SECTION 02015
INSTRUMENTATION

PART 1 – GENERAL

1.01 DESCRIPTION

A. The Work of this Section shall include the furnishing of all materials, labor, equipment, incidentals, and all else necessary for installing, protecting, and modifying instrumentation at the Bogue Brook Reservoir Dam.

B. New instrumentation at the dam shall include installing one (1) new staff gage to be affixed to the angled upstream face of the dam on the right side of the spillway. The sloping staff gage shall be marked with graduations that allow direct measurement of reservoir elevation in feet.

C. Existing instrumentation at the dam shall be protected and/or modified to accommodate construction including spillway concrete work and the change in grade at the downstream toe of dam. The existing instrumentation consists of two upstream piezometers (GZ-7 and GZ-8) and one downstream piezometer (GZ-4) installed in boreholes and shown on the Contract Drawings. Cables for vibrating wire piezometers at GZ-7 and GZ-8 are currently routed up the face of dam within a ¾-inch (0.75") diameter galvanized steel conduit to a protective enclosure at the crest. The piezometers and cables shall be protected during construction. The conduit and box shall be removed and replaced after work is complete at the upstream side of the dam. The piezometer and protective roadbox at GZ-4 shall be raised to accommodate the raise in grade.

D. Special care shall be used to protect all instruments during construction so that they remain functional after the construction is complete. Any instrument damaged or rendered inoperable during construction shall be replaced by the Contractor at no additional cost to the Owner.

1.02 SUBMITTALS

A. Five days prior to purchase, submit Manufacturers Cut Sheets of the staff gages and a description of installation procedures. Submit details for fastening the staff gage to the concrete. Submit distances between the foot-mark graduations so the sloping gage can be read directly in feet of elevation.

PART 2 - PRODUCTS

2.01 STAFF GAGES

A. The Staff Gage shall be custom made for installation on the sloped upstream face of dam and consist of an iron frame coated with backed enamel. Staff sections shall be a minimum of 3½ inches (3.5") wide (unnumbered) and graduated with black marks in feet and tenths of feet. Individual number plates shall be attached adjacent to the un-numbered graduated gauge. Number plates shall be 2-inch by 3-inch enameled plates with black digits. Graduated gages and number plates shall be mechanically attached to the backing structure with stainless steel anchor bolts. Staff gage and figure plates shall be Ben Meadows or Stevens Style "E" or approved equal. The staff gage shall be long enough to extend along the sloping upstream face of the dam from the bottom of the mounting location (approximately elevation 190 feet) to

elevation 207 feet. Installed bottom elevation will vary depending on installation location as directed by the Resident Engineer.

B. All fittings and anchors shall be stainless steel. Anchor adhesives shall be an approved epoxy compound or non-shrink mortar. Other anchor systems such as "Tapcon" concrete screws or equivalent may be acceptable with approval from the Owner.

2.02 EXISTING INSTRUMENTATION PROTECTION/MODIFICATIONS

A. Piezometer GZ-4 shall be extended upward and fitted with a flush-mounted protective road box. If a new road box is required the road box shall be traffic-rated as tested by an official testing laboratory to meet AASHTO Standard for "H-20" Truck Loadings. The top of new road box cover shall be permanently marked with "Monitoring Well", and shall be bolted-down to prevent unauthorized access. The top cover shall be gasketed to minimize entry of surface water. Road box shall be Emco Wheaton Monitoring Well Manhole A0721-106A; 6-inch diameter road box, or approved equal.

B. Piezometers GZ-7 and GZ-8 shall be protected during the course of the work. Cables, conduits and protective enclosure at the upstream face of the dam shall be moved where necessary and reinstalled upon completion of activities affecting the instrumentation, including but not limited to sheet pile and concrete apron installation, concrete demolition, and installation of new reinforced concrete facing.

PART 3 - EXECUTION

3.01 STAFF GAGE INSTALLATION

A. The Contractor shall install one staff gage on the sloped upstream concrete face of dam on the right side of the spillway as directed by the Resident Engineer. The location will be selected so as to facilitate visual readings from the right abutment.

B. The Contractor shall clean and prepare the surface of the concrete as needed, prior to attaching the staff gage and numbers. The staff gage and numbers shall be mechanically attached flush against the wall using anchor bolts.

C. Please note the staff gage shall be custom made specifically for the sloped face of the Bogue Brook Reservoir Dam. The contractor shall confirm the slope of the face prior to fabrication of the staff gage. Markings on the staff gage shall account for the slope so that accurate vertical water elevation readings may be taken.

D. The bottom of the staff gage shall be at approximate elevation 190 to 195 feet at a location selected by the Resident Engineer. The top will be set at elevation 207 feet.

E. The staff gage shall be labeled with elevations at one-foot (1') vertical increments (please note marking locations shall be adjusted to compensate for installation on the sloped dam face) showing the actual elevations as per the NAVD88 datum. The staff gage vertical foot-markers shall be set at even vertical foot elevations.

3.02 EXISTING INSTRUMENTATION MODIFICATION

A. The Contractor shall identify all locations of existing instrumentation using the Contract Plans as a guide.

B. The Contractor shall remove those portions of the instrumentation which will interfere with the Work. The Contractor shall protect the remaining portions of the instrumentation, such that they are not damaged, and prevent soil or other deleterious material from entering the instruments.

C. Risers for existing instrumentation within road boxes shall be extended to four inches (4") below the proposed grade. Risers for existing instrumentation within protective casings shall be extended to two inches (2") below the top of the protective casing. Instrument risers shall be extended using materials identical to that in-place, with watertight joints. The annulus around the new casing shall be backfilled with non-shrink grout and be brought to within three inches (3") of the top of the instrument casing.

D. If the existing road box for GZ-4 is unable to be salvaged, a new road box shall be installed. The road box shall be flush with the proposed/finish grade.

E. A concrete pad with a minimum thickness of 6 inches shall be constructed around each instrument road box. The pad shall extend laterally a minimum of twelve inches (12") from the outside of the road box. The pad shall be constructed to be free of cracks, or other defects likely to affect water-tightness. The top of the concrete pad shall be level with finish grade at the instrument location.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT FOR PAYMENT

A. No measurement shall be made for Instrumentation. The bid item for Instrumentation is a lump sum quantity.

4.02 PAYMENT

A. Payment for the scope of the work specified herein, including all labor, materials, equipment and incidentals, and mobilization/demobilization costs to protect existing instrumentation and install new instrumentation will be paid for based on the Lump Sum price stated for Item No. 02015.01 on the Form for Bid.

Item No.	Payment Item	Unit
02015.01	Instrumentation	Lump Sum

*** * * END OF SECTION * * ***

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SECTION 02065
DEMOLITION, REMOVAL, AND DISPOSAL

PART 1 – GENERAL

1.01 DESCRIPTION

A. This Section describes the general parameters and requirements for dismantling, relocation, demolition, removal, off-site stockpiling and lawful off-site disposal of certain existing materials and structures at the Bogue Brook Reservoir Dam site.

B. The work of this section shall include removal of existing material which may be re-used as part of the final project configuration.

C. The Contractor shall obtain all necessary permits, including local, state, and federal permits, coordinate all required inspections with appropriate agencies, and conduct all work in accordance with all local, state, and federal rules, regulations, and guidance.

D. If necessary, excavation support systems required for the work of this Section shall be in accordance with the requirements of Section 02200.

1.02 SCOPE OF WORK

A. The scope of the work of this Section shall include the demolition, removal, and disposal of portions of the existing low-level outlet pipe and valves as shown on the Contract Drawings and enlargement of the existing low-level outlet pipe opening through the existing concrete dam facing to accept the new low-level outlet pipe.

B. The scope of the Work of this Section shall also include the chipping, sawcutting and removal of deteriorated concrete on the upstream sloped face and crest of the Bogue Brook Reservoir Dam. Surface preparation of the existing upstream concrete dam face will also need to be executed so that installation of new structural concrete facing at the upstream face and top of dam can be accomplished.

C. Useable valves, and any other materials specifically requested to be salvaged by the Owner shall be relocated by the Contractor to a facility within 25 miles of the Site, as requested by the Owner and at no additional cost to the Owner. All other material becomes property of the Contractor and must be lawfully disposed of off-site.

D. The removal and disposal of all miscellaneous materials and debris at the job site, including timber, trash, wood chips, mulch, and other materials shall be considered incidental to other Sections of the Work.

E. The work of this section must be coordinated with other work, including bypass of surface water flow.

1.03 EXISTING CONDITIONS

A. The dam consists of a partially reinforced concrete buttress (i.e. Ambursen) dam with earthen embankments at both abutment areas. The concrete central portion of the dam is

approximately 241 feet long with a maximum height of approximately 21 feet and a top width of 4 feet. The earthen embankments have a combined length of approximately 103 feet, with a maximum height of approximately 5 feet.

B. The primary spillway is an approximately 29 feet wide overflow weir within the main concrete portion of the dam, at the maximum section. The spillway is a broad-crested uncontrolled concrete weir set at approximate elevation 203.7 NAVD88. The normal pool elevation of the Bogue Brook Reservoir is approximately 203.7 feet. The spillway discharges to an earthen channel with a small stone berm downstream of the dam.

C. The outlet works are comprised of an existing non-functional 16-inch cast iron blow off pipe and valve under the spillway ; an existing 16-inch low-level outlet pipe through the concrete dam left of the spillway. A 10-inch diameter blow off pipe branches from the 16-inch low-level outlet pipe downstream of the dam. The low-level outlet is connected by a gate valve to a 12-inch conduit which conveys water to Beckwith Reservoir. All gate and other valves for both non-functioning and functional outlets are under full hydrostatic reservoir head.

D. The Contractor's attention is brought to the fact that the work of this Contract is located adjacent to, and in areas of Bogue Brook Reservoir Dam. As such, water control, sedimentation protection, and dewatering activities must be coordinated with demolition activities in order to protect the adjacent water bodies and wetland resource areas.

1.04 SALVAGE

A. Debris resulting from demolition activities shall be segregated and recycled to the greatest extent possible. Salvage value accrues to the Contractor, except in cases where material is specifically reserved by the Owner. Material that the Owner does not request shall become the property of the Contractor.

B. Material salvaged for the Owner by the Contractor shall be handled with care so as to not damage the material, to the extent possible. Material salvaged for the Owner shall be transported and placed in a storage location on-site, or to a facility located within 25 miles of the site, or as designated by the Resident Engineer, at no additional cost to the City. Materials that might be designated for salvaging by the City or for use at other locations in this project includes, but is not limited to, existing valves and pipe.

1.05 PROJECT CONDITIONS

A. Explosives: Blasting and use of explosives is not permitted.

B. Burning: Burning on site is not permitted.

C. Protection: The Contractor shall prevent injury to persons and damage to abutting property. The Contractor shall further provide adequate shoring and bracing to prevent uncontrolled collapse and immediately repair damaged property to its condition prior to being damaged.

D. The Contractor shall carefully examine all of the Contract Documents for requirements that affect the work of this Section. Certain construction, systems, or equipment identified in

the Contract Documents or by the Resident Engineer in the field shall remain in-place for future service and shall be protected.

E. The Contractor shall immediately repair, to the satisfaction of the Resident Engineer, any damage directly and indirectly caused by the Contractor's operations at no cost to the Owner.

F. The Contractor shall remove and legally dispose of all clearing debris, demolition debris, and solid waste from the Site. No on-site disposal of stumps shall be allowed. On-site recycling or reuse of demolition debris, including brick, concrete, and asphalt, is not allowed, except where specifically authorized by the Specifications or by the Resident Engineer.

1.06 RELATED WORK SPECIFIED ELSEWHERE

A. The following is a list of related work items that shall be performed or furnished under other Sections of these Specifications as indicated.

1. Regulatory Requirements – Section 01060
2. Temporary Dewatering and Water Control - Section 01565
3. Temporary Cofferdam - Section 02170
4. Earthwork - Section 02200
5. Ductile Iron Pipe and Fittings – Section 02660
6. Valves and Appurtenances – Section 02665
7. Cast-In-Place Concrete – Section 03300

1.07 SUBMITTALS

A. At least two weeks prior to performing any demolition work, the Contractor shall submit a plan detailing procedures, equipment, sequences of operations, and schedule to perform the demolition activities called for in this Work Item. The Work Plan shall include the name, contact information, and qualifications of any subcontractors assisting with or conducting the demolition. The submission shall also include procedures for supporting of excavation sidewalls, if necessary the plan shall also include the name, location, and owner of the off-site disposal facility accepting the demolition debris.

PART 2 - PRODUCTS

This Section Not Used.

PART 3 - EXECUTION

A. The Contractor shall determine means and methods for all dismantling and demolition tasks specified as part of the Work, subject to the restrictions contained in this specification and subject to approval by the Resident Engineer.

B. Erect, and maintain temporary barriers and security devices including warning signs and lights, and similar measures, for protection of the public, Owner, Contractor's employees and existing improvements to remain.

C. Protect the remaining portions of the dam as well as adjacent landscaping and utilities that are not to be demolished.

D. Take all steps necessary to prevent movement or settlement of adjacent portions of the dam and other existing structures and utilities.

E. The Contractor shall coordinate the work with the installation of the temporary cofferdam and water controls. Uncontrolled release of the Reservoir through the outlets during the demolition shall not be permitted.

F. The Contractor shall coordinate with the Owner regarding the transport and stacking of the salvaged material to remain the property of the Owner. The Resident Engineer will provide the Contractor with the address of the facility where salvaged material shall be delivered.

PART 4 - MEASUREMENT AND PAYMENT

No measurement shall be made of any work performed under this section. No separate payment shall be made for any work performed under this section. The cost of any work done or facilities provided under this section is incidental to the work and shall be included under other bid items within the Contract.

*** * * END OF SECTION * * ***

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SECTION 02110
CLEARING, GRUBBING, AND STRIPPING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall furnish all labor, material, tools and equipment and perform all operations necessary to cut and clear trees, remove surficial debris, grub primary roots, stumps and surficial stones, clear the site, and strip topsoil prior to excavation work.

B. The Work shall consist of clearing, grubbing, stripping, removal and lawful off-site disposal of all vegetation, roots, stumps, surficial debris and unsuitable spoil from proposed areas of construction within the limits of Work as shown on the Contract Drawings.

C. The Contractor shall conduct work in a manner that preserves and protects all vegetation to remain and objects designated by the Resident Engineer.

D. Clearing, Grubbing, and Stripping shall be performed at portions of the dam embankments and within other areas of excavation downstream of the dam to complete the work as shown on the drawings. Additional clearing, grubbing and stripping shall be required at the staging areas.

E. The Owner may pre-mark certain trees within the project area which are NOT to be cut or otherwise disturbed. The Contractor shall survey and mark out limits of tree clearing for the Owner and coordinate with the Resident Engineer regarding this effort and then shall protect the marked trees from harm.

1.02 SCOPE

The general scope of all clearing, grubbing, and stripping shall be to execute all work necessary to prepare all areas on the site for further earthwork (excavation or filling), demolition, or other construction. The Contractor shall clear, grub, and strip all areas where construction shall take place as shown on the Contract Plans, as well as any other areas necessary for the work of the Contract (with approval from the Resident Engineer). Contractor shall perform ALL necessary clearing, grubbing, and stripping at all locations on the site, irrespective of the basic descriptions provided below:

Clearing and Grubbing shall encompass all Work necessary to remove all trees, vegetation, stumps, and roots from the dam embankment, upstream and downstream embankment slopes, abutment areas, staging areas, and other necessary locations as shown on the Drawings. Trees and vegetation outside the area of disturbance shall NOT be cleared, grubbed, or otherwise disturbed.

Stripping shall encompass all Work necessary to remove organic-containing topsoil from the dam embankment, upstream and downstream embankment slopes, abutment areas, staging areas, and other necessary locations as necessary to accomplish the work and as shown on the Drawings. The typical minimum depth of stripping shall be six inches (6”). This depth may be varied based on the extent of topsoil and root penetration. In particular, extra depth may be necessary on some portions of the embankment. Areas outside the area of disturbance shall NOT be stripped or otherwise disturbed.

Backfill of excavations, including stumping, shall be in accordance with Section 02200.

1.03 REQUIREMENTS

A. All Work shall comply with all codes, rules, regulations, laws, and ordinances of the Town of Montville, Connecticut, the State of Connecticut, and all other authorities having jurisdiction within the Work area.

B. All Work shall commence only after respective sedimentation and erosion control measures are in place to the satisfaction of the Owner and its Resident Engineer in accordance with Section 01560 of these Specifications. The Contractor remains solely responsible for the suitability and adequacy of any of the sedimentation and control materials, methods, and procedures.

C. The Contractor shall not burn trees, brush, stumps, and other ignitable materials.

D. The Contractor shall obtain permission from the Resident Engineer prior to using storage areas within the Site boundaries for collection or stockpiling of surficial debris and/or topsoil. Stockpiles shall only be in areas shown on the Contract Drawings or as approved by the Resident Engineer.

E. Any clearing beyond the boundary limits shall not be permitted without express permission from the Owner. Prior to any clearing, the limits of tree clearing shall be marked out by a Professional Land Surveyor Registered in Connecticut.

F. The Contractor shall make all arrangements necessary for the legal disposal of trees, stumps, surficial debris, unsuitable spoil, and other material collected during Site clearing, grubbing and stripping. Debris materials shall be temporarily stockpiled at an approved on-site location and lawfully disposed of off-site. Timber cleared from the site may be salvaged by the Contractor for any other lawful off-site uses. Topsoil shall be segregated and reused on-site in grassed areas or as final treatment of stockpile and staging/laydown areas, or legally disposed of off-site.

1.04 RELATED SECTIONS

A. Section 01560 – Temporary Erosion and Sedimentation Control

B. Section 02200 – Earthwork

C. Section 02930 – Loaming and Seeding

1.05 SUBMITTALS

At least ten days prior to the work of this Section, submit to the Owner for review and comment a plan showing the boundaries of all areas to be cleared, grubbed, and stripped, and showing the locations of proposed stockpiles. Indicate in the submittal the sediment and erosion control measures which will be implemented on and around the stockpiles. Indicate means and methods of clearing and grubbing and of accessing areas to be cleared and grubbed. Indicate stockpile areas and means of placement which will minimize re-handling. Indicate sequencing, if any. Indicate off-site disposal locations, along with any required permits which the Contractor or disposal facility is required to obtain.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.01 PREPARATION

A. The Contractor shall confirm with the Resident Engineer those areas to be cleared, grubbed, and stripped and the location for the stockpiles for materials.

B. The Contractor shall coordinate with the Owner to identify and protect trees which will NOT be cleared from the site. These trees shall be prominently marked.

C. The Contractor shall locate, identify and protect sensitive areas (especially wetland areas, protected trees, forest areas, and any utilities) from damage during work.

D. The Contractor shall protect bench marks, survey control points, valves, and existing geotechnical instrumentation from damage or displacement.

3.02 CLEARING, GRUBBING, AND STRIPPING

A. The Contractor shall clear, cut, or otherwise remove all trees and vegetation from the indicated areas. Identified trees and trees and vegetation outside the indicated areas shall be protected.

B. The Contractor shall remove surficial debris, vegetation, stumps, roots, and obstructions including topsoil, which will affect excavation and embankment operations on the Site. This shall include grubbing of all stumps and major subsurface root systems where roots exceed a quarter of an inch in diameter.

C. The Contractor shall place all surficial debris and unsuitable material into on-site stockpiles for off-site disposal at an approved disposal location by the Contactor. Transportation and disposal will be performed at the Contractors convenience after approval of the material for disposal and location of disposal.

D. The Contractor shall screen and/or otherwise treat stripped topsoil which is intended for re-use as loam. Topsoil to be reused as loam shall meet all requirements and testing for loam set forth in Section 02930 prior to re-use on-site. Excess soil materials from the clearing and stripping processes may be permanently stockpiled in designated on-site areas with the prior approval of the Owner.

E. No on-site burning is allowed. The Contractor may chip cleared trees and stumps to create wood chip mulch. This material shall be transported off-site for lawful disposal unless directed for on-site reuse by the Resident Engineer. The Owner may have use for some portion of the material and shall be allowed to remove quantities not used on-site by the Contractor. The remaining material shall be lawfully disposed of off-site. This work shall be considered incidental and the cost shall be included in the price bid for this item.

F. No additional payment will be made for moving of stockpiles or re-handling of material. The stockpiles shall be sited, placed, and graded in such a way as to minimize re-handling necessary.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT FOR PAYMENT

No measurement shall be made of this item. The bid item under this section is a lump sum quantity.

4.02 PAYMENT

Payment for the scope of the work specified herein, including all labor, materials, equipment and incidentals and mobilization/demobilization costs to clear, grub, and strip vegetation and soil materials from embankments and other areas necessary to facilitate the work and as shown on the Contract Drawings.

Item No.	Payment Item	Unit
02110.01	Clear, Grub, and Strip	Lump Sum

*** * * END OF SECTION * * ***

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SECTION 02170
TEMPORARY COFFERDAMS

PART 1 – GENERAL

1.01 SCOPE

A. This section includes the installation, maintenance, and removal of temporary cofferdam needed to prevent water intrusion into the work area and allow work to proceed in the dry. The work under this section includes the furnishing of all labor, equipment, supplies, materials, and utilities required for the design, operation, maintenance, supervision, and removal of the temporary cofferdam.

B. The cofferdam shall be constructed upstream of the Bogue Brook Dam with a minimum top elevation as shown on the Contract Drawings to protect the work area from temporary fluctuations of the Reservoir due to variations of inflow to the reservoir. The Contractor shall install the cofferdam following completion of reservoir pumping and drawdown as indicated on the Contract Drawings. The minimum height of the cofferdam is anticipated to be at least 7 feet, dependent on the Contractor's chosen cofferdam alignment and bottom elevations along the alignment. The Contractor shall verify bottom elevations along the chosen alignment. The temporary cofferdam shall remain in-service until all upstream work, including sheet pile cut off, concrete apron, concrete infill between buttresses, concrete demolition and refacing, low-level gate operator and low-level outlet, is complete and accepted by the Engineer and the cofferdam is no longer needed to protect the work area.

C. It is anticipated that the Contractor will install temporary cofferdam supplied by PORTADAM, Inc. of Laurel Springs, N.J. or approved equivalent. It is anticipated that modification to the temporary cofferdam seal will be required after the reservoir is lowered since the reservoir head on the PORTADAM will be less than 1 foot in places. Modification to the PORTADAM may include the use of oversized sand bags, super sacks or other similar items. Alternate types of cofferdams may be proposed by the contractor subject to review and acceptance by the Owner.

D. If commercially available temporary cofferdams such as PORTADAM are not used, the Contractor shall engage a Professional Engineer registered in the State of Connecticut to design the temporary cofferdam, at no additional cost to the Owner. The Contractor's engineer shall design the temporary cofferdam to meet the performance standards contained in this section based on his interpretation of the data presented herein and shown on the Contract Drawings. The Contractor's Engineer shall submit a stamped design package which shall demonstrate that the temporary cofferdam system is capable of meeting the performance specifications stated herein. The Contractor's engineer shall then supervise the installation of the temporary cofferdam and certify its performance.

E. The temporary portable cofferdam systems shall be Contractor (supplier)-designed and shall include furnishing and installing a full system for excluding both surface water and seepage. The systems shall include all necessary supports, membranes, and other required materials.

F. The Work of this Section shall be performed in concert with temporary water control efforts as provided for under Section 01565. Initial and ongoing dewatering within the cofferdam, as well as seepage control measures shall be provided under the Work of temporary water control but shall be specifically designed and implemented to work with the temporary cofferdam system to keep the work area dry and stable. Water control pumping systems shall be sized above those specified to accommodate the expected leakage through and seepage under the cofferdam. The Contractor shall have sole responsibility for water control within the work area.

G. The temporary cofferdam shall be placed so as not to interfere with other components of the work and the existing dam. All work shall be performed in accordance with the plans and specifications and to the satisfaction of the Owner and its Engineer. The final alignment of the temporary cofferdam shall be determined by the Contractor.

H. Bidders are advised that the Owner specifically excludes cofferdams or other systems which would require dumping of soil into the Reservoir (except for specifically approved buttressing and seepage control material inside the cofferdams). The temporary cofferdam shall provide the required protection for the work area while meeting concerns regarding siltation and erosion and minimizing disruption to the aquatic environment.

1.02 RELATED WORK

A. The following is a list of related work items that shall be performed or furnished under other sections of these specifications as indicated:

1. Regulatory Requirements – See Section 01060
2. Sedimentation and Erosion Control – See Section 01560
3. Temporary Dewatering and Water Control – See Section 01565
4. Earthwork – Section 02200
5. Concrete – Section 03300
6. Valves and Appurtenances – Section 02665

1.03 SUBMITTALS

A. Not less than two (2) weeks prior to the scheduled installation of the temporary cofferdams, the Contractor shall submit his proposed method of installing, maintaining and removing the temporary cofferdams, to the Engineer for review. The submittal shall include as a minimum the following items:

1. The Contractor's proposed design, layout, sequence of installation, sealing, maintenance, supervision and removal of temporary cofferdams. Maintenance and supervision requirements during non-working hours (i.e., nights, holidays and weekends) should be addressed.

2. All materials to be used for the work of this Section.

3. The designer's, installer's and supervisor's qualifications. These individuals shall each have documented experience on at least five installations of similar temporary cofferdams under similar conditions in ponds, lakes, or reservoirs.

4. Proposed methods of controlling seepage and maintaining stable subgrade conditions inside the cofferdam under both low and high head conditions.

5. The Contractor's proposed emergency contingency plan for prevention or control of potential flooding of the work area during storm events. The contingency plan should address, but not be limited to: control and protection of the low-level outlet, wind and/or wave conditions under which the temporary cofferdam may be used, leakage/seepage/sand boil control measures and a health and safety plan.

6. Scheduling requirements with regard to reservoir drawdown, erosion and sedimentation control, surface water, groundwater, and seepage control, installation of sheet piles, demolition of upstream concrete facing, demolition of the upstream portion of the existing low-level outlet, and excavation and reconstruction of the low-level outlet.

PART 2 – PRODUCTS

2.01 TEMPORARY COFFERDAM MATERIALS

A. The temporary cofferdam for use in the Reservoir shall be a steel frame and membrane system for the temporary retention of water. The system shall utilize a sloped, tubular, welded steel frame system to support a robust impermeable membrane. The upstream temporary cofferdam shall be the Portadam system provided by PORTADAM, Inc. of Laurel Springs, N.J. or approved equivalent. Alternative systems such as steel sheeting may be proposed by the Contractor.

B. The temporary cofferdam shall traverse the reservoir upstream of the dam area such that the existing dam and work area can be completely dewatered.

C. All temporary cofferdam components shall be clean of contaminants and any other materials that could adversely impact water quality.

D. Structural support members shall be tubular, welded steel in accordance with manufacturer's recommendations.

E. Liner shall be impervious, inert, flexible fabric membrane. The bed sealing apron shall be weighted to provide negative buoyancy.

F. System shall be sized and designed in accordance with the foundation bearing capacities, based on anticipated water depth (hydraulic loading). System shall be able to accommodate reservoir levels coincident with the top of the system.

G. The temporary cofferdam shall be capable of providing protection for a range of water heights that may vary from 0 feet of head to the specified top of cofferdam elevation. Incorporating sand bags, super sacks or other similar approved material with the Portadam system shall be provided to ensure adequate protection for the lower head conditions.

H. The minimum top elevation of the temporary cofferdam shall be as specified.

I. All materials used in the construction of cofferdams shall be clean and free of substances or materials which might lead to contamination of the Reservoir, wetlands, or other water courses, including chemical contaminants, zebra mussels, and millfoil.

J. Any sandbags shall be free of rips or tears which would lead to a loss of sand into the Reservoir, or wetlands, and bag openings shall be tied to prevent the same.

K. Loose soil material will NOT be an acceptable material for the construction of the temporary cofferdam.

L. No temporary cofferdam component shall penetrate into the dam concrete or embankment without the written consent of the Owner's Engineer

PART 3 – EXECUTION

3.01 GENERAL

A. The Contractor shall be responsible for maintaining a safe, clean and accessible work site at all times. The Contractor shall have full responsibility for the complete and proper diversion of water from the work site at all stages of the project. The Contractor shall, at no additional cost to the Owner, repair any damage to any equipment, material or work caused by seepage, flood, overtopping, or other failure of the temporary cofferdam system.

B. The Contractor shall take all reasonable and prudent precautions during construction to provide and maintain the temporary cofferdams and other related equipment. The temporary cofferdams shall be maintained and supervised by the Contractor's personnel qualified to do such work.

C. All OSHA requirements and all applicable State and local environmental requirements shall be satisfied.

D. In the case of overtopping of the cofferdam by waves, settlement or high waters, means shall be provided for controlled flooding of the work area.

E. All pumping and water discharge shall be in accordance with Sections 01060, 01560 and 01565.

F. Temporary cofferdam components which settle, tilt or move laterally shall be righted, reset or enlarged as necessary at no additional expense to the Owner.

G. The Contractor shall take all such precautions necessary to protect the site and the Works of this Contract, either completed or incomplete, from flood waters and flows which would either damage the Work or the site or cause delay of the Work.

H. In the event of the Reservoir water level rising higher than the limits of the cofferdam during the performance of the Work, the Contractor shall undertake measures to protect existing structures and new work.

I. In the event of anticipated flooding, the Contractor shall remove all equipment, erosion-susceptible material items or materials subject to damage from water, and items or

materials that could adversely impact water quality from areas liable to be inundated or otherwise impacted by flooding. The Contractor shall secure the site and make all efforts to protect completed and incomplete work.

3.02 DESIGN REQUIREMENTS

A. The temporary cofferdam shall be designed for all expected site-specific conditions, including, but not limited to: wind, waves, temperature, ice, precipitation, variations in reservoir level, bottom conditions and site bathymetry/topography. The top of the cofferdam should extend to at least the minimum specified elevation.

B. The temporary cofferdam system must be designed to accommodate ice loading of a minimum of 5,000 pounds per linear foot applied at the normal water surface if the cofferdam is expected to be in place during the winter season when ice will be present. Alternatively, the Contractor may submit an alternative active system (with appropriate backup system) to prevent ice formation against the cofferdam (e.g. bubblers).

3.03 REMOVAL

A. The Owner shall be informed at least five (5) days prior to removal or relocation of any portion of the temporary cofferdam system. The work inside the temporary cofferdam must be observed and accepted by the Owner prior to removal.

B. The temporary cofferdam structures shall remain in place for a period of at least two (2) days after re-flooding of the dewatered area to the then current reservoir water surface elevation to allow for containment and settlement of any miscellaneous suspended particles.

C. All parts of the temporary cofferdams shall be removed from the site at the end of the work.

3.04 WATER MANAGEMENT

A. The Contractor shall manage water within the areas encircled by the cofferdams and is responsible for all necessary bypass flows. Management of surface water and groundwater (seepage, etc) is specified under separate Sections of the Contract.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT FOR PAYMENT

A. No measurement shall be made for the temporary cofferdam associated with water control for completion of work of this Contract. Items for this work shall include but not necessarily be limited to construction, maintenance, and removal of the temporary cofferdam. Items associated with the temporary cofferdam shall be a lump sum quantity.

B. Where an alternative cofferdam/de-watering system is proposed by the Contractor, the lump sum bid for the contract shall be deemed to be full compensation for all labor, equipment and material including all engineering design.

4.02 PAYMENT

A. Payment for the scope of work specified herein, including all labor, materials, equipment, and incidentals associated with the temporary cofferdams shall be paid for at the applicable lump sum price stated for item 02170.01 on the Form for Bid.

It should be noted that payment of 60% of the price bid will be made after installation of the temporary cofferdams are complete. The remaining 40% will paid after cofferdam removal is complete.

Item No.	Payment Item	Unit
02170.01	Temporary Cofferdam	Lump Sum

*** * * END OF SECTION * * ***

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SECTION 02200
EARTHWORK

PART I – GENERAL

1.01 GENERAL

A. The work of this section applies to all operations involving earthwork and/or soil and stone/rock materials. This specification generally governs the execution of excavation, slope smoothing/shaping, fill placement, crushed stone and riprap placement, filling of stump holes created by clearing and grubbing operations, and all other earthwork tasks. This specification also generally governs acceptable soil and rock material properties. The provisions of this specification shall apply to all such work and materials unless specifically superseded in another specification.

B. When earthwork is included as a fundamental or incidental part of the work of a pay item, the Contractor shall provide all equipment, materials, labor, and incidentals, and do all work necessary to complete the earthwork shown on the Contract Drawings. The cost of which shall be included with and compensated for under the measurement and payment provisions specified herein.

C. Crushed Stone bedding material and Riprap shall be sized as indicated on the Contract Drawings or as indicated in the Specification. The Contractor shall be responsible for all furnishing, processing, transportation, and placement necessary to achieve stone with quality and gradations meeting the specifications. Where indicated, filter fabric shall be provided and placed under all stone bedding material, as shown on the Contract Drawings or as indicated in the Specification.

D. Placement, intermediate grading and final grading of areas of Riprap placement shall be included in the Work of this Section at no additional cost to the Owner. Such work may involve handling and placement of individual stones to achieve a stable slope to the lines and grades shown on the Plans. The cost of such work shall be incorporated in the prices bid under the appropriate sections.

1.02 SCOPE OF WORK

A. Provide all equipment, materials and labor and do all work necessary to complete the earthwork as shown on the Contract Drawings which includes, but is not necessarily limited to the following:

1. Clearing and removal/grubbing of vegetation to be removed as part of the slope protection work, and separate stockpiling of topsoil, subsoil, and other excavated materials to be reused and/or disposed.
2. Excavation, temporary on-site stockpiling, and disposal of unsuitable and excess materials associated with excavation between buttresses, installation of overtopping protection, riprap erosion protection, and excavation of roots/root balls.
3. Furnishing and installation of geotextile material for use as a separator under crushed stone used at the upstream dam face.
4. Furnishing, stockpiling, placement, and grading of Crushed Stone from off-site sources for use as bedding.

5. Furnishing, stockpiling, placement, grading, and compaction of off-site fill for backfilling root ball voids.
6. Over-excavation of unsuitables to the satisfaction of the Engineer and replacement/compaction with approved backfill materials.
7. Rough and fine grading/smoothing of all subgrades and, compaction of existing materials and fills, backfills, and refills.
8. Dewatering as necessary and in accordance with Section 01565 so that all work as specified herein is conducted in the dry.
9. Protection of existing above and below ground structures, pavements, and utilities to remain.
10. Maintenance of existing access roads and staging areas for the duration of the Contract and reinstatement to their original conditions upon the completion of the work.

1.03 RELATED SECTIONS

A. The following is a list of related work items that shall be performed or furnished under other Sections of these Specifications as indicated:

1. Regulatory Requirements - See section 01060
2. Temporary Water Control – See Section 01565
3. Subsurface, Hydraulic, & Hydrologic Data – See Section 01566
4. Temporary Erosion and Sedimentation Control – See Section 02100
5. Loaming, Seeding and Revegetation – See Section 02930

1.04 FIELD MEASUREMENTS

A. Verify survey benchmarks and intended elevations for the work prior to commencement of the work.

B. Verify final grades for conformance to design plans.

1.05 REFERENCE STANDARDS (current versions of each)

A. ASTM C33 – Standard Specification for Concrete Aggregates.

B. ASTM D6913 Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis [replacing ASTM D422 Standard Test Method for Particle-Size Analysis of Soils (Withdrawn 2016)].

C. ASTM D7928 Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis [replacing ASTM D422 Standard Test Method for Particle-Size Analysis of Soils (Withdrawn 2016)]

D. ASTM D1556 Standard Test Method for Density and Unit Weight of soil in Place by the Sand-Cone Method.

E. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.

F. ASTM D6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

G. OSHA Regulations, 29 CFR Part 1926 – Excavations

1.06 SUBMITTALS

A. Two (2) weeks prior to the commencement of work, submit the proposed sequence of operations, methods, equipment, and means to perform the work specified herein.

B. Two (2) weeks prior to the delivery of any stone material to the site, the Contractor shall submit the name and location of the proposed quarry(s) to be used to supply the stone products. The Contractor shall provide the Owner with information regarding the type and physical characteristics of the stone, as required below. The Contractor shall also provide copies of any certifications or approvals of the quarry's products from other agencies.

C. Two (2) weeks prior to the delivery of any crushed stone, stone, rock, or riprap to the site, the Contractor shall submit a description of the material, the source of the material, a gradation analysis, density/specific gravity test results, and samples of the materials as required by the Engineer.

D. Five (5) working days prior to the delivery of any geotextile filter fabric to the site, the Contractor shall submit manufacturer's specifications and samples of the material.

E. Submit for review, at least five (5) working days prior to use of any fill material, a minimum 10 pound representative sample of each fill material to be used, along with laboratory test results performed on a representative sample for grain size distribution (sieve) and moisture-density (proctor). Test results shall be submitted for all fill to be used, whether imported from off-site or re-used from on-site excavations.

1. The Contractor may elect to perform gradation testing in advance of Proctor tests. If this is done, the Contractor shall allow sufficient time for review of separate gradation and proctor test results prior to use on-site.
2. If, in the opinion of the Engineer, the nature of on- or off-site fill changes during the course of the Work, the Contractor shall resubmit a representative sample of the results of new gradation and protector testing prior to further material usage in the Work. These additional tests shall be at no additional cost to the Owner.

F. At least ten (10) days prior to use, the Contractor shall submit the identity and location of each source of imported off-site fill material. It is hereby noted that the Contractor shall be prepared, if requested by the Owner and/or Engineer, to submit results of environmental testing performed on a representative sample of each proposed material. If requested testing shall be required for each 500 cubic yards (CY) of each type of material from each source of material. Environmental testing shall include, but is not necessarily limited to, the following: Total Petroleum Hydrocarbons (TPH) by ASTM D3328/EPA Method 8100, Volatile Organic Compounds (VOCs) by EPA Method Polynuclear Aromatic Hydrocarbons (PAH) by EPA Method 8270, and metals (RCRA 8) by EPA Methods 6010/7471A. Such testing shall be considered incidental to the earthwork items and performed at no additional cost to the Owner.

Note that the Engineer is more likely to grant partial or full relief regarding environmental testing requirements if proposed materials are from virgin sources. The Engineer will request environmental testing if site history or evidence of potential environmental contaminants is observed.

G. Despite review and comment by the Owner and its Engineer, the Contractor shall remain solely responsible for the adequacy and safety of materials and methods used in construction.

1.07 PERMITS AND CODES

A. All work shall conform to the Contract Drawings and Specifications and shall comply with applicable codes and regulations.

B. The Contractor shall comply with all rules, regulations, laws and ordinances of the State of Connecticut, Town of Montville, and all other local authorities having jurisdiction at the site. All labor, materials, equipment and services necessary to make the work comply with such requirements shall be provided without additional cost.

C. Excavation safety and support in accordance and compliance with all applicable OSHA and other regulations shall be the sole responsibility of the Contract.

D. The Contractor shall be responsible for clearing the site with Call Before You Dig, the Owner, and relevant Town of Montville Departments which may maintain utility structures in and around the site.

1.08 PROJECT CONDITIONS

A. The Contractor shall be responsible for any damage to existing roadways, buildings, utilities, and other structures caused by construction activities and shall repair any damage to the satisfaction of the Owner and at no additional cost to the Owner. As may be necessary, routes used as haul roads shall be returned to their original condition or better as shown on the drawings and specified hereinafter, before final acceptance of the project.

B. The Contractor's attention is called to the fact that the project is a dam site. A higher standard of earthwork construction practices and quality is required for work on and around a dam. Typical construction practices may require modification or adjustment to meet dam construction standards. Additional care is required since the consequences of mishaps could extend beyond the project site were a dam failure to result.

1.09 PROTECTION OF EXISTING PROPERTY

A. The work shall be executed in such a manner as to prevent any damage to the Owner's facilities at the site and adjacent property and any other property and existing improvement, such as but not limited to streets, curbs, paving, service, utility lines, structures, monuments, bench marks, and other public or private property. Protect the work from damage caused by settlement, lateral movements, undermining, washout and other hazards created by earthwork operations.

B. In case of any damage or injury caused in performance of the work, the Contractor shall, at his own expense, make good such damage or injury to the satisfaction of, and without

cost to, the Owner. Existing roads, sidewalks, curbs, pipes, utilities, or other facilities damaged during the project work shall be repaired or replaced to their original condition at the Contractor's expense. The Contractor shall replace, at his own cost, existing bench marks, monuments and other reference points which are disturbed or destroyed.

C. Buried structures, utility lines, etc., including those which project less than eighteen inches (18") above grade, which are subject to damage from construction equipment shall be clearly marked to indicate the hazard. Markers shall indicate limits of danger areas, by means which will be clearly visible to operators of trucks and other construction equipment, and shall be maintained at all times until completion of the project. The Contractor shall ultimately be responsible for the final location, marking, and protection of all existing underground facilities. Locations of underground utilities shown on the Contract Drawings are approximate and may not be complete.

D. In order to determine the exact location of underground utilities, the Contractor may be required to excavate test pits. These test pits are considered incidental to excavation, and the Contractor shall receive no additional compensation.

E. As excavations approach pipes, conduits or other underground structures, stop digging by machinery and continue with hand tools. Such manual excavation shall be considered incidental to normal excavation.

1.10 DRAINAGE

A. Contractor shall provide, at his own expense, adequate drainage facilities to complete all work items in an acceptable manner. Drainage shall be done in a manner so that runoff will not adversely affect construction product, construction procedures, nor cause excessive disturbance of underlying natural ground or exacerbate erosion and sedimentation and shall be performed in accordance with the criteria set forth in the applicable sections of these Specifications.

B. The Contractor shall grade and ditch the staging areas and access roads, as necessary, to direct and control surface runoff in working areas, subject to approval of the Engineer.

C. Water from excavations shall be disposed of in such a manner as will not cause injury to public health, nor the Reservoir and any other surface water body quality, nor to public or private property, nor to existing work, nor to the work completed or in progress, nor to the surface of roads, walks and streets, nor cause any undue interference with the use of the same by the public, except in the designated work areas.

1.11 FROST PROTECTION AND SNOW REMOVAL

A. The Contractor shall, at his own expense, keep the operations under this contract clear and free of accumulations of snow within the limit of work and on access roads as required to carry out the work.

B. The Contractor shall NOT place fill over frozen soils and shall NOT place frozen fill. Frozen soils, including soils that have frozen after placement or were disturbed by freezing, shall be removed to the satisfaction of the Engineer prior to fill placement. No payment shall be made for removal of frozen soil nor for replacement with suitable fill.

1.12 LAYOUT AND GRADES

A. Lay out all lines and grade work at the site in accordance with drawings and specifications. Establish permanent bench marks determined by a Professional Land Surveyor Registered in Connecticut. Maintain all established bounds and bench marks and replace any which are destroyed or disturbed.

B. The word "subgrade" as used herein means the required surface of existing ground, final prepared ground after excavation, or compacted fill, but prior to placement of any expected loam.

1.13 SUBSURFACE DATA

A. Subsurface borings were performed at the site in January 2016. A dive inspection submerged portions of the upstream face was performed in July 2016. Exploration logs and summary of subsurface conditions are provided in the CTDEEP 401 Permit Application, prepared by GZA GeoEnvironmental, Inc. and dated July 2017. The dive survey is available to bidders upon request to the Owner. This information is specifically not part of the Contract Documents, but is available to bidders for informational purposes. Refer to Section 01566 for additional information.

B. Review available logs, records of explorations, groundwater level data, and geotechnical and environmental testing results and other pertinent data for the site. After obtaining Owner's permission, take whatever additional subsurface explorations deemed necessary at no expense to the Owner.

C. The above-referenced data are for general information and are accurate only at the particular locations and times the subsurface explorations were made. It is the Contractor's responsibility to make interpretations and to draw conclusions based on the character of materials to be encountered and the impact on his work, based on his expert knowledge of the area and of earthwork techniques.

D. The exploration locations shown on the Drawings and permit applications showing existing ground elevations, are only for whatever use the Contractor may make of them with no responsibility on the part of the Engineers, Surveyors, the Owner, and/or their Representatives for the accuracy and/or the reliability of the information given.

E. If a potential conflict exists between the Drawings and these technical specifications, the Contractor shall, immediately upon its discovery, request clarification from the Engineer.

F. By submitting a Proposal, the Contractor affirms that they have carefully examined the site and all conditions affecting the work under this Section. No claim for additional costs will be allowed because of lack of full knowledge of existing conditions as indicated in the Contract Documents, or obvious from observation at the site.

PART 2 - PRODUCTS

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.

2.01 FILL MATERIALS

All off-site material brought to the site shall be free of contaminants. The Contractor shall identify the source of the material and provide results of environmental testing performed on a representative sample of the material from each source.

The Owner may request, at no additional cost to the Owner, that the Contractor engage the services of a Licensed Environmental Professional (LEP) to certify that proposed off-site fill is suitable for use under the provisions of Section 22a-449(c)-102(a)(1) of the Regulations of Connecticut State Agencies (RCSA), and all other relevant laws and regulations.

Recycled aggregate product (RAP) containing asphalt shall NOT be used as fill material, nor shall any fill contain concrete or former building materials.

A. On-Site Common Fill Material

Common fill from on-site sources used as backfill of excavations/root ball voids and to regrade work areas as applicable shall consist of material previously excavated by the Contractor from the project site. Excavated material will be examined by the Engineer to judge its suitability for re-use on the project site as backfill material. Excavated material shall be judged suitable if it generally meets the standards for Common Fill, being a non-friable, non-soluble, well graded soil, free of rubbish, ice, snow, tree stumps, roots and organic matter, with no less than fifteen percent (15%) and no more than thirty percent (30%) passing the No. 200 sieve. There shall be no stones greater than 3 inches in size. There shall also be no observable indications of contamination.

The Engineer shall be the sole judge of the suitability of excavated material for use as on-site backfill. Peat or other organics are NOT acceptable for Common Fill. Excavated boulders or bedrock are not acceptable for use of Common Fill. The Contractor may, at his own expense, choose to modify the excavated material (by screening, mixing, etc.) to attempt to make the material more suitable for re-use. Mixing of peat with other material will NOT be permitted to produce Common Fill material. Some additional handling of suitable material (drying, mixing, culling of oversized stones) may be necessary and shall be done at no additional cost to the Owner.

Material judged to be unsuitable or extra material shall be separated from the rest. Material unsuitable for use in the primary work areas may be used elsewhere on site in less critical areas, at the judgment of the Engineer or may be removed from the site by the Contractor.

B. Off-Site Common Fill Material

Off-site material imported for use as Common Fill shall have generally the same characteristics as stated above under On-Site Common Fill Material. Sand-Gravel, and other such material shall not be used as Embankment Fill in the dam embankment locations where capacity to retain water is important. Off-Site Common Fill shall be graded within the following limits:

Sieve Size	Percent Finer by Weight
3-inch	100
No. 10	70 to 95
No. 40	40 to 65
No. 200	15 to 30

It is envisioned that common fill from off-site sources would essentially consist of glacial till material with a moderate level of plasticity.

C. Crushed Stone

Crushed Stone material for use as bedding shall consist of aggregate that is inert material from hard, non-soluble, durable stone and course sand, free from loam, clay, surface coatings, sod, and deleterious or organic materials.

Crushed Stone material shall generally consist of material similar to ¾-inch crushed stone and shall have a gradation meeting the following requirements:

Sieve Size	Percent Finer by Weight
¾ inch	85 to 100
½ inch	15 to 45
No. 8	0 to 5

The thickness of crushed stone bedding below riprap shall be as indicated on the plans, but in no case shall the layer be less than 6 inches in thickness. Crushed Stone bedding material below riprap shall be underlain by geotextile filter fabric if erosion/slope protection is performed in the dry.

D. Filter Stone ("Pea Stone")

Filter stone (pea stone) material used for the proposed toe-drain along the base of the downstream portion of the dam shall consist of aggregate that is inert material from hard, **non-soluble**, durable stone and coarse sand, free from loam, clay, surface coatings, sod, and deleterious or organic materials

Filter Stone material used for the proposed toe-drain along the base of the downstream portion of the dam shall generally consist of material similar to the CONNDOT M.01.01 No. 8 material, or 3/8-inch crushed stone, and shall have a gradation meeting the following requirements:

Sieve Size	Percent Finer by Weight
½ inch	100
⅜ inch	85-100
No. 4	10-30
No. 8	0-10
No. 16	0-5

E. Bank Gravel ("Trap Rock")

Bank gravel material used for the proposed access road along the left portion of the downstream channel shall consist of aggregate that is inert material from hard, **non-soluble**, durable stone and coarse sand, free from loam, clay, surface coatings, sod, and deleterious or organic materials.

Bank gravel material used for the proposed access road along the left portion of the downstream channel shall generally consist of material similar to the CONNDOT M.02.06 Grading "B" material, or 4-inch minus crushed stone, and shall have a gradation meeting the following requirements:

Sieve Size	Percent Finer by Weight
5 inch	100
3½ inch	90 to 100
1½ inch	55 to 95
¼ inch	25 to 60
No. 10	15 to 45
No. 40	5 to 25
No. 100	0 to 10
No. 200	0 to 5

F. Low Permeability Fill

Low permeability fill shall be a well graded material, free of rubbish, ice, snow, tree stumps, roots, organic material, or other deleterious materials. There shall be no stones greater than three inches in diameter. Materials shall have a permeability of no more than $1x10^{-6}$ centimeters per second at 95% of the standard proctor density, as determined by a compacted permeability test (ASTM D5084). Material shall be placed within ±2% of its optimum moisture content.

Gradation of low permeability fill shall adhere to the following:

Sieve Size	Percent Finer by Weight Sand-Gravel
3 inches	100
No. 4	50 to 100
No. 40	40 to 80
No. 200	20 to 50

Soil characteristics shall abide by the following requirements:

Soil Characteristic	Minimum Value	Maximum Value
Plasticity Index	7	20
Uniformity Coefficient (Cu)	12	---
Coefficient of Curvature (Cc)	1	3

G. Select Sand Fill

Select Sand Fill shall be free from ice and snow, roots, silt, clay, loam, shale and other deleterious or organic matter. Select Sand Fill shall conform to the quality requirements of ASTM C 33. Select Sand Fill shall conform to the following gradation requirements:

Sieve Size	Percent Finer by Weight Sand-Gravel
½ inch	100
⅜ inch	85 to 100
No. 4	60 to 100
No. 16	35 to 80
No. 50	10 to 55
No. 100	2 to 10

Select Sand Fill material will be used as a filter material around the toe drain and for filling of sand bags (if used).

H. Stone Riprap ("Intermediate Riprap")

Stone Riprap shall consist of hard, durable, **non-soluble** and sound angular stone which is resistant to weathering. Rounded stones, boulders, elongated, thin or flat pieces whose breadth or thickness is less than one-third its length will not be allowed. The parent rock for rockfill and stone riprap stones shall be igneous or metamorphic rock. **Sedimentary rock types such as shale, sandstone, or similar soft stone, and soluble rock such as limestone or dolomite is not allowed**. The stone shall be free of cracks, overburden, spoil, silt, clay, loam, organics and other deleterious matter.

Riprap stone shall conform to the suitability requirements of the U.S. Army Corps of Engineers Engineering Manual (EM) 1110-2-2302, and shall conform to the following standards:

Unit Weight	Dry unit weight 165 pcf or greater
Absorption	Less than 1 percent
Sulfate Soundness[1]	Less than 5 percent loss
Abrasion[2]	Less than 20 percent loss for 500 revolutions
Freezing-Thawing[3]	Less than 10 percent loss for 12 cycles
Drop Test[4]	No breakage or cracking
Wetting and Drying[5]	Less than 5 percent breakdown after 10 cycles
Solubility[6]	None (no loss of mass)

1. Sulfate Soundness: Stone(s) shall exhibit a less than five percent (5%) loss per the U.S. Army Corps of Engineers standardized method CRD-C 127 for Magnesium Sulfate.

2. Abrasion: Stone(s) shall exhibit a loss of less than 20 percent (20%) for 500 revolutions based on the Los Angeles abrasion test per U.S. Army Corps of Engineers standardized method CRD-C 145.

3. Freezing-Thawing: Stone(s) shall exhibit a loss of less than 10 percent for 12 cycles based on the U.S. Army Corps of Engineers standardized method CRD-C 144

4. Drop Test: The Contractor shall perform a Drop Test on representative samples of the stones to evaluate suitability. The test stone(s) shall be dropped from a bucket or cherry picker, or by other means from a height half the average diameter of the stone or a minimum of 2 feet onto a rigid surface or second stone of comparable size. The stone shall be examined before testing as well as afterward. Stone(s) shall exhibit no breakage or cracking based on the Drop Test. Failure criteria are development of new cracks, opening of existing cracks, and loss of small pieces from the surface of the stone. The Drop Test shall be repeated to the satisfaction of the Engineer.

5. Wetting and Drying: Submerge stone in water for 18 hours, oven dry at 140°F, and cool to complete one cycle.

6. Solubility: Apply 3 M hydrochloric acid (HCl) to the stone to determine if the stone is a carbonate rock (i.e soluble). The stone is considered soluble if a positive reaction (effervescence) is observed. HCl testing shall be performed in accordance witht eh United States Department of Agriculture – Natural Resources Conservation Service standardize method "Assessing Carbonates in the Field with a Dilute Hydrochloric Acid (HCL) Solution", Note 5.

Gradations of riprap material shall be as specified below or, if not stated, then based upon the thickness of the stone riprap layer as shown on the plans. In all cases, no more than five percent (5%) by weight shall pass a 2-inch sieve. No stone dimension shall be greater than three (3) times the length of another.

1. Stone Riprap shall meet the requirements of "Intermediate Riprap", as defined in Section M.12.02.2 of the State of Connecticut Department of Transportation – Standard Specifications for Roads, Bridges, and Incidental Construction (2004)

Intermediate Riprap Gradation

Stone Size (in.)	% of the weight (mass)
18	0
10 to 18	30 to 50
6 to 10	30 to 50
4 to 6	20 to 30
2 to 4	10 to 20
< 2	0 to 10

2.02 GEOTEXTILE FILTER FABRIC

A. Woven geotextile filter fabric shall be composed of high-tenacity monofilament polypropylene yarns, which are woven into a stable network such that the yarns retain their relative position. Filter fabric shall be inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids. Woven filter fabric shall be Mirafi Woven Filter Weave (FW) 700 or approved equivalent.

B. Non-woven geotextile filter fabric shall be composed of interlocking polypropylene fibers formed into a stable network such that the yarns retain their relative position. Filter fabric shall be inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids. Non-woven filter fabric shall be Mirafi 160N or approved equivalent.

2.03 GEOGRID

A. Geogrid, for use as a separator between Crushed Stone bedding and Articulated Concrete Blocks, shall be composed of black high-tenacity polypropylene yarns that are woven together to produce an open mesh geotextile. The geogrid shall be inert to biological degradation and resistant to naturally encountered chemicals, alkalis, and acids. Geogrid shall be Mirafi Miramesh TR, or approved equivalent.

PART 3 – EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Grades both existing and finished, are indicated on the Contract Drawings. The Owner is not responsible for existing grades shown on the Contract Drawings. The Contractor shall check all areas wherein grades are shown to satisfy him/herself as to actual conditions. The Contractor shall be responsible for establishing all control points and marks necessary for the work. Precautions shall be taken to preserve the materials outside the lines of the limit of work in the most undisturbed condition possible. The Contractor shall:

1. Identify and check all required lines, levels, contours, and datum.
2. Notify the Engineer in writing of unanticipated subsurface conditions and discontinue affected work area until notified to resume.
3. Identify and flag known utility and underground structure locations.
4. Maintain and protect existing utilities, pipes, and drainage structures remaining which pass through work area.
5. Protect plant life, grassed areas, and other features remaining as a portion of final landscaping.

6. Do not stock pile materials adjacent to structures which may be damaged by the surcharge forces imposed.
7. Verify fill materials to be reused are acceptable.

B. Prior to any excavation, filling, or grading operations, all topsoil and subsoil, brush, vegetation, etc., or similar organic soils shall be stripped to their full depth in all areas required to be filled, excavated, or graded and stockpiled for subsequent evaluation and reuse.

Stripped materials suitable for re-use as loam shall be stockpiled. Stockpiles shall be kept separate and not mixed with other materials. Excess stripped materials and unacceptable materials shall be legally disposed of off-site by the Contractor unless otherwise specified.

C. Where excavations are to be made in paved or surface treated areas, the pavement shall be cut with a pavement saw or wheel cutter prior to excavation unless otherwise noted.

3.02 PROTECTION OF ADJACENT FACILITIES AND PROPERTIES

A. Protect all adjacent facilities which may be damaged by excavation/filling work. All construction induced damage shall be repaired by the Contractor at no additional expense to the Owner.

B. The work area shall be graded, shaped, and otherwise drained in such a manner as to minimize soil erosion, siltation of drainage channels, pond and stream, damage to existing vegetation and property outside the limits of the work area.

3.03 EXCAVATION

A. Excavation shall consist of the removal of soil, boulders, 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 until such areas have been observed by the Engineer.

B. 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.

C. Excavation shall be to the limits as necessary to install components of the Work unless otherwise specified. Excavation of unsuitable material beyond the limits necessary shall only be performed as authorized by the Engineer.

D. 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.

E. Excavating equipment shall be of such size and type, and operated in a manner that will not damage items such as, but not limited to, existing paved surfaces, utilities, structures and trees.

F. The Contractor shall, at his own expense, be responsible to make excavations under all conditions present at the Work site, (i.e. alongside existing dam infrastructure, near existing below grade utilities, and other objects 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.

3.04 FILL PLACEMENT AND COMPACTION

A. General

1. All subgrades shall be proof rolled prior to placement of fill. Proof roll the subgrade by means of a vibratory drum having a static weight of not less than 5,000 pounds. Proof rolling may be omitted as allowed by the Engineer. Subgrades that are underwater during filling will not require proof rolling. Soft areas shall be excavated and replaced with suitable compacted fill as determined by the Engineer.

2. Particular care shall be taken in compacting material adjacent to existing structures including but not limited to the spillway, training walls, spillway appurtenances and downstream stone wall to be reconstructed. Compaction of subgrades and fill material within one foot of existing structures may require the use of hand tampers, as required by the Engineer.

3. Fill shall not be placed over wet, frozen, or spongy subgrades. In the event these conditions occur, the Contractor shall excavate and remove the unsuitable material prior to placing more fill.

4. The Contractor shall dewater to maintain groundwater levels a minimum of one foot (1') below bottom of excavations and/or subgrades. All fill is to be placed "in-the-dry," except where filling below reservoir level.

5. Place and compact materials in continuous horizontal layers not exceeding twelve inch (12") loose lift thickness.

6. All placed fill shall be compacted to a firm and stable configuration with a minimum compaction of ninety-five percent (95%) of the maximum dry density as determined by ASTM Test D-698 (Standard Proctor Test), and a water content between plus or minus two percent of the optimum moisture content. If wet fill cannot be adequately compacted, remove and replace with drier fill.

7. Fill that is too wet for proper compaction, as determined by testing or the Engineer's judgment, shall be disced, harrowed, or otherwise dried to a proper moisture content for compaction to the required density, specified herein. If the fill material cannot be dried within forty eight (48) hours of placement, it shall be removed and replaced with drier fill at the Contractor's expense.

8. Fill that is too dry for compaction, as determined by testing or the Engineer's judgment, shall receive water uniformly applied over the surface of the loose layer. Sufficient water shall be added to allow compaction to the required density.

9. Compaction of fill material shall be performed to meet the above stated density criteria, but with a minimum six (6) passes of an approved compactor weighing at least 5,000 pounds (static weight) and providing at least 10,000 pounds of dynamic

force. Make additional passes as necessary to achieve the specified degree of compaction.

10. When compacting behind or adjacent to structures or rock, place and compact fill in loose layers not more than eight inches (8") thick. Compact with a vibratory plate compactor or small vibratory drum roller to the minimum specified dry density and to the satisfaction of the Engineer.

11. Fill which becomes disturbed after compaction shall be removed and replaced or re-compacted to the specified degree of compaction at the Contractor's expense.

12. Placement and compaction of soil material on the embankments shall be in a direction parallel to the top of the embankment, where possible.

13. The Contractor shall scarify the surface between all lifts of dam embankment material if it appears, in the sole opinion of the Engineer, that a smooth plane susceptible to preferential seepage may develop between lifts.

14. The Contractor shall strip all organic topsoil from along the length and breadth of all areas which are to have fill material placed on top.

B. Filling of Rootball/Stump Holes

1. Voids from vegetation removal shall be backfilled to within 6 inches of ground surface in a controlled manner with a suitable soil that is generally similar to the existing embankment fill material or Sand and Gravel.

2. Within each void, the stump grinding remnants shall be removed and the subgrade compacted with a walk-behind vibratory compactor prior to placement of fill. Do not place fill over wet, frozen or spongy subgrades. In the event these conditions occur, excavate and remove the unsuitable material prior to placing more fill.

3. Place and compact fill in loose layers not more than eight inches (8") thick. Compact each lift with 4 to 6 passes of a vibratory compactor to a firm and stable configuration. If wet fill cannot be adequately compacted, remove and replace with drier fill; if the fill is too dry to be compacted, moisten prior to placement. Compaction will be assessed via visual observation of the Engineer.

4. Within 6 inches of ground surface, place loam as specified above in Part 2 in preparation for seeding as per the requirements of this Section.

3.05 GENERAL RIPRAP PLACEMENT

A. The prepared soil subgrade in riprap placement areas shall be cleared of all stones greater than 6 inches in diameter, along with any other items that may damage the geotextile (if used). The prepared surface shall be observed and approved by the Engineer prior to installation of the geotextile or placement of the Crushed Stone bedding layer.

B. The geotextile shall be placed on the prepared soil subgrade by unrolling directly from the rolls in a direction approximately parallel to the slope. Folds and wrinkles in the geotextile shall be avoided. Adjacent rolls or sections of geotextile shall be overlapped a minimum of 3

feet, with the geotextile covering ground of higher elevation overlapping that which covers ground of lower elevation. The geotextile shall be fixed in place so that slippage does not occur as work continues. If neither a Crushed Stone bedding layer nor a geotextile is shown below the riprap layer, the Contractor shall place geotextile fabric as if it had been shown on the plans.

C. Storage and handling of geotextile filter fabric shall be as per the manufacturer's recommendations for protection from sunlight, ultraviolet rays, heat, dirt debris, etc. which could affect its properties. Uncovered geotextile shall not be left exposed to sunlight, either on the roll or in place. Torn, punctured or otherwise damaged fabric shall not be used. Mishandled or damaged material shall be removed from the site and replaced at no additional cost to the Owner.

D. Crushed Stone bedding material shall be placed immediately after the placement of the geotextile filter fabric. The Crushed Stone bedding layer shall be placed on the prepared subgrade and compacted in layers not exceeding 6 inches. Compaction shall be to be firm and stable configuration as determined by the Engineer. The Contractor shall grade and shape the final surface to conform to the Drawings and shall provide a uniform and acceptable surface for placement of the riprap.

E. After Crushed Stone bedding layer and/or geotextile placement, the riprap shall be placed on the slope in uniform fashion to the required thickness. Riprap may be dumped from an excavator or loader bucket, but from no greater than two feet above the ground. Riprap shall be dumped directly onto its final location without rolling down the slope. Care shall be taken during placement so as not to damage or disturb the crushed stone bedding layer or underlying geotextile. Do not dump riprap directly from truck onto slope or other riprap placement area.

F. Riprap shall be placed in such a manner as to produce a reasonably well graded distribution of the various stone sizes, with no localized areas of uniform size material. **Each of the largest stones are to touch adjacent large stones**. The smaller size stones shall fill the spaces between the larger stones so as to obtain a minimum practical percent of void space. Dumping from trucks and spreading shall not be allowed. Post-placement manipulation of the riprap shall be performed such that individual stones are in contact with one another, without gaps or spaces between.

G. Riprap shall be compacted and shaped by tamping and manipulation with the bucket of an excavator, or other means acceptable to the Owner and its Engineer.

H. It may be necessary to handle and place individual riprap stones to place the material such that it achieves a stable slope conforming to the lines, grades, and slopes shown on the Contract Plans. The Contractor shall be responsible for all efforts necessary to place the riprap in such a manner which produces a stable slope conforming to the lines, grades, and slopes shown on the Contract Plans. The Contractor shall not place material beyond the limits shown.

I. "Chink" the final riprap surface, manually if necessary, to eliminate any significant gaps in the riprap surface. "Chinking" shall involve the placement and setting of smaller stones in gaps between larger stones so as to provide a more uniform coverage across the riprap surface. No additional payment shall be made for chinking materials or effort.

J. Riprap placed directly on bedrock shall not require a Crushed Stone bedding layer nor a geotextile layer, however, adjacent filter fabric shall be lapped in such a manner so as to prevent loss of sub-grade or movement of soil along bedrock surfaces.

K. Tolerances for placement of stone riprap shall be within plus or minus six inches (±6") of the dimensions shown on the plans.

L. Riprap on Stilling Basin Slab

1. Riprap placed on the stilling basin slab shall have the minimum thickness shown on the drawings.
2. The contractor shall not damage the underlying concrete slab during riprap placement. Riprap shall not be dumped or allowed to fall or roll into place. Riprap shall be placed individually in piece-by-piece fashion and laid carefully by hand or machine claw and thumb.

3.06 MODIFICATION OF UPSTREAM SLOPE

A. The existing upstream embankment of the Bogue Brook Reservoir Dam is an unprotected vegetated slope. Some minor excavation will be required at the upstream slope to smooth/shape the slope such that is suitable to facilitate placement of the new low permeability fill and erosion/slope protection.

3.07 STOCKPILING

A. Stockpile materials on site in such a manner as to maintain segregation of different types of material.

B. The Contractor shall provide, at no additional cost, temporary signage which identifies the type of soil or rock material in each stockpile.

3.08 SPOIL DISPOSAL

A. Disposal of excess or unsuitable soil shall be the responsibility of the Contractor. The Contractor shall be responsible for all handling and transport, including dewatering and hauling to place spoil in disposal area.

B. Spoil material may consist of common excavated material, common excavated material with organics and roots, peat, topsoil, sediment, cobbles, rock, we material, or other material which is unsuitable or has been excavated in excess of that quantity needed for fill at the site.

C. The Contractor shall control the water content of the spoil (i.e. dewatering) such that it is suitable for transport. The Contractor shall not create sanitary problems during the transport of spoil material and shall be responsible for cleaning areas where liquids or solids have leaked.

D. The Contractor shall be responsible to ensure that free liquid is properly transported. "Wet soils" shall not be loaded for transport. The Contractor shall dewater "wet soils," and properly dispose of free liquids in accordance with local, state, and federal regulations. The Contractor

shall dispose of any free liquids that may result during transportation at no additional cost to the Owner and without adverse impacts to nearby water bodies.

E. The Contractor shall adhere to all requirements of permits acquired for the project including those listed under Specification Section 01060.

PART 4 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No measurement will be made for the earthwork activity of this Contract, with the exception of Bank Gravel for Access Road. Earthwork items of the contract shall include excavation, backfilling, compaction, grading and all related earthwork activity, including riprap, as required to execute the requirements of this Section. All other earthwork necessary to performed the work of this Contract shall be considered an incidental part of the work items in this and other specification sections unless specifically specified herein. Earthwork bid items shall be a lump sum quantity.

B. Measurement of furnishing, placement, and compaction of Bank Gravel imported from off-site sources and placed on-site shall be on a basis of the certified weight of the Bank Gravel for Access Road successfully placed, in Tons. Certified weight slips shall be submitted to the Resident Engineer for approval and countersignature and no payment shall be made for quantities not approved by the Resident Engineer.

4.02 PAYMENT

A. Payment for the scope of work associated with all earthwork activity, with the exception of Bank Gravel for Access Road, specified herein shall be paid for at the applicable lump sum price for item 02200.01 stated on the Form for Bid. It shall include all labor, materials, equipment, and incidentals required for stripping, excavation, temporary stockpiling of soil, furnishing, placement, and compaction of necessary fill materials, removal and legal disposal of excess soils.

B. Payment for the scope of work specified herein, including all labor, materials, equipment, and incidentals, including provision, transport, handling, placement, compaction, shaping and testing associated with furnishing and placement of Bank Gravel for Access Road shall be paid for at the applicable unit price for item 02200.02 stated on the form for bid.

Item No.	Payment Item	Unit
02200.01	Earthwork for Dam Repairs	Lump Sum
02200.02	Bank Gravel for Access Road	Ton

*****END OF SECTION*****

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SECTION 02385
ARTICULATED CONCRETE BLOCK

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide all supervision, facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete all operations in connection with the installation of closed-celled articulated concrete block (ACB) wave and overtopping protection in accordance with the lines, grades, design and dimensions shown on the Drawings and as specified herein.

1.02 RELATED SECTIONS

A. Carefully examine all of the Contract Documents for requirements which affect the work in this section. Other specification sections which directly relate to the work of this section include, but are not limited to, the following:

Section 02100 – Sedimentation and Erosion Control
Section 02220 – Earthwork
Section 03300 – Concrete

1.03 REFERENCED STANDARDS

A. References herein to any technical society, organization, group or body are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable:

ASTM: American Society for Testing and Materials
OSHA: Occupational Safety and Health Administration
AASHTO: American Association of State Highway Transportation Officials

1.04 SUBMITTALS

A. The Contractor shall furnish manufacturer's certificates of compliance for cellular concrete blocks/mats, revetment cable, and any revetment cable fittings and connectors to the Owner’s Consultant prior to the start of mat fabrication.

B. The Contractor shall furnish to the Owner’s Consultant all manufacturer's specifications, literature, shop drawings for the fabrication of the mats, and any recommendations, if applicable, that are specifically related to this project, 14 days prior to assembly of the cellular mats.

PART 2 - PRODUCTS

2.01 GENERAL

A. ACBs including blocks, cables, and fittings must conform to ASTM D6684, Standard Specification for Materials and Manufacture of Articulating Concrete Block (ACB) Revetment Systems.

B. All articulated concrete block mats shall be pre-manufactured as an assembly of concrete blocks, with specific hydraulic capacities, bound into mats by the use of revetment cables. Cellular concrete mats may be assembled on-site by hand-placing individual blocks with subsequent insertion of cables.

C. Individual blocks in the articulated mats shall be staggered and interlocked for enhanced stability. The mats shall be constructed of closed cell blocks. Parallel strands of cable shall extend through two (2) ducts in each block in a manner which provides for longitudinal binding of the blocks within the mats. Each row of blocks shall be laterally offset by one-half block width from the adjacent row so that any given block is cabled to four other blocks (two in the row above and two in the row below).

D. The gross area of each individual block in direct contact with the subgrade shall be no less than one square foot. Each block shall incorporate interlocking surfaces that prevent lateral displacement of the blocks within the mats when they are lifted by the longitudinal revetment cables. The interlocking surfaces must not protrude beyond the perimeter of the blocks to such an extent that they reduce the flexibility or articulation capability of the cellular mats or become damaged or broken when the mats are lifted during shipment or placement. Once the mats are in place, the interlocking surfaces shall prevent the lateral displacement of the blocks even if the cables should become damaged or removed. The mats must be able to flex a minimum of 18° between any given row or column of blocks in the uplift direction and a minimum of 45° in the downward direction.

E. The cables inserted into the mats shall form lifting loops at one end of the mat with the corresponding cable ends spliced together to form a lifting loop at the other end of the mat. The cables shall be inserted after sufficient time has been allowed for the concrete to complete the curing process.

F. The articulated concrete mats shall be placed adjacent to the downstream toe of dam, and over and adjacent to the downstream concrete splash pad. Under no circumstances shall the filter fabric be affixed (i.e. chemically bonded to the blocks) to the mattress in a manner in which would jeopardize the functionality of the filter fabric. Specifically, the filter fabric shall be independent of the block system.

2.02 ARTICULATED CONCRETE BLOCKS

A. General

1. This specification covers concrete blocks for erosion control mats .

2. Concrete units covered by this specification are made from normal weight aggregates.

B. Materials

1. Cementitious Materials - Materials shall conform to the following applicable ASTM specifications:

   a. Portland Cements - Specification C 150
   b. Blended Cements - Specification C 595
   c. Hydrated Lime Types - Specification C 207
   d. Pozzolans - Specification C 618, for Fly Ash and Raw or Calcined Natural Pozzolans for use in Portland Cement Concrete.

2. Aggregates shall conform to the following ASTM specifications, except that grading requirements shall not necessarily apply:

   a. Normal Weight - Specification C 33, for Concrete Aggregates.

C. Casting

1. The concrete units may be produced using dry cast methods.

D. Physical Requirements

1. At the time of delivery to the work site, the units shall conform to the physical requirements listed below.

Minimum Compressive Strength Net Area (psi)Minimum psi		Water Absorption Maximum lb/ft^3	
Avg. of 3 units	Individual Unit	Avg. of 3 units	Individual Unit
4,000	3,500	10	12

2. Additionally, the manufacturer shall meet all requirements pertaining to a concrete unit's durability pertaining to a freeze-thaw environment according to ASTM C666/C666M, Test Method for Resistance of Concrete to Rapid Freezing and Thawing or ASTM C1262, Test Method for Evaluating the Freeze-Thaw Durability of Dry-Cast Segmental Retaining Wall Units and Related Concrete Units.

3. Units shall be sampled and tested in accordance with ASTM D 6684-01, Standard Specification for Materials and Manufacture of Articulating Concrete Block (ACB) Revetment Systems.

E. Visual Inspection

1. All units shall be sound and free of defects that would interfere with either the proper placement of the unit or impair the performance of the system.

Surface cracks incidental to the usual methods of manufacture, or surface chipping resulting from customary methods of handling in shipment and delivery, shall not be deemed grounds for rejection.

2. Cracks exceeding 0.25 inches (1/4") in width and/or 1.0 inch (1") in depth shall be deemed grounds for rejection.

3. Chipping resulting in a weight loss exceeding 10% of the average weight of a concrete unit shall be deemed grounds for rejection.

4. Blocks rejected prior to delivery from the point of manufacture shall be replaced at the manufacturer's expense. Blocks rejected at the job site shall be repaired with 4,000 psi structural grout or replaced at the expense of the Contractor.

F. Sampling and Testing

1. The Contractor or their authorized representative shall be accorded proper access to facilities to inspect and sample the units at the place of manufacture from lots ready for delivery.

2. Field installation procedures shall comply with the procedures utilized during the hydraulic testing procedures of the recommended system. All system restraints and ancillary components (such as synthetic drainage mediums) shall be employed as they were during testing. For example, if the hydraulic testing installations utilize a drainage layer then the field installation must utilize a drainage layer; an installation without the drainage layer would not be permitted.

3. The theoretical force-balance equation used for performance extrapolation tends for conservative performance values of thicker concrete units based on actual hydraulic testing of thinner units. When establishing performance values of thinner units based on actual hydraulic testing of thicker units, there is a tendency to overestimate the hydraulic performance values of the thinner units. Therefore, all performance extrapolation must be based on actual hydraulic testing of a thinner unit then relating the values to the thicker units in the same "family" of blocks.

4. Additional testing, other than that provided by the manufacturer, shall be borne by the purchaser.

G. Manufacturer

1. The individual blocks comprising the mat shall have the nominal characteristics, such as the open area, that are presented below.

Class	Type	Lbs	Lbs./Sq.ft.	Length Inches	Width Inches	Height Inches	Open Area %
55L	Closed	138	53	17.4	23.6	6.0	0

2. Articulated concrete blocks shall be ARMORFLEX® Class 55L as manufactured by ARMORTEC, or approved equivalent.

2.03 REVETMENT CABLE AND FITTINGS

A. Revetment cable shall be constructed of preformed galvanized aircraft cable. The cables shall be made from individual wires and strands that have been formed during the manufacture into the shape they have in finished cable.

B. Cable shall consist of a core construction comprised of six (6) or seven (7) wires wrapped within seven (7) or nineteen (19) wire strands. The revetment cable shall have the following physical properties:

Nominal Cable Diam.	Approx. Avg. Strength (Lbs.)	Lbs./100 ft Min.	Max.
⅜"	13,300	23.6	24.3

C. The revetment cable shall exhibit resistance to mild concentrations of acids, alkalis, and solvents. Fittings such as sleeves and stops shall be aluminum, and the washers shall be galvanized steel.

D. Selection of cable and fittings shall be made in a manner that insures a safe design factor for mats being lifted from both ends, thereby forming a catenary. Consideration shall be taken for the bending of the cables around hooks or pins during lifting. Revetment cable splicing fittings shall be selected so that the resultant splice shall provide a minimum of 75% of the minimum rated cable strength.

2.04 GEOTEXTILE FABRIC

A. Geotextile fabric (geogrid and non-woven geotextile filter fabric) shall be as specified in Section 02200. Geogrid shall be compatible with the block manufacturer's recommendations. Geogrid shall be placed directly below the concrete block. Non-woven geotextile filter fabric shall be placed below Crushed Stone base material. shall be Mirafi 700XG woven filter fabric or approved equivalent. Minimum

2.05 CRUSHED STONE BASE BELOW BLOCKS

A. Refer to Section 02220 – Earthwork for Crushed Stone base requirements.

2.06 PRE-ASSEMBLED ARTICULATED CONCRETE BLOCK MATS

A. The cellular concrete blocks, cables and fittings shall be fabricated at the manufacturer or another approved location into mats in accordance with the Contractor's approved submittal.

B. The cellular concrete mats shall have the ability for fabrication in various lengths, widths, and in combinations of length and/or widths. Special mats are a combination of two opposing dimensions either in the longitudinal or transverse

direction of the mats. The special mats are available in various dimensions that allow for a custom fit to a site-specific project.

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

A. Areas upon which the overtopping protection system are to be placed shall be constructed to the lines and grades shown on the Contract Drawings and to the tolerances specified in the Contract Documents.

B. Excavation: Where articulated concrete block is to be placed on soil, remove loam, subsoil, fill and/or natural soils down to inorganic subgrade elevation necessary to install the specified articulated block overtopping protection system. Refer to the Contract Drawings for a cross-section detail depicting requirements in both grassed and paved areas.

C. Grading

1. Subgrades, downstream of the concrete splash pad, shall be graded and proof-compacted to a smooth plane surface. All slope deformities, roots, stones and other deleterious matter which project normal to the subgrade must be re-graded or removed. No holes, "pockmarks", footprints, or other voids greater than 1.0 inch in depth normal to the subgrade shall be permitted. No grooves or depressions greater than 0.5 inches in depth normal to the subgrade with a dimension exceeding 1.0 foot in any direction shall be permitted. Where such areas are evident, they shall be brought to grade by placing compacted homogeneous material. Prior proof-compact subgrade a minimum of 4 passes using a smooth-drum vibratory roller (minimum dynamic force at drum 10,000 pounds) prior to placement of geotextile fabric. Overexcavate, backfill and compact any loose or otherwise unstable areas.

2. Excavation and preparation for anchor trenches, flanking trenches, or aprons shall be done in accordance to the lines, grades and dimensions shown in the Contract Drawings. The anchor trench hinge-point at the top of the slope shall be uniformly graded so that no dips or bumps greater than 0.5 inches over or under the local grade occur. The width of the anchor trench hinge-point shall also be graded uniformly to assure intimate contact between all cellular concrete blocks and the underlying grade at the hinge-point.

3. No fabric, stone or blocks shall be placed thereon until subgrades have been accepted by the Owner’s Engineer.

3.02 PLACEMENT OF GEOTEXTILE FILTER FABRIC

A. Filter Fabric, as specified herein, shall be placed within the limits shown on the Contract Drawings. Filter fabric is not necessary where articulated concrete blocks are placed over the concrete splash pad.

B. The geotextile shall be placed directly on the prepared subgrade, in intimate contact with the subgrade, followed by a 6-inch-thick drainage layer consisting of crushed stone. The geotextile shall be free of folds or wrinkles. The geotextile shall not be walked on or disturbed when the result is a loss of intimate contact between the geotextile and the articulated block or the geotextile and the subgrade. The geotextile filter fabric shall be placed so that the upstream strip of fabric overlaps the downstream strip. The longitudinal and transverse joints shall be overlapped at least two (2) feet. The geotextile shall extend at least one foot beyond the top and bottom revetment termination points. If cellular concrete blocks are assembled and placed as large mattresses, the top lap edge of the geotextile should not occur in the same location as a space between cellular concrete mats unless the space is concrete filled.

3.03 PLACEMENT OF ARTICULATED CONCRETE BLOCKS/MATS

A. Articulated concrete block/mats, as specified in Part 2 of these Specifications, shall be constructed within the specified lines and grades shown on the Contract Drawings.

B. Placement.

The cellular concrete blocks shall be placed in locations specified on the drawings, in such a manner as to produce a smooth plane surface in intimate contact with the concrete unit. No individual block within the plane of placed cellular concrete blocks shall protrude more than one-half inch or as otherwise indicated by the Owner's Engineer. To ensure that the cellular concrete blocks are flush and develop intimate contact with the subgrade, the blocks shall be "seated" with a light roller or other means consistent with the manufacturer's literature.

1. If assembled and placed as large mattresses, the cellular concrete mats shall be attached to a spreader bar or other approved device to aid in the lifting and placing of the mats in their proper position by the use of a crane or other approved equipment. The equipment used should have adequate capacity to place the mats without bumping, dragging, tearing or otherwise damaging the underlying crushed stone or fabric. The mats shall be placed side-by-side and/or end-to-end, so that the mats abut each other. Mat seams or openings between mats greater than two (2) inches shall be filled with 4000 pound per square inch (psi) compressive strength grout. Whether placed by hand or in large mattresses, distinct changes in grade that results in a discontinuous revetment surface in the direction of flow shall require a grout seam at the grade change location so as to produce a continuous surface.

C. Thereafter gaps between concrete blocks shall be backfilled with crushed stone and compacted in a timely manner to assure there are no voids. Backfilling and compaction shall be in accordance with Section 02220.

D. The Contractor shall consult with the manufacturer of the cellular concrete blocks/mats who shall provide construction advice during the initial installation phases of the project as required.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT FOR PAYMENT

No measurement shall be made of this item. The bid item under this section is a lump sum quantity.

4.02 PAYMENT

Payment for the scope of the work specified herein, including all labor, materials, equipment, crushed stone base, geotextile and incidentals and mobilization/demobilization costs to provide the articulated block overtopping protection system associated with the work of this Contract shall be paid for at the applicable Lump Sum price stated on the Form for Bid.

Item No.	Payment Item	Unit
02385.01	Articulated Block for Overtopping Protection	Lump Sum

*****END OF SECTION*****

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SECTION 02458
STEEL SHEET PILE

PART 1 – GENERAL

1.01 SCOPE

A. Under the Work of this Section, the Contractor shall provide all labor, materials, equipment, and supervision necessary to furnish and install permanent, interconnected steel sheet piling for the purpose of creating an upstream seepage cutoff for the Bogue Brook Reservoir Dam. The new sheet pile cut off shall be installed upstream of existing sheet pile and concrete apron.

B. Steel sheet piling shall be used to create a below-grade hydraulic cutoff for the Bogue Brook Reservoir Dam. It is the intent of this specification that upon completion, a sheet pile cutoff consisting of steel sheeting with interlocking, water-tight joints will have been installed to the design elevations. It is intended that the sheeting will serve as an cutoff for the rehabilitated Bogue Brook Reservoir dam to reduce seepage beneath the dam. The steel sheet pile cutoff shall tie into the existing concrete dam with a reinforced concrete apron and low-permeability fill at the left embankment.

C. New steel sheet piling shall be installed at locations as shown on the Drawings. Connections to existing features shall be as indicated on the Drawings, and modified as appropriate to accommodate conditions encountered during construction.

D. Driving of sheet piles shall be completed prior to placement of cast-in-place concrete as specified in Section 03300.

E. Obstructions shall be removed or bypassed to allow sheetpile installation to the specified tip elevations.

1.02 RELATED WORK

A. The following is a list of related work items that shall be performed or furnished under other Sections of these Specifications as indicated:

1. Temporary Erosion and Sediment Control - Section 01560
2. Temporary Water Control – Section 01565
3. Subsurface, Hydraulic, & Hydrologic Data – See Section 01566
4. Temporary Cofferdams – Section 02170
5. Earthwork – Section 02200
6. Cast-in-Place Concrete – Section 03300

1.03 SUBMITTALS

A. At least 30 days prior to the beginning of installation of the sheet piles, the Contractor shall submit the following.

B. Manufacturer’s specifications for the proposed sheet piles, including material data, geometry, interlock size, and configuration and tip protection.

C. Driving plan and schedule for installation of the sheet pile cutoff.

D. Method of installation, including installation appurtenances.

E. Method of extracting piles.

F. Method(s) of bypassing or removing obstructions, including equipment to be used. Include proposed depths at which different obstruction bypass removal methods will be used.

G. Pile Driving Vibratory and Impact Equipment: Include type, make, maximum rated energy, and rated energy per blow of hammer; weight of striking part of hammer; weight of drive cap; details, type and structural properties of hammer cushion and type of leads.

H. Templates and false work to be used for support and layout of piles during driving.

I. Mill certificates for sheet piles.

J. Drivability Study and Wave Equation Analyses (Vibratory and Impact Hammers): Results of Drivability Study and Wave Equation analyses shall demonstrate that the proposed driving systems are capable of obtaining the indicated penetration in conformance with Contract Documents, without damage to the piles due to driving stresses. Energies transferred from the hammer to the pile must be evident in the submitted wave equation analyses. It shall be the Contractor's responsibility to see that reasonable and conservative assumptions be made in the Wave Equation analyses to demonstrate transfer energies for the hammers and respective hammer types. Separate analyses shall be performed for each type of proposed hammer.

1. Analyses shall be performed to the specified deepest tip elevation for the purpose of completing the drivability analysis to demonstrate the suitability of the proposed pile driving systems. The system shall be capable of advancing sheetpile to glacial till or bedrock.
2. Analyses shall demonstrate that the proposed driving systems do not exceed 90 percent of the steel pile yield strength in tension or compression. The analyses shall verify that the sheet section size is adequate. Minimum sheet section modulus is specified below.
3. Analyses shall demonstrate that the proposed driving systems are capable of obtaining the indicated penetration in conformance with Contract Documents. Refusal criteria shall be included in the submittal.
4. A narrative shall be included detailing any assumptions used in performing the analyses and including summary Wave Equation input and results.
5. Vibratory hammer frequency or frequency range, and impact hammer drop to be used during operation shall be clearly stated. Observational methods for verification of hammer frequency and drop shall also be clearly stated.
6. Wave Equation submittals shall be prepared by and bear the stamp of a Professional Engineer registered in the Commonwealth of Massachusetts.

1.04 SUBSURFACE AND UNDERWATER DATA

A. A dive survey of submerged portions of the upstream face was performed in July 2016. Subsurface data is discussed in Sections 02200. The dive survey is available to bidders upon request to the Owner. The subsurface information and underwater survey are subject to the limitations discussed in Section 02200.

1.05 QUALITY CONTROL

A. The Contractor shall inspect all material delivered to the site. Any material damaged shall be rejected and replaced.

1.06 QUALIFICATIONS

A. All piling shall be furnished and installed by a Contractor experienced in the type of piling work specified. The Contractor shall have at least five (5) years of experience and at least 10 successful installations of the same general type and class of piles. The superintendent proposed for the work shall have at least five (5) years of experience in pile driving and shall be experienced in piling operations of this class and nature.

B. The Contractor's engineer shall be registered in the state in which the work is performed and shall have not less than ten (10) years of experience in pile design on similar projects.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Sheet piles shall be new PZ-27 hot rolled steel sheet piles, or approved equivalent, with the following properties:

- ASTM A572 - Grade 50 hot rolled Steel Piles or higher
- Minimum section depth of 12.0 inches
- Minimum wall thickness of 0.375 inches (⅜")
- Minimum elastic section modulus of 30.2 in^3/ft
- Minimum moment of inertia of 184.20 in^4/ft

B. Acceptable suppliers of steel sheet piling shall be Skyline Steel, MAFCO, or approved equivalent.

C. Larger sections shall be used if the need is supported by the Contractor's submitted and reviewed drivability study.

D. Piles shall be provided with steel pile tip protection along the pile web and flanges.

PART 3 – EXECUTION

3.01 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Materials shall be handled and stored in accordance with the Manufacturer's recommendations.

B. Upon delivery of materials to the site, the Contractor shall visually inspect all materials for defects or damage (including breaks, cracks, warping, etc.). If serious defect of damage is detected, the Contractor shall notify the Owner and Engineer immediately. Damaged sheet piles may be rejected at no cost to the Owner.

C. Store and handle materials carefully to prevent physical damage. Materials shall be securely stored in designated staging areas. Store bundled sheet piling on relatively level surface with a slight pitch to allow water to drain. Contractor should not break bundled sheets until ready for immediate installation.

D. If handling hole(s) are used, they shall consist of up to two standard two and nine-sixteenths inch (2.5625") diameter hole(s) located six inches (6") from one end. Holes shall be plated over using same thickness and grade steel as the pile material so as to produce a watertight finished product.

3.02 GENERAL INSTALLATION

A. Sheetpiles shall be driven to refusal at depths between the minimum tip elevation shown on the drawings and refusal, whichever is deeper. Refusal shall be defined by the reviewed and accepted drivability submittal. Minimum tip elevation is defined as the bottom of the original existing sheetpile or the original existing concrete cut-off, whichever is deeper.

B. The Contractor shall schedule the pile installation sequence so that no piling shall be driven within 50 feet of concrete or grout less than 7 days old, unless otherwise accepted by the Engineer.

C. Vibratory hammer and impact hammer shall both be on-site at all times during pile driving operations, or available on short notice such that the Contractor's schedules are not impacted. The Contractor shall provide and maintain in good operating condition all equipment necessary for the proper and efficient handling and installation of piles. The Contractor shall submit to the Owner specifications for the type, size and configuration of the proposed pile driving equipment.

D. Hammers shall at all times be operated at rates and energy outputs recommended by the manufacturer for the driving conditions encountered and as accepted by the Engineer. If the piles cannot be installed to the required tip elevation using a vibratory hammer, the Contractor shall drive piles with an impact hammer as determined by WEAP and accepted by the Engineer. Each hammer shall be operated at all times at the speed and conditions recommended by the manufacturer. Hammer energy used shall be at least 75 percent of the hammer energy indicated in the accepted drivability submittal.

E. The WEAP shall be performed, submitted, and approved prior to driving any piles. The analysis shall take into account, the proposed hammer system including all cushions, pile cap block, pile preparations and length, and anticipated soil properties. The WEAP shall demonstrate that the piles will not be damaged during driving and that the hammer system may adequately drive the piles to the specified tip elevations without overstressing the piles.

F. Driving equipment and methods shall be in accordance with the sheeting manufacturer's recommended methods. No jetting will be permitted.

G. Adequate precautions shall be taken to insure that piles are driven plumb. Sheet piling shall not be driven more than ½ inch (0.5") per foot out of plumb in the plane of the wall, nor more than $^{1}/_{16}$ inch (0.0625") per foot out of plumb perpendicular to the plane of the wall. If, in the sole opinion of the Engineer, piles that are suspected of having been driven out of interlock with adjacent piles or otherwise damaged shall be immediately removed and replaced by new piles at the Contractor's expense. If the Contractor requests to install taper piles to correct out-of-

plumb piles, the Owner's written consent shall be obtained. If permitted, the maximum taper shall be ⅛ inch (0.125") per foot. The Contractor will not be compensated for tapered piles.

H. Piles which are damaged, mislocated, or driven out of vertical alignment as determined by the Owner or Engineer, shall be immediately withdrawn and replaced by new piles at no additional cost to the Owner.

I. Install driving guide, template, or wale system to aid in driving a straight and plumb wall. A "two level" template as well as front and rear wale/bracing system is strongly suggested.

J. Proposed steel sheet piles shall tie into the Bogue Brook Reservoir dam with a reinforced concrete apron and low-permeability fill to create a water-tight barrier. Pilings shall be placed and driven to be interlocked throughout their length with adjacent pilings to form a continuous hydraulic cut-off.

K. To reduce plugging of the socket, the Contractor shall provide a plug such as a steel bolt at the bottom of the exposed female socket on each new sheet. Where possible, drive with ball end leading.

L. It is intended that all piles shall be installed to the minimum elevations (or deeper) as shown on Contract Drawings.

M. If departures from the Contract Drawings and Specifications are deemed necessary, reasons therefore shall be submitted to the Engineer for his review. Accepted departures shall be made at no additional cost to the Owner.

N. The use of vibratory hammers shall be discontinued and impact hammers employed when the penetration rate due to vibratory loading is one foot or less per minute. A protecting cap shall be employed during driving when using impact hammers to prevent damage to the tops of pilings. Pilings damaged during driving or driven out of interlock shall be removed and replaced at the Contractor's expense.

O. Take corrective action, when required, if sheet piles bow or get out of interlock. Pilings found to be bowed or out of interlock shall be removed and replaced at the Contractor's expense.

P. Piles shall be undamaged after driving. If piles are installed out of the specified tolerances, notify the Engineer immediately. No payment will be allowed for additional piles required by improper driving.

Q. Tolerances

a. Vertical: The top of the proposed piles shall be neatly cut-off in the new concrete apron. Tolerance on pile top/cut off elevation shall be ½ inch (0.5").
b. Horizontal: For payment purposes, horizontal deviation from terminal points shown on the drawings is a maximum of six (6) inches. Upon written approval from the Owner, the Contractor may deviate from the alignment shown on the drawings at no additional expense to the Owner.

R. The Contractor shall be responsible for repairing any and all damage to adjacent structures caused during the driving of piles.

S. The Contractor shall visually inspect existing structures for deformation or movement during pre-trenching and pile driving operations. Pre-trenching or pile driving shall be suspended if movement or damage is observed in existing structures. The Contractor shall submit an alternate method for installation of sheet piles which will not cause excessive movements or damage to surrounding structures.

3.03 SPLICES

A. Splices will not be allowed without approval by the owner.

B. Splices (if allowed) shall provide a full penetration butt weld and steel fish plate (splice plate) on at least one side. The fish plate shall be a minimum of six inches (6") in width by fourteen inches (14") long and shall be centered across the splice in the belly of the pile. The fish plate shall be fillet welded to the pile along all sides of the plate. All welds shall be performed and inspected in accordance with American Welding Society (AWS) D1.1 "Structural Welding Code" using E70xx electrodes.

C. Accurate alignment of spliced sections shall be maintained. Prior to splicing, partially drive adjacent sheets to assist with alignment.

D. Exposed male (ball) sides of interlocks shall be welded to close the gap between the two sheets and provide a watertight barrier at the interlock. The weld at the ball side of the interlocks shall not penetrate the interlock or interfere with the function of the interlock.

E. Splices shall be staggered a minimum of 3-feet (3') from nearest splices. Do not provide more than one splice per pile.

3.04 OBSTRUCTIONS

A. The Contractor should anticipate that obstructions may be encountered above the lowest tip elevation during driving. If obstructions are encountered, the Contractor should be prepared to bypass or drive through obstructions by, at a minimum, pre-excavation, partially or completely removing sheets, inspecting tip and interlock damage, redriving, installing drive shoes, altering alignment, replacing sheets damaged by obstructions, and/or driving sheets individually. The Engineer may recommend to leave hanging sheets dependent on the location and elevation of the obstruction and the Contractor's attempts to bypass.

B. All rocks, timbers, debris or other obstructions which interfere with driving of the piles, shall be penetrated, cored or removed by the Contractor, at no additional cost to the Owner. Do not drive piles until mud-line is clear of debris or other material interfering with pile driving. Such debris and obstructions shall be removed. Excavation for the removal of obstructions shall be limited to one pile location at any one time.

C. If an abrupt increase in driving resistance is encountered, the driving shall be stopped. If the pile has not been advanced to the indicated tip elevation at the time that driving is stopped, the Contractor shall notify the Engineer and shall, subject to the acceptance of the Engineer, extract the pile and attempt to clear the obstruction by spudding, probing or some other technique.

D. If the obstruction cannot be cleared by spudding, the Contractor shall core or drill through the obstruction or presplit the obstruction.

E. The Contractor shall, subject to the acceptance of the Engineer, select a method of coring or drilling compatible with material through which the hole is to be made. The hole shall be advanced by drilling and/or chopping inside a temporary steel liner or casing. Pilot holes may be advanced to determine the extent of obstruction, but blasting in either the pilot holes or in the full diameter holes will not be permitted. Coring or drilling shall proceed only to the depth required to penetrate the obstruction as directed by the Owner.

F. All spoil shall be controlled to minimize disturbance to site conditions and hindrances to pile installation procedures and requirements. Spoil and waste material shall be collected and removed from the site by the Contractor.

G. Piles shall be installed to the full depth of the hole immediately after completion of each cored or drilled hole and the void around the pile shall be filled with bentonite pellets. The fill shall extend from the bottom to top of the cored or drilled hole.

H. Details of the coring or drilling equipment and methods shall be submitted to the Engineer for review, at least two weeks prior to beginning the work.

I. Piles abandoned because of obstructions shall be pulled out at the discretion of the Engineer and the hole filled with sand or crushed stone.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT FOR PAYMENT

A. Steel sheet pile will be measured and paid for at the applicable unit rate for installed permanent steel sheetpile measured from the specified cut-off to the driven tip elevation. No measurement or payment will be made for sheetpile not shown on the drawings.

B. Measurement and payment for obstruction removal or bypass will be made by the vertical linear foot of obstruction, as determined by the Owner or Engineer, removed below the minimum tip elevations as defined herein and shown on the Contract Drawings. No measurement or payment will be made for obstruction removal above the minimum tip elevations. Measurement will be made for vertical feet of each pile which encounters an obstruction and for which submitted and reviewed obstruction removal techniques are used by the Contractor in a diligent manner, as determined by the Owner or Engineer.

4.02 PAYMENT

Payment for the scope of the work specified herein, including all labor, materials, equipment, and incidentals and mobilization/demobilization costs associated with the installation of new sheet pile cut off upstream of the Bogue Brook Reservoir Dam, and all other work incidental to this item shall be paid for at the applicable unit prices stated on the Form for Bid.

Item No.	Payment Item	Unit
02458.01	Steel Sheet Pile	Square Feet
02558.02	Obstruction Removal	Vertical Linear Feet

*** * * END OF SECTION * * ***

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SECTION 02660
DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to install, clean, and test ductile-iron pipe and fittings, as indicated on the Contract Drawings and specified herein for repairs and improvements to the low-level outlet and blow-off pipes.

B. Pipe fitting notation used in the Contract Documents is for the Contractor's convenience and does not relieve him/her from installing and jointing different fittings or additional items required to achieve a complete piping system.

C. For joints in buried exterior pipelines, provide mechanical-joint (restrained as indicated).

1.02 ASSOCIATED WORK SPECIFIED ELSEWHERE

A. Items appurtenant to this work are a part of the contract work specified under other sections of these Specifications and are mentioned here for cross-reference purposes.

1. Section 02200 – Earthwork
2. Section 02665 – Valves
3. Section 11282 – Slide Gate and Operator

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A242 -Standard Specification for High-Strength Low-Alloy Steel
2. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
3. ASTM A674 - Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids.
4. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe.
5. ASTM C150 - Standard Specification for Portland Cement.

B. American Water Works Association (AWWA)

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 – Ductile-Iron and Gray-Iron Fittings, 3-in through 48-in (75mm through 1219mm) for Water
4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C150 -Thickness Design of Ductile-Iron Pipe.

6. AWWA C151 -Ductile-Iron Pipe, Centrifugally Cast, for Water.
7. AWWA C115 - Flanged Ductile Iron Pipe With Ductile Iron or Grey Iron Threaded Flanges.
8. AWWA C153 - Ductile-Iron Compact Fittings, 3-in through 24-in and 54-in through 64-in, for Water.
9. AWWA C550 -Protective Interior Coatings for Valves and Hydrants
10. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
11. AWWA C606 - Grooved and Shouldered Joints.
12. AWWA C651 - Disinfecting Water Mains.
13. AWWA M41 -Ductile Iron Pipe and Fittings Manual of Water Supply Practices

C. National Sanitation Foundation (NSF)

1. NSF 61 -Drinking Water System Components Health Effects.

D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 QUALITY ASSURANCE

A. The Owner reserves right to inspect and test by independent service at manufacturer's plant or elsewhere at Owner’s expense.

B. Visually inspect and hammer test before installation.

C. It is a requirement of these Contract Documents to have all of the ductile iron pipe under this section designed and supplied by a single manufacturer rather than have selection and supply of these items by a number of different manufacturers. Similarly, it is a requirement of these Contract Documents to have all of the ductile iron fittings under this section designed and supplied by a single manufacturer rather than have selection and supply of these items by a number of different manufacturers. All connections between the pipe and fittings shall be compatible.

D. Each length of ductile iron pipe supplied for the project shall be hydrostatically tested at the point of manufacture to 500 pounds per square inch (psi) for a duration of 10 seconds per AWWA C15 1. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any leak or rupture of the pipe wall. Certified test results shall be furnished in duplicate to the Owner prior to time of shipment.

E. All ductile-iron pipe and fittings to be installed under this project shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. Furnish in duplicate to the Owner sworn certificates of such tests and their results at least 5 calendar days prior to the shipment of the goods.

F. Inspection of the pipe and fittings may also be made by the Owner after delivery. The pipe is subject to rejection at any time on account of failure to meet any of the Specification requirements even though pipe may have been accepted as satisfactory at the place of

manufacture. Pipe rejected after delivery (including defects from manufacturing) shall immediately be removed from the job at the Contractor's expense.

G. All pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory selected by the Owner at the Owner's expense.

H. A manufacturer's representative shall be made available to the Owner and Resident Engineer during the manufacturing furnishing, transporting, and unloading of the pipe during installation and testing of the pipe to assist in insuring that the pipe is properly fabricated, transported, unloaded, stored in the field, joined, and tested. Manufacturer's responsibilities relate only to the proper care and treatment of the pipe during these procedures and not the techniques or procedures used during installation and testing.

1. The designated factory representative shall be made available at any time the Owner may request. The field or site representative shall be made available a minimum of 10 working days (time on site) during the project when requested by the Owner.
2. The cost for the services of the factory representative, including expenses, shall be considered incidental and at no additional cost to the Owner.

I. The manufacturer shall meet the following criteria and furnish the necessary project information, which demonstrates the required experience:

1. Experience that includes successful fabrication (followed by installation, acceptance and service) to AWWA C151 standards of at least 50,000 lineal feet of the largest specified diameter or larger ductile iron pipe with similar linings/coatings within the past 5 years.
2. Experience shall include the successful fabrication of at least 50-fittings in compliance with AWWA C110 or C153 of the largest specified diameter or larger with similar linings/coatings within the past 5 years.
3. Experience that includes the successful fabrication (followed by installation, acceptance and service) of at least 10,000 lineal feet of the largest specified diameter or larger push-on style, boltless restrained joint for ductile iron pipe within the last 5 years.

J. All pipe and fittings shall be marked in accordance with all applicable AWWA standards. Legibly and permanently mark all pipe, fittings, specials and appurtenances to be consistent with the laying schedule and marking drawings (if required) with the following information:

1. Manufacturer, date.
2. Size, type, class, or wall thickness.
3. AWWA Standard(s) produced to.
4. Each pipe shall be identified with sequential numbering consistent with the laying schedule and marking drawings and each marked pipe shall appear on the marking drawings in the identified location for installation.
5. Special fittings, bends, and appurtenances requiring specific orientation shall be appropriately marked with the words "TOP" in the correct position and in a consistent

location.

1.05 DESCRIPTION OF SYSTEMS

A. Pipe shall be made in the United States. Pipe and fittings shall be as supplied by the U.S. Pipe and Foundry, Griffin Pipe Products, all pipe divisions of the McWane Company or an approved equal who is a member of the Ductile Iron Pipe Research Association (DIPRA). All ductile iron pipe shall be supplied by a single manufacturer and all ductile iron fittings shall be supplied by a single manufacturer. The fittings supplier shall certify in writing that their fittings are compatible with the supplied brand of pipe.

B. Pipe is to be installed in those locations shown on the Drawings, and only where specifically indicated.

C. Contractor is responsible for compatibility between joints of all items they supply.

1.06 SUBMITTALS

A. Submit shop drawings and product data, including piping layouts, design calculations, warranty test reports, in accordance with Section 01300 and the referenced standards.

B. Submit the name of the pipe and fitting suppliers and a list of materials to be furnished.

C. Prior to shipment of pipe, certified copies of mill tests confirming the type of materials used in the pipe, and shop testing of pipe to show compliance with the requirements of the applicable standards, along with a sworn affidavit of compliance that the pipe complies with the referenced standards, shall be submitted.

D. Submit copies of all shop tests, including hydrostatic tests.

E. Submit shop drawings with a tabulated laying schedule for piping 12-inches and larger which references stations and invert elevations as shown on the Drawings as well as all fittings, bends, outlets, restrained joints, tees, special deflection bells, adapters, solid sleeves and specials, along with the manufacturer's drawings and specifications providing complete details of all items. The laying schedule shall show pipe class, class coding, station limits and transition stations for various pipe classes. The above shall be submitted to the Owner for approval before manufacture and shipment. The location of all pipes shall conform to the locations indicated on the Drawings. Full length pipe may be supplied from inventory provided that all specification requirements are met. Shop drawings shall include but not be limited to:

1. Complete and dimensional working drawings of all pipe layouts, including pipe stationing, invert elevation at changes in grade or horizontal alignment, all elements of curves and bends both in horizontal alignment and vertical position.

2. The grade of material; size and wall thickness of the pipe and fittings and appurtenances; type and location of fittings, specials, and valves; and the type and limits of the lining, lining reinforcing and coating systems of the pipe and fittings. Methods and procedures recommended by the coating manufacturer shall be documented.

3. Joint details; methods and locations of supports; and complete information concerning

type, size and location of all welds. Shop welds (no field welding will be allowed) shall be clearly differentiated and welds shall be clearly detailed with preparation procedures for all pipe and parent material comprising each weld. Critical welding procedures shall be identified along with methods for controlling welding stresses and distortions. Locations and proposed joint details shall also be clearly identified.

4. Method of manufacture of pipe; joint details; fittings; and any specials,

5. Dimension and general depth for typical pipe lengths.

6. Detail of joint between pipes for both push-on and restrained joints together with installation instructions.

7. Dimensions and general details for all fittings including joint details for both mechanical and restrained joints.

8 All other pertinent information for all items to be furnished; product data to show compliance of all couplings, supports, fittings, coatings and related items.

9. Prior to furnishing the pipe-laying schedule, test pits shall be dug where the new pipe connects to the existing outlet pipe(s) to ascertain the location, elevation, and cross sectional dimensions of the present lines. This information shall be forwarded to the pipe manufacturer for incorporation into the pipe-laying schedule.

F. Submit anticipated production and delivery schedule.

G. Prior to shipment of pipe, submit a certified affidavit (i.e. certificates) of compliance from the manufacturer stating that the pipe, fittings, gaskets, linings and exterior coatings for this project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified herein. No pipe or fittings may be installed without such certification.

H. Submit handling procedures for all phases from finished fabrication through delivery including storage, transportation, loading, and unloading. This shall include storage at the project site and required protection following installation prior to startup.

1.07 DELIVERY, HANDLING & STORAGE

A. All pipe and appurtenances are subject to examination by the Owner or the Resident Engineer at the point of delivery. Material found to be defective due to manufacture or damage in shipment shall be rejected or recorded on the bill of lading and removed from the job site. The Owner or its Resident Engineer reserves the right to require tests as specified in the applicable AWWA standard to ensure conformance with the standard. In case of failure of the pipe or appurtenance to comply with such specifications, the Contractor shall replace defective materials at no additional cost to the Owner.

B. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe, pipe linings and pipe coatings. See AWWA C600 and the referenced AWWA Standards for Shipping, handling and storage procedures.

C. Pipe shall be transported to the job site on padded bunks or oak timbers and secured with steel banding or nylon tie down straps to adequately protect the pipe and coating. Slings, hooks, or pipe tongs or other devices acceptable to the Owner or Resident Engineer shall be used in pipe handling. No uncushioned ropes, chairs, wedges, cables or levers shall be used in handling finished pipe, fittings or couplings. Under no circumstances shall the pipe or fittings be dropped

or skidded against each other. Care shall be taken to protect pipe coating. Padded wooden pipe cradles, or chocks suitable for the protection of coatings shall be used between finished pipes and beneath them when pipes are placed upon rough surfaces. Pipe shall not be stored on bare ground unless soft sand berms are used to support the pipe and are accepted by the Owner or Resident Engineer.

D. Stored materials shall be kept safe from damage. The interior of all pipe, fittings and other appurtenances shall be kept free from dirt, excessive corrosion or foreign matter at all times.

E. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall to manufacturer's recommendations and/or AWWA C600

F. Gaskets for mechanical and push-on joints to be stored shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

G. Mechanical-joint bolts shall be handled and stored in such a manner that ensures proper use with respect to types and sizes.

PART 2 PRODUCTS

2.01 DUCTILE IRON PIPE

A. Inside of pipe shall have a double cement lining with seal coating that meets or exceeds the requirements of AWWA/ANSI Standard C104/A21.4. Outside of pipe shall have standard bituminous coating.

B. Thickness class, unless otherwise indicated or specified:

1. Minimum Thickness Class 52.

2. Minimum thickness Class 53 for use with flanged pipe. Minimum thickness for use with grooved couplings conforming to AWWA C606 except minimum thickness Class 56 for ductile-iron pipe 18 in. and larger.

C. Restrained joint pipe shall be TR-Flex by U.S. Pipe, Flex-Ring by American Cast Iron Pipe Co. or acceptable equivalent.

D. A Certificate of Compliance indicating conformance with the above specified requirements for ductile iron pipe shall be submitted to the Resident Engineer. Certificates of Compliance shall be submitted prior to shipment of the pipe. Certificate of Compliance shall be notarized by a Notary Public or Justice of the Peace.

2.02 END TREATMENTS/JOINTS

A. Ductile iron pipefitting joints shall be push-on rubber gasket type employing a single elongated grooved rubber gasket or rubber-gasket mechanical joint per AWWA C111 in unrestrained areas. In restrained areas, both pipe and fitting joints shall be push on rubber gasket, locking ring type restrained joints per the manufacturer' standard described in Paragraph E. All gasket

materials shall comply with Table 5-1 of AWWA M-41. Rubber-gasket joints shall conform to AWWA C111. Gasket shall be of styrene butadiene rubber (SBR).

B. Unless otherwise noted, all ductile iron pipe/fitting joints shall be push-on rubber gasket type per AWWA C111 in unrestrained areas.

C. The grooved rubber gaskets and joint lubricant shall be furnished with the pipe. The gasket shall be plainly identified as to the pipe size and packaged in a suitable and satisfactory manner for shipment.

D. All joint accessories shall be furnished with each pipe and shall be plainly identified as to pipe size.

E. Restraint for push on joint pipe shall be positive locking "Locked-type" joints manufactured by the pipe and fitting manufacturer that utilize restraint independent of the joint gasket. All restrained joints shall be suitable for the specified 350 psig test pressure. Joints shall be fabricated of heavy section ductile iron casting. Bolts and nuts shall be low carbon steel conforming to ASTM A193 Grade B7. Restraint for mechanical joint pipe shall use retainer glands for restraining joint, EBAA Iron, Inc. 800 series or approved equal. Restrained push on joints shall be by one of the following or an approved equal:

- "TR Flex" by US Pipe and Foundry Company
- "Snap Lok" by Griffin Pipe Products Company.
- "Superlok"by Clow Water Systems Company

1. The minimum number of restrained joints required for resisting forces at fittings and changes in direction of the pipe shall be determined from the length of restrained pipe on each side of the fittings and changes in direction necessary to develop adequate resisting friction with the soil.

2. Restrained pipe joints that achieve restraint by incorporating cut out sections in the wall of the pipe shall have a minimum wall thickness at the point of the cut out that corresponds with the minimum specified wall thickness for the rest of the pipe.

F. Couplings and Adapters

1. For cast-iron pipe to ductile iron pipe connections, sleeve type couplings shall be Dresser Style 38, 138 or equal. Couplings shall be furnished with black steel bolts and nuts and with pipe stop removed. The couplings shall be provided with plain, Grade 27 rubber gaskets and with black, steel, trackhead bolts and nuts. When buried in the ground, the bolts and nuts shall be stainless steel.

   a. Buried sleeve-type couplings shall have a protective wrapping of “Denso” material by DENSO Inc. of Texas or equal. Where “Denso” material is used, the joint shall be packed up with "Densyl mastic" to give an even contour for wrapping with "Densopol" tape. A 1.5 millimeter (mm) thick coating of “Denso” paste shall be applied following by 100mm or more wide "Densopol" tape wound spirally round the joint with at least 50 percent overlap.

2. All sleeve type couplings 24-inches and smaller shall be restrained using a harness restraint assembly suitable for the pressures required, as manufactured by Star National Products of Ohio or approved equal. All components of the restraint system shall be

for buried service and corrosion resistant. A manufacturer's certification as to the quality of the material (i.e. tiebolts, tienuts, tierods, tiecouplings, tie washers, etc.) shall be furnished for all joint restraint products. Manufacturer shall determine the number of tie rods required.

3. Split Sleeve type flexible couplings shall be Victaulic Depend-O-Lok Style E x E (unrestrained) or F x F (self-restrained) or equal.

4. Grooved flexible joints for ductile iron pipe sizes 36-inch and smaller must be in accordance with AWWA C606 and shall be Victaulic Style 31 or equal.

5. Shouldered flexible joints for ductile iron pipe larger than 36-inches shall be Victaulic Style 44 or equal.

2.03 FITTINGS

A. Pipe fittings shall be ductile iron with pressure rating of 350 psi for 24-inch and smaller piping and 250 psi for 30-inch and larger piping. Fittings shall meet the requirements of AWWA C110 or AWWA C 153 as applicable. Fittings shall have the same pressure rating, as a minimum, of the connecting pipe.

B. All fittings shall have mechanical joints as specified in AWWA C111

C. Bolt holes in the mechanical joint bells of all fittings shall straddle the vertical centerline of the fitting (laying in horizontal position).

D. All joint accessories shall be furnished with each fitting and shall be plainly identified as to size.

E. Compact ductile iron fittings that meet AWWA specification may be used if approved in writing by the District.

PART 3 EXECUTION

3.01 STORAGE OF WATER PIPE AND FITTINGS

A. Prior to storing water pipe and fittings on the job site, the Resident Engineer and the Owner shall be notified at least 24 hours in advance as to when pipe and fittings will arrive. Upon arrival, the Resident Engineer may visually inspect the pipe for class rating and evidence of mishandling.

B. After acceptance of the pipe and fittings, the Contractor shall provide a water tight seal at both ends of the pipe, with a minimum of 4 mil. polyethylene plastic wrap. This shall be accomplished using sheet plastic or bags secured with duct tape.

C. All pipe shall be stacked on 4 inch x 4 inch timbers in tiers with chocks nailed at each end to prevent movement of the pipe. A maximum allowance for height is specified under Part 1 of this Section.

D. Loader forks are allowed for the unloading and stacking of pipe provided it is done with care. If pipe hooks are used in the ends of pipe for unloading purposes, they should be of special

shape and padded so as to fit either the plain or bell end without damaging the pipe lining. Lifting chains shall not be allowed in place of pipe hooks.

E. Transporting of the pipe from the stacked pile to the trench by a loader using forks or approved hooks is acceptable provided it is done with care. The pipe may not be strung along the ditch line until after review of the locations and acceptance by the Resident Engineer.

3.02 BURIED PIPE INSTALLATION

A. All water mains, valves, fittings and appurtenances shall be laid/installed in the dry and shall be installed in accordance with the manufacturer's recommendations. Ductile iron pipe, fittings and appurtenances shall be installed in accordance with the requirements of AWWA Standard C 600, latest edition.

B. Water mains and appurtenances shall be installed in accordance with the horizontal and vertical alignment shown on the Contract Drawings. The Contractor shall investigate and locate connection to existing 12-inch Beckwith conduit and supply appropriate pipe and fittings to connect the new low-level outlet to the Beckwith conduit.

C. Should any deviations in the alignment be necessary due to conflicts with other utilities or other reasons, the changes must first be approved by the Engineer. Any deviations in design must be noted in the record drawings by the Contractor.

D. Water main pipe shall be continuously bedded in bedding material as specified herein. Bedding shall be installed not less than six (6) inches below the bottom of the pipe and up to the spring line (mid point) of the pipe. Bedding shall be tamped or chinked into place after the pipe is set in place.

E. Pipe sections shall be lowered into the trench and set in place in such a manner so as to prevent damage or injury to the pipe. The Contractor shall use slings, straps, or other approved means to adequately support the pipe as it is being lifted and lowered into the trench. Pipe shall not be dropped from trucks onto the ground or into the trench. Any pipe so dropped shall be immediately rejected and removed from the job site by the Contractor.

F. Each length of pipe to be installed shall be examined by the Resident Engineer for cracks, defects or damage in the coating or lining, and any other evidence of unsuitability. The Contractor shall keep the length of open/excavated trench to a minimum. Trenches shall be backfilled to within two (2) pipe lengths of the end of the pipe being laid and backfilled for compaction. Trenches shall be backfilled at the end of the day and shall not be left open overnight.

G. Whenever pipe installation work is not in progress, the end(s) of the pipe being installed shall be satisfactorily plugged to prevent intrusion of soil, stones, water, debris, animals, or other such materials into the pipe. When pipe laying operations resume, the end(s) of the pipe shall be thoroughly cleaned and the temporary plugs removed.

H. Push-on joints shall be made in strict accordance with the manufacturer's instructions and as specified in AWWA Standard C 600, latest edition. A rubber gasket shall be inserted in the groove of the bell end of the pipe and joint surfaces cleaned and lubricated. The plain end of the pipe to be entered shall then be inserted in alignment with the bell of the pipe to which it is to be jointed and pushed home with a jack or by other means. After jointing the pipe, a metal feeler shall be used to make certain that the rubber gasket is located correctly.

I. Mechanical joints at valves, fittings and where designated shall be in accordance with the "Notes on Method of Installation" under ANSI Specification A21.11 and the instructions of the manufacturer. To assemble the joints in the field, the Contractor shall thoroughly clean the joint surfaces and rubber gasket with soapy water before tightening the bolts. Bolts shall be tightened to the specified torques. The use of extension wrenches or pipe over handle of ordinary ratchet wrenches to secure greater leverage shall not be allowed.

J. Joint Deflection. When it is necessary to deflect pipe at the joints from a straight line in either the vertical or horizontal plane, the amount of joint deflection shall not exceed fifty (50) percent of the manufacturer's maximum recommended joint deflection.

3.03 CUTTING OF PIPE

A. The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat workmanlike manner without damage to the pipe or cement lining. Unless otherwise noted, cutting shall leave a smooth end at right angles to the axis of the pipe.

B. Ductile iron pipe shall be cut only by means of abrasive saws, hack saws, wheel type cutters, or milling type cutters. The use of "squeeze" type pipe cutters, cutting torches, diamond points, and dog chisels will not be permitted. This work shall be done by the Contractor in a manner satisfactory to the Engineer and only experienced personnel shall be engaged thereon.

C. Flame cutting of the pipe by means of an oxyacetylene torch shall not be allowed.

3.04 INSTALLATION OF BURIED VALVES & FITTINGS

A. Large valves (i.e. greater than 10 inches) shall be supported with blocking so as to prevent the weight of the valve from being supported by the pipe during installation.

B. Valve boxes shall be installed with a cushion of sand between the valve and the valve box. In wet areas, washed stone shall be placed around the valve box with a layer of straw or a geotextile fabric to prevent fine soil from mixing with stone during initial backfill. Valves and boxes shall be set with the stem vertical and box vertically centered over the operating nut. Valves shall be set on a firm foundation and supported by tamping backfill material under and at the sides of the valve. The valve box shall be supported during backfilling and maintained in vertical alignment with the top flush with finish grade.

C. Retaining glands shall be used on all fittings, bends, caps, plugs and at other locations as indicated by the Engineer or shown on the Drawings.

D. Couplings and fittings shall be installed in accordance with the manufacturer's recommendations.

3.05 CLEANING

A. At the conclusion of the work, thoroughly clean all of the pipe to remove all dirt, stones, pieces of wood, or other material which may have entered during the construction period. All debris shall be removed from the pipeline. The Contractor shall take extreme caution when installing the pipe to prevent debris from entering it. Contractor shall use watertight plugs as specified.

B. If dirt or debris enters a water main during construction, the Contractor shall remove the debris and swab the interior of the pipe with a 5.26 percent chlorine solution. If the Owner determines that debris cannot be adequately removed by manual methods, then the material shall be removed by mechanical means (i.e. hydraulically propelled foam pig) and swabbed with a 5.26 percent chlorine solution. Any mechanical means of removal shall be at no additional cost to the Owner.

C. After the pipe has been cleaned and if the reservoir level is above the pipe or water in the excavation is above the pipe following a heavy rain, the Owner will examine the pipe for leaks. If defective pipes, fittings or joints are discovered at this time, they shall be repaired or replaced by the Contractor at no additional cost to the Owner.

3.06 TESTING

A. All water mains shall be hydrostatically pressure tested for leakage prior to acceptance.

B. All pipelines shall be thoroughly flushed prior to testing to remove all soil, debris and other materials that may have entered the lines during construction. Flushing shall be accomplished by partially opening and closing valves several times under expected line pressure, with flow velocities adequate to flush deposited material(s) out of the pipes and valves. Flushing velocities shall not be less than 3.5 to 4.0 feet per second (FPS).

C. Water mains shall be tested at a pressure equal to 1.5 times the maximum expected working pressure of the line segment being tested. Pressure testing shall be conducted in accordance with Section 4 of AWWA Standard C 600, except as otherwise specified herein.

D. Prior to applying the specified test pressure, all air shall be expelled from the lines. If a suitable means of expelling air at high points does not exist, the Contractor shall install all necessary taps so that air can be purged and the testing completed. Upon completion of the pressure tests, the corporation stops shall either be left in place or removed and plugs inserted as indicated by the Engineer and/or the Owner.

E. The pressure shall be raised to the test pressure required for each section being tested as determined by the Engineer. When the test pressure is reached, the time shall be recorded and the test shall begin. The duration of each pressure test shall be a minimum of two (2) hours. During the test, pressure shall be maintained in the section of pipeline being tested by means of a recirculating by-pass type test pump located at the upstream end of the pipe. Water shall be added in measured amounts from a container of known volume if required to maintain pressure. The addition of excessive amounts of water, as judged by the Engineer, shall constitute immediate test failure. All gauges and test equipment must be accepted by the Engineer.

F. During the test, the line will be examined by the Engineer for visible leaks and breaks. Any defects in the line shall be repaired, and any defective materials shall be removed and replaced by the Contractor at no additional cost to the Owner.

G. Leakage Test. The leakage test shall be performed in conjunction with the pressure test. Leakage and allowable leakage shall be as defined in Section 4 of AWWA Standard C 600, latest edition.

H. Allowable leakage (per AWWA Standard C 600) at various test pressures is shown in Table 1

which follows:

TABLE I
Allowable Leakage per 1,000 ft (305m) of Pipeline* - gph†

Avg. Test Pressure psi (Bar)	Nominal Pipe Diameter - Inches (mm)															
	3 (75)	4 (100)	6 (150)	8 (200)	10 (250)	12 (300)	14 (350)	16 (400)	18 (450)	20 (500)	24 (600)	30 (750)	36 (900)	42 (1050)	48 (1200)	54 (1370)
450 (31)	0.48	0.64	0.95	1.27	1.59	1.91	2.23	2.55	2.87	3.18	3.82	4.78	5.73	6.69	7.64	8.60
400 (28)	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.60	4.50	5.41	6.31	7.21	8.11
350 (24)	0.42	0.56	0.84	1.12	1.40	1.69	1.97	2.25	2.53	2.81	3.37	4.21	5.06	5.90	6.74	7.58
300 (21)	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	3.12	3.90	4.68	5.46	6.24	7.02
275 (19)	0.37	0.50	0.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99	3.73	4.48	5.23	5.98	6.72
250 (17)	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37	2.85	3.56	4.27	4.99	5.70	6.41
225 (16)	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25	2.70	3.38	4.05	4.73	5.41	6.03
200 (14)	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55	3.19	3.82	4.46	5.09	5.73
175 (12)	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98	2.38	2.98	3.58	4.17	4.77	5.36
150 (10)	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.21	2.76	3.31	3.86	4.41	4.97
125 (9)	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	2.01	2.52	3.02	3.53	4.03	4.53
100 (7)	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.80	2.25	2.70	3.15	3.60	4.05

* If the pipeline under test contains sections of various diameters the allowable leakage is the sum of the computed leakage for each size.

† To obtain leakage in liters/hour, multiply the values in the table by 3.7854

I. Results

1. If the section fails to pass the pressure and leakage test, the Contractor shall locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at his own expense and without extension of time for completion of the work. Additional tests and repairs shall be made until the section passes the specified test.

2. If, in the judgment of the Resident Engineer, it is impractical to follow the specified procedures exactly for any reason, modifications in the procedure shall be made as required or accepted; but, in any event, the Contractor shall be responsible for the ultimate tightness of the piping within the above requirements. The tests shall be repeated as often as necessary, and at the Contractor's expense, to assure the Owner and Resident Engineer that all piping and valves are free of defects and that all joints are tight.

3.07 TESTING VALVES

A. All valves shall be pressure tested during the pipeline test. An acceptable test for each gate valve shall be no loss of pressure in the line test pressure as each valve is closed.

B. The Contractor shall make any taps and furnish all necessary caps, plugs, tees, etc., as required to facilitate testing. The Contractor shall also furnish a test pump, gauges and any other equipment required in conjunction with conducting the hydrostatic tests. The Contractor shall at all times protect the water mains from damage and existing water mains from contamination.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT FOR PAYMENT

No measurement shall be made of this item. The bid item under this section is a lump sum quantity.

4.02 PAYMENT

Payment for the scope of the work specified herein, including all labor, materials, equipment, and incidentals associated with the installation of new ductile iron pipe and fittings for the low-level outlet, cleaning, pressure testing, and all other work incidental to this item shall be paid for at the applicable Lump Sum price stated on the Form for Bid.

Item No.	Payment Item	Unit
02660.01	Ductile Iron Pipe and Fittings	LS

*****END OF SECTION*****

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SECTION 02665
VALVES AND APPURTENANCES

PART 1 GENERAL

1.01 SCOPE

A. The work covered by this section shall include the furnishing of all labor, materials, equipment, and incidentals required to install, complete and ready for operation, all valves, valve boxes, and appurtenances as shown on the Contract Drawings and as specified herein.

B. New valves are required as guard gates on the downstream ends of the low-level outlet pipe and for the low-level outlet blow-off.

1.02 REFERENCES

A. The specifications and standards referenced herein, in the editions cited, published by the following organizations, form a part of this section.

B. American Water Works Association (AWWA)

C. American Society for Testing and Materials (ASTM)

1.03 ASSOCIATED WORK SPECIFIED ELSEWHERE

A. Items appurtenant to this work are a part of the contract work specified under other sections of these Specifications and are mentioned here for cross-reference purposes.

1. Section 02200 - Earthwork
2. Section 02660 - Ductile Iron Pipe and Fittings
3. Section 11282 – Slide Gate and Operator

1.04 QUALITY ASSURANCE

A. Valves and accessories shall be new and manufactured in the United States of America

B. Inspect and test at foundry according to applicable standard specifications.

C. The Owner reserves right to inspect and test by independent service at manufacturer's plant or elsewhere at his own expense.

D. Visually inspect and open/close before installation to ensure proper operation.

1.05 SUBMITTALS

A. At least five (5) calendar days prior to the installation of the valves and piping, the Contractor shall submit to the Owner's Engineer the following information:

1. A schematic of the proposed piping system along with manufacturer's catalog data on the valve, including joints, fittings, and pipes to be used.
2. Complete manufacturer's specifications, including material descriptions.
3. Description of manufacturer's standard materials and coating of major components.
4. Recommended spare parts and cost information.
5. List of special tools furnished with the equipment.
6. List of materials and supplies furnished with the equipment.
7. Approximate shipping weight of the equipment and, if shipped unassembled, the number of components and approximate weight of each.

1.06 DELIVERY, STORAGE, HANDLING

A. Prepare valves for shipping as follows:

1. Ensure valves are dry and internally protected against rust and corrosion.
2. Protect valve ends against damage to threads, flange faces, and weld-end preps.

B. Use the following precautions during storage:

1. Do not remove valve end protectors (unless necessary for inspection); then reinstall for storage.
2. Protect valves from weather. Store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement in watertight enclosures.

C. Use a sling to handle valves whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 GENERAL

A. Valves and appurtenances shall conform to the standards of the Owner.

B. Valve sizes shall be the same size as the upstream pipe, unless otherwise indicated.

C. Provide accessories including bolts, nuts, glands, and gaskets.

D. Valves shall have the same end connections as the pipeline in which it is installed. All pipe connections shall be flanged or mechanical.

E. Valves, and appurtenances installed on this project shall be manufactured and installed in compliance with the following specifications. Types and sizes of valves, and appurtenances shall be as designated on the Drawings. All valves shall be of standard manufacture and of highest quality, both as to material and workmanship. All valves shall have the name monogrammed or initialed by the manufacturer thereon and shall be identified by catalog numbers.

F. Valves and appurtenances of the same type shall be from one manufacturer.

G. All valves shall be of ample strength to withstand and operate satisfactorily under the working pressures and shall be designed for normal cold-water use.

H. All valves shown on the Drawings in one view or schematic but missing on other views or schematics are required. All valves with non-rising stems shall have valve position indicators if not buried.

2.02 GATE VALVES

A. Gate valves shall be of the double rotating disc, ductile iron body, parallel seat design. Independent wedging action shall be designed to spread the two discs against the seats in the valve body. Seats in the valve body shall be field replaceable without removing the valve from the pipeline. Discs are to be free to revolve 360 degrees for even distribution of wear on disc face and mating seat rings.

B. The two discs must be interchangeable with each other and field replaceable without removing valve from pipeline. Either disc must be able to seat with line pressure.

C. Wedging surfaces shall be protected by stainless steel shoes for corrosion resistance.

D. Valves to be available with flanged or mechanical joint ends for connection to piping specified.

E. Non-rising stem valves without gears shall have double O-ring stem seals instead of conventional packing. Valve design shall allow replacement of the O-rings with the valve under pressure in the full open position.

F. All valves 16 inches and larger to be equipped with gearing for facilitation of opening. When bypass valve is furnished, it shall be bolted to the bottom or side of the main valve as required.

G. All valves shall be equipped with an operating nut oriented for vertical operation. All operating nuts shall be 2 inches square.

H. Valves shall be rated up to 250 pounds per square inch (psi) cwp. All valves shall be subject to seat test between gate discs as well as shell test for body and bonnet. Shell test to be at twice the rated working pressure for all size valves.

I. All internal and external ferrous surfaces shall be coated with liquid applied epoxy in compliance with NSF-61. Valves to be equal in all respects to the Kennedy Double Disc Parallel Seat ValveSeries.

J. Buried valves or valves used with extension stems shall be inside screw, non-rising stem with mechanical joint ends.

K. Bronze gate rings shall be rolled, peened or pressed into grooves of dovetail or similar shape in the gates. Body-seat rings shall be bronze-threaded and screwed into the body.

L. Stuffing box follower bolts shall be of steel and the nuts shall be of bronze. O-ring stuffing boxes may be used.

M. The design and machining of the valves shall be such as to permit packing the valves without undue leakage while they are wide open and in service.

N. Valves shall be Kennedy Double Disc Parallel Seat Valve or approved equal.

2.03 EXTENSION STEMS

A. Where the depth of the valve is such that its centerline is more than 4 feet below grade, provide operating extension stems to bring the operating nut to a point 6 inches below the surface of the ground and/or box cover. Extension stems shall be steel and shall be complete with 2-inch square operating nut.

B. Construct shafts and coupling of carbon steel, galvanized after fabrication. Provide 2-inch operating nut.

C. Size shafts to safely withstand repeated reversals and stress due to full thrust of operating mechanism. Couple shaft to valve stem with a coupling, with a torque rating equal to, or greater than, torque required to operate the valve.

2.04 VALVE BOXES

A. Provide a valve box of the adjustable type of heavy pattern, constructed of cast iron and provided with a 6 inch cast iron cover for each buried valve.

B. Valve boxes shall be manufactured in North America by Clow Corporation, Tyler/Union Corporation, United States Foundries, or equal.

C. Valve boxes shall be round, 2-piece, sliding type, cast iron. The upper section of each box shall have a flange on top having sufficient bearing area to prevent settling. The bottom of the lower section shall be belled to enclose the operating nut of the valve. The barrel shall be 5½- inch O.D. minimum.

D. Boxes shall be of lengths consistent with pipe depths. Boxes shall be adjustable, with a lap of at least 6 inches when in the most extended position.

E. Slot covers for easy removal.

F. Covers for valve boxes on water mains shall have the word WATER cast in the top.

G. Coat valve boxes with coal-tar pitch enamel or other approved coating.

H. Valve boxes shall be suitable for the size valve on which they are used. The length of the lower section shall be adequate for trench adjustment, no top or mid-section adapters.

I. Provide at least one tee-handled wrench for the valves installed, unless additional wrenches are required due to variations in valve bury depth. Wrenches shall be field measured to accommodate the depth of bury and provide waist high operation.

2.05 ENCASEMENT MATERIAL

A. Encasement material shall be polyethylene film per AWWA C105 with a minimum thickness of 8 mils.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine valve interior through the end ports for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks used to prevent disc movement during shipping and handling.

B. Actuate valve through an open-close and close-open cycle. Examine functionally significant features, such as guides and seats made accessible by such actuation. Following examination, return the valve closure member to the shipping position.

C. Examine threads on both the valve and the mating pipe for form (i.e., out-or-round or local identification) and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

E. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.

F. Replace any defective valves with new valves at no additional cost to the Owner.

3.02 VALVE INSTALLATION

A. Check operation of all valves before installing.

B. It is the Contractor’s responsibility to verify the size of the pipes. If valves are not the correct size the Contractor shall furnish new valves of the correct size at no additional cost to the Owner.

C. Install valves per accepted manufacturer's written instructions and the requirements of AWWA C500. All bolt threads shall be lubricated with graphite and oil prior to installation.

D. Install valves in horizontal piping with stem at or above the center of the pipe. Install valves and actuators to be plumb in the vertical direction.

E. Wrap buried fittings and flanged joints with 2 layers of polyethylene film per AWWA C105. Complete the wrap prior to placing concrete anchors, supports and thrust blocks.

F. Install support blocking in accordance with NFPA 24 and as shown in Contract Drawings.

G. Valve box covers shall be seated flush and encased in a concrete slab shown in the Contract Drawings

3.03 FIELD QUALITY CONTROL

A. After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.04 CLEANING

A. Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or coating.

3.05 FINAL ACCEPTANCE WARRANTY

A. Final acceptance of all equipment furnished under these Specifications will be withheld until after the installation and field testing by the Resident Engineer. The manufacturer and the Contractor shall guarantee the equipment against defects of any kind for a period of one year after final testing and acceptance.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT FOR PAYMENT

No measurement shall be made of this item. The bid item under this section is a lump sum quantity.

4.02 PAYMENT

Payment for the scope of the work specified herein, including all labor, materials, equipment, and incidentals and mobilization/demobilization costs associated with the installation of valves for the low-level outlet and blow-off, and all other work incidental to this item shall be paid for at the applicable Lump Sum price stated on the Form for Bid.

Item No.	Payment Item	Unit
02665.01	Valves	LS

*****END OF SECTION*****

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SECTION 02710
TOE DRAIN SYSTEM

PART 1 – GENERAL

1.01 DESCRIPTION

A. The Contractor shall furnish all labor, materials, and equipment and shall perform all work required to construct the toe drain system at the Bogue Brook Reservoir Dam, as shown on the plans and as specified in this and other sections.

B. The work of this item shall consist of the construction of a toe drain system on the downstream side of the dam, as shown on the Contract Drawings. The toe drain pipes shall discharge through the proposed headwall into the water course downstream of the dam.

C. The purpose of the toe drain systems is to collect subsurface seepage through the dam and foundation and discharge it in a controlled manner. The system shall be constructed in such a manner as to facilitate that goal.

D. The toe areas shall be cleared, grubbed, and stripped prior to the work of this Section. .

E. The work of constructing toe drain system shall include, but not be limited to, the following:

1. Excavation of trench for the toe drain.
3. Provision and installation of perforated PVC toe drain pipe and solid PVC discharge pipe. Backfill and compaction of select sand fill (filter sand) material and filter stone material around the toe drain pipe, and backfill and compaction of soil material around discharge pipes.
4. Installation of toe drain cleanouts at the ends of the toe drain pipes and other locations shown on the plans.
5. All other incidental work necessary to construct the toe drain system as shown on the Contract Drawings.

1.02 RELATED WORK

A. The following is a list of related work items that shall be performed or furnished under other sections of these specifications as indicated:

1. Temporary Erosion and Sedimentation Control - Section 01560.
2. Temporary Water Control – Section 01565
3. Clearing, Grubbing, and Stripping – Section 02110
4. Earthwork – Section 02200
5. Loaming and Seeding- Section 02930
6. Cast-in-Place Reinforced Concrete – Section 03300

1.03 REFERENCE STANDARDS

A. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

B. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

1.04 SUBMITTALS

A. Not less than five (5) calendar days prior to the scheduled start of construction of the toe drain system, the Contractor shall submit shop drawings and material certifications and samples as per the requirements of the individual technical specifications. These shall include, but not be limited to, information on PVC pipe products.

PART 2 – PRODUCTS

2.01 PVC DRAIN PIPE

A. All PVC pipe shall be manufactured from a Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM D1785 and D2665 (where applicable), consistently meeting and/or exceeding the Quality Assurance test requirements of these standards with regard to material, workmanship, burst pressure, flattening, and extrusion quality. The pipe shall be manufactured in the USA, using domestic materials, by an ISO 9001 certified manufacturer. Standard lengths of pipe sizes 6 inches and larger shall be beveled each end by the pipe manufacturer.

B. All PVC joints shall be made in accordance with ASTM D2729.

C. Perforations shall be circular holes free of any cuttings, frayed edges or material that could impede flow. Diameter shall be as shown on the drawings ±1/16-inch (0.0625”). Holes shall be arranged in rows parallel to pipe axis. Perforations shall be spaced evenly along each row such that the center-to-center distance between holes is not less than 8 times the hole diameter. Minimum perforation opening shall be as follows:

Nominal Pipe Size (inches)	Minimum Number of Rows	Minimum Opening Area per Foot of Pipe (in^2)
4	2	0.22
6	4	0.44
8	4	0.44
10	4	0.44
12	6	0.66

Rows shall be spaced uniformly. Rows shall be arranged at equal distance from the bottom on each side of the vertical centerline of the pipe with rows of perforations separated by an arc of 60 to 125 degrees. Perforations shall only be drilled on the bottom half of the pipe.

D. Pipe shall be underdrain type as manufactured by CertainTeed Corporation or approved equal.

2.02 CLEANOUTS

A. Cleanouts shall be constructed with solid Schedule 80 PVC pipe. Schedule 40 PVC Tee connections shall be used to connect the cleanout to the slotted pipe.

B. Covers for the cleanouts shall be manufactured from the same material as the cleanout fittings, and shall be threaded, solid plugs to prevent surface drainage and soil from entering the toe drain system.

PART 3 – EXECUTION

3.01 PREPARATORY WORK

A. Prior to beginning the construction of toe drain system, the downstream areas shall be cleared, grubbed, and stripped. Where present, filling, compaction, and grading of underlying soil shall be performed as specified in Section 02200.

B. Prior to the beginning of construction of the toe drain system, any unsuitable soil material found in the existing subgrade shall be removed and replaced with compacted fill to the satisfaction of the Resident Engineer.

C. Prior to the start of work on toe drains, all water control and erosion and sedimentation control measures must be in place.

3.02 TOE DRAIN CONSTRUCTION

A. Excavate the trench for toe drain collection pipes and discharge pipes to lines and grades shown on the Contract Drawings. All earthwork, including excavation support, shall conform to Section 02200. The maximum length of open trench shall not exceed forty feet (40’). The intent is to limit the effects of the excavation on the stability of the dam.

B. Construct toe drain cleanouts at the locations shown on the Contract Drawings.

C. Place and join the perforated pipe as per manufacturer’s specifications. Backfill and compact in 6-inch maximum thick lifts. Compact each lift with four passes of a vibratory plate compactor.

D. Protect the toe drain system from heavy equipment loads until final grades have been achieved.

PART 4 – MEASUREMENT AND PAYMENT

MEASUREMENT

A. No measurement will be made for the toe-drain construction of this Contract. Toe-drain construction items of the contract shall include excavation, installation, backfilling, compaction, grading and all related toe-drain construction activities, including installation

toe-drain cleanouts, as required to execute the requirements of this Section. All other earthwork necessary to perform the work of this Contract shall be considered an incidental part of the work items in this and other specification sections unless specifically specified herein. Toe-drain construction bid items shall be a lump sum quantity.

3.02 PAYMENT

A. Payment for the scope of work associated with base toe-drain construction activities specified herein shall be paid for at the applicable lump sum price stated on the Form for Bid. It shall include all labor, materials, equipment, and incidentals required for construction of the toe-drain system.

Item No.	Payment Item	Unit
02710.01	Construction of Toe-drain System	Lump Sum

*** * * END OF SECTION * * ***

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SECTION 02760
ABANDONMENT OF SPILLWAY BLOW-OFF PIPE

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall furnish all labor, materials, and equipment and shall perform all work required to cut, partially remove, cap, plug, grout, abandon, and decommission the 16-inch blow-off pipe below the spillway at the Bogue Brook Reservoir Dam.

1.02 EXISTING CONDITIONS

A. The 16-inch blow off outlet is located below the left side of the primary spillway, about 70 feet from the right end of the dam. The pipe material is assumed to be cast iron. The pipe has not been operated recently. The most recent diving survey indicated a series of smaller pipes inside the 16 inch pipe and a blockage, potentially indicating a prior abandonment of the pipe. It shall be the Contractor's responsibility to verify condition, size, and length of the spillway blow-off outlet in the field.

C. The existing spillway blow-off pipe passes through the Dam underneath the spillway. It is critical that no actions be undertaken during the course of this work which jeopardize the integrity of the dam.

D. The spillway blow-off outlet discharges to a riprap and earthen outlet channel at the base of the spillway. The spillway blow-off outlet has a single downstream gate valve located in the valve house underneath the buttressed Ambursen dam spillway.

E. A dive survey of submerged portions of the upstream face was performed in July 2016. Subsurface data is discussed in Section 02200. The dive survey is available to bidders upon request to the Owner. The subsurface information and underwater survey are subject to the limitations discussed in Section 02200.

F. The following description was provided by the divers after the July 18, 2016 dive by Diving Service Incorporated:

In the center of the dam a rectangular box structure 15' wide by 4' high extends upstream 6'. 42" below the top of the box is the crown of a 16" ID iron pipe. The pipe ends with a bell section 9' upstream from the face of the concrete box. When probed there was 3' of sediment over consistent hard refusal thought to be a localized concrete slab.

1.03 RELATED WORK

A. The following is a list of related work items that shall be performed or furnished under other sections of these specifications as indicated:

1. Temporary Erosion and Sedimentation Controls - See Section 01560.
2. Temporary Water Control – See Section 01565
3. Temporary Cofferdam – See Section 02170
5. Ductile Iron Pipe and Fittings – Section 02660
6. Valves – Section 02665

1.04 SUBMITTALS

A. Not less than ten (10) calendar days prior to the scheduled start of pipeline abandonment, the Contractor shall submit his proposed method of abandonment and details of products to be used to the Owner's Engineer for review.

PART 2 – PRODUCTS

2.01 CONCRETE INFILL

All cement concrete placed shall be a 4,000 psi, low-permeability mix. The concrete shall have a maximum water/cement ratio of 0.45 with a maximum slump at point of placement of 4 inches and shall have an air entrainment of five percent (±1%). The low-permeability, cement concrete shall be proportioned per ACI 211.1.

2.02 NON-SHRINK GROUT

A. Non-Shrink grout shall be prepackaged, non-metallic, and non-gaseous. It shall be non-shrink when tested in accordance with ASTM-C1107 Grade B or C at a fluid consistency (flow cone) of 20 to 30 seconds. Thirty-minute-old grout shall flow through the flow cone after slight agitation, in temperatures of 4 degrees C (40 degrees F) to 32 degrees C (90 degrees F). Grout shall be bleed free and attain 7,500 pounds per square inch (51.7 mPa) compressive strength in 28 days at fluid consistency.

B. Products such as SikaGrout 212, as manufactured by Sika Corporation of Lyndhurst, New Jersey, or Approved Equal meeting the performance specification shall be acceptable for use in pipeline abandonment.

2.03 PARGING MATERIAL

Parging material shall be one part Type S Portland cement and two parts sand.

PART 3 – EXECUTION

3.01 GENERAL

The work required and services for the pipeline abandonment shall be done in a safe workmanlike manner and shall conform to any pertinent local or state law, regulation or code. Good housekeeping consistent with safety shall be maintained.

3.02 PREPARATORY WORK

The Reservoir shall be nearly completely drawn down for work and all water control and sediment and erosion control measure shall be fully in place before beginning the work of this section. Emergency demobilization measures as submitted under Section 01900 shall specifically address protecting and plugging the upstream end of the pipe in the event of rapid increase in the water level in the reservoir.

3.03 DISCONNECTION FOR OTHER UTILITIES

No connecting pipes are known, however if found, disconnect the spillway blow-off from all other pipes and utilities. The sections of the pipe to be grouted must be completely isolated prior to grouting. Any connecting pipes must be cut and capped. Remove or fully open any valves found upstream of the proposed capping location.

3.04 CUTTING AND CAPPING

A. Material shall meet the requirements of Section 02660. Cap upstream section when appropriate as part of overall grouting program.

3.06 PIPELINE PLUGGING

A. To ensure a temporary closure upgradient from the pipe blockage, use masonry or other bulkhead suitable for the pipeline to provide a water-tight seal at upstream end capable of resisting grout pressures. Approved mechanical plugs or inflatable packers may be substituted at the Contractor's option for the bulkhead. Alternative methods to confine the grout, such as addition of vertical pipe sections may be allowed.

B. Use non-shrink grout to fill the entire length of pipe remaining after cutting. No voids or air pockets shall remain within the plug volume of the pipe after the work is complete. If feasible, suitable provision for air venting of the plug volume shall be provided to provide for complete filling. Grouting by gravity is preferable, but in no instance, shall grouting pressures exceed 20 pounds per square inch.

C. A layer of parging at least ½ inch thick shall be placed around the upstream end of the pipe and extending at least 20 inches along the length of the pipe. The upstream end shall then be encased in a concrete block with minimum side dimensions of 24 inches.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT FOR PAYMENT

No measurement shall be made of this item. The bid item under this section is a lump sum quantity.

4.02 PAYMENT

Payment for the scope of the work specified herein, including all labor, materials, equipment, and incidentals and mobilization/demobilization costs associated with the cutting, removal, and abandonment of the spillway blow-off pipe, as well as other work incidental to this item including grouting of the remaining pipe. Work incidental to this item shall be paid for at the applicable Lump Sum price stated on the Form

Item No.	Payment Item	Unit
02760.01	Pipeline Abandonment	LS

*** * * END OF SECTION * * ***

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SECTION 02930
LOAMING, SEEDING, AND REVEGETATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Work under this Section includes the furnishings of all labor, equipment, supplies and materials for loaming, seeding, revegetating, and related items, as indicated on the drawings and/or as specified herein as follows:

1. Loam (topsoil)
2. Seeding
3. Fertilizing
4. Temporary Erosion Protection
5. Maintenance

B. The Work of this Section covers loaming and seeding operations, as well as prior preparation and subsequent conditioning (fertilizer and erosion protection) and maintenance, at all locations where fill is placed, excavations made, or existing vegetation is disturbed.

C. The performance of this work shall be judged by the establishment of appropriate ground cover in the indicated areas. The Contractor shall be responsible for the watering, mowing, and other proper care of the seeded areas until final acceptance.

D. Topsoil stockpiled and screened under other Sections may be used as loam, but the Contractor shall furnish additional loam at his/her own expense if required. The Contractor shall supply acceptable weed-free loam from off-site sources.

E. In general, the work shall consist of all loaming, seeding, and revegetation necessary to prepare all areas on the site for revegetation, placing, seeding with approved seed mix, conditioning and fertilizing the soil as required, protecting the area from erosion through the use of mulch or biodegradable blankets, and maintaining the seeded areas (watering, etc.) until the grass and vegetation is well established. The Contractor shall be responsible for all maintenance and repair of loam and seeded areas until final acceptance. The Contractor shall loam, seed, and revegetate all areas where construction shall take place as shown on the Contract Plans, as well as any other areas necessary for the work of the Contract (with approval from the owner). The Contractor shall perform ALL necessary loaming, seeding, and revegetation at all locations on the site.

1.02 SCOPE OF WORK

A. The Work of this Section shall consist of establishing vegetation, including the provision of, handling, placement, grading, shaping, conditioning, and fertilizing of on-site stock piled topsoil or loam from approved, weed-free off-site sources, in the unexpected event that off-site material is needed, to all areas where fill is placed, excavations made, or existing vegetation is disturbed. The typical final thickness of the loam layer shall be six (6) inches.

B. The Work of this Section shall include the seeding of loamed areas with approved seed

mix, protecting the area from erosion through the use of mulch or biodegradable blankets, and maintaining the seeded areas (watering, maintenance seeding, etc.) until the grass and vegetation is well established.

C. The Contractor shall loam, seed and revegetate all areas where construction shall take place as shown on the Contract Plans, as well as any other areas necessary for the work of the Contract (with approval from the Owner). The basic scope of each loaming, seeding and revegetation area is discussed below; however, the Contractor is informed that these divisions in no way relieve the Contractor of his obligation to perform ALL necessary loaming, seeding, and revegetation at all locations on the site during all phases and stages of the project, irrespective of the basic descriptions provided below:

Loaming, seeding and revegetation shall be performed at all areas where tree removal is performed, all staging and laydown areas and all other areas disturbed by construction or shown on the Drawings.

1.03 RELATED WORK

A. The following is a list of related work items that shall be performed or furnished under other Sections of these Specifications as indicated:

1. Temporary Erosion and Sedimentation Control – See Section 01560
2. Clearing, Grubbing and Stripping – See Section 02110
3. Earthwork – See Section 02200

1.04 PROTECTION OF THE RESERVOIR AND WATERWAYS

Because the project is located adjacent to Bogue Reservoir, a public drinking water supply, it is critical that no fertilizers or other chemicals be allowed to reach open water or stream areas. No fertilizers shall be applied to areas below normal water surface elevation. DO NOT over-fertilize and take care that runoff containing fertilizer does not enter the reservoir or downstream channels. NO herbicides, pesticides, or similar chemicals are allowed at the site. Fertilizers must be approved prior to application and shall not contain herbicides or pesticides.

1.05 SUBMITTALS

The Contractor shall submit to the Owner for review and approval, the following information a minimum of eight (8) days in advance of starting any loaming, seeding, and revegetation operations:

A. Composition, test data as specified herein, and Manufacturer's information or source of following material:

1. Soil Chemistry Test Results
2. Loam (topsoil) material
3. Seed (including certification of weed content)
4. Limestone
5. Fertilizer
6. Compost
7. Mulch and/or Erosion Protection Blanket material.

PART 2 – PRODUCTS

2.01 LOAM

A. Loam (topsoil), stripped, screened and stored on-site as specified in Section 02110, shall be approved by the Owner before reuse. If the topsoil does not meet the specified criteria below, or if sufficient quantities are not available on-site, then loam from outside sources shall be furnished.

B. Loam, shall consist of loose, friable, sandy loam, or loam, free of admixture of subsoil, refuse, stumps, rocks, brush, weeds and other materials which will prevent the formation of a suitable seed bed. No stones in excess of one and one-quarter inch (1¼") in diameter will be tolerated. The soils shall conform to the following gradation:

Sieve Size	Percent Finer by Weight
1-inch	90 to 100%
No. 4	70 to 95%
No. 40	30 to 85%
No. 100	25 to 50%
No. 200	20 to 40%

(No more than 15 percent of loam shall be clay)

The Contractor shall notify the Owner of the location of the source of supply for the loam at least ten days prior to delivery of the loam to the project site. Any imported materials which do not meet the above requirements shall be rejected and removed from the site.

The loam shall contain at least 10 percent, but not more than 20 percent, organic material as determined by the loss during ignition of oven-dried samples. Test samples shall be dried to a constant weight at a temperature of 221 degrees F ± 5°F. Loam shall be amended with well-cured compost as necessary to achieve minimum 10 percent organic content.

Loam shall not have greater than 500 parts per million salt.

C. Testing Requirement

All loam (topsoil) shall, at the Contractor's expense, be subjected to a Standard Soil Test with Organic Matter which shall include reporting of the following parameters: pH, Buffer pH, Extractable Nutrients, Extractable Heavy Metals (e.g. Lead), Cation Exchange Capacity, Percent Base Saturation, Percent Organic Matter, and Total Soil Nitrogen. The laboratory test results shall provide recommendations for nutrient and pH adjustments.

A minimum of one test shall be performed on each distinct loam (topsoil) source. A standard soil test shall be performed for every 500 CY of loam used at the site.

Soil testing shall be performed at the University of Connecticut Soil Nutrient Analysis Laboratory or other approved accredited testing laboratory.

Laboratory analytical testing for contaminants as specified in Section 02200 shall be performed.

2.02 COMPOST

A. Compost mature and well cured (4-6 months curing after completion of thermophillic compost process) and moderately screened. It shall have a moisture content that results in no visible free water or dust produced when handling the material.

B. Compost shall meet the following criteria:

	Minimum	Maximum
Percent passing 2”	100%	--
Percent passing 1”	90%	100%
Percent passing ¾”	70%	100%
Percent passing ¼”	4%	75%

C. Compost pH shall be between 6.0 and 8.5. Manufactured inert material (plastic, metal, etc) shall be less than 0.5 percent on a dry weight or volume basis, whichever provides the least amount of foreign material. Minimum organic matter shall by 40 percent dry weight basis as determined by Loss-On-Ignition Matter Method. Soluble salt contents shall be less than 6.0 mmhos/cm. The compost shall be composed of a minimum of 65 percent by volume recycled plan waste. A maximum of 35 percent by volume of other approved organic waste and/or biosolids may be substituted for recycled plant waste. The supplier shall provide written verification of feedstock sources.

D. Compost shall be certified free of herbicides and other harmful chemicals.

2.03 SEED

A. Seed shall be the commercial product of a reputable grower approved by the Owner and shall be certified to be not more than one (1) year old. Seed mixes provided by New England Wetlands Plants, Inc. (NEWPI) or other approved grower/vendor and optimized for the on-site conditions shall be applied where shown on the Contract Plans. The seed mix proposed for use shall be the New England Erosion Control/Restoration Mix for Dry Sites or equivalent. Plant species typically provided as follows:

Creeping Red Fescue (Festuca rubra), Annual Rye-grass (naturalized)(Lolium multiflorum), Little Bluestem (Schizachyrium scoparium), Indian Grass (Sorgastrum nutans) Upland Bentgrass (Agrostis perennans), Rough Bentgrass/Ticklegrass (Agrostis scabra), Blue Grama (Bouteloua gracilis), Canada Wild Rye (Elymus canadensis), Perrenial Ryegrass (naturalized)(Lolium perenne).

B. The loading rate shall be 1 pound of New England Erosion Control/Restoration Mix for Dry Sites per 1,250 square feet of seed area or the manufacturer’s recommended application rate, whichever is greater.

C. Other seed mixes may be utilized subject to prior approval by the Owner.

D. The seed shall be furnished and delivered premixed in the proportions specified above. All seed shall comply with applicable State and Federal seed laws. A grower's certificate of compliance with the specifications shall be submitted by the grower with the shipment of the seed. The certificate shall include the guaranteed percentage of purity, weed content

and germination of the seed, and also the net weight and date of shipment. No seed shall be sown until the Contractor has submitted the certificate to the Owner.

2.04 FERTILIZER

Fertilizer shall be furnished in containers plainly marked with chemical analysis of the product and showing one of the following compositions by weight:

	(1)	(2)	(3)
Nitrogen	10% min.	8% min.	7% min.
Available Phosphoric Acid	6% min.	6% min.	7% min.
Water Soluble Potash	4% min.	4% min.	7% min.

At least 50 percent by weight of the nitrogen content of the fertilizer shall be derived from organic materials.

2.05 LIMESTONE

Limestone shall consist of pulverized limestone obtained by grinding either calcareous or dolomitic limestone so that ninety-five percent (95%) of the material will pass a No. 20 sieve and at least fifty percent (50%) shall pass a No. 100 sieve, and shall have a satisfactory neutralizing value.

2.06 EROSION CONTROL BLANKET MATERIAL

A. Erosion control blankets shall be appropriate for use on slopes where mulch is not stable. The erosion protection blankets shall be for temporary application and shall be biodegradable and non-toxic. Materials such as jute, coir fiber, and mattresses with straw matrices are judged acceptable, provided no other unsuitable material is included. All erosion control products should be new and previously unused and free of weed and other undesirable seeds. The purpose of these materials is to provide temporary erosion control during the period of establishment of the underlying grass. The blankets shall allow for the growth of grass seeded under the blankets.

B. Erosion control blankets anchors shall be compatible with the blanket material and shall be of wooden or other biodegradable material.

2.07 MULCH

A. Mulch used in this project shall be straw free from weeds or coarse matter. A sample shall be submitted. Hay mulch shall not be allowed.

B. Woodchip mulch may also be used. Woodchip mulch may be made from timber cleared from the site.

C. Special care shall be taken to insure that mulch imported to the site is free from invasive wetland species seeds or plant matter.

PART 3 – EXECUTION

3.01 LOAM

A. Loam (topsoil), shall be amended in accordance with the recommendations of the Testing Laboratory provided in their report and in accordance with these specifications.

B. Loam shall be spread on the designated areas so as to form a cover of loam to a minimum depth of 6 inches unless otherwise shown on the drawings or directed by the Owner or Resident Engineer. Areas designated for covering with loam shall be scarified or otherwise roughened, just prior to the application of loam. After the spreading of loam all stiff clods, hard lumps, large stones, trash, wood, brush, stumps, roots, or other objectionable material shall be gathered and removed from loamed area. Compaction may be accomplished by the use of a lawn roller, weighing not more than 100 pounds per foot of width, commonly used for this work.

C. Promptly fertilize, seed, mulch, or otherwise cover, and stabilize through tracking with suitable equipment any loam placed on grades steeper than 5 percent.

3.02 APPLICATION RATES OF LIMESTONE, FERTILIZER AND SEED

A. Prepared soils shall be collected and submitted to the approved testing for testing in accordance with their guidelines. At a minimum, the soil shall be tested as per the requirements in Paragraph 2.01 of this Section. Soils shall be treated in accordance with the recommendations of the Testing Laboratory provided in their report.

B. Limestone, if required by the results of soil testing, shall be applied and thoroughly incorporated in the layer of loam to adjust the acidity of the material. Typical limestone application rates in the area have been on the order of one hundred and thirty-five pounds (135 lbs.) per thousand square foot (1,000 sq. ft.); however, the results of the test shall dictate the rate of limestone application.

C. Fertilizer, if required by the results of soil testing, shall be raked to a depth of at least two inches (2") and the area brought to a smooth surface. Typical fertilizer application rates in the area have been on the order of seven and one-half pounds (7.5 lbs.) per one thousand square feet (1,000 sf); however, the results of the test shall dictate the rate of fertilizer application.

D. Limestone and/or fertilizer shall be mixed thoroughly into the loam seedbed during preparation and prior to seeding. Mixing shall be accomplished through disking or similar method.

E. Compost, if required by the results of soil testing, may be incorporated into the loam prior to spreading or following spreading. Application rate should be as required to achieve a minimum or 10 percent organic matter. Typically this can be achieved by applying a 2-4 inch depth of compost on top of the spread loam and thoroughly incorporating the compost into the upper six (6) inches of soil. Wide-tracked equipment must be used to avoid compaction of the soil.

F. The seed mixture shall be sown at a minimum rate of two pounds (2 lbs.) per one thousand square feet (1,000 sf).

G. Mulch shall be applied at a rate of seventy to ninety pounds (70-90 lbs) per one thousand square feet (1,000 sf).

H. As an alternative to mulch, or if mulch is found to be ineffective in preventing erosion prior to vegetation establishment, erosion control blankets may be installed as per the manufacturer's recommendations.

3.03 TIME OF SEEDING

A. The recommended seeding periods are from April 1 to June 1, and from August 15 to October 1. The Contractor may seed at other times. Regardless of the time of seeding, the Contractor shall be responsible for a full growth of grass. When directed, areas in the project which do not develop a satisfactory growth of grass shall be re-fertilized and reseeded. Re-fertilizing the reseeding shall be incidental to the original seeding item requirements. All seeding must be completed by October 15, unless authorization is obtained from the Owner.

B. Dormant seeding after October 15 shall be allowed, however, seed application rate shall be doubled.

3.04 FERTILIZING AND LIMING

A. Fertilizing and liming shall be done when the soil is in a moist condition and at least twenty-four (24) hours before the sowing of seed. The fertilizer and lime shall be applied to the soil by means of a mechanical spreader or other approved method capable of maintaining a uniform rate of application and shall be thoroughly harrowed, raked or otherwise mixed with the soil to a depth of not less than one inch (1"). The fertilizer and lime shall not be applied together. If the limestone and fertilizer are applied dry, the limestone shall precede the fertilizer and shall be worked thoroughly into the soil before the fertilizer is spread.

B. Extreme care shall be taken by the Contractor so as not to introduce fertilizer into the Reservoir or other waterways. Over-fertilization will not be allowed.

3.05 SOWING SEED

A. Grass seed of the required mixture and quality shall be spread by a mechanical seeder or other method which sow the seed uniformly at the required rate over the entire area to be seeded. The mechanical seeder shall be capable of being operated to avoid the growth of grass in rows and shall be so operated. After seeding, all areas shall be lightly raked by hand to mix the seed and loam. Seeded areas shall be rolled with a lawn roller not to exceed one hundred and twenty pounds (120 lbs.) in weight.

3.06 TEMPORARY EROSION CONTROL BLANKET INSTALLATION

A. Erosion control blankets shall be installed over all areas of revegetation where slopes exceed 4 horizontal to 1 vertical (4H:1V). The slopes of the embankments shall be protected using erosion control blankets.

B. Protection of seeded areas shall be either through the installation of temporary biodegradable erosion control blankets or the application of mulch. Temporary erosion

control blankets may be necessary if mulch is found to be ineffective in controlling erosion prior to the establishment of vegetation.

C. Temporary erosion control blankets shall be installed as per the manufacturer's instructions and recommendations. In general, such blankets are installed down (perpendicular to) slopes and are anchored in a trench at the top of the slope.

D. All temporary erosion control blankets must be anchored to the ground by the use of stakes, as per the manufacturer's instructions and recommendations. In general, stakes should be placed in staggered rows on 2 to 3 foot centers. Stakes should be long enough to achieve adequate anchorage.

3.07 MULCHING

A. Protection of seeded areas shall be either through the application of mulch or the installation of temporary biodegradable erosion control blankets.

B. Areas which have been seeded shall be mulched immediately following seeding. Areas which cannot be seeded within the specified seeding periods shall be mulched to provide temporary protection to the soil surface. Mulch shall be spread with a mulch blower or by hand. Mulch shall be immediately anchored with a mulch-anchoring tool (operated perpendicular to the contour) or by tracking with a tracked vehicle (operated parallel to the contour). Applying mulch simultaneous to seeding in a hydroseeding operation is acceptable.

C. Straw mulch shall be applied to seeded areas at a rate of 10 pounds per 100 square feet. The rate shall be doubled for unseeded areas.

D. Wood chip mulch shall be applied to a uniform depth of approximately 3 inches.

3.08 MAINTENANCE

The Contractor shall be responsible for the watering, mowing, and other proper care of the seeded areas until final acceptance. If seeded areas have not established by the end of the Fall growing season, the maintenance period shall extend through the following Spring.

3.09 REPAIR

The Contractor shall be responsible for repair of all damage to and erosion of the loamed and seeded areas until final acceptance by the Owner. Repair responsibilities shall include, but not be limited to, repair of eroded areas, reseeding, replacement of erosion control measures, regrading, etc. The intent is to facilitate the establishment of an adequate ground cover over all disturbed areas on the site. If seeded areas have not established by the end of the Fall growing season, the period during which the Contractor is responsible for repairs shall extend through the following Spring.

3.10 ACCEPTANCE

A. Seeded areas shall show no gaps or dead spots at acceptance. The grass growth shall be widespread and robust with vigorous, healthy root growth

B. The Contractor is responsible for ensuring that a satisfactory firm stand of grass is obtained

and shall do all necessary reloaming, refertilizing and reseeding and make all necessary repairs, regardless of cause of damage, to this effect until final acceptance of the project.

C. If seeded areas have not established and been accepted by the end of the Fall growing season, the Owner will defer evaluation for acceptance until the following Spring.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT FOR PAYMENT

No measurement shall be made of this item. The bid item under this section is a lump sum quantity.

4.02 PAYMENT

Payment for the scope of the work specified herein, including all labor, materials, equipment, and incidentals and mobilization/demobilization costs associated with the loaming, seeding and revegetation, as well as other work incidental to this item shall be paid for at the applicable Lump Sum price stated on the Form

Item No.	Payment Item	Unit
02930.01	Loaming, Seeding and Revegetation	LS

*** * * END OF SECTION * * ***

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