticides and shall be applied according to applicable standards. Provide protective equipment for all personnel that are fabricating, field treating, or handling treated timber. Trim cuts and abrasions before field treatment. Paint depressions or openings around bolt holes, joints, or gaps including recesses formed for counterboring with preservative treatment and after bolt or screw is installed. Fill with a marine silicone sealant.
4. Provide solid sawn timbers of stress rated Number 2 Southern Pine or as required by the HDPE riser manufacturer for all timber weir boards with a stress as indicated and as identified by the grade mark of a recognized association covering the species used. Number 2 Southern Pine shall be interpreted as the minimum weir board design standard for this project. The association shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used.
5. Fabricate lumber and timbers to the greatest extent possible before preservative treatment. Each piece of treated lumber or timber shall be branded by the producer in accordance with AWPA M6-96.
6. Cut, bevel, and face timbers prior to plant preservative treatment.
7. Cut and frame lumber and timber so that joints will fit over contact surface. Secure timbers in alignment. Open joints are unacceptable. Shimming is not allowed unless shown.
8. Use only full-length timber for blocking.

#### 2.04 BEDDING AND COVER MATERIALS

- A. General: Conform to Section 31 00 00 for bedding and backfill around and on top of pipe.
- B. Bedding for Flexible Pipe (HDPE): Clean course aggregate Gradation No. 57 conforming to Division 700 of the DelDOT Standard Specifications.
- C. Cover and Fill: Conform to Section 31 00 00.

#### 2.05 ACCESSORIES

- A. Geotextile Fabric: Non-woven, non-biodegradable conforming to Division 800 of the DELDOT Standard Specifications for Type 1 Engineering Fabric.
- B. Concrete: Concrete shall conform to the specified mix designs in Section 03 30 00.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on Drawings.

#### 3.02 PREPARATION

- A. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

### 3.03 EXCAVATION AND BEDDING

- A. Excavate pipe trench in accordance with Section 31 23 17.
- B. Excavate to lines and grades shown on Drawings or required to accommodate installation of encasement.
- C. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation.
- D. Provide sheeting and shoring in accordance with Section 31 23 17.
- E. Place bedding material at trench bottom, level continuous layer not exceeding 8-inch compacted depth; compact to 95 percent per Section 31 23 17.
- F. Maintain optimum moisture content of bedding material to attain required compaction density.

### 3.04 INSTALLATION – PIPE

- A. Install in accordance with manufactures instructions and as indicated on Drawings.
- B. Install plastic pipe, fittings, and accessories in accordance with ASTM F2160.
- C. Seal joints watertight.
- D. Begin at downstream end and progress upstream.
- E. Keep pipe and fittings clean until work is completed and accepted by Engineer.
- F. Repair surface damage to pipe with protective coating with two coats of compatible bituminous paint coating.
- G. Install cover at sides and over top of pipe

### 3.05 INSTALLATION – HDPE FLASHBOARD RISER

- A. General: The HDPE Flashboard Riser shall be installed, anchored, and connected to the Water Control Structure concrete foundation cap in accordance with the manufacturer's requirements and guidelines.
  - 1. The Contractor shall submit a detailed handling and installation plan for the HDPE Flashboard Riser, with consideration for all other construction phasing associated with the water control structure.
    - a. The HDPE Flashboard Riser Shop Drawings, Handling and Installation plans shall be approved by the Engineer prior to construction.

- b. In addition to the Engineer, the manufacturer shall review and approve the handling and installation plan to ensure the Contractor's proposed methods will not damage or impair the riser element.
- 2. The Contractor shall construct the slip joint connection under shored and dry conditions to ensure the best quality.
- 3. The Contractor is responsible for the proper fit and alignment of the timber weir boards.

### 3.06 PIPE ENDS

- A. Place fill at pipe ends to match embankment slopes, concrete aprons, adjacent construction, end sections, or end walls as indicated on Drawings.

### 3.07 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Lay pipe to alignment and slope gradients noted on Drawings; with maximum variation from indicated slope of 1/8 inch in 10 feet.
- C. Maximum Variation from Intended Elevation of Culvert Invert: 1/2 inch.
- D. Maximum Offset of Pipe From Indicated Alignment: 1 inch.
- E. Maximum Variation in Profile of Structure from Intended Position: 1 percent.

### 3.08 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Request inspection prior to and immediately after placing bedding.
- C. Soil Compaction Testing: In accordance with Section 31 23 17.
- D. When tests indicate Work does not meet specified requirements, remove work, replace, and retest.

### 3.09 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.
- B. Protect pipe and bedding from damage or displacement until backfilling operation is in progress.

END OF SECTION

## **SECTION 35 43 37 RIPRAP SCOUR PROTECTION**

### **PART 1 - GENERAL**

#### **1.01 UNIT PRICES**

##### **A. DELDOT R-6- Base Bid and Alternate No. 1**

1. Payment For "DELDOT R-6" shall include all handling, hauling, stockpiling, placement, and compaction of stone associated with Scour Protection as shown in the contract drawings.
2. Measurement: "DELDOT R-6" shall be measure on the basis of tonnage.
3. Unit of Measure: Tonnage (TON)

#### **1.02 SECTION INCLUDES**

- A. The work covered by this section includes the furnishing of all transportation, labor, equipment, materials, and incidentals to complete the construction of riprap for scour protection as shown on the Contract Drawings or specified herein. The words rock, riprap and stone used in this section are interchangeable and shall mean one and the same material. The work shall include:

1. Riprap scour protection around water control structures

#### **1.03 RELATED SECTIONS**

- A. Section 31 00 00 Earthwork
- B. Section 31 34 19 Geotextiles

#### **1.04 REFERENCES**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. Unless otherwise indicated the most recent edition of the publication, including any revisions, shall be used.
- C. Delaware Department of Transportation (DelDOT), Specifications for Road and Bridge Construction, August 2001.
- D. American Society For Testing And Materials (ASTM)
- |            |                                                                               |
|------------|-------------------------------------------------------------------------------|
| ASTM C 88  | (2013) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate  |
| ASTM C 97  | (2015) Absorption and Bulk Specific Gravity of Dimension Stone                |
| ASTM C 127 | (2015) Relative Density (Specific Gravity) and Absorption of Coarse Aggregate |

ASTM C 295 (2012) Petrographic Examination of Aggregates for Concrete

ASTM C 535 (2012) Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

E. U.S. Army Corps Of Engineers (USACE)

EM 1110-2-1096 Laboratory Soils Testing

CRD-C 144-73 Method of Testing Stone for Resistance to Freezing and Thawing

1.05 SUBMITTALS

- A. Prior to construction, the Contractor shall submit test results from a certified laboratory, which demonstrate that all rock products meet the specified gradation, sulfate soundness, Los Angeles abrasion, petrography, absorption, and specific gravity requirements. Test results shall be dated within 90 days of the date submitted.

PART 2 - PRODUCTS

2.01 RIPRAP MATERIAL

- A. General: Riprap shall consist of fresh, sound, hard, dense, durable stone of crystalline igneous or metamorphic rock which shall be separated from bedrock by quarrying. No sedimentary rock, schistose rock or any highly foliated rock will be acceptable. Rock shall be free of seams and thin layers of soft, decomposed, weak, or water-soluble materials.
- B. Riprap shall be Delaware Department of Transportation (DelDOT) Class R-6. This rock shall have a maximum size of 24 inches, 15 to 50 percent smaller than 12 inches, and 0 to 15 percent smaller than 6 inches.
- C. Size and Shape of Stone: Riprap shall be furnished in blocky and angular shapes, with its greatest dimension not greater than three times its least dimension. Flat stones, slabs, boulders, and parts of boulders will be rejected. Not more than 5% by weight of clean spalls resulting from loading and shipment will be allowed in any one vessel.
- D. Petrography: Stone shall be subjected to petrographic and x-ray diffraction analysis in accordance with ASTM C 295. Rock shall be fresh, interlocking crystalline structure, free of objectionable material such as expansive clays.

- E. Evaluation Testing: Rock shall meet the following test criteria:

Property	Test Method	Test Value
Specific Gravity	ASTM C 97	2.65 minimum
Absorption	ASTM C 127	Less than 2%
Abrasion	ASTM C 535	Less than 20% loss for 500 revolutions
Sulfate Soundness	ASTM C 88	Less than 18% for 5 cycles

Freezing and Thawing    CRD-C 144-73    Less than 10% loss for 12 cycles

2.02 SOURCES OF RIPRAP

- A. The Contractor may utilize one or more sources of riprap. The Contractor shall provide documentation that rock from these sources meets the requirements of these specifications.

2.03 ROCK NOT MEETING THE SPECIFICATIONS

- A. If, during the progress of the work, it is found that the stone being furnished and/or placed by the Contractor does not fully meet all the requirements of the specifications, the Contractor shall be required to furnish other rock of a quality acceptable to DNREC. Any rock rejected at the site of the work as not meeting the requirements of these specifications for quality, condition, size, gradation or otherwise shall be removed from the site by and at the expense of the Contractor, and rock of suitable quality shall be furnished and/or placed at no additional cost to DNREC.

PART 3 - EXECUTION

3.01 PLACEMENT OF RIPRAP

- A. General: Care shall be taken to place the riprap to make a compact mass, and form as nearly as practicable a cross-section of uniform height, width, and slopes as shown on the Contract Drawings. Rocks shall be carefully placed so as to leave no large voids between them. Rock shall be placed in accordance with the construction sequence. The rock layers shall be placed to the full specified thickness in one operation.

END OF SECTION

## **APPENDIX 1**

### **PAYROLL REPORT SAMPLE**





**APPENDIX 2**

**GEOTECHNICAL REPORTS**



# GEO-TECHNOLOGY ASSOCIATES, INC.

GEOTECHNICAL AND  
ENVIRONMENTAL CONSULTANTS

*A Practicing Geoprofessional Business Association Member Firm*



June 11, 2015

Moffatt & Nichol  
2700 Lighthouse Point East, Suite 501  
Baltimore, Maryland 21224

Attn: Mr. Peter Kotulak, P.E.

Re: Subsurface Exploration  
***Little Creek Wildlife Management Area Enhancement Project (Task 2)***  
Kent County, Delaware

Gentlemen:

In accordance with our agreement dated March 17, 2015, Geo-Technology Associates, Inc. (GTA) has performed a subsurface exploration for the impoundment embankments at the Little Creek Wildlife Area located in Kent County, Delaware. The exploration consisted of performing Standard Penetration Test borings at 7 locations along the impoundment embankments in order to collect subsurface data for engineering analysis. The results of the field testing, laboratory analyses, and our geotechnical recommendations regarding raising the height of the embankment are included in this report.

Sincerely,  
**GEO-TECHNOLOGY ASSOCIATES, INC.**

Timothy Hill  
Project Manager

Meghan Lester, P.E.  
Vice President

TH/ML/amd  
141191  
Attachments

18 Boulden Circle, Suite 36, New Castle, DE 19720 (302) 326-2100 Fax: (302) 326-2399

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## REPORT OF GEOTECHNICAL EXPLORATION

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# **LITTLE CREEK WILDLIFE MANAGEMENT AREA ENHANCEMENT PROJECT OLD LEVEE EVALUATION**

**Kent County, Delaware**

JUNE 2015

Prepared For:

**MOFFAT & NICHOL**  
2700 Lighthouse Point East, Suite 500  
Baltimore, Maryland 21224

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Prepared By:

**GEO-TECHNOLOGY ASSOCIATES, INC.**  
*Geotechnical and Environmental Consultants*  
18 Boulden Circle, Suite 36  
New Castle, Delaware 19720  
(302) 326-2100  
GTA Job No: 141191

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## **REPORT OF GEOTECHNICAL EXPLORATION**

### **LITTLE CREEK WILDLIFE MANAGEMENT AREA ENHANCEMENT PROJECT OLD LEVEE EVALUATION KENT COUNTY, DELAWARE JUNE 2015**

#### **INTRODUCTION**

This report presents the results of the geotechnical exploration performed for the levee berms within the southern water impoundment at the Little Creek Wildlife Area, in Kent County, Delaware. There are two divider berms in the southern impoundment. The eastern most berm is partially breached and the western most berm is generally intact and separates the fresh water impoundment from the salt water impoundment. GTA also completed a previous investigation of this site which included performing Standard Penetration Test (SPT) borings drilled at 2 locations in the western most divider berm to depths of approximately 20 to 25 feet below the existing berm elevation. The results of those borings are discussed in GTA's Report of Geotechnical Exploration, dated October 13, 2014.

Additionally, Geo-Technology Associates, Inc. (GTA) understands that the existing levee along the bay which serves as the eastern boundary for the southern impoundment has undergone some erosion and, as such, will be reconstructed. No survey plans were available for the berm embankments at the time this report was prepared; however, it is understood that the levee will be reconstructed to an elevation of approximately 8 feet NAVD.

GTA was retained to perform a geotechnical exploration of the existing levee and breached divider berm. The scope of this study included a field exploration, laboratory testing, and engineering analyses. Included in our field exploration were Standard Penetration Test (SPT) borings drilled at 7 locations along the impoundment levee to depths of approximately 25 to 45 feet below the existing berm elevation. Limited laboratory testing was performed to verify the visual classifications and characterize general subsurface conditions. Conclusions and recommendations regarding the site were derived from engineering analysis of field and laboratory data, and review of available aerial photographs.

## **SITE DESCRIPTION**

The south impoundment area is situated within the Little Creek Wildlife Area in Kent County, Delaware. Specifically, the south impoundment is located south of the Little River and east of Bayside Drive. (State Route 9). The specific areas investigated within the impoundment included the eastern levee berm and the partially beached divider berm in the central and eastern portions of the impoundment. The general location of the site and surrounding features are shown on *Figure 1: Site Location Map*, in Appendix A.

The general area is a tidal and fresh water marsh that is close to mean sea level with top of berm elevations along the perimeter of the impound estimated to be about Elevation (EL) 4 to 8. The breached divider berm within the interior portion of the impoundment is estimated to be about EL 2 to 3. The upland areas and farmland in the vicinity of the south impoundment are at about EL 5 to 10. An outlet control structure maintains the water level in the fresh water impoundment above the water level in the salt water impoundment. No survey plans were available at the time this report was prepared. However, based visual observations and data obtained from Google Earth imagery the berm appears to be about 50 to 70 feet wide at the base and approximately 15 to 20 feet wide at the top.

## **RELEVANT GEOLOGY**

Based on the Geologic Map of Kent Castle County, Delaware (2007), prepared by the Delaware Geological Survey (DGS), the area is situated in the Coastal Plain Physiographic Province, which is characterized by undifferentiated and interlayered sedimentary deposits. Specifically the site is mapped as underlain by Holocene Age marsh deposits. These materials are described as structureless to finely laminated, black to dark gray, organic-rich, silty clay to clayey silt, with discontinuous beds of peat and rare shells. The deposit ranges from 1 to 40 feet thick and is generally mapped where there is salt-tolerant marsh grass present. Refer to the publication for further information.

## **SUBSURFACE EXPLORATION**

The subsurface exploration was conducted March 30, 2015 through April 2, 2015. The field exploration consisted of drilling Standard Penetration Test (SPT) borings at 7 locations

along the centerline of the central and eastern most levee berms. The test borings designated as LC-11 through LC-13 were performed along the divider berm using a UTV-mounted CME 45C. The test borings designated as LC-14 through LC-17 were performed with the eastern most berm using an ATV-mounted CME 55. The test borings were drilled to depths of approximately 25 to 45 feet below the existing ground surface. The drill rigs were equipped with hollow stem augers and a safety hammer. The test locations were selected and field located by GTA by measuring from existing site features. Elevations at the test locations were surveyed at a late date by representatives from Morris & Ritchie Associates, Inc. (MRA). The approximate test boring locations are indicated on the attached *Exploration Location Plan, Figure 2*.

Standard Penetration Testing was performed in the boreholes, with soil samples obtained at approximate 2-foot intervals in the upper 10 feet and at 5-foot intervals thereafter. Standard Penetration Testing involves driving a 2-inch O.D., 1½-inch I.D. split-spoon sampler with a 140-pound hammer free-falling 30 inches. The number of blows required to drive the sampler 24 inches was recorded in 4 intervals of 6 inches. The total number of hammer blows required to drive the sampler from the 6 to 18 inch interval is the SPT N-value. Uncorrected blow counts are noted on the logs.

Also, undisturbed samples of fine-grained soils were obtained using a thin-wall tube sampler in general accordance with ASTM D1587. The thin-wall (Shelby tube) sampling procedure consisted of slowly pushing a 3-inch O.D. tube into the soil, waiting for a period of about 15 minutes, manually rotating the sampler, and then retrieving the tube. Two Shelby Tube samples were obtained during the investigation. One Shelby Tube sample was obtained at boring location LC-13 at a depth of 4 to 6 feet below ground surface and the other Shelby Tube sample was obtained at boring location LC-17 at a depth of 21 to 23 feet below ground surface. Recoveries of the undisturbed samples were 77 percent and 100 percent, respectively.

Detailed descriptions of the encountered subsurface conditions are indicated on the individual boring logs, which are included in Appendix B. The soil samples retrieved from the borings were brought to GTA's laboratory for visual classification by engineering personnel and limited laboratory testing. The soil descriptions indicated on the logs are based on visual



observations of the individual soil samples using the Unified Soil Classification System (ASTM D2488) as summarized in the *Notes for Exploration Logs* included in Appendix B, supplemented by the laboratory test results.

### **SUBSURFACE CONDITIONS**

In general agreement with the known site conditions and the published geology, test borings LC-14 through LC-17 encountered approximately 6 to 7 feet of fill materials comprised primarily of silt, clay and sand mixtures with varying amounts of organic matter. The fill materials were generally soft to medium stiff and were underlain by very soft to stiff, organic and elastic silts and clays. Loose to medium dense sands, silt and gravel mixtures were encountered below the silt and clay materials. The very soft to stiff organic and elastic silts and clays were encountered to depths ranging from 7 to 39½ feet. Below these materials, loose to medium dense sand, silt and gravel mixtures were generally encountered to the depths ranging from 19 to 45 feet. Medium stiff to very stiff clay was encountered below the sand, silt and gravel layers at test boring location LC-12 and LC-13 and these soils extended to the maximum depth explored.

Unconfined compressive strengths of the fine grained soils recovered from the split spoon samples were estimated using a Pocket Penetrometer. Pocket Penetrometer values indicated unconfined compressive strengths varying between about 200 psf in the very soft to soft soils and 2000 psf in the stiff to very stiff soils. These values correlate to undrained shear strengths varying from about 100 to 1000 psf.

Groundwater was initially encountered during drilling at depths ranging from 1 to 13½ feet below existing surface grades. Subsequent groundwater readings after removal of the augers were recorded at depths ranging from 1 to 6½ feet below existing surface grades. The boreholes at test locations LC-14, LC-15 and LC-17 caved dry at depths ranging from about 7 to 12 feet following removal of the augers. The groundwater elevation likely fluctuates with the level of the water in the adjacent impoundments and tidal changes in Delaware Bay. Only one long term water level reading (LC-11) was recorded since majority of the borings were backfilled upon completion for safety considerations.

## **LABORATORY ANALYSIS**

Selected samples obtained from the borings were tested for particle-size distribution, Atterberg Limits, and natural moisture content. The particle-size distribution and Atterberg Limits testing were performed on samples to determine their classification using the Unified Soil Classification System (USCS), which provides information regarding soil's engineering behavior. The results of the testing are summarized in the table below.

### **SUMMARY OF INDEX TESTING**

<b>BORING</b>	<b>DEPTH (FEET)</b>	<b>USCS CLASSIFICATION</b>	<b>LL%</b>	<b>PI%</b>	<b>NMC%</b>
LC-13	4 to 6	Organic SILT with sand (OH)	124	61	209.6
LC-14	7 to 9	Organic SILT (OH)	99	40	225.2
LC-16	8 to 10	Organic SILT with sand (OH)	87	43	119.1
LC-17	21 to 23	Organic SILT (ML)	NP	NP	376.9

LL=Liquid Limit; PI=Plasticity Index; NP=Non-plastic; NMC=Natural Moisture Content

The particle size distribution reports are included in Appendix C. Organic content test were performed on the above referenced samples. The organic content based on a dry weight basis ranged from 12.1 to 42.65%. The compression index ( $c_c$ ), coefficients of consolidation ( $c_v$ ) under specific load conditions, and initial void ratio ( $e_o$ ) were also calculated, and are indicated on the consolidation test report included in Appendix C.

## **CONCLUSIONS AND RECOMMENDATIONS**

Based on the results of the boring and laboratory data, there is a 7-foot to 33-foot thick layer of very soft to soft compressible silts and clays below the interior and perimeter levee berms. We have considered that this layer is normally consolidated so any new load from regarding and/or berm reconstruction activities will cause additional settlement. Given the width and configuration of the of the existing perimeter levee embankment, there is an adequate factor of safety for slope stability under normal pool conditions and rapid draw down conditions provided no significant changes are made in geometry of the berm. Depending on the design for the levee embankment within the interior impound area, the use of slope reinforcement may be required to achieve an adequate factor of safety for stability. GTA should review final plans to assess the need for slope reinforcement.

Estimated settlement at the end of primary consolidation due to imposed loads equal to approximately 1 foot to 5½ feet of new embankment fill for the eastern levee ranges from about ½ to 2½ feet. Settlements for the divider berm are estimated to be on the order of ½ to 1 feet. Very soft/organic soils typically exhibit large secondary compression settlements under a constant load, and this mechanism is dominant after primary consolidation is complete. Settlements due to secondary compression were estimated to range from about ½ to 1½ inches over a period of 30 years, in addition to the ½- to 2½-foot of settlement expected after 90 percent consolidation is achieved. It should be expected that some subsidence at the ground surface from lateral bulge during the filling operations will occur.

### ***Grading Activities***

The fill slopes should generally be limited to 3H:1V (horizontal:vertical) or flatter if the toe of the slope extends into open waterways to reduce the potential for a bearing capacity failure. Due to the soft and compressible nature of the underlying soils and the variability in the fill placement quantities required to achieve the proposed design elevation, it is anticipated that some differential settlements or localized subsidence may occur after the new embankment fill is placed. Therefore, GTA recommends that a periodic evaluation and maintenance program be implemented to assess and correct any potential areas that may be exhibiting signs of differential settlement or subsidence that could result in a breach of the levee. More specific details for staging, sequence of construction, the need for groundwater control measures and instrumentation or monitoring can be provided to address the soft ground issues once a concept plan is prepared.

The embankment materials shall be spread in level, continuous, horizontal layers for the width and length of such portion at that elevation. Where the lift ties back into an existing slope steeper than 5H:1V, the layer should be keyed or benched into the existing slope. Additionally, GTA recommends that the embankment faces be filled steeper than proposed then reshaped or shaved to their intended design slope. Also, during construction, any previously placed and compacted materials which have become soft or loose due to exposure to weather, which contain erosion channels or cracks, or which are excessively dry, shall be reworked or removed before successive lifts are placed.

*Eastern Levee*

At the time this report was prepared, proposed grading changes to the berm were not available. Given the limited work area and the site constraints, filling the embankment and placing additional fill as necessary as settlement occurs is likely the most cost-effective and practical solution to providing the desired freeboard.

Prior to placing any new fill to raise or widen the levee berm, the upstream and downstream face of the slope would need to be cleared and grubbed. Prior to the placement of compacted fill, the area should be stripped to remove any vegetation, organic material, surface debris, or other unsuitable materials from the cartway and slopes. Any surficial materials identified as unstable or unsuitable should be undercut to stable stratum and backfilled with controlled, compacted fill as recommended in the field by the Geotechnical Engineer.

Fill should be placed in lifts and be compacted in accordance with the specifications included in this report. The stripping of organics, proofrolling, undercutting of any uncontrolled or unsuitable material, and placement of controlled, compacted fill should be observed by a Geotechnical Engineer or their qualified representative. Off-site borrow, should meet Unified Soil Classification System (USCS) designation ML, CL, SC, SM, or GM. The contractor should provide a sample of the borrow materials to the engineer for testing and approval. All borrow sources should be approved by the geotechnical engineer prior to hauling the material to the site. Structural fill should be placed and compacted to a minimum of 95 percent of the Standard Proctor (ASTM D698) maximum dry density.

Upon satisfactory evaluation of the subgrade, structural fill should be placed in lifts and compacted in accordance with the specifications included in this report. The materials will typically need to be within 3 to 4 percentage points of the optimum moisture before compactive effort is applied. Positive drainage should be maintained on the site during construction to reduce the potential for subgrade degradation due to ponding water. Depending on the moisture content at the time of construction, the soils could require drying to reduce the moisture content to within the required working range for compaction. All structural fill should be constructed in maximum 8-inch thick loose lifts.

*Divider Berm*

Based on the results of the SPT testing, the soils within the upper 6 feet are very soft to soft and will be marginally stable for construction due to their moist to wet condition and shallow groundwater table. Prior to filling this impoundment, we recommend that the impoundments be dewatered. We assume that the base of the reconstructed embankment will be at least 50-feet wide at the base. We recommend that the initial lift of new structural fill consist a stabilization layer composed of relatively clean sand with less than 10 percent fines (SP or SP-SM). This initial lift should be placed by dumping onto a stabilized area, then pushing out a minimum 18 to 24-inch thick loose lift using light, low ground pressure bulldozers. Trucks should be kept off of the stripped subgrade, but may be allowed to dump off the edge of the stabilization layer after compaction.

The full thickness of the sand bridge lift can be effectively densified using a heavy, smooth drum vibratory roller with minimum energy rated at 60,000 ft-lbs. Densification should continue until the entire thickness of the lift is compacted to at least 95 percent of the maximum dry density as determined by the Standard Proctor test (ASTM D698).

Any areas that cannot be stabilized using this method will require the use of a high strength geotextile or geogrid over the sand bridge lift. The type of geosynthetic should be determined in the field based on a review of the conditions. This method of stabilization should be successful if executed properly; however, we recommend that a significant contingency be allotted for undercutting and replacement of any areas that cannot be stabilized using this method. It should be noted that the stripping of organics, subgrade evaluations, undercutting of any unsuitable/unstable material, and placement of controlled, compacted fill should be observed by a geotechnical engineer or their qualified representative.

Once the site has been stabilized, materials classifying as SM and ML are considered suitable for use as compacted fill. Additional recommendations can be provided if the berm will need to be designed with a core trench or cut-off to reduce seepage between impoundments. Except as recommended previously for the initial stabilization lift, the fill should be constructed

in maximum 8-inch-thick loose lifts and be compacted to the a minimum of 95 percent of the Standard Proctor (ASTM D698) maximum dry density.

### ***Instrumentation***

During grading activities and embankment reconstruction, instrumentation consisting of settlement plates and piezometers should be installed and monitored during the surcharge process and waiting period. A minimum of three settlement plates should be placed on the subgrade soils before placing structural fill for the building pad. The settlement monuments should be constructed of ¼-inch, 18-inch x 18-inch, or larger, steel plate set at or near the current subgrade elevation. Threaded ¾- to 1-inch diameter steel pipe should be welded vertically to the plate. A PVC casing pipe should be placed over the steel pipe to isolate it from the fill. Additional pipe can be added as needed using threaded pipe couplers as the fill is placed. A detail sketch of a settlement monument can be prepared, if necessary.

Surveyed elevation readings should be shot to the nearest 0.005 foot at least prior to and during fill placement. After fill placement, surveyed elevations should be made weekly. The monument riser pipes should be well marked and protected to avoid disturbance by construction traffic. The survey data should be provided to the geotechnical engineer for review. Based on our evaluations of the settlement readings, we can assess when construction of the foundations within the monitoring area can begin.

In addition to the settlement plates, piezometers equipped with pore pressure transducers and/ or vibrating wires can be installed into the alluvial layer at several locations. Weekly readings should be performed to monitor pore pressure dissipation during consolidation. The piezometers and pore pressure readings can be used to better understand the subsurface drainage and to refine the time-rate settlement model using actual field data.

### **CONSTRUCTION MONITORING SCOPE**

We recommended that during final design and construction of the subject project, GTA be retained to provide consultation and observation and testing during construction generally as follows.

- Review final civil plans and specifications to evaluate if they conform to the intent of this report.
- Provide recommendations for an instrumentation program if deemed appropriate based on the final design.
- Provide installation and review of instrumentation during construction to evaluate soft ground response during loading.
- Observe the proof-rolling of the embankment to evaluate stability.
- Provide on-site observation and testing of structural fill.

### **LIMITATIONS**

This report has been prepared for the exclusive use of Moffatt & Nichol in accordance with generally accepted geotechnical engineering practice. No warranty, express or implied, is made. Use and reproduction of this report by any other person without the expressed written permission of GTA and Moffatt & Nichol is unauthorized and such use is at the sole risk of the user.

The analysis and recommendations contained in this report are based on the data obtained from the test borings. The test borings indicate soil conditions only at specific locations and times and only to the depths penetrated. They do not necessarily reflect strata variations that may exist between the test boring locations. If variations in subsurface conditions from those described are noted during construction, recommendations in this report may need to be re-evaluated.

In the event that any changes in the nature, design, or location of the facilities are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and conclusions of this report are verified in writing. Geo-Technology Associates, Inc. is not responsible for any claims, damages, or liability associated with interpretation of subsurface data or reuse of the subsurface data or engineering analysis without the express written authorization of Geo-Technology Associates, Inc.

The scope of our services for this geotechnical exploration did not include any environmental assessment or investigation for the presence or absence of wetlands, or hazardous or toxic materials in the soil, surface water, groundwater or air, on or below or around this site. Any statements in this report or on the logs regarding odors or unusual or suspicious items or conditions observed are strictly for the information of our Client.

This report and the attached logs are instruments of service. If certain conditions or items are noted during our investigation, Geo-Technology Associates, Inc. may be required by prevailing statutes to notify and provide information to regulatory or enforcement agencies. Geo-Technology Associates, Inc. will notify our Client should a required disclosure condition exist.

**141191**

**GEO-TECHNOLOGY ASSOCIATES, INC.**



# Important Information About Your Geotechnical Engineering Report

*Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.*

*The following information is provided to help you manage your risks.*

## Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply the report for any purpose or project except the one originally contemplated.*

## Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

## A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,

- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

## Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

## Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

## A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

## A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

## Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

## Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time to perform additional study.* Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

## Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that

have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

## Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

## Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

## Rely on Your ASFE-Member Geotechnical Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.



8811 Colesville Road/Suite G106, Silver Spring, MD 20910  
Telephone: 301/565-2733 Facsimile: 301/589-2017  
e-mail: [info@asfe.org](mailto:info@asfe.org) [www.asfe.org](http://www.asfe.org)

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# **APPENDIX A**



**Notes:**

- 1) Base map obtained from Google Earth Imagery, Inc. from April 2013.



GEO-TECHNOLOGY ASSOCIATES, INC.  
*Geotechnical and Environmental Consultants*  
 18 Boulden Circle, Suite 36  
 New Castle, Delaware 19720  
 (302) 326-2100  
 Fax (302) 326-2399

**SITE LOCATION MAP**

LITTLE CREEK WILDLIFE  
 MANAGEMENT AREA  
 OLD LEVEE EVALUATION  
 KENT COUNTY, DELAWARE

SCALE  
 NTS

DATE  
 JUNE 2015

DRAWN BY  
 GOOGLE

REVIEW BY  
 ML

JOB NO.  
 141191

FIGURE NO.  
 1





Key:  
LC-# Number and approximate location of Test Borings performed for this study

JOB NUMBER.:  
141191

FIGURE:  
2

REVIEW BY:  
ML

SCALE:  
NTS

DATE:  
JUNE 2015

EXPLORATION LOCATION PLAN  
LITTLE CREEK WILDLIFE MANAGEMENT  
AREA  
OLD LEVEE EVALUATION  
KENT COUNTY, DELAWARE

GEO-TECHNOLOGY ASSOCIATES, INC.  
*Geotechnical and Environmental Consultants*  
18 Boulden Circle, Suite 36  
New Castle, Delaware 19720  
(302) 326-2100  
Fax (302) 326-2399



Notes: (1) Layout was obtained from Google Earth Imagery, Inc from July 2010.  
(2) Exploration Location Plan should be read together with GTA Report Job No. 141191 for complete evaluation.

# **APPENDIX B**

# NOTES FOR EXPLORATION LOGS

## KEY TO USCS TERMINOLOGY AND GRAPHIC SYMBOLS

MAJOR DIVISIONS (BASED UPON ASTM D 2488)			SYMBOLS	
			GRAPHIC	LETTER
COARSE - GRAINED SOILS  MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELY SOILS  MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS  (LESS THAN 5% PASSING THE NO. 200 SIEVE)		GW
		GRAVELS WITH FINES  (MORE THAN 15% PASSING THE NO. 200 SIEVE)		GP
				GM
				GC
	SAND AND SANDY SOILS  MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS  (LESS THAN 5% PASSING THE NO. 200 SIEVE)		SW
		SANDS WITH FINES  (MORE THAN 15% PASSING THE NO. 200 SIEVE)		SP
				SM
				SC
FINE - GRAINED SOILS  MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS  LIQUID LIMIT LESS THAN 50	SILT OR CLAY ( $<15\%$ RETAINED THE NO. 200 SIEVE)		ML
		SILT OR CLAY WITH SAND OR GRAVEL ( $15\%$ TO $30\%$ RETAINED THE NO. 200 SIEVE)		CL
		SANDY OR GRAVELY SILT OR CLAY ( $>30\%$ RETAINED THE NO. 200 SIEVE)		OL
		SILTS AND CLAYS  LIQUID LIMIT GREATER THAN 50	SILT OR CLAY ( $<15\%$ RETAINED THE NO. 200 SIEVE)	
	SILT OR CLAY WITH SAND OR GRAVEL ( $15\%$ TO $30\%$ RETAINED THE NO. 200 SIEVE)			CH
	SANDY OR GRAVELY SILT OR CLAY ( $>30\%$ RETAINED THE NO. 200 SIEVE)			OH
	HIGHLY ORGANIC SOILS			PT

NOTE: DUAL SYMBOLS ARE USED TO INDICATE COARSE-GRAINED SOILS CONTAINING AN ESTIMATED 10% FINES BY VISUAL CLASSIFICATION OR WHEN THE SOIL HAS BETWEEN 5 AND 12 PERCENT FINES FROM LABORATORY TESTS; AND FOR FINE-GRAINED SOILS WHEN THE PLOT OF LIQUID LIMIT & PLASTICITY INDEX VALUES FALLS IN THE PLASTICITY CHART'S CROSSHATCHED AREA. RESULTS OF LABORATORY TESTING ARE USED TO SUPPLEMENT THE CLASSIFICATION OF THE SOILS BASED ON THE VISUAL-MANUAL PROCEDURES OF ASTM D2488.

## ADDITIONAL TERMINOLOGY AND GRAPHIC SYMBOLS

ADDITIONAL DESIGNATION	DESCRIPTION		GRAPHIC SYMBOLS
	TOPSOIL		
	MAN-MADE FILL		
	GLACIAL TILL		
	COBBLES AND BOULDERS		
RESIDUAL SOIL DESIGNATION	DESCRIPTION	"N" VALUE	
	HIGHLY WEATHERED ROCK	50 TO 50/1"	
	PARTIALLY WEATHERED ROCK	MORE THAN 50 BLOWS FOR 1" PENETRATION, AUGER PENETRABLE	

## COARSE-GRAINED SOILS (GRAVEL AND SAND)

DESIGNATION	BLOWS PER FOOT (BPF) "N"
VERY LOOSE	0 - 4
LOOSE	5 - 10
MEDIUM DENSE	11 - 30
DENSE	31 - 50
VERY DENSE	>50

NOTE: "N" VALUE DETERMINED AS PER ASTM D1586

## FINE-GRAINED SOILS (SILT AND CLAY)

CONSISTENCY	BPF "N"
VERY SOFT	<2
SOFT	2 - 4
MEDIUM STIFF	5 - 8
STIFF	9 - 15
VERY STIFF	16 - 30
HARD	>30

NOTE: ADDITIONAL DESIGNATIONS TO ADVANCE SAMPLER INDICATED IN BLOW COUNT COLUMN:  
WOH = WEIGHT OF HAMMER  
WOR = WEIGHT OF ROD(S)

## SAMPLE TYPE

DESIGNATION	SYMBOL
SPLIT-SPOON	S-
SHELBY TUBE	U-
ROCK CORE	R-

## WATER DESIGNATION

DESCRIPTION	SYMBOL
ENCOUNTERED DURING DRILLING	
UPON COMPLETION OF DRILLING	
24 HOURS AFTER COMPLETION	

NOTE: WATER OBSERVATIONS WERE MADE AT THE TIME INDICATED. POROSITY OF SOIL STRATA, WEATHER CONDITIONS, SITE TOPOGRAPHY, ETC. MAY CAUSE WATER LEVEL CHANGES.

# LOG OF BORING NO. LC-11








Sheet 1 of 1

PROJECT: **Little Creek Wildlife Management Area**  
 PROJECT NO.: **141191**  
 PROJECT LOCATION: **Kent County, Delaware**

WATER LEVEL (ft):  $\nabla$  **1.0**  $\nabla$  **1.0**  $\nabla$  **1.0**  
 DATE: **3/30/15** **3/30/15** **3/31/15**  
 CAVED (ft): **In Augers** **N/A** **N/A**

DATE STARTED: **3/30/15**  
 DATE COMPLETED: **3/30/15**  
 DRILLING CONTRACTOR: **Walton Corporation**  
 DRILLER: **B. Holden**  
 DRILLING METHOD: **Hollow Stem Auger**  
 SAMPLING METHOD: **Split Spoon**

WATER ENCOUNTERED DURING DRILLING (ft)  
 GROUND SURFACE ELEVATION: **2.37**  
 DATUM: **NAVD88**  
 EQUIPMENT: **CME 45C**  
 LOGGED BY: **T. Hill**  
 CHECKED BY: **M. Lester**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION		REMARKS
S-1	0.0		WH/24	WH/24	2.4	0	OL		No recovery. Auger cuttings visually classified as organic SILT.		
S-2	2.0		WH/24	WH/24					Same		
S-3	4.0	17	WH/24	WH/24		5	OL		Dark brown, wet, very soft, organic SILT, contains with abundant root fibers		
S-4	6.0	16	WH/12-4-5	4	-5.1				Same		
S-5	8.0	21	9-16-22-20	38		10	SM		Gray, wet, loose, Silty SAND Same, moist, dense, trace gravel		
S-6	13.0	19	5-9-13-11	22	-10.6	15	GP-SP		Gray, tan, wet, medium dense, Sandy GRAVEL		
S-7	18.0	22	8-6-6-6	12	-16.1	20	SP-SM		Light brown, wet, medium dense, Poorly-graded SAND with silt		
S-8	23.0	24	8-8-9-12	17	-20.6	25	GP-SP		Tan, wet, medium dense, Sandy GRAVEL		
					-22.6				Boring terminated at 25.0 feet		

NOTES: **Surveyed boring locations and ground surface elevations provided by MRA.**



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LOG OF BORING NO. LC-11

Sheet 1 of 1



# LOG OF BORING NO. LC-12

Sheet 1 of 1

PROJECT: **Little Creek Wildlife Management Area**  
 PROJECT NO.: **141191**  
 PROJECT LOCATION: **Kent County, Delaware**

WATER LEVEL (ft): **0.8** **1.0** **BOC**  
 DATE: **3/31/15** **3/31/15**  
 CAVED (ft): **In Augers** **N/A**

DATE STARTED: **3/31/15**  
 DATE COMPLETED: **3/31/15**  
 DRILLING CONTRACTOR: **Walton Corporation**  
 DRILLER: **B. Holden**  
 DRILLING METHOD: **Hollow Stem Auger**  
 SAMPLING METHOD: **Split Spoon**

WATER ENCOUNTERED DURING DRILLING (ft)  
 GROUND SURFACE ELEVATION: **2.66**  
 DATUM: **NAVD88**  
 EQUIPMENT: **CME 45C**  
 LOGGED BY: **T. Hill**  
 CHECKED BY: **M. Lester**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
S-1	0.0	1	WH/24	WH/24	2.7	0	OL		Dark brown, moist, very soft, organic SILT, trace to some root fibers	
S-2	2.0	0	WH/24	WH/24		0.7			No recovery	
S-3	4.0	0	WH/24	WH/24		5			No recovery	
S-4	6.0	6	WH/24	WH/24	-3.3		OL		Dark brown, very soft, organic SILT, trace to some root fibers	
S-5	8.0	19	2-2-2-2	4	-5.8		SM		Gray, wet, loose, Silty SAND	
S-6	13.0	18	2-2-4-7	6	-11.3		SP-SM		Gray, wet, loose, Poorly-graded SAND with Silt	
S-7	18.0	24	14-15-17-19	32		20			Same, tan, dense	
S-8	23.0	21	5-6-7-9	13	-20.3		CH		Gray, moist, stiff, Fat CLAY	
					-22.3	25			Boring terminated at 25.0 feet	

NOTES: **Surveyed boring locations and ground surface elevations provided by MRA.**



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**LOG OF BORING NO. LC-12**

Sheet 1 of 1

# LOG OF BORING NO. LC-13

Sheet 1 of 1

PROJECT: **Little Creek Wildlife Management Area**  
 PROJECT NO.: **141191**  
 PROJECT LOCATION: **Kent County, Delaware**

WATER LEVEL (ft): **1.7** **1.2** **BOC**  
 DATE: **3/31/15** **3/31/15**  
 CAVED (ft): **In Augers** **N/A**

DATE STARTED: **3/31/15**  
 DATE COMPLETED: **3/31/15**  
 DRILLING CONTRACTOR: **Walton Corporation**  
 DRILLER: **B. Holden**  
 DRILLING METHOD: **Hollow Stem Auger**  
 SAMPLING METHOD: **Split Spoon**

WATER ENCOUNTERED DURING DRILLING (ft)  
 GROUND SURFACE ELEVATION: **2.35**  
 DATUM: **NAVD88**  
 EQUIPMENT: **CME 45C**  
 LOGGED BY: **T. Hill**  
 CHECKED BY: **M. Lester**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
S-1	0.0	4	WH/24	WH/24	2.4	0	OL		Dark brown, wet, very soft, organic SILT, some root fibers	 Tube 4-6 feet 77% recovery
S-2	2.0	7	WH/24	WH/24	-1.7				Same, abundant root fibers	
U-1	4.0	23				5	OH		Dark brown, moist, Organic SILT with sand	
S-4	6.0	20	WH/24	WH/24	-4.7		SM		Dark brown, wet, very loose, Silty SAND, trace root fibers	
S-5	8.0	19	2-4-5-7	9		10			Same, gray, loose, no root fibers	
S-6	13.0	13	6-9-12-11	21	-11.7	15	SP-SM		Tan, wet, medium dense, Poorly-graded SAND with silt, some gravel	
S-7	18.0	11	7-9-8-7	17	-16.7	20	CH		Gray, moist, very stiff, Fat CLAY with Sand, mottled	
S-8	23.0	17	6-8-8-7	16	-22.7	25			Same, no mottles	
									Boring terminated at 25.0 feet	

NOTES: **Surveyed boring locations and ground surface elevations provided by MRA.**



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LOG OF BORING NO. LC-13

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# LOG OF BORING NO. LC-14








Sheet 1 of 1

PROJECT: **Little Creek Wildlife Management Area**  
 PROJECT NO.: **141191**  
 PROJECT LOCATION: **Kent County, Delaware**

WATER LEVEL (ft): **13.5** **Dry** **BOC**  
 DATE: **4/1/15** **4/1/15**  
 CAVED (ft): **In Augers** **12.0**

DATE STARTED: **4/1/15**  
 DATE COMPLETED: **4/1/15**  
 DRILLING CONTRACTOR: **Walton Corporation**  
 DRILLER: **B. Holden**  
 DRILLING METHOD: **Hollow Stem Auger**  
 SAMPLING METHOD: **Split Spoon**

WATER ENCOUNTERED DURING DRILLING (ft) **14.0**  
 GROUND SURFACE ELEVATION: **8.21**  
 DATUM: **NAVD88**  
 EQUIPMENT: **CME55 ATV**  
 LOGGED BY: **T. Hill**  
 CHECKED BY: **M. Lester**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
S-1	0.0	4	1-1-2-2	3	8.2	0	FILL		Tan and gray, moist, soft, lean clay with sand FILL, trace root fibers	
S-2	2.0	16	4-5-5-7	10			FILL		Same Brown, moist, medium stiff, sandy silt FILL, trace root fibers	
S-3	4.0	13	4-5-7-5	12		5			Same	
S-4	6.0	23	4-4-4-4	8	1.2		OH		Dark brown, moist, medium stiff, organic SILT, some root fibers	
S-5	8.0	3	3-3-2-3	5	-0.8		ML		Brown, moist, medium stiff, Sandy SILT	
						10				
S-6	13.0	17	4-4-5-7	9	-4.8		CH		Gray, very moist, medium stiff, Sandy Fat CLAY	
						15				
S-7	18.0	18	4-6-7-8	13	-9.8		SM		Gray, wet, medium dense, Silty SAND, trace roots	
						20				
S-8	23.0	11	9-11-13-16	24					Same, no root, some gravel	
					-16.8	25			Boring terminated at 25.0 feet	

NOTES: **Surveyed boring locations and ground surface elevations provided by MRA.**



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LOG OF BORING NO. LC-14

Sheet 1 of 1

# LOG OF BORING NO. LC-15





Sheet 1 of 1

PROJECT: **Little Creek Wildlife Management Area**  
 PROJECT NO.: **141191**  
 PROJECT LOCATION: **Kent County, Delaware**

WATER LEVEL (ft): **6.5** **6.4** **BOC**  
 DATE: **4/1/15** **4/1/15**  
 CAVED (ft): **In Augers** **N/A**

DATE STARTED: **4/1/15**  
 DATE COMPLETED: **4/1/15**  
 DRILLING CONTRACTOR: **Walton Corporation**  
 DRILLER: **B. Holden**  
 DRILLING METHOD: **Hollow Stem Auger**  
 SAMPLING METHOD: **Split Spoon**

WATER ENCOUNTERED DURING DRILLING (ft) **8.0**  
 GROUND SURFACE ELEVATION: **7.84**  
 DATUM: **NAVD88**  
 EQUIPMENT: **CME55 ATV**  
 LOGGED BY: **T. Hill**  
 CHECKED BY: **M. Lester**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL		
									DESCRIPTION	REMARKS
					7.8	0	FILL		Dark brown, moist, soft, organic silt FILL with root fibers	
S-1	0.0	4	1-1-2-1	3					Gray, moist, medium stiff, silt with sand FILL, some roots	
S-2	2.0	12	3-3-3-4	6					Same, soft	
S-3	4.0	2	1-1-1-1	2		5				
S-4	6.0	9	2-2-2-2	4	1.8		OL		Dark brown, wet, soft, organic SILT, trace root fibers	▼
S-5	8.0	20	1-2-2-3	4					Same	▼
						10				
					-5.2		CL		Gray, moist, stiff, Sandy Lean CLAY, some mottling	
S-6	13.0	19	3-6-9-13	15		15				
S-7	18.0	22	2-2-2-2	4		20			Same, wet, soft, no mottling	
					-15.2		GM-SM		Dark gray, wet, medium dense, Sandy GRAVEL with Silt	
S-8	23.0	16	4-6-9-11	15						
					-17.2	25			Boring terminated at 25.0 feet	

NOTES: **Surveyed boring locations and ground surface elevations provided by MRA.**



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LOG OF BORING NO. LC-15

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# LOG OF BORING NO. LC-16





Sheet 1 of 2

PROJECT: **Little Creek Wildlife Management Area**  
 PROJECT NO.: **141191**  
 PROJECT LOCATION: **Kent County, Delaware**

WATER LEVEL (ft): **7.5** **Dry** **BOC**  
 DATE: **4/1/15** **4/1/15**  
 CAVED (ft): **In Augers** **7.0**

DATE STARTED: **4/1/15**  
 DATE COMPLETED: **4/1/15**  
 DRILLING CONTRACTOR: **Walton Corporation**  
 DRILLER: **B. Holden**  
 DRILLING METHOD: **Hollow Stem Auger**  
 SAMPLING METHOD: **Split Spoon**

WATER ENCOUNTERED DURING DRILLING (ft) **1.5**  
 GROUND SURFACE ELEVATION: **6.48**  
 DATUM: **NAVD88**  
 EQUIPMENT: **CME55 ATV**  
 LOGGED BY: **T. Hill**  
 CHECKED BY: **M. Lester**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
S-1	0.0	13	3-3-3-3	6	6.5	0	FILL		Gray, moist, medium stiff, silt with sand FILL, trace root fibers	
S-2	2.0	17	2-3-3-4	6					Gray, moist, medium stiff, lean clay with sand FILL, trace root fibers	
S-3	4.0	2	2-2-2-2	4		5			Same, soft, abundant root fibers	
S-4	6.0	16	2-2-3-4	5	0.5		OH		Dark brown, moist, medium stiff, organic SILT, trace root fibers	
S-5	8.0	21	1-1-1-1	2		10			Dark brown, wet, very soft, organic SILT with sand, some root fibers	
S-6	13.0	19	WH/24	WH/24	-6.5		OH/OL		Dark brown, moist, very soft, organic CLAY with root fibers	
S-7	18.0	23	WH/24	WH/24	-12.0		CH		Gray, wet, very soft, Fat CLAY	
S-8	23.0	24	WH/24	WH/24		25			Same	
S-9	28.0	24	WH/24	WH/24					Same, abundant root fibers	

NOTES: **Surveyed boring locations and ground surface elevations provided by MRA.**



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LOG OF BORING NO. LC-16



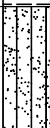

Sheet 1 of 2

# LOG OF BORING NO. LC-16

Sheet 2 of 2

PROJECT: **Little Creek Wildlife Management Area**  
 PROJECT NO.: **141191**  
 PROJECT LOCATION: **Kent County, Delaware**

WATER LEVEL (ft): **7.5** **Dry** **BOC**  
 DATE: **4/1/15** **4/1/15**  
 CAVED (ft): **In Augers** **7.0**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL		
									DESCRIPTION	REMARKS
						30			Same, trace root fibers	
S-10	33.0	24	WH/18-1	WH/18		35				
S-11	38.0	24	WH/18-1	1	-31.5		OL		Dark brown, wet, very soft, organic SILT with root fibers (peat)	
S-12					-33.0	40	SM		Dark brown, wet, loose, Silty SAND	
S-13	43.0		9-10-10-11	20	-36.5		SP/ GP		Gray, wet, medium dense, Poorly-graded SAND with gravel	
					-38.5	45			Boring terminated at 45.0 feet	
						50				
						55				
						60				
						65				



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LOG OF BORING NO. LC-16

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# LOG OF BORING NO. LC-17







Sheet 1 of 2

PROJECT: **Little Creek Wildlife Management Area**  
 PROJECT NO.: **141191**  
 PROJECT LOCATION: **Kent County, Delaware**

WATER LEVEL (ft): **12.5** **Dry** **BOC**  
 DATE: **4/2/15** **4/2/15**  
 CAVED (ft): **In Augers** **8.0**

DATE STARTED: **4/2/15**  
 DATE COMPLETED: **4/2/15**  
 DRILLING CONTRACTOR: **Walton Corporation**  
 DRILLER: **B. Holden**  
 DRILLING METHOD: **Hollow Stem Auger**  
 SAMPLING METHOD: **Split Spoon**

WATER ENCOUNTERED DURING DRILLING (ft) **18.0**  
 GROUND SURFACE ELEVATION: **6.50**  
 DATUM: **NAVD88**  
 EQUIPMENT: **CME55 ATV**  
 LOGGED BY: **T. Hill**  
 CHECKED BY: **M. Lester**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
S-1	0.0	3	1-1-1-1	2	6.5	0	FILL		Brown, moist, soft, sandy silt FILL, trace organic material	
S-2	2.0	14	2-2-3-3	5					Same, dark brown, medium stiff	
S-3	4.0	5	2-2-1-2	3	2.5	5	CL		Brown and gray, moist, soft, Lean CLAY, trace organic material	
S-4	6.0	16	2-2-2-2	4	0.5		OH		Dark brown, moist, soft, organic CLAY, some to abundant root fibers	
S-5	8.0	14	2-1-2-1	3					Same	
						10				
S-6	13.0	1	1-1-1-1	2	-6.5		CH		Gray, moist, soft, Sandy CLAY, trace organic material	
						15				
S-7	18.0	17	1-1-1-1	2					Gray, wet, soft, Fat CLAY with sand	
						20				
U-1	21.0	24			-14.5		ML		Black/Dark brown, wet, Organic SILT, some root fibers	Tube 21-23 feet 100% recovery
S-8	23.0	11	1-2-2-2	4					Same, soft	
						25				
S-9	28.0	11	1-2-2-3	4	-21.5		MH		Gray, wet, soft, Elastic SILT with sand	

NOTES: **Surveyed boring locations and ground surface elevations provided by MRA.**



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LOG OF BORING NO. LC-17

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# LOG OF BORING NO. LC-17

Sheet 2 of 2

PROJECT: **Little Creek Wildlife Management Area**  
 PROJECT NO.: **141191**  
 PROJECT LOCATION: **Kent County, Delaware**

WATER LEVEL (ft): **12.5** **Dry** **BOC**  
 DATE: **4/2/15** **4/2/15**  
 CAVED (ft): **In Augers** **8.0**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL		
									DESCRIPTION	REMARKS
						30				
S-10	33.0	22	6-9-8-9	17	-26.5		SW		Gray, wet, medium dense, Well-graded SAND	
					-28.5	35			Boring terminated at 35.0 feet.	
						40				
						45				
						50				
						55				
						60				
						65				



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**LOG OF BORING NO. LC-17**

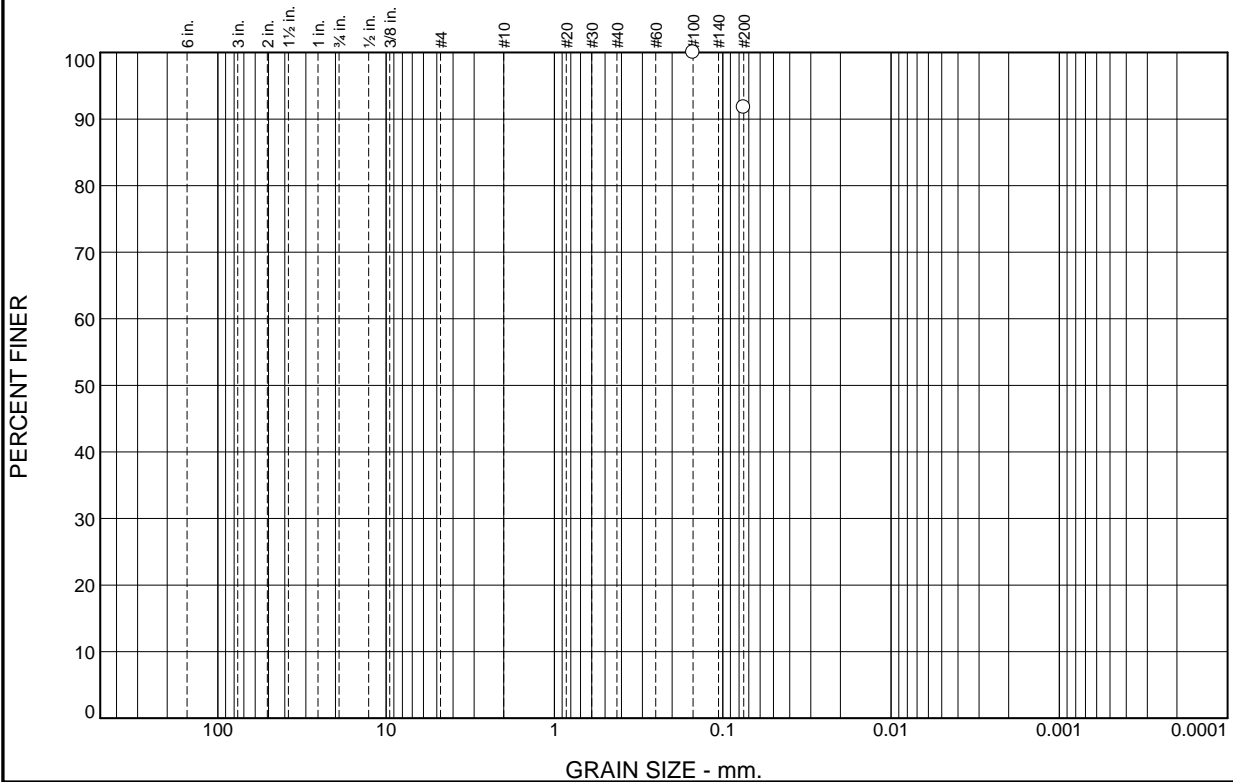
Sheet 2 of 2



# APPENDIX C

ASTM Specifications performed may include D421, D422, D2216, D2217 and D4318.

# Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.0	8.2	91.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#100	100.0		
#200	91.8		

\* (no specification provided)

**Soil Description**  
Dark brown, moist, Organic SILT, contains organic material

**Atterberg Limits**  
PL= 59 LL= 99 PI= 40 NM= 225.2

**Coefficients**  
D<sub>90</sub>= D<sub>85</sub>= D<sub>60</sub>=  
D<sub>50</sub>= D<sub>30</sub>= D<sub>15</sub>=  
D<sub>10</sub>= C<sub>u</sub>= C<sub>c</sub>=

**Classification**  
USCS= OH AASHTO= A-7-5(51)

**Remarks**  
Organic Content = 27.5%

Source of Sample: LC-14 Depth: 7.0

Date: 4/6/2015



**GEO-TECHNOLOGY ASSOCIATES, INC.**  
18 Boulden Circle, Suite 36  
New Castle, DE 19720

**Client:** Moffatt & Nichol  
**Project:** Little Creek Wildlife Management Area

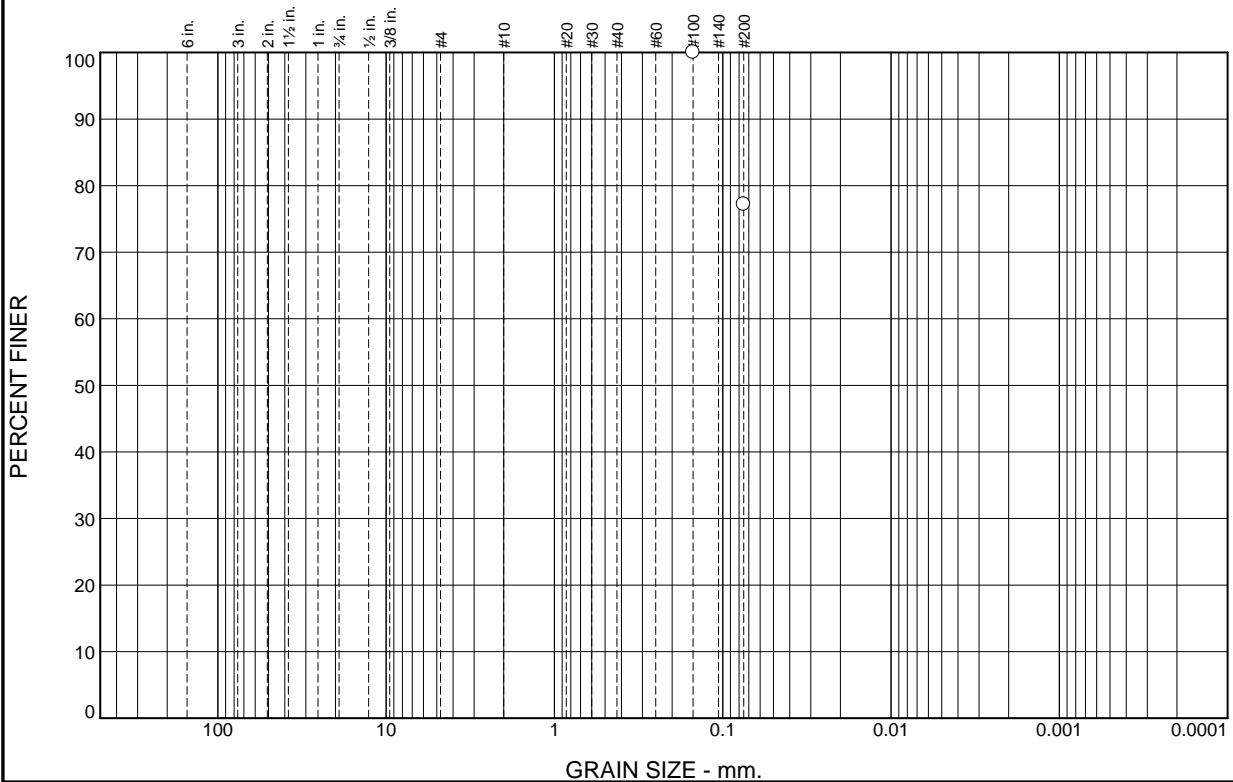
**Project No:** 141191

**Figure** 4

**Tested By:** K. Kershaw **Checked By:** M. Lester

ASTM Specifications performed may include D421, D422, D2216, D2217 and D4318.

# Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.0	22.8		77.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#100	100.0		
#200	77.2		

\* (no specification provided)

## Soil Description

Dark brown, wet, Organic SILT with Sand

## Atterberg Limits

PL= 44 LL= 87 PI= 43 NM= 119.1

## Coefficients

D<sub>90</sub>= 0.1107 D<sub>85</sub>= 0.0951 D<sub>60</sub>=  
D<sub>50</sub>= D<sub>30</sub>= D<sub>15</sub>=  
D<sub>10</sub>= C<sub>u</sub>= C<sub>c</sub>=

## Classification

USCS= OH AASHTO= A-7-5(39)

## Remarks

Organic Content = 12.13

Source of Sample: LC-16 Depth: 8.0  
Sample Number: S-5

Date: 4/6/2015



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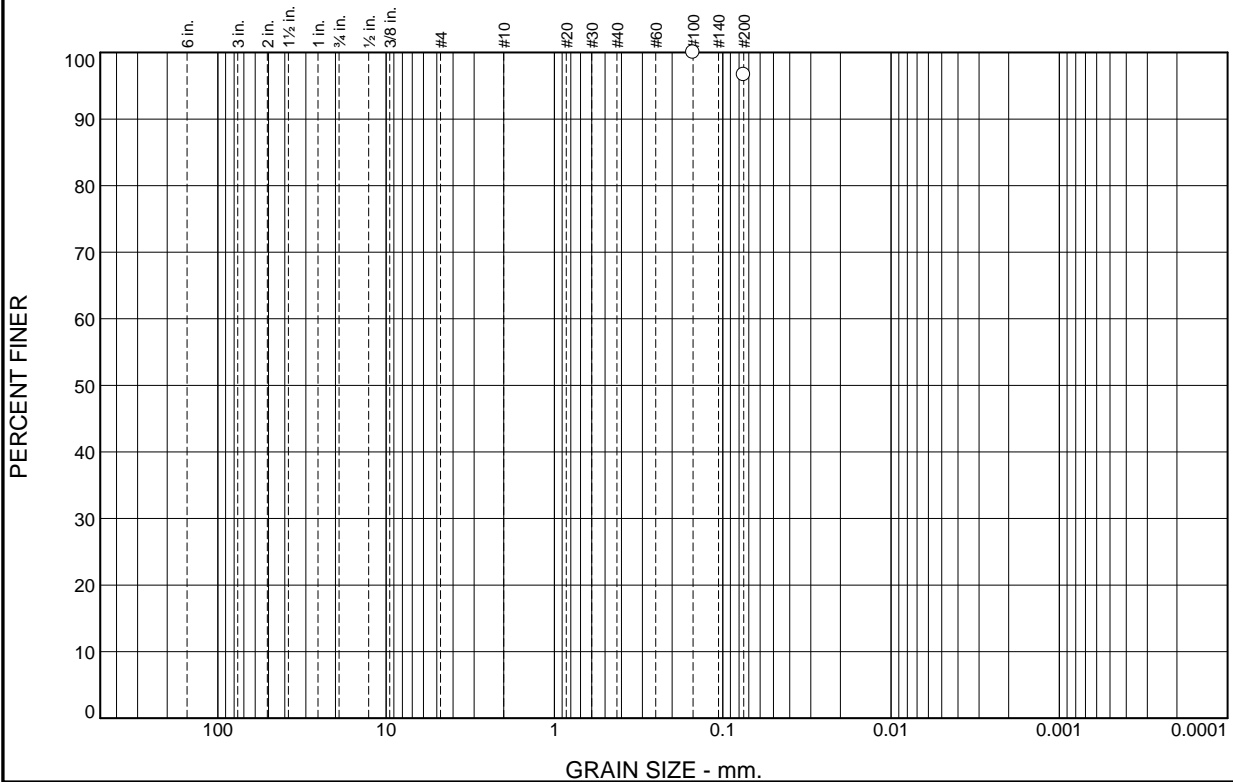
Project No: 141191

Figure 5

Tested By: K. Kershaw Checked By: M. Lester

ASTM Specifications performed may include D421, D422, D2216, D2217 and D4318.

# Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.0	3.3	96.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#100	100.0		
#200	96.7		

\* (no specification provided)

**Soil Description**  
Black/Dark brown, wet, Organic SILT

**Atterberg Limits**  
PL= NP    LL= NP    PI= NP    NM= 376.9

**Coefficients**  
D<sub>90</sub>=    D<sub>85</sub>=    D<sub>60</sub>=  
D<sub>50</sub>=    D<sub>30</sub>=    D<sub>15</sub>=  
D<sub>10</sub>=    C<sub>u</sub>=    C<sub>c</sub>=

**Classification**  
USCS= ML    AASHTO= A-4(0)

**Remarks**  
Organic Content = 42.55

Source of Sample: LC-17    Depth: 21.0  
Sample Number: U-1

Date: 4/15/2015



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New Castle, DE 19720

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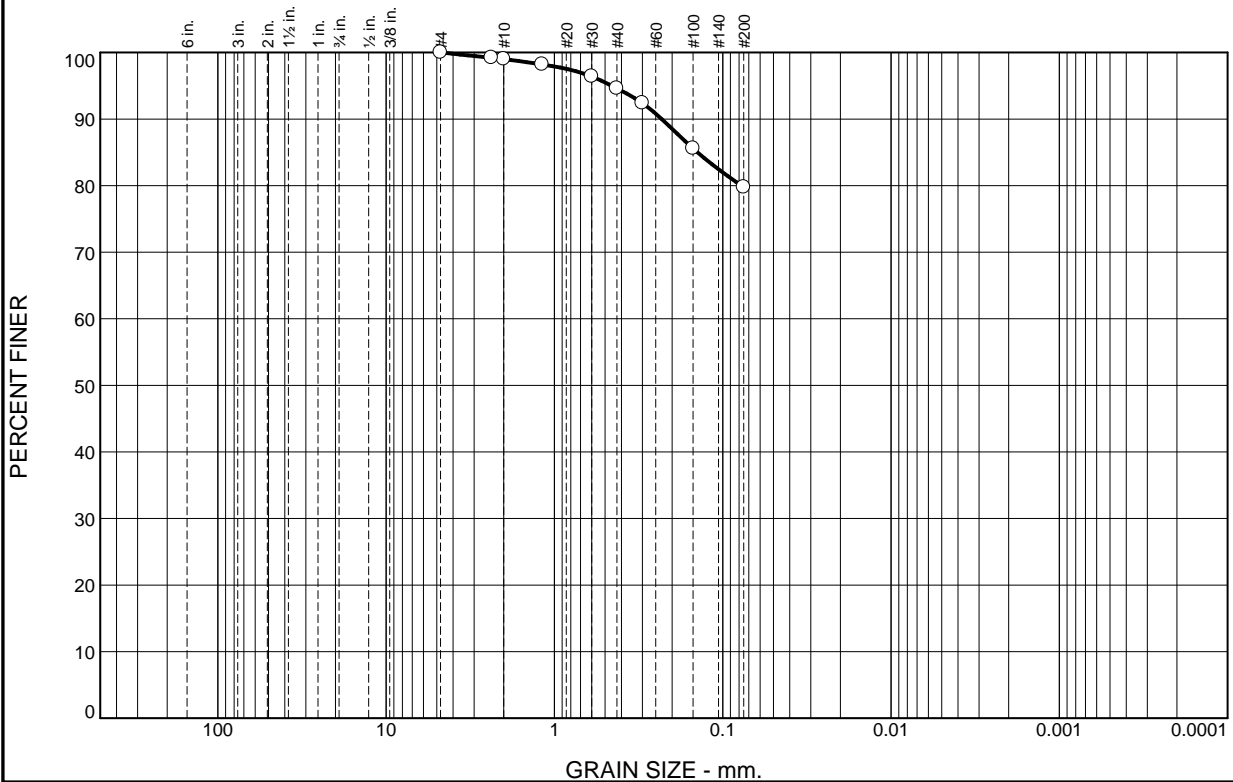
**Project No:** 141191

**Figure** 6

Tested By: J. Day    Checked By: M. Lester

ASTM Specifications performed may include D421, D422, D2216, D2217 and D4318.

# Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	1.0	4.4	14.8	79.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.2		
#10	99.0		
#16	98.2		
#30	96.4		
#40	94.6		
#50	92.4		
#100	85.6		
#200	79.8		

\* (no specification provided)

## Soil Description

Dark brown, moist, Organic SILT with sand

## Atterberg Limits

PL= 63 LL= 124 PI= 61 NM= 209.6

## Coefficients

D<sub>90</sub>= 0.2304 D<sub>85</sub>= 0.1414 D<sub>60</sub>=  
D<sub>50</sub>= D<sub>30</sub>= D<sub>15</sub>=  
D<sub>10</sub>= C<sub>u</sub>= C<sub>c</sub>=

## Classification

USCS= OH AASHTO= A-7-5(61)

## Remarks

Pushed tube 4-6 feet 77% recovery  
Organic Content = 17.4%  
Dry Unit Weight = 24.3 pcf

Source of Sample: LC-13 Depth: 4.0  
Sample Number: U-1

Date: 4/15/2015



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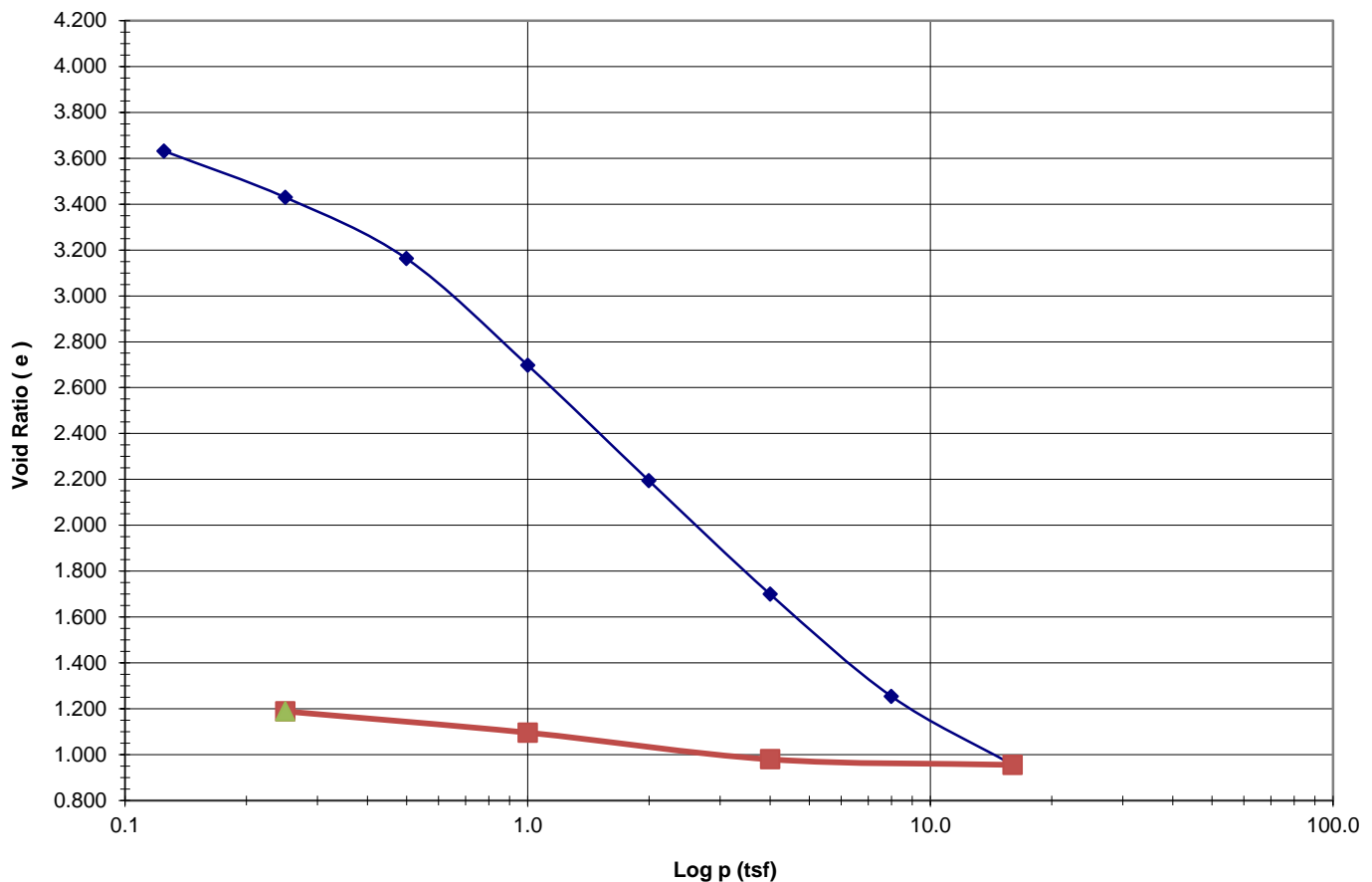
Project No: 141191

Figure 3

Tested By: J. Day

Checked By: M. Lester

e vs log p



Test	Load	Cv		Test	Load	Cv		Test	Load	Cv	
1	0.5 TSF	0.02									
2	1.0 TSF	0.02									
3	2.0 TSF	0.01									
Specimen Identification				Classification (USCS)	Dry Density (pcf)		Natural Moisture	LL (%)	PI (%)		
LC-13, U-1, 4 - 6 ft				OH	24.3		209.6%	124	61		

Remarks: Test performed in general accordance with ASTM D2345. Cv values in feet squared per day.  
 Maximum past pressure = 1100 psf  
 Cc = 1.66



Geo-Technology Associates, Inc.  
 18 Boulden Circle, Suite 36  
 New Castle, Delaware 19720  
 Telephone: (302) 326-2100  
 Fax: (302) 326-2399

### CONSOLIDATION TEST REPORT

Project: Little Creek Old Levee

Client: Moffatt & Nichol

Number: 141191