Smithsonian Institution

Office of Planning, Design & Construction

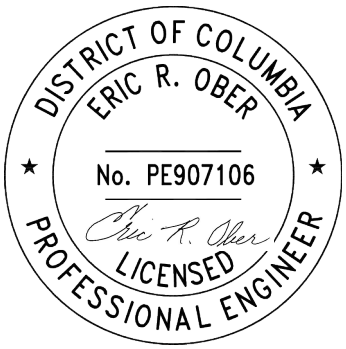
SPECIFICATIONS

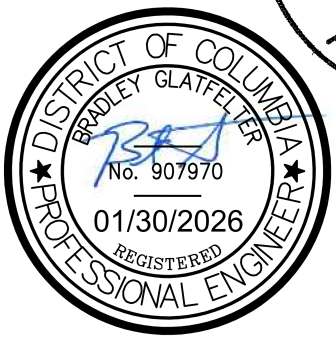
PROJECT NO.: SF: 2233104 | EC: 20230426

PROJECT TITLE: Mitigate Storm Water at Elephant Yards

FACILITY: National Zoological Park
3001 Connecticut Ave. NW
Washington, D.C. 20008

DATE: 01/30/2026





This project is approved as being in conformance with applicable provisions of the Smithsonian Directive (SD) 410.

Michael J. Carrancho, P.E., Deputy Director Date

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SUPPLEMENTARY CONDITIONS FOR CONSTRUCTION

SECTION A - PROJECT SUMMARY AND INFORMATION

1. PROJECT INFORMATION

1.1 Project No. 2233104

NZP-DC : Mitigate Storm Water At Elephant Yards
Smithsonian's National Zoo & Conservation Biology Institute
3001 Connecticut Avenue, NW
Washington, D.C. 20008

1.2 Smithsonian Institution Contacts:

Contracting Officer (CO), address for Fed Ex and UPS delivery:
Smithsonian Institution
Office of Contracting
600 Maryland Avenue, SW, Suite 500E
Washington, DC 20024

Contracting Officer (CO), address for USPS delivery:
Smithsonian Institution
Office of Contracting
MRC 1200
P.O. Box 37012
Washington, DC 20013-7012

Contracting Officer's Technical Representative (COTR), address for Fed Ex and UPS delivery:
Smithsonian Institution
Attn: Tanner Smith, Office of Planning, Design, and Construction
General Services Building
National Zoological Park
3001 Connecticut Avenue, NW
Washington, DC 20008

2. SUMMARY OF WORK

2.1. The Smithsonian Institution intends to award a firm fixed-price construction contract to the successful Offeror. The Offeror shall furnish supervision, labor, materials, and equipment

needed to do the project work at the Smithsonian National Zoological Park 3001 Connecticut Avenue, NW Washington, DC 20008

2.2. Unless otherwise indicated, communications, submittals, requests, and notices required by the Specifications to be submitted to the Architect or Engineer shall be submitted to Smithsonian through the COTR. References to review, approval, or other action by the Architect or Engineer shall mean action by Smithsonian, acting through the COTR and with assistance from the Architect-Engineer of Record, as applicable. The COTR's authority is limited to that delegated in writing by the Contracting Officer. The COTR is not authorized to modify the Contract or make commitments affecting contract price, quality, quantity, period of performance, or any other term or condition of the Contract. Only the Contracting Officer may modify the Contract.

2.3. The term "Contract Documents" shall be deemed to include all Contract Clauses, the terms and conditions of the Request for Proposal (RFP), and all drawings and specification documents including, without limitation, the documents identified in Section 2.4.1. below. All work shall be performed in strict accordance with the Contract Documents as shown, or as may be changed by modification issued by the Contracting Officer. No deviations are permitted unless a change notice is issued and approved in advance by the Smithsonian Institution Contracting Officer.

2.4. Contract Documents includes, without limitation, the Drawings, Specifications and Basis of Design as referenced below*:*

2.31. NZP-DC: Mitigate Storm Water at Elephant Yards, SI Project No. **2233104**

a. Drawings, dated 1/30/2026
Sheets 01 through 39

b. Specifications, dated 1/30/2026
Pages 01 through 219

2.5 The Contractor shall furnish all supervision, labor, materials, and equipment needed to do the project work at the Veterinary Hospital at the Smithsonian Institution's National Zoological Park (NZP) located at 3001 Connecticut Ave NW Washington DC 20008.

2.6. The work includes but is not limited to:

a) Re-grading of Yards 1 and 4.
b) Partial demolition and reconstruction of Pool 1 edge.
c) Infill of Pool 2.
d) Installation of new below-grade drainage piping and storm structures in Yards 1, 2, and 3.
e) Seeding of Yard 4.

When contractor has completed and checked his work, he or she will contact COTR for an inspection. Contractor shall clean up and dispose all debris associated with job. Contractor will be responsible for all labor, materials, and equipment to complete project.

This brief description, however, shall not, in any way, be construed to limit the Contractor's obligation for compliance with the contract specifications

2.7. Critical Elements of the Work: The successful Contractor shall be fully qualified to install critical elements of the Work. Upon request of the Contracting Officer, the successful Contractor shall submit a statement of qualifications to address the following critical elements of the Work:

a. Excavation, fill, and grading of substrates.
b. Installation of below-grade stormwater drainage infrastructure.
c. Partial demolition of concrete.
d. Installation of poured-in-place concrete to emulate natural forms, including stamped patterns.
e. Protection of existing trees and other existing to remain elements.
f. General Contractor and Subcontractor's supervisor shall have a minimum of five (5) years' experience with the materials and processes being installed.
g. Experience with coordinating complex projects within an operating campus.
h. Corporate climate that has a full commitment to the project's Safety Program.
i. Quality Control program that ensures all the project's requirements are delivered within contract's conformance requirements. This program should include the contractor's ability to field review documents, implement testing procedures, and ensure that the contract standards are fully adhered to.

3. CONTRACT TIME FOR COMPLETION

3.1 Work under this contract shall begin by the Contractor within ten (10) workdays after the Notice to Proceed and shall be completed within the total contract time of 180 calendar days. All work, including inspections, testing, correction of deficiencies, permit close-out, and project close-out activities, shall be completed in every respect within the contract time.

3.2 The start date and completion date shall be as stated in the Notice to Proceed issued by the Contracting Officer.

3.3 Special Phasing Requirements

a. Work in Yards:
   1. Work in Yard 4 can begin at any time of the year (anticipate October start), but cannot overlap with the work in Yard 1 or Yard 2.
   2. Start of Work in Yard 1 and Yard 2 must take place during the colder months and after completion of Yard 4. Work in Yards 1 and 2 can occur simultaneously. Given the smaller scope, work in Yard 2 will finish first and be turned over, while work in Yard 1 continues and is subsequently turned over.
   3. Proposed sequencing of work in yards described herein, shall be reconfirmed with Animal Care staff during pre-construction meeting.

b. Animal management requirements of construction are indicated within the contract documents.

c. An approved site staging plan will be required prior to the commencement of work, with consideration of animal, staff, and public safety and access.

d. Vehicle and pedestrian access to the project areas is indicated in the contract documents. Coordinate access needs with COTR and Animal Care Staff throughout the duration of the project.

4. SCHEDULE OF ALTERNATES AND OPTIONS FOR BID

4.1. The following is a brief statement of the Work identified for bid alternates and bid options and costs shall be identified in the bid schedule. The complete description of the Work is identified elsewhere in the drawings and specifications.

BASE BID:

- Includes full re-grading of Yard 1 and partial re-grading of Yard 4, in order to improve stormwater management and reduce runoff and erosion at the elephant yards. Re-grading includes installation of surface retaining logs to hold back the soil, and buried elevation-setting elements at the new swales to support ongoing maintenance and re-forming of drainage swales.
- Includes infill of Pool 2 in Yard 2 with substrate and a clay bath, and associated drainage infrastructure to control ponding and runoff around the former pool.
- Includes partial demolition and reconstruction of the entry to Pool 1 in Yard 1, to improve elephant and maintenance accessibility, and reduce sand and soil overflow into the pool.

ADD ALTERNATE 1: Use of sod in lieu of seed for Yard 4. (90 days to be added if accepted)
Includes use of sod to restore grass cover throughout Yard 4, instead of seeding.

ADD OPTION 1: Pool 1 decorative concrete paving. (45 days to be added if accepted)

- Includes application of decorative stamped concrete patterns on exposed surfaces of the Pool 1 concrete apron, intended to create a more naturalistic appearance and textured surface.

ADD OPTION 2: Pool 1 ramp and floor demolition and reconstruction. (45 days to be added if accepted)

- Includes further demolition of the concrete ramp and floor of Pool 1, including the existing sump pit, drain line, and failed joint and perimeter waterproofing.
- New drain line to be run, and new sump pit constructed along with re-pouring of pool floor and ramp, installation of new joint and perimeter waterproofing, and stamping of concrete surface.

5. SCHEDULE OF UNIT PRICES – NOT USED

6. BIDDER/OFFEROR EXAMINATION OF SITE

6.1. Every effort was made to indicate all work necessary to complete the project as identified. All bidders must carefully examine the premises during the bid period and satisfy themselves as to the extent, nature and location of the work, general and local conditions, particularly those bearing on transportation, disposal, handling and storage of materials, availability of labor, water, electric power, access routes, uncertainties of the weather, type of equipment and facilities needed for the successful execution of the Work.

6.2. Pre-Bid Conference and Site Visit. Before the bid opening date, the COTR will announce a scheduled pre-bid conference and site visit. The purpose of the scheduled meeting is to provide an opportunity for all bidders to review the project site. Any comments, information or discussion during the site visit shall not modify the contract documents. All questions must be submitted in the form of an RFI to the designated representatives on the RFP.

6.3. This project is in a public area and requires no special arrangements to visit the site between the hours of 8:00AM and 5:00 PM.

7. AVAILABILITY OF DOCUMENTS

7.1. The bidders will be provided electronic versions of drawings and specifications from:

Smithsonian Institution
Office of Planning, Design, and Construction
600 Maryland Avenue, SW., Suite 5001
Washington, DC 20024

7.2. The bidder is responsible for making their own hard copies of the solicitation documents.

SECTION B - SPECIAL PROJECT REQUIREMENTS

8. UNITS OF MEASURE

8.1. All fabrication and installation shall be performed in accordance with the units of measure given in the Contract Documents. Units of measure on this project are Imperial Units.

9. NON-PUBLIC, TENANT AND SECURED SPACES

9.1. Certain tenant spaces, non-public spaces, utility and equipment rooms and other areas related to or used for purposes of storage, conservation, research, curation of SNZCBI collection and artifacts or for scientific research may have restricted access.

9.2. The Contractor shall identify to the COTR as soon as possible, but no less than two (2) workings days in advance, any occupied areas that the Contractor must access that are located outside the limits of the project site. The Contractor shall identify in writing:

9.2.1. Restricted areas to be accessed.

9.2.2. Specific reason for needing access.

9.2.3. Nature of the work to be performed.

9.2.4. Date(s) and hours needed to complete construction work activity.

9.3. NOTE: All staff on site must receive Animal Programs training before entering any restricted areas. Contractor to maintain a list of "Animal Programs Trained Personnel".

10. NZCBI ARTIFACTS AND SCIENTIFIC RESEARCH MATERIALS (NOT USED)

11. PROTECTION OF HISTORIC PROPERTIES

11.1. The project site is located in a designated National Historic Landmark property and requires special attention to the quality of materials selected for installation and workmanship efforts to satisfactorily preserve and restore historic elements and finishes of an historic landmark structure.

11.2. Upon request of the COTR, the Contractor shall submit evidence of technical competence in restoration work for National Historic Landmark structures, including subcontractor resumes, references and photographs or previous similar work.

11.3. Without exception, all original building fabric of the National Zoological Park is designated historic. All work that impacts the building's fabric share be pre-approved by the COTR prior to the commencement any work.

12. COMMITMENT TO SUSTAINABILITY

This is not a LEED project however Construction Waste Management and Disposal in Section 29 will apply.

12.1. The Smithsonian Institution is a trust instrumentality of the United States (recognized as a tax-exempt organization under Section 501(c)(3) of the Internal Revenue Code) and although not an Executive Branch of the U.S. Government, is committed to planning, designing, constructing, maintaining and operating its owned and leased buildings and facilities consistent with Federal environmental and energy management requirements, as listed in the Smithsonian SF Codes, Standards and Guidelines document, dated February 15, 2012, to the maximum extent practical.

13. COMMISSIONING – NOT USED

SECTION C - CONTRACTOR USE OF PREMISES

14. HOURS OF WORK, WORKDAYS AND GOVERNMENT HOLIDAYS

14.1. Work shall be performed, under this contract, during the normal workdays of Monday through Friday, except Smithsonian holidays and special events as specified herein and the normal work hours of 7:00 AM to 3:30 PM. The SNZCBI opens to the public at 8:00 a.m. daily, and use of public trails, roads, walks, etc. are limited during public hours and during special events. Coordinate with COTR.

14.2. The premises will be continually occupied, requiring that certain work under this contract may need to be performed during periods other than that specified above. All shutdowns and outages must be approved by and coordinated with the COTR and occur between the hours of 10:00 p.m. to 5:00 a.m., unless otherwise approved.

14.3. For each occasion, the Contractor intends to work on Saturdays, Sundays, or Smithsonian holidays or during hours other than those indicated above, the Contractor shall obtain written permission from the COTR, at least three (3) working days in advance.

14.4. Smithsonian Holidays: For holidays that fall on Saturday, the Smithsonian holiday is observed on the previous Friday. For holidays that fall on Sunday, the Smithsonian holiday is observed on the following Monday. The Smithsonian Holidays are listed below. Also see the National Zoological Park website for a listing of special events.

New Year's Day	January 1
Martin Luther King Jr.'s Birthday	January, third Monday
George Washington's Birthday	February, third Monday
Memorial Day	May, last Monday
Juneteenth	June 19
Independence Day	July 4
Labor Day	September, first Monday
Columbus Day	October, second Monday
Veterans' Day	November 11
Thanksgiving Day	November, fourth Thursday
Christmas Day	December 25
*President's Inauguration Day	*January 20, xxxx

15. CONDITIONS AFFECTING CONTRACTOR'S WORK

15.1. Existing Occupied Spaces: The premises will be occupied by visitors, staff, and collection animals during the performance of the Work. The Contractor shall schedule work activities to minimize interruption of occupants and occupied spaces. Efforts will be made to temporarily move employees and contents out of specific areas under construction, as needed, during the times requested by the Contractor. However, the needs of the Smithsonian Institution take precedence and free access for the Contractor cannot always be guaranteed. The Contractor may work in animal areas only in the presence of authorized Smithsonian staff or guard personnel. Areas that will remain occupied includes the grounds of the SNZCBI.

15.1.1 Contractor to develop a work plan that incorporates all elements of paragraph 2.3.

15.1.2 Exhibit closures and shifting of animals between exhibits and holding spaces are to be coordinated with COTR and Animal Care staff with a minimum of 14 days of notice.

15.1.3 Area must be free from any debris, tools, equipment, etc. and animal containment must be in place prior to animals being shifted to that area.

15.1.4 Contractor to confirm prior access daily in primary and secondary containment area unless the area has been fully turned over to the contractor.

15.2. Relocation of Existing Occupants: N/A

15.3. Space for Contractor Use: The space available for Contractor's use shall be coordinated with COTR at the project site. Space allocation and availability are subject to change, at the discretion of the Smithsonian, to meet the needs of all parties requiring access and space within the building, work area, and the surrounding areas. Anticipated access and work areas are provided within the contract documents.

16. CONTRACTOR CONDUCT, DELIVERIES, HAULING AND ACCESS

16.1. Normal deliveries shall be made between the hours of 6:00 AM and 09:00 AM. The Contractor's materials and equipment shall be delivered, received, receipted for, and handled by the Contractor's personnel.

16.2. Access to the site for on- and off-loading of all material, structures and equipment shall be designated by the COTR .

16.3 SI's loading docks and delivery areas require special access requests and coordination for contractors use. SI will not accept contractor's deliveries at the loading dock.

16.4 Comply with **SNZCBI's Motor Vehicle Operations on Walkways**, responsibilities, and procedures for operating motor vehicles on walkways of the National Zoological Park (SNZCBI) in Rock Creek.

16.4.1 **Definitions:**

Walkways. Interior paths on SNZCBI grounds at Rock Creek intended for pedestrian visitors and staff, such as Olmsted Walk, Asia Trail, and American Trial.

Motor vehicle. Any motorized, gas or electric apparatus used to transport personnel or supplies, with the exception of individual motorized electric wheelchairs, or what are commonly known as Electric Control Vehicles (ECVs) and Police Segways.

16.4.2 **Policy**

Any motor vehicles on the grounds shall be operated at a speed considered safe for movement among pedestrians. The posted speed on Zoo public roadways is 25 miles per hour from Connecticut Avenue to the Crossroads, 15 miles per hour from the Crossroads to Adams Mill gate and 10 miles per hour from Adams Mill gate to the Veterinary hospital. Speed limits may be reduced during construction and special events. Caution is required as pedestrians must cross public roadways when walking from parking lots to the Zoo exhibits.

i. Walkways are for the main purposes of providing safe movement of pedestrians throughout the Park's exhibit areas. Vehicular traffic on walkways is restricted to an absolute minimum needed to accomplish the SNZCBI mission. Contractor vehicles whose business requires that they drive on walkways shall proceed with **extreme** caution. Individuals operating vehicles on walkways must remain constantly vigilant and be prepared to react quickly, if necessary.

ii. On walkways, vehicles shall be operated at a safe speed appropriate to the circumstances, never exceeding the equivalent of 5 miles per hour after 09:00 a.m. Prior to 09:00 a.m., vehicles below 26,000 lbs. gross vehicle weight rating (GVWR), may reach a maximum of 10 miles per hour. If installed, the vehicle's headlights and emergency flashers shall be on at all times.

iii. Motor vehicles are prohibited on all zoo walkways between the hours of 09:00 a.m. and 6:00 p.m. year-round, with limited exception (see part 5 below). During the restricted hours between 09:00 a.m. and 6:00 p.m., a police escort shall be requested by contacting the police supervisor on duty at 633-4111. If SNZCBI Police cannot escort the vehicle, the driver must arrange a pedestrian escort by a suitably trained person to be in front of the vehicle with a safety vest or flag.

iv. Privately owned vehicles (POVs) must be off zoo walk-ways by 7:00 am.

v. All carts (including but not limited to; EZ Go, Gator, Club Car, and Cushman) must use an approved chock to keep the cart secured when not in use.

vi. Any individual operating a motor vehicle on SNZCBI grounds must possess a current valid government issued driver's license.

16.4.3 **Responsibilities**

i. SI Staff ensures that:
   1. Police officers observe and enforce the provisions of this directive.
   2. A police escort is provided whenever possible if needed for safe transit of a vehicle on walkways.
   3. All SI Staff shall take corrective actions when they observe violations of this directive and shall report the violation to the COTR.

16.4.4 **Controlling Traffic on Walkways**

i. Vehicular traffic and parking are prohibited on zoo walkways between the hours of 8:00 am and 6:00 pm each day, with limited exceptions (see below). Deliveries should be scheduled whenever possible before 8:00 a.m. if access to walkways is required.

ii. The following vehicles are permitted on zoo walkways during the period of prohibition if they are escorted by a uniformed SNZCBI Police or other approved escort (who must walk in front of the vehicle wearing a brightly colored safety vest or signaling caution with flags and voice notification).

iii. Police vehicles, as deemed necessary for security or emergency purposes. No escort required.

iv. Park Management and SI vehicles responding to an urgent maintenance requirement or an emergency with an escort.

v. Veterinary vehicles responding to an animal emergency or a situation involving animal welfare with an escort.

vi. Any motorized cart needed to perform a vital duty must request approval from the COTR.

vii. Contractors must use vehicles to perform essential services within the prohibited hours must get approval from the COTR. When there is a need to bring in a company trucks, oversized vehicle, i.e., dump-truck, cranes, or other special equipment, at least two walking escorts must be provided. One forward and one aft with flags and safety vests; this also applies whenever this type of equipment has to back-up or perform any other special maneuvers, i.e., loading, unloading, lifting, dumping and so forth outside the designated work area.

viii. NZP Police, NZP and SI senior staff have the authority to stop any motor vehicle operating on a walkway and determine whether or not such operation is in violation of policy.

ix. In instances where the motor vehicle's operations do not meet the criteria for being on the walkway, the Police or NZP Senior Staff member may direct the driver to remove the motor vehicle from the walkway and proceed to the nearest available NZP roadway or street. Failure to comply with this policy, or to follow this sub-part instructions could lead to disciplinary action.

x. The Police may stop and expel from the walkway any vehicle exceeding the speed limit, operating the vehicle in an unsafe manner, or not in compliance with this policy. The following situations create unnecessary risk and will not be tolerated while operating a motor vehicle on pathways in the Zoo:

1. Talking, texting, or using devices that require manual manipulation.
2. Eating or drinking.
3. Smoking by the operator or a passenger in any motor vehicle as referenced in the Smithsonian Directive (SD 209).
4. Exceeding the maximum seating capacity or design of the vehicle.
5. Transporting personnel in cargo area or failure to secure load.
6. Operating any vehicle with a visible or known safety defect.

17. DRESS AND DEPORTMENT

17.1. Contractors' personnel shall be fully and appropriately clothed at all times and shall conduct themselves in a manner appropriate to a public place. The COTR may require removal of any individual from the premises and project for unacceptable dress, demeanor, or disruptive conduct, if the Contractor superintendent fails to correct conditions in violation of this paragraph.

17.2. The Government reserves the right to exclude or remove from the site or building any employee of the Contractor or Subcontractor as the Government deems incompetent, careless, insubordinate, or otherwise objectionable, or whose continued employment of the work is deemed by the Government to be contrary to public interest.

18. CONTRACTOR PARKING

18.1. Contractor Parking: One parking space will be assigned to the Contractor for use during the contract period. The space will be located as close to the project site as possible. Coordinate with COTR.

18.2. The assigned space can only be used by the company vehicle. The vehicle must be clearly marked with company name and/or logo. The permit shall be displayed on the vehicle dashboard on the driver's side. Vehicles not in compliance with this clause are subject to ticketing and towing by the NZP police. Costs associated with parking violations shall be the sole responsibility of the Contractor.

18.3 Parking spaces will not be provided for the Contractor's employees. Employees will be required to comply with the NZP's pay parking regulations.

18.4 General Parking is available at $30 per day. For arrivals prior to 8:00 AM a parking pass must be purchased online a minimum of one day in advance. After 8:00 AM payments are to be made to parking attendants in the vehicle check-in lot bus lot. Early arrival parking vouchers must be to be printed and displayed in the windshield for identification.

18.5 All Vehicles not in compliance with NZP Parking Requirements are subject to ticketing and towing by the NZP Police. All costs associated with parking violations shall be the sole responsibility of the Contractor's personnel**.**

19. EATING, DRINKING, SMOKING, AND ILLEGAL SUBSTANCE USE

19.1. Eating and drinking in Smithsonian buildings or leased space will be allowed only in designated areas. Offenders may be subject to removal from the premises and project should the Contractor's Superintendent fail to correct conditions, which, in the opinion of the COTR, violate this clause.

19.2. Gambling and the consumption of alcoholic beverages by the Contractor's personnel is prohibited in all Smithsonian buildings or leased space.

19.3. Smoking, vaping, using E-cigarettes or carrying lighted tobacco products is prohibited in all Smithsonian buildings or leased space, in exhibition and public spaces, in areas where hazardous materials are stored or handled and in areas undergoing construction, renovation or repair. Acceptable areas for smoking are outside of the building, as designated by the Smithsonian Facility Manager, and/or Office of Safety, Health, and Environmental Management (OSHEM).

19.4. The possession, sale and/or use of narcotics or other illegal substances or firearms by Contractor employees are strictly prohibited in all Smithsonian facilities and leased space. Contractor employees are strictly prohibited from working on the project under the influence of alcohol and/or illegal substances. Contractor employees in violation of any of the above prohibitions will be removed from the project.

SECTION D - PROJECT COORDINATION

20. COORDINATION OF TRADES

20.1. The Contractor shall coordinate work of different trades so that interference between mechanical, electrical, architectural, and structural work, including existing services, shall be avoided.

20.2. Refer to MasterSpec (AIA) Division 01 sections on General Commissioning Requirements following this section 010000.

20.3 Where work by separate entities requires off-site fabrication of products and accurate interfacing of materials to produce the required results, the Contractor shall prepare coordination drawings to indicate how work shown on separate shop drawings will be interfaced, intermeshed, and sequenced for installation. Coordination drawings shall be submitted in accordance with the requirements of the "Submissions" section.

20.3.1. Work installed prior to approval of coordination drawings shall be at the Contractor's risk. Subsequent relocations required to avoid interferences shall be made without additional expense to the Smithsonian. If an interference develops, the COTR will decide which work shall be relocated, regardless of which was installed first.

20.4. Installation of equipment and systems shall allow the maximum practical space for operation, repair, removal, and testing, within the limits indicated on the Contract Documents. Pipes, conduit, ducts, and other system components shall be installed as close as possible to ceiling slabs, walls, and columns to minimize space used while accommodating function and maintenance.

21. QUALITY CONTROL

21.1. The Contractor shall provide qualified site personnel responsible for quality control, inspections, testing and re-testing as necessary for all work, including that of Subcontractors, to assure compliance with the contract documents. CQC Representative may be the project's designated supervisor.

21.2. **Testing Requirements: Contractor shall be responsible for all field sampling and in-place testing required by the contract documents.** This statement supersedes all other drawing and specification references to Owner-provided sampling and/or testing.

21.2.1. Independent Testing Laboratory: The Contractor shall provide an independent, commercial testing laboratory to perform all sampling and testing services required. The testing services shall be on- or off-site as required. Submit complete documentation of all tests performed in connection with the construction contract.

21.2.2. Smithsonian Acceptance of Laboratories: Except for factory tests, all field sampling and testing normally performed by commercial laboratories shall be performed by an independent commercial laboratory employed by the Contractor and accepted by the COTR. The Contractor shall submit the following information to the COTR for approval:

21.2.2.1. Name, registration number and engineering discipline of the Registered Professional Engineer in charge of the laboratory.

21.2.2.2. Affidavit of compliance and certification that the laboratory performs work in accordance with requirements as stated in the contract documents.

21.2.2.3. A list of testing equipment proposed for each test procedure including latest calibration data.

21.2.2.4. A copy of the latest Laboratory Inspection Report by an independent agency with laboratory certification that deficiencies (if any) have been corrected.

21.2.2.5. Names and qualifications of persons actually performing testing and sampling. Changes in personnel shall be approved by the COTR prior to performance of work under this contract.

21.3.4. Test Results: Test results shall cite the contract requirements; the test or analytical procedures used the actual results and include a statement that the item tested or analyzed conforms or fails to conform to specification requirements. The cover sheet for each report shall be conspicuously stamped in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements, as the case may be. All test reports shall be signed by a testing laboratory representative authorized to sign certified test reports. The Contractor shall arrange for immediate and direct delivery of the signed reports, certifications, and other documentation to the COTR.

21.8. Documentation: The CQC shall prepare the following documentation for systematic inspection, testing, and verification of various aspects of the deliverable project. Documentation should include but not limited to: (1) Establishing Quality Standards, (2)Setting Acceptance Criteria, (3)Implementing Quality Control Measures, (4)Monitoring Process Performance and (5)Identifying Defects and Non-Conformities.

21.8.1 Submittal Review: Prior to submitting information to the Smithsonian, the CQC shall review and sign all submissions. This signature confirms a detailed submittal review for coordination and compliance has been conducted on behalf of the General Contractor.

21.8.2. Daily Reports: The Contractor's Daily Report, as discussed in the section Contractor Correspondence and Daily Reports, shall be signed by the CQC Representative as well as the Superintendent. The CQC Representative's signature certifies that, to the best of his or her knowledge, the report is complete and correct and that all materials, equipment and work described on the report are following the contract plans and specifications, except as noted otherwise.

21.8.3. Special Inspection and Documentation: Reports of Special Inspections shall be signed by both the CQC Representative and the CQC Specialized Supplemental Person who witnessed the test or inspection certifying compliance with the specific contract requirement.

21.8.4. As-Builts: The CQC Representative shall ensure that all requirements for as-built record drawings and specifications are met. The CQC Representative or Specialized Supplemental Personnel assigned to inspect that particular portion of work shall initial each as-built drawing or technical specification section to certify its accuracy prior to submission in accordance with the Project Close-Out Requirements section.

22. PERMITS, LICENSES & FEES

22.1. The Contractor shall obtain and pay for all applicable permits and licenses required by D.C. regulating agencies, including but not limited to erosion and sediment control, storm water management, water quality as it relates to Rock Creek disturbance, elevator permits, waste containers etc. Current schedules of fees can be found on the regulating agencies' websites.

22.2. The Contractor shall pay all duties, fees, taxes, and other charges and give all notices necessary and incidental to the due and lawful execution of the work.

22.3. The Contractor shall keep the Smithsonian indemnified against all penalties and liability for breach of provisions of any national, provincial, district or city statute, ordinance or law and the regulations and by-laws of any local or other duly constituted authority, which may be applicable to the Work and with such rules and regulations of public bodies and companies.

22.4. Accessibility for Physically Disabled Persons: The Contractor's shall provide temporary constructions at the site as necessary to maintain access for physically disabled persons. All provisions for temporary access shall be subject to the approval of the COTR.

23. UTILITY SERVICE INTERRUPTIONS AND NEW CONNECTIONS

23.1. Any planned interruption in utility service must be approved by and coordinated through the COTR. The Contractor shall submit a written request as far in advance of scheduled interruption as possible, but no less than two (2) full working days in advance. The Contractor shall make the necessary temporary provisions to supply continuous electrical power, HVAC space conditioning and security as required during periods when service is interrupted.

23.2. Work shall be coordinated to minimize the number and duration of outages.

23.3. All planned shutdowns and outages must occur between the hours of 6:00 p.m. to 6:00 a.m., unless otherwise approved by the COTR.

23.4. The Contractor's work efforts to restore service shall be continuous until the interrupted utility is back in service.

23.5. The electrical power may not be interrupted without advanced coordination with the COTR.

23.6. A fire watch shall be provided for the time periods when fire suppression and detection systems are out of service.

24. SI-FURNISHED ITEMS INSTALLED BY THE CONTRACTOR

24.1. The following items shall be furnished by the Smithsonian for installation by the Contractor as part of this contract:

ITEM	DELIVERY LOCATION
Not Applicable	

24.2. Required delivery dates for all Smithsonian furnished items shall be included in the Contractor's Project Schedule, as discussed in the Schedules and Payments section. Any items requiring delivery within the first sixty (60) days of the project or prior to submission of the Project Schedule shall be identified at the Preconstruction Meeting.

24.3. The COTR will notify the Contractor of scheduled delivery dates no less than two (2) full working days in advance of delivery. The Contractor shall accept delivery of the items on scheduled dates or be responsible for any damage and/or expenses resulting from his failure to take delivery. Promptly upon delivery, the Contractor shall contact the COTR, and they shall jointly inspect the material or equipment for possible shortage or damage. If a shortage or damage is found, the Contractor and the COTR shall submit a report to the Contracting Officer.

24.4. The Contractor shall be responsible for proper storage and protection of items delivered, including all expenses incidental thereto.

24.5. For each item, the Contractor shall receive, sign for receipt, provide additional transportation as necessary, uncrate, assemble, locate in place, and provide complete installation including all connections necessary for operation or use. Installation and connection shall be in accordance with manufacturer's specifications as well as contract documents, including all labor and material required.

25. SALVAGE

25.1. The Smithsonian Institution assumes no responsibility for salvage value or any loss or damage to materials or structures on the site for which the Contractor may have reflected a salvage value in his or her offer.

25.2. Except as specifically stated in the contract documents, construction materials, equipment or other items that are to be removed and neither re-used under this contract nor reserved as property of the Smithsonian Institution shall become the property of the Contractor and shall be removed from the premises by the Contractor.

26. CUTTING, PATCHING AND MATCHING EXISTING WORK

26.1. Existing work shall be cut, drilled, altered, removed, or temporarily removed and replaced as necessary for performance of work under the contract. Work that is replaced shall match similar existing work. Structural members shall not be cut or altered, except where noted on drawings, without authorization of the COTR. Work to remain in place, which is damaged or

defaced during this contract shall be restored to match the conditions existing at the time of award of the contract, at no additional cost to the Smithsonian.

26.2. Conditions exposed by removal of existing work that do not match new finishes or align with new work shall be called to the COTR's immediate attention. Necessary corrective work directed by the COTR will be subject to adjustment provisions as stated in the General Conditions of the contract.

SECTION E - PROTECTION OF THE SITE DURING CONSTRUCTION

27. PROTECTION OF THE SITE

27.1. The Contractor shall provide adequate protection for all parts of the building, including interior and exterior surfaces, its occupants, contents, and grounds wherever work under this contract is performed.

27.2. Plan for Protection of the Site: The Contractor shall submit a plan for protection of the site to the COTR for approval. The plan shall be submitted no less than five (5) working days after the Preconstruction Meeting. As a minimum, the Plan shall describe:

27.2.1. Proposed method, location, and construction of temporary enclosures.

27.2.2. Routes of access and egress, including those for people with disabilities.

27.2.3. Location and maintenance of emergency exits.

27.2.4. Methods of protection of existing surfaces and occupants.

27.2.5. Means of connection of temporary enclosures/surfaces to existing historic materials.

27.3. During construction, temporary enclosures shall be constructed to prevent unauthorized access or egress. Dust and fume barriers shall be constructed, as needed, or as determined by the COTR, to seal and isolate the work area from the remainder of the interior areas while the work is in progress. Wood used for protection of the site shall be pressure-impregnated, fire-retardant. All plastic sheeting shall be fire retardant 6-mil polyethylene. Submit product data to the COTR for review and approval.

27.4. The Contractor shall submit information describing the proposed construction of temporary enclosures and methods of installation to the COTR for approval. Any connections to existing structures must be accomplished in such a way as to minimize disturbance of existing surfaces.

28. PROTECTION OF FLORA, FAUNA, AND IRRIGATION SYSTEM

28.1. Flora Protection: The Contractor is expressly prohibited from collecting plant materials on Smithsonian property.

28.2. The Contractor shall not store materials inside the dripline of trees or shrubs. Prior to the start of the work on site, the Contractor shall surround trees within the project site and adjacent areas with a protective 6-foot-high chain link fence located 1 foot minimum outside the drip line.

28.3. Vehicular traffic inside the dripline of trees, on turf areas or on flowerbeds is not permitted without prior approval of the Smithsonian's Department of Horticulture through the COTR. If flowerbeds must be crossed by vehicles, bridging is required. Bridging shall be 4-inch-thick timbers, 2 layers of ¾ inch exterior grade plywood or 2" x 10", or 1" protective plastic decking such as Bravo mat or equal to help prevent soil compaction of the soil in the lawn areas and flowerbeds. Any turf area used for parking with prior approval as noted above must first be planked by the Contractor.

28.4. Where aerial work is being performed above flower/shrub beds, the Contractor shall protect them with an approved protective framework installed at least 300 mm above the tops of the plant materials. The Contractor shall submit the proposed method of protection to the COTR for approval. Trees and shrubs shall only be tied back with the approval of the COTR.

28.5. Any damage to the existing irrigation systems during construction shall be repaired by the Contractor within two calendar days from when the damage occurred.

28.6. NOT USED

28.7. The Contractor shall bear all costs for repairs to the damaged irrigation system. Where the low voltage control wiring is damaged due to construction, then said wiring shall be replaced from the zone valve to controller. No splicing will be permitted.

28.8. Identification tape, when damaged, shall be replaced with an identification wire from valve to controller.

28.9. All damaged irrigation piping shall be cleared of debris prior to making the connections.

28.10. The Contractor shall bear all costs for replacement of damaged plant materials. Replacement plant materials shall meet the criteria established by the SNZCBI's Department of Horticulture.

28.11. Plant material removed by the Contractor for reuse shall be balled, bagged, and protected in accordance with instructions prepared by the SNZCBI's Department of Horticulture.

28.12. Turf areas damaged during construction shall be repaired by the Contractor by rototilling a minimum depth of 6 inches, backfilled with sandy-loam topsoil. Sod shall be certified sod, none netted and a minimum of one year old. Sod shall be 90:10, consisting of a minimum of three varieties tall fescues and one Kentucky Bluegrass. The SNZCBI's Department of Horticulture, through the COTR, must approve the source of the sod. The Contractor shall bear all costs for these repairs. Suggested sources are:

Oakwood Sod Farm, Inc.
29307 Waller Road
Delmar, MD 21875
Phone: (410) 896-4009
Toll-Free: (800)379-8488

Collins Wharf Sod
25361 Collins Wharf Rd
Eden, MD 21822
Phone: 410-334-6676
Fax: 410-749-3815
cwsod@collinswharfsod.com

Summit Hall Sod Farm
21300 River Road
Poolesville, MD 20837-9114
Phone: 301-948-2900

Fax: 301-349-2668

28.13. The Contractor shall be responsible for the daily removal of trash and construction debris from turf and flower/shrub beds within the limits of construction.

28.14. Any plant material destroyed and/or damaged by the Contractor during construction shall be replaced with like genus and species of the same size, at no additional cost to the Smithsonian. The damaged plant materials must be replaced prior to final payment. The same applies to artifacts or furniture collection pieces. The COTR requires five (5) working days' notice should any of the artifacts or furniture collection need to be removed to facilitate construction.

28.15. Any construction scaffolding on turf and planted beds must be coordinated with the SNZCBI's Department of Horticulture, through the COTR, to ensure that its installation will not damage or destroy existing plant materials or turf area or interfere with daily maintenance of the grounds. Trees may be tied back to permit scaffolding erection, no more than 4 feet if possible. The tying back must be performed by a certified Arborist with the approval of SNZCBI's Department of Horticulture through the COTR. Where scaffolding is necessary to facilitate construction, SNZCBI's Department of Horticulture requires a three (3) workday notice for said work.

28.16. NOT USED

28.17. Fauna Protection: The Contractor is prohibited from hunting, collecting, or feeding animals on Smithsonian property. All food and food wrapping brought on the premises must be properly disposed of in approved containers, which are secured from animals.

28.18. If a generator is placed on the turf, Contractor must have the COTR's approval of its placement. Generator shall be placed on anti-compactor boards. The generator must be placed in a drip containment basin.

28.19. A schedule of values for plant material is not required.

28.20. Use requirements for 28.21 topsoil, 28.22 screened leaf mold, 28.23 soil mix aggregate, and 28.25 ground limestone when any of the following conditions occur:

a) When landscaping is part of the work, but a separate soil spec is not provided
b) When a Contractor has damaged an area that includes soil or landscaping and is to be repaired
c) For backfill as noted under 28.24

28.21. Topsoil: ASTM D 5268, fertile, naturally sandy loam as defined by USDA Handbook no. 18, Figure 38. It shall be natural, surface soil in a friable condition and contain less than 3% subsoil. The topsoil shall be free of hardpan material, stones, and clods larger than ½ inch in diameter, sticks, tree or shrub roots, debris, toxic substances (e.g., Residual herbicides) and other material detrimental to plant growth. The area and the topsoil shall be free of plant or plant parts of undesirable plants such as, but not limited to, Bermuda grass, nut sedge, mugwort, Johnson grass, Quack grass, Canada Thistle, or noxious weeds as set forth in the Federal Seed Act. It shall be certified free of Southern Blight.

28.21.1 Contractor shall notify COTR of location of all sources of the topsoil and

furnish the COTR a certified report from the agricultural experiment station or approved agricultural laboratory of an analysis performed not more than 60 days prior to the date of submission. If the topsoil is a mix, it shall be mixed off-site. The topsoil shall be certified to meet the following requirements:

a. Shall be a natural, original surface soil of a sandy loam texture with a mechanical analysis of 60-65% sand, 15-25% silt and 10-15% clay.

b. Shall have at least 2%, but not more than 5%, organic matter.

c. Soil pH shall be 5.5 to pH 6.5 inclusive unless otherwise specified.

d. Soil salinity by electrical conductivity measurement shall not exceed 600 parts per million (ppm) as determined by Black, Editor "Method of Soil Analysis," Part 2, published by the American Society of Agronomy, 1965.

e. The soil nutrient level shall be greater than 100 lbs./acre of magnesium, 150 lbs./acre of phosphorous and 120 lbs./acre of potassium.

28.21.2. Agricultural limestone at not more than 5 pounds per cubic yard of topsoil may be used to adjust an acidic condition provided it is well mixed in a manner, which does not destroy the structure of the soil.

28.21.3. Topsoil that has been synthesized by blending materials which individually do not meet the requirements of this specification will not be accepted even though the resulting blend meets the organic matter, mechanical analysis, pH, and soluble salts requirements.

28.21.4. The COTR reserves the right to inspect and sample all topsoil at the source and at the time of delivery. These inspections will be made without cost to the Contractor.

28.21.5. Topsoil must not be delivered or handled in a frozen or muddy condition.

28.21.6. Shipment and Delivery - All soil must be approved by the COTR before delivery to the site. Any material not meeting requirements of this specification will be rejected on or after delivery.

28.22. SCREENED LEAF MOLD

As available through Maryland Environmental Services, 2020 Industrial Drive, Annapolis, MD 21401 (301/261-8596) or approved equal, completely composted, and free from all materials such as glass, paper, plastics, etc. Composted sewage sludge shall not be used.

28.23. SOIL MIX AGGREGATE

Aggregate shall be Solite 3/8 as manufactured by Solite Corp., 2508 Chamberlain Avenue, Richmond, VA or approved equal. Lightweight aggregate shall be expanded shale or slate expanded by the rotary kiln process. The aggregate shall meet the requirements of the American Society of Testing Materials C331-81 and C33-80.

28.24. BACKFILL

28.24.1 When existing soil is acceptable for use: Existing topsoil shall be used unless so directed otherwise by the COTR. The following mixture in accordance with the specifications herein, thoroughly mixed by volume shall be used as backfill:

6 parts existing soil
2 parts leaf molds
2 parts Solite #388

28.24.2. When existing soil is not acceptable for use: If so, determined by the COTR that the existing soil is not acceptable for use, the Contractor shall excavate all soil to a depth of 24 inches and disposed of off-site. The following backfill mixture, thoroughly mixed by volume in accordance with the specifications herein, shall replace the excavated soil:

60% sandy loam topsoil
20% Solite #388
20% Composted leaf mold

28.24.3. Backfill shall be mixed off site. If requested, backfill shall be mixed in the presence of the COTR. Backfill must be approved by the COTR before delivery to the job site.

28.25. GROUND LIMESTONE

Lime: ASTM C 602, Class T, agricultural limestone containing a minimum 80% calcium carbonate equivalent with a minimum 99% passing a No. 8 (2.36 mm) sieve and a minimum 75% passing a No. 60 (250 micrometer) sieve.

28.25.1. Provide lime in the form of dolomitic limestone.

29. DEBRIS CONTROL AND DAILY CLEANUP

29.1. The Contractor shall regularly clean up the work areas and shall, at all times, maintain the project in as neat and orderly a manner as is consistent with normal operations. Debris resulting from construction operations shall be removed from the site daily by the Contractor. The Contractor shall keep all access, haul routes and site areas free of dirt, debris and other materials resulting from construction activities.

29.2. Under no circumstances shall any rubbish or waste be dropped or thrown from one level of scaffolding to another or within or outside the building. Rubbish may be lowered by way of chutes, taken down on hoists or lowered in receptacles.

29.3. In addition to a general daily clean-up and removal of rubbish, the Contractor shall immediately prior to final inspection for completion and acceptance, or when directed by the COTR, have all surfaces swept and dusted, and all finished surfaces washed and in a new appearing condition with all stains, soil marks, dirt and other forms of defacement removed.

29.4. Trash receptacles: The Contractor shall provide enclosed trash receptacle(s) in quantity and size necessary to meet project needs, located as approved by the COTR. Trash receptacles shall be placed out of public viewing.

29.5. The Contractor shall recycle, salvage, or otherwise divert from landfills and incinerators, at least 50%, with a goal of at least 75%, by weight (tons), unless otherwise noted, of non-hazardous construction and demolition material. The contractor shall track recycling efforts and diversion rates using the Construction and Demolition Waste Tracking Sheet, attached. Before any work is started, the contractor shall submit a Construction Waste Management Plan, consisting of waste identification and a waste reduction work plan. Waste identification shall indicate anticipated types and quantities of demolition, site-clearing, and construction waste generated by the Work. Include estimated quantities and assumptions for estimates. Waste reduction work plan shall list each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures. With each application for payment, the contractor shall submit the Construction and Demolition Waste Tracking Sheet, attached, with data compiled for the payment period, including receipts from hauler or destination. Before request for substantial completion, the contractor shall submit calculated end-of-Project percentage of waste diverted from landfills and incinerators (recycled, salvaged, or disposed) as a percentage of total waste generated by the Work. With request for final payment, the contractor shall submit actual percentage of waste diverted from landfills and incinerators (recycled, salvaged, or disposed) as a percentage of total waste generated by the Work. Refer to *Construction Waste Demolition Waste Tracking Sheet*, following this section.

29.6. All food and food wrappings brought on the premises must be properly disposed of in approved containers that are secured from animals and pests.

29.7 All project waste must go to licensed disposal or recycling facility such as a C & D Landfill. Contractor shall provide SI (generator) with documentation that all waste has been properly characterized and disposed of in accordance with applicable regulations and defined under the 40 CFR 261.2.

30. DUST AND AIR QUALITY CONTROL

30.1. The Contractor will execute the Work by methods that minimize dust, vapors and gases raised by construction operations. The Contractor will utilize engineering controls and work practices to prevent airborne dust, vapors, gases, and objectionable odors from dispersing into the atmosphere and from being drawn into existing air-intake louvers, ductwork, and adjacent elevator shafts. A work plan of methods and means for this section shall be submitted to the COTR for review and approval.

30.2. Dust barriers shall be erected, where necessary, to protect adjacent areas from dust infiltration as required by the COTR. Dust barriers shall be rigid and visually opaque and shall seal the work area by affixing to the structure on all sides (i.e., ceiling, walls, and floor). Wood used for dust barriers shall be pressure-impregnated, fire-retardant treated lumber. All plastic sheeting shall be fire-retardant 6-mil polyethylene. Submit product data for review and approval to the COTR. Dust barriers shall be erected such that they are outside of the elephants' 15' reach distance. Coordinate with COTR and Animal Care Staff as needed.

30.3. Means of connection of dust barriers to existing structures shall not damage the building fabric. Details of barriers shall be submitted for approval to the COTR.

30.4. No open fires or burning of trash are permitted.

31. NOISE CONTROL

31.1. The Contractor shall comply with the regulations of the District of Columbia and OSHA Standards 1926.52 and 1910.95 and all other regulations relative to safety noise control.

31.2. Activities that generate excessive noise or vibration and interrupt SNZCBI functions or create public disturbances may be required to be performed during off-hours at the discretion of the COTR.

31.3. The Contractor shall provide sound attenuation to maintain acoustic level below 50 dBA at a distance of 15 m or below 50 dBA in occupied staff areas if less than 15 m away from noise source.

32. VERMIN, PEST, AND RODENT CONTROL

32.1. The Contractor shall use non-chemical means and practices that deter or prevent the introduction of pests into the project site or premises. No chemical means shall be permitted. Contractor's focus should be NO FOOD DEBRIS on site with mandatory daily cleanup and removal.

33. DRILLING, WELDING TORCH CUTTING AND OTHER OPERATIONS THAT PRODUCE AIRBORNE CONTAMINANTS

33.1. Daily Permits:
When welding, torch cutting or other heating operations are to occur inside existing structures, the Contractor shall obtain a daily **HOT WORK PERMIT**.

During the course of the Work, all existing smoke and heat detectors and sprinklers heads must remain operable. Coverings may be applied to protect them from spray coatings or other hazardous conditions only during the actual operations. Coverings must be removed immediately after the operations have concluded, but at the end of each working day at a minimum. When work produces dust or other airborne contaminants, e.g., spray painting, that could impair existing fire suppression or detection system(s) or when the system itself is otherwise impaired (drained down, etc.), the Contractor shall obtain a daily **FIRE SYSTEM IMPAIRMENT PERMIT**. Each permit must be obtained at least two working days in advance from the COTR and posted at the job site prior to beginning the scheduled work.

33.2. Fire Watch: No welding or torch cutting shall be performed unless adequate fire protection is provided. The Contractor shall maintain a fire watch for the duration of welding, cutting, and heating operations and for at least 30 minutes after the 'hot' work has stopped. A fire extinguisher (minimum 10 pounds, dry-chemical type, typical) shall be on hand when drilling, welding, or cutting.

33.3. Use of Impact Hammers: The use of impact hammers or other equipment causing vibration, noise and dust may be harmful to collection animals and/or building occupants. The Contractor shall request approval from the COTR at least five (5) working days before beginning

this type of work to ensure adequate time for notification of building occupants and protection of objects and collections.

33.4 Ventilation: The Contractor shall provide adequate ventilation to prevent air contamination or the accumulation of toxic materials. Take necessary measures to prevent welding fumes from entering mechanical ventilation systems, or passive transfer to adjacent areas. Seal all adjacent ducts and equipment openings with plastic. Where transfer is deemed likely or verified by the COTR, utilize local exhaust ventilation with HEPA filtration to control welding fumes. The Contractor shall submit means and methods for controlling air contamination to the COTR for review and approval.

SECTION F - TEMPORARY CONSTRUCTION FACILITIES

34. CONTRACTOR FIELD OFFICES, TRAILERS, AND SHEDS

34.1. The Contractor may establish a temporary office at the project site. The Contractor shall provide information about proposed locations of any temporary office, sheds, trailers and staging and storage areas and designation of size, color, and materials to the COTR for approval at least fourteen (14) days prior to mobilization.

34.2. The Contractor may provide his own locking device on the door to the temporary office, trailer or shed. The Contractor shall be solely responsible for the safekeeping and security of the construction facilities, materials, and equipment.

34.3. Upon completion of the Work, the temporary offices, trailers, and sheds shall be removed, and the area returned to its original pre-contract condition.

35. STAGING, STORAGE AND WORK AREAS

35.1. Staging and Storage Areas: The Contractor shall coordinate with the COTR the use of any area proposed for staging and storage of materials and equipment at least five working days prior to mobilization or at the Preconstruction Meeting, whichever is first.

35.2. The Contractor shall provide adequate storage and protection of materials and equipment delivered to the site to prevent theft, weather damage, mold infiltration, moisture damage and other physical damage. The site shall be maintained in a neat and orderly manner as to further minimize hazards to personnel, animals, visitors, materials, and equipment.

35.3. Plan for Staging, Storage & Work Areas: The Contractor shall submit a drawing of areas proposed for construction operations for approval by the COTR at least fourteen (14) days prior to mobilization or at the Preconstruction Meeting, whichever is first. The drawing shall show buildings, utilities, temporary toilet facilities, temporary utility extensions, temporary interior walls and barriers to limit unauthorized intrusion and to control noise and dust, pedestrian walkways, vehicular access, temporary fencing, trailers, sheds, storage areas and the Contract's desired route for access and egress to the premises and to the project site.

35.4. All wood used for temporary, interior construction shall be pressure-impregnated with a "Dricon" treatment or an equal treatment approved by the Smithsonian Institution. All pieces must bear the UL "FR-S" stamp. Intumescent (fire-retardant) paint shall not be used. All plastic sheeting shall be fire retardant 6-mil polyethylene. Submit product data to the COTR for review and approval.

35.6 Temporary Chain Link Fencing with Lockable Gates shall isolate the public, SI staff and collection animals in accordance with the contract plans and technical specifications. In the event that all the work area locations are not specifically indicated within the contract documents, the contractor shall identify and implement a safe isolation barrier. All fence sections will be maintained in a new or like new condition. Damaged sections will be removed from site.

35.6.1 **FENCE TYPE - Temporary Chain Link Fencing:** Contractor shall provide and maintain a 6’ 0” tall by 7’ 0’ wide steel pipe framed fence with 2” x 2”

galvanized steel fabric barrier surrounding the construction site and or work zones. Provide panel support bracing - 1-3/8" Pipe 7' L with (2) bends and bases to add extra support to chain-link panels as required to ensure fence is stabilized to withstand anticipated winds while remaining upright.

35.6.2 **BASE TYPE -** Temporary Post Stands: Hi-Viz Anchor Stand Temporary Fence Base to Prevent stubs, trips, and other accidents with a high-visibility temporary fence base when placed on or near walking surfaces.

36. SANITARY/TOILET FACILITIES

36.1. Contractors' personnel will be permitted to use designated public restrooms located on the premises, subject to the regulations and control of the COTR. If, in the opinion of the COTR, the Contractors' personnel fail to maintain acceptable dress and conduct appropriate to a public place, permission to use the public restrooms may be rescinded. In the event the project's location warrants temporary facilities the location and quantity of units shall be approved by the COTR.

37. TEMPORARY UTILITY SERVICES AND EXTENSIONS

37.1. Existing electrical and water utilities are available for the Contractor's use as designated by the COTR. Contractor shall implement basic conservation measures or privilege to access will be rescinded.

SCAFFOLDING AND PLATFORMS

38.1. The Contractor shall erect temporary scaffolding in accordance with OSHA 29 CFR 1926.451 and ANSI A10.8. The Contractor shall provide landing platforms with stairways or ladders for proper access and egress to all work areas.

38.2. For all frame scaffolding greater than 4 m in height, the Contractor shall submit working drawings to the COTR a minimum of ten (10) working days in advance of scaffolding erection. Working drawings submitted by the Contractor shall be certified by a registered Professional Engineer. Provide additional safety plan and training certifications for any motorized scaffolding or lifts. Provide weight and size of any proposed motorized lifts for approval.

38.3. During non-working hours, the Contractor shall close and lock the scaffolding/lifts with a physical barrier to prevent access by unauthorized persons.

39. PROJECT SIGNS – N/A

SECTION G - MEETINGS

40. PRECONSTRUCTION MEETING

40.1. A Preconstruction Meeting will be scheduled with the Contractor before any work is started at the site. As soon as possible after the Date of Award, the COTR will contact the Contractor to arrange a time, date, and place for the conference. Items to be discussed at the Preconstruction Meeting include, but are not limited to:

40.1.1. Contract Time: Notice to Proceed date and Completion date.

40.1.2. Scheduling and Submittals.

40.1.2.1. Progress Schedule

40.1.2.2. Payment Breakdown Schedule

40.1.2.3. Required Submittals

40.1.3. Mobilization and Staging – Area for Materials and Equipment.

40.1.4. Access to the Premises, Haul Routes, Loading Dock.

40.1.5. Contractor Deliveries.

40.1.6. Security Requirements/List of Contractor's Personnel.

40.1.7. Emergency Procedures and Phone Numbers.

40.1.8. Protection of Site and Premises.

40.1.9. Fire Protection, Safety and Health Requirements.

40.1.10. Utility Interruptions, Rough-in Inspections, Testing.

40.1.11. Applications for Payment.

40.1.12. Pre-Condition Survey of the Site.

40.1.13. Accessibility Requirements.

40.1.14. Sequence of Construction.

40.1.15. Quality Assurance and Inspection of the Contract Work.

40.1.16. Sustainability Requirements.

40.1.17. Building Systems Commissioning.

40.1.18. Quality Control.

40.1.19. Preservation of Wildlife and Natural Resources.

40.2. All of the Contractor's staff and Subcontractors or Suppliers whose presence is necessary or requested by the COTR shall attend the Preconstruction Meeting.

40.3. Coordination Plan: The Contractor shall use the Preconstruction Meeting to develop a Coordination Plan for interaction with other parties working in or using the facility. The plan shall be submitted no less than five (5) working days after the Preconstruction Meeting and shall address interactions with other contractors, tenants, the public and any others making use of the site and surrounding areas. As a minimum it shall include:

40.3.1. Locations of overlap in use of the site by the Contractor and others, including work areas, delivery points, access/egress areas.

40.3.2. Specific items of work by others required to support critical milestones in the Contractor's schedule.

40.3.3. Completion or delivery of work by others that may impact the Contractor's schedule.

40.3.4. Portions of the work that create special hazards or disturbances.

40.3.5. Portions of the work that affect utilities, fire-protection or detection systems or security systems.

40.3.6. Events requiring access to areas outside of the project site or secured spaces.

40.3.7. Protection to be provided by the Contractor for work completed by others either before or during this project.

41. PRE-CONDITION SURVEY OF THE SITE

41.1. After the Preconstruction Meeting and before the start of work on the site, the project site (i.e., building, yards, contents, grounds, and equipment) shall be inspected by the Contractor, major Subcontractors, COTR and other Smithsonian Institution and SNZCBI personnel as may be required for the purpose of verification of the existing conditions. Any damages or defective equipment will be noted at this time and this survey will serve as the basis for the establishment of the pre-contract conditions. The Contractor and Smithsonian Institution will jointly establish the identification of pre-contract conditions.

41.2. Any damage to the buildings, yards, their contents, grounds, or equipment that occurs during the contract period, unless noted as existing during the inspection as specified above shall be repaired to its pre-contract condition by the Contractor at no cost to the Smithsonian. The COTR will determine the adequacy of the repairs as required in the previous paragraph.

41.3. Written and photographic documentation: The Contractor shall prepare photographic presentation report in PDF format to identify all damages or defects of materials, equipment, and the site. The Contractor shall submit report electronically to the COTR before staring any work on site.

41.4 Underground Infrastructure: For the purpose is to prevent damage to underground infrastructure, the contractor shall provide a utility location service for all areas to be excavated. Note: Miss Utility will locate only Washington Gas's Service lines on the NZP campus, all other utilities must be located by the contractor's firm.

PROJECT MEETINGS

42.1. Progress Meetings: The COTR will lead regular progress meetings with an interdisciplinary integrated management team consisting of representatives (as required) of the

Contractor, Smithsonian, Architect/Engineer, Commissioning Provider, major Subcontractors and other critical Subcontractors and suppliers. The purposes of these meetings are to expedite the work, coordinate and schedule the Work and coordinate the work with Smithsonian activities. Progress meetings shall be held weekly unless otherwise directed by the COTR. The time and place of the meetings will be established at the Preconstruction Meeting. The Contractor shall ensure that all required Subcontractors and suppliers attend the Progress Meetings and the COTR will ensure that all necessary SI personnel attend.

42.2. Special-Topic Meetings: At the discretion of the COTR, additional separate meetings may be scheduled to address issues of quality control, sustainability requirements, coordination between contractors on the premises, coordination with other agencies, scheduling of the work, application for payments, etc. The Contractor's staff and Subcontractors or Suppliers whose presence is necessary or requested by the COTR shall attend.

42.3. Meeting Minutes: The Contractor shall promptly prepare minutes of each meeting and transmit to the COTR, within five (5) working days.

SECTION H – SUBMISSIONS

43. SUBMITTAL DEFINITIONS

43.1. Submittals are defined to include shop drawings, product data, samples and additional data required for submission to the COTR for review and approval prior to incorporation into the work. All documentation transmission shall be electronic, unless otherwise requested.

43.1.1. Shop Drawings: Detailed drawings, schedules, diagrams, and illustrations prepared specifically for this project by the Contractor or any subcontractor, manufacturer, supplier, or distributor to illustrate fabrication and/or installation of a portion of the Work.

43.1.2. Schedule: A detailed tabulation of components, items, or parts to be furnished for use on this project.

43.1.3. Statement: An affirmation prepared by the Contractor, the installer or manufacturer of a material, product, or system, to satisfy a requirement defined in a technical section.

43.1.4. Factory Test Report: A written report of the findings of a test performed by the Contractor on an actual portion of the Work or prototype prepared for this project before it is shipped to the site.

43.1.5. Field Test Report: A written report of the findings of a test performed by the Contractor on a portion of the Work during or after installation.

43.1.6. Certificate of Compliance: A written statement, signed by an authorized official of the manufacturer of a product or system or supplier of a material attesting that the product, system, or material meets the requirements of the contract documents. The certificate of compliance must be dated after the award of this Contract and must name the project and cite the specification section, paragraph, and requirements, which it is intended to address.

43.1.7. Product Data: Illustrations, standard schedules, performance charts, instructions, brochures, diagrams, manufacturer's descriptive literature and catalog information illustrating a material, product or system to be installed on this project, including all data related to LEED requirements, such as recycled and regional content information, Volatile Organic Compound (VOC) product schedules, Forest Stewardship Council (FSC) chain-of-custody documentation and other documentation as requested by the COTR.

43.1.8. Color Charts: Pre-printed brochures showing the color range of a material.

43.1.9. Test Reports: Reports verifying that a material, assembly, system, process, or laboratory meets requirements established in the Contract Documents. Reports shall indicate compliance by naming and describing the test method and test results. Testing must have occurred within three (3) years of the date of award of this contract.

43.1.10. Samples: Physical examples of materials, equipment, assemblies, or workmanship establishing standards for evaluating finished Work.

43.1.11. Color/Texture Selection Sample: Samples of an available range of textures and/or colors of a material formed of the actual finish material over a substrate identical to that which will be used in the field.

43.1.12. Mock-up: An assembly or sample panel constructed in accordance with specifications to show construction details, finished appearance and/or performance.

43.1.13. Material Safety Data Sheets: Instructions, warnings and recommended and required handling and use procedures for individual hazardous materials published by the product manufacturer.

44. SUBMITTALS AND REVIEWS

44.1. Contractor Responsibility for Submittals: The Contractor shall provide all required submittals, by technical specification section, in accordance with the contract documents. All submittals, with exception of mockups or samples, are to be submitted electronically by email in PDF format. The Contractor shall clearly indicate on the submittal that it has been reviewed by the Contractor and found to meet the project requirements. Any items submitted as substitutions shall be clearly identified as such on the submittal and the transmittal document. If shop drawings show variations from the contract documents because of standard shop practices or for other reasons, the Contractor shall provide a separate, written description of variations along with the submittal. The Contractor shall:

44.1.1. Review each submittal for conformance with requirements of the contract documents and coordination with related work.

44.1.2. Determine and verify all field measurements, required material quantities, method of assembly or erection, installation requirements and proper connection to adjoining materials installed by others.

44.1.3. Assure that all submittals use the appropriate units of measure. All drawings and technical data shall be in SI (metric) units for projects designed in SI units. Preprinted literature in other units shall be accompanied by documentation to show conformance to project requirements.

44.1.4. Transmit all required submittals for a technical specification section at the same time unless prior written waiver of this requirement has been provided by the COTR.

44.1.5. Transmit submittals to the COTR in a logical and orderly sequence in accordance with the Submittal Schedule to prevent project delays or adversely impact work by the Smithsonian Institution or other contractors.

44.1.6. Correct and resubmit submittals according to response from Smithsonian Office of Planning Design & Construction.

44.1.7. Commence work on items requiring submittals only after all related submittals are reviewed and approved by the Smithsonian. All Work shall conform to approved submittals.

44.2. Submittal Schedule and Control Log: The Contractor shall submit, to the COTR, a schedule of work-related submittals using the Smithsonian SF Submittal Log form within *fourteen (14) calendar days after the effective date of the Notice to Proceed. (An electronic Submittal Log form is available upon request.) Submittals shall be listed in the order they are scheduled to be submitted, and the following information shall be given:

44.2.1. Project Name, Project Number, Contractor Name, Contract Number.

44.2.2. Technical Specification Section for each submittal.

44.2.3. Unique Submittal Number.

44.2.4. Description of item to be submitted, as listed in the specifications.

44.2.5. Date item must be submitted to the Smithsonian in order to support the project schedule.

44.2.6. Subcontractor providing submittal (in "Comments" column).

44.3. Quantities for Submittals: Unless otherwise noted in the technical specification, the Contractor shall deliver to the COTR:

44.3.1. Shop Drawings: Submit electronic copy of shop drawings in PDF format. Submittal will be forwarded electronically to the AE for review. After submittal review, submittal will be returned to the Contractor electronically, in PDF format. Submit in DWG format, if requested. Submit reproducible black line prints, if requested.

44.3.2. Product Data, Test Reports, Color Charts, etc. The Contractor will make electronic submittals in PDF format, except for Color Charts. Submit two (2) original Color Charts from each product representative to be retained by the Smithsonian; copies or printouts from the computer will not be accepted. After submittal review, submittal will be returned to the Contractor electronically, in PDF format.

44.3.3. Color/Texture Samples: Submit two (2) samples, minimum size 600 mm by 600 mm, unless otherwise specified. After submittal review, the Smithsonian may retain one (1) sample.

44.3.4. Mock-up and Sample Installations: Unless otherwise specified, minimum size shall be as noted to complete a panel section or normal break in the work.

44.3.5. Written Text Documents, Plans and Reports: Submit electronic copy of written text documents, plans, and reports in PDF format. Submittal will be forwarded electronically to the AE for review. After submittal review, submittal will be returned to the Contractor electronically, in PDF format.

44.4. Submittal Reviews by the Smithsonian: Reviewed submittals will be marked "Approved," "Approved as Noted," "Resubmit" or "Disapproved." Submittal approval by the Smithsonian shall not relieve the Contractor of responsibility for submittal errors, omissions, or deviations from the contract documents. Approval of submissions does not constitute acceptance

of substitutions except as covered under sub-paragraph entitled "Contract Requests for Substitutions."

44.5. Submittal Review Period: The Contractor shall transmit, to the COTR, all submittals sufficiently in advance of the time necessary for fabrication and installation to allow for review by the Smithsonian and return to the Contractor, including any time needed for correction and resubmission by the Contractor. The expected time required by the Smithsonian for review of initial submission is 14 calendar days. No extension of the Contract Time will be granted for the Contractor's failure to allow sufficient time for review and processing, including resubmission of items that are initially rejected due to improper submission or non-compliance with the Contract Documents.

44.6. Contractor Requests for Substitutions as Equal: Contractor requests for items identified by manufacturer, brand name, make, catalog number, etc. in the contract documents shall be submitted to the Contracting Officer for approval prior to contract award, in accordance with the General Conditions. After award of the contract, contractor requests for substitutions may be considered and accepted by the Smithsonian at the discretion of the Contracting Officer.

44.7. Construction Progress Schedule Submittal: The Contractor shall submit a progress schedule within one (1) calendar day from the date of the Notice to Proceed. No work shall start at the site until the progress schedule has been approved by the COTR. The schedule shall provide a weekly breakdown of activity including interaction between trades and be subdivided in accordance with items of work or areas of the job where the work is to take place. The schedule shall also list equipment, special devices, hardware, products, or other items requiring long lead time, when these items are ordered and the projected delivery dates. The last week of the schedule shall reflect final inspection, testing, and the correction of deficiencies.

45. CRITERIA FOR PRODUCT SELECTION

45.1. To the greatest extent possible, subject to the restrictions of the Buy American Act, provide products, materials, or equipment of a singular generic kind from a single source. Where more than one choice of a product or material is available for Contractor's selection, select an option, which is compatible with other products and materials already selected.

45.2. Provide products complete with accessories, trim, finish, safety guards and other devices and details needed for complete installation for intended use and effect.

45.3. Products, which, by nature of their application, are likely to be needed at a later date for maintenance and repair or replacement work, shall be current models for which replacement parts are available.

45.4. Product selection shall be done in accordance with the following requirements:

45.4.1. Standards, Codes and Regulations: Select from among products that follow the project requirements, as well as with construction standards, all applicable codes and regulations and LEED requirements.

45.4.2. Performance Requirements: Provide products that comply with specific performances indicated and are recommended by the manufacturer (in published product literature or by individual certification) for the application indicated.

45.4.3. Prescriptive Requirements: Provide products that have been produced in accordance with prescriptive requirements, using specified ingredients and components and complying with specified requirements for mixing, fabricating, curing, finishing, testing and other operations in the manufacturing process.

45.4.4. Visual Matching: Where matching with an established sample for color, pattern, and/or texture, the COTR shall determine whether a proposed product matches the sample.

45.4.5. Avoidance of banned materials: The Contractor will commit to not using the following toxic and hazardous materials:

45.4.5.1. Products containing asbestos, urea formaldehyde, polychlorinated biphenyls (PCBs) and/or chlorinated fluorocarbons.

45.4.5.2. Products containing lead content, including older or flux containing more than 0.2 percent lead; domestic water pipe or pipe fittings containing more than 8 percent lead; and paint containing more than 0.06 percent lead.

46. PHOTOGRAPHIC DOCUMENTATION

46.1. The Contractor shall provide digital photographs of the project site and construction activities throughout the progress of the Work, acceptable to the Smithsonian Institution. The COTR shall determine the vantage points from which photographs will be taken.

1. At least 24 color progress photographs shall be taken monthly. The actual number and location of views shall be directed by the COTR. Plus Photographs shall be taken at the start and finish of various elements of construction designated by the COTR.

47. CONTRACTOR CORRESPONDENCE AND DAILY REPORTS

47.1. The Contractor shall correspond with the COTR for all matters related to this construction project, unless otherwise directed. All correspondence shall be signed and dated by the Contractor and shall reference the project, project number and contract number.

47.2. The Contractor shall maintain daily reports using the Smithsonian Institution Contractor's Daily Report form. Reports shall be numbered consecutively, and all sections shall be completed or noted as "not applicable." Reports shall contain detailed remarks each day, including but not limited to progress on the job, problems discovered and discussions with Smithsonian staff. Reports shall be submitted to the COTR each day for the previous workday.

SECTION I - SAFETY, HEALTH, AND FIRE PROTECTION

48. JOB SITE SAFETY

48.1. Safety Coordinator: The Contractor shall designate a person responsible and accountable for personnel safety at both corporate and project level at the project site for the duration of the project. Contracts specifically requiring safety or industrial hygiene personnel shall include a copy of their resumes. Qualifications for the Safety Coordinator shall include the OSHA 30-hour course or equivalent course.

48.2. Job Site Safety Plan: The Contractor shall submit a Jobsite Safety Plan at least 15 calendar days prior to mobilization to the site for approval by the COTR. As a minimum, the plan shall detail the procedures, designated persons, instructions, and reports to be used to assure jobsite safety for all contractors, subcontractors, Smithsonian personnel, the public and others on the site.

48.2.1. Site Specific Safety Plan: Upon award of this contract, the contractor shall provide a Site-Specific Safety Plan (SSSP). The SSSP is a safety and health policy and program document and outlines how the contractor will safely conduct their work. This plan shall be job-specific and shall also address any unusual or unique aspects of the project or activity for which it is written. The SSSP shall interface with the employer's overall safety and health program, and a copy shall be available on the work site. Any portions of the employer's overall safety and health program that is referenced in the SSSP shall be included as appropriate. The plan shall include but not limited to the following:

a. Signature Sheet that must include plan concurrence (e.g., Chief of Operations, Corporate Chief of Safety, Corporate Industrial Hygienist, project manager or superintendent, project safety professional, project QC). Provide concurrence of other applicable corporate and project personnel (Contractor).
b. Background Information that must include Brief project description, description of work to be performed, and location; phases of work anticipated these will require a Job Hazard Analysis (JHA's). OSHA 3071
c. Statement of Safety and Health Policy
d. Responsibilities and lines of Authority
e. Subcontractors and Suppliers
f. Training
g. Safety and Health inspections that include assignment of responsibilities for a minimum daily/weekly job site safety and health inspection during periods of work activity level of technical proficiency needed to perform the inspections, proof of inspector's training/ qualifications.
h. Accident Reporting
i. Plans (programs, procedures) required by the Safety Manual. Based on a risk assessment of contracted activities and on mandatory OSHA compliance programs, the Contractor shall address all applicable occupational risks and compliance plans. Using the 29 CFR 1926 and/or current and accepted procedures in the EM 385-1-1 as a guide.
j. Risk Management Processes Detailed project-specific hazards and controls shall

be provided by a Job Hazard Analysis (JHA) for each major phase/activity of work, including but not limited to work involving confined space, fall protection, trenching/excavation, crane/rigging, steel erection, hot work, protection of the public, scaffolding, and other activities that involve high risk potential.

k. Jobsite supervisor/superintendent shall sign safety plan and JHA submissions with a final approved copies kept on the jobsite for operational references.
l. Project Evaluation for OSHA's silica standard (29 CFR 1926.1153) focuses on reducing exposure to respirable crystalline silica 12.

Key requirements include:

i. Lowering the permissible exposure limit (PEL) from 250 ug/m3 TWA to 50 ug/m3 TWA.
ii. Implementing engineering controls, respiratory protection, a written plan, proper training, ongoing medical surveillance, and oversight by a competent person.

48.3. Occupational Safety and Health: This contract is subject to Title 29 of the Code of Federal Regulations, Part 1910 "Occupational Safety and Health Standards" and Part 1926 "Safety and Health Regulations for Construction" pursuant to the Occupational Safety and Health Act (OSHA) of 1970 administered by the US Department of Labor, Occupational Safety and Health Administration.

48.4. Emergency Assistance: The Contractor shall post, at the site, telephone numbers for reporting emergencies, including the SNZCBI's Police Station, ambulance, police, fire department, gas utility, electric utility, water/sewer utility, poison prevention aid and hazardous-waste handling. This information shall be posted in a conspicuous location within the project area prior to the start of any work at the site.

48.5. Safety Signs: The Contractor shall post legible accident prevention signs in construction areas in accordance with OSHA standards. Safety signs shall conform to ANSI 235.1 and 235.2 Vehicular traffic control devices, barricades and signals shall conform to ANSI D6.1.

48.6. Report of Accident or Illness: In the event of any accident or illness for which medical assistance is required, any criminal action or any fire, the Contractor shall notify the appropriate authority (Ambulance, Police, and Fire Dept.), Smithsonian Security, SNZCBI Police, and the COTR.

48.7. Emergency Evacuation: The Contractor shall post evacuation routes and facility emergency/self-protection plans at the site, train all employees in emergency procedures, and document such training. In the event of a fire, the Contractor shall immediately activate the alarm at the nearest fire alarm pull station and notify SNZCBI Police. Upon the activation of the audible alarm, the building will be evacuated. No personnel shall reenter the facility until security personnel signal that the building is safe.

48.8. Contractor Personnel to be Contacted: The Contractor shall submit a written list of emergency telephone numbers and names of persons to contact for the General Contractor superintendent and for each major sub-contractor working on the project site. The initial list shall be submitted to the COTR at the Preconstruction Meeting. The list shall be updated and resubmitted to the COTR as needed.

48.9 The Contractor shall be responsible for implementing the approved Plan throughout the duration of the project and shall promptly update the Plan as conditions or regulatory requirements change. Failure to submit or adhere to the approved Plan may be grounds for suspension of work, withholding of payments, or termination of the contract for cause.

49. TOXIC AND HAZARDOUS SUBSTANCES

49.1. The Contractor shall submit to the COTR for approval, at least ten (10) working days prior to their intended use, a written list of toxic and hazardous substances that will be used on the project. The Contractor shall submit a "Material Safety Data Sheet" similar to OSHA Form No. 20 with a Spill Prevention plan and Response Protocols for these substances to identify the following information:

49.1.1. Product Identification.

49.1.2. Hazardous Ingredients.

49.1.3. Physical Data.

49.1.4. Fire and Explosion Hazard Data.

49.1.5. Health Hazard Data.

49.1.6. Emergency and First Aid Procedures.

49.1.7. Reactivity Data.

49.1.8. Spill Prevention and Response Protocols.

49.1.9. Special Protection Information.

49.1.10. Special Precautions.

49.1.11. Volatile Organic Compound (VOC) Content.

49.1.12 Include fluids used within equipment and vehicles operated on site.

49.2. The Contractor will commit to not using the following toxic and hazardous materials:

49.2.1. Products containing asbestos, urea formaldehyde, polychlorinated biphenyls (PCBs) and/or chlorinated fluorocarbons.

49.2.2. Products containing lead content, including solder or flux containing more than 0.2% lead; domestic water pipe or pipe fittings containing more than 8% lead and paint containing more than 0.06% lead.

49.2.3. Chlorofluorocarbon (CFC)-based refrigerants in new base building heating, ventilating, air conditioning and refrigeration (HVAC&R) systems and comprehensive CFC phase-outs when reusing existing base building HVAC equipment.

49.2.4. The Contractor hereby understands that historic properties may contain pre-existing harmful materials and coatings including, but not limited to, arsenic, lead, dioxide, polyvinylchloride (PVC) and asbestos. Upon discovery of hazardous or toxic materials, the Contractor shall alert the COTR immediately.

49.3 The Contractor shall monitor the use of all toxic and hazardous substances to ensure that exposure to their workers from airborne concentration of, or physical contact with, these substances does not exceed applicable regulatory worker health and safety exposure limits.

49.4. The Contractor shall monitor the use of all toxic and hazardous substances to ensure that exposure to Smithsonian Institution and SNZCBI employees and visitors to airborne concentrations of, or physical contact with, these substances is maintained as low as reasonably achievable. Any equipment or technical measures for this purpose must first be approved by the SNZCBI's Safety Office through the COTR. Under no circumstances shall exposure exceed the established Short-Term Exposure Limit or 50% of the established Threshold Limit Values or Permissible Exposure Limits (whichever is less) as specified in either:

49.4.1. "Threshold Limit Values and Biological Exposure Indices" of the American Conference of Governmental Industrial Hygienists, latest revision, or

49.4.2. Title 29 CFR Part 1910, Subpart Z - "Toxic and Hazardous Substances" of the Occupational Safety and Health Standards, latest revision.

49.5. Exposure of the SNZCBI's animals to air-borne or any other physical contact with any toxic or hazardous substance will be prohibited.

49.6. All toxic and hazardous substances and materials used by the Contractor must be removed from the SNZCBI property upon completion of the project.

49.7. The Contractor shall provide methods, means and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances and pollutants produced by construction operations. The removal of contaminated waste shall follow applicable laws and regulations.

49.8. To achieve compliance with the requirements of this section, administration or engineering controls shall first be implemented whenever feasible. When such controls are not feasible to achieve full compliance, protective equipment or other protective measures shall be used to keep exposure of all persons within the prescribed limits. Descriptions of equipment or technical measures to be used for this purpose must be submitted to the COTR for approval. The Contractor's requirements for compliance with all applicable Local, Federal, and State regulations remain in force.

49.9. The SI may reject any product that poses a high risk of fire or health hazard to staff, visitors, or the building, based on flammability criteria (e.g., low flashpoint) or established toxicity data (e.g., designation as a human carcinogen).

49.10. The Contractor shall submit, to the COTR, a list of the hazardous materials to be stored on site and the manner in which they will be stored. All containers and storage cabinets shall be approved by the COTR and labeled as to hazard and content.

49.11. The SI has made every effort to identify and to notify the Contractor of hazardous materials that may be encountered during the work. However, if suspected asbestos-containing material, lead-based paint, or other suspected hazardous materials are encountered during

demolition or other phases of the work, the work involving the suspected material shall cease and the Contractor shall notify the COTR immediately.

50. PERSONAL PROTECTIVE EQUIPMENT

50.1. Personal protective equipment for eyes, face, ears, nose, head, extremities, and/or full body shall be provided, used, and properly maintained by the Contractor whenever necessitated by reasons of hazards encountered in a manner capable of causing illness, injury, or impairment in the function of any part of the body.

50.2. Persons required to use personal protective equipment shall be thoroughly trained. Training programs shall, as a minimum, meet OSHA and EPA requirements where applicable. The Contractor shall submit proof and criteria for employee training as requested.

51. BARRICADES, BARRIERS, AND WALKWAYS

51.1. The Contractor shall provide safety barricades in accordance with the District of Columbia Building Code and applicable OSHA regulations. The Contractor shall also provide barricades, subject to approval by the COTR, to deter passage of persons and/or vehicles into construction areas as specified or necessary.

51.2. The Contractor shall install temporary barriers, in a manner satisfactory to the COTR, to contain and secure the site from unauthorized entry and to minimize the adverse effects of noise, dust and vapors generated by construction activities on surrounding areas. Barriers shall be constructed of pressure-impregnated fire-retardant treated wood, with fire-retardant 6-mil polyethylene, as necessary. Submit all product data to the COTR for review and approval. Also see article 35. Staging, Storage and Work Areas in this specification section.

51.3. If the work interferes with public or employee access to the facility or parts of the facility, as determined by the COTR, the Contractor shall provide personnel barriers and signage to create easily identifiable, accessible (to people with disabilities) walkways around the work. Signs shall be posted at decision points to prevent unnecessary travel along changed routes and to dead ends. The barriers shall be erected and dismantled in phases so that a clear route is always available. The COTR and Contractor personnel shall have access through the barriers to the work areas. The Contractor may use hardware on the barrier doors to prevent entry by unauthorized persons.

51.3.1. Interior barriers shall be of standard drywall partition construction, painted and terminated at the underside of the existing ceilings. All requirements for fire protection shall be maintained.

51.3.2. Exterior barriers shall be of dimensional lumber and plywood, painted on both sides, and supported to prevent overturning. Barriers shall be repainted and maintained as necessary to remain in good condition as long as they are required.

51.4. Unless specifically indicated otherwise, barricades, barriers and associated signs shall be removed upon completion of the Work. The Contractor shall coordinate the dismantling and removal with the COTR.

52. EXISTING FIRE PROTECTION SYSTEMS

52.1. During the course of the Work, all existing smoke and heat detectors and sprinkler heads must remain operable. Coverings may be applied to protect them from spray coatings or other hazardous conditions only during the actual operations. Coverings must be removed immediately after the operations have concluded. Damaged detectors and sprinkler heads shall be replaced immediately by the Contractor at no additional cost to the Smithsonian Institution. The Contractor shall test replaced detectors and sprinklers after installation to the satisfaction of the COTR.

SECTION J – SECURITY REQUIREMENTS

53. GENERAL SECURITY REQUIREMENTS

53.1 The Contractor's personnel must comply with security requirements imposed by the National Zoological Park, including any necessary security clearances. Failure to inspect the site or obtain knowledge of security regulations shall not relieve the Contractor from security requirements or from performance of any part of the work.

53.2. Fourteen (14) days prior to the start of work on the site, the Contractor, after receiving the Notice to Proceed, shall submit to the COTR for approval, a list of the names and addresses of all employees and subcontractor employees who will be working on the site. The list shall identify the Prime Contractor and each subcontractor and trade. It shall be updated as necessary to accurately identify all workers who will be working on the site during the project.

53.3. Provide at the Preconstruction Meeting the name and telephone number of the Contractor's Superintendent and authorized alternate individual who can be reached on a 24-hour basis.

53.4. Notify the COTR prior to disturbing any alarm wiring, devices, systems, etc. Planned disturbances will be coordinated at least three (3) working days in advance of when the work is scheduled. Any alarm wiring, devices or systems that are disturbed for any reason must be reported to the COTR within five (5) minutes of the occurrence. The COTR will determine the procedures for repairing the damage and who will perform the repair work. The Contractor will bear the cost of such repairs.

53.5 The contractor shall provide adequate security to prevent the presence of unauthorized persons on the work site area, and to keep doors secured when not in actual use to ensure the integrity of the barrier as well as for the property security.

53.6. The Contractor is prohibited from hunting, collecting, or feeding animals on Smithsonian property.

53.7. The Contractor is prohibited from feeding, petting, or harassing any SNZCBI animal(s).

54. IDENTIFICATION BADGES

54.1 Contractors who are expected to be onsite for more than 30 days, are to pass a background check and be issued a Smithsonian Access Control Badge.

54.2. Contractors without a Smithsonian Access Control Badge must be escorted when entering the property.

54.3. Contractors who hold Smithsonian Access Control Badges are authorized to self-escort or escort other contractors onto the property.

55. SECURITY OF TEMPORARY OPENINGS

55.1. Any temporary opening in the building perimeter or between non-public and public interior spaces must be closed and secured with means acceptable to the COTR at the end of each workday. A clear and safe path shall be maintained at all times to allow visitors entrance into the National Zoological Park and its buildings. The Contractor shall secure his facilities and equipment during non-working times at his own expense. Authorized Smithsonian personnel shall have access to the work site.

56. EXISTING BUILDING ALARM SYSTEMS

56.1 Contractor and COTR shall review work plans prior to starting work to identify alarms and notifications that will be impacted by the scheduled work.

56.2 COTR shall approve all modifications and adjustments to inactivate notifications.

57. NZP POLICE OFFICER DUTY CHARGES N/A

SECTION K - SCHEDULES AND PAYMENTS

58. SCHEDULE OF VALUES

58.1. The Contractor shall submit, to the COTR, a schedule of estimated values of all parts of the work. The breakdown of costs on the Schedule of Values shall follow the divisions used in the project specifications and shall reflect major items and groups of items shown on the Contractor's project schedule. All values shall be in US dollars.

58.2. Wages: The contractor shall verify wages and comply with regulated wage scales, i.e., Davis-Bacon, Service Contract Act, etc.

59. SCHEDULING & PAYMENTS / CRITICAL PATH METHOD

59.1. CPM Scheduling: The work under this project will be scheduled and reported by the Contractor using the Critical Path Method. Submit Project Schedule in both PDF format and original scheduling software format. The approved Project Schedule(s) shall be used by the Contractor for planning, organizing, executing, and directing the work; for monitoring and reporting progress; and for requesting payment for work completed. All costs shall be identified in US dollars.

59.1.1. Order and Inter-Dependence of Activities: The Critical Path Method will be followed to show the order and interdependence of activities and the sequence in which the work is to be accomplished. Each activity shall be tied to all activities that must logically precede or follow it, and all paths shall be continuous through to completion date(s).

59.1.2. Work Breakdown Parameters for Activities: The activities shown on the network diagram shall include construction activities, submittal processing by the Contractor, submittal processing by the Smithsonian, procurement activities for major equipment, fabrication of special materials and equipment, installation of special materials and equipment, inspections, and tests. All field activities that affect progress toward contractually required dates for completion of all or parts of the Work shall be shown. The level of detail shall be such that the duration of any activity will be no longer than ten (10) working days and no activity will have a dollar value exceeding $30,000, except as allowed by prior and specific approval of the COTR. All aspects of the contract activities are to be identified and priced accordingly in the proposal. This is to include, but shall not be limited to, separate pricing for bonds, insurance, CQC related work, etc. As-built drawings and all closeout requirements shall be line item priced.

59.1.3. Cost-loading of Activities: The Project Schedule shall include a dollar value (cost) for each work activity. The cost shall include labor, materials, equipment, small tools, incidentals and a prorated portion of overhead and profit. The sum of all activity costs shall be equal to the total Contract Price. Each activity cost shall be coded with a cost code corresponding to a line item on the Schedule of Values.

59.1.4. Computer Software: The Contractor shall use a computerized CPM scheduling software designed for use on MS computers. The name of the software proposed for use shall be submitted to the COTR, along with literature about the program's capabilities,

functions, and operations, demonstrating that the requirements of the entire section entitled "Scheduling of the Work / Critical Path Method" can be met.

59.2. Required Schedules: The Contractor shall prepare and submit a Preliminary Project Schedule, Complete Project Schedule, Condensed Summary Schedule, Progress Schedules, and Recovery Schedules as described below.

59.2.1. Complete Project Schedule: Within 14 calendar days after receipt of Notice to Proceed, the Complete Project Schedule shall be submitted to the COTR for review and approval. The Contractor's submission of the Preliminary Project Schedule shall include one (1) hard along with a PDF and Native File Copy.

59.2.2. Condensed Summary Schedule: Along with each copy of the Complete Project Schedule, the Contractor shall submit to the COTR for approval, a condensed summary version consisting of not more than 250 activities summarizing major work elements.

59.2.3. Progress Schedules: Each month, the Contractor shall prepare a Progress Schedule by inputting all information regarding actual start and actual finish dates, projected through the end of the month, into the computerized Project Schedule. Complete discussion of this requirement is contained in the section "Reporting Progress and Applying for Payment."

59.2.4. Recovery Schedule: If the work falls substantially behind the approved Project Schedule the COTR may require the Contractor to submit a Recovery Schedule in accordance with the Construction Contract Clauses paragraphs relating to "Commencement, Prosecution and Completion of Work." Upon request, the Contractor shall submit a Recovery Schedule to the COTR for approval within ten (10) working days. The requirements set forth herein in the sub-paragraph entitled "Complete Project Schedule," shall apply to all activities shown on the Recovery Schedule.

59.3. Changes Related to Requests for Proposals: For all proposals involving requests for time extensions or other significant changes to schedule, the Contractor shall submit a listing of all the activities affected, added, or deleted (by node numbers). The effect in time and money shall be described for each activity. If, in the opinion of the COTR, the proposed change may impact the completion date(s), the Contractor shall submit a diagram of that portion of the network schedule affected by the changes, along with standard reports for analysis.

59.3.1 Diagrams and reports submitted to illustrate the impact of a proposed change shall show the necessary revisions to activities, along with their costs, durations, and trade responsibilities. Failure to submit such a diagram with a proposal shall constitute a waiver of any claims for time extensions associated with the subject of that proposal.

59.3.2 Modification of activity times shall be agreed to by both the Contractor and the COTR. In the event that agreement on modified activity times cannot be reached, the COTR will direct the specific time adjustments to be entered into the program to determine approved, revised, contract completion dates.

59.4. Response to Application:

59.4.1. Payment shall be made only for progress agreed upon by the COTR, performed on original Contract Work or approved modifications, in accordance with the current, approved work in place. Failure to submit the Application in accordance with the specifications will prevent the processing of payments.

59.4.2. Payments will be made electronically to the Contractor's financial institution on record with the Contracting Officer. Any changes of address must be made in writing, signed by the Contractor's authorized person, and submitted to the Contracting Officer.

59.5. Reporting Progress and Applying for Payment: Each month, the Contractor shall apply for payment and submit a report of the actual construction progress as follows:

59.5.1. By the 25th of each month, the Contractor and the COTR shall have inspected the work to determine percentages complete for each item, projected through the end of the month. The parties shall attempt to reach agreement on each item, but if they cannot reach an agreement the COTR will determine percent complete.

59.5.2. By the last day of the month, the Contractor shall submit electronically an Application for Payment based on the determined percentages complete for each item. The application shall be submitted on the Smithsonian standard Application for Payment form. Each copy of the Application for Payment shall be accompanied by the following:

1. A Progress Schedule identifying the cumulative progress superimposed on the latest revision of the approved Project Schedule. The net progress for the month and applicable dates shall be clearly indicated.
2. A complete set of copies of certified weekly-payroll data for the period.
3. A complete set of monthly progress photos as defined in Article 46 of this Section.
4. A completed monthly waste diversion report.
5. An update to date change order log.

60. ASSIGNMENT OF CLAIMS

60.1. Assignment of Claims are subject to the approval of the Contracting Officer. Any Assignment of Claim or subsequent re-assignment shall meet the requirements of the General Conditions contract clause entitled "FAR 52.232-23 Assignment of Claims."

60.2. All documents for assignments shall be written in the English language and shall be original ink signatures of the Contractor and assignee. All monies shall be identified in US dollars.

SECTION L - PROJECT CLOSEOUT REQUIREMENTS

61. PROJECT CLOSEOUT

61.1. Definition: Project closeout is a scheduled process for fulfillment of remaining contract requirements at the end of the project in preparation for final acceptance, final payment, and normal termination of contract, beneficial occupancy, and establishment of the warranty period.

62. FINAL COMPLETION PROCEDURE

62.1 Definition: The date of Final Completion of the Project is the date, as confirmed by the COTR, when the Work is satisfactorily completed and accepted in accordance with the Contract Documents, as amended and/or modified.

62.2 Preliminary Procedures: Before requesting final inspection to determine the date of Final Completion, complete the following:

62.2.1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."

62.2.2. Submit certified copy of Final Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by COTR. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

62.2.3. Arrange for final changeover of locks.

62.2.4. Submit evidence of payment and transfer date of utility company accounts for those utilities previously billed to the Contractor during construction.

62.2.5. Submit evidence that all regulatory agency permits and code requirements have been completed and recorded, as necessary.

62.2.6. Submission of a signed, written statement that no damage has occurred to the Site as documented by the Final Photographic/Videotape Documentation report.

62.2.7. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

62.2.8. Submit Operations and Maintenance Manuals

62.2.9. Submit Final Facility Asset Data Spreadsheet

62.2.8. Final Clean-up.

62.3 Submission of Operations and Maintenance Manuals: Prior to requesting Final Completion Inspection, the Contractor shall submit, to the COTR, electronic PDF format version of manuals for all systems and equipment, as specified in the technical sections of this specification. shall be organized into suitable volumes of manageable size using the divisions of the Specifications as a guide. Each manual shall have a table of contents and shall be assembled to conform to the table of contents with tab sheets locating each subject. The instructions shall be legible and easy to read. The words "Operation and Maintenance Manual," the name and location of the project, project number, contract number, date, and the name of the general contractor, shall appear on the cover sheet. Data shall be specific to the equipment that is installed and reflect all approved changes and substitutions. Manuals shall include, as a minimum, the following data:

62.3.1. Detailed description of each system and each of its components, including layout showing piping, valves, controls, and other components and including diagrams and illustrations where applicable.

62.3.2. Wiring and control diagrams with data to explain detailed operation and control of each component.

62.3.3. Control sequence describing start-up, operation and shut down.

62.3.4. Procedures for starting, operating, and shut down.

62.3.5. Installation instructions.

62.3.6. Maintenance and overhaul instructions.

62.3.7. Lubricating schedule, including type, grade, temperature range and frequency.

62.3.8. Emergency instructions and safety precautions.

62.3.9. On-site acceptance test results for equipment installed under this contract.

62.3.10. Approved product data, shop drawings and system as-builts.

62.3.11. Copies of approved certifications and laboratory test reports (where applicable).

62.3.12. Notarized copies of warranties (originals to be provided as required by "Warranties and Guarantees").

62.3.13. Written instructions for test procedures.

62.3.14. Performance curves and rating data.

62.3.15. Parts list, including source of supply, recommended spare parts and service organization convenient to Smithsonian.

62.3.16. Name, address, and telephone number of each subcontractor who installed equipment and systems, local representative for each type of equipment and each system.

62.3.17. Other pertinent data applicable to the operation and maintenance of particular systems or equipment and/or other data as specified Divisions 2 through 33 of the Specifications.

62.4. Facility Asset Data: The following building information, obtained and developed by the Architect, Engineer(s) and/or SI during the design phase, may be available to the Contractor:

62.4.1 SI Facility Asset Data Spreadsheet (xlsx)

62.3.2. Collect, verify, and provide Facility Asset Data for import by the SI into the TRIRIGA Facility Center data system. Utilizes templates as provided by SI and procedures described below:

1. Contractor will complete / verify information on spreadsheet provided by SI
2. Submit SI Facility Asset Data Spreadsheet(s) with equipment submittal(s) for review / approval
3. Provide monthly SI Facility Asset Data Spreadsheet updates. Spreadsheet(s) should reflect work completed the previous month. Monthly Updates to include:

. a. Attribute Updates
b. Submittal Package approved (Yes or No)
c. Installed Date
d. In Service Date
e. Out of Service Date for Assets being removed or retired

4. SI to review for Accuracy and Status and will upload into FC as required.
5. Meeting between SI COTR, FM Asset Manager and Contractor to be scheduled.
a. SI would return spreadsheet(s) and Asset Tags with Asset ID# and Asset Name
b. Labels to be placed on equipment by FM Asset Manager in coordination with contractor and OPDC COTR.

62.5. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, COTR will either proceed with inspection or notify Contractor of unfulfilled requirements. COTR will prepare a final Letter of Acceptance after inspection or will notify Contractor of construction that must be completed or corrected before letter will be issued.

62.5.1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

62.6. Final Application for Payment: Complete all requirements for transmittal of the Final Application for Payment in accordance with Division 01 Section “Payment Procedures”, including submission of:

62.6.1. Final labor data and Construction Progress Schedule update.

62.6.2. Certification, signed by the Contractor, that all Contract requirements, including Contract Modifications have been met.

62.6.3. Release of assignment of claims or consent of surety submitted, as necessary.

62.6.4. Return of all parking permits.

62.6.5. Final Project Record Documents.

1. As-Built Record Drawings Submitted: During the progress of the work the Contractor shall maintain a complete and up-to-date set of record prints, open to inspection by the COTR at any time. These prints shall provide a complete and accurate as-built record of all changes to the Contract Drawings, including rerouting of runs, relocation of items or control points and all other modifications. The exact location of pipes, conduit, or other features concealed underground, under concrete, in chases or above ceilings shall be shown by perpendicular dimensions from at least two available landmarks. As-built drawings. The As-Built documents shall be made to scale marked "As-Built" and signed and dated by the Contractor. The Contractor shall furnish an electronic copy of as-built record drawings in PDF and DWG formats to the COTR on the same size as the contract drawings, color highlighted, dated, and marked "As-Built." -

2. As-Built Record Survey of Underground Utilities Submitted: If outside or underground utilities are part of the work, the Contractor shall furnish, to the COTR for approval, an acceptable and accurately dimensioned (GIS) survey showing location and elevation of underground storage tanks, all utility lines for water, gas, electrical, sewer, steam, etc., including valves, connections and changes in direction, as installed under the contract, within the property lines and outside the building walls. Points where utility lines emerge from the building shall be located from lot monuments. The survey shall be made to scale and must be marked "As-Built" and signed and dated by the Contractor. The Contractor shall furnish an electronic copy of as-built record drawings in PDF and DWG formats to the COTR on the same size as the contract drawings.

3. As-Built Record Specifications Submitted: The Contractor shall provide digitally set of project specifications with annotations to identify any changes made during construction, referencing modification numbers, dates and originators of authorizing letters or memos and other sources of changes. Each sheet shall be marked "As-Built" dated by the contractor in MS Word and PDF Format.

62.7. LIST OF INCOMPLETE ITEMS (PUNCH LIST)

62.7.1. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction
1. Organize list of spaces in sequential order,
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
a. Project name.
b. Date.
c. Name of Contractor.
d. Page number
e. Total number of pages
f. SI Project Number.

62.8. SUBMITTAL OF PROJECT WARRANTIES

62.8.1. Time of Submittal: Submit written warranties on request of COTR for designated portions of the Work where commencement of warranties other than date of Final Completion is indicated, or when delay in submittal of warranties might limit COTR's rights under warranty.

62.8.2. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by COTR during construction period by separate agreement with Contractor.

62.8.3. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual. Organize in a PDF.
1. Warranty Electronic File: Submit Warranties in a submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

62.8.4. Warranty of Construction: The Contractor shall warrant that the work performed under this contract conforms to the contract requirements and is free of any defect in equipment, materials, design furnished, or workmanship performed by the Contractor or any subcontractor or supplier at any tier. Unless otherwise stated in the technical sections of the Specifications, the warranty of the Work shall continue for a period of one (1) year from the date of Final Completion status. If the Smithsonian takes partial occupancy before Final Completion, then the warranty for that

portion shall be in effect for a period of one (1) year beginning on the date of Final Completion for that portion of the Work.

62.8.5. Response Time for Warrantee Items – For all items under the warrantee period that are deemed by the COTR as essential to the 24/7 operations of the facility, the contractor will provide (at no additional cost to SI) emergency response and corrective actions as required (less than 4 hours). Provide 24/7 contact personal.

62.9. PRODUCTS

62.8.1. MATERIALS

i. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

62.10 FINAL CLEANING

62.10.1. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

62.10.2 Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

i. Complete the following cleaning operations before requesting inspection for certification of Completion for entire Project or for a designated portion of Project:

1. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
2. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
3. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
4. Remove tools, construction equipment, machinery, and surplus material from project site.

5. Remove snow and ice to provide safe access to building.
6. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
7. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
8. Sweep concrete floors broom clean in unoccupied spaces.
9. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
10. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
11. Remove labels that are not permanent.
12. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
13. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
14. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
15. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
    a) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
16. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
17. Leave Project clean and ready for occupancy

62.11. REPAIR OF THE WORK

62.11.1. Complete repair and restoration operations before requesting inspection for determination of Final Completion.

62.11.2. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specify condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
   a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

   a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.

63. DEMOSTRATION AND TRAINING

63.1.1. Provision of Instructions to Smithsonian Personnel -where instructions to Smithsonian personnel are specified in other sections, furnish, without additional expense to the Smithsonian, the services of competent instructors, who will give full instruction in the care, adjustment and operation of the systems and equipment to designated Smithsonian employees.

1. Each instructor shall be familiar with all parts of the system on which he or she is to give instruction and shall be knowledgeable about the systems' operation and required maintenance. Factory trained instructors shall be employed wherever practical and available.

2. Unless otherwise required or approved, the instruction shall be given during the regular work week after the equipment has been accepted and turned over to the Smithsonian for regular operation. Where significant changes or modifications in equipment are made under the terms of the contract, additional instruction shall be provided as may be necessary to acquaint the operating personnel of the changes or modifications. Unless otherwise stated, at least half of the time allocated for instruction shall be "hands-on," using the actual system installed.

3. Upon completion the Contractor shall obtain written acknowledgment from the COTR that the required instruction was completed.

63.2.3. Posting of operating instructions approved by the COTR for each system and each principal piece of equipment. Include wiring and control diagrams showing the complete layout of the entire system including equipment, piping, valves, and control sequence framed under clear laminated plastic and posted

where directed by the COTR. Printed or engraved operating instructions for each principal piece of equipment including start-up, proper adjustment, operating lubrication, shut-down safety precautions, procedure in the event of equipment failure and any other necessary items of instruction as recommended by the manufacturer of the unit shall be attached to or posted adjacent to the piece of equipment. Operating instructions exposed to the weather or wet or humid conditions shall be made of weather-resisting materials or shall be suitably framed and enclosed to be weather protected. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling. The Contractor shall coordinate the location of posted instructions with the COTR

SECTION M – BONDING AND INSURANCE

64.1. Bonding: In accordance with IDIQ Contract requirements.

64.2 Insurance: In accordance with IDIQ Contract requirements.

Construction and Demolition Waste Tracking Sheet:
To be submitted with each application for payment for the payment period, and at project completion with total waste data and total percentage of waste diverted from landfill for entire project period.

Project Name: _____
Start Date: _____
End Date: _____

Material Description	Disposal date	Diverted from Landfill or incinerator? (Y/N)	Diversion method (Recycled, Salvaged, etc.)	Hauler or Destination (submit receipts)	Volume (in cubic feet)	Weight (in tons)
Land Clearing Debris						
Gypsum Wallboard Scrap						
Cardboard						
Paper goods						
Beverage containers						
Assorted Plastic						
Wood Pallets						
Asphaltic Concrete Paving						
Concrete						
Brick						
CMU						
Lumber						
Plywood and OSB						
Wood Paneling						
Wood Trim						
Miscellaneous Metals						
Structural Steel						
Rough Hardware						
Insulation						
Roofing						
Doors and Frames						
Door Hardware						
Windows						
Non-Window Glass						
Glazing						
Acoustical Tile						
Carpet						
Carpet Pad						

Material Description	**Disposal date**	**Diverted from Landfill or incinerator? (Y/N)**	**Diversion method (Recycled, Salvaged, etc.)**	**Hauler or Destination (submit receipts)**	**Volume (in cubic feet)**	**Weight (in tons)**
Demountable Partitions						
Equipment						
Cabinets						
Plumbing Fixtures						
Piping						
Piping Supports and Hangers						
Valves						
Sprinklers						
Mechanical Equipment						
Electrical Conduit						
Copper Wiring						
Light Fixtures						
Lamps						
Lighting Ballasts						
Electrical Devices						
Switchgear and Panel boards						
Transformers						
Other:						
Other:						
Other:						
				Total Diverted		
				Total Not Diverted		
				Total All Waste = Total Diverted + Total Not Diverted		
				% Diversion Rate* = Total Diverted/Total All Waste		

**Percentage Diversion Rate to be compiled after project completion. Minimum Diversion rate is 50%. Goal Diversion rate is 75%.*

END OF SUPPLEMENTARY CONDITIONS FOR CONSTRUCTION

SECTION 02 4119 – SELECTIVE DEMOLITION

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:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Pre-Demolition Conference: Conduct conference at the Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

C. Schedule of Selective Site Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

E. Pre-Demolition Photographs or Video: Submit before Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
3. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.

F. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.

G. Storage or sale of removed items or materials on-site is not permitted.

H. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect and Owner.

E. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
2. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.

1. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.
2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.

d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Section 015713 "Temporary Erosion and Sediment Control."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.

3.4 SELECTIVE SITE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.

B. Reuse of Building Elements: Project has been designed to result in end-of-Project rates for reuse of building elements as follows. Do not demolish building elements beyond what is indicated on Drawings without Architect's approval.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE SITE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Cut concrete full depth at junctures with construction to remain and at regular interals using power-driven saw, and then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn demolished materials.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

SECTION 03 0100
CONCRETE REPAIR

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The Contract Requirements and the General Requirements (Division 1) of the Contract for Construction are hereby made a part of this Section.

1.2 SCOPE OF WORK

A. Work includes but is not limited to providing all labor, materials, equipment, and supervision to accomplish the following concrete repair work in accordance with the Drawings and Specifications. Locations of repairs are shown on the Drawings and as identified by the Engineer on site.
B. Repair areas of spalled and/or delaminated concrete with repair materials at existing retaining walls.

1.3 REFERENCES

A. The following references are incorporated into these Specifications. Specific requirements from each reference that are necessary to execute the work described in this specification shall be managed on a case by case basis. These written Specifications take precedence over incorporated references. The references included in the Specifications refer to the most-recent revision of the publication. The Contractor shall be familiar with the reference contents.
   1. ACI 301 – Specifications for Structural Concrete.
   2. ACI 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete – and as specified.
   3. ACI 305R – Guide to Hot Weather Concreting.
   4. ACI 306R – Guide to Cold Weather Concreting.
   5. ACI 308R – Guide to Curing Concrete.
   6. ACI 309R – Guide for Consolidation of Concrete.
   7. ACI 347 – Recommended Practice for Concrete Formwork.
   8. ICRI Guideline No. 120.1 – Guidelines and Recommendations for Safety in the Concrete Repair Industry.
   9. ICRI Guideline No. 210.3R – Guide for Using In-Situ Tensile Pull-Off Tests to Evaluate Bond of Concrete Surface Materials.
   10. ICRI Guideline No. 310.1R – Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion.
   11. ICRI Guideline No. 310.2R – Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
   12. CRSI – Placing Reinforcing Bars Recommended Practices.

1.4 SUBMITTALS

A. Subcontractors' qualifications.
B. Properly labeled samples and manufacturer’s data sheets for all materials to be used.
C. Manufacturer's MSDS sheets for all materials to be used.

D. Specialty repair concrete mix proportions and mixing procedures, and application and curing procedures.

E. Certifications (in time to prevent delay in the work) by the producers of the materials that all materials supplied comply with all the requirements of the appropriate ASTM and ACI Standards.

F. Concrete placement, curing, and protection procedures.

G. Repair-sequence plans showing the proposed sequence of repairs. Plans shall show areas of work, shall include a schedule of time, and shall be coordinated with other proposed repair work.

1.5 QUALITY CONTROL AND QUALITY ASSURANCE

A. The Contractor shall conduct a quality control program that includes, but is not limited to, the following:

1. Inspection of all materials to ensure conformity to contract requirements and that all materials are new and undamaged.
2. Establishment of procedures for executing the work.
3. Inspecting all surface preparation prior to repair material application.
4. Inspecting all reinforcement for placement in plan and elevation and for proper support to prevent displacement during concrete placement.
5. Inspection of work in progress to ensure that work is being done in accordance with established procedures, manufacturer's instructions, specific Engineer instructions, if given, or recommended practices as given in the References of Para. 1.3.
6. Inspection and sounding of all work completed, including visually examining all repairs for cracking and sounding all repairs to check for debonding.

B. The Contractor is responsible for correction of concrete work that does not conform to the specified requirements, including strength, mix proportions, air-void system, tolerances, and finishes. Correct deficient concrete as directed by the Engineer.

C. The Engineer can reject concrete that exhibits the following defects:

1. Bulging: Concrete surfaces that bulge due to insufficiently secured formwork, undersized ties, or flat bar clamps.
2. Wavy Concrete: Concrete surfaces that exhibit waves.
3. Spalling: Concrete spalling due to alkali reactivity, improper removal of formwork, expansion of cast-in steel during the welding process, or other reasons caused by the contractor.
4. Cracking and Crazing: Concrete cracking and crazing due to lack of control joints, improper curing, uncontrolled drying, or non-conformance of water/cement.
5. Excessive Bug holes: Bug holes resulting from improper vibration and excessive heights of individual layers of pours between vibration. Air holes due to spreading of concrete with vibrators rather than moving buckets or hoses.
6. Honeycombing: Concrete honeycombing including loss of fines from leaking formwork or other causes.
7. Discoloration: Concrete discoloration caused by any reason, including inconsistent concrete mix, different sources of cement and aggregates, temperature variation between individual pour and curing phases, improper and inconsistent use of vibrators, variation of time span of concrete in formwork, form oils, and migration of plasticizer into concrete

from exposed sealant beads on formwork and around cast-in items such as electrical outlet boxes.

8. Visible Pour Joints: Visible pour joints in concrete resulting from leaking formwork due to lack of gaskets and insufficient overlap with old concrete preventing proper tightening of formwork. Placement of concrete layers in excessive heights and spreading concrete with vibrator.
9. Debris in Concrete: Concrete that includes debris, whether caused by insufficient cleaning of formwork, or lack of cleanout and access doors at base of formwork.

D. Qualifications

1. The Contractor and its site superintendent shall have at least five years experience supervising the installation of similar concrete repairs at similar deteriorated structures.
2. All finishing crewmembers shall be ACI-Certified Concrete Flatwork Technicians and Finishers. The supervisor shall be an ACI-Certified Flatwork Technician and shall have input to the crew's placement and finishing procedures regarding the application of ACI Standards for quality flatwork. The ACI Standards that shall be observed are contained in the ACI – Concrete Craftsman Series.

E. Preinstallation Conference

1. Attend a preinstallation conference to be held with a representative of the Owner, Engineer, Contractor's field superintendent, foreman, and other trades involved to discuss the conduct of the work of this Section.

F. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

G. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be ACI-certified Concrete Field Testing Technician, Grade I, or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Laboratory Testing Technician – Level 1. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician – Level 2.

1.6 TECHNICAL SUPPORT

A. The Contractor shall arrange with the materials manufacturer or distributor to have the services of a competent field representative at the work site prior to any mixing of components to instruct the work crews in the proper mixing and application procedures. The representative shall remain at the job site after work commences and continue to instruct until the representative, the Contractor, and the Owner are satisfied that the crew has mastered the technique of installing the systems successfully.

1. The manufacturer's field representative must be fully qualified to perform the work and shall be subject to the approval of the Owner.
2. The Contractor shall be completely responsible for the expense of the services of the required manufacturer's field representative and the contract price shall include full compensation for all costs in connection therewith.

1.7 GENERAL PROCEDURES

A. Work only in areas permitted by the Owner-approved schedules and sequence plans.
B. Remove all tools, buckets, and materials from work areas and store neatly at a central location daily at the end of work.
C. Do not stockpile materials, debris, or equipment on elevated structure.
D. Construction loads shall not exceed 40 lbs per square foot.
E. Deliver materials clearly marked with legible and intact labels with manufacturer's name and brand name, and identifying contents of containers.
F. Store materials in areas where temperatures conform to manufacturer's recommendations and instructions.
G. Protect the building and its contents from all risks associated with the work in this Section. Schedule and execute all work without exposing adjacent building areas to water, dust, and debris, or materials used by this Contractor. Protect adjacent areas from damage. Repair all damage as a result of the work of this Section to its condition at the start of work, or if such cannot be determined, to its original condition. Clean all stains by approved means.
H. Protect the work from damage such as impact, marring of the surfaces, and other damage.
I. Compliance with OSHA and all other safety laws and regulations is the exclusive responsibility of the Contractor, subcontractors, suppliers, consultants, and workforce.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Specialty Repair Mortar for Vertical Wall Repairs
    1. SikaEmaco 440CI by Sika Corporation, Lyndhurst, New Jersey
    2. Eucocrete Supreme, by The Euclid Chemical Company, Cleveland, Ohio.
    3. Deck Mix FP by US Concrete Products, Timonium, Maryland.
    4. Approved equivalent.
B. Specialty Repair Mortar for Vertical Wall Repairs Less than 1 ft by 1 ft
    1. SikaEmaco 425 Gel Patch by Sika Corporation, Lyndhurst, New Jersey
    2. Tamms Structural Mortar, by The Euclid Chemical Company, Cleveland, Ohio.
    3. US Thin Patch V/O by US Concrete Products, Timonium, Maryland.
    4. Approved equivalent
C. Aggregate for Extending Specialty Repair Materials:
    1. Coarse aggregate for extending concrete repair materials shall conform to ASTM C33. Aggregate shall be nominal 3/8 in. maximum size (No. 8 distribution per ASTM C33, Table II), clean, well graded, saturated surface dry, and shall have low absorption and high density.
    2. Following the procedure presented in ASTM C1778, that aggregate shall be nonreactive in the presence of alkalis in accordance with ASTM C1260 or ASTM C1293. Aggregates will be acceptable as non-deleteriously reactive if the aggregate produces ASTM C1567 expansion values of less than 0.1% at 14 days using the same source material and relative proportions of cementitious materials proposed for use in the mix design.

D. Adhesive for Reinforcing Bar Dowels and Adhesive Anchors:

1. Hilti HIT-HY200 epoxy by Hilti, Inc., Tulsa, Oklahoma.
2. Set-3G, by Simpson Strong-Tie, Enfield, Connecticut
3. AC100+ Gold, by Powers Fasteners, Brewster, New York.
4. Approved Equivalent.

E. Reinforcement

1. Welded wire reinforcement shall conform to ASTM A185, epoxy coated in accordance to ASTM A884.
2. Reinforcing bars shall conform to ASTM A615, Grade 60 deformed bars.

F. Mechanical Reinforcing Bars Couplers

1. Bar Lock Couplers, finish to match reinforcing bars, by Dayton Superior, Miamisburg, Ohio. Sizes to match bars to be coupled.
2. Zap Screwlok, finish to match reinforcing bars, by BarSplice Products, Dayton, Ohio. Sizes to match bars to be coupled.
3. Approved equivalent.

G. Galvanic Anodes in Repair Areas

1. Galvashield XPT Anodes by Vector Corrosion Technologies, Wesley Chapel, Florida.
2. Approved equivalent.

H. Tie Wire: No. 16 gauge annealed, plastic coated.

I. Concrete Patching Pins: Stainless steel, 10 mm diameter.

1. Dryfix helical anchors, by Helifix, Streetsboro, Ohio.
2. Spira-lok helical tie, by Blok-lok, Woodbridge, Ontario, Canada.
3. CTP Concrete Patch-Tie, by Construction Tie Products, Michigan City, Indiana.
4. Approved equivalent.

J. Supports, chairs, bolsters, spacers, etc., are to conform to Chapter 3 of the

K. CRSI Manual of Standard Practice. Provide types that will hold reinforcement in position as shown and are in accordance with requirements of ACI 318 except as specified.

L. Protective Coating for Existing Reinforcement:

1. Sika Armatec 110 Epocem by Sika Corporation, Lyndhurst, New Jersey.
2. Duralprep A.C. by The Euclid Chemical Company, Cleveland, Ohio.
3. Approved equivalent.

M. Moisture-Retaining Cover: One of the following, complying with ASTM C171:

1. Polyethylene-coated, blended polyester fabric.
2. HydraCure Wet Curing Cover, PNA Construction Technologies, Inc., 9 Dunwoody Park, Suite 111, Atlanta, Georgia 30338.
3. Polyethylene film.

4. Polyethylene-coated burlap

2.2 MIX PROPORTIONS

A. Specialty Repair Mortar:

1. Proportion and mix specialty repair mortar in accordance with the manufacturer's written instructions.

2. Extend specialty repair mortar with aggregate for specific repair depths in accordance with the manufacturer's recommendations, including all restrictions on reactive aggregate.

B. Bonding Grout for Specialty Repair Mortar

1. Bonding grout for specialty repair mortar shall be in accordance with the manufacturer's written requirements, or as required by the Engineer.

2.3 EQUIPMENT

A. Mixing Equipment

1. Mix specialty repair mortar using equipment and procedure recommended by the material manufacturer.

B. Concrete Removal Equipment:

1. Use concrete saws, chipping hammers, and other concrete removal equipment and cutting tools appropriate for the work and approved by the Engineer.

2. At repair areas, do not use chipping hammers heavier than nominal 15 lb class.

C. Pumping Equipment

1. The pump for placing the concrete into forms and cavity shall be compatible with the material being placed, sized to the quantity of material being installed at any one time, and available for use when needed. Hydraulic/swing valve or peristaltic pumps are recommended. All pumping equipment shall have adequate controls to regulate flow rates.

2. The connection of the pump to the form shall be done with clean rubber hose or a combination of clean hose and clean pipe. Abrupt changes in line size (from larger to smaller) will cause blockage; therefore, long tapered reducers shall be used when changing pipe or hose size.

3. For connections between tight joints or hose sections, use a metal clamp with a rubber gasket. Special attention shall be given to the water tightness of all connections under pressure. Otherwise, the mix will dry out in the line and cause blockage.

4. Pressure gauges shall be attached to the pump line near the exit port to monitor cavity pressure.

PART 3 - EXECUTION

3.1. LOCATION OF REPAIR AREAS

A. The Contractor is responsible for visually inspecting and sounding all concrete surfaces, as required to discover and repair all deteriorated concrete as directed by the Engineer and in accordance with the requirements of the Drawings and Specifications.

1. Concrete shall be considered "unsatisfactory" when it exhibits weakness due to crazing, cracking, spalling, volume change, disintegration, erosion, scaling, popping, delamination,

unbonding, etc.

2. Concrete shall be considered satisfactorily "sound" when it "rings" under the hammer blow and resists chipping in a manner equal to virgin original concrete in the structure that has not exhibited deterioration.

3.2. CONCRETE REMOVAL AND SURFACE PREPARATION FOR CONCRETE REPAIRS

1. For all concrete removal activities, install sound barriers if necessary to maintain the acceptable noise level.

2. Do not cut, nick, bend, or damage reinforcing steel or embedded conduit. All damage will be repaired at no cost to the Owner.

3. Provide 3/4 in. deep saw-cut edges around the perimeter of the repair area, normal to the face of the surrounding concrete. The saw cuts shall form polygons that have 90° corners and enclose the deteriorated area. Make saw cuts after determining actual concrete cover over reinforcement, post-tensioning tendons, or embedded conduit . Do not cut into reinforcement. Reduce depth of saw cut over reinforcement as required.

4. Remove all spalled and/or delaminated concrete in the area to be repaired. Remove additional concrete within the repair area to such additional breadth and depth as required to expose uncorroded reinforcing bars and a surface of sound concrete, or to limits indicated on sections and details of the Drawings. Remove concrete to a minimum depth of 3/4 in. beyond the innermost layer of reinforcement. Roughen concrete surface to a minimum amplitude of 1/8 in. or as shown on the Drawings. Conduct concrete removal in a manner to prevent cutting, nicking, bending or otherwise damaging the reinforcement or embedded conduit. All damage will be repaired at no cost to the Owner.

5. Remove all loose particles and deleterious materials from the exposed sound concrete, exposed reinforcing bars, and accessories by sandblasting. Clean reinforcing bars to SSPC-6, commercial blast finish, or better.

6. Install shear connectors, reinforcement, and accessories as shown on the Drawings and as directed by the Engineer.

3.3. COATING OF EXISTING REINFORCEMENT

A. Coat all exposed reinforcement and accessories with protective coating in accordance with the coating manufacturers written instructions. Existing reinforcement and accessories that are completely detached from the concrete during concrete removal may be replaced with new epoxy-coated reinforcement and accessories instead of applying protective coating. Do not apply the coating to any concrete surface. The contractor will be responsible for removing all coating from prepared concrete surfaces prior to placing repair material.

3.4. SUPPLEMENTAL REINFORCEMENT

A. Reinforcing bars with metal loss greater than 15% of the original bar cross-section shall be brought to the attention of the Engineer for strength evaluation prior to continuing repair work.

B. Provide supplemental reinforcement as shown on the Drawings and as directed by the Engineer. Tie the reinforcement to existing bars with a minimum lap of 40 bar diameters, or 60 bar diameters for epoxy-coated reinforcement. Where lap splices are not possible or where directed by the Engineer, splice supplemental reinforcement with approved mechanical couplers.

C. Provide supplemental accessories to support exposed reinforcement in accordance with the requirements of CRSI and as directed by the Engineer.

3.5. INSTALLATION OF SACRIFICIAL ANODE S

A. Install anode units immediately following preparation and cleaning of the steel reinforcement.

B. Provide sacrificial anodes along perimeter of all concrete repair areas at a maximum spacing of 12 in. with a minimum of one sacrificial anode per repair area.

C. Provide sacrificial anodes at the reinforcing bar assembly, attaching anode tie wires to the exposed bare, cleaned, uncoated-steel reinforcement. The tie wires shall be wrapped around the steel reinforcement and twisted tight to allow little or no free movement. Mask the existing steel reinforcement and steel tie wires to prevent applying protective coating within 1 in. of the anode-to-reinforcement connection.

D. Provide sufficient clearance between anodes and the concrete substrate to allow a minimum concrete or mortar cover over the anode of 1 in.

E. Electrical Continuity:

1. Confirm electrical connection between anode tie wire and reinforcing steel by measuring DC resistance (ohm, Ω) of DC potential with a multi-meter.

2. Confirm electrical continuity of the exposed reinforcing steel within the repair area. If necessary, electrical continuity shall be established with steel tie wire.

3. Electrical continuity is acceptable if the DC resistance measured with multi-meter is 1 Ω or less or the DC potential is 1 mV or less.

3.6. FORMWORK

A. Construct forms to match configuration of existing surrounding concrete or as otherwise shown on the drawings.

B. The Contractor shall design forms in accordance with ACI 347R.

C. At form and pump repairs, forms shall be designed to withstand safely the pressure developed by the weight and load of repair material and the pump pressure. Maximum pressure exerted on formwork occurs after the cavity is full and pressurized.

D. The Engineer shall review formwork design. Review by the Engineer shall not in any way relieve the Contractor of its responsibility for the safety and adequacy of the formwork.

E. Immediately prior to erecting formwork, remove dust and debris from the prepared surfaces of sound concrete and reinforcement with a high-pressure water cleaner capable of pressures in excess of 6,000 psi.

F. Provide watertight forms at vertical and underside repair areas. Preformed foam gaskets or cast-in-place foam shall be used to address difficult-to-match surfaces. Tape the boundaries of the forms with two-sided rubberized asphalt tape. Provide a secondary seal around the perimeter of the form with silicone sealant. Keep bentonite-impregnated oakum on the job for emergency sealing of form edges.

G. At form and pour repairs, provide a chute at the top for introduction of the repair concrete and release of air from the form and a drain port at the bottom.

H. At form and pump repairs, provide a valved port for introduction of the concrete at one side of the bottom of the repair and a minimum of two valved ports to vent air.

3.7. MORTAR PLACEMENT FOR VERTICAL REPAIRS

A. After the protective coating on reinforcing bars has cured, flood form with water for a minimum

of 2 hrs.

B. Immediately prior to placement, drain water completely and seal drainage outlets.

C. Provide adequate labor, equipment, and materials to ensure that the mortar/concrete for each repair is placed within the manufacturer's limit on time between mixing and placing of repair material. If time between mixing and placing exceeds the manufacturer's time limit, construct a bulkhead to achieve a proper construction joint.

D. Place specialty repair mortar in accordance with the manufacturer's written instructions. Provide a means of accurately measuring the amount of water introduced to the mix. Follow manufacturer's written directions for addition of water.

E. Placement by Pumping:

1. The hardware shall be in place with valves ready to have the hose attached.
2. Start pumping with all valves open, filling the form in a manner that prevents air entrapment.
3. Continue pumping even after concrete flow occurs from adjacent ports in order to expel air. When the flow is without intrusion of air, the pump is temporarily shut off, the port closed off, and the pump line connected to the adjacent port that has seen flow. This sequence shall continue until the cavity is filled.
4. Clean off the connections as ports are changed by washing the concrete out of the rubber seal and the clamp and grooves in order to reconnect the hose to the pumping ports.
5. Monitor pump line pressure at all times to prevent excessive back pressure when pumping long distances.
6. Special care shall be exercised in the final pressurization because excessive pump line pressure may cause the form to fail.
7. Cavity pressure shall not exceed the formwork design pressure. The nozzlemen shall carefully watch and listen for "cracking" in the form and/or slight bulging of the form, which is an indication that pressure is building in the form. When this condition is achieved, all vents in the form shall be capped or plugged off and all valves closed.
8. After the concrete has reached the initial set, unscrew the valves and nipples from the flanges and clean them with a water hose. When concrete is still green, use a screwdriver and water to remove the material. A wire brush is helpful to clean the threads. The valves can be taken apart and the ball cleaned and regreased.
9. Concrete shall be placed in such a manner as to avoid honeycombing, bugholes, air pockets, and incomplete filling. Any concrete with such defects shall be removed and replaced at the Contractor's expense.

F. Ensure proper consolidation in the form using mechanical vibrators as required.

3.8. MORTAR PLACEMENT FOR VERTICAL REPAIRS LESS THAN 1 FT BY 1 FT

A. After the protective coating on reinforcing bars has cured, spray the surface with water to ensure that the substrate is saturated surface dry (SSD) with no standing water.

B. Provide a thin coat of the mixed material thoroughly onto the surface to ensure sufficient bonding.

C. Before the bond coat dries, thoroughly compact the mortar onto the substrate and around the exposed reinforcement.

D. The specialty repair mortar can be applied in single lifts up to 1.5 in. If multiple lifts are used, lightly rake the surface of each lift after initial set and before applying subsequent lifts.

E. If the material sags during application, completely remove the specialty repair mortar and properly reprime the existing substrate and reapply the mortar at a reduced thickness.

F. Finish the specialty repair mortar by striking off with a straight edge and close with a steel trowel. Do not overwork the completed surface.

G. Provide adequate labor, equipment, and materials to ensure that the mortar for each repair is placed within the manufacturer's limit on time between mixing and placing of repair material.

H. Place specialty repair mortar in accordance with the manufacturer's written instructions. Provide a means of accurately measuring the amount of water introduced to the mix. Follow manufacturer's written directions for addition of water.

3.9. CURING

A. Cure specialty repair mortars in accordance with the material manufacturer's written instructions for moist curing.

B. Curing compounds are prohibited.

C. After the finishing operation is completed, the surface shall be promptly covered with curing covers. Care shall be exercised to ensure that the curing cover is installed in accordance with the manufacturer's written instructions and that it is placed immediately after finishing.

D. Surfaces at cast-in-place concrete repairs shall receive a moist cure for at least seven days. At specialty repair mortar repairs, surfaces shall receive a moist cure as required by the manufacturer, but for a minimum of two days. The curing covers shall be kept continuously wet.

E. Appearance of plastic shrinkage cracks due to inadequate finishing and curing shall be cause for rejecting the affected work. Surface concrete in the rejected area shall be removed and replaced at no additional cost to the Owner or his representatives.

F. During the curing period, the concrete shall be protected from damage due to mechanical disturbances such as shock and vibration due to adjacent construction activity. All finished concrete surfaces shall be protected from damage.

G. At formed and pumped/poured cast-in-place concrete repairs, formwork shall remain in place for at least seven days. At specialty repair mortar repairs, formwork shall remain in place as required by the manufacturer, but for a minimum of three days.

3.10. REMOVAL OF SURFACE DEPOSITS

A. Stains, efflorescence, fins, and other surface deposits resulting from the work of this Section that are objectionable by the Engineer shall be removed by methods acceptable to the Engineer.

END OF SECTION 03 0100

SECTION 03 3000
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 ENVIRONMENTAL REFERENCE INFORMATION (NON-MANDATORY)

A. Production of portland cement is highly energy intensive and produces large quantities of carbon dioxide (CO2), a gas that contributes to climate change. Approximately one ton of CO2 is produced for every ton of cement, and cement production accounts for over 5% of global CO2 emissions.

B. A goal of this project is to reduce the amount of cement required while meeting other performance requirements. This specification addresses the use of supplementary cementitious materials (SCMs), such as fly ash and slag, to reduce portland cement content. Using larger and better-graded aggregates can also reduce cement use, because the mix paste proportion is reduced.

C. Products that emit volatile organic compounds (VOCs) contribute to smog and, if used inside, indoor air quality concerns. This specification addresses the use of low-VOC curing techniques, sealers, and form-release agents.

1.2 SUMMARY

A. Except for that specifically excluded below, furnish, and combine materials for all the work indicated on the Drawings or herein specified to be of plain or reinforced concrete, its installation with forms and reinforcement, its curing, and its finishing. Shop drawings, tools, ways, apparatus, and equipment necessary for concrete production, installation, and finish are included.

1.3 DEFINITIONS

A. Supplementary Cementitious Materials (SCM): One or more of the following: blended hydraulic cement, fly ash and other pozzolans, slag cement, and silica fume; subject to compliance with requirements.

B. Special Inspector: Personnel performing Owner-provided testing and inspections as specified and as required by the Governing Building Code.

1.4 REFERENCES

A. A. Follow the guidelines contained in the latest editions of the following codes, specifications, and standards, including references contained in each document, except where more stringent requirements are shown or specified.

B. American Association of State Highway and Transportation Officials (AASHTO):
   1. AASHTO T260 – Methods of Sampling and Testing for Total Chloride Ion in Concrete and Concrete Raw Materials.

C. American Concrete Institute (ACI):
   1. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.
   2. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
   3. ACI 214 – Recommendation for Evaluation of Compression Test Results of Field

Concrete.
4. ACI 301 – Standard Specification for Structural Concrete.
5. ACI 304 – Recommended Practice for Measuring, Mixing, and Placing Concrete.
6. ACI 305 – Recommended Practice for Hot Weather Concreting.
7. ACI 306 – Recommended Practice for Cold Weather Concreting.
8. ACI 306.1 - Standard Specification for Cold Weather Concreting.
9. ACI 308 – Guide to Curing Concrete.
10. ACI 309 – Recommended Practice for Consolidation of Concrete.
11. ACI 311 – Recommended Practice for Concrete Inspection.
12. ACI 315 – Manual of Standard Practice for Detailing Reinforced Concrete Structures.
13. ACI 318 – Building Code Requirements for Reinforced Concrete.
14. ACI 347.3R-13 – Guide to Formed Concrete Surfaces.
15. ACI 613 – Recommended Practice for Selecting Proportions for Concrete

D. ASTM International (ASTM)
1. ASTM C31 – Standard Method of Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 – Standard Specification for Concrete Aggregates.
3. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C94 – Standard Specification for Ready-Mixed Concrete.
5. ASTM C143 – Standard Method of Test for Slump of Portland Cement Concrete.
6. ASTM C150 – Standard Specification for Portland Cement.
7. ASTM C173 – Standard Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method.
8. ASTM C192 – Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Laboratory.
9. ASTM C231 – Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method.
10. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
11. ASTM C494 – Standard Specifications for Chemical Admixtures of Concrete.
12. ASTM C595 – Standard Specification for Blended Hydraulic Cement.
13. ASTM C1866 – Standard Specification for Ground-Glass Pozzolan for Use in Concrete.
14. ASTM E329 – Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as Used in Construction.
15. ASTM C1116 – Standard Specification for Fiber-Reinforced Concrete

E. National Ready Mixed Concrete Association (NRMCA):
1. NRMCA Check List for Certification of Ready Mixed Concrete Production Facilities

F. Concrete Reinforcing Steel Institute (CRSI):
1. Manual of Standard Practice

1.5 SUBMITTALS

A. General:
1. All submissions shall be in accordance with the submission schedule, which shall be developed and agreed between the Engineer and Construction Manager at the commencement of the project.
2. Review of submittals is of a general nature only, and the responsibility for conformance to the intent of Contract Documents shall remain with the Contractor. Review does not imply or state that the Contractor has correctly interpreted the construction documents.

3. The Contractor shall make all submittals in electronic PDF file format. The COTR assisted by the Structural Engineer of Record (SER) will only return PDF files to the Contractor.
4. Simultaneously with reinforcing steel shop drawings, the Contractor shall submit coordinated slab and wall penetration drawings showing locations and sizes of sleeved penetrations required by plumbing, electrical, mechanical, and fire protection trades.

B. Submit the following action submittals for review and approval:

1. Concrete Mix Design for Each Type of Concrete: The Contractor shall warrant by the submission of the design mixes that such mixes are totally representative of the concrete that he intends to supply to meet the requirements of the Contract Documents. Submit new design mixes for review and approval when any change in materials are required or needed. Submit all information for each mix design in its own submittal. Include the following information in a single submittal for each concrete mix design:
    a. Method used to determine the proposed mix design (per ACI 301, Article 3.9).
    b. Compressive Strength at 7, 28, and 56 (if specified) Days . Submit strength test records, mix design materials, conditions, and proportions for concrete used for record of tests, standard deviation calculation, and determination of required average compressive strength. For mass concrete, also submit compressive strength at 56 days.
    c. Gradation of Fine and Coarse Aggregates: Testing data confirming proposed aggregates meet ASTM C33 class designation. Include ASTM test results for aggregates subject to freeze-thaw environment.
    d. Certification of nonreactivity of aggregates: Include supplier's certificate demonstrating that aggregate is nonreactive in the presence of alkalis in accordance with ASTM C1260 or ASTM C1293.
    e. Proportions of all ingredients, including all admixtures and macrofiber reinforcement to be added at the time of batching. Addition of water during delivery, at the Project site, or during placement is prohibited unless specifically approved by the COTR with assistance from the SER. Refer to Section 3.9.B.
    f. Water-cement ratio.
    g. Placement method including any hot- or cold-weather procedures.
    h. Slump tested in accordance with ASTM C143.
    i. Air content of freshly mixed concrete by the pressure method, ASTM C231, for normal weight concrete mix designs only or the volumetric method, ASTM C173, for lightweight or normal weight concrete mix designs.
    j. Unit weight of concrete ASTM C138.
    k. Mill test reports of fly ash chemical and physical analysis and certification of compliance with ASTM C618, Class C or F, if used.
    l. Manufacturer's Data Sheets of each concrete admixture, macrofiber reinforcement, supplementary cementitious material, including brand name, manufacturer, dosage sequence, and dosage rate range.
    m. Mineralization Additive Product Data Sheet.
2. Shop drawings for reinforcement detailing, fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 – Manual of Standard Practice for Detailing Reinforced Concrete Structures, showing bar schedules, stirrup spacing, bent bar diagrams, and arrangement of concrete reinforcement. Include special reinforcing required for openings through concrete structures. Drawings shall be coordinated to show the

locations of all sleeves, inserts, and embeds installed by other trades including but not limited to exterior wall panels, plumbing, mechanical, electrical, fire protection, and tel-data.

3. Plans showing the proposed locations of construction and control joints.
4. Product data for proprietary materials and items, including reinforcement and forming accessories, form release agent, form facing products, admixtures, synthetic macrofiber reinforcement, patching compounds, bonding agents, curing compounds, joint protectors, base plate grout, and others if requested by the Engineer.
5. Proposed methods for finishing concrete flatwork.
6. Proposed methods for curing cast-in-place concrete.

C. Submit the following informational submittals for record:

1. Health and Safety Data Sheets for each concrete admixture.
2. Proposed Schedule of Concrete Placement. Contractor shall keep a permanent log of the dates and times of concrete placement and where on the project the concrete was cast. This log shall be made available to the COTR and SER for inspection, upon request.
3. Qualifications of Concrete Foreman showing 5 years of experience with this type of concrete installation.
4. Hot and cold weather concreting procedures
5. Tickets for each batch of concrete delivered to the jobsite containing the following information:
    a. The mix design identification.
    b. The design compressive strength of the concrete being delivered.
    c. The volume of concrete in the delivery truck.
    d. The time the concrete was batched (i.e., the time that water was discharged into the delivery truck to mix with the cement and aggregates).
    e. The weights of aggregates, cementitious materials, and water in each batch.
    f. List of admixtures (including synthetic macrofibers) and dosage rates.
    g. Slump of concrete as placed at the point of deposit in the work.
    h. Permissible volume of water added to the delivery truck after initial batching.
    i. Location where the concrete is being placed.
    j. If, upon reaching the jobsite, the concrete cannot be placed within the time limits stated below, or if the type of concrete delivered is incorrect, the Owner’s Testing Laboratory will reject the load.

1.6 QUALITY ASSURANCE

A. Foreman’s Qualifications: Concrete work shall be done under the supervision of an experienced concrete foreman having at least 5 years of foreman experience with cast-in-place concrete, similar to that used on this project.

B. The Contractor shall perform all work in strict accordance with all applicable laws and regulations of the building code and with all other authorities having jurisdiction. All such requirements shall take precedence over the requirements of the Specifications, except in cases where the requirements of the Specifications are more exacting or stringent.

C. Concrete Mix Design: The Contractor shall employ an independent testing laboratory, acceptable to the Owner, to perform material evaluation tests and to design concrete mixes or, when acceptable to the COTR with assistance from the SER, provide copies of recently made material tests and mix designs.

1. If, at any time during construction, the concrete resulting from the approved mix design deviates from Specification requirements, the Contractor shall have his laboratory modify the design, subject to approval, until the specified concrete is obtained.

D. Testing of materials and inspections of installed work shall be completed throughout the duration of the project, as directed by the COTR. The Contractor shall provide free and safe access to material stockpiles and facilities for inspectors.

1. Retesting of rejected materials and/or reinspection of deficient work shall be done at the Contractor's expense.

E. The Contractor is responsible for correction of concrete work that does not conform to the specified requirements, including strength, mix proportions, air void system, tolerances, and finishes. Correct deficient concrete as directed by the COTR with assistance from the SER.

F. All finishing crewmembers shall be ACI-Certified Concrete Flatwork Finishers. The supervisor shall be an ACI Certified Flatwork Finisher and shall have input to the crew's placement and finishing procedures regarding the application of ACI Standards for quality flatwork. The ACI Standards that shall be observed are contained in the ACI – Concrete Craftsman Series.

G. The Engineer will reject cast-in-place concrete that exhibits the following defects:

1. Bulging: Concrete surfaces that bulge due to insufficiently secured formwork, undersized ties, or flat bar clamps.
2. Wavy Concrete: Concrete surfaces that exhibit waves along plywood joints due to moisture migration into unsealed cuts of plywood sheets causing swellings.
3. Spalling: Concrete spalling due to shale, alkali reactivity, rusting steel too close to the surface, carbonation, improper removal of formwork, expansion of cast-in steel during the welding process, or other reasons.
4. Cracking and Crazing: Concrete cracking and crazing due to lack of control joints or high water/cement ratio (above 0.50).
5. Air Holes: Air holes resulting from improper vibration and excessive heights of individual layers of pours between vibration. Air holes due to spreading of concrete with vibrators rather than moving buckets or hoses.
6. Honeycombing: Concrete honeycombing, including loss of fines from leaking formwork or other causes.
7. Discoloration: Concrete discoloration caused by any reason, including inconsistent concrete mix, different sources of cement and aggregates, temperature variation between individual pour and curing phases, improper and inconsistent use of vibrators, variation of timespan of concrete in formwork, form oils, and migration of plasticizer into concrete from exposed sealant beads on formwork and around cast-in items such as electrical outlet boxes.
8. Visible Pour Joints: Visible pour joints in concrete resulting from leaking formwork due to lack of gaskets and insufficient overlap with older concrete preventing proper tightening of formwork, placement of concrete layers in excessive heights, and spreading concrete with vibrator.
9. Debris in Concrete: Concrete that includes debris, whether caused by insufficient cleaning of formwork or lack of cleanout and access doors at base of formwork.

H. The Contractor shall schedule a Concrete Preconstruction Meeting at least 30 days prior to placement of any concrete. Attendance at the meeting shall include the Construction Manager, the Ready Mix Supplier, the Concrete Subcontractor, the Concrete Pumping Subcontractor, Concrete Polishing Subcontractor, Special Inspector, the Field Testing Laboratory, and the Engineer. The agenda of the meeting shall be prepared by the Contractor and shall include, but not be limited to, the following:

1. Review of concrete mix designs.
2. Field testing and quality control.
3. Concrete placing sequence and schedule.
4. Formwork, shoring, reshoring, and stripping procedures.
5. Placing, jointing, and finishing procedures.
6. Cold-weather and hot-weather concreting procedures.
7. Construction of control and isolation joints, joint-filler strips, and semi-rigid joint fillers.
8. Construction of pour strips.
9. Vapor-retarder installation.
10. Anchor rod, anchorage device, and embedment installation and tolerances.
11. Steel reinforcement installation.
12. Installing sleeves furnished by other trades and penetration coordination drawings.
13. Curing and protection procedures.
14. Slab flatness and levelness criteria and measurement.
15. Review of independent special inspection and testing and inspecting agency procedures for field quality assurance.

I. The Contractor shall obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

J. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specification for Structural Concrete."
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

K. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

L. The Owner shall employ a Special Inspector to oversee and administer, and an independent Testing Agency(s) to perform, a Program of Structural Tests and Inspections for compliance with Building Code. The SER has prepared a statement of structural tests and inspections, specifying the structural tests and inspections to be performed throughout the construction of this project. Submission to and approval of this statement by the local building official must be complete prior to beginning construction.

1. The Special Inspector will organize and direct the test and inspection program. All inspection and test reports shall be submitted to the Contractor, COTR and the SER. The Contractor shall be responsible for understanding the test and inspection program and notifying the Testing Agency and the Special Inspector when work is ready for tests and/or inspections. The Contractor will provide access to the Testing Agency, Special Inspector, COTR, and the SER. Inspections and tests of the Program of Structural Tests and Inspection Program will not relieve the Contractor of its responsibility for supervision,

testing, and inspection for quality control of the work.

2. The Testing Agency and Special Inspector shall submit written reports to the Contractor, COTR, and the SER within two business days of all inspections that describe any construction that does not conform to the Contract Documents. The Special Inspector shall reinspect all nonconforming construction after the Contractor has corrected the nonconforming construction and prepare a written report of the reinspection within two business days of the reinspection.

M. The Owner's Representative will provide testing and inspection reports to the local building official when requested by the local building official. Upon completion of the construction, the independent Special Inspector will make a final report on the satisfactory completion of the Program for Structural Tests and Inspection to the building official and to the Owner's Representative.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending, damage, and exposure to road salt spray.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Use form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. High-density overlay, Class 1 or better.

b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.

c. Structural 1, B-B or better; mill oiled and edge sealed.

d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 in. x 3/4 in., minimum.

C. Form-Release Agent: Commercially formulated form-release agent with a maximum of 100 g/l volatile organic compounds (VOC) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

D. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 in. to the plane of exposed

concrete surface.

2. Furnish ties that, when removed, will leave holes no larger than 1 in. in diameter in concrete surface.

3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

A. Construction Waste Management: Steel reinforcement waste material shall be source-separated and recycled.

B. Recycled Content of Steel Products: Provide products with a minimum of 85% postconsumer recycled content and 10% preconsumer recycled content by weight. Documentation of recycled content must be submitted prior to purchasing the material.

C. Regional Production: Provide steel reinforcement processed and fabricated within a 500 mi radius of the project site. Recycled steel scrap used in the production of the reinforcement must also be sourced from within a 500 mi radius of the project site. Documentation of the location of the material must be submitted prior to purchasing the material.

D. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

E. Plain-Steel Tie Wire: ASTM A82, as drawn

2.3 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's Manual of Standard Practice, of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless steel bar supports.

B. Mechanical Bar Couplers:

1. Where required, provide mechanical couplers capable of developing 125% of the reinforcing bar yield strength.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C150, Type I.

B. Blended Cement: ASTM C595.

1. Type IL, Portland Limestone Cement

2. Type IS, Portland-Slag Cement

3. Type IP, Portland-Pozzolan Cement

4. Type 1T, Ternary-Blended Cement

5. Type 1T (HS) for Exposure Class S3 (high sulfate resistance)

C. Fly Ash: ASTM C618, Class F or Class C. Maximum mercury content 2 ppb (0.002 mg/l). Fly ash may not be sourced from a coal plant co-fired with hazardous waste, medical waste, or tire-derived fuel, or from a municipal solid waste incinerator.

1. Source fly ash from a coal-fired power plant located within 500 mi of the project site. Provide documentation on source location of material prior to purchase .

D. Slag Cement: ASTM C989, Grade 100 or 120. Slag cement may not be sourced from a plant co-fired with hazardous waste, medical waste, or tire-derived fuel.

1. Source slag cement from a plant located within 500 mi of the project site. Provide documentation on source location of material prior to purchase .

E. Silica Fume: ASTM C1240, amorphous silica.

F. Ground-Glass Pozzolan: ASTM C1866

2.5 AGGREGATES

A. Aggregate shall be nonreactive in the presence of alkalis in accordance with ASTM C1260 or ASTM C1293. Aggregates will be acceptable as non-deleteriously reactive if the aggregate produces ASTM C1567 expansion values of less than 0.1% at 14 days using the same source material and relative proportions of cementitious materials proposed for use in the mix design.

B. ASTM C33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 5 years satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Nominal Maximum Coarse-Aggregate Size: See construction documents.

a. Free of materials with deleterious reactivity to alkali in cement.

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

2.6 WATER:

A. ASTM C94/C94M and potable.

2.7 ADMIXTURES:

A. General Admixture Requirements:

1. The concrete supplier and Contractor shall use manufacturer’s product identified in this Section or submit alternate manufacturer product for approval consideration by the COTR with assistance from the SER.

2. All admixtures used in the concrete shall be produced by a single manufacturer.

3. Concrete supplier and Contractor shall certify compatibility of all ingredients in each mix design. Use admixtures in strict accordance with manufacturer’s recommendations.

4. Concrete supplier and Contractor shall account for admixture volume in the concrete mix proportions in accordance with admixture manufacturer’s recommendations.

5. Do not use calcium chloride or admixtures containing more than 0.1% chloride ions.

B. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures. Subject to compliance with requirements; provide one of following, or approved equivalent:

1. Air-Mix, Euclid Chemical Co.
2. Darex AEA or Daravair, W.R. Grace & Co.
3. MasterAir VR10 or MasterAir AE 200, BASF.
4. Sealtight AEA, W.R. Meadows, Inc.
5. Sika AER, Sika Corp.

C. Water-Reducing Admixture: ASTM C494, Type A. Subject to compliance with requirements; provide one of following, or approved equivalent:

1. PSI N, Cormix Construction Chemicals.
2. Eucon WR-75, Euclid Chemical Co.
3. WRDA, W.R. Grace & Co.
4. Master Pozzolith or MasterPolyheed, BASF.
5. Metco W.R., Metalcrete Industries.
6. Prokrete-N, Prokrete Industries.
7. Plastocrete 161, Sika Corp.

D. Water-Reducing and Retarding Admixture: ASTM C494, Type D. Subject to compliance with requirements; provide one of following, or approved equivalent:

1. Eucon Retarder 75, Euclid Chemical Co.
2. Daratard-17, W.R. Grace & Co.
3. MasterPozzolith 100 XR, BASF.
4. Protard, Prokrete Industries.
5. Plastiment, Sika Corporation.

E. Water-Reducing Accelerating Admixture: ASTM C494, Type E. Subject to compliance with requirements; provide one of following, or approved equivalent:

1. Q-Set, Conspec Marketing & Manufacturing Co.
2. Lubricon NCA, Cormix Construction Chemicals.
3. Accelguard 80, Euclid Chemical Co.
4. Daraset, W.R. Grace & Co.
5. MasterSet FP 20, BASF.
6. Accel-Set, Metalcrete Industries.

F. High-Range Water-Reducing Admixture: ASTM C494, Type F or Type G. Subject to compliance with requirements; provide one of following, or approved equivalent:

1. Super P, Anti-Hydro Co., Inc.
2. Eucon 37, Euclid Chemical Co.

3. WRDA 19 or Daracem, W.R. Grace & Co.
4. Rheobuild 1000 or MasterPolyheed, BASF.
5. Superslump, Metalcrete Industries.
6. PSPL, Prokrete Industries.
7. Sikament 300, Sika Corp.

G. Shrinkage Reducing Admixture: Mix capable of maintaining long-term strain to 300 microstrain or less.

1. Eclipse by Grace Construction Products
2. Approved equal.

H. Synthetic Macrofiber Reinforcement

1. Adfil Strux 90/40 Synthetic Macrofiber by Chryso Saint-Gobain
2. Approved equal.

2.8 WATERSTOPS

A. Self-Expanding Strip Waterstops: Manufactured rectangular or trapezoidal strip, nonbentonite hydrophilic waterstop, 1/2 in. x 1 in. Subject to compliance with requirements, provide one of following:

1. Adcore ES by GCP Applied Technologies.
2. Approved equal.

B. Groutable Hose Waterstop System: 1/2 in. permeable tube injected with chemical grout.

1. Injecto Tube with De Neef Injecto Pure by GCP Applied Technologies.
2. Approved equal.

2.9 VAPOR RETARDERS

A. Plastic Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape. Subject to compliance with requirements, provide one of following, or approved equivalent:

1. Fortifiber Corporation; Moistop Ultra A.
2. Raven Industries Inc.; Vapor Block 15.
3. Reef Industries, Inc.; Griffolyn

2.10 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet. Polyethylene film or white burlap-polyethylene sheet shall not be used on slabs to be polished.

C. Curing Paper: ASTM C171, opaque appearance, for all concrete flatwork. Lap and seal all seams.

For slabs to be polished, provide suitable opaque curing paper that will impart a uniform surface appearance.

D. Water: Potable.

2.11 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Reglets: Fabricate reglets of not less than 0.0217-inch-thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

D. Adhesive Rebar Anchors/Dowels:

1. HIT-HY 200 System by Hilti.
2. SET-XP System by Simpson.
3. Approved equal providing same or higher allowable tensile and shear loads at the indicated embedment, spacing, and edge distance.

E. Nonmetallic Nonshrink Grout: ASTM C109 compressive strength of 8,000 psi minimum at 28 days, prepared at flowable consistency. Provide “Five Star” by U.S. Grout Corp., or approved equal.

F. Slab-on-Grade Construction Joint Dowels:

1. Square Dowel System by PNA Construction Technologies.
2. Approved equal.

2.12 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures. Do not use the same testing agency for field quality control testing.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Ground Granulated Blast-Furnace Slag: 50 percent.
4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
5. Silica Fume: 10 percent.
6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble chloride-ion content in hardened concrete to 0.15% by weight of cement unless COTR with assistance from the SER approves a higher limit and corrosion inhibitors are added to the mixture to offset the additional chloride. Water-soluble chloride ion content by weight of cement and of concrete shall be tested in accordance with FHWA RD-77 or AASHTO T260-84.

D. Air Content: Measure at point of deposit into the work. If concrete will be pumped, design mix for air loss due to pumping.

E. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious-materials ratio below 0.50 .

4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.13 FABRICATING REINFORCEMENT:

A. Fabricate steel reinforcement according to CRSI's Manual of Standard Practice.

2.14 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94/C94M, and furnish batch ticket information.

1. When air temperature is between 80°F and 90°F, reduce maximum mixing and delivery time from 90 min. to 75 min.; when air temperature is above 90°F, reduce maximum mixing and delivery time to 60 min.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.

3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1. GENERAL

A. Coordinate the installation of joint materials, sleeves, embedded items, floor drains, and other related materials with placement of forms and reinforcing steel.

B. Cast in Place Contractor shall coordinate with Structural Precast Concrete Fabricator's reviewed and approved shop drawings for placement of dowels connecting cast-in-place concrete elements to structural precast concrete elements. Contractor shall use templates, provided by Precast Fabricator, for placing dowels within specified tolerances.

3.2. FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Construct forms tight enough to prevent loss of concrete mortar.

D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like for easy removal.
2. Do not use rust-stained steel form-facing material.

E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

G. Chamfer exterior corners and edges of permanently exposed concrete.

H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.3. EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.4. REMOVING AND REUSING FORMS

A. Leave formwork in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.5. VAPOR RETARDERS

A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

3.6. STEEL REINFORCEMENT

A. General: Comply with CRSI’s Manual of Standard Practice for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, road salts, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7. JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. New Concrete Common with Existing Concrete: Where new concrete will be placed against existing concrete, roughen surface of existing concrete to 1/4 in. minimum amplitude.

C. Construction Joints: Install so that the strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

D. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.

E. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces. Apply bonding agent in strict accordance with the manufacturer’s

instructions. Do not exceed open time prior to placing fresh concrete.

F. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated.

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

2. Sawed 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 concrete develops random contraction cracks.

G. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, -grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are indicated.

3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

H. Doweled Joints: Install dowel bars/plates and support assemblies at joints where indicated and in strict accordance with the manufacturer’s requirements.

3.8. WATERSTOPS

A. Self-Expanding Strip Waterstops: Install at locations indicated according to manufacturer's written instructions. Install in longest lengths practicable.

1. Clean surfaces thoroughly prior to installation. Prepare surfaces using the methods recommended by the manufacturer. Do not install waterstop onto any substrates with standing water.

2. Refer to manufacturer’s written instructions for installation requirements including adhesive bedding, nailing, and overlap requirements. All materials used in installation shall be manufactured by the same supplier and compatible with the waterstop.

B. Groutable Hose Waterstop System: Install at locations indicated according to manufacturer's written instructions. Install in longest lengths practicable.

1. Refer to manufacturer’s written instructions including tube installation requirements, grout and catalyst storage and mixing, and cleaning requirements.

3.9. CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water or admixtures to concrete during delivery, at the Project site, or during placement, unless withheld during batching and specifically approved by COTR assisted by the

SER. If approved by COTR, delivery tickets must show volume of water withheld at plant and volume added at site. Total water content of the mix shall not exceed water content shown on approved mix design.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete for concrete elements continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 in. into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 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 average of the high and low air temperatures is expected to fall below 40°F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
4. Do not apply deicing salts to concrete flatwork for at least 1 yr after placement.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90°F at time of placement. Chilled mixing water 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 the Contractor's option.

2. If the concrete supplier wants to withhold trim water in accordance with the recommendations of ACI 305, a hot weather placement plan detailing how the total water content of the mix will be controlled and recorded is required for approval by the COTR assisted by the SER.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10. FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats, or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture. Grind smooth any surface defects that would telegraph through applied floor finishes.

C. Broom Finish: Apply a broom finish to exterior concrete slabs-on-grade, pads, platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

2. Finish fiber reinforced concrete so as to minimize visible fiber at surface of concrete.

a. Broom once in one direction only.

b. Do not overlap broom strokes.

c. Broom finishing shall be timed as necessary to minimize fiber being pulled from concrete.

d. Keep broom clean and damp.

D. Finish surfaces with tolerances according to ASTM E 1155 (ASTM E 1155M) for a randomly trafficked floor surface. Refer to drawings for flatness and levelness requirements.

3.11. CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

D. Cure concrete according to ACI 308.1 by one or a combination of the following methods:

1. Moisture Curing: Use moisture curing for concrete flatwork. Keep surfaces continuously moist for not fewer than 7 days with the following materials:
    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water-saturated and kept continuously wet. Cover concrete surfaces and edges with 12 in. lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Use moisture-retaining-cover curing for concrete flatwork. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 in., and sealed by waterproof tape or adhesive. Cure for not fewer than 7 days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure polished concrete and concrete surfaces to receive penetrating liquid floor treatments.

3.12. JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
    1. Defer joint filling until concrete has aged at least one month.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semi-rigid joint filler full depth in saw-cut joints and at least 2 in. deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.13. CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when as directed and approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

3.14. QUALITY CONTROL AND QUALITY ASSURANCE

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections and tests performed by the independent Special Inspector and Testing Agency do not relieve the Contractor of the responsibility of control over the quality of the Work.

C. Refer to the Program of Structural Tests and Inspection, including but not limited to inspection of the following:
    1. Steel reinforcement placement.
    2. Anchor rods and embedded items.
    3. Verification of use of required design mixture.
    4. Concrete placement, including conveying and depositing.

5. Curing procedures and maintenance of curing temperature.
6. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Corrosion Inhibitor:
    a. Test plastic concrete for presence of corrosion inhibitor using the "Hach" Nitrite Test by the Hach Co., Loveland, CO. Test each concrete sample used for concrete compression test cylinders at the rate of one test for each 50 cubic yards, or fraction thereof, of each mix design placed in any one day.
7. Compression Test Specimens: ASTM C 31/C 31M.
    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    b. Cast and field cure one set of two standard cylinder specimens for each composite sample.
8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength

and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

11. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Engineer.
14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
16. Measure floor and slab flatness and levelness according to ASTM E1155 within 24 hours of finishing.

END OF SECTION 03 3000

SECTION 281643
ELECTRIC BARRIER SYSTEMS

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:
   1. Hot Grass Systems and Accessories.

1.3 ACTION SUBMITTALS

A. Product Data: Components for all electric barrier fence components and controls, including dimensions and data on features, performance, electrical characteristics, ratings, finishes, limitations, storage and maintenance data. Provide written information to Owner on performing operation and maintenance at completion of project.

B. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.

   1. Show electrical diagrams for all component parts.
   2. Coordinate all circuiting and power feeds for work of this section.
   3. System Wiring Diagrams: Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for systems with all terminals and interconnections identified.
   4. Details of transient voltage surge protection.

C. Equipment and System Operation Description: Include method of operation and supervision of each component and each type of circuit. Show sequence of operations for manually and automatically initiated system or equipment inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are unacceptable.

D. Samples for Initial Selection: Of one unit of Hot Grass.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Other Information Submittals:

1. Test Plan and Schedule: Test plan defining all tests required to ensure that system meets technical, operational, and performance specifications within 60 days of date of Contract award.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric barrier system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Project Record Documents," include the following:

1. Data for each type of product, including features and operating sequences, both automatic and manual.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. An employer of workers, at least one of whom is a technician.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Altitude: Sea level to 4,800 feet.
2. Master Control Unit: Rated for continuous operation in an ambient of 30 to 95 deg F and a relative humidity of 20 to 80 percent, noncondensing.
3. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph and snow cover up to 24 inches thick.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of perimeter security devices and equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FUNCTIONAL DESCRIPTION OF SYSTEM

A. Description: Provide following components and equipment as required to provide a complete system for each type of electric barrier specified and indicated on drawings.

2.2 SYSTEM COMPONENT REQUIREMENTS

A. Compatibility: Detection devices and their communication features, connecting wiring, and master control unit shall be selected and configured with accessories for full compatibility with the following equipment:

B. Basis of Design for quality products, unless otherwise noted, shall be Premier 1 Fencing Systems, telephone 800-282-6631, www.premier1supplies.com, or equal, installed as per manufacturer's instructions and as directed by The Owner's representatives.

C. Each Hotwire System shown on drawings including: Hot Grass
   1. 333000 Cut Out Switch
      a. "Knife" style switch with stainless steel connections.
      b. Suitable for interior or exterior use
   2. 164208 Insulated Galv. Lead out wire (total length as required)
      a. Double insulated cable.
      b. Heavy duty (Class IV) galvanized coating on each strand of wire.
      c. Highly pliable, stays in place when twisted.
      d. Exterior usage.
   3. 337000 Manual Joint clamp
      a. Galvanized, exterior use, electrical connector for 12.5 gauge high-tensile (HT) wire.
      b. Connection for up to four wires.
   4. Basis of design: 'Tall Hot Grass' system as fabricated and supplied by Hot Grass & Vines LLC, https://www.hotgrassandvines.com/tallhotgrass.html#/, in quantities necessary to complete the layout as shown on the Drawings, and as directed by Owner's Representative in the field.
      a. 76 inch tall faux grass clumps made from fiberglass poles and painted wires that distributes an electric charge from the electric fence charger.
      b. End of wires to have looped ends (for animal eye safety).
      c. System comes with wire crimps to connect clumps of faux grass together, forming a naturalistic electric animal barrier.

D. Equipment List might not be a complete list of parts needed for a complete system. Installer to provide a complete system. Other equal quality manufacturers of electric barrier system can be submitted for review and approval.

E. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of electric barrier fencing.

B. Inspect built-in and cast-in anchor installations, before installing perimeter security, to verify that anchor installations comply with requirements. Prepare inspection reports.

1. Remove and replace anchors where inspections indicate that they do not comply with requirements. Reinspect after repairs or replacements are made.
2. Perform additional inspections to determine compliance of replaced or additional anchor installations. Prepare inspection reports.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Existing energizer to be used as noted on drawings.

3.2 SYSTEMS INTEGRATION

A. Integrate electric barrier systems with the following equipment and objects:

1. Animal Barrier Fences, gates, and partition walls
2. Plantings
3. Buildings and structures

3.3 SYSTEM INSTALLATION

A. Install all work in accordance with the requirements of the manufacturer and supplier of electric fencing components and all approved shop drawings.

B. All mounting hardware, insulator and supporting devices will be furnished and installed by the Contractor.

C. Electrical Contractor shall provide (furnish and install) all electric fence wire, attachments and electrical connections. Fully coordinate installation with General Contractor.

D. Provide driven ground rod for proper grounding of hot wire systems as recommended by manufacturer if required. Coordinate location of ground rods with Architect.

E. Test all electric barrier systems for continuity before energizing. Test systems upon initial energization with portable IntelliTest Digital Voltmeter and record voltage of furthest distance from energizer.

F. Install all lead out insulated wires in rigid exterior rated, buried conduit. Seal end of raceway from entry of moisture, dust, etc.

G. For non-solar powered/stand-alone energizers, confirm a surge protected circuit to the energizer unit.

H. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with perimeter security system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

I. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

J. Electrostatic-Field System: Install field and sense wires on insulators and standoffs as indicated on drawings or this section.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals.

3.5 GROUNDING

A. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at cabinet. Isolate from power system and equipment grounding. Provide 5-ohm ground. Measure, record, and report ground resistance.

C. Install any grounding electrodes of type, size, location, and quantity per manufacturer's recommendations. Comply with manufacturer's recommendations installation requirements.

3.6 FIELD QUALITY CONTROL

A. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

1. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.

B. Perform tests and inspections.

C. Tag all equipment, stations, and other components at which tests have been satisfactorily completed.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 3 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to one visit to Project during other than normal occupancy hours for this purpose. Visit for this purpose shall be in addition to any required by warranty.

END OF SECTION 281643

SECTION 31 1000 – SITE CLEARING

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:

1. Protecting existing trees, shrubs, groundcovers, plants and grass to remain.
2. Removing existing trees, shrubs, groundcovers, plants and grass.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, site utilities
7. Temporary erosion- and sedimentation-control measures.

B. Related Sections:

1. Section 015713 "Temporary Erosion and Sediment Control" for temporary erosion and sedimentation control measures.
2. Section 024119 "Selective Demolition" for partial demolition.

1.3 Applicable Specifications

A. Erosion and Sediment Control Field

B. American Association of Nurserymen (A.A.N.)

C. International Society of Arboriculture (I.S.A.) National Arborist Association (N.A.N.)

1.4 ENVIRONMENTAL REQUIREMENTS

A. Construct temporary erosion control systems as shown on Construction Drawings and in accordance with applicable County requirements to protect adjacent properties and water resources from erosion and sedimentation.

B. Contractor shall not begin construction without a eNOI permit governing discharge of storm water from site for entire construction period. eNOI permit requires Erosion Control Plan to be in place during construction.

C. Contractor shall be totally responsible for conducting storm water management practices in accordance with a eNOI permit and for enforcement action taken or imposed by Federal or State agencies, including cost of fines, construction delays, and remedial actions resulting from Contractor's failure to comply with provisions of eNOI permit.

1.5 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.

D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally 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.

E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.

G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.6 MATERIAL OWNERSHIP

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

1.7 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.8 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 permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or the District.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

D. Utility Locator Service: Notify Miss Utility before site clearing.

E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

F. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

I. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

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

B. Locate and clearly identify trees, shrubs, and other vegetation to remain.

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

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

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control specific to the site that complies with the District Standards and Specifications and Erosion and Sedimentation Control Field Handbook.

B. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.

B. Locate, identify, and disconnect utilities indicated to be abandoned in place.

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

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

D. Removal of underground utilities is included in earthwork sections and with applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security and utilities sections.

3.4 CLEARING AND GRUBBING

A. 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 sod and grass before stripping topsoil.

B. Strip topsoil to depth indicated on Drawings in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

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

1. Limit height of topsoil stockpiles to 72 inches.
2. Do not stockpile topsoil within protection zones.
3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.6 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and 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 along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

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.

B. Dispose of trees and shrubs in accordance with the Garbage, Refuse and Weeds Ordinance of the District code. When approved by the COTR, material may be dumped within the Contract area where directed.

C. Do not burn materials on the site.

D. Remove material from the site as it accumulates. Do not allow waste material to accumulate for more than 48 hours.

END OF SECTION

SECTION 31 2000 – EARTH MOVING

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:

1. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses, and plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Subbase course for concrete walks and pavements.
5. Subbase course and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Sections:
1. Section 0155713 "Temporary Erosion and Sediment Control" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.

1.3 APPLICABLE SPECIFICATIONS

A. American Association of State Highway and Transportation Officials (AASHTO)

B. American Society for Testing and Materials (ASTM)

C. Occupational Safety and Health Act, State & Federal (OSHA)

D. DC Department of Transportation, Road and Bridge Specifications (DDOT)

1.4 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

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: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer 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.

E. Drainage Course: Aggregate layer 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. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
3. 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 that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom; measured according to SAE J-1179.
2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket; measured according to SAE J-732.

I. 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 a geotechnical testing agency, according to ASTM D 1586.

J. 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.

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

L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

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

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Controlled low-strength material, including design mixture.
3. Geofoam.
4. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: 12 by 12 inches.
2. Warning Tape: 12 inches long; of each color.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to [ASTM D 698] [ASTM D 1557].

C. Blasting plan approved by the District.

D. Seismic survey report from seismic survey agency.

E. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, which might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.7 QUALITY ASSURANCE

A. Blasting: Comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:

1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
2. Seismographic monitoring during blasting operations.

B. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:

1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
2. Seismographic monitoring during blasting operations.

C. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.8 PROJECT CONDITIONS

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

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

B. Improvements on Adjoining Sites: Authority for performing any earth moving indicated on sites adjoining this project’s site will be obtained by Contractor from COTR in coordination with NZCBI staff.

1. Do not proceed with work on adjoining sites until directed by COTR.

C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Section 311000 "Site Clearing”, are in place.

D. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.

5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

E. Do not direct vehicle or equipment exhaust towards protection zones.

F. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

G. Underground Utilities: The location of existing utilities has been indicated on the drawings based on the best information available. The completeness or accuracy of the information is not guaranteed. Contractor shall notify "Miss Utility" in accordance with the provisions stipulated in the Underground Utility Protection Ordinance (Chapter 55), of the District's Code.

H. Overhead Utilities: The Contractor shall identify and protect all existing overhead utility poles and facilities in the vicinity of the Work. The Contractor will be solely responsible for all necessary notification and coordination with the utility owner(s). There will be no payment made for necessary bracing, sheeting, shoring, or other work required to protect and maintain existing utility poles or overhead utilities.

I. Existing Foundations: When foundations are located such that excavation may endanger or interfere with an existing structure or utility, the Contractor shall take all measures necessary to protect the existing utilities or structures. There will be no payment made for these measures.

J. Stability of Excavation: The Contractor shall be solely responsible for the stability of excavations and for meeting all State and Federal OSHA requirements. Provide all sheathing, lagging, bracing, and other support required to retain the stability of excavations.

K. Care and Restoration of Pavement and Property: When excavations are to be made in paved surfaces, the Contractor shall sawcut or use of a similar tool so as to provide a clean, uniform edge with a minimum of disturbance to remaining pavement. Pavement and other property outside of the defined Limits of Disturbance shall be preserved in the condition existent prior to construction. Damage or other impacts upon pavement or property outside the Limits of Disturbance shall be restored immediately at the Contractor's expense.

L. Construction Tolerance: Compact, shape, slope, and dress to yield the grades and slopes illustrated on the approved plans. In backfilled or other non-paved areas, grades shall be within 0.10 foot of the design grade. Slopes shall not be steeper than 2(H):1(V) and shall not deviate from a theoretical plane surface by more than 0.5 feet.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

C. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

D. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

G. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.

H. Sand: ASTM C 33; fine aggregate.

I. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

J. Backfill: Backfill shall be free of vegetation, masses of roots, and stones over 3-inches in any dimension, frozen material, cinders, ashes, refuse, or porous matter. Organic matter shall not exceed minor quantities and shall be well distributed. In addition, Backfill shall be of such a nature and in such condition that it can be compacted to a dense and stable fill.

K.

L. Top Soil:

1. Topsoil furnished by the Contractor shall consist of a natural friable surface soil without admixtures of subsoil, refuse, or foreign materials. It shall be reasonably free from roots, hard clay, coarse gravel, stones larger than 2 inches in any dimension, noxious weeds (including quackgrass rhizomes and the nut-like tubers of nutsedge), tall grass, brush, sticks, stubble, or other materials which would be detrimental to the proper development of vegetative growth.
2. Topsoil shall contain not less than 3% nor more than 10% organic matter by weight.

3. The Contractor shall submit per Section 01 0000 to the COTR a soil analysis describing the soil composition including pH factor and percentage of organic content prior to placing any Topsoil.

2.2 GEOTEXTILES – FILTER FABRIC

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 157 lbf; ASTM D 4632.
3. Sewn Seam Strength: 142 lbf; ASTM D 4632.
4. Tear Strength: 56 lbf; ASTM D 4533.
5. Puncture Strength: 56 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 40, No. 60, or No. 70 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.5 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 247 lbf; ASTM D 4632.
3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
4. Tear Strength: 90 lbf; ASTM D 4533.
5. Puncture Strength: 90 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

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 earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 LOCATION AND PROTECTION OF EXISTING STRUCTURES AND UTILITIES

A. Locate all utility pipes, conduits and facilities well ahead of the excavation process. Plainly mark

all such locations and comply with the Underground Utility Protection Ordinance (Chapter 55), of the District's Code.

B. Where the Contractor has identified or anticipates existing utilities, structures, or artifacts, excavate using hand tools or other labor intensive activity as necessary to protect the facilities. No extra compensation or time will be allowed for this activity

C. In case of damage caused by the Work, notify the owner or appropriate agency or party and affect repair in a manner resulting in a condition at least equal to the condition prior to construction. No extra compensation or time will be allowed for repair of damages.

3.3 DEWATERING

A. At all times during construction – provide, place and maintain ample means and devices with which to remove promptly all water entering trenches and other excavations. Keep excavations dry until the structures, pipes, and appurtenances to be built therein have been completed and backfilled. Dispose of all water pumped or drained from the work without impact to the Work, traffic, or injury to public or private property, and in compliance with all Local, State, and Federal regulations.

3.4 EXPLOSIVES

A. Explosives: Do not use explosives.

B. Explosives: Obtain written permission from authorities having jurisdiction before bringing explosives to Project site or using explosives on Project site.

1. Perform blasting without damaging adjacent structures, property, or site improvements.
2. Perform blasting without weakening the bearing capacity of rock subgrade and with the least-practicable disturbance to rock to remain.

3.5 TRENCH EXCAVATION

A. Carry out the excavation, dewatering, sheeting, and bracing in such manner as to eliminate any possibility of undermining or disturbing the foundations of any existing structure, utility, facility, or any work previously completed.

B. Excavate pipe trenches to the necessary depth as shown on the drawings, holding the width below top of pipe as shown in the Standard Details.

C. the Contractor shall comply with all OSHA and/or other applicable regulations for excavation.

D. Excavate trenches to provide a uniform and continuous bearing and support for the pipe and appurtenant structures on solid and undisturbed ground and at the specified grade at every point.

E. Correct any part of the trench bottom excavated below the specified grade with approved materials and thoroughly compact. Shape the bottom of all pipeline trenches to fit the lower part of the pipe exterior for a width of a least 60% of the pipe breadth. Shape the excavation and/or bedding for pipe bells, joints, and fittings. Care shall be taken that stones and lumps shall not become nested.

F. Should an unacceptable bedding for the proposed pipe or structure be encountered, notify the Engineer. The Engineer may direct additional excavation below the bottom of the proposed pipe or structure and direct the contractor to provide an alternate bedding or foundation. Additional excavation due to the fault or negligence of the Contractor or without prior approval from the Engineer shall be remedied at the expense of the Contractor.

3.6 EXCAVATION FOR STRUCTURES

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. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
3. 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.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

3.7 Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop EXCAVATION FOR WALKS AND PAVEMENTS

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

3.8 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

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

C. Authorized additional excavation and replacement material will be paid for according to Contract provisions for [changes in the Work.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 STORAGE OF HANDLING AND DISPOSAL OF EXCAVATED MATERIALS

A. Carefully remove loam and topsoil to be incorporated in the finished work and store separate from the other excavated material. Failure to isolate loam and topsoil from the other excavations shall require that said soils not be used as topsoil.

B. Excavation shall include the disposal of material deemed unsuitable by the COTR for reuse in the Work. The Contractor shall stockpile, treat, and/or otherwise manipulate suitable materials which may be incorporated into the project at a later date or different location. The Contractor is responsible for protecting any stockpiled material from contamination by unsuitable material and from degradation by any other means. Failure by the Contractor to adequately handle and protect excavated material will result in the Contractor being directed to use Select Borrow or other approved material at no expense to the Smithsonian Institution. Unless otherwise specified, the Contractor will be solely responsible for securing the necessary area for stockpiling, treating, protecting, and related activities.

C. Do not mix pavement with other excavated material. Dispose of excavated pavement away from the work site immediately. All costs associated with removing, handling, transporting, di posing, etc. of existing pavement, curb and gutter, sidewalks, driveway aprons, etc. is considered to be incidental to Excavation and no additional compensation will be considered for such activities.

D. All materials deemed unsuitable for use in the Work by the COTR shall be disposed of by the Contractor at his own expense. Storing, transporting, loading, handling, treating, and other associated costs are considered to be incidental to the Work and no additional compensation will be considered for such activities.

E. The Smithsonian Institution shall take preference over others in claiming excavated material. The Contractor shall consult the COTR before disposing of such materials.

F. The Contractor will be responsible for disposal arrangements. No additional compensation will be made to accommodate materials from the project.

3.11 BACKFILL – GENERAL

A. If the COTR determines that sufficient approved material from excavation on the job-site is not available for backfill, the Contractor shall secure material from areas outside the job-site to complete the backfill.

B. All backfill materials shall contain sufficient moisture for proper compaction.

C. Except in proposed landscape areas, or where otherwise specified, each layer of material shall be compacted to a dry density not less than 95 percent of the maximum determined by the Modified Proctor Compaction Test. Upon completion of backfilling in any area under the contract, the Owner may make tests to determine the degree of compaction of the backfill material. If the results of test indicate densities less than specified, the Contractor shall, at his own expense, remedy the condition as directed, in such portions of the trenches as may be required.

D. Backfill all excavations as rapidly as practicable after the completion of each section of the work.

All unauthorized excavations made by the Contractor shall be immediately backfilled at the Contractor's expense. Complete all backfilling to the dimensions and levels shown on the drawings.

E. The placement of material around structures shall be carried out symmetrically around the structure in horizontal lifts not to exceed six inches of loose material. The Contractor shall protect, and be responsible for any damages to adjacent structures or utilities.

F. Start backfilling around concrete structures only after the concrete has reached sufficient strength to withstand the pressure exerted by the material and compacting equipment and after carrying out and satisfactorily completing the tests specified in Section 03100, Concrete Formwork, Reinforcement and Materials.

G. At points which cannot be reached by mobile mechanical equipment, use suitable power driven tampers to achieve the same degree of compaction.

H. No material shall be placed or compacted when it is wet or frozen or when the sub grade or previously placed material is wet or frozen.

3.12 UTILITY TRENCH BACKFILL

A. The sub grade shall be properly shaped before any material is placed and compacted. Care shall be taken that stones and lumps shall not become nested.

B. Place backfill material in six-inch layers to a point at least two feet above the pipe crown. Thoroughly compact each layer for the full trench width and under, around, and over the pipe, using hand-operated mechanical tampers exerting a pressure of not less than 250 foot pounds per square foot of tamping force. The contractor will be responsible for pipe damage as a result of excessive tamping force.

C. Remainder of trench, more than two feet above pipe crown, may be backfilled by machinery in one-foot layers, thoroughly compacted.

3.13 FINAL GRADING AND TOP SOIL

A. Prior to placement of topsoil, the subgrade shall be disced or rototilled to a minimum depth of 2 inches.

B. Topsoil shall be uniformly distributed in a 4-8 inch layer and lightly compacted to a thickness of 4 inches (or as indicated on the plans) using a cultipacker, roller, or other approved equipment weighing 100-160 pounds per linear foot of roller.

C. Topsoil shall not be placed when either the topsoil or the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to proper grading.

D. Final grading shall not permit ponding of water.

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 FILL OR EMBANKMENT

A. Fill or embankment above existing grade shall consist of the placing, shaping, and compaction of approved Backfill material as illustrated on the approved plans.

B. Concrete foundations, slabs, rocks, boulders, and similar material removed during excavation may be utilized in embankments when said material will be located five feet or more below the proposed subgrade surface. When such materials are used, they shall be fractured into pieces such that no dimension exceeds 18 inches in any dimension or plane. The Contractor shall take care to ensure that no voids develop, and will be held responsible for any surface settlement resulting there from.

C. The embankment material shall be uniformly compacted throughout in lifts of no more than 12 inches, except in the case of rock, where lifts of up to 2 feet may be used. Except as otherwise allowed in the paragraph above, the embankment material shall conform to the requirements of Backfill. Each layer shall be compacted at optimum moisture content and the embankment shall have the required maximum density of ninety five percent (95%) as compared to the density of the same material when tested in accordance with AASHTO T- 99.

D. Do not place embankment upon frozen ground or areas covered with snow or ice or saturated soils.

E. The area upon which embankments are to be placed shall be denuded of vegetation per Section 02100.

F. Compact the ground upon which the embankment will be constructed to a depth of 8 inches prior to placing any fill material.

G. Embankments to be constructed over swampy areas may be deposited by end dumping the original course. This course may exceed 8”, but shall be the minimum depth required to support the equipment and shall be determined by the Engineer. The use of compaction equipment will not be required on the original course.

3.16 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 pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

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

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

4. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.18 SUBSURFACE DRAINAGE

A. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer [to 85 percent of maximum dry unit weight according to ASTM D 698] [with a minimum of two passes of a plate-type vibratory compactor].

B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer [to 85 percent of maximum dry unit weight according to ASTM D 698.
2. Place and compact impervious fill over drainage backfill in 6-inch- thick compacted layers to final subgrade.

3.19 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

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

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place drainage course 6 inches or less in compacted thickness in a single layer.
3. Place drainage 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.
4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.20 TESTS AND TESTING

A. The optimum moisture content and the maximum density of each type of material used for structural fill and backfill shall be determined by “Standard Test Methods for Moisture Density Relations of Soils and Oil- Aggregate Mixtures Using 5.5-lb. Rammer and 12-inch Drop (ASTM D698) or (AASHTO T-99)”.

B. The field moisture content of materials being compacted shall be determined by “Laboratory Determination of Moisture Content of Soil,” (ASTM D2216). The field density of compacted material shall be determined by either “Standard Test Method for Density of Soil in Place by Sand Cone Method,” (ASTM D1556) or- “Standard Test Method for Density of Soil in Place by the Rubber Balloon Method,” (ASTM D2167).

C. Perform sufficient field density and field moisture content tests on each lift of material to ensure the Engineer that the requirements of this Section of the Specifications are compiled with.

D. State when and where the tests are to be made so that the Engineer may observe the testing. Submit certified reports verifying test results. The Engineer may order more testing should he feel the above procedures to give inadequate information, or if he feels the results of such testing to be questionable

3.21 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.

D. Maintenance of backfilled excavations.

1. The Contractor shall maintain the backfilled area in proper condition for a period of one year after final acceptance of the project. All defects shall be promptly corrected. If the Contractor fails to do so within a reasonable time after the receipt of written notice from the Engineer, the Smithsonian Institution may correct any dangerous condition at the Contractor's expense.
2. The Contractor shall be responsible for any injury or damage that may result from improper maintenance of trenches at any time previous to the end of the aforementioned guarantee period.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 31 3700 – RIPRAP, BOULDERS, AND BEDDING

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 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. T85, Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate.
      b. T96, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
      c. T103, Standard Method of Test for Soundness of Aggregates by Freezing and Thawing.
      d. T104, Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.
      e. T248, Reducing Field Samples of Aggregate Test Size.

   2. ASTM International (ASTM): D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3)).

1.3 SUBMITTALS

A. The Contractor shall cooperate with Engineer in obtaining and providing samples of all specified materials.

B. The Contractor shall submit certified laboratory test certificates for all items required in this section.

C. The Contractor shall full material specification including parent quarry and supplier.

PART 2 - PRODUCTS

2.1 MATERIALS

A. DRAINAGE STONE AND ROCK

1. Rock used shall be the type designated on the DRAWINGS and shall conform to Table 1.

Rock Designation	% Smaller Than Given Size By Weight	Intermediate Rock Dimension (inches)	d_{50}* (inches)
Delaware River Stone	80 - 100 0	5 3	4
*d_{50} = Mean Particle Size			

2. The rock designation and total thickness of rock shall be as shown on the DRAWINGS. The maximum stone size shall not be larger than the thickness of the riprap.
3. Neither width nor thickness of a single stone shall be less than one-third (1/3) of its length.
4. The specific gravity of the stone shall be two and one-half (2.5) or greater.
5. Specific gravity shall be according to the bulk-saturated, surface-dry basis, in accordance with AASHTO T85.
6. The bulk density for the stone shall be 1.3 ton/cy or greater.
7. The stone shall have a percentage loss of not more than forty percent (40%) after five hundred (500) revolutions when tested in accordance with AASHTO T96.
8. The stone shall have a percentage loss of not more than ten percent (10%) after five (5) cycles when tested in accordance with AASHTO T104 for ledge rock using sodium sulfate.
9. The stone shall have a percentage loss of not more than ten percent (10%) after twelve (12) cycles of freezing and thawing when tested in accordance with AASHTO T103 for ledge rock, procedure A.
10. Rock shall be free of calcite intrusions.
11. Gradation:
    a. Each load of stone shall be reasonably well graded from the smallest to the largest size specified.
    b. Stones smaller than the two to fifty percent (2 to 50%) size will not be permitted in any amount.
    c. Control of gradation shall be by visual inspection. However, in the event the COTR determines the stone to be unacceptable, the COTR shall pick two (2) random truckloads to be dumped and checked for gradation.
        1) Mechanical equipment and labor needed to assist in checking gradation shall be provided by the contractor at no additional cost.
12. Color:
    a. The color of the stone shall be brown/tan and be approved by the COTR prior to delivery to the project site.
    b. Color shall be consistent on the entire project and shall match the color of rock to be used for all other portions of the work.
13. Broken concrete or asphalt pavement shall not be acceptable for use in the WORK.
14. Rounded riprap (river stone) is required, as specifically designated on the DRAWINGS.

Approximate Proportions (loader buckets)	Material Type	Material Description
Top layer	Top dressing	3 to 5-inch Delaware River Stone (round washed river rock that is well graded, 80-100% passing 5-inch sieve, 0% passing 3-inch sieve)

Note: Mix proportions and material gradations are approximate and are subject to adjustment by the ENGINEER.

B. BEDDING:
1. Gradation for granular bedding shall conform to drawings.
2. Granular bedding designation and total thickness of bedding shall be as shown on the drawings.
3. Granular bedding shall meet the same requirements for specific gravity, absorption, abrasion, sodium sulfate soundness, calcite intrusion, and freeze-thaw durability as required for riprap.
    a. Broken concrete asphalt pavement or sledge, shall not be acceptable for use in the work. Rounded river rock is not acceptable unless specifically designated on the drawings.
    b. The requirements for the wear test in AASHTO T96 shall not apply

PART 3 - EXECUTION

3.1 PREPARATION

A. Channel slope, bottom, or other areas that are to be protected with stone, boulders, soil riprap, or void-filled riprap shall be free of brush, trees, stumps, and other objectionable material and be graded to a smooth compacted surface as shown on the drawings.

B. The contractor shall excavate areas to receive stone to the subgrade as shown on the drawings accounting for granular bedding.

C. The contractor shall excavate areas to receive stone to the specified depth

D. Subgrade Materials:
1. The subgrade materials shall be stable.

E. Additional Compaction:
1. Additional compaction shall not be required unless specified in the construction documents..
2. When subgrade is built up with embankment material it shall be compacted to ninety five percent (95%) maximum density (ASTM D698).

F. Bedding:
1. After an acceptable subgrade is established, bedding shall be immediately placed and leveled to the specified elevation on the drawings.
2. Immediately following the placement of the bedding material, the riprap shall be placed.
3. If bedding material is disturbed for any reason, it shall be replaced and graded at the contractor's expense.
4. Contamination:
    a. In-place bedding materials shall not be contaminated with soils, debris or vegetation before the riprap is placed.
    b. If contaminated, the bedding material shall be removed and replaced at the contractor's expense.

3.2 PLACEMENT

A. DRAINAGE STONE
1. Following acceptable placement of granular bedding, riprap placement shall commence as follows:
    a. Machine Placed DRAINAGE STONE:
        1) Rock shall be placed on the prepared slope or channel bottom areas in a manner which will produce a reasonably well graded mass of stone with the minimum practicable percentage of voids.
        2) Rock shall be machine placed, unless otherwise stipulated in the drawings or specifications
        3) It is the intent of these specifications to produce a fairly compact perimeter rock protection in which all sizes of material are placed in their proper proportions. Unless otherwise authorized by the COTR, the stone protection shall be placed in conjunction with the construction of perimeter drainage only sufficient delay in construction of the riprap protection, as may be necessary, to allow for proper construction of the portion of the embankment and channel bottom which is to be protected.
    b. Slope Placement:
        1) When stone is placed on slope, placement shall commence at the bottom of the slope working up the slope.
    c. The entire mass of stone shall be placed on either channel slope or bottom so as to be in conformance with the required gradation mixture and to line, grade, and thickness shown on the drawings.
    d. Stone shall be placed to full course thickness at one operation and in such a manner as to avoid displacing the underlying bedding material. Placing of riprap in layers, or by dumping into chutes, or by similar methods shall not be permitted.
    e. All material used for stone protection for channel slope or bottom shall be placed and distributed such that there shall be no large accumulations of either the larger or smaller sizes of stone. Some hand placement may be required to achieve this distribution.
    f. The basic procedure shall result in larger materials flush to the top surface with faces and shapes arranged to minimize voids, and smaller material below and between larger materials.

g. Surface grade shall be a plane or as indicated, but projections above or depressions under the finished design grade by more than ten percent (10%) of the rock layer thickness shall not be allowed.
h. Smaller rock shall be securely locked between the larger stone. It is essential that the material between the larger stones not be loose or easily displaced by flow or by vandalism.
i. The stone shall be consolidated by the bucket of the backhoe or other means that will cause interlocking of the material.
j. All rock is to be placed in a dewatered condition beginning at the toe of the slope or other lowest point.
k. The contractor shall maintain the riprap protection until accepted. Any material displaced for any reason shall be replaced to the lines and grades shown on the drawings at no additional cost to the COTR. If the bedding materials are removed or disturbed, such material shall be replaced prior to replacing the displaced riprap.

2. Hand Placed DRAINAGE STONE:
   a. Hand placed riprap shall be performed during machine placement of riprap and shall conform to all the requirements of PART 2, above.
   b. Hand placed riprap shall also be required when the depth of riprap is less than two (2) times the nominal stone size, or when required by the drawings or specifications.
   c. After the riprap has been placed, hand placing or rearranging of individual stones by mechanical equipment shall be required to the extent necessary to secure a flat uniform surface and the specified depth of riprap, to the lines and grades as shown on the drawings.
3. Soil Replacement Over Stone:
   a. Where stone is designated to be buried, place onsite excavated material that is free from trash and organic matter in stone voids by washing and rodding.
   b. Prevent excessive washing of material into sewer.
   c. When voids are filled and the surface accepted by the COTR, place a nominal six (6) inches of topsoil over the area, or as designated on the drawings.
   d. Fine grade, seed, and mulch per the specifications.

3.3 REJECTION OF WORK AND MATERIALS

A. The COTR will reject placed riprap, boulders, soil riprap and bedding that do not conform to this section. The contractor shall immediately remove and re-lay the stone and bedding to conform to specifications.

B. Stone and bedding that do not conform to this section shall be rejected, whether delivered to the job site or placed.

C. Rejected stone and bedding shall be removed from the project site by the contractor at the contractor’s expense.

END OF SECTION

SECTION 32 1313 – CONCRETE PAVING

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:

1. Driveways.
2. Roadways.
3. Parking lots.
4. Curbs and gutters.
5. Walkways

    a. Color Concrete Pavement
    b. Special Finishes
    c. Natural Color Concrete Pavement

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of product or exposed finish, prepared as Samples of size indicated below:

1. Exposed Aggregate: 10-lb Sample of each mix.

C. Other Action Submittals:

1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

2. The Concrete Plant shall provide the concrete mix design and certified test reports on the aggregate, admixture, cement, and curing materials to be incorporated in the concrete for the project.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer of detectable warnings, ready-mix concrete manufacturer, and testing agency.

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

C. Material Test Reports: For each of the following:

1. Aggregates.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

C. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

D. ACI Publications: Comply with ACI 301M (ACI301) unless otherwise indicated.

1.7 PROJECT CONDITIONS

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

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 FORMS

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

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less.

2. Forms shall conform to VDOT Section 403.03.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn galvanized steel wire into flat sheets.

C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

D. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.

E. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

F. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.

G. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.

H. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.

I. Plain-Steel Wire: ASTM A 82/A 82M, as drawn galvanized.

J. Deformed-Steel Wire: ASTM A 496/A 496M.

K. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, plain deformed.

L. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.

M. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain-steel bars.

N. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

O. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

P. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

Q. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

R. Zinc Repair Material: ASTM A 780.

2.3 FIBER REINFORCEMENT

A. Steel Fiber Reinforcement: ASTM A820/A820M-22 Cold-drawn wire or deformed steel, Type I, 1.5-2.5 inch long, aspect ratio of 50-80, hooked-end or crimped fibers.

B. Synthetic Microfiber Reinforcement: ASTM C1116 Type III, polypropylene virgin microfibers, 0.25 to 1.5 inch long, monofilament or fibrillated.

C. Synthetic Macrofiber Reinforcement: ASTM C1116 TYPE III, polyolefin virgin macrofibers, 1.5-2.0 inch long, aspect ratio of 50 to 90, flexible self-fibrillating or rigid embossed fibers.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout the Project:
   1. Portland Cement: ASTM C 150, white Portland cement Type I.

B. Normal-Weight Aggregates: ASTM C 33, Class 4S, Class 4M, Class 1N, uniformly graded. Provide aggregates from a single source.
   1. Maximum Coarse-Aggregate Size: 1-inch nominal.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:

   1. Aggregate Sizes: ¾ to 1 inch, ½ to ¾ inch, 3/8 to 5/8 inch nominal.
   2. Aggregate Source, Shape, and Color: Match existing.

2.5 JOINT FILLER

A. Joint filler shall be ½-inch perforated asphalt expansion joint material conforming to ASTM D994 or ASTM D 1751.

2.6 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301M (ACI 301), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

   1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
   2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.

3. Where fiber-reinforcement is required, reinforcement to be added at concrete plant at 1.5 lbs/cubic yard.

B. Proportion mixures to provide normal-weight concrete with the following properties:
1. Compressive Strength (28 Days): 4,000 psi
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45
3. Slump Limit: 3 inches, plus or minus 1 inch

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.

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

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete batches larger than 1 cu. yd, increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.

3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earth Moving."

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 EDGE FORMS AND SCREED CONSTRUCTION

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

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

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

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 reinforcement 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. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

G. 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 of adjacent mats.

3.5 JOINTS

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

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

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Provide tie bars at sides of paving strips where indicated.
3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. 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, to match jointing of existing adjacent concrete paving:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch, 3/8-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.

a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.

2. Sawed 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.

a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.

3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes.

F. Expansion Joint: Preformed expansion joint for use in PCC pavement, base, sidewalk, curb and gutter construction and sewer-water structures shall meet the requirements of AASHTO M 153, Type II (Cork). Preformed joint material shall be new material for all Work and furnished in longest lengths practicable for intended use as determined by the Engineer, and in no case shall joint material be furnished in lengths less than 10 feet. Pieces for curb and gutter and as directed shall be cut in exact size from larger furnished sections. All splices in joint material shall be carefully made to insure against penetration of PCC between adjacent strips of joint material. Joint material shall neither be furnished nor stored in rolls. When dowel bars or other approved load transfer devices are specified, the preformed filler shall have holes of the proper diameter or size drilled through it at the specified intervals to receive the bars and to insure a tight fit

3.6 CONCRETE PLACEMENT

A. Before placing concrete, remove all construction debris, water and ice from the places to be occupied by the concrete. Give particular attention to the removal of dirt and debris from all formed construction joints.

B. Concrete, when deposited, shall have a temperature ranging between a minimum of 50 degrees Fahrenheit and a maximum of 90 degrees Fahrenheit. When the temperature of the surrounding air is below 50 degrees or above 90 degrees Fahrenheit, concreting shall be done in accordance with the recommendations noted in ACI-306 and ACI-305 respectively.

C. Mix concrete in such quantities as required for immediate use and place prior to loss of slump. Do not retemper concrete.

D. Spade, work and vibrate concrete as it is being poured, to secure its maximum density, free from voids and completely filling the forms. Thoroughly work concrete to secure the complete

envelopment of all parts of the reinforcing steel and completely fill the corners of the forms. Maintain not less than 2 approved vibrators on the work at all times. Use tremies or chutes for drops of more than 5-feet.

E. Fill under Slabs on Grade: Clean sand, or aggregate, evenly spread and compacted to the full depth, unless otherwise shown on the Contract Drawings.

F. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

G. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

H. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F , uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F 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 specified and approved in design mixtures.

I. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

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

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and 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. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 SPECIAL FINISHES

A. Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in paving surface as follows:

1. Immediately after float finishing, spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

B. Seeded Exposed-Aggregate Finish: Immediately after initial floating, spread a single layer of aggregate uniformly on paving surface. Tamp aggregate into plastic concrete and float finish to entirely embed aggregate with mortar cover of 1/16 inch.

1. Spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove sheeting when ready to continue finishing operations.
3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on paving surface according to manufacturer's written instructions and as follows:

1. Uniformly spread 25 lb/100 sq. ft. of dampened, slip-resistive aggregate over paving surface in two applications. Tamp aggregate flush with surface using a steel trowel, but do not force below surface.
2. Uniformly distribute approximately two-thirds of slip-resistive aggregate over paving surface with mechanical spreader, allow to absorb moisture, and embed by power floating. Follow power floating with a second slip-resistive aggregate application, uniformly distributing remainder of material at right angles to first application to ensure uniform coverage, and embed by power floating.
3. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
4. After curing, lightly work surface with a steel wire brush or abrasive stone and water to expose nonslip aggregate.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Curing shall be started as soon as it is possible to apply the curing medium without damaging the surface, preferably immediately upon completion of the finishing operation.

C. Curing shall continue uninterrupted for a minimum period of 14 days. Rapid drying upon completion of the curing period shall be prevented. At no time during the curing period shall the temperature of the concrete be permitted to drop below 40 degrees Fahrenheit.

D. Comply with ACI 306.1 for cold-weather protection.

E. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

F. 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 seven days with the following materials:

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

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, 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 occurring during installation or curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.10 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/2 inch.
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch.
6. Vertical Alignment of Dowels: 1/4 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.11 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb/gal.

3.12 SAMPLING, TESTING AND ENFORCEMENT

A. Retain first paragraph below to identify who shall perform tests and inspections. If retaining second option, retain "Field quality-control reports" Paragraph in "Informational Submittals" Article.

The Contractor shall furnish such facilities as the Engineer may require for onsite testing and for collecting and forwarding concrete samples for testing to an approved independent laboratory selected by the Engineer. The laboratory shall for each 10 cu. yds. of concrete. The laboratory shall maintain records showing brand of cement, brand and quantity of admixtures, time and location of the batch from which the test was made, air content, slump, and compressive strength. The laboratory shall supply the test cylinders, slump cones, field technicians, and all equipment necessary for performance of field and laboratory testing specified herein.

B. One strength test shall consist of four field specimens. One (1) specimen for testing at seven (7) days, one (1) specimen for testing at fourteen (14) days, and two (2) specimens for testing at twenty-eight (28) days. The samples for strength tests shall be taken in accordance with –"Method of Sampling Fresh Concrete" (ASTM C-172). Cylinders for acceptance tests shall be molded and laboratory-cured in accordance with "Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Field" (ASTM C-31) and tested in accordance with "Method of Test for Compressive Strength of Molded Concrete Cylinders" (ASTM C-39). Each strength test result shall be the average of two cylinders from the same sample tested at seven (7), fourteen (14) and twenty-eight (28) days.

C. When the frequency of testing will provide less than five strength tests for a given class of concrete, make tests from at least five randomly selected batches or from each batch if fewer than five are used. When the total quantity of a given class of concrete is less than 30 cu. yds., the strength tests may be waived by the Engineer if, in his judgment, adequate evidence of satisfactory strength is provided.

D. Should individual tests of laboratory-cured specimens produce results more than 500 psi below specified strength (f'c), or tests of field-cured cylinders indicate deficiencies in protection and curing, take steps to assure that load carrying capacity may have been significantly reduced, tests of cores taken from the area in questions shall be required in accordance with "Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete" (ASTM C-42). Three cores shall be taken for each cylinder test more than 500 psi below specified strength (f'c). If the concrete in the structure will be more than superficially wet under service conditions, the cores shall be immersed in water for at least 48 hours and tested wet.

E. Concrete represented by the above core tests will be considered structurally adequate if the average of the three cores is equal to at least 85 percent of specified strength (f'c) and if no single core is less than 75 percent of f'c. To check testing accuracy, locations represented by erratic core strengths may be retested. If these strength acceptance criteria are not met by the core tests, and if structural adequacy remains in doubt, the Engineer shall order load tests for the questionable portion of the structure, or declare the section to be defective.

3.13 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Defective concrete is defined as concrete in place which does not conform to strength, shapes, alignments, appearance, and/or elevations as shown on the drawings; areas which contain faulty surface areas and/or concrete surfaces not finished in accordance with these specifications.

C. Remove all defective concrete and replace in a manner meeting with the Engineer's approval. Should only surface imperfections occur, patch at the discretion of, and in a manner satisfactory to, the Engineer. Permission to patch the work shall not be considered as a waiver of the County's right to require complete removal and replacement of such defective work should the patching fail to satisfactorily restore the required quality and appearance of the work.

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

E. Protect concrete paving 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.

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

END OF SECTION

SECTION 32 1316
DECORATIVE CONCRETE PAVING

PART 1 - GENERAL

1.1 RECORD 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 stamped, colored and sealed concrete paving in exterior locations indicated on drawings.

B. Related Sections:

1. Division 03 Section “Cast-in-Place Concrete” for general building applicationsof concrete.
2. Division 32 Section “Concrete Paving” for more information related to site paving.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Submit all technical information for all products specified, including concrete coloring, sealants, expansion joint materials, curing compounds, bonding agents, etc. Submit color charts showing complete range of standard colors for concrete and grout materials.

B. Samples for Verification: For each type of exposed color, pattern, or texture indicated. See 1.6.G.

C. Other Action Submittals:

1. Design Mixtures: For each decorative concrete paving mixture. Include alternate design mixtures when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer, ready-mix concrete manufacturer and testing agency.

B. Certification: Submit the following certifications in writing for review:

1. From the Manufacturer and Installer: Written certification that specifically states the required bonding agent is acceptable for the application intended.
2. From the Installer: Written certification that the sub-base for any application is acceptable.
3. Material certificates are defined under Division 32 Concrete Paving.

C. Material Test Reports: Submit test reports for the following:

1. ANSI/ASTM A185: Welded SH Wire Fabric Reinforcing
2. ASTM C33: Concrete Aggregates.
3. ASTM C94: Ready Mix Concrete.
4. ASTM C150: Portland Cement.

D. Field quality-control reports.

E. Shop Layout Drawings showing location of joints in colored concrete and stamped colored concrete – see Civil details.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer of decorative concrete paving systems. Provide at least one person present at all times during execution of this work who is thoroughly familiar with materials and methods required and is trained and licensed by manufacturer and has at least 3 years of experience with similar installations.

B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

D. Source Limitations: Obtain decorative concrete paving products and each type or class of cementitious material of the same brand from same manufacturer's plant and obtain each aggregate from single source.

E. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

F. ACI Publications: Comply with ACI 301 unless otherwise indicated.

G. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of full-thickness sections of decorative concrete paving to demonstrate typical joints; surface color, pattern, and texture; curing; and standard of workmanship. Finished concrete surface must provide slip resistance. Mockups to include sealant and traction additive for approval by Architect and Owner's representative.
2. Build mockups of decorative concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect or Owner's Representative and not less than 36 inches x 36 inches.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

H. Preinstallation Conference: Conduct conference at Project site or Construction trailer.

1. Review methods and procedures related to decorative concrete paving. Require representatives of each entity directly concerned with decorative concrete paving to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Decorative concrete paving Installer.
e. Manufacturer's representative of decorative concrete paving system.

1.7 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 FORMS

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

1. Use flexible or uniformly curved forms for curves of a radius of 100 feet or less. Do not use notched and bent forms.

B. Forms for Textured Finish Concrete: Units of face design, size, arrangement, and configuration indicated. Provide solid backing and form supports to ensure stability of textured form liners.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. See Division 32 Concrete Paving.

2.3 CONCRETE MATERIALS

A. See Division 32 Concrete Paving.

2.4 SURFACE COLORING MATERIALS

A. Pigmented Dry-Shake Hardener: Factory-packaged, dry combination of portland cement, hard natural aggregates, and synthetic mixed metal oxide pigments. Use color pigments that are finely ground, nonfading interground with cement.

1. Complying with ASTM C 979 Pigments for Integrally Colored Concrete.
2. Abrasion resistant for interior or exterior locations with pedestrian or vehicular traffic.
3. Weather resistant, UV stable, and alkali resistant. Will not migrate from standing water, and can be used to color concrete fountains, pools, water features, or wet environments.
4. Basis of Design Product:

    a. Scofield, (A Sika company), L. M. Company; LITHOCHROME Color Hardener. Color to be selected by Architect from manufacturer's full range.
    b. Or Approved Equal.
    c. Location: As indicated on drawings.

B. Pigmented Powder Antiquing Release Agent: Factory-packaged, dry combination of surface-conditioning and dispersing agents interground with color pigments that facilitates release of stamp mats. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

1. Release agent add UV stable color accents when stamp tools are lifted from freshly placed wet concrete.
2. Zero VOC.
3. Products: Subject to compliance with the requirements, provide the following:

    a. Scofield, L. M. Company; LITHOCHROME Antiquing Release Pro. Color to be selected by Architect from manufacture's full range.
    b. Or Approved Equal.
    c. Location: As indicated on drawings.

2.5 STAMPING DEVICES

A. Stamp Tools: Open-grid, aluminum or rigid-plastic stamp tool, or semirigid poly urethane mat capable of imprinting joint and texture patterns on plastic concrete.

1. Basis of Design Product and Texture:

    a. Scofield (a Sika brand), L. M. Company; Lithotex Pavecrafters.
        1) Hadley Creek Shale Texture.
    b. Or Approved Equal.
    c. Location: Extents as noted on drawings.

2.6 CURING AND SEALING MATERIALS

A. Clear, semi-gloss, waterborne, membrane forming, curing and sealing compound meeting ASTM C309.

1. Exterior usage, UV stable, abrasion and stain resistant coating.
2. Self-crosslinking acrylic copolymer with 25% solids.
3. Basis of Design Product: Scofield (a Sika Company) Cureseal-W or approved equal.

2.7 RELATED MATERIALS

A. Joint Sealants: All control and expansion joints with color coordinated sealant shall be to requirements of Section “Joint Sealants”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below decorative concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Division 31 Section "Earth Moving."

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

B. Protect adjacent construction from discoloration and spillage during application of color hardeners, release agents, curing compounds, and sealers.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

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

B. Contractor to coordinate extent of formwork required accordingly.

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

3.4 JOINTS

A. General: Refer to Structural and Civil details. Submit shop layout drawings indicating location of joints. In stamped colored concrete, all joints shall be integral with specific pattern. No saw cutting of joints across a pattern will be permitted.

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

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.

D. 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, see Civil Drawings.:

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

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

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

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. 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.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

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 reinforcement, dowels and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F 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 specified and approved in design mixtures.

K. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

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

3.6 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared, and 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. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

3.7 PIGMENTED DRY-SHAKE HARDENER

A. Pigmented Dry-Shake Hardener Finish: After initial floating, apply dry-shake materials to paving surfaces according to manufacturer's written instructions:

3.8 STAMPING

A. Tool Stamping: After floating and while concrete is plastic, apply mat or tool-stamped finish, per manufacturer's recommendation.

1. Pigmented Powder Release Agent: Uniformly distribute per manufacturer's recommendation.
2. After application of release agent, accurately align and place stamp tools in sequence.
3. Cover surface with polyethylene film, stretch taut to remove wrinkles, lap sides and ends 3 inches, and secure to edge forms. Lightly broom surface to remove air bubbles.
4. Accurately align and place stamp tools in sequence and tamp into concrete to produce required imprint pattern and depth of imprint on concrete surface. Gently remove stamp tools. Hand stamp edges and surfaces unable to be imprinted by stamp tools.
5. Carefully remove polyethylene film immediately after tool stamping.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

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

E. Curing Compound: Apply curing compound immediately after final finishing. Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after application. Maintain continuity of coating, and repair damage during curing period.

1. Cure concrete finished with pigmented mineral dry-shake hardener as recommended by Manufacturer.

F. Curing and Sealing Compound: Apply uniformly in continuous operation according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

G. Traction Additive: Use traction additive in sealant to provide slip resistance. Apply according to manufacturer's instructions. Mockup required for Owner's approval.

H. Curing Paper: Cure with unwrinkled curing paper in pieces large enough to cover the entire width and edges of slab. Do not lap sheets. Fold curing paper down over paving edges and secure with continuous banks of earth to prevent displacement or billowing due to wind. Immediately repair holes or tears in paper.

3.10 SEALER

A. Water-Based Sealer: Apply uniformly in continuous operations according to manufacturer's written instructions.

3.11 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:
   1. Elevation: 3/4 inch.
   2. Thickness: Plus 3/8-inch, minus 1/4 inch.
   3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/2 inch.
   4. Lateral Alignment and Spacing of Dowels: 1 inch.
   5. Vertical Alignment of Dowels: 1/4 inch.
   6. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
   7. Joint Spacing: 3 inches.
   8. Contraction Joint Depth: Plus 1/4 inch, no minus.
   9. Joint Width: Plus 1/8 inch, no minus.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

   1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
   2. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
   4. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
   6. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
   7. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
   8. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three-consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Owner, Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7 and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Decorative concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.13 REPAIRS AND PROTECTION

A. Remove and replace decorative concrete paving that is broken or damaged or does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Detailing: Grind concrete "squeeze" left from tool placement. Color ground areas with slurry of color hardener mixed with water and bonding agent. Remove excess release agent with high-velocity blower.

C. Protect decorative concrete paving 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 decorative concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

3.14 DECORATIVE CONCRETE PAVING SCHEDULE

A. Decorative Concrete Paving: See drawings including any corresponding site details for material locations and pattern requirements.

END OF SECTION 321316

SECTION 32 9113
SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Planting Soils.
2. Animal Substrates.

B. Related Requirements:

1. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.
2. Section 329300 "Plants" for placing planting soil for plantings.

1.2 DEFINITIONS

A. AAPFCO: Association of American Plant Food Control Officials.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

C. CEC: Cation exchange capacity.

D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

F. Imported Soil: Soil that is transported to Project site for use.

G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.

H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

M. SSSA: Soil Science Society of America.

N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

Q. USCC: U.S. Composting Council.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Include sieve analyses for aggregate materials.
4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:

B. Planting Soil and Report before commencement of work:

1. Submit 1 cubic foot of specified Planting Soil for COTR approval.
2. Before delivery of planting soil, furnish a soil analysis made by an approved soil testing laboratory stating the percentage of silt, clay, sand, and organic matter, the pH and the mineral and plant nutrient content of the topsoil. State recommended quantities for nitrogen, phosphorous, limestone, aluminum sulfate, or other soil amendments to make soil suitable.

C. Sand Sample: Prior to delivery, submit one-quart samples of proposed sand material for COTR approval.6

D. Elephant Yard 4 Substrate: Submit 1 cubic foot of specified Elephant Yard 4 Substrate for COTR approval.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1.7 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

B. Sample Collection and Labeling: Have samples taken and labeled by state-certified, -licensed, or -registered soil scientist under the direction of the testing agency.

1. Number and Location of Samples: Minimum of eight representative soil samples from varied locations for each soil to be used or amended for landscaping purposes.
2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.8 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.

B. Physical Testing:

1. Soil Texture: Soil-particle, size-distribution analysis by the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":

    a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.

2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D698 (Standard Proctor).

C. Chemical Testing:

1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."
3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium, and vanadium. If RCRA metals are present, include recommendations for corrective action.
4. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.

D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT NEC-67 or SSSA NAPT SERA-6, including the following:

1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
5. Nitrogen ppm.
6. Phosphorous ppm.
7. Potassium ppm.
8. Manganese ppm.
9. Manganese-availability ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.
13. Sodium ppm.
14. Soluble-salts ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.

E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.

1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inch depth of soil.
2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inchdepth of soil.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 SOILS AND SUBSTRATES SPECIFIED BY COMPOSITION

A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.

B. Elephant Yard 4 Substrate: Depth as indicated on drawings. Substrate mix consisting of the following: 20% compost and 80% sand. Soil mix shall be thoroughly pre-mixed by a batch mixer before delivery.

C. Sand: Masonry sand with rounded edges, washed free of loam, clay, and other foreign substances and of the following size range and color.

1. Size Range: per Owner specification.
2. Color: The most readily available natural sand color range.
3. Basis of Design Suppliers:

a. Wheat's Lawn and Custom Landscape, Vienna, VA. 703-641-4790.
b. Gudelsky Materials, Brandywine, MD. 301-888-7263.

D. Compost: Basis of Design: Leaf-Gro or SI approved equal.

E. Planting-Soil Type: Sandy loam according to USDA textures; and modified to produce viable planting soil.

1. Unacceptable Properties: Clean soil of the following:

a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant

growth.

b. Unsuitable Materials: Stones, roots, plants, sod, and clay lumps. .

2.2 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:

1. Feedstock: Limited to leaves.
2. Reaction: pH of 5.5 to 6.5.
3. Soluble-Salt Concentration: Less than 4 dS/m.
4. Moisture Content: 35 to 55 percent by weight.
5. Organic-Matter Content: 50 to 60 percent of dry weight.
6. Particle Size: Minimum of 98 percent passing through a 1/2-inch sieve.

B. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

2.3 FERTILIZERS

A. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

PART 3 - EXECUTION

3.1 GENERAL

A. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

B. Proceed with placement only after unsatisfactory conditions have been corrected.

C. Contractor shall give Owner’s Representative sufficient notice before soil mix installation to allow inspection of the site to ensure that subsoil is free of debris and meets penetrability standards.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. Excavation: Excavate substrates from designated area(s) to the required depth and stockpile until amended. Separate subgrade material from clean reusable sand and elephant yard substrate

mixes.

B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

C. Screening: Pass unamended soil through a 2-inch sieve to remove large materials.

3.3 PLACING MANUFACTURED PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply amended soils and substrates on-site in its final, blended condition. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 12 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply 6” of soils and substrates over prepared, loosened subgrade. Mix thoroughly into top of subgrade.

C. Application: Spread substrates to total depth indicated on Drawings, but **not less than required to meet finish grades after natural settlement**. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Lifts: Apply planting soil and substrates in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each lift of planting soil, sand and substrates to 85 percent of maximum Standard Proctor density according to ASTM D698.

1. Soil that has been compacted should drain water at the rate of 1” per hour. After placing a total of 24” of soil or reaching final grade, whichever comes first, water lightly for at least three hours to encourage settling before adding next layer of soil. Repeat once final grade is reached.
2. Construction traffic must be limited within areas planned for vegetation.

E. Finish Grading: Grade planting soil and substrates to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

F. Confirmation of finish grades: In all planted areas a layer of soil mix per drawing designations shall be placed as called for so the bed surface will be at the specified finish grade when mixture has settled. Grades shall be true to line, fair to curvature and accurate to grades shown on the Drawings and as directed by Architect. Finish grades are measured from the top of the finished soil mix after settling.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Compaction: Test compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D698. Space tests at no less than one for each 1000 sq. ft. of in-place soil or part thereof.

C. Soil will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.5 PROTECTION

A. Protection Zone: Identify tree protection zones according to Civil drawings and DOEE specifications.

B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Vehicle traffic.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.
7. Excavation or other digging unless otherwise indicated.

C. If planting soil, sand, substrates or subgrade is over compacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the soil or substrate and contamination; restore the subgrade as directed by COTR-Smithsonian Institute and replace contaminated soil or substrate with new material.

3.6 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

3.7 SPECIAL CLEANUP FOR EXHIBIT AREAS

A. Note: It is essential that no hard loose materials larger than 1/2" in any dimension be left in any animal area or within animal reach. All metal, wood, plastic, or other construction debris shall be removed from these areas. Each contractor shall be responsible for compliance with this requirement for work in his/her area and shall be liable for repair or replacement of work (including exhibit windows) damaged by an animal using objects within its reach as a result of work in this Section.

END OF SECTION 329113

SECTION 32 9200
TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Seeding.
2. Hydroseeding.
3. Sodding.
4. Sprigging.
5. Turf renovation.

B. Related Requirements:

1. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.

1.2 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. USE OF PESTICIDES AND HERBICIDES IS NOT ALLOWED ON THIS PROJECT.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329115 "Soil Preparation (Performance Specification)" and drawing designations for planting soils.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.

C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides:USE OF PESTICIDES AND HERBACIDES IS NOT ALLOWED ON THIS PROJECT.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by COTR-Smithsonian Institution for maintenance of seeded turf during one growing season. Submit before expiration of required maintenance periods.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

1. Experience: Three years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials;

discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk materials with appropriate certificates.

1.8 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting Substantial Completion.

1. Spring Planting: After last hard frost date (generally April 2nd).
2. Fall Planting: Before first hard frost date (generally November 10th).

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:

1. Quality, State Certified: State-certified seed of grass species as listed on drawings.

2.2 TURFGRASS SOD

A. Turfgrass Sod: Approved, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.

B. Sod should be free of biodegradable netting.

C. Turfgrass Species: As indicated on drawings with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed.

2.3 SPRIGS

A. Sod Sprigs: Healthy living stems, rhizomes, or stolons with a minimum of two nodes and attached roots free of soil, of the species identified on the drawings.

2.4 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

C. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.5 PESTICIDES

A. General:USE OF PESTICIDES AND HERBACIDES IS NOT ALLOWED ON THIS PROJECT.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329115 "Soil Preparation (Performance Specification)."

B. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

C. Before planting, obtain COTR-Smithsonian Institution's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 SEEDING

A. Sow seed with rotary spreader. Do not broadcast or drop seed when wind velocity exceeds 5 mph.

1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
2. Do not use wet seed or seed that is moldy or otherwise damaged.
3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow Zoo Mix seed at a total rate of 4 lb/1000 sq. ft.

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray. Buffalograss seeded areas need to be kept damp through the germination period.

D. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

E. Overseed disturbed turf areas at a rate of 3lbs/1000 sq. ft.

F. Saturate seeded areas with fine water spray. During first week after planting, water daily or more frequently as necessary to maintain soil moisture. Contractor to maintain watering of seed until irrigation system is complete and working.

3.5 HYDROSEEDING

A. Hydroseeding: Mix specified seed, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with nonasphaltic fiber-mulch manufacturer's recommended tackifier.

2. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.

3.6 SODDING

A. Lay sod within 24 hours of harvesting unless a suitable preservation method is accepted by Architect prior to delivery time. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.7 SPRIGGING

A. Broadcast sprigs uniformly over prepared surface at a rate of 10 cu. Ft/1000 sq. ft., and mechanically force sprigs into lightly moistened soil.

1. Spread a ¼” think layer of soil mix on sprigs.
2. Lightly roll and firm soil around sprigs after planting.
3. Water sprigs immediately after planting and keep moist by frequent watering until well rooted.

3.8 TURF RENOVATION

A. Renovate existing turf where indicated.

B. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
2. Install new planting soil as required.

C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.

D. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel,

and other construction materials resulting from Contractor's operations, and replace with new planting soil.

E. Mow, dethatch, core aerate, and rake existing turf.

F. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

G. Till stripped, bare, and compacted areas thoroughly to a soil depth of 8 inches.

H. Install new planting soil to fill low spots and meet finish grades.

I. Apply seed and protect with straw mulch as required for new turf.

J. Water newly planted areas and keep moist until new turf is established.

3.9 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, weeding, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

3.10 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue

maintenance until turf is satisfactory.

3.11 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off COTR-Smithsonian Institution's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.12 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Seeded Turf: 90 days from date of planting completion.

    a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

2. Sodded Turf: 90 days from date of planting completion.

END OF SECTION 329200

SECTION 32 9300
PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plant materials.
2. Fertilizers.
3. Tree-stabilization materials.

B. Related Requirements:

1. Section 015639 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
2. Section 329200 "Turf and Grasses" for turf (lawn) planting, hydroseeding, and erosion-control materials.

1.2 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Plant materials.
2. Fertilizers.
3. Tree-stabilization materials.

B. Product Data Submittals: For each product.

1. Plant Materials: Include quantities, sizes, quality, and verified sources for plant materials.

C. Samples for Verification: Actual sample of finished products for each of the following:

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with manufacturer's certified analysis of standard products.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Member in good standing of either the National Association of Landscape Professionals or AmericanHort.
2. Experience: Three years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
3. Installer's Field Supervision: Maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certification: Installer's field supervisor certified in one of the following categories from the National Association of Landscape Professionals:

    a. Landscape Industry Certified Technician - Exterior.
    b. Landscape Industry Certified Horticultural Technician.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

C. Measurements: Measure in accordance with ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify COTR-Smithsonian Institution of sources of planting materials 30 days in advance of delivery to site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, or walkways and pavements; or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

D. Handle planting stock by root ball.

E. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

F. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
2. Do not remove container-grown stock from containers before time of planting.
3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: After last hard frost date (generally April 7th).
2. Fall Planting: Before first hard frost date (generally October 29th).

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions in accordance with manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by COTR-Smithsonian Institution.
b. Structural failures, including plantings falling or blowing over.

2. Warranty Periods: From date of Substantial Completion.

a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.

3. Include the following remedial actions as a minimum:

a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIALS

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; with tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); with crossing trunks; with cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an

established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to COTR-Smithsonian Institution, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare in accordance with ANSI Z60.1.

D. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for plant.

2.2 FERTILIZERS

A. Granular Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition:

a. 0.75 lb/1000 sq. ft. 3 percent of actual nitrogen, 4 percent phosphorous, and 3 percent potassium, by weight.
b. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

B. Liquid Fertilizers: Miracle-Gro or similar liquid fertilizer that is surface-applied via watering. No granular tablet fertilizers are allowed.

1. Nutrient Composition: 20% nitrogen, 10% phosphorous, and 5% potassium, by weight plus micronutrients.

C. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and maximum of 5.5 percent inert material.

2.3 HERBICIDES AND PESTICIDES

A. Pesticides: USE OF PESTICIDES AND HERBICIDES IS NOT ALLOWED AS PART OF THIS PROJECT.

2.4 TREE-STABILIZATION MATERIALS

A. Root-Ball Stabilization Materials:

1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated; stakes pointed at one end.
2. Proprietary Root-Ball Stabilization Devices: Proprietary below-grade stabilization systems to secure new tree plantings by root ball and that do not encircle the trunk; sized according to manufacturer's written recommendations, unless otherwise noted.

    a. Duckbill Rootball Tiedown Kit, or approved equal. www.macleancivilproducts.com/product/duckbill/rootball-tiedown-kitsucts.com

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Suspend planting operations during periods of excessive soil moisture until moisture content reaches acceptable levels to attain required results.
4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove soil and contamination as directed by COTR-Smithsonian Institution and replace with new planting soil.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain COTR-Smithsonian Institution's acceptance of layout before excavating or planting. Make minor adjustments as required.

3.3 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil in accordance with Section 329113 "Soil Preparation".

B. Before planting, obtain COTR-Smithsonian Institution's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

C. Application of Mycorrhizal Fungi: At time directed by Architect, broadcast dry product uniformly in prepared tree pits at application rate in accordance with manufacturer's written instructions.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately three times as wide as ball diameter for all plant stock.
3. Do not excavate deeper than depth of root ball, measured from the root flare to the bottom of root ball.
4. If area under the plant was initially dug too deep, add soil to raise it to correct level and thoroughly tamp the added soil to prevent settling.
5. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
6. Maintain supervision of excavations during working hours.
7. Keep excavations covered or otherwise protected when unattended by Installer's personnel.

B. Backfill Soil: Subsoil and topsoil removed from excavations may **not** be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify COTR-Smithsonian Institution if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

D. Drainage: Notify COTR-Smithsonian Institution if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball in accordance with ANSI Z60.1. If root flare is not visible, remove soil in a level manner from root ball to where the top-most root emerges from the trunk. After soil removal to expose root flare, verify

that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.

1. Backfill: Planting soil at depths indicated on drawings.
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Balled and Potted and Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.

1. Backfill: Planting soil at depths indicated on drawings.
2. Carefully remove root ball from container without damaging root ball or plant.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Continue backfilling process. Water again after placing and tamping final layer of soil.

E. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of root ball.

3.6 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines as directed by COTR-Smithsonian-Institution.

C. Prune, thin, and shape trees, shrubs, and vines in accordance with standard professional horticultural and arboricultural practices. Unless otherwise indicated by COTR-Smithsonian Institution, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.7 INSTALLATION OF TREE-STABILIZATION MATERIALS

A. Root-Ball Stabilization: Install at- or below-grade stabilization system to secure each new planting by root ball unless otherwise indicated.

1. Proprietary Root-Ball Stabilization Device: Install root-ball stabilization system sized and positioned as recommended by manufacturer unless otherwise indicated and in accordance with manufacturer's written instructions.

3.8 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.9 REPAIR AND REPLACEMENT

A. Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by COTR-Smithsonian Institution.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by COTR-Smithsonian Institution.

B. Remove and replace trees that are more than 25 percent dead or in unhealthy condition before end of corrections period or are damaged during construction operations that COTR-Smithsonian Institution determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size as those being replaced for each tree of 4 inches or smaller in caliper size.
2. Provide two new tree(s) of 4-inch caliper size for each tree being replaced that measures more than 6 inches in caliper size.
3. Species of Replacement Trees: Same species being replaced.

3.10 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and

trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

END OF SECTION 329300

SECTION 33 0597 – UNDERGROUND UTILITY WARNING TAPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Underground Utility Warning Tape.

1.2 REFERENCES

A. ASTM International (ASTM):
1. ASTM D882 - Standard Test Method For Tensile Properties Of Thin Plastic Sheeting.
2. ASTM D1709 - Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.
3. ASTM D1938 - Standard Test Method for Tear-Propagation Resistance (Trouser Tear) of Plastic Film and Thin Sheeting by a Single-Tear Method.
4. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting.
5. ASTM D2578 - Standard Test Method for Wetting Tension of Polyethylene and Polypropylene Films.
6. ASTM D2582 - Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting.
7. ASTM D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles.

B. American National Standards Institute (ANSI):
1. ANSI Z535.1 - Safety Colors.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data:
1. Manufacturer's data sheets on each product to be used.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Typical installation methods.

C. Verification Samples: Two representative units of each type, size, pattern and color.

D. Shop Drawings: Include details of materials, construction and finish. Include relationship with adjacent construction.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum five years documented experience.

B. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.

C. Source Limitations: Provide each type of product from a single manufacturing source to

ensure uniformity.

D. Mock-Up: Construct a mock-up with actual materials in sufficient time for Architect's review and to not delay construction progress. Locate mock-up as acceptable to Architect and provide temporary foundations and support.
   1. Intent of mock-up is to demonstrate quality of workmanship and visual appearance.
   2. If mock-up is not acceptable, rebuild mock-up until satisfactory results are achieved.
   3. Retain mock-up during construction as a standard for comparison with completed work.
   4. Do not alter or remove mock-up until work is completed or removal is authorized.

1.5 PRE-INSTALLATION CONFERENCE

A. Convene a conference approximately two weeks before scheduled commencement of the Work. Attendees shall include COTR, Architect, Contractor and trades involved. Agenda shall include schedule, responsibilities, critical path items and approvals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store and handle in strict compliance with manufacturer's written instructions and recommendations.

B. Protect from damage due to weather, excessive temperature, and construction operations.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.8 WARRANTY

A. Manufacturer's standard limited warranty unless indicated otherwise.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: TerraTape, DetectaMark, Berntsen

B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. Uniform Colors per APWA: Per ANSI Z535.1.
   1. Red: Electric Power Lines, Cables, Conduit, and Lighting Cables.
   2. Yellow: Gas, Oil, Steam, Petroleum, or Gaseous materials.
   3. Orange: Fiber Optic Lines, Telecommunication, Alarm, Signal lines, Cables, and Conduit.
   4. Blue: Water Lines, and Potable Water,
   5. Green: Sewers and Drain Lines,

6. Brown: Contaminated Sewer.

B. Ink Printing: Permanent and cannot be removed by normal handling or upon burial.

C. Chemical Composition of Tape and Ink: Inert and will not degrade when exposed to acids, alkalis and other destructive substances commonly found in soil.

D. Useful Life: Lasts longer than utility lines.

E. Can be installed by plows at same time as utility line; depending on product.

2.3 PRODUCT TYPES

A. Basis of Design: Sentry Line Detectable as manufactured by Terra Tape.
1. Material: A tri-layer laminate consisting of a 100 percent virgin polyolefin pigmented film, a solid aluminum foil core and a clear protective encapsulating film.
   a. Clear Protective Encapsulating Film: Allows full view of foil to ensuring continuity.
   b. Solid Aluminum Foil Core: Provides detectability utilizing either inductive or conductive modes using a pipe and cable locator.
2. Color: Blue. Printing: CAUTION WATER LINE BURIED BELOW.
3. Color: Green. Printing: CAUTION SEWER LINE BURIED BELOW.
4. Color: Orange.
   a. Printing: CAUTION COMMUNICATION CABLE BURIED BELOW.
   b. Printing: CAUTION FIBER OPTIC CABLE BURIED BELOW.
5. Color: Red.
   a. Printing: CAUTION ELECTRIC LINE BURIED BELOW.
   b. Printing: CAUTION HIGH VOLTAGE CABLE BURIED BELOW.
6. Color: Yellow.
   a. Printing: CAUTION ELECTRIC LINE BURIED BELOW.
   b. Printing: CAUTION GAS LINE BURIED BELOW.
7. Thickness Overall per ASTM D2103: 6.0 mil (0.15 mm).
8. Weight per ASTM D2103: 32 lbs per 1000 sq ft (15.6 kg per 100 sq m).
9. Tape Width: 3 inch (76 mm).
   a. Load at Yield per ASTM D882:
      1) Machine Direction: 70 lbf (311 N).
      2) Transverse Direction: 65 lbf (289 N).
   b. Load at Break per ASTM D882:
      1) Machine Direction: 45 lbf (200 N).
      2) Machine Direction: 2459 Psi (25 Mpa).
10. Tape Width: 6 inch (152 mm).
   a. Load at Yield (Calculated Value) per ASTM D882:
      1) Machine Direction: 140 lbf (622 N).
      2) Transverse Direction: 130 lbf (578 N).
11. Elongation per ASTM D882: Machine Direction: 80 percent.
12. Tongue Tear per ASTM D1938: 6.5 lbf (29 N).
13. Trapezoidal Tear per ASTM D4533: 11.5 lbf (51 N).
14. PPT Resistance per ASTM D2582: 9.5 lbf (42 N).
15. Dart Impact per ASTM D1709 (B): 1.6 lbs (0.73 Kg).
16. Printability per ASTM D2578: Greater than or equal to 40 Dynes.

17. Terra Clips: For connecting two lengths of detectable tape. The connection connects the tape lengths mechanically and electrically.

B. Basis of Design: Sentry Line Reinforced Detectable as manufactured by Terra Tape.
   1. Material: A tri-layer laminate consisting of a 100 percent virgin polyolefin pigmented film, polyester laid scrim, a solid aluminum foil core and a clear protective encapsulating film.
      a. Clear Protective Encapsulating Film: Allows full view of foil to ensuring continuity.
      b. Solid Aluminum Foil Core; Provides detectability utilizing either inductive or conductive modes using a pipe and cable locator.
   2. Color: Orange. Printing: CAUTION FIBER OPTIC CABLE BURIED BELOW.
   3. Color: Red. Printing: CAUTION ELECTRIC LINE BURIED BELOW.
   4. Thickness Overall per ASTM D2103: 8.0 mil (0.20 mm).
   5. Weight per ASTM D2103: 43 lbs per 1000 sq ft (21 kg per 100 sq m).
   6. Tape Width: 3 inch (76 mm).
      a. Load at Yield per ASTM D882:
         1) Machine Direction: 125 lbf (556 N).
         2) Transverse Direction: 140 lbf (623 N).
      b. Load at Break per ASTM D882:
         1) Machine Direction: 70 lbf (311 N).
         2) Machine Direction: 2917 Psi (20.1 Mpa).
   7. Tape Width: 6 inch (152 mm).
      a. Load at Yield (Calculated Value) per ASTM D882:
         1) Machine Direction: 250 lbf (1112 N).
         2) Transverse Direction: 280 lbf (1246 N).
   8. Elongation per ASTM D882: Machine Direction: 275 percent.
   9. Tongue Tear per ASTM D1938: 12 lbf (53 N).
   10. Trapezoidal Tear per ASTM D4533: 24 lbf (107 N).
   11. PPT Resistance per ASTM D2582: 25 lbf (110 N).
   12. Dart Impact per ASTM D1709 (B): 1.6 lbs (0.73 Kg).
   13. Printability per ASTM D2578: Greater than or equal to 40 Dynes.
   14. Terra Clips: For connecting two lengths of detectable tape. The connection connects the tape lengths mechanically and electrically.

C. Options:
   1. Custom Printing: Permanent black ink on colored tape. Can be custom printed with company names, logos, phone numbers and/or messages in up to four different colors.
   2. Plastic cores.
   3. Individual or custom boxing.
   4. Large diameter sideboards and core plugs for long lengths.
   5. Export packaging / paperwork.
   6. Stock Sizes: 3 inch (76 mm) x 1000 ft (304.8 m) rolls.
   7. Stock Sizes: 3 inch (76 mm) x 6000 ft (1828.8 m) rolls.
   8. Stock Sizes: 6 inch (152 mm) x 1000 ft (304.8 m) rolls on plastic cores.
   9. Stock Sizes: 6 inch (152 mm) x 6000 ft (1828.8 m) rolls on plastic cores.

D. Accessories:
   1. Dispenser Reels and Handles: Allow rapid installation in a trench. Simply hold the

roll over the trench while walking along side.

2. Dispenser Boxes: For more efficient use when traveling from job site to job site.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly constructed and prepared.

B. If substrate preparation is the responsibility of another installer, notify COTR in writing of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions approved submittals and in proper relationship with adjacent construction.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Coordinate field inspection in accordance with appropriate sections in Division 01.

B. Manufacturer's Services: Coordinate manufacturer's services in accordance with appropriate sections in Division 01.

3.5 CLEANING AND PROTECTION

A. Clean products in accordance with the manufacturers recommendations.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 33 4100 – STORM UTILITY DRAINAGE PIPING

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:

1. PVC pipe and fittings
2. Storm Sewer pipe and fittings
3. Cleanouts
4. Drains
5. Manholes
6. Concrete
7. Public stormwater inlets
8. Stormwater detention structures
9. Stormwater Quality
10. Earthwork
11. General
12. Pipe installation
13. Pipe and joint construction
14. Cleanout installation
15. Drain installation
16. Manhole and catch basin installation
17. Private storm sewer connections
18. Stormwater inlet and outlet installation
19. Concrete placement
20. Stormwater disposal system installation
21. Connections
22. Closing abandoned storm drainage systems
23. Pipe lining by thermoformed pipe method
24. Identification
25. Field quality control
26. Minimum requirements for as-built plan
27. Cleaning

1.3 APPLICABLE SPECIFICATIONS

A. American Society for Testing and Materials (ASTM)

B. DC Department of Transportation, Standards and Guidelines

1.4 APPLICABLE REFERENCE

A. DC's Standards and Specifications Manual

B. Erosion and Sediment Control Field Handbook

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Submit full descriptions and details of all pipe and appurtenances proposed for the project.

C. Submit certifications from the manufacturers that the inspections and test specified in the referenced standards have been made and that the results of such inspections and tests comply with the requirements of the applicable standard. Certificates of compliance and approval shall apply.

D. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Catch basins, stormwater inlets, and dry wells. Include plans, elevations, sections, details, frames, covers, and grates.
3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames, covers, design calculations, and concrete design-mix reports.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

B. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1-inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

C. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.

D. Field quality-control reports.

E. Submit full descriptions and details of all pipe and appurtenances proposed for the project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.8 PROJECT CONDITIONS

A. Quality Assurance

1. The manufacturer shall provide facilities or a certified laboratory for conducting load bearing, hydrostatic and other tests required for production by the ASTM.
2. The Engineer will inspect pipe, fittings, and joint material upon delivery to the site. The Contractor shall provide ample space between rows of stockpiled pipe to facilitate the inspection.
3. Final inspection will be conducted by the Engineer upon completion of final paving and finished grading.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC Water-Service Piping:

1. Pipe: ASTM D 1785, Schedule 40 and Schedule 80 PVC, with plain ends for solvent-cemented joints.
2. Fittings: ASTM D 2466, Schedule 42a20 and ASTM D 2467, Schedule 80 PVC, socket type.

2.2 STORM SEWER PIPE AND FITTINGS

A. Concrete Storm Sewer Pipe

As indicated in the plan storm sewer pipes may be reinforced concrete pipe with a minimum inside diameter of 15-inches. Reinforced concrete pipe shall be Class III, IV, or V as called for on the plans and shall conform to the specifications of ASTM C-76. The pipe shall have bell and spigot ends with "O-ring" gasket joints conforming to ASTM C-443. Alternate materials may be approved by the District on a case by case basis.

B. High-Density polyethylene (HDPE) Storm Sewer Pipe

As indicated in the plan storm sewer pipes may be HDPE pipe. This specification describes 4- through 60-inch (100 to 1500 mm) ADS N-12 WT IB pipe (per AASHTO) for use in gravity-flow land drainage applications. Equal materials and/or manufacturers may be utilized if approved by Engineer of Record.

1. Pipe: ADS N-12 WT IB pipe (per AASHTO) shall have a smooth interior and annular exterior corrugations.
   a. 4- through 10-inch (100 to 250 mm) pipe shall meet AASHTO M252, Type S.
   b. 12- through 60-inch (300 to 1500 mm) pipe shall meet AASHTO M294, Type S or ASTM F2306.
   c. Manning's "n" value for use in design shall be 0.012.

2. Joint Performance: Pipe shall be joined using a bell & spigot joint meeting the requirements of AASHTO M252, AASHTO M294, or ASTM F2306. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly. 12-through 60-inch (300 to 1500 mm) diameters shall have an exterior bell wrap installed by the manufacturer.

3. Fittings: Fittings shall conform to AASHTO M252, AASHTO M294, or ASTM F2306. Bell and spigot connections shall utilize a welded bell and valley or saddle gasket meeting the watertight joint performance requirements of AASHTO M252, AASHTO M294, or ASTM F2306.

4. Field Pipe and Joint Performance: To assure watertightness, field performance verification shall be accomplished by testing in accordance with ASTM F2487. Appropriate safety precautions must be used when field-testing any pipe material. Contact the manufacturer for recommended leakage rates.

5. Material Properties: Material for pipe and fitting production shall be high-density polyethylene conforming with the minimum requirements of cell classification 424420C for 4- through 10-inch (100 to 250 mm) diameters, and 435400C for 12- through 60-inch (300 to 1500 mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The 12- through 60-inch (300 to 1500 mm) pipe material shall comply with the notched constant ligament-stress

(NCLS) test as specified in Sections 9.5 and 5.1 of AASHTO M294 and ASTM F2306 respectively.

6. Installation: Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in trafficked areas for 4- through 48-inch (100 to 1200 mm) diameters shall be one foot. (0.3 m) and for 60-inch (1500 mm) diameter the minimum cover shall be 2 ft. (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 (compacted), Class 2 (minimum 90% SPD) or Class 3 (minimum 95%) material. Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.01. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the latest installation guidelines.

C. Storm Sewer Pipe Under Building Slab

All storm sewer pipes under building slab must be reinforced concrete pipe with a minimum inside diameter of 15-inches. Reinforced concrete pipe shall be Class III, IV, or V as called for on the plans and shall conform to the specifications of ASTM C-76. The pipe shall have bell and spigot ends with "O-ring" gasket joints conforming to ASTM C-443. Alternate materials may be approved by the District on a case by case basis. Additionally, a form-and-form liner shall be installed to continuously seal the interior of the pipe run. Fold-and form liner must comply with ASTM F1871 and ASTM F1504.

2.3 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    a. Josam Company
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.
    d. Tyler Pipe
    e. Watts Water Technologies, Inc.
    f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group
3. Description: ASME A112.36.2-2022 CSA B79/2, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
4. Top-Loading Classification(s): Light Duty, Medium Duty, Heavy Duty, and, Extra-Heavy Duty.
5. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. Plastic Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the

following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Canplas LLC.
   b. IPS Corporation.
   c. NDS Inc.
   d. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
   e. Sioux Chief Manufacturing Company, Inc.
   f. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.

3. Description: ASME A112.36.2-2022 CSA B79/2, PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.4 DRAINS

A. Cast-Iron Area Drains:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Nyloplast
      b. Josam Company
      c. MIFAB, Inc.
      d. Smith, Jay R. Mfg. Co.
      e. Tyler Pipe
      f. Watts Water Technologies, Inc.
      g. Zurn Specification Drainage Operation; Zurn Plumbing Products Group
   3. Description: ASME A112.6.3 gray-iron round body with anchor flange and round secured grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated.
   4. Top-Loading Classification(s): Medium and Heavy Duty.

B. Cast-Iron Trench Drains:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Josam Company
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Tyler Pipe
e. Watts Water Technologies, Inc.
f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group

3. Description: ASME A112.6.3, 4-inch- wide top surface, rectangular body with anchor flange or other anchoring device, and rectangular [secured] grate. Include units of total length indicated and quantity of bottom outlets with inside calk or spigot connections, of sizes indicated.
4. Top-Loading Classification(s): Heavy Duty

2.5 MANHOLES

A. Standard Precast Concrete Manholes:

1. Precast concrete manhole bases, risers and cones shall conform to the requirements of ASTM C-478 with configurations as shown in the drawings. Cones shall be eccentric.

2. Each precast section shall be clearly marked on the inside near the top with the following information where applicable: ASTM designation, Standard detail or drawing number, station location and designation, date of manufacture and name or trademark of manufacturer. Precast concrete manholes shall be manufactured by Americast, or approved equal.

B. Manhole Frames and Covers:

1. Manhole frames and covers shall be constructed of gray or ductile iron conforming to ASTM A-48 and A-536. Frames and covers shall have machined bearing surfaces to prevent rocking and rattling under traffic. Manhole covers shall be as shown on the Construction Standards and as indicated on the Contract Drawings. Frames and covers shall be manufactured by Dewey Brothers Inc., or equal.

C. Mortar:

1. Mortar used in manhole construction shall be one part of Portland cement conforming to ASTM C-150, Type II, and two parts of sand conforming to ASTM C-144, with enough water added to produce mortar of the proper consistency for the type of joint.

D. Manhole Neck Adjustments:

1. Adjustments to manhole necks shall be limited to 2 inches of concrete. Concrete adjustment rings shall be used for adjustments in excess of 2 inches, but not to exceed 12 inches. Nonshrink grout shall be used between adjustment rings.

E. Manhole Steps
1. Manhole steps shall be a composite of No. 3 grade 60 deformed steel bar incased in copolymer polypropylene plastic of the "press-fit" design or rubber. Steps shall be PSI-PF as manufactured by M.A. Industries, Inc. or Wedge-Lok as manufactured by Delta Pipe Products Inc., or approved equal.

2.6 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

a. Invert Slope: 1 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.

a. Slope: 4 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel.

2.7 PUBLIC STORMWATER INLETS

A. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to DDOT Standards and Guidelines.

B. Gutter Inlets: Made with horizontal gutter opening, of materials and dimensions according to DDOT Standards and Guidelines. Include heavy-duty frames and grates.

C. Combination Inlets: Made with vertical curb and horizontal gutter openings of materials and dimensions according to DDOT Standards and Guidelines. Include heavy-duty frames and grates.

D. Frames and Grates: Heavy duty according to DDOT Standards and Guidelines

2.8 STORMWATER DETENTION STRUCTURES

A. Cast-in-Place Concrete, Stormwater Detention Structures: Constructed of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Ballast: Increase thickness of concrete as required to prevent flotation.
2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and cover.
3. Steps: Individual FRP steps or FRP ladder wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of structure to finished grade is less than 60 inches.

B. High-Density Polyethylene (HDPE), Stormwater Detention Structures: This specification describes ADS Retention/Detention Pipe Systems for use in non-pressure gravity-flow storm water collection systems utilizing a continuous outfall structure. Other equal products or manufacturers may be used as approved by Engineer of Record.

1. Pipe Requirements: ADS Retention/Detention systems may utilize any of the various pipe products below: •
   a. N-12 WT IB pipe (per AASHTO) shall meet AASHTO M294, Type S or ASTM F2306
   b. N-12 WT IB pipe (per ASTM F2648) shall meet ASTM F2648
   c. N-12 MEGA GREENTM WT IB shall meet ASTM F2648
2. Joint Performance: Watertight (WT IB): WT IB pipe shall be joined using a bell & spigot joint. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. 12- through 60-inch (300 to 1500 mm) diameters shall have an exterior bell wrap installed by the manufacturer. Pipe & fitting connections shall be with a bell and spigot connection utilizing a spun-on or welded bell and valley or saddle gasket. The joint shall meet the watertight requirements of ASTM D3212 and gaskets shall meet the requirements of ASTM F477. Detention systems are subject to greater leakage than typical single run storm sewer application and therefore are not appropriate for applications requiring long-term fluid containment or hydrostatic pressure. For additional details refer to ADS Technical Note 7.01 Rainwater Harvesting with HDPE Cisterns.

3. Fittings: Fittings shall conform to ASTM F2306 and meet joint performance requirements indicated above for fitting connections. Custom fittings are available and may require special installation criterion.
4. Installation: Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in non-traffic areas for 12- through 60-inch (300 to 1500mm) diameters shall be one foot (0.3m). Minimum cover in trafficked areas for 12- through 36-inch (300 to 900mm) diameters shall be one-foot (0.3m) and for 42- through 60-inch (1050 to 1500mm) diameters, the minimum cover shall be two feet (0.6m). Backfill shall consist of Class 1 (compacted) or Class 2 (minimum 90% SPD) material, with the exception that 60-inch fittings shall use Class 1 (compacted) material only. Minimum cover heights do not account for pipe buoyancy. Refer to ADS Technical Note 5.05 HDPE Pipe Flotation for buoyancy design considerations. Maximum cover over system using standard backfill is 8 feet (2.4m); contact a representative when maximum fill height may be exceeded. Additional installation requirements are provided in the ADS Drainage Handbook Section 6 Retention/Detention.

C. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

PART 3 – EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 GENERAL

A. Maintain a minimum 5-feet horizontal distance between storm sewer and all other utilities.

B. Temporarily support, protect and maintain all underground and surface structures and utilities encountered in the process of the work. Where the grade or alignment of the pipe is obstructed by existing utilities, such as conduits, pipes or drains, the obstruction shall be permanently relocated by the Contractor in cooperation with the Owners of said utilities.

C. Use the proper tools for the safe handling and laying of pipe. Unload pipe by hand, skidways or hoists in such a manner so that material is not dropped or damaged. Distribute pipe at site of installation near area where it is to be laid. Protect machined ends of pipe from damage and keep pipe free from dirt and debris.

D. Install piping in such a manner as to obtain sufficient flexibility and to prevent excessive stresses in materials and excessive bending moments at joints. Conduct work in strict conformance with the procedures established by the manufacturers of the various types of pipe.

E. Bring any conflicts during the installation of piping to the attention of the Engineer.

F. All storm drainage facilities to be accepted by the District for perpetual maintenance shall be located such that maintenance and replacement can be accomplished without disturbing private-owned, permanent structures.

G. The minimum vertical clearance between storm sewer and other utilities shall be 1.0 foot, unless provisions to prevent damage to the underlying utility are detailed for approval by DPW.

H. Storm sewers shall be installed within public rights-of-way whenever possible. Proposed storm sewers shall be installed such that the following horizontal clearance from any private property lines or buildings are maintained. When a storm sewer cannot be installed with the minimum necessary horizontal clearance from private property, a permanent easement across the private property necessary to provide the horizontal clearances listed below shall be recorded prior to construction.
   1. 10 feet from center line of storm sewer mains less than 27 inches in diameter and 10 feet or less in depth.
   2. 15 feet from center line of storm sewer mains less than 27 inches in diameter and greater than 10 feet in depth.
   3. 15 feet plus half the diameter from the centerline of storm sewer mains greater than 27 inches, any depth.
   4. The above standards and specifications may be modified in instances where proposed development, site restrictions, and other unusual circumstances present unusual hardships and provisions are made to provide permanent sheeting shoring protection for the pipe.

I. Proposed easements shall be shown on plats prepared in conformance with plat standards prescribed in chapter 23, subdivisions, of the District's Code, and shall be submitted to the District for review and approval by the District Manager or designee. Deeds of easement shall be submitted to the District for review and approval, subject to the approval of the District Manager or designee, and approval as to form by the District Attorney.

J. No permanent structures, temporary structures, facilities or objects shall be placed within a storm sewer easement without the approval of the District.

K. No new permanent structure may be constructed adjacent to an existing storm drainage facility where that new permanent structure interferes with or encumbers the maintenance or rehabilitation of the existing storm drainage facility.

L. Design plans shall show and clearly label the location of all existing and proposed storm drainage easements.

M. Where required, design plans shall show cross sections to demonstrate that proposed facilities adjacent to District-owned storm drainage facilities will not impact the maintenance and reconstruction of the facility.

N. All plans and specifications for construction of proposed storm sewer facilities must be approved by the District. No sanitary sewer facilities shall be constructed without approved plans, shop drawings and construction cut sheets.

O. Pipes are to be stenciled at least once every four feet with permanent waterproof paint or approved equal. Stencil shall be minimum 1" letters STM for separated storm and CS for contaminated storm.

3.3 PIPING INSTALLATION

A. Lay pipe to a true uniform line and grade from elevations indicated on the drawings with continuous bearing of barrel on cradle or bedding material.

B. Lay pipe up-grade with the bell end pointing in the upstream direction and the spigot end pointing in the downstream direction. Lay each section of pipe in such a manner as to form a close concentric joint with the adjoining section and to prevent any sudden offsets in the flow line.

C. Ensure that pipe is well bedded on a solid foundation. Correct any defects due to settlement. Excavate bell holes sufficiently large to ensure making of proper joints. Exercise precautions to include the furnishing and placing of bedding to prevent any pipe from resting directly on rock.

D. Plug or grout lift holes left in the pipe prior to backfilling operations.

E. As the work progresses, clear the interior of the pipe of all dirt and superfluous materials of every description.

F. Keep trenches and excavations free of water during construction and until final inspection. Do not lay pipe in water or in a frozen bedding condition. Prevent flotation and re-lay pipe that has floated.

3.4 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join hub-and-spigot, cast-iron soil piping with gasketed joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
3. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
4. Join ductile-iron culvert piping according to AWWA C600 for push-on joints.
5. Join ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
6. Join corrugated steel sewer piping according to ASTM A 798/A 798M.
7. Join corrugated aluminum sewer piping according to ASTM B 788/B 788M.

8. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
9. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.6 DRAIN INSTALLATION

A. Install type of drains in locations indicated.

1. Use Light-Duty, top-loading classification drains in earth or unpaved foot-traffic areas.
2. Use Medium-Duty, top-loading classification drains in paved foot-traffic areas.
3. Use Heavy-Duty, top-loading classification drains in vehicle-traffic service areas.
4. Use Extra-Heavy-Duty, top-loading classification drains in roads.

B. Embed drains in 4-inch minimum concrete around bottom and sides.

C. Fasten grates to drains if indicated.

D. Set drain frames and covers with tops flush with pavement surface.

E. Assemble trench sections with flanged joints.

Embed trench sections in 4-inch minimum concrete around bottom and sides.

3.7 MANHOLE AND CATCH BASIN INSTALLATION

A. Construct manholes of precast concrete in accordance with Standard Details and the plans, unless directed otherwise. Provide monolithic base of precast construction and make water-tight connections between base and risers, unless modifications to the existing system are being performed. Manhole wall and bottom construction shall be such as to ensure water tightness. If directed by the District, the entire wall exterior shall be painted with waterproof coating. Place axis of manholes directly over the center lines of the pipes unless otherwise shown. The manhole foundation shall be adequately designed to support the manhole and any superimposed loads that may occur. Manholes in fill areas shall have a foundation extending a minimum depth of 18 inches into undisturbed earth and shall be designed only with prior approval from the District.

B. Construct appropriate flow channels in the bottom of manholes and catch basins as shown on the Construction Standards and plans. Cast-in-place concrete shall be a minimum four-inches thick, non-reinforced, 3000 psi concrete with smooth form troweled finish. Flow channel construction shall provide a smooth transition between adjacent sections. Provide a positive means of bonding channel to base of structure.

C. Cast-in-place concrete for manholes and catch basins shall be placed monolithically. Concrete shall be allowed to drop freely up to five-feet in height; where greater drops are required, a tremie or other device approved by the Engineer shall be used.

D. Joints for brickwork and precast concrete block work shall be completely filled and shall be smooth and free from surplus mortar on the inside of the manhole. Brick shall be laid radially with every sixth course laid as a stretcher courses. Brick and concrete block manholes and catch basins shall be parged over the entire inside surface of the walls.

E. Cut all pipes flush with the inside wall of the manhole structure. In 48-inch diameter precast structures, provide flexible rubber gasket between the structure wall and the incoming pipe. Provide field sleeve where required to assure a tight fit. In structures larger than 48-inches, secure pipe tightly into the wall with quick-setting non-shrink grout.

F. Firmly anchor manhole steps to wall according to manufacturer's recommendations. Steps shall be installed in accordance with Standard Drawing M-2.0.

G. Install vented or bolted manhole frames and covers, as indicated on the plans. Adjust the frame and cover to finished grade by brick or concrete adjusting ring construction.

H. For repair of existing structures, joints for brickwork and precast concrete block work shall be completely filled and shall be smooth and free from surplus mortar on the inside of the structure. Brick shall be laid radially with every sixth course laid as a stretcher course. Brick and concrete block manholes shall be plastered with mortar over the entire outside surface of the walls.

3.8 PRIVATE STORM SEWER CONNECTIONS

A. Storm Sewer Connections are privately owned and maintained from the storm sewer main up to and including the property served. Pipe and fitting for storm sewer service connections shall conform to the requirements of the DC Plumbing Code

B. No mechanical discharge of groundwater, stormwater, or other collected water onto the public right of way shall be permitted.

C. Connections to existing storm sewer mains shall be at manholes or inlets. The connection shall be made by core-drilling the structure and using a manhole adaptor appropriate for the pipe and structure materials. Connections at brick or masonry structures shall be made by carefully chiseling or removing single bricks or blocks such that the clearance between the connection pipe and any portion of the manhole is minimized.

D. Connections directly to pipes shall not be allowed without specific approval by the District Engineering Bureau and issuance of appropriate permits. Where specifically permitted by District, connections to existing pipes shall be made using saddles or fittings designed specifically for use on the pipe material which it is proposed to be used upon. Concrete saddles shall not be permitted.

   For connections to pipes 24” and smaller, the saddle shall be a strap-style saddle with straps extending around the entire circumference of the pipe. Connections to pipes larger than 24” shall use saddles or fittings specifically designed and manufactured for such connection, with appropriate anchors. When anchors are set into concrete pipes, expansion anchors shall not be permitted. Such fittings or saddles shall eliminate any encroachment of the pump discharge pipe into the flow line of the existing pipe when flowing full. Saddles shall provide flexural relief for the pump discharge line without transmitting any stress onto the storm sewer pipe.

3.9 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated.

C. Install outlets that spill onto grade, anchored with concrete, where indicated.

D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

E. Construct energy dissipaters at outlets, as indicated.

3.10 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.11 STORMWATER DISPOSAL SYSTEM INSTALLATION

A. Chamber Systems: Excavate trenches of width and depth, and install system and backfill according to chamber manufacturer's written instructions. Include storage and leaching chambers, filtering material, and filter mat.

B. Piping Systems: Excavate trenches of width and depth, and install piping system, filter fabric, and backfill, according to piping manufacturer's written instructions.

3.12 CONNECTIONS

A. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

    a. Shielded flexible couplings for same or minor difference OD pipes.
    b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.

c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure-type pipe couplings for force-main joints.

3.13 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. When abandoning existing storm sewers; excavate and remove existing structure and storm sewer lines or abandon in place by filling pipes with flowable fill and plugging at all open ends. Excavate and remove structure to a minimum of 2 feet below finished grade, fill the structure with sand or DDOT aggregate material.

3.14 PIPE LINING BY THERMOFORMED (FOLD AND FORM) PIPE METHOD

A. GENERAL

1. DESCRIPTION OF WORK

a. The work specified under this section provides for the rehabilitation of an existing sewer pipeline or conduit using PVC Fold and Form trenchless technology. The process consists of installing a thermoformed PVC pipe liner inside an existing sewer (Host Pipe) from manhole to manhole as described in the following sections. When installed the liner will be a seamless, joint-less, solid wall PVC pipe liner that tightly conformed to the interior contours of the original host pipe. The liner shall be continuous from manhole to manhole with no seams or joints. In most cases required service connections will be reconnected using closed circuit television and remotely controlled cutters.

b. The Pipe liner shall be Premier Pipe (resin-impregnated cured in-place liner) manufactured by American Pipeliners or “Approved equal” and installed by a certified professional such as AM-Liner East.

2. REFERENCED DOCUMENTS

This specification references ASTM standards and other related standards, which are made a part hereof by reference and shall be the latest edition thereof.

ASTM D638 Standard Test Method for Tensile Properties of Plastics

ASTM D790 Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

ASTM D1784 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

ASTM F1947 Standard Practice for Installation of Folded/Formed Poly (Vinyl Chloride) (PVC) Pipe Type A for Existing Sewer and Conduit Rehabilitation

ASTM F1504 Standard Specification for Folded/Formed Poly (Vinyl Chloride) Pipe Type A for Existing Sewer and Conduit Rehabilitation

ASTM F2122 Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

NASSCO SG-11.010/03 Specification for Sewer Line Cleaning

3. SUBMITTALS
   a. The contractor shall submit for approval:
      1) Shop Drawings, Product Data, Samples and Miscellaneous Submittals
      2) Product technical data including physical properties data sheet and manufacturers installation instructions.

   b. Certifications:
      1) The Contractor shall be licensed directly by the manufacturer of the product and provide written certification that he is an experienced and qualified installer of the product.
      2) Manufacturers certification that the product meets the requirements of the standards referenced
      3) Submit documentation from the manufacturer that there is an established and ongoing quality control and quality assurance program for the product at the manufacturer's production facility. This should include proof that the manufacturer has the necessary equipment and trained personnel to properly implement the program.

   c. Phasing Plan including:
      1) By-pass pumping procedure (if necessary)
      2) Order of construction

4. SAFETY

   The Contractor shall conform to all work safety requirements of pertinent regulatory agencies, and shall secure the site for the working conditions in compliance with the same. The Contractor shall erect such signs and other devices as are necessary for the safety of the work site.

   The Contractor shall also perform all of the work in accordance with applicable OSHA standards. Emphasis shall be placed upon the requirements for entering confined spaces and working with steam.

5. AS-BUILT DRAWINGS - Reference Division 1

B. PRODUCTS

1. BASIC MATERIALS
   The pipe shall be made from PVC compound meeting all the requirements for cell classification 12334 as defined in specification D1784 and with minimum physical properties:

Tensile Strength	Test Method D638	6,000psi (41.4MPa)
Tensile Modulus	Test Method D638	320,000psi (2206MPa)
Flexural Strength	Test Method D790	6,000psi (41.4MPa)

Flexural Modulus	Test Method D790	320,000psi (2206MPa)
Heat Deflection Temp	Test Method D648	115°F (46°C) Tested @ 264psi (2MPa)

2. OTHER REQUIREMENTS

a. Pipe Flattening
There shall be no evidence of splitting, cracking or breaking when the rounded pipe is tested according to section 11.3 of ASTM F1504.

b. Pipe Impact Strength
The impact strength of rounded pipe shall not be less than the values in Table 1 when tested in accordance with test method D2444 as referenced in ASTM F1504.

Table 1: Minimum Impact Strength at 73°F (23°C)

6 (150)	210 (284)
8 (200)	210 (284)
10 (250)	220 (299)
12 (300)	220 (299)
15 (375)	220 (299)
18 (450)	220 (299)
24 (600)	220 (299)
30 (750)	220 (299)

c. Pipe Stiffness
Values for pipe stiffness for the rounded pipe shall comply with Table 2 when tested in accordance with test method D2412 as referenced in ASTM F1504.

Table 2: Minimum Pipe Stiffness at 5% Deflection

Pipe Size, in. (mm)	Pipe Stiffness, psi (kPa)	Dimension Ratio, (DR)
6 (150)	36 (250)	35
8 (200)	36 (250)	35
10 (250)	36 (250)	35
12 (300)	22 (153)	41
15 (375)	12 (83)	50
18 (450)	6 (41)	66
24 (600)	6 (41)	66
30 (750)	6 (41)	66

d. Extrusion Quality
The extrusion quality of the pipe shall be evaluated by both of the following test methods:

1) Acetone Immersion**:** The pipe shall not flake or disintegrate when tested in accordance with test method D2152 as referenced in ASTM F1504.
2) Heat Reversion**:** The extrusion quality of the pipe shall be estimated by heat reversion method in accordance with practice F1057 as referenced in ASTM F1504.
3) Flexural Properties: The flexural strength and modulus of the pipe shall be

tested in accordance with test method D790 as referenced in ASTM F1504.

e. Dimensions

1) Formed Pipe Diameter: The average outside diameter of the formed pipe shall meet requirements in Table 3, +/- 1.0% when tested in accordance with test method D2122 as referenced in ASTM F1504.

2) Formed Pipe Wall Thickness: The wall thickness of the formed pipe shall not be less than the values specified in Table 3 when tested in accordance with test method D2122 as referenced in ASTM F1504.

Table 3: Formed Pipe Dimensions

Nominal Outside Diameter, in. (mm)	Minimum Wall Thickness in.(mm)	DR
6 (150)	0.17 (4.34)	35
8 (200)	0.23 (5.78)	35
10 (250)	0.28 (7.23)	35
12 (300)	0.292 (7.4)	41
15 (375)	0.30 (7.6)	50
18 (450)	0.27 (6.8)	66
24 (600)	0.34 (8.7)	66
30 (750)	0.43 (10.8)	66

f. Workmanship, finish, and appearance

The formed pipe shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other defects. The pipe shall be as uniform as commercially possible in colour, opacity, density and other physical properties.

g. Product Marking

Pipe shall be clearly marked as follows at intervals of 5ft. (1.5m) or less:

- Manufacturer's name or trademark and code
- Nominal outside diameter
- The PVC cell classification, for example "12334"
- The legend "DR XX FOLDED PVC PIPE"
- The designation "Specification ASTM F1504"
- Length marker and liner distance label, for example "100ft" ("30.5m")

h. Packaging

The full length of the PVC pipe is coiled onto a reel in a continuous length for storage and shipment. The minimum diameter of the reel drum or core shall be 48in (1,219mm).

C. EXECUTION

1. PRE-INSTALLATION

a. Host Pipe Preparation

1) The host pipe shall be cleaned in accordance with SPECIFICATION FOR SEWER LINE CLEANING as provided by the National Association of Sewer Service Companies (NASSCO). For bidding purposes, the Contractor shall assume that the pipes require normal cleaning which is defined as two to three passes with a jet cleaner unless unique conditions are noted as special provisions, on the TV log sheets or videos made available to the Contractor before the bid opening. Special additional cleaning not identified will be paid for on a time and material basis.

2) Debris that would interfere with the installation of the pipe liner shall be removed. The Contractor shall dispose of debris in a location provided by the Owner and in accordance with all Federal, State and Local regulations

3) The pipeline shall be cleared of obstructions such as solids, dropped joints, protruding service connections or collapsed pipe that may prevent pipe liner installation. If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment then a point repair excavation shall be made to uncover and remove or repair the obstruction. Such point repair shall be approved in writing by the Owner's representative prior to commencement of the work and shall be considered as a separate pay item.

4) High levels of groundwater infiltration into the host pipe, that will affect the successful installation of the liner shall be remediated by either chemical grouting or point repair prior to lining as approved by the Engineer. Such repairs shall be approved in writing by the Owner's representative prior to commencement of the work and shall be considered as a separate pay item.

5) Pre-Lining television Inspection: Prior to lining the Contractor shall inspect the pipeline by means of closed-circuit television to identify any unknown defects or obstructions and to accurately locate active services. Color video recordings in DVD/CD, MPEG, or .avi format shall be made of the television inspections and two copies each shall be supplied to the Owner along with a computer generated or hand-written inspection report. The Contractor shall make accurate television inspection logs that clearly show the location, in relation to adjacent manholes, of each source of infiltration discovered. Other data of significance including the locations of service connections, joints, defective materials, unusual conditions, roots, storm sewer connections, collapsed sections, presence of scale and corrosion and other discernible features shall be recorded and one copy of such records shall be supplied to the Owner in electronic format along with the video recordings. The contractor shall submit a report to the Owner detailing any defects in the pipeline that will prevent the successful installation of the liner. This report shall also contain a plan for proposed corrective action for repairs to the pipeline. Such repairs shall be approved in writing by the COTR prior to commencement of the work.

b. Flow Control

When required for acceptable completion of the pipe liner installation, the Contractor shall implement the pre-approved by-pass pumping plan in section 1.4.3.1.

2. LINER INSTALLATION

a. Pre-Heating

Prior to insertion of the liner into the host pipe the Contractor shall pre-heat the liner in the manner proscribed by the manufacturer's installation instructions. The heated liner must be pliable enough to be pulled into the host pipe with as little resistance as possible.

b. Pipe Liner Insertion

The liner pipe shall be inserted into the sewer through existing manholes, without modification of the manholes. Insertion of the liner into the host pipe will be accomplished by pulling the liner into the host pipe by means of a steel cable strung through the host pipe from a winch located at the downstream manhole. The end of the liner shall be prepared for attachment to the cable in accordance with the manufacturer's instructions. The connection between the pulling cable and the prepared end of the liner shall be a swivel device to prevent twisting of the liner as it is pulled through the host pipe. The heated liner coil shall be placed in such a manner as to prevent damage to the liner as it is pulled through the manhole and into the host pipe.

A member of the installation crew at the upstream end shall monitor the speed of the pull; he must coordinate the speed of the pull with the winch operator at the downstream manhole via two-way radio. The crewmember coordinating the insertion of the liner shall ensure that the liner has the proper amount of slack, to prevent it from being either stretched or kinked.

c. Stress Relief

After the liner has been inserted into the host pipe, the Contractor shall relieve any stress imparted to the liner during the insertion in a manner proscribed in the manufacturer's installation instructions.

d. Processing

The Contractor shall supply suitable heat source equipment. The equipment shall be capable of delivering steam through the lining section to uniformly raise the temperature of the PVC material to effect forming of the liner pipe.

Suitable monitors shall be installed to gauge steam temperatures and pressures at the input and exhaust ends of the liner. Steam monitoring methods and forming period shall be recommended by the liner manufacturer.

After forming the liner shall be cooled using compressed air or a mixture of compressed air and water. Cooling shall be deemed complete when the temperature of the exhaust air or air water mixture has remained constantly below 90ºF for a minimum of 10 minutes.

e. Pipe Liner Trimming

After installation the ends of the PVC liner shall be cut off in the maintenance hole. The cuts shall be smooth and parallel with the maintenance hole wall. The finished liner shall not protrude into the maintenance hole over 4 inches.

If the maintenance hole has been lined through, the top half of the liner pipe may be cut off even with the top of the shelf, leaving the channel lined.

f. Sealing Manhole Connections

If a watertight seal is required at the manhole it may be accomplished by troweling a high viscosity epoxy cement or resin around the exposed ends of the liner and the surface of the manhole. The surface of the epoxy cement shall be shaped to smoothly transition the exposed liner to the manhole wall. If specified by the Owner a hydrophilic gasket may be placed between the pipe liner and the host pipe prior to expansion of the liner. In either case the exposed liner in the manhole shall be smoothly transitioned into the wall of the manhole using the epoxy cement.

g. Service Connections

The exact number and location of service connections shall be determined from the CCTV inspection done in section 3.1.3.5 of this specification. It shall be the Contractor's responsibility to accurately locate all existing service connections whether in service or not. The Contractor shall reconnect all potentially active service connections to the pipe liner, including those from unoccupied, abandoned or vacant lots. Capped service connections shall not be reconnected unless otherwise directed by the Owner. The Contractor shall be responsible for restoring/correcting, without delay, all missed service lateral connections. All service connections that are reinstated after lining shall be shown on the "As Built Drawings" with the exact distance from the upstream manhole.

All existing service connections shall be reinstated either by remotely controlled robotic device or by excavation.

Only experienced operators shall make robotic service connection reinstatements. Should a dimple not form or cannot be clearly ascertained at a given service connection its position must be carefully re-verified using the inspection video from 3.1.3.5.

Service reconnections shall be smooth and circular in nature as observed by a pan and tilt TV camera. The hole shall be a maximum of 105% and a minimum of 90% of the service pipe diameter. The opening shall be smooth and conform to the inside shape and size of the original connection. Trial cuts should be repaired per the pipe liner manufacturer's recommendations at no cost to the Owner.

3. POST INSTALLATION INSPECTION

Upon completion, and before acceptance of the work, the Contractor will inspect the rehabilitated pipeline using a CCTV camera with a pan and tilt head. The inspection shall be recorded on either SSD or DVD. The Operator will stop the camera at each lateral reinstatement and using the pan and tilt feature record and catalog each of the service connection cuts. The Contractor shall submit the post-installation video in either VHS or DVD format to the Owner for acceptance of the work.

4. INSPECTION AND TESTING

a. Visual Inspection

The pipe liner shall be continuous and joint-less. The pipe liner shall be free of all visual and material defects except those resulting from pre-lined host pipe conditions identified in the pre-lining video.

b. Testing

If required, the Contractor shall provide liner field samples to the Owner prior to installation for testing. The Owner will pay all expenses for the testing of liner samples to verify that the field samples meet the minimum specified values listed in Section 2.1. The samples shall be tested per the recommendations of the pipe liner manufacturer. The Contractor shall pay for the cost of re-tests made necessary by the failure of a sample to meet the minimum specified values listed in Section 2.1. Field samples shall be collected in accordance with Section 7.3 of ASTM F1947.

Normally separate leakage testing of the liner is not required, since the liner is under constant pressure during the cool down period. However, if separate leakage testing of the liner is required by the Owner in the specifications it shall be conducted at the time of installation after cool down and before the laterals are cut, in accordance with Section 7 of F1947.

5. DEFECT REPAIR OR REPLACEMENT

Any defects, which in the judgment of the Owner and the pipe liner manufacturer that will affect the integrity or strength of the liner, shall be repaired or the pipe liner replaced at the Contractor's expense per the pipe liner manufacturers recommendations. All repairs or replacement of defective work shall be completed to the full satisfaction of the Owner.

6. WARRANTY

The Manufacturer shall warrant the product for a period of 10 years from the date of manufacture, against failure as a result of defects in materials or manufacturing, and that when properly installed the product will perform in accordance with the Manufacturer's specifications, literature and data sheets.

3.15 IDENTIFICATION

A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.16 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.

5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

    a. Exception: Piping with soil tight joints unless required by authorities having jurisdiction.
    b. Option: Test plastic piping according to ASTM F 1417.
    c. Option: Test concrete piping according to ASTM C 924.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.17 MINIMUM REQUIREMENTS FOR AS-BUILT PLAN

A. Upon completion of the construction and prior to release of bonds or final payments by Smithsonian, the Contractor shall submit and obtain approval of as-built plans. One set of as-built plans shall be provided in electronic format (BIM and PDF) and shall include:
1. Invert elevations
2. Manhole top elevations
3. Percent of grade between structures
4. Horizontal distance between structures and manholes
5. Pipe material
6. Location of connection to existing system
7. Type of structures installed
8. Label on plan and profile the point of private and public responsibility for maintenance

3.18 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION

SECTION 334100.1 – INLETS AND GRATES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work consists of furnishing storm inlet frame and grate units, basin tops of various size, and sewer-water manhole frame and cover units to replace units made unusable from conditions beyond the Contractor's control; Work also includes furnishing water valve casing frames and covers to replace obsolete conic water valve frames encountered.

1.2 SUBMITTALS

A. Provide copies of the inspection and electronic reports complying with NASSCO Pipeline Assessment and Certification Program (PACP) standards for all segments of sewer and manholes inspected. Provide a certified letter signed by the Contractor stating that all storm sewers installed as part of the project are confirmed to be installed per the contract documents.

1.3 QUALITY ASSURANCE

A. The vendor performing the Television Inspections shall hold a valid NASSCO PACP certification.

PART 2 - PRODUCTS

2.1 GENERAL

Materials shall meet the following requirements:

- Inlet grates and frames
- Manhole frames and covers
- Manhole steps
- Precast concrete tip units for inlet boxes, manholes, grade adjustment rings, top slabs, and transition slabs
- Concrete top units for inlet boxes

PART 3 - EXECUTION

3.1 GENERAL

A. Excavate for the structure as required. Place concrete foundations and walls monolithically. Set frames, concrete top units, and grade adjustment rings (if required for inlets and manholes) on a bed of nonshrink grout to provide full bearing on the supporting surface. Set pipes in inlets and manholes, flush with the inside structure face. For pipes protected by endwalls, set flush with the exposed structure face.

B. Clean drainage structures, as indicated, including inlets, manholes, endwalls, spring boxes, grates, and scuppers. Repair any damage resulting from the cleaning operations. Prevent material cleaned from structures from entering streams or other bodies of waters and dispose of this material in a satisfactory manner.

3.2 DOCUMENTATION

A. All documentation shall clearly reference the adjacent structure numbers for each segment of pipe inspected.

B. Electronic media location records shall be kept by the Contractor and will clearly show the location, by distance in 1/10 of a foot or nearest mm, from the manhole wall, in relation to an adjacent manhole of each infiltration point observed during inspection. In addition, other points of significance such as locations of storm sewer connections, cracks, fractures, broken pipe, presence of scale and corrosion, and other discernible features, as defined in the PACP defect codes, will be recorded on electronic media and a copy of such records will be supplied to the Owner.

C. Digital photographs of the pipe condition and all defects shall be taken by the Contractor. Photographs shall be located by distance, in increments of 1/10 of a foot, from the adjacent manhole or structure wall.

D. Electronic media recordings shall be in a format and media which is acceptable to the Owner.

END OF SECTION