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SECTION 010000  
GENERAL REQUIREMENTS

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**SECTION 010000****GENERAL SPECIFICATIONS****PART 1 GENERAL****1.01 SCOPE OF WORK**

- A. Furnish all labor, materials, equipment, and incidentals required to complete the project as shown in the Plans, Drawings, and as specified in this Project Manual.
- B. The work includes completion of the following major elements as further described in the Contract Documents:
  - 1. Earthwork including excavation of unsuitable soils, placement of fill, and grading.
  - 2. Installation of drainage structures, pipe, and bioretention systems.
  - 3. Installation of landscaping.
  - 4. Surface restoration, including grading to match existing and placement of loam and seed
  - 5. Other miscellaneous tasks as referenced on the Plans and in this Project Manual.

**1.02 CONSTRUCTION SEQUENCE**

- A. Prior to the start of any mobilization, construction, or ordering of materials, the Contractor shall schedule a Pre-Construction Meeting and Site Walk with the Engineer and Owner.
- B. Erosion control measures shall be installed by the City as indicated on the plans and as directed by the Engineer during the Site Walk prior to commencing any work. Such measures shall be maintained throughout the Contract period.
- C. The Contractor shall ensure that no excavation be left open, unguarded, or water filled during any period of time when work is not in progress. All subsurface work shall be completed with temporary surfacing in a particular area before proceeding to other work areas.
- D. Prior to the start of construction, the Contractor shall submit a schedule for the work to be completed under this Contract for approval by the Owner.
- E. The contractor is responsible to furnish any necessary temporary lighting to support operations.
- F. If required, permanent pavement striping can occur no sooner than two (2) weeks but no later than four (4) weeks following completion of paving operation in the area to be striped.

## 1.03 CHANGE IN AMOUNT OF WORK

- A. The Owner reserves the right to increase or decrease the amount of any item of work included in the Bid Form, as may be desirable or necessary during the course of this Contract. The unit prices quoted in the Bid Form shall apply without change to such variation in the quantity of work to the extent provided by law.

## 1.04 EXISTING UTILITIES

- A. Determining the location and depth of existing utilities will be the responsibility of the Contractor. The drawings do not show the exact location and depth of all utilities, nor do they show all utilities that may be encountered. If needed to perform the work, the Contractor shall locate all utilities in the area of the work by experimental excavations (if necessary) prior to and as the work progresses.
- B. The Contractor shall notify the proper utility companies and Owner to obtain the location of all utilities prior to beginning work. The marked locations shall be preserved by the Contractor during the course of the work, until such time as they are no longer needed.
- C. All utilities interfered with or damaged by the Contractor shall be immediately and properly restored by the Contractor. The Contractor shall fully compact all backfill material around and under all existing utilities encountered or crossed.

## 1.05 TEMPORARY FACILITIES

- A. If needed, the Contractor shall obtain the prior approval of the Owner and electrical utility provider for the temporary use of unmetered electrical power.
- B. The use of any utility, including storm drainage and water supply systems, shall be coordinated with the Owner prior to such use.

## 1.06 STOCKPILE OF MATERIALS

- A. The Contractor shall stockpile materials, plants, and equipment to be used in the construction in approved location(s) as directed by the Owner or Engineer. Erosion control measures shall be maintained by the City around all stockpiles, as required by the Owner or Engineer. The Contractor is responsible for dust control. All storage locations shall be restored to their original condition by the Contractor at his/her expense.
- B. Materials shall be stored so as to preserve their quality and fitness for the work. Stockpiled materials approved before storage may be re-inspected prior to their use in the work.

## 1.07 DISPOSAL OF SURPLUS MATERIAL AND DEBRIS

- A. All surplus material removed from the excavations or from abandoned units shall remain the property of the Owner and shall be deposited by the Contractor as directed by the Owner within the limits of the project area where the work is being performed until such time that the Owner determines the materials can be removed or disposed.
- B. All unsuitable material removed from the excavations or from abandoned units that the Owner does not desire to retain shall be legally disposed of by the Contractor at his/her expense.
- C. During the progress of work the Contractor shall maintain the work site and adjoining areas in a neat and orderly manner and shall not allow the accumulation of construction debris. The Contractor shall use a suitable rubbish container at the site if so directed by the Owner or Engineer. Should the Contractor neglect to maintain the site free of accumulated debris, the Owner reserves the right to have the service performed by others at the Contractor's expense.
- D. Before acceptance and payment for the work at the substantial completion and final completion stages of construction, all temporary structures, surplus materials including excavated material, equipment, abandoned units, and debris which the Contractor may have accumulated during the work on the site or any adjoining property shall be removed of and properly disposed of at the Contractor's expense.

## 1.08 PERMITS AND FEES

- A. The Contractor shall obtain and comply with all required permits to complete the work, including all fees and bonds at his/her expense. The Contractor shall be solely responsible for performing all acts and providing all materials required to comply with all terms and conditions of required permits and licenses.

## 1.09 NOTIFICATION OF CONSTRUCTION

- A. At least five (5) business days prior to beginning the work the Contractor shall notify the following agencies to provide information regarding proposed excavations:
  - 1. DIG SAFE;
  - 2. City of Warwick DPW
  - 3. Police Department;
  - 4. Fire Department;
  - 5. Owner's Site Representative; and
  - 6. Engineer

## 1.10 SUBMITTALS

- A. The Contractor shall submit to the Engineer for acceptance, shop drawings, and other forms as required in Section 013000 of this Project Manual, for all items to be furnished under this Contract.
- B. The Contractor shall submit certificates of compliance for all backfill, bedding, pavement and other bulk materials from the source of supply demonstrating conformance with the Contract Specifications. If the Engineer so desires, materials may be approved at the source of supply before delivery is started.

#### 1.11 EMERGENCY SERVICE

- A. The Contractor shall maintain a full-time telephone service with access to his/her representative having the authority to respond to emergency situations such as settled trenches, weather damage, etc. The emergency telephone service number and list of contact personnel shall be submitted to the Owner and Engineer prior to beginning work, and shall be maintained throughout the progress of work and the full contract period.
- B. The Contractor shall be capable of placing response personnel at the work site within one (1) hour of emergency notification.

#### 1.12 HOURS OF OPERATION

- A. No outdoor activity by the Contractor shall be permitted on the site outside of the hours of 7:00 a.m. to 9:00 p.m., Monday through Friday and 7:00 a.m. – 3:00 p.m., Saturday, except as required by the Contract Documents, unless local ordinances or other regulations otherwise prohibit work during these hours, or unless otherwise authorized by the Owner.
- B. The Owner may approve other work hours for special considerations such as work to be completed during off-peak hours. The Contractor must receive written approval from the Owner prior to working during such hours.
- C. It is the Contractor's responsibility to ensure that he/she is working within the hours permitted by the local and state laws and regulations. The Contractor is fully responsible for obtaining and paying all permit fees to work on weekends and holidays as may be required by local or state authorities and the payment of any fees associated with work outside the ordinances for weekday work.
- D. If approved by the Owner, any work necessary to be performed after regular hours; on Saturdays, Sundays or legal holidays; shall be performed by the Contractor without additional expense to the Owner.

#### 1.13 PRECONSTRUCTION CONFERENCE

- A. Prior to the start of the construction there will be a preconstruction conference and site walk to discuss the phasing and scheduling of the construction project. The specific time and place of the conference will be arranged by the Owner after the Contract has been awarded.

#### 1.14 PROGRESS MEETINGS

- A. During the course of the construction project, the Contractor shall attend status meetings as scheduled by the Engineer or Owner to be held at the Site or at the Department of Public Works Main Office. The attendance of subcontractors and suppliers may be required during the progress of the work. The Contractor's Project Manager shall attend the meeting and shall be prepared and authorized to discuss the following items:

1. Progress of Work in relation to Contract Schedule;
2. Proposed Work activities for forthcoming period;
3. Resources committed to Contract;
4. Coordination of Work with others;
5. Status of procurement of equipment and materials;
6. Status of Submittals;
7. Outstanding actions, decisions, or approvals that affect Work activities;
8. Security issues;
9. Quality Issues;
10. Potential Claims;
11. Contract Changes;
12. Costs and Budget;
13. Labor; and
14. Insurance.

**END OF SECTION 010000**

**SECTION 010100****MOBILIZATION AND DEMOBILIZATION****PART 1 GENERAL****1.01 SCOPE**

- A. The work shall consist of the mobilization and demobilization of the Contractor's forces and equipment necessary for performing the work required under the Contract.
- B. This work shall not include mobilization and demobilization for specific items of work for which payment is provided elsewhere in the Contract.
- C. Mobilization will not be considered as work in fulfilling the Contract requirements for commencement of work.

**1.02 GENERAL**

- A. Mobilization shall include all activities and associated costs for transportation of Contractor's personnel, equipment, and operating supplies to the site; establishment of offices, buildings, and other necessary general facilities for the Contractor's operations at the site; premiums paid for performance and payment bonds, including coinsurance and reinsurance agreements as applicable; and other items specified in these Specifications.
- B. Demobilization shall include all activities and costs for transportation of personnel, equipment, and supplies not required or included in the Contract from the site; including the disassembly, removal and site clean up of offices, buildings and other facilities assembled on the site specifically for this Contract.
- C. This work includes mobilization and demobilization required by the Contract at the time of award. If additional mobilization and demobilization activities and costs are required during the performance of the Contract as a result of changed, deleted, or added items of work for which the Contractor is entitled to an adjustment in Contract price, compensation for such costs will be included in the price adjustment for the item or items of work changed or added.

**END OF SECTION 010100**

**SECTION 010250**

**MEASUREMENT AND PAYMENT**

**PART 1 GENERAL**

1.01 SCOPE

- A. The purpose of this section is to define the method of measurement and payment for each of the Bid items listed in the PROPOSAL FORM.
- B. The Contractor shall be responsible for all work associated with each Bid item for the price Bid, and shall have no claim for additional compensation due to his/her unfamiliarity with the measurement and payment requirements.
- C. All work performed as described in these contract documents will be paid for under one (1) or more of the items listed in the PROPOSAL FORM. All other activities required in connection with performance of the work, including all work required under Section 010000, GENERAL REQUIREMENTS, whether described in the contract documents or mandated by applicable codes, permits and laws, will not be separately paid for unless specifically provided for in the form of general bid, but will be considered incidental to performance of the overall project.
- D. Each unit or lump-sum price stated in the PROPOSAL FORM shall constitute full compensation as herein specified for each item of work completed in accordance with the drawings and specifications.
- E. The payment items listed herein and in the PROPOSAL FORM are intended to provide full payment for the work shown on the drawings and specified herein. Any work called for or implied in the documents but not listed as a payment item shall be considered incidental to the overall project.
- F. Unless otherwise noted, each item shall be furnished and installed in accordance with the Technical Specifications whether a specific applicable payment item exists or not.

1.02 ALLOWANCES:

- A. Payment will be made for invoices submitted by the Contractor subject to the conditions and limitations in the Contract Documents.
- B. The Contractor shall not add overhead or profit to the Allowance Items listed in the Bid Schedule.
- C. The allowances will be adjusted to the actual amount paid for such services and supported by invoice. No retainage will be withheld from this amount.

- D. The Contractor shall be responsible for the prompt payment for these allowance services to the appropriate payee providing said service, and shall submit evidence to the Engineer of payments to the payee prior to its inclusion in the invoice.

#### 1.04 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

The method of measurement and unit price shall be as noted in the Proposal Form. The unit price or lump sum price shall constitute full compensation for complete in place acceptance, including labor, tools, materials, equipment, and all incidentals and items of work necessary to complete the work in a manner suitable for final acceptance by the Owner. The basis of payment noted in the Supplemental Standards and Specifications are not applicable.

**END OF SECTION 010250**

**SECTION 011100****HEALTH AND SAFETY PLAN****PART 1 GENERAL**

## 1.01 GENERAL

- A. The Contractor shall take steps as described herein to be prepared for the possibility of an encounter with hazardous materials.
- B. Prior to the start of work on the site, Contractor shall submit a site specific health and safety plan, for record purposes only, prepared or reviewed by a Certified Industrial Hygienist, which includes consideration of all potential hazards at the site. The plan shall be submitted not more than fourteen (14) days after receipt of the written Notice to Proceed from the Owner. Work may not proceed at the project site until the Contractor's health and safety plan has been received by the Owner or Engineer.
- C. Contractor shall be cognizant of the minimum standards set forth in OSHA 29 CFR 1910.120. The health and safety plan shall include, but shall not necessarily be limited, to the following:
  - 1. Identification of Contractor's Site Safety Officer.
  - 2. Identification of Hazards and Risks Associated with Project.
  - 3. Contractor's Standard Operating Procedures, including Personnel Training and Field Orientation.
  - 4. Respiratory Protection Training Requirements.
  - 5. Levels of Protection and Selection of Equipment Procedures.
  - 6. Type of Medical Surveillance Program.
  - 7. Personal Hygiene Requirements and Guidelines.
  - 8. Zone Delineation of the Project Site.
  - 9. Site Security and Entry Control Procedures.
  - 10. Field Monitoring of Site Contaminants.
  - 11. Contingency and Emergency Procedures.
  - 12. Listing of Emergency Contacts.
- D. Personal protective equipment required to provide the appropriate level of dermal and respiratory protection shall be determined based on the standards set forth in the

Contractor's health and safety plan. The Owner or Engineer may conduct air monitoring for quality control purposes.

**END OF SECTION 011100**

**SECTION 012636**  
**SUPPLEMENTAL INSTRUCTIONS**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

A. In addition to the project specific technical specifications, the technical aspects of proposed construction shall be in accordance with the following documents:

1. The *Rhode Island Department of Transportation Standard Specifications for Road and Bridge Construction, 2013 Edition*, with latest revisions, *exclusive of Sections 102, 103, 104, 105, 106, 107, 108 and 109*.
2. The *Rhode Island Department of Transportation Standard Details*, with latest revisions.
3. The *Rhode Island Soil Erosion and Sediment Control Handbook, Revised 2014*, prepared by the Rhode Island State Conservation Committee.
4. The Rhode Island Department of Environmental Management, Rhode Island Stormwater Design and Installation Standards Manual, March 2015.

Any reference to "Measurement and Payment" in the Supplemental Specifications shall be excluded.

**END OF SECTION 012636**

**SECTION 013000****SUBMITTALS****PART 1 GENERAL****1.01 SHOP AND WORKING DRAWINGS**

- A. As required by the General Conditions, the Contractor shall submit a schedule of shop and working drawings submittals.
- B. In accordance with the accepted schedule, the Contractor shall submit promptly to the Engineer, through its authorized resident representative at the job site, or by mail, attention: Contractor Shop Drawings, six (6) copies each of the shop and working drawings required as noted in the specifications, of equipment, structural details, and materials fabricated especially for this Contractor.
- C. Such drawings shall show the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish shop coat, grease fittings, etc., depending on the subject of the drawings. When it is customary to do so, when the dimensions are of particular importance, or when so specified, the drawings shall be certified by the manufacturer or fabricator as correct for this Contract.
- D. All shop and working drawings shall be submitted to the Engineer by and/or through the Contractor, who shall be responsible for obtaining shop and working drawings from its subcontractors and returning reviewed drawings to them. All shop and working drawings shall be prepared on standard size, 24-inch by 36-inch sheets, except those which are made by changing existing standard shop or working drawings. All drawings shall be clearly marked with the names of the Owner, Project, Contractor and building equipment or structure to which the drawing applies, and shall be suitably numbered.
- E. Only drawings which have been prepared, checked and corrected by the fabricator should be submitted to the Contractor by its subcontractors and vendors. Prior to submitting drawings to the Engineer, the Contractor shall check thoroughly all such drawings to satisfy itself that the subject matter thereof conforms to the Contract Documents in all respects. Shop drawings shall be reviewed and marked with the date, checker's name and indication of the Contractor's approval, and only then shall be submitted to the Engineer. Shop drawings unsatisfactory to the Contractor shall be returned directly to their source for correction, without submittal to the Engineer. Shop drawings submitted to the Engineer without the Contractor's approval stamp and signature will be rejected. Any deviation from the Contract Documents indicated on the shop drawings must be identified on the drawings and in separate submittal to the Engineer.

- F. The Contractor shall be responsible for the prompt submittal and resubmittal, as necessary, of all shop and working drawings so that there will be no delay in the work due to the absence of such drawings.
- G. The Engineer will review the shop and working drawings as to their general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections of comments made on the drawings during the review do not relieve the Contractor from compliance with requirements of the Contract Documents. The Contractor is responsible for: conforming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating its work with that of all other trades; and performing its work in a safe and satisfactory manner. The review of the shop drawings is general and shall not relieve the Contractor of the responsibility for details of design, dimensions, code compliance, etc., necessary for interfacing with other components, proper fitting and construction of the work required by the Contract and for achieving the specified performance.
- H. With few exceptions, shop drawings will be reviewed and returned to the Contractor within ten (10) days of submittal.
- I. No material or equipment shall be purchased or fabricated especially for this Contract nor shall the Contractor proceed with any portion of the work, the design and details of which are dependent upon the design and details of equipment or other features for which review is required, until the required shop and working drawings have been submitted and reviewed by the Engineer as to their general conformance and compliance with the project and its Contract Documents. All materials and work involved in the construction shall then be as represented by said drawings.
- J. Two (2) copies of the shop and working drawings and/or catalog cuts will be returned to the Contractor. The Contractor shall furnish additional copies of such drawings or catalog cuts when he needs more than two (2) copies.

#### 1.02 SAMPLES

- A. Samples specified in individual Sections include, but are not necessarily limited to, physical examples of the work such as sections of manufactured or fabricated work, small cuts or containers of materials, complete units of respectively-used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols, and units of work to be used by the Engineer or Owner for independent inspection and testing, as applicable to the work.
- B. The number of samples submitted shall be as specified. Submittal and processing of samples shall follow the procedures outlined for shop and working drawings unless the specifications call for a field submittal or mock-up.
- C. Acceptance of samples will be acknowledged via a copy of the transmittal noting status. When samples are not acceptable, prompt re-submittal will be required.

**END OF SECTION 013000**

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SECTION 030000  
CONCRETE

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**SECTION 033000**  
**CAST-IN PLACE CONCRETE**

**PART 1 - GENERAL**

1.01 SCOPE

This section specifies cast-in-place concrete.

1.02 RELATED WORK

- A. Section 330513 Manholes and Structures

1.03 REFERENCES

- A. ACI – Structural Concrete for Buildings.
- B. ACE 304 – Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- C. ACI 308 – Standard Practice for Curing Concrete.
- D. ACI 318 – Building Code Requirements for Reinforced Concrete.
- E. ASTM C94 – Ready-Mixed Concrete.
- F. ASTM C150 – Portland Cement.
- G. ASTM C260 – Air Entraining Admixtures for Concrete.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301.
- B. Acquire cement and aggregate from same source for all Work.
- C. Use only one (1) brand of cement and admixtures unless otherwise approved in writing by the Engineer or Owner.
- D. Provide the Engineer or Owner with delivery ticket in accordance with ASTM C94 for each load of concrete.

**PART 2 - PRODUCTS**

2.01 MATERIALS

A. Cement:

1. Type I or Type II Portland Cement: ASTM C150. Use only one (1) brand of cement.
2. For areas with poor aggregate quality: Type II Portland Cement, ASTM C150. Use only one (1) brand of cement.
3. Type III Portland Cement: ASTM C150. For use at the Contractor's option under Cold Weather Concreting and Curing and Proportioning Concrete for Cold Weather.

B. Aggregate:

1. ASTM C33, "Specifications for Concrete Aggregate," Size Number 57.
2. For areas with poor quality aggregate, aggregate shall conform to ASTM C33 and meet the following minimum standards:

<u>TEST</u>	<u>ASTM</u>	<u>LIMIT</u>
<u>Fine Aggregate</u>		
Sieve Analysis	C 33	(as specified below)
Clay lumps & Friables	C 142	2% Max
Light Weight Material	C 123	2% Max
Material finer than No. 200	C 117	3% Max
Sand Equivalent	C 241	80% Min
Soundness (NaSO4)	C 88	10% Max

<u>Coarse Aggregate</u>		
Sieve Analysis	C 33	(as specified below)
Clay Lumps & Friables	C 142	0.5% Max
Light Weight Material	C 123	1.0% Max

Gradation follows:

<u>Fine Aggregate</u>		<u>Coarse Aggregate</u>	
Sieve Passing Size	% Passing (Weight)	Sieve Passing Size	% Passing (Weight)
3/8	100	1-1/2	100
No. 4	90-100	1	90-100
No. 16	45-75	3/4	50-80
No. 30	25-55	3/8	15-40
No. 100	0-8	No. 4	0-10

C. Admixtures for Concrete:

1. Air-entraining admixtures - ASTM C260.
2. Water-reducing retarding admixtures - ASTM C494, Type D. Water-reducing, retarding admixtures may be used when approved by the Engineer or Owner. The time limit between batching and placing concrete may be extended up to an additional two (2) hours. Use a quantity of admixture within the range of the manufacturer's recommendation. The amount of water may be reduced; other proportions shall remain the same.
3. Furnish the following information to the Engineer or Owner for approval:
  - a. Brand name of the admixture.
  - b. Amount of admixture, per cubic yard of concrete to be used.
  - c. Reason for requesting the use of the admixture.

## D. Water:

1. Clear, clean, and suitable for domestic consumption.

## 2.02 CONCRETE MIX

## A. Schedule - Concrete Types and Finishes:

1. Proportion concrete in accordance with ACI 318. The strength of concrete (f<sub>c</sub>), air entrainment, slump, and finish meet the requirements below:
  - a. Structural Concrete /Foundation Walls.

Unit	Requirement
Compressive Strength (f <sub>c</sub> ) (28 day)	3,000 psi
Air Entrained	4-6%
Slump (±1 inch)	5"
Finish form	Finish with honeycomb filled surface

- b. Non-Structural Concrete, Walks and Slabs.

Unit	Requirement
Compressive Strength (f <sub>c</sub> ) (28 day)	2,500 psi
Air Entrained	4-6%
Slump (±1 inch)	5"
Finish	Broom finish or as specified on drawings

- B. Add air entraining agent to normal weight concrete mix for work exposed to exterior.

## C. Proportioning Concrete for Cold Weather:

1. For concrete placed under "Cold Weather Concreting and Curing" condition, the Contractor may elect to alter the required proportions in one of the following ways:
  - a. Type III Portland Cement.
    - 1) Type III Portland Cement may be substituted in equal quantities for Type I or II Portland Cement.
  - b. Additional Cement.
    - 1) An additional sack per cubic yard of Type I or Type II Portland Cement may be added.

## D. Temperature Limits for Cold Weather Concrete:

1. Provide concrete having a minimum temperature of 50 degrees F and a maximum temperature of 90 degrees F at the time of placing. The temperature of the mixing water shall not exceed 140 degrees F. If aggregates are heated, heat uniformly with steam or water coil. Aggregate temperature shall not exceed 95 degrees F. Aggregate water mix temperature shall not exceed 80 degrees F. Do not use materials containing frost or icy lumps.

## E. Proportioning Grout Fill:

1. Fine concrete aggregate with three (3) sacks of cement per cubic yard and a maximum slump of six (6) inches.

**PART 3 - EXECUTION**

## 3.01 MIXING

## A. Plant Batched and Transit Mixed:

1. Batch at a central plant and mix enroute to the project in transit mix trucks in compliance with ASTM C94.
2. Place truck or transit mixed concrete within a maximum of 1-1/2 hours after introduction of cement into the batch. In hot weather or due to other contributing factors, a time less than 1-1/2 hours may be required by the Engineer or Owner.
3. Time interval between placement of batches not to exceed thirty (30) minutes.

## B. Plant Batched and Project Mixed:

1. Batch aggregates at a central plant and add water, cement, and admixture at the project.
2. Meet all requirements specified for transit mix.
3. Add cement, water, and admixture by accurate measurement, using measuring devices approved by the Engineer or Owner.

## C. Project Batched and Mixed:

1. Batch and mix at project site.
2. Methods and apparatus used to batch the design mix will be reviewed for approval by the Engineer or Owner.
3. Mixer rated capacity shall not be less than one (1) bag per batch. Batch quantities requiring fractional bags will not be allowed.
4. Mix concrete a minimum period of 1-1/2 minutes after all materials are in the drum.

## D. Hand Mixed:

1. Hand mixing may be allowed only upon written approval of the Engineer or Owner. Batches not to exceed 1/2 cubic yard in volume.

## 3.02 MIX ADJUSTMENTS

A. After the mix period but no later than fifteen (15) minutes from start of mixing, water may be added once for purposes of acquiring minimum slump, provided specified water-cement ratio is not exceeded. Adding water beyond these conditions constitutes retempering which will not be allowed. When water is added, an additional twenty (20) revolutions at mixing speed is required.

B. Air-entraining admixtures will not be allowed to be added after the start of mixing for purposes of acquiring minimum air content.

## 3.03 CONCRETE PLACEMENT

A. Notify Engineer or Owner a minimum of 24 hours prior to placement.

B. Convey concrete from a mixer to the forms as near final position as practical in a manner which will prevent segregation or loss of materials.

- C. Place concrete in maximum eighteen (18) inch horizontal layers.
- D. Immediately after placing, thoroughly compact concrete with mechanical vibrators. Provide minimum of two (2) vibrators. Provide minimum of two (2) power sources unless commercial power is available at site. Hand tamping or "spudding" when permitted, will be approved in writing by the Engineer or Owner.
- E. Place each concrete section in a continuous operation, such as bottom slab, walls, and top slab.
- F. Do not drop concrete freely from higher than four (4) feet above the surface of concrete being poured.
- G. Do not place concrete in water or allow water to rise over freshly placed concrete until a set is sufficient to prevent damage.

#### 3.04 SEAL CONCRETE PLACEMENT

- A. Seal concrete may be deposited under water in a compact mass and in approximate horizontal layers without vibrating or tamping. Vibrate or tamp seal concrete when not placed under water.
- C. Use tremie tube, closed bottom-dump bucket, or other means approved in writing by the Engineer or Owner.
- C. Tremie tubes shall be not less than ten (10) inches in diameter and bottom-dump buckets shall not be less than 1/2 cubic yard capacity.
- D. Place point of discharge upon the prepared foundation or upon concrete already placed, then discharge and raise slowly during the discharge travel.
- E. Avoid agitating the mixture or allowing water to enter the tube or bucket.

#### 3.05 PROTECTION FROM RAINFALL

- A. Protect flat work during periods of precipitation with adequate waterproof covering. Support covering so that finishing may be performed and initial set obtained without damage. Dragging of tarpaulins or other covering across unset concrete will not be permitted.

#### 3.06 CURING

- A. Commence curing and protection of concrete immediately after placing. Cure Type I and Type II Portland Cement seven (7) days continuously and Type III Portland Cement three (3) days continuously by one (1) of the following methods:

## 1. Water Curing:

Keep all surfaces of concrete and forms left on concrete wet. Shade concrete from sun with covering material or with sand or sawdust on slab, except during periods of required finishing. Use of sprinklers or flooding is permitted on slabs.

## 2. Membrane Curing:

- a. A liquid membrane-forming material may be used for curing at the Contractor's option. Complete required surface finish prior to application of curing compound; use water curing during finishing period. Spray material to surface at the rate of one (1) gallon per 300 square feet in two (2) applications, resulting in a coverage of 1 gallon per 150 square feet. Apply first coat immediately after acceptance of finish. Thoroughly wet concrete with water and apply material just as surface film of water disappears. Apply second coat after first application has set. Recoat any rupture to the membrane seal immediately or use water cure method.

## 3.07 COLD WEATHER CONCRETING AND CURING

- A. When descending air temperature at the project falls below 40 degrees F the Contractor may at their option, continue concreting under conditions stated below. Normal concreting operations may resume when the temperature at the site exceeds 40 degrees F.
- B. Provide cover and heating equipment sufficient to maintain the temperature of the concrete at not less than 50 degrees F for a period of three (3) days for Type I and Type II cement. Maintain the temperature at not less than 50 degrees F for a period of two (2) days for Type III cement or when one additional sack of Type I or Type II cement is added.
- C. Provide additional protection to prevent the concrete temperature from dropping more than 40 degrees F in the 24 hour period following the required protection period.
- D. Keep all surfaces of concrete and any forms remaining on concrete wet. Remove and replace any concrete injured by frost and freezing as directed by the Engineer or Owner.

## 3.08 FIELD QUALITY CONTROL

- A. All tests will be performed by and at the expense of the Contractor. Concrete for the samples shall be provided by the Contractor at no additional cost to the Owner. Samples for testing will be selected on a random sample basis in

accordance with ASTM C172. If the measured slump or air content falls outside the specified limits, a check test shall be made immediately on another portion of the same load. In the event of a second failure, the concrete shall be considered to have failed the requirements of the specification.

B. The following concrete tests will be taken:

1. Slump:

Testing will be in accordance with ASTM C143. If the slump is greater than the specified range, the concrete will be rejected.

2. Air Content:

Testing will be in accordance with ASTM C231. If the air content exceeds the specified range, the concrete will be rejected.

3. Compressive Tests:

Compressive test cylinders will be molded, cured, prepared and tested in accordance with ASTM C31 and ASTM C39. Cylinders will be taken for testing at seven (7) and twenty-eight (28) days.

C. Test results of cylinders tested at twenty-eight (28) days will form the basis for acceptance or rejection of concrete strength. Each twenty-eight (28) day compressive test result shall be the average of the compressive test of two (2) cylinders from the same batch. No more than two (2) samples from each load will be taken. The concrete strength will be evaluated in accordance with ACI 318. The strength level of the concrete will be considered satisfactory if the averages of all sets of three (3) consecutive strength test results equal or exceed the required  $f_c$  and no individual strength test result falls below the required  $f_c$  by more than 500 psi.

**END OF SECTION 033000**

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SECTION 310000  
EARTHWORK

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**SECTION 310000****EARTHWORK****PART 1 - GENERAL**

## 1.01 SCOPE

- A. The work of this section includes the furnishing of all labor, materials, tools, equipment, accessories and appurtenances necessary to satisfactorily complete all stripping of topsoil, excavation of earth and rock, stockpiling, removal of unsatisfactory materials, saw cutting and pavement removal, backfilling, filling, compaction, and grading not specified elsewhere, and all incidental work pertaining thereto within the limits of the work indicated or required as specified herein.

## 1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

## 1.03 PROTECTION OF WORK

- A. The Contractor shall prosecute the work so that no damage occurs to adjacent utilities, structures, property, or any other installation located in or adjacent to work areas. Damaged utilities shall be repaired with similar or better materials of the same size and to requirements of the utility owner. The Contractor shall have on site the necessary manpower, materials and equipment such as pumps, piping, and the like as required protecting and maintaining uninterrupted flows in existing utilities during construction.
- B. Excavations shall be kept free from water, snow and ice during construction. Bedding and backfill material shall not be placed in water. Water shall not be allowed to rise upon or flow over bedding and backfill material.
- C. The Contractor shall maintain all benchmarks, monuments and other reference points and, if disturbed, shall replace them at no additional cost to the Owner.
- D. Excavating equipment shall be of such size and type, and used in a manner, that will not damage existing items such as but not limited to paved surfaces, utilities, structures, trees.
- E. The finished subgrade shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the finished

surfaces are placed. Until the subgrade has been observed by the Engineer, no pavement materials shall be installed thereon.

- F. The City shall install silt sack at all catch basins within the vicinity of construction and perimeter erosion controls (if necessary) and the Contractor shall take whatever steps necessary to prevent catch basins and drain lines from receiving silt and sediment washed from project work areas. The Contractor shall clean out catch basins and drain lines that have not been successfully protected.

#### 1.04 SUBMITTALS

- A. Shop drawings and brochures shall be submitted for all items to be furnished in accordance with the provisions of the General Conditions as supplemented.
- B. Submittals required under this section shall include, but not be limited to the following:
1. Materials Testing Results;
  2. Materials Brochures;
  3. Temporary Earth Support Certification Letter Including Design Calculations
  4. Control of Water Certification Letter; and
  5. Soil Testing and Compaction Testing Reports

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

- A. Fill materials, meeting the following requirements, shall be used in the areas shown on the drawings or where specified herein. Fill materials may be obtained from either on-site excavations or from off-site sources as appropriate.

#### 2.02 SUITABLE EXCAVATED MATERIAL

- A. Suitable excavated material shall be material excavated for the installation of proposed stormwater management facilities that meets the below specifications for gravel borrow, select fill or crushed stone. The re-use of this material must be approved by the Owner. The contractor shall provide the Owner with documentation showing that the excavated material meets the below specifications.

#### 2.03 GRAVEL BORROW

- A. Gravel borrow shall consist of hard, durable gravel and sand, free from trash organic matter and clay, surface coatings, and other deleterious material.

- B. Gravel Borrow shall be placed in maximum twelve (12) inch lifts compacted to a minimum density of 95 percent of the maximum density determined by ASTM D1557, (Modified Proctor).
- C. Gravel borrow shall have a maximum stone size of three (3) inches and shall meet the following gradation requirements:

<u>U.S. Sieve Size</u>	<u>Percent Passing</u>	
	<u>Bank Run Processed Sand/Gravel</u>	<u>Reclaimed Processed Material</u>
3 inch	60-100	100
1 1/2 inch		70-100
3/4 inch		50-85
1/2 inch	50-85	
3/8 inch	45-80	
No. 4	40-75	30-55
No. 40	0-45	
No. 50		8-25
No. 200	0-10	2-10

#### 2.04 GRAVEL BORROW BEDDING

- A. Gravel borrow bedding shall consist of hard, durable gravel and sand, free from trash organic matter and clay, surface coatings, and other deleterious material.
- B. Gravel borrow bedding shall be placed in maximum twelve (12) inch lifts compacted to a minimum density of 95 percent of the maximum density determined by ASTM D1557, (Modified Proctor).
- C. Gravel borrow bedding shall have a maximum stone size of one and one half (1-½") inches and shall meet the following gradation requirements:

<u>U.S. Sieve Size</u>	<u>Percent Passing</u>
1 1/2 inch	100
1/2 inch	50-85
3/8 inch	45-80
No. 4	40-75
No. 40	0-45
No. 200	0-10

2.05 SELECT FILL

- A. Select fill shall consist of hard durable sand or sand and gravel, free from trash, organic matter, clay, surface coatings and other deleterious materials.
- B. Select shall be placed in twelve (12) inch lifts compacted to a minimum density of 95 percent of the maximum density determined by ASTM D1557, (Modified Proctor).
- C. Select fill placed between the mid-height of a pipe and twelve (12) inches above a pipe shall have a maximum stone size of three (3) inches. Select fill used for other purposes shall have a maximum stone size of two thirds of the loose lift thickness and that portion passing the three (3) inch sieve shall meet the following gradation requirements, as determined by ASTM C136 and ASTM C117:

U.S. Sieve Size	Percent Passing
4 inch	100
No. 10	30-100
No. 40	0-70
No. 200	0-15

2.06 CRUSHED STONE

- A. Crushed stone used for the crushed stone waterways shall be clean double washed crushed stone. Crushed stone shall consist of clean, crushed, non porous rock, or crushed gravel, uniformly blended.
- B. Crushed stone shall be 2" to 2 1/2" in diameter.

2.07 PEA STONE

- A. Pea stone shall consist of clean, semi-round stone.
- B. Pea stone shall meet the following gradation requirements:

U.S. Sieve Size	Percent Passing
1/2 inch	100
3/8 inch	85-100
#4	10-30
#8	0-10
#16	0-15

**PART 3 - EXECUTION**

## 3.01 PREPARATION

## A. Stripping

1. Prior to any excavation, filling, or grading operations, all topsoil, subsoil, fill or similar organic soils found within the Limit of Work line shall be stripped to their full depth in the area of all structures and in all areas required to be filled, excavated or graded. Stripped materials suitable for re-use as loam shall be stockpiled. Stockpiles shall be kept separate and not mixed with any other materials. Excess stripped materials and unacceptable materials shall be legally disposed of off-site by the Contractor unless otherwise specified.

## B. Pavement Cutting- N/A, to be completed by the City

## C. Excavation

1. Excavation shall consist of the removal of soil, rock, and other materials to the limits shown on the drawings, specified herein, and as required to provide firm bearing. No structures, pavements, utilities or fill materials of any kind shall be placed in, or upon excavated areas such as have been observed by the Engineer.
2. Rippable rock shall be considered earth excavation. Rippable rock is defined as rock which can be excavated using a single tooth hydraulic ripper pulled by a D8 Dozer or equivalent equipment.
3. Excavated materials meeting the requirements for the various fill materials specified herein shall be stockpiled for reuse. Unsuitable or excess suitable materials shall be legally disposed of off-site by the Contractor unless otherwise specified.
4. Excavation shall be to the limits as necessary to install utilities, pavement or other facilities unless otherwise specified. Excavation of unsuitable material beyond the limits necessary shall only be performed as authorized by the Engineer.
5. The proposed contour lines and spot grades shown on the drawings are finish elevations. Excavation to subgrade shall be the distance below these elevations as may be required by the size and thickness of the pavements, structures, utilities and surface treatments as shown on the drawings, details and sections, or as specified herein.

6. Over-excavation beyond the specified or detailed limits shall be backfilled and properly compacted by the Contractor and at no additional cost to the Owner.
7. Excavating equipment shall be of such size and type, and operated in such a manner, that will not damage items such as, but not limited to, existing paved surfaces, utilities, structures and trees.
8. The Contractor shall, at his own expense, be responsible to make excavations along objects to remain as necessary to complete the work. This may require the Contractor to perform hand excavation. The Contractor has the full responsibility for this work for which there shall be no special compensation unless otherwise noted herein.

D. Trench Excavation

1. Trench excavation shall consist of the removal of all materials encountered. Excavations shall be made to accommodate the elevation depth of cover, or detail shown on the drawings or specified. Trench widths shall be kept to the minimum practicable but shall be at least three (3) feet wide or two (2) feet plus the diameter of the pipe, whichever is greater. The bottom of the trenches shall be firm and free of water and shall be accurately graded and shaped to allow placement of required bedding beneath the bottom of all barrels, bells or couplings of all pipes installed.
2. Design criteria require that pipe be laid in trench conditions, therefore trenches for utilities in fill areas shall be excavated after all fill materials have been placed, spread and compacted to an elevation at least one (1) foot above the top of the proposed utility. This requirement is necessary to fulfill design criteria and should not be construed as a dictation of the Contractor's means and methods of construction.
3. If, through the Contractor's error, the excavations are carried beyond the specified limits, or if inadequate dewatering causes softening of the subgrade which necessitates removal, backfill shall be with gravel fill, placed and compacted as specified hereinafter under Trench Backfilling. Backfill shall be performed at no additional cost to the Owner.
4. When trenching occurs around trees to remain, the tree roots shall not be cut but rather, the trench shall be tunneled under or around the roots by careful hand digging and without injury to the roots.

5. The Contractor shall excavate to provide a minimum cover over the top of the pipe and fittings of five (5) feet below finished grade unless otherwise shown.

E. Excavation in Graded Areas

1. Excavation in graded areas shall be performed as necessary to bring such areas to proper subgrade or finish grade. Subgrade for grass areas shall be a minimum of six (6) inches below finish grade unless otherwise specified.

F. Excavation of Unsuitable Foundation Materials Below Trench Grade and/or Subgrade

1. Existing soils, which are considered unsuitable foundation materials by the Engineer, shall be removed to the limits directed by the Engineer. The lateral limit for the excavation of unsuitable material beneath structures shall be defined as the intersection point, with suitable subgrade material, of an imaginary line drawn downward at a forty-five (45) degree angle from the outside of the foundation. For pipelines, the horizontal limits are defined as two (2) feet plus the diameter of the pipe or a minimum total width of three (3) feet whichever is larger unless otherwise directed or shown. The horizontal limits are defined as two (2) feet outside the outside face of the manhole or catch basin base.
2. The exposed subgrade shall be compacted and the area backfilled with gravel fill. The Engineer shall be present during the excavation of all unsuitable soils in order to permit verification of the limits of and volume of material removed.

G. Experimental Excavation

1. The Contractor shall make excavations at locations authorized by the Engineer, for the purpose of confirming the location and depth of existing utilities or structures.
2. Additional experimental excavations shall be requested by the Contractor to precisely locate utilities and underground structures which may be affected by his work. The Contractor shall backfill the experimental excavations with materials meeting the specification for common fill, unless directed otherwise by the Engineer. Backfill of experimental excavation shall be compacted in accordance with the requirements for Trench Backfilling.

3.02 TEMPORARY EARTH SUPPORT

- A. The Contractor shall design, furnish, install and maintain temporary earth support systems, if required.

### 3.03 CONTROL OF WATER

- A. The Contractor shall evaluate the impact of the anticipated subsurface soil and groundwater conditions on his proposed method of excavation and dewatering and other operations in accordance with these specifications.

### 3.04 PIPE BEDDING AND TRENCH BACKFILLING

#### A. General

1. The requirements for the pipe bedding and trench backfilling are described herein and are shown on the drawings. Drainage pipes shall be installed at the depths shown on the drawings.
2. Pipe and/or structures shall be placed on specified bedding materials, to provide uniform support and a stable foundation for the pipeline or structure and backfill material. No bedding shall be placed on unstable subgrade soils. An unstable subgrade is defined as a condition of running sand, running silt, quick bottom, or otherwise soft, soupy or spongy bottom. If an unstable condition exists, or develops during the excavation, the Contractor shall excavate, dewater and stabilize the subgrade to the extent necessary to provide a firm stable foundation prior to placing bedding, pipe and/or structures.
3. The height of fill adjacent to structures and pipelines shall be increased at approximately the same rate on all sides to prevent displacement.

#### B. Trench Bedding

1. Pipelines and appurtenant items of work shall be laid in the bedding material, from the bottom of the excavation to the mid-diameter of the pipe, for the full width of the trench. Bedding material shall be compacted to a minimum density of 95 percent of the maximum density as determined by ASTM D1557 (modified Proctor) and shall meet the requirements for gravel fill or crushed stone.
2. The type and thickness of bedding material shall be adjusted based on field conditions, as follows:
  - a. Where the bottom of the trench is stable and the existing material at trench grade meets the requirements for Gravel Borrow, as determined by the Engineer, the Contractor will not be required to

- excavate six (6) inches below the pipeline for placement of bedding material. Gravel Borrow or crushed stone bedding material shall be placed and compacted to the mid-diameter of the pipe as specified hereinbefore.
- b. When the subgrade material does not meet the specification for Gravel Borrow, the excavation shall be made to a depth of six (6) inches below the bottom of the pipe for placement of bedding material.
  - c. Where the bottom of the trench excavation is below the groundwater level and pumping of water is done from within the excavation, the Contractor shall use a bedding system which provides a stable working surface which limits the disturbance of the subgrade and prevents migration or washing of fine soils from the subgrade due to the flow of water into the trench. If the subgrade is stable and meets the requirements of gravel fill, excavation for six (6) inches of bedding material is not required.
  - d. Where the subgrade soil type is a low or non-plastic silt (ML), silty or clayey sand (SM, SC), fine to medium sand (SP), or clayey gravel (GM, GC), as defined by the soil classification system described in ASTM Standard Method D2487 (Unified System), a two (2) layer bedding system shall be utilized, with an approved filter cloth to prevent migration of silt into the bedding material. The upper layer of this two (2) layer system, from the mid-diameter of the pipe to six (6) inches below the bottom of pipe, shall consist of crushed stone. The lower layer shall consist of at least six (6) inches of gravel borrow placed on top of the filter cloth. The filter cloth shall be continuous along the trench bottom, and shall wrap up the sides of the trench, to above the mid-diameter of the pipe and laid on top of the crushed stone from the trench wall to the pipe to prevent downward migration of fines. All joints and ends in the filter cloth shall lap at least twelve (12) inches to form a closure.
3. If the Contractor excavates beyond the required limits, the Contractor shall backfill this unauthorized excavation with compacted gravel borrow at no additional cost to the Owner. Gravel Borrow used to replace unsuitable material or unauthorized excavation shall be compacted to a minimum density of 95 percent of the maximum density determined by ASTM D1557, (Modified Proctor).
  4. The type and size of compaction equipment used shall not cause excessive surcharge loads on any walls or other structures.

## 3.05 SOIL TESTING

## A. General

1. Three (3) types of soil tests shall be performed by an approved soil testing laboratory furnished by the Contractor. The Soil Testing Laboratory shall be approved by Owner. The type of tests, timing and frequency are described in 3.07B, 3.07C and 3.07D below.
2. The performance of these tests does not relieve the Contractor of his responsibility to control his operations and perform tests as necessary to assure that the work performed meets the requirements of the specifications.

## B. Sieve Analysis Tests

1. Sieve analysis tests shall be performed on soil samples obtained by the Contractor for acceptance of material from off site borrows sources or from on-site excavations. As a minimum, a test shall be performed on at least one (1) random sample obtained from each type of fill being placed on site. Additional tests shall be performed on samples obtained from the fill when it is suspected by the Engineer that the material does not meet specifications. Tests shall also be performed when it is noted that the gradation of material actually being placed differs significantly from the documented gradation from a particular source.
2. Sieve analysis shall be performed in accordance with ASTM C136 and ASTM C117.

## C. In-Place Density Tests

1. In general, at least one (1) test shall be performed for each fifty (50) feet of pipeline installed, and conducted at a minimum of every two lifts. Structural and embankment fills shall be tested at least once for each one hundred (100) cubic yards of fill placed. For structures and embankments, a minimum of four (4) tests shall be performed during each of two (2) separate visits by the testing laboratory.
2. Tests shall be performed in accordance with ASTM D1556, ASTM D2167, or ASTM D2922.
3. The Test locations shall be determined by the Engineer.

4. Testing subcontractors shall be retained by the Contractor to perform testing to meet the requirements. Test results shall be submitted to the Owner.

D. Moisture Density Relationship Test

1. Moisture Density Relationship Tests (Proctor Tests) shall be performed in conjunction with In-Place Density Tests for each different fill material tested.
2. Tests shall be performed in accordance with ASTM D1557.

3.06 GRADING

- A. The areas to be graded shall be raked or machine-graded to remove stones and other unsatisfactory material and then shall be compacted as specified. Any depressions which occur during the compaction operation shall be filled with additional suitable material and then the surface regraded and compacted until true to line and grade as required.

**SECTION 310519.13  
GEOTEXTILES****PART 1 GENERAL**

## 1.01 SCOPE

- A. Furnish of all labor, materials, and equipment necessary to install specified geotextile fabrics in locations as directed by the Engineer.

## 1.02 SUBMITTALS

- A. Shop drawings and brochures shall be submitted for all items to be furnished in accordance with the provisions of the General Conditions as supplemented.
- B. Submittals required under this section shall include, but not be limited to the following:
  - 1. Materials Specifications
  - 2. Materials Brochure
  - 3. General Installation Practices and Installation Schedule

**PART 2 MATERIALS**

## 2.01 FILTER/DRAINAGE FABRIC

- A. Filter fabric for use in trench excavation operations, crushed stone waterways, and bio-retention areas shall be a nonwoven polypropylene fabric, DuPont Typar, Mirafi-140, or approved equal.

**PART 3 EXECUTION**

## 3.01 GENERAL

Installation of geotextile fabrics shall be strictly in accordance with the manufacturer's instructions and specific layout plans and details reviewed by the Engineer.

- A. Filter/Drainage Fabric

The filter/drainage fabric shall be installed in the final graded trench bottom prior to placement of the crushed stone bedding and at other locations shown on the drawings

or designated by the Engineer. The drainage fabric shall be overlapped to prevent intrusion of soil fines into the crushed stone bedding. The Contractor shall follow the manufacturer's installation recommendations.

### 3.02 FINAL INSPECTION AND ACCEPTANCE

- A. The Contractor shall, at its expense, have a manufacturer's representative inspect the work at completion of the installation. Any work found to be unsatisfactory shall be corrected at the Contractor's expense.
- B. The Engineer, at the Contractor's expense, reserves the right to have a manufacturer's representative inspect the installation process at any time during construction.

**END OF SECTION 310519.13**

**SECTION 312319****DEWATERING****PART 1 - GENERAL**

## 1.01 SCOPE

- A. This section specifies designing, furnishing, installing, maintaining, operating, and removing temporary dewatering systems as required to lower and control water levels and hydrostatic pressures during construction; disposing of pumped water; constructing, maintaining, observing and, except where indicated or required to remain in place, removing equipment and instrumentation for control of the system.
- B. Reference to Section 208, Dewatering Basins, in the Rhode Island Department of Transportation Standard Specifications for Road and Bridge Construction shall be utilized for all dewatering operations unless otherwise approved by the Owner or Engineer.

## 1.02 RELATED WORK

- A. Section 310000, EARTHWORK

## 1.03 SYSTEM DESCRIPTION

- A. Dewatering includes lowering the water table and intercepting seepage which could otherwise emerge from the slopes or bottom of the excavation; increasing the stability of excavated slopes; preventing loss of material from beneath the slopes or bottom of the excavation; reducing lateral loads on sheeting and bracing; improving the excavation and hauling characteristics of sandy soil; preventing rupture or heaving of the bottom of any excavation; and disposing of pumped water.
- B. Normal dewatering is defined as using conventional pumps installed in open excavations, ditches, or sumps. Special dewatering is defined as using single or two (2) stage wellpoints, deep wells, or eductor and ejector systems installed in drilled holes or jetted in place.

**END OF SECTION 312319**

## **SECTION 313211**

### **EROSION AND SEDIMENTATION CONTROLS**

#### **PART 1 - GENERAL**

##### 1.01 SCOPE

- A. The City of Warwick will be responsible for the installation and maintenance of silt sack at catch basins in the vicinity of construction and perimeter erosion controls (if required). The Contractor is responsible for inspection of erosion controls and providing dust control. The Work under this section consists of furnishing all necessary labor, equipment, materials, and performing all operations in connection with construction sediment and control measures.

##### 1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Section 010000 General Requirements, apply to this section.

#### **PART 2 – PRODUCTS/EXECUTION**

##### 2.01 DUST CONTROL

- B. In areas subject to surface and air movement of dust, where on-site or off-site damage is likely to occur, one or more of the following preventive measures shall be taken for dust control:
  - 1. Minimize the period of soil exposure through the use of temporary ground cover and other temporary stabilization practices.
  - 2. Sprinkle the site with water until surface is wet. Repeat as needed.

**END OF SECTION 313211**

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**SECTION 32000**  
**EXTERIOR IMPROVEMENTS**

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**SECTION 329000**

**PLANTING**

**PART 1 - GENERAL**

1.01 SCOPE

- A. This section of the specification covers all labor, materials, and equipment necessary to do all loaming, seeding and related work as indicated on the drawings and as herein specified. All lawns disturbed by the Contractor's operations shall be repaired as herein specified.

1.03 PROTECTION OF WORK

- A. For a particular source of loam, the Engineer may require the Contractor to send approximately ten (10) pounds of loam to an approved testing laboratory and have the following tests conducted:

- 1. Organic concentration
- 2. pH
- 3. Nitrogen concentration
- 4. Phosphorous concentration
- 5. Potash concentration

- B. These tests shall be at the Contractor's expense. Test results, with soil conditioning and fertilizing recommendations, shall be forwarded to the Engineer.

1.04 SUBMITTALS

- A. Shop Drawings and/or brochures shall be submitted for all items furnished in accordance with the provisions of the General Conditions.

- B. Submittals required under this section include, but are not limited to, manufacturer's information detailing for the following:

- 1. Seed mixes.
- 2. Fertilizers.
- 3. Mulch material.
- 4. Slope protection material (if required).
- 5. Origin of loam.

- C. Test results shall be submitted to the Engineer for review.

**PART 2 - MATERIALS**

## 2.01 LOAM

- A. Loam shall be a natural, fertile, friable soil, typical of productive soils in the vicinity, obtained from naturally well-drained areas, neither excessively acid nor alkaline, and containing no substances harmful to grass growth. Loam shall not be delivered to the site in frozen or muddy condition and shall be reasonably free of stumps, roots, heavy or stiff clay, stones larger than one (1) inch in diameter, lumps, coarse sand, noxious weeds, sticks, brush or other litter.
- B. The loam shall contain not less than five (5) percent nor more than twenty (20) percent organic matter as determined by the loss of weight by ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 230 degrees F.

## 2.02 LIME

- A. Lime shall be standard commercial ground limestone containing at least fifty (50) percent total oxides (calcium oxide and magnesium oxide), and fifty (50) percent of the material must pass through a 100 mesh screen with ninety-eight (98) percent passing a 20 mesh screen.

## 2.03 FERTILIZER

- A. Fertilizer shall be commercial fertilizer, 10-10-10 fertilizer mixture containing at least forty (40) percent of organic nitrogen. It shall be delivered to the site in the original sealed containers, each showing the manufacturer's guaranteed analysis. Fertilizer shall be stored so that when used it will be dry and free flowing. No fertilizer shall be used which has not been marketed in accordance with State and Federal Laws, relating to fertilizers.

## 2.04 MULCH

- A. Hay Mulch - Hay Mulch shall consist of mowed and properly cured grass, clover or other acceptable plants. No salt hay shall be used.
- B. Straw Mulch - Straw Mulch shall consist of stalks or stems of grain after threshing.
- C. Wood Fiber Mulch/Bark Mulch - Wood Fiber Mulch shall be Dark Hemlock Mulch and shall consist of wood fiber produced from clean, whole uncooked

wood, formed into resilient bundles having a high degree of internal friction and shall be dry when delivered to the project.

#### 2.05 SEED

- A. Seed shall be of an approved mixture, the previous year's crop, clean, high in germinating value, a perennial variety, and low in weed seed. Seed shall be obtained from a reliable seed company and shall be accompanied by certificates relative to mixture purity and germinating value.
- B. Seed mixes shall meet the material specifications of Oakland Beach Bioretention Mix and Endophyte Seed Mix detailed in the Site Plan Set.

#### 2.06 SLOPE EROSION PROTECTION

- A. If required, erosion control blanket shall be one hundred percent (100%) degradable plastic mesh with one hundred percent (100%) degradable straw or straw/coconut fill. Fill shall be held together by degradable fastening. Weight shall be 0.50 lb/sq. yd. Erosion control blankets shall be applied parallel to direction of water flow. The erosion control blankets shall be by North American Green, Evansville, IN or approved equal. For slopes 2:1 or greater, Model SC150 shall be used. For slopes less than 2:1, Model S150 shall be used.
- B. Six (6) inch wire staples shall be placed according to manufacturers recommendations to anchor the mesh material. Staples shall be designed to decompose.

#### 2.07 PLANT MATERIAL

- A. All plant material shall conform in size, grade, and quality to the "AAN American Standard for Nursery Stock" as approved by the United States of America Standards Institute in effect at time of bid advertisement. All scientific and common plant names of the items specified shall conform to the edition of "Standardized Plant Names", as adopted by the American Joint Committee on Horticultural Nomenclature in effect at time of bid advertisement.
- B. All plant material shall be nursery grown, no collected material will be accepted. All plant material shall be free from all insects, pests, plant diseases, disfiguring knots, stubs, sunscald, abrasions, or cuts of the bark or any other form of injury harmful to the health of the plant material. All plant material shall comply with State and Federal Laws with respect to inspection for plant diseases and insect infestations.

**PART 3 - EXECUTION**

## 3.01 SURFACE PREPARATION

- A. After approval of rough grading, loam shall be placed on areas affected by the Contractor's operations. Loam shall be at least six (6) inches compacted thickness.
- B. Lime shall be applied to bring the pH to 6.5 or, without a soil test, at the rate of 2 to 3 tons of lime per acre.
- C. Fertilizer shall be applied according to the soil test, or without a soil test, at the rate of 1,000 pounds per acre.
- D. Loam shall be worked a minimum of three (3) inches deep, thoroughly incorporating the lime and fertilizer into the soil. The loam shall then be raked until the surface is finely pulverized and smooth and compacted with rollers, weighing not over one hundred (100) pounds per linear foot of tread, to an even surface conforming to the prescribed lines and grades. Minimum depth shall be six (6) inches after completion.

## 3.02 SEEDING

- A. Seeding shall be done when weather conditions are approved as suitable, in the periods between April 1 and May 30 or August 15 to October 15, unless otherwise approved.
- B. If there is a delay in seeding, during which weeds grow or soil is washed out, the Contractor shall remove the weeds or replace the soil before sowing the seed, without additional compensation. Immediately before seeding is begun, the soil shall be lightly raked.
- C. Seed shall be sown at the approved rate, on a calm day by machine.
- D. One half the seed shall be sown in one (1) direction and the other half at right angles. Seed shall be raked lightly into the soil to a depth of 1/4 inch and rolled with a roller weighing not more than one hundred (100) pounds per linear foot of tread.
- E. The surface shall be kept moist by a fine spray until the grass shows uniform germination over the entire area. Wherever poor germination occurs in areas larger than three (3) sq. ft., the Contractor shall reseed, roll, and water as necessary to obtain proper germination at no additional cost to the owner.

- F. The Contractor shall water, weed, cut and otherwise maintain and protect seeded areas as necessary to produce a dense, healthy growth of perennial lawn grass.
- G. If there is insufficient time in the planting season to complete the fertilizing and seeding, permanent seeding may be left until the following planting season, at the option of the Contractor or on order of the Engineer. In that event, a temporary cover crop shall be sown. This cover crop shall be cut and watered as necessary until the beginning of the following planting season, at which time it shall be plowed or harrowed into the soil, the area shall be fertilized and the permanent seed crop shall be sown as specified.

### 3.03 PLACING MULCH

- A. Hay or Straw Mulch shall be loosely spread to a uniform depth over all areas designated on the plans, at the rate of 4-1/2 tons per acre, or as otherwise directed.
- B. Hay or Straw Mulch may be applied by mechanical apparatus, if in the judgment of the Engineer the apparatus spreads the mulch uniformly and forms a suitable mat to control slope erosion. The apparatus shall be capable of spreading at least eighty (80) percent of the hay or straw in lengths of six (6) inches or more, otherwise it shall be spread by hand without additional compensation.
- C. Wood Fiber Mulch/Bark Mulch shall be uniformly spread over certain selected seeded areas at the minimum rate of 1,400 pounds per acre unless otherwise directed. It shall be placed by spraying from an approved spraying machine having pressure sufficient to cover the entire area in one (1) operation.

### 3.04 SEEDING AND MULCHING BY SPRAY MACHINE

- A. The application of lime, fertilizer, grass seed and mulch may be accomplished in one (1) operation by the use of an approved spraying machine. The materials shall be mixed with water in the machine and kept in an agitated state in order that the materials may be uniformly suspended in the water. The spraying equipment shall be so designed that when the solution is sprayed over an area, the resulting deposits of lime, fertilizer, grass seed and mulch shall be equal to the specified quantities.
- B. A certified statement shall be furnished, prior to start of work, to the Engineer by the Contractor as to the number of pounds of limestone, fertilizer, grass seed and mulch per one hundred (100) gallons of water.

- C. This statement should also specify the number of square yards of seeding that can be covered with the solution specified above. If the results of the spray operation are unsatisfactory, the Contractor will be required to abandon this method and to apply the lime, fertilizer, grass seed and mulch by other methods.

### 3.05 PLANT MATERIALS

- A. All plant material shall be dug and handled in accordance with the American Association of Nurseryman's Standards for nursery stock. All shipments shall comply with all nursery inspection and quarantine regulations in accordance with Federal, State, and local regulations. A certificate of inspection shall accompany each shipment.
- B. All plant material shall be kept moist, fresh, and protected against exposure to sun, wind, and freezing temperatures. Balled and burlapped plants shall have their rootballs covered by earth, wood chips, cloth, straw, or other suitable material which shall be kept moist.
- C. All plant material with the exception of pines shall be planted during the following seasons: Spring - March 1 to June 15 and Winter - September 1 to December 1. Pines shall be planted during the following season: Spring - April 1 to May 15 and Winter - August 15 to October 15. No planting shall be performed in frozen ground or when snow covers the ground.
- D. Plant material locations shall be staked on the project site in accordance with the Plans prior to any plant pits being excavated. All staked locations shall be approved by the Engineer prior to excavation.
- E. Planting holes shall be twice the diameter of the root ball in width and equal to the depth of the root ball to the level at which it was grown in the nursery. Any excavation in excess of that required shall be replaced and compacted at eighty-five (85) percent maximum density.

### 3.06 INSPECTION AND ACCEPTANCE

- A. At the beginning of the planting season following that in which the permanent grass crop is sown, the seeded areas will be inspected. Any section not showing dense, vigorous growth at that time shall be promptly reseeded by the Contractor at his own expense. The seeded areas shall be watered, weeded, cut and otherwise maintained by the Contractor until the end of that planting season, when they will be accepted if the sections show dense, vigorous growth.

**END OF SECTION 329000**

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SECTION 330000  
UTILITIES

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**SECTION 330513****MANHOLES AND STRUCTURES****PART 1 GENERAL**

## 1.01 SCOPE:

- A. The Work under this section includes the furnishing of all labor, materials, tools and equipment necessary to construct pre-cast concrete manholes including bases complete with inverts, tables, steps, frames grates and covers, fittings, and piping as specified herein and shown on the Drawings.

## 1.02 RELATED WORK

- A. Section 310000, EARTHWORK

## 1.03 SYSTEM DESCRIPTION

- A. Pre-cast sections shall conform in shape, size, dimensions, materials, and other respects to the details indicated on the Drawings or as ordered by the Engineer.
- B. All manhole and catch basins shall have concrete bases. Concrete bases shall be pre-cast unless otherwise specified. Invert channels shall be formed of brick and mortar upon the base.
- C. Riser and cone sections shall be pre-cast concrete.

## 1.04 REFERENCES

- A. The following standards form a part of this specification as reference herein.

## American Society for Testing and Materials (ASTM)

ASTM	A48	Gray Iron Castings
ASTM	C32	Sewer and Manhole Brick
ASTM	C144	Aggregate for Masonry Mortar
ASTM	C207	Hydrated Lime for Masonry Purposes
ASTM	C478	Pre-Cast Reinforced Concrete Manhole Sections

ASTM	C923	Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes
ASTM	C1244	Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO	M198	Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
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### 1.05 SUBMITTALS

- A. Shop Drawings and/or brochures shall be submitted for all items furnished in accordance with the provisions of the General Conditions.
- B. Submittals required under this section include, but are not limited to, shop drawings or manufacturer's literature for the following:
1. Pre-cast manholes
  2. Grates, covers and frames.
  3. Horizontal joint sealing material
  4. Pipe connections and fittings
  5. Steps
- C. Tests reports as required shall be submitted to the Engineer.

## PART 2 - PRODUCTS

### 2.01 PRE-CAST CONCRETE SECTIONS

- A. All pre-cast concrete sections shall conform to ASTM C478 with the following exceptions and additional requirements:
1. The wall thickness of pre-cast sections shall be as designated on the Drawing's meeting the following minimum requirements:

Section Diameter	Minimum Wall Thickness
------------------	------------------------

(Inches)	(Inches)
48	5
60	6
72	7
84	8

2. Type II cement shall be used except as otherwise approved.
  3. Sections shall be steam cured and shall not be shipped until at least five (5) days after having been cast.
  4. Minimum compressive strength of concrete shall be 4000 psi at twenty-eight (28) days.
  5. No more than two (2) lift holes may be cast or drilled in each section.
  6. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the inside of each pre-cast section.
  7. Acceptance of the sections will be on the basis of material tests and inspection of the completed product.
  8. Circumferential steel reinforcement for walls and bases shall be a minimum of 0.12 sq. in./lin. ft. for 4-foot diameter sections and 0.17 sq. in./lin. ft. for 5- and 6-foot diameter sections. Reinforcing shall extend into tongue and groove.
- B. Conical reducing sections shall have a wall thickness not less than five (5) inches at the bottom and wall thickness of eight (8) inches at the top. Conical sections shall taper from a minimum of 48 inches diameter to 24 or 30-inches diameter at the top, as shown on the Drawings.
- C. Except where insufficient depth of cover dictates the use of a shorter base, bases shall be a minimum of four (4) feet in height.
- D. Slab top sections shall conform to the Contract Drawings, with a particular attention focused upon the reinforcing steel.
- E. The tops of the bases shall be suitable shaped by means of accurate ring forms to receive the riser sections.
- F. Joint sealant between concrete base and precast concrete manhole riser sections shall be a flexible performed butyl resin material. The sealant shall be Kent Seal or Con Seal conforming to either Federal Spec. SS-S-210 (210A), AASHTO M-198, and AASTM C990.

- G. Pre-cast sections shall be manufactured to contain wall openings of the minimum size to receive the ends of the pipes, such openings being accurately set to conform with line and grade of the sewer or drain. Subsequent cutting or tampering in the field for the purpose of creating new openings or altering existing openings, will not be permitted except as directed by the Engineer.
- H. "Drop-over" (dog house) manhole shall be placed where indicated on the drawings. The Contractor shall accurately measure the diameter of the existing outlet pipe and inform the manufacturer of its size, so that the "Drop-over" type opening can be cut into the pre-cast manhole base. The bottom shall be cast-in-place by the Contractor.
- I. The Engineer reserves the right to reject any unsatisfactory pre-cast section and the rejected unit shall be tagged and removed from the job site immediately.
- J. The Engineer may also require the testing of concrete sections as outlined under Physical Requirements in ASTM C478 with the Contractor bearing all testing costs.

## 2.02 BRICK MATERIALS

- A. Brick shall be sound, hard, and uniformly burned brick, regular and uniform in shape and size, of compact texture, and satisfactory to the Engineer. Bricks shall be Grade SA, hard burnt clay brick, and shall not absorb more than 6% of their dry weight when boiled for five hours in water.
- B. Rejected brick shall be immediately removed from the Work and brick satisfactory to the Engineer substituted.
- C. Mortar for brick work shall be composed of one part Portland Cement and two parts sand, measured by volume, to which no more than 10 pounds of lime shall be added for each bag of cement.
- D. Cement shall be Type II Portland Cement as specified for concrete masonry.
- E. Hydrated lime shall be Type S conforming to ASTM C207.
- F. The sand shall comply with ASTM C144 specifications for "Fine Aggregate," except that all of the sand shall pass a No. 8 sieve.

## 2.03 FRAMES, GRATES, COVER AND STEPS

- A. Castings shall be of good quality, strong, tough, even-grained cast iron, smooth, free from scale, lumps, blisters, and holes, any defect of every nature which would render them unfit for the service for which they are intended. Contact surfaces of covers and frame seats shall be machined to prevent rocking of covers. Frames and covers shall

be heavy duty cast iron 30-inch diameter.

- B. All castings shall be thoroughly cleaned and may be subject to a careful hammer inspection at the Engineer's discretion.
- C. Castings shall be ASTM A48 Class 30B or better.
- D. The surface of the manhole covers shall have diamond pattern with the cast words "WATER", "DRAIN" OR "SEWER", whichever is appropriate. Sewer manhole covers shall have a single 3/4-inch diameter vent hole.
- E. Manhole steps shall conform to ASTM C478 requirements and shall be fabricated of Grade 60 steel enclosed in a copolymer polypropylene plastic jacket. Steps shall be uniformly spaced at a maximum of twelve (12) inches unless otherwise shown on the Drawings.

## 2.03 SEWER MANHOLE ACCESSORIES

- A. Gasket materials shall be top grade (10% solids, vulcanized) butyl rubber and shall meet or exceed AASHTO M-198.
- B. Couplings at the manhole-pipe interface shall be made with a rubber seal system (with or without stainless steel straps) meeting the requirements of ASTM C923 and recommended for this type of connection.
- C. Stubs installed as specified and indicated on the Drawings shall be short pieces of the same class pipe as that entering the manhole and shall have either stoppers or end caps as shown on the drawings. Stoppers or end caps shall be especially designed for that application.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Pre-Cast Sections
  - 1. Pre-Cast bases shall be supported on a compacted level foundation of crushed stone, as specified in Section 310000, EARTHWORK, at least six (6) inches thick, but shall vary to the depth necessary to reach sound undisturbed earth.
  - 2. Pre-cast reinforced concrete sections shall be set vertical and with sections in true alignment.

3. Manhole base sections shall be provided with KOR-N-SEAL EPDM rubber boot with stainless steel band and clamp, or approved equal. Exterior surface of all sewer manholes shall be waterproofed with an asphaltic waterproof coating.
4. Butyl rubber joint sealant shall be installed between each concrete section. The sealant shall be carefully placed around the entire circumference of the joint to form a complete watertight seal.
5. Manhole joints and lifting holes shall be sealed inside and out with waterproof non-shrink grout to assure water tightness. Mortar shall be hammered into the holes until it is dense and an excess of paste appears on the surface, and then finished smooth and flush with the adjoining surfaces.

B. Brick Work

1. Bricks shall be moistened by suitable means, as directed, until they are neither so dry as to absorb water from the mortar nor so wet as to be slippery when laid.
2. Each brick shall be laid as a header in a full bed and joint of mortar without requiring subsequent grouting, flushing or filling, and shall be thoroughly bonded as directed.
3. The brick inverts shall conform accurately to the size of the adjoining pipes. Side inverts shall be curved and main inverts (where direction changes) shall be laid out in smooth curves of the longest possible radius which is tangent to the centerlines of adjoining pipe.

C. Castings

1. Cast iron frames, grates and covers shall be as specified. The frames and covers shall be set by the Contractor to conform accurately to the grade of the finished pavement, existing ground surface, or as indicated on the Drawings. Frames shall be adjusted to meet the street surface.
2. The bearing surfaces of sewer manhole frames and covers against each other shall be machined to give continuous contact throughout their entire perimeter. All iron castings shall be thoroughly cleaned and fins removed before being delivered. All frames within all state roadways shall have a minimum depth of 8-inches and be heavy duty. Frames on local streets shall have a minimum depth of 6-inches and be heavy duty.
3. A maximum of two (2) courses of brick and mortar will be allowed under frames. Further adjustment will be performed with precast manhole rings.

4. Frames shall be set concentric with the top of the concrete section and in a full bed of mortar so that the space between the top of the concrete section or brick headers and the bottom flange of the frame shall be completely filled and made watertight. A thick ring of mortar extending to the outer edge of the concrete shall be placed all around the bottom flange. The mortar shall be smoothly finished to be flush with the top of the flange and have a slight slope to shed water away from the frame.
5. Covers and/or grates shall be left in place in the frames, for safety reasons, except while Work is being performed.

D. Accessories

1. Accessories shall be installed in accordance with manufacturer's instructions.
2. Stubs shall be set accurately to the dimensions indicated on the Drawings. Stubs shall be sealed with suitable watertight plugs.

### 3.02 LEAKAGE TESTS

- A. General: Leakage tests shall be made and observed by the Engineer. Tests shall be performed prior to backfilling. The test shall be by vacuum or by water exfiltration as follows:
- B. Vacuum Testing of Manholes
1. Each manhole shall be tested immediately after assembly and prior to backfilling.
  2. All lift holes shall be plugged with an approved non-shrink grout.
  3. No grout shall be placed in the horizontal joints before testing.
  4. All pipes entering the manhole shall be plugged, taking care to securely brace the plugs from being drawn into the manhole.
  5. The test head shall be placed at the inside of the top of the cone section and the seal inflated in accordance with the equipment manufacturer's instructions.
  6. A vacuum of ten (10) inches of mercury shall be drawn and the vacuum pump shut off. With the section valve closed, measure the time required for the vacuum to drop to nine (9) inches. The manhole shall pass in accordance with the time criteria for various manhole depths:

<u>MANHOLE DIAMETER</u>	<u>MINIMUM TIME REQUIRED FOR 1" Hg DROP</u>		
	<u>0-10' DEEP</u>	<u>10'-15' DEEP</u>	<u>15'-25' DEEP</u>
4'	60 sec.	75 sec.	90 sec.
5'	75 sec.	90 sec.	105 sec.
6'	90 sec.	105 sec.	120 sec.

7. If the manhole fails the initial test, the Contractor shall make proper repairs or replace the manhole and retest at no additional compensation. If the manhole again fails the vacuum test, additional repairs shall be made and the manhole water tested.

C. Water Testing of Manholes

1. After the manhole has been assembled in place, all lifting holes and those exterior joints within six (6) feet of the ground surface shall be filled and pointed with an approved non-shrinking mortar. The test shall be made prior to placing the shelf and invert and before filling and pointing the horizontal joints below the six (6) foot depth line. If the groundwater table has been allowed to rise above the bottom of the manhole, it shall be lowered for the duration of the test. All pipes and other openings into the manhole shall be suitably plugged and the plugs braced to prevent blow out.
2. The manhole shall then be filled with water to the top of the cone section. If the excavation has not been backfilled and observation indicated no visible leakage, that is, no water visibly moving down the surface of the manhole, the manhole may be considered to be satisfactorily water-tight. If the test, as described above is unsatisfactory as determined by the Engineer, or if the manhole excavation has been backfilled, the test shall be continued. A period of time may be permitted if the Contractor so wishes, to allow for absorption. At the end of this period, the manhole shall be refilled to the top of the cone, if necessary, and the measuring time of at least eight (8) hours begun. At the end of the test period, the manhole shall be refilled to the top of the cone, measuring the volume of water added. This amount shall be extrapolated to a 24-hour rate and the leakage determined on the basis of depth. The leakage for each manhole shall not exceed one (1) gallon per vertical foot for a 24-hour period. If the manhole fails this requirement, but the leakage does not exceed three (3) gallons per vertical foot per day, repairs by approved methods may be made as directed by the Engineer to bring the leakage within the allowable rate of one (1) gallon per foot per day. Leakage due to a defective section or joint or exceeding the three (3) gallon per vertical foot per manhole shall be the Contractor's responsibility to uncover the manhole as necessary and to disassemble, reconstruct or replace it as directed by the Engineer. The manhole shall then be re-tested and, if satisfactory, interior joints shall be filled and painted.

4. No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorptions, etc., i.e. it will be assumed that all loss of water during the test is a result of leaks through the joints or through the concrete. Furthermore, the Contractor shall take any steps necessary to assure the Engineer that the water table is below the bottom of the manhole throughout the test.
5. If the groundwater table is above the highest joint in the manhole, and if there is no leakage into the manhole as determined by the Engineer, such a test can be used to evaluate the water-tightness of the manhole. However, if the Engineer is not satisfied, the Contractor shall lower the water table and carry out the test as described herein before.

## 6.02 CLEANING

- A. All new manholes shall be thoroughly cleaned of all silt, debris and foreign matter of any kind, prior to final inspection.

**END OF SECTION 330513**

**SECTION 33 4611**  
**BIORETENTION SYSTEMS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The Bioretention Systems shall conform to Rhode Island Stormwater Design and Installation Standards Manual, Appendix F.5.2 Construction Specifications for Bioretention Systems (attached at end of Section).

**END OF SECTION 334611**

## **F.5.2 Construction Specifications for Bioretention Systems**

### **F.5.2.1 Material Specifications**

The allowable materials to be used in bioretention area are detailed in Table F-18.

### **F.5.2.2 Bioretention Soil**

The soil should be a uniform mix, free of stones, stumps, roots or other similar objects larger than two inches. No other materials or substances should be mixed or dumped within the bioretention area that may be harmful to plant growth, or prove a hindrance to the planting or maintenance operations. The bioretention soil should be free of noxious weeds.

The bioretention system shall utilize planting soil having a composition as follows:

- Sand: 85-88%
- Soil fines: 8 to 12% (no more than 2% clay)
- Organic Matter\*: 3 to 5%

\*Note: For bioretention applications with a soil depth of less than 4 feet, add 20% (by volume) of well aged (3 months), well aerated, leaf compost (or approved equivalent) to the above planting soil mixture. Where soil fines content is less than 12%, add a corresponding % of leaf compost.

A textural analysis is required to ensure the bioretention soil meets the specification listed above. The bioretention soil should also be tested for the following criteria:

pH range	5.2 - 7.0
magnesium	not to exceed 32 ppm
phosphorus P <sub>2</sub> O <sub>5</sub>	not to exceed 69 ppm
potassium K <sub>2</sub> O	not to exceed 78 ppm
soluble salts	not to exceed 500 ppm

All bioretention areas should have a minimum of one test. Each test should consist of both the standard soil test for pH, phosphorus, and potassium and additional tests of organic matter, and soluble salts.

Since different labs calibrate their testing equipment differently, all testing results should come from the same testing facility.

Should the pH fall out of the acceptable range, it may be modified (higher) with lime or (lower) with iron sulfate plus sulfur.

### **F.5.2.3 Mulch Layer Specifications.**

A finely shredded, well-aged organic hardwood mulch is the preferred accepted mulch; a finely shredded, well-aged organic dark pine mulch may be accepted on a case-by-case basis. Bark dust mulches and wood chips will float and move to the perimeter of the bioretention area during a storm event and are not acceptable.

Shredded mulch must be well aged (6-12 months) for acceptance.

Mix approximately ½ the specified mulch layer into the planting soil to a depth of approximately 4 inches to help foster a highly organic surface layer.

### **F.5.2.4 Compaction**

It is very important to minimize compaction of both the base of the bioretention area and the required backfill. When possible, use excavation hoes to remove original soil. If bioretention area is excavated using a loader, the contractor should use wide track or marsh track equipment, or light equipment with turf type tires. Use of equipment with narrow tracks or narrow tires, rubber tires with large lugs, or high pressure tires will cause excessive compaction resulting in reduced infiltration rates and storage volumes and is not acceptable. Compaction will significantly contribute to design failure.

Compaction can be alleviated at the base of the bioretention facility by using a primary tilling operation such as a chisel plow, ripper, or subsoiler. These tilling operations are performed to refracture the soil profile through the 12-in compaction zone. Substitute methods must be approved by the engineer. Rototillers typically do not till deep enough to reduce the effects of compaction from heavy equipment.

When backfilling the bioretention facility, place soil in lifts 12in or greater. Do not use heavy equipment within the bioretention basin. Heavy equipment can be used around the perimeter of the basin to supply soils and sand. Grade bioretention materials with light equipment such as a compact loader or a dozer/loader with marsh tracks.

### **F.5.2.5 Plant Installation**

The plant root ball should be planted so 1/8<sup>th</sup> of the ball is above final grade surface. Root stock of the plant material should be kept moist during transport and on-site storage. The diameter of the planting pit should be at least six inches larger than the diameter of the planting ball. Set and maintain the plant straight during the entire planting process. Thoroughly water ground bed cover after installation.

Trees should be braced using 2 in x 2 in stakes only as necessary and for the first growing season only. Stakes are to be equally spaced on the outside of the tree ball.

Grasses and legume seed should be tilled into the soil to a depth of at least one inch. Grass and legume plugs should be planted following the non-grass ground cover planting specifications.

The planting soil specifications provide enough organic material to adequately supply nutrients from natural cycling. The primary function of the bioretention structure is to improve water quality. Adding fertilizers defeats, or at a minimum, impedes this goal. Only add fertilizer if compost or mulch is used to amend the soil. Rototill urea fertilizer at a rate of 2 pounds per 1,000 square feet.

#### **F.5.2.6 Underdrains**

*Underdrains should be in accordance with RIDOT specification section 703 – Underdrains and Combination Underdrains and the following provisions, as applicable.*

Underdrains should be placed on a minimum 3'-0" wide section of filter cloth. Pipe is placed next, followed by the gravel bedding. The ends of underdrain pipes not terminating in an observation well should be capped.

The main collector pipe for underdrain systems should be constructed at a minimum slope of 0.5%. Observation wells and/or clean-out pipes must be provided (one minimum per every 1,000 square feet of surface area).

#### **F.5.2.7 Miscellaneous**

The bioretention facility may not be constructed until all contributing drainage area has been stabilized.

Table F-18 Materials Specifications for Bioretention

Parameter	Specification	Size	Notes
Planting Soil	sand 85-88% soil fines 8 - 12% ( $\leq$ 2% clay) organics 3 - 5%	n/a	USDA soil types loamy sand or sandy loam
Mulch	shredded hardwood mulch preferred	n/a	aged 6 months, minimum
Geotextile	Class "C" apparent opening size (ASTM-D-4751) grab tensile strength (ASTM-D-4632) burst strength (ASTM-D-4833)	n/a	for use over underdrains (extend 1 – 1.5 ft each side) and as necessary on sides of bioretention basin
Sand (2"-4" layer over choker stone)	AASHTO M-6 or ASTM C-33	0.02" to 0.04"	Sand substitutions such as Diabase and Graystone #10 are not acceptable. No calcium carbonated or dolomitic sand substitutions are acceptable. No rock dust can be used for sand.
Choking Stone Layer (4" layer pea gravel)	AASHTO M43 (ASTM D 448) No. 8 or 89 gravel	0.375" to 0.75"	
Underdrain Gravel	RIDOT Specs. Sec. 703 AASHTO M-43	1.0"	Double-washed and clean of fines
Underdrain Piping	RIDOT Specs. Sec 703 ASTM D 1785 or AASHTO M-278	4 to 6" rigid schedule 40 PVC	3/8" perf. @ 6" on center, 4 holes per row; minimum of 3" of gravel over pipes; not necessary underneath pipes
Poured-in-place Concrete (if required)	See RIDOT Specs. Sec. 600; f'c = 3,500 lb. @ 28 days, normal weight, air-entrained; reinforcing bars to meet ASTM 615-60	n/a	on-site testing of poured-in-place concrete required: 28-day strength and slump test; all concrete design (cast-in-place or pre-cast) <i>not using previously approved standards</i> requires design drawings sealed and approved by a RI-licensed structural PE.

**Table F-19 Bioretention Construction Inspection Checklist**

Project:

Location:

Site Status:

Date:

Time:

Inspector:

CONSTRUCTION SEQUENCE	SATISFACTORY/ UNSATISFACTORY	COMMENTS
<b>1. Pre-Construction</b>		
Pre-construction meeting		
Runoff diverted		
Facility area cleared		
If designed as exfilter, soil testing for permeability		
Facility location staked out		
<b>2. Excavation</b>		
Size and location		
Lateral slopes completely level		
If designed as exfilter, ensure that excavation does not compact subsoils.		
Longitudinal slopes within design range		
<b>3. Structural Components</b>		
Stone diaphragm installed correctly		

CONSTRUCTION SEQUENCE	SATISFACTORY/ UNSATISFACTORY	COMMENTS
Outlets installed correctly		
Underdrain		
Pretreatment devices installed		
Soil bed composition and texture		
<b>4. Vegetation</b>		
Complies with planting specs		
Topsoil adequate in composition and placement		
Adequate erosion control measures in place		
<b>5. Final Inspection</b>		
Dimensions		
Proper stone diaphragm		
Proper outlet		
Soil/ filter bed permeability testing		
Effective stand of vegetation and stabilization		
Construction generated sediments removed		
Contributing watershed stabilized before flow is diverted to the practice		

Comments:

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**Actions to be Taken:**

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