Specifications for this project are arranged in accordance with the Construction Specification Institute numbering system and format. Section numbering is discontinuous and all numbers not appearing in the Table of Contents are not used for this Project.

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PEA PATCH ISLAND IMPROVEMENTS
FORT DELAWARE STATE PARK
DELAWARE RIVER NEAR DEALWARE CITY, DE
DIVISION OF PARKS AND RECREATION CONTRACT No. 2019-FD-100

BID FORM

For Bids Due: ***November 14, 2019 at 1:00 PM*** To: Dept. of Natural Resources and Environmental Control
Division of Parks and Recreation
Office of Design and Development
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 Number: ( ) _____ _____ **Fax Number: ( ) _____ _____**

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 itemized below:

$ _____

($)

Allowance 1 - Driving Surface Aggregate: 6 CY x Unit Price $_____/Unit of Measure = $_____Amount.

Allowance 2 – Organic Lock Pathway Aggregate: 6 CY x Unit Price $_____/Unit of Measure = $_____Amount.

Allowance 3 – Graded AASHTO No. 57 Aggregate Base: 6 CY x Unit Price $ /Unit of Measure = $_____Amount.

Total Bid: $ _____

($)

PEA PATCH ISLAND IMPROVEMENTS
FORT DELAWARE STATE PARK
DELAWARE RIVER NEAR DEALWARE CITY, DE
DIVISION OF PARKS AND RECREATION CONTRACT No. 2019-FD-100

BID FORM

ALTERNATES

Alternate prices conform to applicable project specification section. Refer to specifications for a complete description of the following Alternates. An "ADD" or "DEDUCT" amount is indicated by the crossed out part that does not apply.

ALTERNATE No. 1: Add the maintenance building in its entirety.

Add/Deduct: _____
($)
No. of Days to Complete Alternate 1: _____

ALTERNATE No. 2: Add the three seasons pavilion in its entirety.

Add/Deduct: _____
($)
No. of Days to Complete Alternate 2: _____

ALTERNATE No. 3: Add Helical Pile Static Load Testing.

Add/Deduct: _____
($)
No. of Days to Complete Alternate 3: _____

ALTERNATE No. 4: Alternative Pavilion Foundation Design.

Add/Deduct: _____
($)
No. of Days to Complete Alternate 4: _____

ALTERNATE No. 5: Alternative Maintenance Building Foundation Design.

Add/Deduct: _____
($)
No. of Days to Complete Alternate 4: _____

PEA PATCH ISLAND IMPROVEMENTS
FORT DELAWARE STATE PARK
DELAWARE RIVER NEAR DEALWARE CITY, DE
DIVISION OF PARKS AND RECREATION CONTRACT No. 2019-FD-100

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:

		DEDUCT	ADD
UNIT PRICE No. 1:	Helical Screw Foundation (EA)	$ _____	$ _____
UNIT PRICE No. 2	Borrow, Type F (CY)	$ _____	$ _____
UNIT PRICE No. 3	Disposal of Excess Material off Island (CY)	$ _____	$ _____
UNIT PRICE No. 4	Driving Surface Aggregate (CY)	$ _____	$ _____
UNIT PRICE No. 5	Open Graded Stone AASHTO 57 (CY)	$ _____	$ _____
UNIT PRICE No. 6	Organic Lock Pathway Aggregate (CY)	$ _____	$ _____
UNIT PRICE No. 7	Barracks Path 6-feet wide by 100-feet long	$ _____	$ _____
UNIT PRICE No. 8	***Heronry Path 8-feet wide by 100-feet long***		

PEA PATCH ISLAND IMPROVEMENTS
FORT DELAWARE STATE PARK
DELAWARE RIVER NEAR DEALWARE CITY, DE
DIVISION OF PARKS AND RECREATION CONTRACT No. 2019-FD-100

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, 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: _____
(Authorized Signature)

(Seal)

_____
(Title)

ATACHMENTS Date: _____

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

PEA PATCH ISLAND IMPROVEMENTS
FORT DELAWARE STATE PARK
DELAWARE RIVER NEAR DEALWARE CITY, DE
DIVISION OF PARKS AND RECREATION CONTRACT No. 2019-FD-100

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 *Owner*, **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.

	Subcontractor Category	Subcontractor	Address (City & State)	Subcontractors tax payer ID # or Delaware Business license #
1.	Sitework			
2.	Helical Piles			
3.	Concrete			
4.	Pre-engineered Pole Building System			
5.	Water Transportation			
6.	Boardwalk & Heronry Observation			

PEA PATCH ISLAND IMPROVEMENTS
FORT DELAWARE STATE PARK
DELAWARE RIVER NEAR DEALWARE CITY, DE
DIVISION OF PARKS AND RECREATION CONTRACT No. 2019-FD-100

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 to the Office of Design and Development, Division of Parks and Recreation, DNREC.

All the terms and conditions of the Pea Patch Island Improvements 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 _____ of 20_____.

My commission expires _____. NOTARY PULIC _____

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

PEA PATCH ISLAND IMPROVEMENTS
FORT DELAWARE STATE PARK
DELAWARE RIVER NEAR DEALWARE CITY, DE
DIVISION OF PARKS AND RECREATION CONTRACT No. 2019-FD-100

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, including subcontractors 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.

SECTION 31 10 00 - SITE CLEARING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Removing existing trees, shrubs, groundcover, plants, and grass.
2. Clearing and grubbing.
3. Stripping and stockpiling topsoil.
4. Removing above- and below-grade site improvements.
5. Disconnecting, capping or sealing, and abandoning site utilities in place removing site utilities.
6. Temporary erosion and sedimentation control measures.

B. Related Sections include the following:

1. Division 31 Section "Earthwork" for soil materials, excavating, backfilling, and site grading.

1.3 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS (NOT USED)

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without written permission from the DNREC.
2. Provide alternate routes around closed or obstructed traffic ways.

B. Utility Locator Service: Notify Miss Utility a minimum of 3 days prior to performing any land disturbing activities. Contact Miss Utility of Delmarva 1-800-282-8555

C. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS (Not Applicable)

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 2 Section "Earthwork."

1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TREE PROTECTION

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.

1. Do not store construction materials, debris, or excavated material within fenced area.

2. Do not permit vehicles, equipment, or foot traffic within fenced area.
3. Maintain fenced area free of weeds and trash.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

1. Cover exposed roots with burlap and water regularly.
2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
3. Coat cut faces of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
4. Backfill with soil as soon as possible.

D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

1. Replace trees that cannot be repaired and restored to full-growth status, as determined by Architect.

3.3 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Arrange with utility companies to shut off indicated utilities.
2. Owner will arrange to shut off indicated utilities when requested by Contractor.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify the Owner not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without the DNREC's written permission.

C. Excavate for and remove underground utilities indicated to be removed.

D. Removal of underground utilities is included in Division 2 Sections covering site utilities.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.

3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 24 inches below exposed subgrade.
4. Use only hand methods for grubbing within tree protection zone.
5. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

A. Remove grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and non-soil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Do not stockpile topsoil within tree protection zones.
2. Dispose of excess topsoil as specified for waste material disposal.
3. Stockpile surplus topsoil to allow for re-spreading deeper topsoil.

3.6 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.7 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

1. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 31 10 00

SECTION 31 20 00 – EARTHWORK SITE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for pavements, walkways, and pads.
2. Excavating and backfilling for retaining walls and structures.
3. Subbase course for concrete walks.
4. Subbase course for asphalt paving.
5. Subsurface drainage backfill for walls and trenches.
6. Excavating and backfilling for utility trenches.
7. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.

B. Related Sections include the following:
1. Division 31 Section *Site Clearing* for, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
2. Division 32 Section *Erosion and Sediment Control*, for temporary erosion and sediment control.
3. Division 32 Section *Lawns and Grasses* for finish grading, including preparing and placing topsoil and planting soil for lawns.

1.03 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation, including the backfill of retaining walls, footings and foundations.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Course placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill. See section 2.1 for the requirements of borrow soil.

E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by an independent geotechnical testing agency, according to ASTM D 1586.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.04 SUBMITTALS

A. Comply with Division 1 Section *Submittal Procedures*.

B. For Approval

1. Product Data: For the following:
   a. Geotextile support fabric.
   b. Geotextile filter fabric.

C. For Information:
1. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
   a. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.
   b. Laboratory compaction curve according to ASTM D 698 for each on-site and borrow soil material proposed for fill and backfill.

1.05 PROJECT/ SITE CONDITIONS

A. Test borings and other exploratory operations may be made by the Contractor at no cost to the Owner.

B. Existing Utilities: Locate existing underground utilities by hand excavation in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.

1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner. Do not break utility connections without providing temporary services, as acceptable to Engineer.
2. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, during occupied hours, except when permitted in writing by Engineer and then only after acceptable temporary utility services have been provided.
    a. Provide, to Architect, a minimum of 48 hour notice to proceed before interrupting any utility.
3. Demolish and completely remove from site any existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

C. Use of Explosives: The use of explosives is not permitted.

D. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.

1. Operate warning lights as recommended by authorities having jurisdiction.
2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

1.06 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable regulatory requirements of municipality and utility companies.

B. Under pavements, prepared subgrade must be proof rolled to a visually firm and stable condition and to a minimum of 95 percent maximum dry density as determined by a standard proctor test (ASTM: D698) with a minimum 10-ton smooth-wheeled roller in presence of a qualified Geotechnical Engineer or Technician prior to the placing of any base material.

C. A qualified Geotechnical Engineer or Technician, paid for by the Owner, shall monitor all site preparing, grading, and fill construction. The Engineer/Technician should observe and document the site preparation, existing fill material removal, and fill/backfill construction work, and make appropriate field tests, as necessary, to verify that acceptable fill materials are being used and that construction is being performed in accordance with applicable plans, specifications and acceptable construction practices.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations. **Note: No warranty is made regarding the amount of on site soils material suitable for use as fill or backfill of any kind.**

B. Satisfactory Soils: Satisfactory soils for use as fill are defined below:

1. Structural fill, Fill under building slabs on grade and foundations, drives and parking, and behind retaining walls (where applicable): Where available, on site soil materials may be used where these on site soils conform to the requirements of the Delaware Department of Transportation Type G – Select borrow. Where sufficient on site soils materials are not available, off site borrow conforming to the requirements of the Delaware Department of Transportation Type G – select borrow shall be provided.

2. Fill under walkways: Where available, on site soil materials may be used where these on site soils conform to the requirements of the Delaware Department of Transportation Type C – select borrow. When sufficient on-site soils materials are not available, off site borrow conforming to the requirements of the Delaware Department of Transportation Type C – select borrow shall be provided.

3. Fill under unimproved, grass or landscape areas: Any on site soil material free of organic material and rocks or clumps larger than 2 inches.

C. Backfill:

1. Backfill for all utility trenches under asphalt, walkway areas: may be on site material where these on site soils conform to the requirements of the Delaware Department of Transportation Type C – Select borrow. When sufficient on-site soils materials are not available, off site borrow conforming to the requirements of the Delaware Department of Transportation Type C – select borrow shall be provided.

2. Backfill for all utility trenches under unimproved, grass areas: Any on site soil material free of organic material and rocks or clumps larger than 2 inches.

D. Fill: All fill shall be comprised of satisfactory soil material as defined above, section 2.01.B.

E. Subbase: Shall be Delaware Department of Transportation Type A CR-1 graded aggregate, DelDOT specification section 821.03.

F. Bedding: Shall be Delaware Dept. of Transportation #57 stone.

G. Drainage Fill Course: Shall be Delaware Dept. of Transportation #57 stone.

2.02 GEOTEXTILES

A. Geotextile Filter Fabric: Nonwoven geotextile, specifically manufactured as a drainage and separation geotextile; made from polypropylene staple fibers; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: 120 lb; ASTM D 4632
2. Tear Strength: 60 lb; ASTM D4533
3. Puncture Resistance: 70 lb: ASTM D 4833.
4. Water Flow Rate: 135 gpm per sq. ft.: ASTM D 4491
5. Apparent Opening Size: No. 70: ASTM D 4751

B. Geotextile Support Fabric: Woven geotextiles, specifically manufactured for use as a support and separation geotextiles, comprised of UV stabilized polypropylene slit film; and with the following minimum properties according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: 315 lb; ASTM D 4632.
2. Tear Strength: 120 lb; ASTM D 4533.
3. Puncture Resistance: 120 lb: ASTM D 4833.
4. Apparent Opening Size: No. 40; ASTM D 4751.

2.03 GEOGRID REINFORCEMENT

A. For use in unsuitable soil areas, as directed by the Architect, shall be an integrally formed grid structure manufactured of a stress resistant polypropylene material. The geogrid shall accept applied force in use by positive mechanical interlock with compacted soil or construction fill materials. The geogrid shall possess sufficient flexural stiffness to enable efficient installation over weak or wet in situ soils and shall possess complete continuity of its properties throughout its structure. Geogrid soil reinforcement shall be Tensar BX1100 geogrid, or approved equal.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 2 Section "Site Clearing."

C. Protect and maintain erosion and sedimentation controls, which are specified in Division 2 Section "Site Clearing," during earthwork operations.

D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.02 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area. The bidder is responsible for

complete dewatering for all site work including stormwater management and erosion control facilities. All dewatering methods must be approved by DNREC and must be per the DNREC ESC Handbook, latest revision effective July 1, 2005. The bidder should thoroughly familiarize themselves with existing on-site soils and groundwater conditions and review the Geotechnical Report.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.03 EXPLOSIVES

A. Explosives: Do not use explosives.

3.04 SITE STRIPPING AND PREPARATION IN STRUCTURAL AREAS

A. At the start of construction all existing topsoil, roots, asphalt and existing fill material should be stripped and removed in their entirety from the proposed building, parking, and drive areas extending to a minimum lateral distance of 10' beyond outer edge of paved areas and 15' beyond outside edge of building footings. Any existing fill material that may be encountered in previously disturbed areas (e.g., utility trenches), as well as any existing utility lines, should also be removed in their entirety from the building area.

B. After completing removal of the above, and upon reaching grade (in cut areas) and/or subgrade (in fill areas), the entire area should be proof-rolled with a minimum 10-ton smooth-wheeled roller or other approved equipment. The purpose of the proof-rolling is to densify the exposed grade/subgrade areas, which have been loosened or disturbed during the stripping/grading operation. In addition, the proof-rolling will expose any localized soft areas not encountered during the test boring program. In subgrade areas to receive structural fill, the exposed subgrade areas should be compacted to a visually firm and stable condition; compacted subgrade must be inspected and approved by the Geotechnical Engineer. This subgrade compaction effort will enable any structural fill to be placed and compacted at the required densities. Any localized soft and/or excessively wet subgrade areas encountered during this program, which cannot be adequately stabilized by drying and compacting, should be undercut and replaced with properly compacted structural fill (DelDOT Type G) or other suitable materials as directed by Geotechnical Engineer.

3.05 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.06 EXCAVATION FOR RETAINING WALLS AND OTHER STRUCTURES (if applicable)

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

3.07 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.08 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate trenches deeper than bottom of pipe elevation to allow for bedding course (bedding course thickness and material shall be as specified on the drawings and/or specs and as recommended by manufacturer). Hand excavate for bell of pipe.

3.09 SUBGRADE INSPECTION

A. Notify Architect/Geotechnical Engineer when excavations have reached required subgrade.

B. If Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below pavements, walkways and structures with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated, or frozen subgrades.

1. Completely proof-roll subgrade in one direction.
2. Proof-roll with a minimum 10-ton vibratory roller or a fully loaded tandem dump truck in the presence of a qualified soils technician.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Geotechnical Engineer, and replace with compacted backfill or fill as directed.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, dust/drought conditions, or construction activities, as directed by Geotechnical Engineer.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, foundations and retaining walls.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Place and compact initial backfill, material as defined in section 2.01.C to a height of 12 inches over the utility pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

D. Place and compact final backfill of material specified in section 2.01.C to final subgrade elevation.

3.13 STRUCTURAL LOAD BEARING FILL/BACKFILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. The load bearing fill material should be placed in horizontal thin lifts with a loose thickness no greater than 8 inches. For top 1-foot of pavement subgrade, each thin lift of fill material should be compacted to 98% maximum dry density, as determined by the Standard Proctor Test (ASTM D-698). For fills below 1 foot of pavement subgrade and for structural fill below building slab and footings/foundations, each thin lift of fill material should be compacted to 95% maximum dry density, as determined by the Standard Proctor Test (ASTM D-698).

Structural fill placement, as defined above, shall extend to a minimum lateral distance of 10' beyond outer edge of paved areas and 15' beyond outside edge of building footings.

C. Place soil material on subgrades free of mud, frost, snow, ice, or other deleterious materials.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs, steps, and fills below 1-foot of pavement subgrade, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. For top 1-foot of pavement subgrade, each thin lift of fill material should be compacted to 98% maximum dry density.
3. Under walkways, scarify and recompact top 6 inches (below subgrade and compact each layer of backfill or fill soil material at 95 percent.
4. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
5. For utility trenches, compact each layer of backfill soil material at 95 percent.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

3.17 SUBBASE AND BASE COURSES

A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase and base course under pavements, courts, and walks as follows:

1. Where shown on the plans, install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Shape subbase course to required crown elevations and cross-slope grades.
3. Place subbase course 6 inches or less in compacted thickness in a single layer.
4. Place subbase course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
5. Compact subbase course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.18 FIELD QUALITY CONTROL

A. Testing Agency: Owner shall engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work complies with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved Areas and Areas beneath athletic courts: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than 3 tests.
2. Structural Fill and Backfill: At each compacted backfill layer, at least 1 test for each 2000 square feet, but no fewer than 2 tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet or less of trench length, but no fewer than 2 tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.19 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.20 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 31 20 00

SECTION 31 23 19 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes construction dewatering.

B. Related Sections:

1. Division 01 Section "Construction Progress Documentation" for recording preexisting conditions and dewatering system progress.
2. Division 31 Section "Earth Moving" for excavating, backfilling, site grading, and for site utilities.
3. Division 31 Section "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
4. Division 33 Section "Subdrainage" for permanent foundation wall, underfloor, and footing drainage.

1.3 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

1. Delegated Design: Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
3. Prevent surface water from entering excavations by grading, dikes, or other means.
4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
5. Remove dewatering system when no longer required for construction.

1.4 SUBMITTALS

A. Shop Drawings: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.

1. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
2. Include a written plan for dewatering operations including control procedures to be adopted if dewatering problems arise.

B. Delegated-Design Submittal: For dewatering system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Qualification Data: For qualified Installer, land surveyor, and professional engineer.

D. Field quality-control reports.

E. Other Informational Submittals:

1. Photographs: Show existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by dewatering operations.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer that has specialized in design of dewatering systems and dewatering work.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to dewatering including, but not limited to, the following:

a. Inspection and discussion of condition of site to be dewatered including coordination with temporary erosion control measures and temporary controls and protections.
b. Geotechnical report.
c. Proposed site clearing and excavations.
d. Existing utilities and subsurface conditions.
e. Coordination for interruption, shutoff, capping, and continuation of utility services.
f. Construction schedule. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
g. Testing and monitoring of dewatering system.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Architect no fewer than (2) days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Architect's and Owner's written permission.

B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for dewatering.
2. The geotechnical report is referenced elsewhere in the Project Manual.

C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Provide temporary grading to facilitate dewatering and control of surface water.

D. Monitor dewatering systems continuously.

E. Promptly repair damages to adjacent facilities caused by dewatering.

F. Protect and maintain temporary erosion and sedimentation controls, which are specified in Division 01 Section "Temporary Facilities and Controls" Division 31 Section "Site Clearing" during dewatering operations.

3.2 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

1. Space well points or wells at intervals required to provide sufficient dewatering.
2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.

D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.

1. Maintain piezometric water level to the minimum DNREC required depth below surface of excavation.

E. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

F. Provide standby equipment on site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering

requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.

1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

3.3 FIELD QUALITY CONTROL

A. Observation Wells: Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers indicated; additional observation wells may be required by authorities having jurisdiction.

1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

B. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

END OF SECTION 31 23 19

SECTION 32 12 16 – TRAMWAY PAVING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

1.02 SECTION INCLUDES

A. Refer to Scope Information Sheets for this contract bound in the Project Manual under Section 01010, SUMMARY OF WORK. The Scope Information Sheets describe generally the work included in each contract, but the work is not necessarily limited to that described.

B. Provisions for Driving Surface Aggregate (DSA), a mixture of crushed stone developed specifically as a surface wearing course for unpaved roads.

C. Proof rolling of prepared subbase.

D. Contractor shall coordinate all construction documents; where conflicts arise between these specifications and the design drawings, the more stringent shall apply. The Contractor is advised to contact Owner with any questions prior to resolving any conflicts, or modifying any of the original design.

1.03 RELATED SECTIONS

A. Prepared subbase is specified in another Division 31, Section “Earthwork Site”.

1.04 SUBMITTALS

A. Material Certificates signed by material producer and Contractor, certifying that each material item complies with or exceeds specified requirements.

1.05 PROJECT/SITE CONDITIONS

A. Weather Limitations: DSA should be allowed to dry or “cure” before being exposed to traffic, otherwise deformations or rutting may occur. If the weather is not conducive to drying for a few days after placement due to low temperatures or precipitation, placement shall be postponed, especially if traffic cannot be kept off the road during the drying period.

B. Construct DSA when atmospheric temperature is above 40 deg F (4 deg C) and when base is dry.

C. Grade Control: Establish and maintain required lines and elevations.

1.06 MATERIALS

A. General: Use locally available materials and gradations that exhibit a satisfactory record of previous installations.

B. Gradation: The required sieve sizes and allowed ranges, determined by weight, for DSA components are as follows:

Sieve Size	% Passing
1.5"	100
0.75"	65 - 95
#4	30 - 65
#16	15 - 30
#200	10 - 15

C. Abrasion Resistance: The loss of mass (LA Abrasion) shall be less than 40 %. Determine the resistance to abrasion using the Los Angeles Abrasion test, ASTM C131.

D. pH: Aggregate shall be in the range of pH 6 to pH 12.45 as measured by ASTM D4972

E. Moisture: Material shall be well mixed and placed at an optimum moisture content or up to 2% below that value as determined for that particular sources. The optimum percentage moisture is to be determined using Proctor Test ASTM D698, Procedure C, Standard. Aggregate provider is encouraged to perform moisture testing prior to loading material for delivery.

F. Plasticity: Material shall not exceed a Plasticity Index (PI) of 6. The laboratory test required for these results is ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

G. Soundness: Determine the percentage of mass (Weight) loss of each fraction of the coarse aggregate after 5 cycles of immersion and drying using a sodium sulfate solution according to PTM No. 510. The maximum weighted percent loss allowed is 20%.

H. Aggregate: All DSA shall be derived from natural rock formations that meet the Pennsylvania State Conservation Commission, DSA program specification for abrasion resistance, pH, and freedom from contaminants.

I. Fines: If fines need to be added to the aggregate to meet DSA gradation requirements, the added material passing the #200 sieve must be derived from rock material that conforms to the Pennsylvania State Conservation Commission, DSA program specifications. No mineral clay or silt may be added. The amount of particles passing #200 sieve shall be determined using washing procedures specified in PTM No. 100.

J. Transportation: Tarps shall be used to cover 100% of the load’s exposed surface from the time of loading until immediately before placement.

PART 2 - EXECUTION

2.01 SURFACE PREPARATION

A. General: Remove loose material from existing paved surface. For proposed roadway that extends beyond existing pavement, ensure that base course is compacted to a visually firm and stable condition. Stone should be placed in 4" lifts and compacted using hand-operated tampers.

Notify Engineer of unsatisfactory conditions. Do not begin DSA placement until deficient subbase areas have been corrected and are ready to receive aggregate

2.02 PLACING DSA

A. Material: Immediately prior to placement, ensure that the DSA is properly mixed so as to prevent the segregation of material. The material may need to have additional water added to ensure optimal moisture content at the time of placement.

B. The DSA should be placed in a single 8" loose lift. The cross slope must be ½" per foot (4%).

C. Methods:
   a. Ideal method of placement is with a track mounted paving machine to ensure minimal segregation of material.
   b. Other Box Spreader (e.g. "Jersey Spreader"). Does not have auger to keep aggregate mixed. Not as good crown control.
   c. Tailgating: spread out of the back of a moving dump truck and use a grader to move material and establish final road shape. Aggregate should be dumped in a relatively uniform layer over the road, not a single pile. Grading passes should be kept to a minimum. Success is dependent on skill of the truck and grader operators.

D. Placing: Material shall be placed to achieve a centerline road crown with 4% slopes to either side. Material shall be placed above top of lagging broads so that after compaction, the DSA surface is flush with or slightly above the top of the lagging boards.

2.03 ROLLING / TAMPING

A. After placement, the material shall be compacted using a minimum ten-ton vibratory roller. DSA Shall be compacted to a minimum of 95% of the dry-mass (dry-weight) density according to ASTM D698, Procedure C, Standard as determined by pre-sampling (Refer to Materials Section)

B. First Pass:
   a. Supported Edge: Where material is held in place by lagging boards, roll slowly in static mode to approximately 1 foot from the lagging boards. Do not roll on lagging boards. The remaining 1 foot shall be compacted using a hand-operated tamper.
   b. Unsupported Edge: Where no lagging exists, the first pass shall roll in static mode near but not over the unsupported outside edge. Once path is firm, move progressively closer to the outside edge with static passes until the unsupported edge is firm.

C. Compaction Sequence: Make overlapping lengthwise passes beginning at the open-edge or 1 foot from the lagging edge and work towards the crown.

D. Vibratory Roller: The first roller pass over all aggregate should be in static mode in order to "set" the aggregate. Successive passes should be done in vibratory mode.

E. Finish Roll: The final pass over each section should be done in static mode to remove all roller edge marks.

F. Over-Rolling: Over-rolling can compromise the material and reduce the strength of the road surface. Visual indicators of over-compaction include: excessive aggregate fines and moisture migrating to the road surface (starts to look like finished concrete); shattering of larger stones on the surface; and a decrease in measured density.

G. Protection: The road should be allowed to dry or "cure" before being exposed to traffic, otherwise deformations or rutting may occur.

2.04 FIELD QUALITY CONTROL

A. A Standard Proctor Test to determine maximum density and optimum moisture content can be used to calibrate a Nuclear Density Gage for on-site compaction testing. On-Site compaction testing is recommended to confirm actual moisture content and density. Adequate compaction is achieved when the aggregate density is at 95% of its maximum dry density.

B. Check surface areas at intervals as directed by Engineer.

END OF SECTION 32 12 16

SECTION 32 13 13 – CONCRETE PAVING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

1.02 SECTION INCLUDES

A. Refer to Scope Information Sheets for this contract bound in the Project Manual under Section 01010, SUMMARY OF WORK. The Scope Information Sheets describe generally the work included in each contract, but the work is not necessarily limited to that described.

B. Concrete steps, pads, curbs, and landings.

1.03 RELATED DOCUMENTS

A. The Delaware Department of Transportation Standard Specifications for Road and Bridge Construction is hereby incorporated into this section and all requirements set forth there, shall be adhered to.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 31 “Earthwork Site” for subgrade preparation, grading and subbase course outside the building area.

C. The Contractor shall coordinate all construction documents; where conflicts arise between these specifications and the design drawings, the more stringent shall apply. The Contractor is advised to contact Owner with any questions prior to resolving any conflicts, or modifying any of the original design.

1.04 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, joint systems, curing compounds, dry-shake finish materials, and others if requested by Architect.

C. Design mixes for each class of concrete. Include revised mix proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

D. Laboratory test reports for evaluation of concrete materials and mix design tests.

E. Material certificates in lieu of material laboratory test reports when permitted by Architect. Material certificates shall be signed by the manufacturer and the Contractor certifying that each material item complies with or exceeds requirements. Provide certification from admixture manufacturers that chloride content complies with requirements.

1.05 PROJECT/ SITE CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

1.06 QUALITY ASSURANCE

A. Concrete Standards: Comply with provisions of the following standards, except where more stringent requirements are indicated.

1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."
2. ACI 318, "Building Code Requirements for Reinforced Concrete."
3. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."
4. Delaware Department of Transportation Standard Specifications.

B. Concrete Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

C. Concrete Testing Service: Engage a qualified independent testing agency to perform materials evaluation tests and to design concrete mixes.

PART 2 - PRODUCTS

2.01 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other acceptable panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

1. Use flexible or curved forms for curves of a 100-foot or less radius.

2.02 REINFORCING MATERIALS

A. Reinforcing Bars and Tie Bars: ASTM A 615, Grade 60, deformed.

B. Welded Steel Wire Fabric: ASTM A 185.

1. Furnish in flat sheets, not rolls, unless otherwise acceptable to Architect.

C. Deformed-Steel Welded Wire Fabric: ASTM A 497.

D. Fabricated Bar Mats: Welded or clip-assembled steel bar mats, ASTM A 184. Use ASTM A 615, Grade 60 steel bars, unless otherwise indicated.

E. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.

F. Supports for Reinforcement: Chairs, spacers, dowel bar supports and other devices for spacing, supporting, and fastening reinforcing bars, welded wire fabric, and dowels in place. Use wire bar-type supports complying with CRSI specifications.

1. Use supports with sand plates or horizontal runners where base material will not support chair legs.

2.03 CONCRETE MATERIALS

A. Concrete materials to be used in project shall comply fully with the requirements of the County of New Castle and DelDOT Standard specifications (more stringent shall apply).

B. Portland Cement: ASTM C 150, Type I.

1. Use one brand of cement throughout Project unless otherwise acceptable to Architect.

C. Fly Ash: ASTM C 618, Type F.

D. Normal-Weight Aggregates: ASTM C 33, Class 4, and as follows. Provide aggregates from a single source.

1. Maximum Aggregate Size: 1-1/2 inches.
2. Do not use fine or coarse aggregates that contain substances that cause spalling.
3. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Architect.

E. Water: Potable.

2.04 ADMIXTURES

A. Provide concrete admixtures that contain not more than 0.1 percent chloride ions.

B. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

C. Water-Reducing Admixture: ASTM C 494, Type A.

2.05 CURING MATERIALS

A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

B. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

1. Waterproof paper.
2. Polyethylene film.
3. White burlap-polyethylene sheet.

2.06 CONCRETE MIX

A. Prepare design mixes for each type and strength of normal-weight concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch method, use a qualified independent testing agency for preparing and reporting proposed mix designs.

1. Do not use the Owner's field quality-control testing agency as the independent testing agency.
2. Limit use of fly ash to 25 percent of cement content by weight.

B. Proportion mixes according to ACI 211.1 and ACI 301 to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Day): 4,500 psi.
2. Compressive Strength (28 Day): 5,000 psi (reinforced concrete drive apron)
3. Maximum Water-Cement Ratio at Point of Placement: 0.45.
4. Slump Limit at Point of Placement: 3 inches.

C. Adjustment to Concrete Mixes: Mix design adjustments may be requested by the Contractor when characteristics of materials, project conditions, weather, test results, or other circumstances warrant.

2.07 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94.

1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.

B. Remove loose material from compacted subbase surface immediately before placing concrete.

3.02 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for paving to required lines, grades, and elevations. Install forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.

B. Check completed formwork and screeds for grade and alignment to following tolerances:

1. Top of Forms: Not more than 1/8 inch in 10 feet.
2. Vertical Face on Longitudinal Axis: Not more than 1/4 inch in 10 feet.

C. Clean forms after each use and coat with form release agent as required to ensure separation from concrete without damage.

3.03 PLACING REINFORCEMENT

A. General: Comply with Delaware Department of Transportation Standard Specifications for placing reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities or replace units as required before placement. Set mats for a minimum 2-inch overlap to adjacent mats.

3.04 JOINTS

A. General: Construct contraction, construction, and isolation joints true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to the centerline, unless indicated otherwise.

1. When joining existing paving, place transverse joints to align with previously placed joints, unless indicated otherwise.

B. Contraction Joints: Provide weakened-plane contraction joints, sectioning concrete into areas as shown on Drawings. Construct contraction joints for a depth equal to at least 1/4 of the concrete thickness, as follows:

1. Tooled Joints: Form contraction joints in fresh concrete by grooving and finishing each edge of joint with a radiused jointer tool.
2. Inserts: Form contraction joints by inserting premolded plastic, hardboard, or fiberboard strips into fresh concrete until top surface of strip is flush with paving surface. Radius each joint edge with a jointer tool. Carefully remove strips or caps of two-piece assemblies after concrete has hardened. Clean groove of loose debris.

C. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than ½ hour, unless paving terminates at isolation joints.

1. Provide preformed galvanized steel or plastic keyway-section forms or bulkhead forms with keys, unless indicated otherwise. Embed keys at least 1-1/2 inches into concrete.
2. Continue reinforcement across construction joints unless indicated otherwise. Do not continue reinforcement through sides of strip paving unless indicated.
3. Provide tie bars at sides of paving strips where indicated.
4. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

3.05 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcing before placing concrete. Do not place concrete on surfaces that are frozen.

C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.

D. Comply with requirements of the Delaware Department of Transportation for measuring, mixing, transporting, and placing concrete.

E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

F. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

G. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete complying with ACI 309R.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcing, dowels, and joint devices.

H. Screed paved surfaces with a straightedge and strike off. Use bull floats or darbies to form a smooth surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces prior to beginning finishing operations.

I. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete.

J. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

K. Cold-Weather Placement: Comply with provisions of ACI 306R and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture

temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

L. Hot-Weather Placement: Place concrete complying with ACI 305R and as specified when hot weather conditions exist.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.06 CONCRETE FINISHING

A. General: Reference Architectural Drawings and Specifications for paving patterns, joint scoring, finishes, coloring, etc.

B. Float Finish: Begin floating when bleed water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Finish surfaces to true planes within a tolerance of 1/4 inch in 10 feet as determined by a 10-foot-long straightedge placed anywhere on the surface in any direction. Cut down high spots and fill low spots. Refloat surface immediately to a uniform granular texture.

C. Unexposed Surfaces:
1. Concrete which will not be exposed in the completed structure shall be any form finish as specified in Section 03100, Concrete Formwork, and ACI 301 for rough form finish.
2. Concrete to receive membrane waterproofing shall receive a "smooth form finish" in accordance with ACI 301.

D. Exposed Surfaces: Unless indicated otherwise, concrete which will be exposed in the completed structure shall receive the following finishes as indicated:
1. Smooth Form Finish: Conform to ACI 301.
2. Smooth Rubbed Finish: Conform to ACI 301.
3. Grout Cleaned Finish: Conform to ACI 301.
4. Unspecified Finish: When finish is not indicated, provide "smooth form finish" as specified above.

E. Medium Sand Blast Finish (Type II – Concrete Pavement):
1. Blasting Operations and Requirements:
   a. Apply sandblasted finish to exposed concrete surfaces where indicated.
   b. Perform sand blasting at least 72 hours after placement of concrete. Coordinate with formwork construction, concrete placement schedule, and formwork removal

to ensure that surfaces to be blast finished are blasted at the same age for uniform results.

c. Determine type of nozzle, nozzle pressure, and blasting techniques required to match the Architect's control samples.

d. Abrasive blast corners and edge of patterns carefully, using back-up boards, to maintain uniform corner or edge line.

2. Depths of Cut: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surface to match the Architect's control samples as follows:
   a. Brush Sand Blast Finish: Remove cement matrix to expose face of fine aggregate; no reveal.
   b. Light Sand Blast Finish: Expose fine aggregate with occasional exposure of coarse aggregate; maximum 1/16-inch reveal.
   c. Medium Sand Blast Finish: Generally expose coarse aggregate; 3/16-inch to 1/4-inch reveal.
3. Surface Continuity: Perform sand blast finishing in as continuous an operation as possible, utilizing the same work crew to maintain continuity of finish on each surface or area of work. Maintain patterns of variances in depths of cuts as indicated.
4. Construction Joints: Use technique acceptable to the Arcthitect/Engineer to achieve uniform treatment of construction joints.
5. Protection and Repair:
   a. Protect adjacent materials and finishes from dust, dirt, and other surface or physical damage during abrasive blast finishing operations. Provide protection as required and remove from site at completion of the work.
   b. Repair or replace other work damaged by finishing operations.
6. Clean-up: Maintain control of concrete chips, dust, and debris in each area of the work. Clean up and remove such material at the completion of each day of operation. Prevent migration of airborne materials by use of tarpaulins, wind breaks, and similar containing devices.

F. Final Tooling: Tool edges of paving, gutters, curbs, and joints formed in fresh concrete with a jointing tool to radii as shown on the plans. Repeat tooling of edges and joints after applying surface finishes. Eliminate tool marks on concrete surfaces.

G. Joints, Coloring, and Patterns: Reference Architect Drawings for all paving joint scoring/patterns, paving finishes, and any concrete paving.

3.07 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with the recommendations of ACI 306R for cold weather protection and ACI 305R for hot weather protection during curing.

B. Evaporation Control: In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before floating.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days with the following materials:

a. Water.
b. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with a 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3.08 TRAFFIC PAINT

A. Traffic Paint: Apply traffic paint for striping and other markings with mechanical equipment to produce uniform straight edges. Apply at manufacturer's recommended rates to provide a 15-mil minimum wet film thickness. All traffic striping is to conform, at a minimum, to the design drawings.

3.09 FIELD QUALITY CONTROL TESTING

A. Employ a qualified independent testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement as follows:

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

a. Slump: ASTM C 143; one test at point of placement for each compressive-strength test but no less than one test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
b. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test but no less than one test for each day's pour of each type of air-entrained concrete.
c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
d. Compression Test Specimens: ASTM C 31; one set of four standard cylinders for each compressive-strength test, unless directed otherwise. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
e. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd. but less than 25 cu. yd., plus one set for each additional 50 cu. yd. Test one specimen at 7 days, test two specimens at 28 days, and retain one specimen in reserve for later testing if required.

2. When total quantity of a given class of concrete is less than 50 cu. yd., Architect may waive strength testing if adequate evidence of satisfactory strength is provided.

3. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
4. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.

B. Test results will be reported in writing to Architect, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in paving, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day and 28-day tests.

3.10 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective, or does not meet the requirements of this Section.

B. Drill test cores where directed by Architect when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep concrete paving not more than two days prior to date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 13