MICRON CONFIDENTIAL

Specifications for the

Construction of

DP-01

Dam Safety Permit Application Specification Package

This Specification Package only applies to TEMP-SMP-01, TEMP-SMP-02, SMP-01, and SMP-11 dams. Refer to Project specifications issued by Jacobs for general requirements not otherwise addressed in this specification package.

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SECTION 00 01 10-A

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SECTION 01 40 00-A

QUALITY REQUIREMENTS

SUMMARY OF CHANGE(S):

REV	DATE	PACKAGE	DESCRIPTION / JUSTIFICATION	AUTHOR

PART 1 GENERAL

1.1 SUMMARY

A. Construction of dams (SMP-01, SMP-11, TEMP-SMP-01, TEMP-SMP-02) requires full time inspection services performed by the Engineer of Record or a representative for the Engineer of Record. The Engineer of Record for Dam Safety permitting is referred to as the Engineer throughout DP-01 Specifications.
   1. Contractor shall provide the Engineer with a minimum of 2 weeks notice prior to commencing any work on the aforementioned dams structures.

B. Section includes requirements regarding quality assurance and control of installation, tolerances, references, field samples, inspecting and testing laboratory services and manufacturers' field services and reports.

C. Related Sections:
   1. Section 01 33 00 – Submittal Procedures.

1.2 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions for handling, storage, installation, and start-up, including each step in sequence.

C. When manufacturers' instructions conflict with Contract Documents, request clarification from the Engineer before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform and Inspect Work in conformance with Special Inspection requirements of the Authority Having Jurisdiction and the Contract Documents.

F. Perform Work by persons qualified to produce required and specified quality consistent with other prominent installers in comparable business.

G. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

H. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

I. Products, materials, and equipment may be subject to review by the Engineer and/or the Owner at place of manufacture or fabrication. Such reviews shall not relieve Contractor of complying with requirements of Contract Documents.

J. Supervise performance of Work in such manner and by such means to ensure that Work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

1.3 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from the Engineer before proceeding.

C. Adjust products to appropriate dimensions, position before securing products in place.

1.4 REFERENCES

A. For products or workmanship specified by association, trades, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.

C. Obtain copies of standards where required by product specification sections.

D. When specified reference standards conflict with Contract Documents, request clarification from the Engineer before proceeding.

E. Neither contractual relationships, duties, nor responsibilities of parties in Contract, nor those of the Engineer shall be altered from Contract Documents by mention or inference otherwise in reference documents.

1.5 LABELING

A. Attach label from agency approved by Authority Having Jurisdiction for products, assemblies, and systems required to be labeled by code.

B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, any safety labels per OSHA requirements and the following information, as applicable, on each label.
   1. Model number.
   2. Serial number.
   3. Performance characteristics.

1.6 TESTING AND INSPECTION SERVICES

A. Employ and pay for services of an independent testing agency or laboratory acceptable to Owner to perform specified testing.

   1. Prior to start of Work, submit testing laboratory name, address, and telephone number, and names of full-time specialist and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of deficiencies reported by inspection.

B. Utilize an independent firm, except as allowed by the American Institute of Steel Construction certification programs for steel fabrication and erection, to perform tests, inspections and other services specified in individual specification sections and Contract Documents and as required by Authority Having Jurisdiction and Owner.
   1. Laboratory: Authorized to operate at Project location and in conformance with ASTM E329.
   2. Laboratory Staff: Maintain full time specialist on staff to review services.
   3. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.

C. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing as required by the Engineer or Owner.

D. Submit test and inspection reports to the Engineer, Contractor, and Authority Having Jurisdiction for record, indicating compliance or non-compliance with Contract Documents within three weeks of completion of the inspection and testing.
   1. Submit reports of non-conforming work within 7 days of completion of the inspection or tests.
   2. Submit final report indicating correction of Work previously reported as non-compliant at the conclusion of the project.

E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
   1. Notify the Engineerand independent firm 24 hours prior to expected time for operations requiring services.

2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

F. Testing and employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

G. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same independent firm per a testing plan developed by the independent firm coordinated with and approved by the Contractor and the Engineer. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

H. Agency Responsibilities:
1. Test samples of mixes submitted by Contractor.
2. Provide qualified personnel at site. Cooperate with the Engineer and Contractor in performance of services.
3. Perform specified sampling and testing of products in accordance with specified standards.
4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
5. Promptly notify the Engineer and Contractor of observed irregularities or non-conformance of Work or products.
6. Perform additional tests required by the Engineer.
7. Attend preconstruction meetings and progress meetings.

I. Agency Reports: After each test, promptly submit two copies of report to the Engineer, Contractor, and Authority Having Jurisdiction. When requested by the Engineer, provide interpretation of test results. Include the following:
1. Date issued.
2. Project title and number.
3. Name of inspector.
4. Date and time of sampling or inspection.
5. Identification of product and specifications section.
6. Location in Project.
7. Type of inspection or test.
8. Date of test.
9. Results of tests.
10. Conformance with Contract Documents.

J. Limits on Testing Authority:
1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency or laboratory may not approve or accept any portion of the Work.
3. Agency or laboratory may not assume duties of Contractor.
4. Agency or laboratory has no authority to stop the Work.

1.7 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of equipment, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment, and training of Owner's personnel as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to the Engineer 30 days in advance of required observations. Observer subject to approval of Owner.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

D. Refer to Section 01 33 00 – Submittal Procedures, Manufacturers' Field Reports article.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 DAM CONSTRUCTION INPECTION REQUIREMENTS

A. Full-time construction inspection of the dams is required for the following list of construction activities which require engineer approval:
   1. The Engineer must verify that proper dewatering techniques as stated in the dewatering plan are in place prior to subgrade preparation work.
   2. The Engineer must inspect and approve the stockpiled embankment fill material and review the required test results prior to placement.
   3. The Engineer must inspect and approve the stockpiled filter diaphragm sand and drain stone and review the required test results prior to placement.
   4. The Engineer must witness all proof-rolling of prepared subgrade for dam foundations.
   5. The Engineer must inspect and approve the subgrade preparation prior to placement of embankment fill material.
   6. The Engineer must inspect and approve the subgrade preparation prior to placement of cutoff trench material.
   7. The Engineer must inspect and approve the subgrade preparation prior to placement of impermeable layer material.
   8. The Engineer must inspect and approve the subgrade preparation prior to any pipe, spillway, manhole, or other structure placement.
   9. The Engineer must inspect and approve embankment fill material placement for the embankment, impermeable layer, and cutoff trench.
   10. The Engineer must inspect and approve filter diaphragm sand and drain stone placement.
   11. During placement of embankment fill, impermeable layer, and cutoff trench an independent third-party testing company must verify compaction of soil.

12. The Engineer must witness placement of RGRCP cradle rebar, formwork, and concrete pours
13. The Engineer must witness Filter HDPE drain pipe fusion, pipe placement, and backfill.
14. The Engineer must witness geotextile placement and prior to placement of riprap at headwalls, spillways, or outfalls
15. The Engineer must be present to witness filter diaphragm drain pipe video inspection.
16. The Engineer must inspect and approve the subgrade preparation prior to start of installation of HydroTurf geomembrane.
17. The Engineer must inspect and approve HydroTurf Geomembrane installation throughout geomembrane weld testing and placement
18. The Engineer must inspect and approve HydroTurf Engineered Turf installation throughout seam bonding and placement
19. The Engineer must inspect and approve HydroBinder Placement and Concrete Treatment including the process for hydrating the HydroBinder cement infil and application of colloidal concrete treatment
20. The Engineer must inspect and approve the proper placement of topsoil and finish site grading.
21. The Engineer must inspect and approve that temporary and permanent seeding and mulching is performed properly.
22. The Engineer must verify that the contractor has completed contract closeout checklist and provided close out as-built documents.

3.2 EXAMINATION

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Examine and verify specific conditions described in individual specification sections.

END OF SECTION

SECTION 01 70 00-A

EXECUTION AND CLOSEOUT REQUIREMENTS

SUMMARY OF CHANGE(S):

REV	DATE	PACKAGE	DESCRIPTION / JUSTIFICATION	AUTHOR

PART 1 GENERAL

1.1 SUMMARY

A. Section includes expanded requirements regarding project closeout procedures, final cleaning, adjusting project record documents, operation and maintenance data, and warranties described to permit direct reference from individual product specification sections.

1.2 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for the Engineers review.

B. Provide submittals to Owner required by authorities having jurisdiction as outlined in this section.

1.3 FINAL CLEANING

A. Execute final cleaning prior to final project assessment or for each phase or portion of the work to be turned over to the Owner. Secure Owner acceptance that the cleaning has been completed per the requirements.

B. Clean site: Sweep paved areas, rake clean landscaped surfaces.

C. Remove waste and surplus materials, rubbish, and construction facilities from site.

1.4 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

C. Prohibit traffic from landscaped areas.

1.5 SEMIFINAL REVIEWS AND COMPLETION LISTS

A. Semifinal Reviews: When the Contractor is of the opinion that the entire project, or portion of project is substantially complete, request a Semifinal Review as required by the Contract terms. Such notice to be given to Owner and the Engineer at least 3 working days before the requested review date.

B. If because of acts or omissions of the Contractor, Owner is required to conduct more than one Semifinal Review of the project, or portion of project, the Engineer may charge the Owner for the additional services required, and such costs will be deducted from the money still due the Contractor.

C. Completion List: items recorded in semifinal reviews will be documented in a Completion List that will be developed by Owner and Contractor. Contractor to take action on Completion List items and document resolution prior to requesting a Final Review.

1.6 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. BIM
   4. Addenda.
   5. RFI and design bulletins.
   6. Change Orders and other modifications to the Contract.
   7. Reviewed Shop Drawings, Product Data, and Samples.
   8. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress, not less than weekly.

E. For Specifications submittal**s:** Legibly mark and record at each product section description of actual products installed provide a complete set of equipment submittal tabulated by specification section, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Actual location, dimension, and elevation of all buried components within the dam embankment and foundation.
   5. Field changes of dimension and detail.
   6. Details not on original Contract drawings.

G. Project Photography and Video: turn over electronic files for project photography and video. See requirements of Section 01 30 00 – Administrative Requirements.]

H. 3D Model(s): turn over electronic files of 3D model(s) and supporting files.

I. Submit documents to Owner.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit data bound in 8-1/2 inch x 11 inch (A4) text pages, three D side ring binders with durable plastic covers.

B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.

C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

D. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

E. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
   1. Part 1: Directory, listing names, addresses, and telephone numbers of Owner representatives, the Engineer, Contractor, Subcontractors, and major equipment suppliers.
   2. Part 2: Operation and maintenance instructions, arranged by system and process flow and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
      a. Significant design criteria.
      b. List of equipment.
      c. Parts list for each component.
      d. Operating instructions.
      e. Maintenance instructions for product and systems.

f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

3. Part 3: Project documents and certificates, including the following:
   a. Shop drawings and product data.
   b. Test reports.
   c. Certificates.
   d. Originals and Photocopies of warranties and bonds.

F. Electronic Format: in addition to the format indicated above, provide the Contents above in electronic format. Provide scanning as required. Include the electronic format on CD or DVD in each of the volumes.

G. The Owner will review the operation and maintenance data furnished by Contractor as a submittal per the process established in Section 01 33 00 - Submittal Procedures.

1.8 MANUAL FOR MATERIALS AND FINISHES

A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. The Engineer will review draft and return one copy with comments.

B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within 10 days after acceptance.

C. Submit one copy of completed volumes 15 days prior to final inspection. Draft copy be reviewed and returned after final inspection, with the Engineers comments. Revise content of document sets as required prior to final submission.

D. Submit two sets of revised final volumes in final form within 10 days after final inspection.

E. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Include information for re-ordering custom manufactured products.

F. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

G. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance, and repair.

H. Additional Requirements: As specified in individual product specification sections.

I. Include listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.9 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Furnish spare parts, maintenance, and extra products in quantities specified in individual specification sections.

B. At the conclusion of Work, turn over to Owner and obtain signed receipts for keys to lockable doors, panels, gates, controls, etc., properly identified and tagged.

C. Deliver to Project site and place in location as directed by Owner; obtain receipt prior to final payment.

1.10 PRODUCT WARRANTIES AND PRODUCT BONDS

A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within 10 days after completion of applicable item of work.

B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.

C. Verify documents are in proper form, contain full information, and are notarized.

D. Co-execute submittals when required.

E. Include Table of Contents and assemble in three D side ring binder with durable plastic cover.

F. Submit prior to final Application for Payment.

G. Time Of Submittals:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
   2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing date of acceptance as beginning of warranty or bond period.

1.11 FINAL REVIEWS AND FINAL PUNCH LISTS

A. Final Reviews: When the Contractor is of the opinion that the entire project , or portion of project is complete and that Completion List item resolutions are documented, request a Final Review as required by the Contract terms. Such notice to be given to Owner at least 5 working days before the requested review date.

B. If because of acts or omissions of the Contractor, Owner is required to conduct more than one Final Review of the project, or portion of project. Owner may charge the Contractor for the additional services required.

C. Completion List: items recorded in semifinal reviews will be documented in a Completion List that will be developed by Owner and transmitted to Contractor. Contractor to take action on Completion List items and document resolution prior to requesting a final review.

1.12 MAINTENANCE SERVICE

A. Furnish service and maintenance of components indicated in specification sections for 1 year from date of Substantial Completion.

B. Do not assign or transfer maintenance service to agent or Subcontractor without prior written consent of Owner.

1.13 CONTRACT CLOSEOUT CHECKLIST

A. Complete and deliver to the Owner the following items (as applicable) prior to final payment application:
1. Verification of completion of the Punch List.
2. Fully executed certificate of Substantial Completion.
3. Local, state, or federal inspections and/or certifications.
4. 1-year workmanship and materials guarantee.
5. Operation and maintenance manuals (six sets).
6. Project as-built documents.
7. Contractor lien release.
8. Consent of surety.
9. Response to field orders.
10. Change orders fully executed.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 Refer to Project Specifications Packages issued by Jacobs for requirements regarding asphalt roadways, sidewalks, fencing, and all other portions of the project work outside of the Scope of Work included in the Dam Safety Permit Application Specification Package, DP-01.

3.2 Refer to Project Specifications Packages issued by Jacobs for general requirements not otherwise addressed in the Dam Safety Permit Application Specification Package, DP-01.

END OF SECTION

SECTION 03 11 13-A

STRUCTURAL CAST-IN-PLACE CONCRETE FORMING

SUMMARY OF CHANGE(S):

REV	DATE	PACKAGE	DESCRIPTION / JUSTIFICATION	AUTHOR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General provisions for formwork for cast-in-place concrete with shoring, bracing, and anchorage.

B. General provisions for form accessories.

C. General provisions for form stripping.

1.2 REFERENCES

A. American Concrete Institute (ACI)

1. ACI 117 Specification for Tolerances for Concrete Construction and Materials

2. ACI 301-16 Specification for Structural Concrete

3. ACI 347-14(21) Guide to Formwork for Concrete

4. ACI SP-4 Formwork for Concrete

B. APA – The Engineered Wood Association

1. PS 1-19 Structural Plywood

1.3 DESIGN REQUIREMENTS

A. Design, engineer, and construct formwork, shoring, and bracing to conform to design and code requirements; resultant concrete to conform to required shapes, lines, and dimensions.

B. All formwork is to be designed and stamped by a licensed professional engineer in the State of New York.

1.4 QUALITY CONTROL

A. Perform Work in accordance with ACI 301 and the recommendations of ACI 347.

B. Maintain one copy of each document on site.

C. Tolerances shall be as necessary to provide completed concrete structure within the tolerances specified in ACI 117.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable Local, State, and Federal building code requirements.

1.6 SUBMITTALS

A. Submit in accordance with the Terms and Conditions.

B. Refer to Submittal Schedule at end of Part 3 for a list of submittal requirements for this Section.

C. At least 14 calendar days prior to forming, submit forming plans, procedures, support system, and product data for forming concrete structures. The formwork drawings shall be stamped and sealed by a licensed professional engineer in the State of New York.

D. Information on formwork design and construction shall be submitted when specified in other specification sections.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Plywood: Concrete form plywood, exterior grade, mill-oiled and edge-sealed as specified herein and in accordance with APA PS-1. High-density overlaid or provided with an equivalent smooth form liner as the minimum form material for surfaces indicated to receive smooth form finish or any rubbed finish.

B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight-fitting, stiffened to support weight of concrete without deflection that is detrimental to structural tolerances and appearance of finished concrete surface.

C. Lumber: Fir species; No. 2 grade or better; with grade stamp clearly visible.

D. Steel: Minimum 16-gauge sheet, well-matched, tight-fitting, stiffened to support weight of concrete without deflection that is detrimental to structural tolerances and appearance of finished surfaces.

2.2 FORMWORK ACCESSORIES

A. Form Ties: Removable snap-off type, galvanized metal, fixed-length, cone type, with waterproofing washer, free of defects that could leave holes larger than 1-¼ inch (32 mm) in concrete surface.

B. Form Release Agent: Colorless, material which will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.

C. Corners: Chamfered, rigid plastic or wood strip, 1 inch by 1 inch size, unless otherwise noted on the Drawings, maximum practical lengths.

D. Nails, Spikes, Lag Bolts, Through Bolts, and Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

E. Joint Filler: Dense, closed-cell, foam rubber approved by the Engineer.

PART 3 EXECUTION

3.1 GENERAL

A. Construct formwork for cast-in place concrete with necessary shoring, bracing, and anchorage to maintain stability. The formwork shall include the openings for other work, form accessories, and form stripping.

3.2 DESIGN

A. Design, engineering and construction of formwork shall be the responsibility of the Contractor.

B. Design, support, brace, and maintain formwork to safely support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. Vertical and lateral loads must be carried to the ground by the formwork system until the in-place concrete has attained adequate strength.

C. Design formwork in accordance with ACI.

D. Design formwork for anticipated live loads, dead loads, and repeated and reduced stresses induced by external form vibrators.

E. Comply with tolerances specified in Section 03 30 00-A “Cast-in-Place Concrete.”

F. Design as a complete system with consideration given to the effects of cementitious materials and mixture additives such as fly ash, cement type, plasticizers, accelerators, retarders, air entrainment and others.

G. Monitor adequacy of formwork design and construction prior to and during concrete placement.

H. Design formwork to prevent damage to existing structures.

3.3 INSPECTION

A. Verify lines, levels, and centers before proceeding with formwork. Ensure that dimensions agree with Drawings.

B. Obtain Engineer approval for formwork before concrete placement. Engineer acceptance does not relieve the Contractor of responsibility for design or erection deficiencies.

3.4 EARTH FORMS

A. Hand-trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

3.5 ERECTION - FORMWORK

A. Erect formwork, shoring, and bracing to achieve design requirements in accordance with requirements of ACI 301.

B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

D. Align joints and make watertight to prevent leakage of mortar. Keep form joints to a minimum.

E. Provide chamfer strips on all external corners, unless indicated otherwise.

3.6 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply form release agent prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. After form release agent is applied to form, the concrete shall be placed within 14 calendar days. If concrete is not placed within 14 calendar days, the forms shall be removed, and form release agent reapplied.

D. Do not apply form release agent where concrete surfaces are scheduled to receive special finishes which may be affected by the agent such as crystal forming waterproofing. Soak contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.

3.7 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in or pass through concrete work.

B. Locate and set in place items which will be cast directly into concrete. Provide accommodations to prevent floatation of these items during concrete placement and curing.

C. Coordinate Work of other specification sections in forming and placing openings, sleeves, bolts, anchors, and other inserts.

D. Install accessories in accordance with manufacturer's instructions, straight, level, and plumb unless indicated otherwise on the Drawings. Secure all embedded items before placing concrete. Ensure that items are not disturbed during concrete placement. Fill voids with readily-removable material to prevent entry of concrete.

E. Install waterstops continuous without displacing reinforcement. Heat seal joints watertight per manufacturer’s instructions.

F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

G. Close temporary openings with tight-fitting panels, flush with the inside face of the forms and neatly-fitted so that joints will not be apparent in exposed concrete surfaces.

3.8 FORM CLEANING

A. Clean and remove foreign matter within forms as erection proceeds.

B. Clean formed cavities of debris prior to placing concrete.

C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms unless formwork and concrete construction proceed within a heated enclosure. Use compressed air or other means to remove foreign matter.

3.9 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 301.

3.10 FIELD QUALITY CONTROL

A. Inspect erected formwork, shoring, and bracing to ensure that Work is in accordance with formwork design and that supports, fastenings, wedges, ties, and items are secure.

3.11 FORM REMOVAL

A. Notify the Engineer at least 48 hours prior to removal of forms.

B. Do not remove formwork until at least 48 hours after the concrete placement is completed.

C. Remove forms in a manner which will not damage concrete.

D. Do not wedge pry bars, hammers or tools against finish concrete surfaces scheduled for exposure to view.

E. It is the Contractor's responsibility to limit construction loads at all times to those which can be carried safely by the developed strength of the concrete structure at time of loading, and by the formwork and shoring in-place at time of loading.

F. Store removed forms in a manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

3.12 SUBMITTAL SCHEDULE

ITEM NO.	SUBMITTAL REQUIREMENT	WITH BID	AS INDICATED
03 11 13-A-01	At least 14 calendar days prior to forming, submit forming plans, procedures, support system, and product data for forming concrete structures. The formwork drawings shall be stamped and sealed by a licensed professional engineer in the State of New York.		Two weeks prior to construction.
03 11 13-A-02	Information on formwork design and construction shall be submitted when specified in other specification sections.		Two weeks prior to construction.

END OF SECTION 03 11 13-A

SECTION 03 15 00-A

CONCRETE JOINTS AND PVC WATERSTOPS

SUMMARY OF CHANGE(S):

REV	DATE	PACKAGE	DESCRIPTION / JUSTIFICATION	AUTHOR

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. The Work includes forming construction and control joints in concrete structures, the tooling or chamfering of exposed edges of concrete, and furnishing and installing PVC materials in joints where shown on the Drawings.

1.2 REFERENCES

A. American Society of Testing and Materials International (ASTM)

1. ASTM D 638 Standard Test Method for Tensile Properties of Plastic

2. ASTM D 746 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

3. ASTM D 747 Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam

4. ASTM D 1203 Standard Test Methods for Volatile Loss from Plastics Using Activated Carbon Methods

B. U.S. Army Corps of Engineers (USACOE)

1. EM 1110-2-2102 Water Stops and Other Preformed Joint Materials for Civil Works Structures

2. COE CRD-C-572 Polyvinylchloride Waterstop

C. American Concrete Institute (ACI)

1. ACI 224.3R Joints in Concrete Construction.

2. ACI 318-19(22) Building Code Requirements for Structural Concrete

3. ACI 350-20 Code Requirements for Environmental Engineering Concrete Structures

D. International Concrete Repair Institute (ICRI)

1. ICRI 0372 Selecting and Specifying Concreter Surface Preparation for Sealers, Coatings, and Polymer Overlays

1.3 SUBMITTALS

A. Refer to Submittal Schedule at end of Part 3 for a list of submittal requirements for this Section.

B. Submit layout for joints.

C. Approval Samples of Waterstops:

1. 2-foot-long sample of each size and type of waterstop to be used in work.

D. Certifications of Waterstops:

1. Manufacturer's certification for PVC compound used to fabricate PVC waterstop. Include physical property test data on compound from tests performed by manufacturer or other laboratory within 18 months before submittal.

2. Sampling certification that samples are representative of waterstop to be used in work.

E. Instructions for Waterstops:

1. Manufacturer's recommendations for installing and splicing waterstop.

F. Waterstop Shop Drawings:

1. Detailed waterstop layout drawings for approval at least 14 calendar days prior to installation of PVC waterstop. Indicate field and shop welded connections and all changes in direction or areas requiring special placement. Provide detail how waterstops will be secured to prevent movement during concrete placement.

1.4 CONTRACTOR QUALITY CONTROL

A. Perform concrete work in accordance with ACI 318, ACI 350, and ACI 224.

B. Do not add, relocate, or omit joints without approval of Engineer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Follow manufacturer's instructions.

B. Keep waterstop out of direct sunlight and prevent contact with dirt, oil, and water.

1.6 DEFINITIONS (NOTE: THE FOLLOWING LANGUAGE REGARDING CONCRETE JOINTS TAKES PRECEDENCE OVER THE LANGUAGE IN THE REFERENCED ACI DOCUMENT ENTITLED "JOINTS IN CONCRETE CONSTRUCTION.")

A. Construction Joints (CJ):

1. Construction joints are joints which are purposely placed in concrete to facilitate construction; to reduce initial shrinkage stresses and cracks; to allow time for the installation of embedded metalwork; or to allow for subsequent placing of other concrete.

2. Bond is required at construction joints regardless of whether or not reinforcement is continuous across the joint.

B. Contraction Joints (CRJ):

1. Contraction joints are joints placed in concrete to provide for volumetric shrinkage of a monolithic unit or movement between monolithic units.

2. Contraction joints are constructed so no bond exists between concrete surfaces forming the joint

3. Except as provided for dowels, reinforcement is never continuous across a contraction joint.

C. Control Joints (CTJ):

1. Control joints are joints placed in concrete to provide for control of initial shrinkage stresses and cracks of monolithic units.

2. Control joints are constructed the same as contraction joints, with the exception that reinforcement is continuous across control joints.

D. Expansion Joints (EJ):

1. Expansion joints are joints provided to allow for expansion and contraction between two adjacent concrete members.

2. Joints are filled with sponge rubber joint filler.

PART 2 PRODUCTS

2.1 PVC WATERSTOPS

A. Polyvinyl Chloride (PVC) Waterstop:

1. Provide flexible PVC waterstop to the dimensions shown on the Drawings. Provide waterstop as manufactured by Greenstreak, Va. 3400 Tree Court Industrial Boulevard, St. Louis, MO 63122, telephone (800) 352-9504, or equal, in the following styles as applicable:

    a. Style 705 (6-inch ribbed with centerbulb).

B. PVC Compound:

1. Domestic virgin PVC with additional resins, plasticizers, stabilizers, or other materials required to meet specified requirements.

2. Do not use reclaimed PVC or manufacturer's scrap.

C. Meet physical characteristic requirements specified in Table 1.

Table 1 - PVC Waterstop Physical Characteristics

Property	Test Method	Requirement
Tensile test, minimum	ASTM D 638, speed D, specimen type IV	2,000 lbs/in^2
Ultimate elongation, minimum	ASTM D 638, speed D, specimen type IV	300 percent
Stiffness in flexure, minimum	ASTM D 747	600 lbs/in^2
Low temperature brittleness at –35 degrees F	ASTM D 746	No cracking or chipping
Volatile loss, change in weight, maximum	ASTM D 1203, method A, 0.08-inch thick specimen	0.50 percent
Tensile strength after accelerated extraction test, percent of tensile strength before extraction test, minimum	COE CRD-C-572	1,600 lbs/in^2, 80 percent
Ultimate elongation after accelerated extraction test, minimum	COE CRD-C-572	280 percent
Change in weight after effect of alkalis test	COE CRD-C-572	+0.25 percent -0.10 percent
Change in Shore durometer hardness after effect of alkalis test	COE CRD-C-572	+/- 5

D. Prepare test specimens in accordance with COE CRD-C-572.

E. Ties for PVC Waterstop: “Hog Rings” or grommets for each edge at 12-inches maximum spacing.

2.2 HYDROPHILIC WATERSTOP

A. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete or other materials, 3/8 by 3/4 inch.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the followings:

a. Adeka Ultra Seal/OCM, Inc.; Adeka Ultra Seal.
b. Greenstreak; Hydrotite
c. Vinylex Corp.; Swellseal

B. Adhesive: Cyanacrylate adhesive or other approved adhesive recommended by waterstop manufacturer for application of waterstop to concrete or other substrate as required.

2.3 BOND BREAKER FOR JOINTS

A. Use a curing compound, or other approved bond breaker. The curing compound shall conform to the requirements of Section 03 30 00 “Cast-In-Place Concrete.”

PART 3 EXECUTION

3.1 INSTALLING PVC WATERSTOPS

A. Before starting installation of waterstops, furnish the Engineer with the manufacturer’s recommendations for installing and making splices in the waterstops.

B. Install waterstops at locations shown on the Drawings.

C. Provide and install all attachment materials, including epoxy, batten bars, and anchors for special waterstops fabricated for attachment to existing structures.

D. Install waterstops in accordance with these Specifications and manufacturer’s written installation instructions and recommendations.

E. Install waterstops so as to form a continuous watertight diaphragm in the joint unless otherwise shown on the Drawings. Vertical waterstops shall extend to 6-inches below the top of walls or floors, unless otherwise shown or specified.

F. Provide additional vibration to concrete surrounding waterstops, over and above that used for adjacent concrete placement, to ensure complete embedment of waterstops in the concrete.

G. Install all waterstops with half of the width of the waterstop embedded in the concrete on each side of the joint, unless otherwise shown or specified.

H. To eliminate faulty installation that may result in joint leakage, take particular care so that waterstops are correctly positioned and secured during installation.

I. Take adequate precautions to completely protect waterstops during progress of the Work.

J. Provide pre-molded waterstop of maximum practicable length to minimize the number of joints.

K. Use only factory made waterstop fabrications for intersections, changes of direction, and transitions.

L. Remove curing compound and other foreign material from waterstops in all joints before placing concrete.

3.2 SPLICING PVC WATERSTOP

A. Splice waterstops at joints in waterstop sections and at intersections of waterstops.

B. Fabricate splices of waterstops with workers who have demonstrated to the satisfaction of the Engineer that they are sufficiently skilled to fabricate the required splices.

C. Only straight butt splices using heat welding are permitted for field splicing of waterstops unless specifically detailed otherwise. Lapping of waterstop, use of adhesives, or solvents is not allowed.

D. Reform waterstops at splices with a remolding iron with ribs to match the pattern of the waterstop.

E. Allow minimum of 10 minutes before new splice is pulled or strained in any way.

F. After allowing joint to cool, bend completed joints at a sharp angle to test. Cut out and reweld joints that separate under this test.

G. Finished splices: Provide cross-section dense and free of porosity with tensile strength of not less than 80% of non-spliced materials.

3.3 CONCRETE JOINTS

A. Construction Joints:

1. Locate construction joints where shown on Drawings or approved by the Engineer in writing. Show proposed locations of construction joints on the placement Drawings submitted under Section 03 30 00 “Cast-In-Place Concrete.” Relocation, addition, or elimination of construction joints is subject to approval by the Engineer.

2. Install waterstop in control joints where shown on the Drawings.

3. Locate horizontal joints in walls at the tops of footings or grade slabs. Place haunches at the same time as slabs.

4. Prepare construction joint surfaces for bonding by sandblasting, steel shot blasting, high-pressure water jetting (6,000 psi minimum), or other method approved by the Engineer to thoroughly clean the surface. Remove all laitance, loose or defective concrete, coatings, sand, curing compound, and other foreign material to expose coarse aggregate uniformly, free of laitance, loose aggregate, or damaged concrete. Roughen concrete to produce minimum roughness profile of 1/4 inch. Conduct surface preparation in a manner sufficient to keep from undercutting the edges of the larger particles of aggregate.

5. Thoroughly moisten surfaces of construction joints to be covered with fresh concrete to saturated surface dry condition and remove standing water leaving the surface damp just before concrete placement.

6. The language in these specifications regarding construction joints takes precedence over the language in the referenced American Concrete Institute Document entitled “Joints in Concrete Construction”.

B. Contraction Joints:

1. Construct contraction joints so that there is no bond between the concrete surfaces forming the joint.

2. Install waterstop in control joints where shown on the Drawings.

3. Construct joints by forming the concrete on one side of the joint and allowing it to set before concrete is placed on the other side of the joint. Coat the surface of the concrete first placed at the contraction joint with curing compound, or other approved bond breaker, before the concrete on the other side of the joint is placed. Protect reinforcement and waterstop from application of curing compound so that reinforcement and waterstop does not become coated with curing compound. The curing compound shall conform to the requirements of Section 03 30 00 “Cast-In-Place Concrete.”

4. The language in these specifications regarding contraction joints takes precedence over the language in the referenced American Concrete Institute Document entitled “Joints in Concrete Construction”.

C. Control joints:

1. Construct control joints using the same procedures as contraction joints. Coat the surface of the concrete first placed at the contraction joint with curing compound, or other approved bond breaker, before the concrete on the other side of the joint is placed. Protect reinforcement and waterstop from application of curing compound so that reinforcement and waterstop does not become coated with curing compound. The curing compound shall be as specified in Section 03 30 00 “Cast-In-Place Concrete.”

2. Waterstop shall be installed in control joints where shown on the Drawings.

3. The language in these specifications regarding control joints takes precedence over the language in the referenced American Concrete Institute Document entitled “Joints in Concrete Construction”.

3.4 SUBMITTAL SCHEDULE

ITEM NO.	SUBMITTAL REQUIREMENT	WITH BID	AS INDICATED
03 15 00-A-01	Submit layout for joints.		Two weeks prior to fabrication or purchase
03 15 00-A-01	Approval Samples of Waterstops: 2-foot-long sample of each size and type of waterstop to be used in work.		Two weeks prior to construction.
03 15 00-A-02	Certifications of Waterstops: Manufacturer's certification for PVC compound used to fabricate PVC waterstop. Include physical property test data on compound from tests performed by manufacturer or other laboratory within 18 months before submittal. Sampling certification that samples are representative of waterstop to be used in work.		Two weeks prior to construction.
03 15 00-A-03	Instructions for Waterstops: Manufacturer's recommendations for installing and splicing waterstop.		Two weeks prior to construction.
03 15 00-A-04	Waterstop Shop Drawings: Detailed waterstop layout drawings for approval at least 14 calendar days prior to installation of PVC waterstop. Indicate field and shop welded connections and all changes in direction or areas requiring special placement. Provide detail how waterstops will be secured to prevent movement during concrete placement.		Two weeks prior to construction.

END OF SECTION 03 15 00-A

SECTION 03 20 00-A

CONCRETE REINFORCING

SUMMARY OF CHANGE(S):

REV	DATE	PACKAGE	DESCRIPTION / JUSTIFICATION	AUTHOR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General provisions for reinforcing steel bars, dowels, and related accessories for cast-in-place concrete.

1.2 REFERENCES

A. ASTM International (ASTM)

1. ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

B. American Concrete Institute (ACI)

1. ACI 301-16 Specifications for Structural Concrete

2. ACI 315R-18 Guide to Presenting Reinforcing Steel Design Details

3. ACI 318-19(22) Building Code Requirements for Structural Concrete

4. ACI 350-20 Code Requirements for Environmental Engineering Concrete Structures

C. Concrete Reinforcing Steel Institute (CRSI)

1. Manual of Standard Practice

2. Placing Reinforcing Bars

3. Reinforcing Bar Detailing

1.3 SUBMITTALS

A. Submit in accordance with the Terms and Conditions.

B. Reinforcement Placement Drawings: Submit reinforcement placement drawings for approval at least 14 calendar days prior to fabrication. Indicate bar sizes; spacings; locations and quantities of reinforcing steel and wire fabric; bending and cutting schedules; and supporting and spacing devices. Show locations of splices. Conform to Drawing structural notes and the CRSI "Reinforcing Bar Detailing" manual. Locate reinforcing splices at points of minimum stress.

C. Certified copies of mill test reports of reinforcement material analyses.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid rusting.

B. Protect from contaminants such as grease, oil, and dirt.

C. Provide identification after bundles are broken and tags removed.

PART 2 PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel: ASTM A615, 60 ksi yield grade, deformed carbon steel bars.

2.2 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16-gauge annealed type.

B. Chairs, Bolsters, Bar Supports, and Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions, in accordance with the current ACI detailing manual or CRSI "Manual of Standard Practice". Use of concrete block, rocks, or other items for reinforcement support will not be allowed.

2.3 FABRICATION

A. Fabricate concrete reinforcing in accordance with ACI 315.

B. Locate reinforcing splices at point of minimum stress. Indicate location of splices on placement drawings.

C. Welding reinforcing bars is not permitted.

PART 3 EXECUTION

3.1 INSTALLATION

A. Before placing concrete, clean reinforcement of loose rust, loose mill scale, dirt, grease, and other substances which could impair the bond with concrete. Remove rust by vigorous rubbing with burlap cloth or wire brushing.

B. Accommodate formed openings while maintaining required clearance.

C. Place, support, and secure reinforcement against displacement. Do not deviate from required positions as shown on the Drawings or the Contractor's approved reinforcing steel placement drawings.

D. Place reinforcement in accordance with the Drawings, the Contractor's reinforcing steel placement drawings, and the CRSI "Placing Reinforcing Bars".

E. See Drawings for structural notes and for reinforcement cover requirements.

F. Splice reinforcing bars by lapping and securely wiring together. Splices at locations other than those indicated are subject to written approval by the Engineer and shall conform to the requirements of ACI 318. Do not use mechanical splices. Do not weld or tack weld reinforcing bars.

G. Place and secure embedded metalwork and conduit so as to not interfere with reinforcement installation.

H. Field bending of reinforcement is not allowed unless approved by the Engineer in writing.

3.2 QUALITY CONTROL

A. Place reinforcement with clear distance of 1-inch, minimum, between reinforcement and anchor bolts, form ties, or other embedded metalwork unless otherwise shown on the Drawings.

B. Tolerances:

1. Maintain concrete cover over reinforcement within ½-inch of specified cover where specified cover is greater than 2½-inches.

2. Maintain concrete cover over reinforcement within ¼-inch of specified cover where specified cover is 2½-inches or less.

3. Maintain spacing of reinforcing bars within 1 inch of required spacing.

3.3 INSPECTION

A. Perform concrete reinforcement work in accordance with the CRSI "Manual of Standard Practice".

B. Notify the Engineer when reinforcing steel is in place and provide at least 48 hours for the Engineer to inspect the reinforcing steel prior to placement of concrete. Concrete placed without inspection and approval by the Engineer may be subject to rejection and removal at no additional cost to the Owner.

C. The Engineer's inspection of steel reinforcing prior to concrete placement will not relieve the Contractor from responsibility to conform to the Drawings and Specifications.

3.4 SUBMITTAL SCHEDULE

ITEM NO.	SUBMITTAL REQUIREMENT	WITH BID	AS INDICATED
03 20 00-A-01	Reinforcement Placement Drawings: Indicate bar sizes; spacings; locations and quantities of reinforcing steel and wire fabric; bending and cutting schedules; and supporting and spacing devices. Show locations of splices. Conform to Drawing structural notes and the CRSI "Reinforcing Bar Detailing" manual. Locate reinforcing splices at points of minimum stress.		Submit reinforcement placement drawings for approval at least 14 calendar days prior to fabrication.
03 20 00-A-02	Certified copies of mill test reports of reinforcement material analyses.		Two weeks prior to fabrication or purchase

END OF SECTION 03 20 00-A

SECTION 03 30 00-A

CAST-IN-PLACE CONCRETE

SUMMARY OF CHANGE(S):

REV	DATE	PACKAGE	DESCRIPTION / JUSTIFICATION	AUTHOR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General provisions for cast-in-place structural at locations shown on the Drawings or directed by the Engineer.

1.2 REFERENCES

A. American Concrete Institute (ACI)

1.	ACI 117	Specification for Tolerances for Concrete Construction and Materials (ACI 117) and Commentary (ACI 117-10 R2015)
2.	ACI 301-16	Specifications for Structural Concrete
3.	ACI 304-00	Guide for Measuring, Mixing, Transporting, and Placing Concrete
4.	ACI 305.1	Specification for Hot Weather Concreting
5.	ACI 306.1	Standard Specification for Cold Weather Concreting
6.	ACI 306.R	Guide to Cold Weather Concreting
7.	ACI 308.1-23	Standard Specification for External Curing of Cast-in-Place Concrete
8.	ACI 309-05	Guide for Consolidation of Concrete
9.	ACI 318-19(22)	Building Code Requirements for Structural Concrete

10.	ACI 350-20	Code Requirements for Environmental Engineering Concrete Structures

B. ASTM International (ASTM)

1.	ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
2.	ASTM C33	Standard Specification for Concrete Aggregates
3.	ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
4.	ASTM C42	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
5.	ASTM C94	Standard Specification for Ready-Mixed Concrete
6.	ASTM C114	Standard Test Methods for Chemical Analysis of Hydraulic Cement
7.	ASTM C138	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
8.	ASTM C143	Standard Test Method for Slump of Hydraulic-Cement Concrete
9.	ASTM C150	Standard Specification for Portland Cement
10.	ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
11.	ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
12.	ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
13.	ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
14.	ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
15.	ASTM C441	Standard Test Method for Effectiveness of Pozzolans or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to the Alkali-Silica Reaction
16.	ASTM C494	Standard Specification for Chemical Admixtures for Concrete

17.	ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
18.	ASTM C1017	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
19.	ASTM C1064	Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
20.	ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
21.	ASTM C1567	Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
22.	ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
23.	ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non extruding and Resilient Bituminous Types)
24.	ASTM D1752	Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

C. American Association of State Highway and Transportation Officials (AASHTO)

1.	AASHTO M182	Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

1.3 DEFINITIONS

A. Curing: Maintaining a satisfactory moisture content and temperature in concrete during its early stages so that the desired properties may develop.

B. Hot Weather: When air temperature has risen to or is expected to rise above, 85°F during the protection period.

C. Cold Weather: When air temperature is fallen to or is expected to fall below 40°F during the protection period.

D. Defective Concrete: Surface defects that include honeycomb, rock pockets, indentations, cracks 0.15-inch wide and larger, and cracks that leak in water-holding structures, spalls, chips, embedded debris, lift lines, sand lines, bleed lines, leakage from form joints, fins, and other projections, form pop outs, texture irregularities, and stains that cannot be removed by cleaning and concrete not conforming to required lines, levels, details, elevations, dimensions, tolerances or specified requirements.

1.4 SUBMITTALS

A. Submit in accordance with the Terms and Conditions.

B. Refer to Submittal Schedule at end of Part 3 for a list of submittal requirements for this Section.

C. Material Approval Data

1. Mix Design: For each concrete mix design, submit proposed mix designs in accordance with ACI 301 for review and approval.

2. Submit the name and manufacturer of each cementitious material, aggregate source, and admixture.

a. The Engineer reserves the right to require submission of manufacturer's test data and certification of compliance with specifications.

b. The Engineer reserves the right to require submission of samples of concrete materials for testing before or during use in concrete construction.

3. Cementitious materials certifications and test reports:

a. Submit the manufacturer's certification and test reports for each lot from which shipments are drawn.

1) Certify materials were tested during production or transfer in accordance with specified reference specification.

2) Submittal of certification and test reports shall not relieve Contractor of responsibility for furnishing materials meeting specified requirement.

D. Concrete Placement Drawings:

1. Submit drawings for each individual concrete placement. An individual concrete placement is defined as a portion of concrete Work placed in one continuous operation between specified lines or joints.

a. Show locations, dimensions, blockouts, openings, recesses, waterstops, and finishes. Identify construction joints, control joints, contraction joints and expansion joints.

b. Show details of items embedded in or associated with placement except reinforcing steel.

c. Include a separate drawing showing placement sequence.

d. Place a title block with Contractor's name, contract title and number, placement identification, and identifying drawing number in lower right hand corner of each drawing.

e. List reference drawings from which details shown on placement drawing were obtained on each drawing.

f. Reference related steel reinforcement drawings associated with placement on each drawing.

E. Submit Contractor's Concrete Placement Schedule including:

1. Complete, detailed concrete placement schedule showing the Contractor's plan for placement of individual features, units, and other elements of concrete work.

2. Detail as necessary to show location, sequence, and date of concrete placements scheduled for each item of concrete work.

3. Detail drawings and placement of reinforcement and embedded items.

F. Concrete Accessories: Manufacturer data confirming conformance with this Section.

G. Cold Weather Placement Plans: The Contractor shall be required to provide cold weather protection of concrete for this project, if concrete placement is proposed during cold weather, as defined in this specification and by ACI 306.1. Submit specific proposed plans to cure concrete during cold weather, including work sequence, protective measures, and monitoring methods/reporting.

H. Concrete Curing Plan: The Contractor shall provide cold weather protection for this project if concrete is anticipated to be placed during winter months. Submit specific proposed plans to cure concrete during cold weather, including work sequence, protective measures, and monitoring methods, and documentation of monitoring.

I. Hot Weather Placement Plans: The Contractor shall provide specific proposed plans detailing proposed plans to place concrete during hot weather, including work sequence, protective measures, and monitoring methods/reporting. Plans that do not contain sufficient detail indicating specifically how concrete will be protected against temperate extremes and damage will be rejected.

J. Submit all batch tickets.

K. Submit all field and laboratory test results.

1.5 QUALITY ASSURANCE AND QUALITY CONTROL

A. Include provisions for hot and cold weather concrete (if conditions warrant).

B. Perform Work in accordance with provisions of all applicable ACI standards.

C. Obtain materials from same source throughout the Work.

D. Project Record Documents: Accurately record as-built concrete dimensions, and tolerances and locations of embedded utilities and components on placement drawings.

E. Sequencing and Scheduling

1. Notify the Engineer at least 48 hours prior to commencing concrete Work.

2. Allow the Engineer to perform an immediate inspection of concrete surfaces upon removal of forms.

3. Notify the Engineer upon discovery of any honeycombing, foreign-embedded items, and defective concrete.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement: ASTM C150 Portland Cement, Type II:

1. Meet equivalent alkalis requirements of ASTM C150 – Table 2.

2. Meet false-set requirement of ASTM C150 – Table 4.

B. Pozzolan: ASTM C618, Class F, Except:

1. Sulfur trioxide, maximum: 4.0 percent.

2. Loss on ignition, maximum: 2.5 percent.

3. Test for effectiveness in controlling alkali-silica reaction under optional physical requirements in Table 2 of ASTM C618. Use low-alkali cement for test.

4. Does not decrease sulfate resistance of concrete by use of pozzolan.

5. Demonstrate pozzolan will have an "R" factor less than 2.5.

a. R = (C-5)/F

b. C: Calcium oxide content of pozzolan in percent determined in accordance with ASTM C114.

c. F: Ferric oxide content of pozzolan in percent determined in accordance with ASTM C114.

6. Pozzolan when tested in accordance with ASTM C441 shall conform to the following: 65 percent minimum reduction in mortar expansion at 14 days, and 0.02 percent maximum mortar expansion at 14 days. Expansion shall be less than control sample expansion.

7. Pozzolan content shall be 20 percent plus or minus 5 percent by weight of the total cementitious materials.

8. Pozzolan and cement shall be stored and batched separately.

C. Aggregates:

1. Fine aggregate: ASTM C33.

2. Coarse aggregate ASTM C33, Size No. 57 or 67.

3. Fine and coarse aggregate shall not be of a carbonate-based rock. Coarse and fine aggregates shall not contain any materials that are deleteriously reactive with the alkalis in the cement in an amount sufficient to cause excessive expansion of mortar or concrete, in accordance with ASTM C1260 and ASTM C1567. The amount of coal and lignite in the fine aggregate shall be less than 0.5 percent.

D. Water: Water for concrete shall be clean and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances that may be deleterious to concrete or reinforcement in accordance with ASTM C1602, including optional requirements of Table 2.

2.2 ADMIXTURES

A. Air Entraining Admixture:

1. Comply with ASTM C260.

2. Use a neutralized vinsol resin formulation for air-entraining admixture used with ASTM C494, Type F or G; and ASTM C1017, Type I or II chemical admixtures.

B. Other Admixtures: Use only when approved and at no additional cost to the Owner. Conform to ASTM C494:

1. Accelerators: Approval does not relax cold-weather placement requirements. Calcium chloride is prohibited.

2. Set-retarders or stabilizers: Approval does not relax hot-weather placement requirements.

3. Water reducers: Type A, D, E, F or G, to achieve workability without exceeding specified water/cement ratio and slump.

4. Mineral admixtures to be used or furnished under this Specification shall be certified to comply with this Specification by the supplier. Certification shall include test results on Specifications, source, and location.

2.3 CURING MATERIALS

A. Water: ASTM C1602, including optional requirements of Table 2.

B. Curing Compound: ASTM C309.

C. Polyethylene Film: ASTM C171.

2.4 STRUCTURAL CONCRETE MIX

A. Mix and deliver concrete in accordance with ASTM C94.

B. Select proportions for normal weight concrete in accordance with ACI 301 and ACI 350.

C. Provide concrete to the following criteria at point of placement. Concrete mix shall meet all specified requirements. Failure to meet any one specified requirement shall be sufficient cause for rejection.

D. Provide concrete to the following criteria:

1. Minimum Compressive Strength (28 days): 5,000 psi

2. Maximum water/cementitious (w/c) material ratio: 0.40

3. Slump: In accordance with ASTM C143 - 3 inches ±1 inch at placement. For concrete with ASTM C1017, Type I or II chemical admixtures, use slump appropriate for placing conditions, with a maximum slump of 8 inches.

4. Entrained Air: 4.5% to 7.5% at point of placement in accordance with ASTM C231.

5. Concrete temperature at placing: 50 to 85 degrees F.

E. Use accelerating admixtures in cold weather only when approved by the Engineer. Use of admixtures will not relax cold weather placement requirements.

F. Use of calcium chloride is not permitted.

G. Use set-retarding admixtures during hot weather only when approved by the Engineer.

H. Use set-controlling admixtures to increase allowable concrete delivery and placement restrictions in accordance with applicable provisions of this Section only when approved by the Engineer.

I. Add other approved admixtures (water reducer/superplasticizer, etc.) in accordance with the manufacturer's recommendations.

J. If a superplasticizer is used, the admixture shall be added to the concrete trucks at the site and the following requirements shall be followed:

1. The manufacturer's recommendations for dosage, mixing, and use.

2. A calibrated field dispenser shall be used. Records of dosage for each concrete truck shall be recorded by the Contractor and provided to the Engineer.

3. Each truck shall be mixed after dosing with the minimum number of drum rotations in accordance with the requirements of ACI 304 and the admixture manufacturer.

4. Field concrete tests (air content, temperature, and slump) shall be performed on each truck before and after adding the admixture.

K. Concrete mix shall meet all specified requirements. Failure to meeting any one specified requirement shall be sufficient cause for rejection.

2.5 CONCRETE CONSOLIDATION EQUIPMENT

A. The consolidation method should be compatible with the concrete mixture, placing conditions, form intricacy, and amount of reinforcement. A combination of internal and external vibration is acceptable.

B. Internal Vibration: Consolidation equipment shall be flexible, electric or pneumatic-drive immersion-type vibrators with an operating speed of 7000 rpm when immersed in concrete.

C. Provide a minimum of one standby vibrator for every 2 vibrators.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that joint locations conform to the approved placement drawings.

B. Verify requirements for concrete cover over reinforcement are met.

C. Verify that anchors, seats, plates, reinforcement, embeds, openings, water stops, and/or other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

D. Verify appropriate mix design for designated placement.

E. Engineer inspection and approval of foundations is required prior to any concrete being placed. Verify with the Engineer that all surfaces on which concrete is to be placed has been inspected and is adequate for concrete placement.

F. Do not place concrete without approval from the Engineer. Use Concrete Placement Form attached to this Section.

3.2 PREPARATION

A. Remove standing water, ice, frost, mud, and debris from foundation, forms, and reinforcement surfaces to be covered by concrete.

B. Prepare surfaces that require bond by water jetting (6,000 psi min), or other approved method approved. Remove all laitance, defective concrete, coatings, curing compound, etc to expose aggregate uniformly and produce a minimum roughness profile of ¼ inch.

C. Prepare soil foundations to be free from frost or ice.

D. Thoroughly moisten surfaces of absorptive foundations to be covered with concrete so that moisture will not be drawn from fresh concrete.

E. Remove hardened concrete, wood chips, and other debris from the interior of forms.

F. Place form release agent or wet forms just prior to placing concrete. Form release agent or any other deleterious material is not acceptable on concrete surfaces.

3.3 PLACING CONCRETE

A. Place concrete in accordance with ACI 304, ACI 309 and ACI 318.

B. Notify the Engineer a minimum of 48 hours prior to commencement of concrete placement operations. The Engineer shall inspect all surfaces on which concrete is to be placed.

C. No concrete shall be placed until all formwork, installation of items to be embedded, and preparation of surfaces involved in the placement have been approved by the Engineer. Formwork and foundation surfaces on which cast-in-place concrete is placed shall be moistened and kept moist until overlying concrete is placed except where form release agent is used.

D. Place concrete in as nearly a continuous operation as practical and in a manner to produce a concrete mass with sufficient continuity and continuance so that it shall harden and act as a monolithic mass with no discontinuous joints or potential places of separation or weakness.

E. Deposit concrete as close as practicable to its final position. Concrete shall be placed by methods that do not cause segregation. Do not drop concrete more than 3 feet.

F. Concrete shall be placed in near-horizontal layers; the depth of each layer shall not exceed 20 inches. Place mixture on prepared foundation or previously completed concrete materials with spreading equipment that prevents segregation and that produces layers of widths and thicknesses as necessary for compaction to the required dimensions. Place each successive layer as soon as practicable after the preceding layer is completed.

G. Consolidate concrete in accordance with ACI 309. Do not place vibrator against reinforcement or forms or use vibrator to transport concrete within forms. Have one extra vibrator and one extra generator on site at all times during placement of concrete to be used in the event of breakdown of primary equipment. Operate vibrator to penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding layer. Manipulate in an up-and-down motion, generally for 5 to 15 seconds, to knit the two layers together.

H. Provide sufficient concrete placing capacity and equipment to deliver and place concrete without undue delay; do not permit cold joints to occur. Discharge concrete into forms within 90 minutes following the first introduction of water and cement or cement and aggregates, whichever occurs first. If the air temperature is 85° F or higher, the time limit specified above shall be reduced to 60 minutes unless the Engineer's approval has been obtained for means to maintain acceptable concrete quality without such time reduction.

I. Ensure reinforcement, inserts, embedded parts, and waterstops are not disturbed during concrete placement or consolidation.

J. Cast-in-place concrete shall not be placed during heavy rain (more than 0.3 inch per hour or 0.03 inch in 6 minutes as defined by the Weather Bureau Glossary of Meteorology). If unusual adverse weather such as heavy rain, severe cold, heavy snow, high wind, or other adverse weather occurs, or is forecast to occur during placement, an interruption in placing operations may be approved or directed. All placed concrete materials shall be fully consolidated before stopping Work. Allow for construction schedule risk and added expense that could occur as a result of adverse weather. Weather delays shall receive no additional compensation.

K. Do not use concrete which has been subjected to more than 250 total revolutions of any combination of mixing and agitating equipment following the first introduction of aggregates to the mixer.

L. Do not retemper concrete.

M. Maintain records of placed concrete items. Record truck number, date, start and stop times, location of placed concrete, quantity, air temperature, concrete placement temperature, slump, air content, admixture quantities, test samples collected and times, and cast test cylinder numbers.

N. Contractor may place concrete by pumping, at Contractor's option. Appropriate mix design provisions must be included in Contractor's approved concrete submittal before any concrete is placed by pumping methods.

O. Wait at least 5 days between adjacent placements of sections of structures with joints, including walls and slabs and before placing structural concrete over backfill concrete, unless otherwise approved by the Engineer.

3.4 CONCRETE FINISHING

A. Finish concrete surfaces on the project as follows.

B. Formed Surfaces: Follow provisions of ACI 301 Surface Finish-3.0. Fill cracks by epoxy injection for submerged structures.

C. Unformed Surfaces:

1. Exposed: Follow provisions of ACI 301 Trowel Finish using a steel trowel, and the following:

a. Finish by screeding and floating with straightedges to bring surfaces to required finish elevation.

b. While concrete is still green but sufficiently hardened to bear a person's weight without deep imprint, wood float to true, even plane without visible coarse aggregate.

c. Use sufficient pressure on wood floats to bring moisture to surface.

d. After surface moisture has disappeared, hand trowel concrete to produce smooth, impervious surface, free from trowel marks.

e. Burnish surface with an additional troweling.

f. Final troweling to produce ringing sound from trowel.

g. Do not use dry cement or additional water during troweling, nor excessively trowel.

2. Unexposed (Buried): Follow provisions of ACI 301 Float Finish, and the following:

a. Finish slabs by screeding with straightedges to bring surface to required finish plane.

b. Wood float finish to compact and seal surface.

c. Remove laitance and leave surface clean.

d. Coordinate with other finish procedures.

D. Broomed Finish: Provide where determined by the Engineer.

1. First provide a monolithic finish as specified above, except immediately after steel troweling, then brush surface with a stiff bristle brush.

2. Brush in parallel strokes at right angles to the forms.

E. Exposed Edges:

1. Chamfer edges of permanently exposed concrete, except slabs and top edges of walls, with a 45 degree bevel 1 inch by 1 inch unless otherwise shown on the Drawings.

2. Tool exposed edges of slabs and top edges of walls to a radius of ¼ inch unless shown otherwise on the Drawings.

F. Tolerances for Concrete Construction: Tolerances are defined as allowable variations from specified lines and grades, and dimensions and as the allowable magnitude of the surface irregularities. Allowable variations from specified lines, grades, and dimension shall be in accordance with ACI 117 and ACI 301.

3.5 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. If a clear membrane curing compound is planned to be used, submit proposed product information to Engineer for approval.

C. Cure and protect concrete for a minimum of 7 days as described in ACI 308.1.

D. Maintain concrete with minimal moisture loss at acceptable curing temperatures for the period necessary for proper hydration of cement and hardening of concrete. Maintain concrete at a minimum temperature of 50º F without excessive heating or excessive moisture loss for a minimum of 7 days. Provide and remove protection to control rate of temperature change per day (as required to prevent temperature cracking).

3.6 FIELD QUALITY CONTROL

A. Collect and complete the batch ticket (delivery ticket) at the placement site with each load of concrete and deliver all batch tickets to the Engineer on a daily basis. Concrete delivered without a batch ticket containing complete information as specified shall be rejected. Provide Engineer access to the batch tickets at any time during the placement. Each batch ticket shall include at a minimum the following information:

1. Supplier’s name and date

2. Truck number

3. Project number and location

4. Concrete class designation and item number

5. Cubic yards batched

6. Time batched

7. Mix design number

8. Type, brand, and amount of each admixture

9. Type, brand, and amount of cement and pozzolan

10. Mass (weights) of fine and coarse aggregates

11. Moisture content of fine and coarse aggregate

12. Gallons of batch water (including ice)

B. Add the following information to the batch ticket at the placement site:

1. Gallons of water added by truck operator plus quantity of concrete in the truck each time water is added

2. Admixture additions to loads at the site including type, brand, and amount

3. Number of revolutions of drum at mixing speed (for truck mixed concrete)

4. Discharge time

5. Location of batch in placement

6. Water-cement ratio

C. The Contractor will be allowed to add water to the batched concrete once at the site, based upon concrete supplier approval and direction, and provided that the specified water to cement ratio is not exceeded and the amount of water withheld at the batch plant or amount of water allowed for addition is on the delivery ticket.

D. Maintain records of placed concrete items. Record truck number, date, start and stop times, location of placed concrete, quantity, air temperature, concrete placement temperature, slump, air content, admixture quantities, test samples collected and times, and cast test cylinder numbers.

E. Perform Work in accordance with ACI 301.

F. Acquire cement from same source for all Work.

G. Acquire fly ash from same source for all Work.

H. Acquire aggregate from same source for all Work.

I. Conform to ACI 305.1 when concreting during hot weather.

J. Conform to ACI 306.1 and 306R when concreting during cold weather.

K. Do not place concrete directly on soil, bedrock, or existing horizontal concrete surface without approval by the Engineer that the foundation has been prepared acceptably for concrete placement.

L. Quality Control Reporting

1. Record quality test results on the form at the end of this Section and submit to the Engineer.

2. Provide test results to the Engineer within 24 hours for field testing, and within 48 hours of laboratory testing to the Engineer.

3.7 CONCRETE MIX TESTING

A. Conduct quality control inspection and testing in accordance with the Standards specified in this Section using qualified personnel and an independent third-party testing agency certified to perform the tests described in this section.

B. Provide access and samples for the Engineer's independent quality assurance testing if requested.

C. Sampling Fresh Concrete

1. Test Method: ASTM C172.

D. Concrete Cylinders

1. Test Method: ASTM C31 and ASTM C39.

2. Frequency: One set of at least 6 concrete test cylinders (6 inch by 12 inch) for each 50 or less cubic yards of concrete, at least once each day of concrete placement for each mix if different mixes are placed in the same day. The specified set of 6 cylinders does not include cylinders required for cold weather, or any additional cylinders for early breaks or other purposes. Contractor may collect additional cylinders if desired.

3. Unless otherwise approved, test each set of 6 cylinders for compressive strength as follows:

a. 2 cylinders at 7 days.

b. 2 cylinders at 28 days.

c. 2 hold cylinders, to be retained for possible testing in the event the 28-day tests fall below the required strength.

4. Collect at least two additional test cylinders during cold weather concreting to be cured on site maintained in the same conditions as the concrete it represents up to the time it is tested.

E. Slump

1. Test Method: ASTM C143.

2. Frequency: One per cylinder set, and at least one per truck for each mix.

3. Perform additional tests when concrete consistency appears to change.

F. Air Content, Unit Weight, and Yield

1. Test Method: ASTM C231 and C138.

2. Frequency: One per cylinder set, and at least one per truck for each mix.

G. Temperature

1. Test Method: ASTM C1064.

2. Frequency: One per cylinder set, and at least one test hourly and one test per truck when air temperature is 50 deg F and below and when 80 degrees F and above.

H. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by Engineer. Additional tests shall be paid for by the Contractor at no additional expense to the Owner. Concrete in the area represented by a core test will be considered adequate if the average strength of the cores is equal to at least 90% of the specified strength f'c and not a single core is less than 85% of the specified strength f'c.

3.8 PATCHING

A. Allow the Engineer to inspect concrete surfaces immediately upon removal of forms.

B. Honeycombing or embedded debris in concrete is not acceptable. Notify the Engineer upon discovery, and repair as determined by the Engineer.

C. Patch imperfections as directed by the Engineer.

3.9 DEFECTIVE CONCRETE

A. Where concrete is considered deficient, the Engineer may require additional testing to be made at no additional expense to the Owner. If additional tests do not indicate concrete meets the requirements, Contractor may be required to remove and replace deficient concrete as directed by Engineer.

B. Additional Tests: The Contractor's independent test firm shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by the Engineer. Testing to determine adequacy of concrete may include cored cylinders in accordance with ASTM C42 or by other methods as directed by the Engineer. Conduct additional tests at no additional expense to the Owner.

C. Nondestructive Testing: Impact hammer, sonoscope, or other non-destructive device may be permitted by the Engineer but will not be used as sole basis for approval or rejection of concrete.

D. Repair hardened concrete that is not within specified tolerances to bring it within tolerance. Such repair shall be accomplished in a manner approved by the Engineer. Concrete repair to bring concrete within tolerances shall be done only after consultation with the Engineer regarding the repair method. The Engineer shall be notified as to the time when repair shall be performed.

E. Repair concrete that is exposed to public view in a manner that shall result in a concrete surface with a uniform appearance. Limit grinding depth on concrete surfaces exposed to view such that no aggregate particles are exposed more than 1/6 inch in cross section at the finished surface. Where grinding has caused or shall cause exposure of aggregate particles greater than 1/6 inch in cross section at the finished surface, concrete shall be repaired by removing and replacing a portion of the concrete per Section 03 01 30~~,~~ "Concrete Repair" at no additional cost to the Owner.

F. When concrete placements result in hardened concrete that does not meet specified tolerances, the Contractor shall, upon request, submit to the Engineer an outline of all preventative actions, such as modifications to forms, modified procedure for setting screeds, and different finishing techniques, to be implemented by the Contractor to avoid repeated failures. The Engineer reserves the right to delay concrete placements until the Contractor implements such preventative actions that are approved by the Engineer.

3.10 PROTECTION

A. Protect finished Work under provisions of ACI 301 and as specified herein.

B. Remove formwork in accordance with the requirements in Specification Section 03 11 13 "Structural Cast-in-Place Concrete Forming.~~"~~

CONCRETE PLACEMENT FORM

PROJECT _____

LOCATION _____

FEATURE _____

STATION _____

CONTRACTOR _____

Pumper Used (Yes/No) _____

DATE				
DAY	SUN	MON	TUE	WED
DAY	THU	FRI	SAT	
WEATHER	Clear	P. Cloudy	Cloudy	Fog
TEMP.	0-32° F	32-50° F	50-75° F	75-100° F
WIND	Calm	Breeze	Moderate	High
WIND DIR.	North	South	East	West
PRECIP.	Rain	Snow	Light	Moderate

CHECKOUT INFORMATION				
CHECKOUT ITEM	**CONTRACTOR**	**RPR/ENGINEER**	**Date**	**Time**
Subgrade Preparation				
Dewatering				
Form Lines, Grades and Dimensions				
Formwork Ties and Bracing				
Reinforcing Steel				
Chamfer				
Embedded Items				
Drain Piping				
Blockouts				
Waterstops				
Placement Equipment				
Concrete Protection				
Drains Voided				
Other (List)				
Note: Initial each item that is applicable; put N/A if an item does not apply. All of the shall be inspected and approved before ordering concrete				
Inspected and Approved		Contractor Representative and Date		
No Exceptions		Resident Project Representative or Engineer and Date		

CONCRETE MIX AND VOLUME

MIX	CONCRETE MIX DESIGNATION	VOLUME ORDERED (CY)	VOLUME WASTED (CY)	VOLUME SPILLED (CY)	OUT OF SPEC (CY)	OVER ORDER (CY)	VOLUME WASTED (CY)	TOTAL VOLUME PLACED (CY)
Mix 1								
Mix 2								
Mix 3								

CONCRETE TESTING INFORMATION

TRUCK #	VOLUME (CY)	TRUCK ARRIVE TIME	PLACE START TIME	PLACE END TIME	WATER ADDED (gallons)	TEMP (°F/°C)	SLUMP (inches)	AIR CONTENT (%)	COMMENTS

3.11 SUBMITTAL SCHEDULE

ITEM NO.	SUBMITTAL REQUIREMENT	WITH BID	AS INDICATED
03 30 00-A-1	Material Approval Data		Two weeks prior to construction.
03 30 00-A-2	Concrete Placement Drawings		Two weeks prior to construction.
03 30 00-A-3	Submit Contractor's Concrete Placement Schedule		Two weeks prior to construction.
03 30 00-A-4	Concrete Accessories		Two weeks prior to construction.
03 30 00-A-5	Cold Weather Placement Plans		Two weeks prior to construction.
03 30 00-A-6	Concrete Curing Plan		Two weeks prior to construction.
03 30 00-A-7	Hot Weather Placement Plans		Two weeks prior to construction.
03 30 00-A-8	Submit all batch tickets.		Per construction schedule.
03 30 00-A-9	Submit all field and laboratory test results.		Per construction schedule.

END OF SECTION 03 30 00-A

SECTION 31 00 00- A

EARTHWORK

SUMMARY OF CHANGE(S):

Rev	Date	Package	DESCRIPTION / JUSTIFICATION	AUTHOR

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Site clearing, grubbing stripping, and topsoil excavation and storage, including tree and stump removal.
2. Excavating, filling, and compacting to attain required grades and densities.
3. Trench excavation and backfill for buried elements.
4. Excavating for footings and foundations.
5. Installation of fill under concrete slabs on grade and related site structures.
6. Provide labor, materials, and equipment necessary to accomplish work specified in this Section.

B. Related Sections:
1. Section 03 30 00-A – Cast-in-Place Concrete.
2. Section 31 23 19-A – Dewatering
3. Section 33 46 01-A – Dam Subdrainage Systems

C. CAUTION: Use of this Section without including the above-listed items results in omission of basic requirements.

D. In the event of conflict regarding earthwork requirements between this Section and another section, the provisions of this Section govern.

1.2 REFERENCES

A. In addition to compliance with industry standards and Owner requirements, ensure that the following government acts and regulations (as applicable for any particular equipment or material) are complied with in design, fabrication, testing and shipment of equipment and materials.

B. Meet or exceed the requirements of the latest edition of the following codes, regulations and standards.

C. American Society for Testing and Materials (ASTM):
   1. ASTM C117 – Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.
   2. ASTM D75 – Standard Practice for Sampling Aggregates.
   3. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600kN-m/m3)).
   4. ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
   5. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).
   6. ASTM D2216 – Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
   7. ASTM D3786 – Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method.
   8. ASTM D4355 – Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
   9. ASTM D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
   10. ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
   11. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
   12. ASTM D4718 – Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.
   13. ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
   14. ASTM D6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

D. Occupational Safety and Health Administration: OSHA 29 CFR 1926, Safety And Health Regulations for Construction.

E. New York State Department of Transportation Standard Specifications, latest edition.

1.3 DEFINITIONS

A. Relative Compaction: Ratio in percent of as-compacted field dry density to laboratory maximum dry density as determined by ASTM D1557 or ASTM D698 as noted in this Specification. Corrections for oversize material may be applied to either as-compacted field dry density or the maximum dry density as determined by the Engineer and as specified in ASTM D4718.

B. Optimum Moisture Content: Determine by ASTM standard specified to determine the maximum dry density for relative compaction. Determine field moisture on basis of fraction passing 3/4-inch sieve.

C. Prepared Ground Surface: Ground surface after clearing, grubbing, stripping, excavation, demolition, and scarification and/or compaction.

D. Completed Course: A course or layer ready for next layer or next phase of work.

E. Well-Graded: A mixture of particle sizes that has no specific concentration or lack thereof of one or more sizes. Well-graded does not define any numerical value that must be placed on coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters. Well-graded is used to define a material type that when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

F. Influence Area: Area within planes sloped downward and outward at an angle of 60 degrees from horizontal from 1 foot outside the outermost edge at base of foundations or slabs, 1 foot outside outermost edge at surface of roadways or shoulder, or 1/2 foot outside exterior edge at spring line of pipes and culverts.

G. Unclassified Excavation: Nature of materials to be encountered has not been identified or described herein.

H. Borrow: Material excavated on site or taken from designated borrow areas on or near site.

I. Imported Material: Imported materials obtained by Contractor from sources off site.

J. Embankment Fill: Fill materials required to raise the existing grade in areas other than under structures.

K. Impermeable Layer: A layer of fine grain material with limited permeability.

L. Cutoff Trench: An excavation at the foundation interface to interrupt seepage flow.

1.4 SUSTAINABLE DESIGN REQUIREMENTS

A. Comply with Section 01 81 13 – Sustainable Design Requirements.

1.5 SUBMITTALS

A. Submit an Earthwork Plan at least 30 days in advance, prior to beginning earthwork, including both excavation and fill describing all facets of work. Include the source and description of filling materials, required laboratory test results of all fill materials, placement and compaction methods, grubbing methods, and field surveys. The Earthwork Plan shall, at a minimum, include all the following:
   1. Schedule for earthwork activities.
   2. Detailed description of the sequencing and operations necessary for construction of the features described in this Section.
   3. Proposed excavation method(s) to be used.
   4. Proposed excavation slopes.
   5. Operations necessary to construct all embedded structures, as well as the filter diaphragm, including descriptions of methods used to place the filter materials to avoid segregation and contamination, and methods to ensure specified compaction is achieved. Indicate interrelationships to other operations including subgrade preparation, dewatering, and adjacent fill placement.

6. Methods of construction to be used to perform the construction safely.
7. Borrow source(s) for imported offsite materials and proposed method(s) of sampling on-site and off-site source(s) for acceptance.
8. Equipment proposed for soil excavation, transport, processing, placement, compaction, and moisture control, including equipment catalog cut sheets with weights, dimensions, and operating data.
9. Stockpiling and placement plan for soils and filter materials describing handling and transport of on-site and off-site materials including proposed haul routes and methods proposed for placement and compaction.
10. Plan to obtain, convey, and store construction water, including proposed water source.
11. Methods for processing, including means and methods of moisture conditioning in advance of material placement and compaction.
12. Methods for protecting Work, to include temporary excavation dewatering, drainage, moisture conditioning, and frost protection measures.
13. Measures to keep filter and drain materials from becoming contaminated with soil or other materials during stockpiling, transportation, placement, and construction activities.

B. Submit approval testing test reports for all imported earthwork materials and on-site excavated materials suitable for use as fill. Any time the Contractor changes the source and/or stockpile from which materials are obtained, additional gradation, and moisture density compaction curve test reports for these new sources shall be required. The Contractor shall include costs for all testing in the bid price. No additional compensation will be allowed for testing.

C. Certified truckload weight bills: Submit certified truckload weight bills at the time of delivery of all materials to site.

D. Refer to Submittal Schedule at end of Part 3 for additional submittal requirements for this Section.

1.6 QUALITY ASSURANCE

A. Perform work in conformance, except as modified in this Section, with current edition of New York State Department of Transportation Standard Specifications, referred to here as Standard Specification.

PART 2 PRODUCTS

2.1 MATERIALS

A. Subgrade Stabilization Fill and Drainage Materials: Crushed gravel, crushed bedrock, or natural gravel meeting the requirements outlined below. Coarse aggregate materials shall be free of organics and other deleterious materials and shall be sounds, durable, and non-reactive. Coarse aggregate shall be tested for soundness in accordance with Standard Specification Method No.: 703-07P, G and shall demonstrate Magnesium Sulfate

Soundness losses less than or equal to 10 percent by weight after 10 cycles. Subgrade stabilization fill may only be used at the locations specified on the Drawings.

AASHTO Size No. 57

US Sieve Size	% Passing by Weight
1 ½"	100
1"	95 – 100
½"	25 – 60
No. 4	0 – 10
No. 8	0 - 5

B. Embankment Fill and Cutoff Trench for dam embankments associated with SMP-01, SMP-11, TEMP-SMP-01, and TEMP-SMP-02 dams (approximate limits of dam embankments as indicated on Drawings): On-site excavated material or imported fill that meets the following requirements.

1. Shall have a Unified Soil Classification (USCS Classification) of SM, SC, GM, GC, CL, or ML.
2. Shall not have a USCS Classification of CH, MH, OL, OH, PT, SW-SM, SP-SC, or SW-SC.
3. Shall have a minimum fines content (passing No. 200 sieve) greater than or equal to 20 percent.
4. Shall have a maximum particle size of 4-inches.
5. A list of required material approval testing for Embankment Fill is presented below. The tests shall be conducted by the Independent Testing Agency at the frequencies designated unless otherwise directed by the Engineer. These tests are for determining the suitability of the material for use as Embankment Fill.

Test	Test Method (Current Version)	Test Frequency
USCS Classification	ASTM D2487	Minimum 2 tests per classification
Gradation with No. 200 wash and hydrometer	ASTM D6913, D7928	
Moisture content	ASTM D2216	
Atterberg limits	ASTM D4318	
Laboratory Moisture-Density (Modified Proctor)	ASTM D1557	Minimum 2 tests per material classification

C. Impermeable Layer

1. Per the NYSDEC Stormwater Management Design Manual, detention ponds liners shall be comprised of clay and/or silt rich soils having at least 50 percent by weight passing a standard US No. 200.

D. Dams Filter and Drainage Materials: See Specification 33 46 00-A Dam Subdrainage System for filter sand and drain stone associated with dam embankments associated with stormwater ponds SMP-01, SMP-11, TEMP-SMP-01, and TEMP-SMP-02.

E. Drain Rock: ASTM D448 No. 57 stone. For use with retaining wall drainage features.

F. Riprap: Hard and durable quarry stone with not more than 35 percent wear when tested for resistance to abrasion in conformance to ASTM C535. The bulk density not less than 160 pounds per dry cubic foot. See Drawings for size and thickness.

G. Topsoil: Refer to Specification 32 92 00-A and Section 731-01 of the Standard Specifications.

H. Water for Compaction: Provide water for compaction as required.

I. Nonwoven Geotextile (Mirafi 160N or approved equal):
1. Pervious sheet of polyester, polyethylene, or polypropylene filaments, oriented to a stable network so that fibers retain their relative positions to each other.
2. Composed of continuous or discontinuous (staple) fibers held together by spun bonding, melt bonding, or needle paneling.
3. Minimum physical property values:

Mass per unit area (ounce/yard^2)	6
Grab tensile strength (pound), ASTM D4632	160
Trapezoid Tear Strength (pound), ASTM D4533	60
CBR Puncture Strength (pound), ASTM D6241	410
Permittivity (sec^{-1}), ASTM D4491	Min 1.5

4. Finish geotextile so that filaments will retain their relative position with respect to each other. Finish edges of woven fabric to prevent outer material from pulling away from fabric.
5. Provide manufacturer's certificate of compliance attesting that geotextile meets requirements of this Specification. Provide mill certificates stating length and width of fabric contained on each roll.

2.2 EQUIPMENT

A. Compaction Equipment: Use suitable compaction equipment to obtain densities specified. Operate compaction equipment in strict accordance with manufacturer's instructions and recommendations. Maintain equipment in such condition that it will deliver manufacturer's rated compactive effort. If inadequate densities are obtained, provide larger and/or different types of additional equipment.

B. Moisture Control Equipment: Use equipment for applying water of a type and quality adequate for work, that does not leak and is equipped with a distributor bar or other approved device to assure uniform application. Use equipment consisting of blades, discs, or other approved equipment for mixing and drying out material.

C. Other Materials and Equipment: Select other materials and equipment not specifically described but required for a complete and proper installation subject to review by the Engineer prior to use.

PART 3 EXECUTION

3.1 INSPECTION

A. Imported Material Acceptance: Imported materials specified in this Section are subject to the following requirements:

1. Test acceptable sources for each imported material. Submit certification that material conforms to Specification requirements along with copies of test results from a qualified commercial testing laboratory as required by Submittals Schedule. Furnish material samples by Contract or at Contractor's sole expense. Clearly mark samples to show source of material and intended use on project. Perform sampling of material source in accordance with ASTM D75. Coordinate sampling schedule at least 24 hours in advance with the Engineer and Owner so they observe sampling procedures.
2. Tentative acceptance of material source based on observation of source by Owner and/or certified test results submitted by Contractor to Owner at Owner's discretion.
3. Deliver no imported materials to site until proposed source and material test submittal(s) has been reviewed by the Engineer and returned marked "No Exceptions Noted".
4. Final acceptance will be based on tests made on samples of material taken from a completed and compacted course.
5. Testing for final acceptance will be performed by Owner or Owner's representative.
6. If tests conducted by Contractor or Owner indicate that material does not meet Specification requirements, material placement will be terminated until corrective measures are taken.
7. Remove and replace material which does not conform to Specification requirements at the Contractor's sole expense.
8. Sampling and testing performed by Contractor at Contractor's sole expense.

B. Inspection of soil excavation, fill placement, and compaction. Inspection of backfill compaction should be performed by an independent third-party testing company and follow ASTM 6938.

3.2 FIELD PREPARATION

A. Clearing and Grubbing: Clear site within areas required for access and execution of work. Remove existing trees, brush, stumps, and waste material on site which are noted for removal as shown on Drawings. Grub out stumps and roots. Prevent damage and disturbance to vegetation and topsoil in areas outside limits as shown on Drawings. Dispose of waste materials offsite in accordance with all federal, state, and local laws relating to such disposal. After completion of clearing and grubbing, get Geotechnical Engineer's acceptance before commencing stripping.

B. Stripping: Prior to beginning any excavation or fill, strip existing ground to remove all vegetation, then strip topsoil to a depth of 18 inches and stockpile for future use. In general, remove topsoil where structures are to be built, trenches dug, and roads, parking lots, walks, equipment pads, staging areas, and similar improvements are constructed within area presently covered with topsoil. Extend the topsoil removal a minimum distance beyond the proposed structures and other improvements described above as directed by the Engineer. Store topsoil clear of construction area. Take care to prevent topsoil from becoming mixed with subsoil.

3.3 EXCAVATION

A. General Excavation: Perform excavation of every description, regardless of type, nature, or condition of material encountered, as specified, shown, or required to accomplish construction.

B. Unclassified Excavation: Excavation is unclassified. Complete excavation regardless of type, nature, or condition of materials encountered. Make own estimate of kind and extent of various materials to be excavated in order to accomplish work.

C. Shoring, Sheeting, Bracing, and Sloping
   1. Shoring, sheeting, and bracing will not be allowed within the footprint of the dams structures without written approval from the Engineer.
   2. All excavations shall be properly sloped in accordance with appropriate safety standards.

D. Structural Excavation for Footings, Retaining Walls, and Related Structures:
   1. Excavation is unclassified. Excavate for structures to lines and grades shown or as required to accomplish construction. Perform all excavation regardless of type, nature, or condition of material encountered.
   2. Method of excavation used is optional; however, do not operate equipment within 5 feet of existing structures or newly completed structures without prior review by the Engineer. Perform with hand tools excavation that cannot be accomplished without endangering present or new structures.

E. Limits of Excavation:
   1. Allow for forms, working space, granular base, and finish topsoil as shown or required. Do not carry excavation for footings and slabs deeper than elevation shown.

2. Replace excavations carried below grade lines shown with same fill material as specified for overlying fill or backfill, and compact as required for such overlying fill or backfill. Where overlying area is not to receive fill or backfill, replace overexcavated material and compact to a density not less than that of underlying ground. Fill excavations under footings with concrete of strength equal to that of footing. Correct cuts below grade by similarly cutting adjoining areas and creating a smooth transition.
3. Correction of overexcavated areas at Contractor's sole expense.

F. Removal of Water:
1. Follow the guidance of Specifications 31 23 19-A to maintain a dewatered work area.

3.4 FOUNDATION PREPARATION

A. After completion of stripping and/or excavation inspect for soft surficial soils and proof-roll subgrade surface. Proof-roll with a fully loaded dump truck or similarly heavy-wheeled vehicle to detect soft or loose zones. Notify the Engineer prior to commencement of proof-rolling. The Engineer must be present for proof-rolling.

B. If soft or loose areas are encountered within the areas of the dam embankment foundations associated with stormwater ponds SMP-01, SMP-11, TEMP-SMP-01, and TEMP-SMP-02, notify the Engineer prior to any over excavation and backfilling operation. At the discretion of the Engineer, undercut identified soft zones a minimum of 2 feet and backfill with Embankment Fill. The Engineer must approve all dams embankment foundations prior to fill placement.

3.5 PLACING GEOTEXTILE

A. Prevent exposure of geotextile to light until needed for construction.

B. Ensure surface to receive geotextile is smooth, free from obstructions, depressions, and sharp objects. Notify the Engineer prior to placing geotextile so that the Engineer may observe surface to receive geotextile.

C. Do not operate machinery directly on geotextile. When placing material over joints, place in direction from overlying geotextile to underlying geotextile. Prevent puncture, tear, or displacement of geotextile and protect from damage. Replace torn areas and holes by placing an overlay of geotextile having dimensions at least 2 feet greater than tear or hole in all directions.

D. Follow all manufacturers' recommendations for storage and placement of geotextile fabrics.

3.6 BACKFILL

A. Preparations for Placing Backfill:
1. Backfill around concrete structures only after concrete has attained specified compressive strength. Remove all form materials and trash from excavation

before placing backfill. Obtain the Engineer's written acceptance of concrete work and attained strength prior to backfilling.

2. Do not operate earth-moving equipment within 5 feet of walls of concrete structures for the purpose of depositing or compacting backfill material without prior review by the Engineer. Compact backfill adjacent to concrete walls with hand-operated tampers or similar equipment that will not damage structure.

3.7 COMPACTION OF FILL

A. Compact all materials by mechanical means. Flooding or jetting will not be permitted. If compaction tests indicate that compaction or moisture content is not as specified, terminate material placement and take corrective action prior to continued placement.

B. Do not place fill or backfill if material is frozen or if surface upon which fill or backfill is to be placed is frozen.

C. Fill Under Pavements: Place fill in lifts not to exceed 10 inches of uncompacted thickness. Compact each lift of subgrade to not less than 95 percent relative compaction as determined by ASTM D1557.

D. Embankment Fill Under Structures:

1. Place specified embankment fill in previously excavated areas under retaining wall, piping, structures, and other areas as shown. Do not exceed loose lifts of 10 inches. Compact each lift to not less than 95 percent relative compaction as determined by ASTM D1557. Moisten material as required to aid compaction. Place material in horizontal lifts and in a manner which avoids segregation.
2. Correct and repair subsequent damage to piping, concrete structures, or other structures caused by settlement of fill material by Contractor at Contractor's sole expense.

E. Backfill Around Structures: Place specified structural fill in lifts not less than 4 inches uncompacted thickness prior to compaction and compact each lift to not less than 95 percent relative compaction as determined by ASTM D1557.

F. Backfill around concrete structures only after concrete has attained compressive strength in Section 03 30 00-A – Cast-in-Place Concrete.

G. Fill for dam embankments, impermeable layer, and cutoff trenches:

1. Place hereinbefore specified Embankment Fill to lines and grades shown. Place fill material in lifts not greater than 10 inches in thickness prior to compaction and compact each lift to not less than 95 percent relative compaction as determined by ASTM D1557. The moisture content for materials, at the time of compaction, shall be between 2 percent below and 2 percent above the optimum moisture content.
2. Perform one in-situ moisture/density test per 500 cy of material placed in a single day. At least one moisture/density test must be performed for each day of fill placement regardless of the quantity of material placed.
3. Place and compact the full width of embankment and spread materials in horizontal lifts. Moisten fill material as necessary to produce specified

compaction. If material is too wet for proper compaction, aerate by blading, discing, or other methods. Dress completed embankment to elevations and slopes shown. Make proper allowance for topsoil where required.

4. The distribution and gradation of materials throughout the filling zone shall be free from lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from the surrounding material. Perform placing operations so that the materials, when compacted, will be blended sufficiently to secure a high degree of compaction, uniformity, and stability. The surface of each fill lift should be roughened using the segmented pad/sheepsfoot roller prior to placing the next fill lift to promote bonding of the individual lifts and preclude formation of preferred seepage planes in the embankment.
5. In tight spaces and against structures where only small compaction equipment can be used, the maximum loose lift thickness shall be limited to 4-inches and the maximum particle size shall be limited to 2-inches.
6. Sheeting and shoring will not be permitted to be used within dam embankments or cutoff trench foundations without explicit approval in writing from the Engineer. All excavations shall be properly sloped.

3.8 PROTECTON OF WORK

A. Use all means necessary to prevent erosion of graded areas during construction and until such time as permanent drainage and erosion measures have been installed.

B. Comply with all stipulations and regulations within NYSDEC SPDES General Permit and all other local, state, and federal agencies.

C. Excavation Safety: Perform excavations in a safe manner. Provide appropriate measures to retain excavation side slopes and prevent cave-ins and rock falls to ensure that persons working in or near the excavation are protected.

D. For trench excavation exceeding 5 feet in depth, provide adequate safety system meeting requirements for applicable state and local codes, rules, regulations, construction safety orders, and federal requirements.

E. The Engineer has not designed or reviewed, is not responsible for, and does not certify any aspect of trench safety systems and/or safety systems for trench excavation which may be described, shown, or depicted, directly or indirectly, in these plans and specifications.

F. Protect trees, shrubs, lawns, walkways, curbs, vaults, manholes, valve boxes, and other features remaining as a portion of final facilities or landscaping.

G. Protect benchmarks, existing structures, fences, utilities, sidewalks, paving, and curbs from equipment and vehicular traffic.

H. Protect above and below grade utilities that are to remain.

I. Notify the Engineer of unexpected subsurface conditions and discontinue work in affected area until notified to resume work.

J. Grade top perimeter of excavations to prevent surface water runoff from flowing into excavation.

K. Identify significant landscape features from the Drawings on site with tags and appropriately protect.

3.9 MOISTURE CONTROL

A. During all compacting operations, maintain optimum practicable moisture content required for compaction purposes in each lift or fill. Maintain moisture content uniform throughout lift. Supplement, if required, by sprinkling fill. Achieve optimum moisture content of fill, plus or minus 2 percentage points, at time of compaction.

B. Do not attempt to compact fill material that contains excessive moisture. Aerate material by blading, discing, harrowing, or other methods to hasten drying process.

3.10 TRENCH EXCAVATION AND BACKFILL

A. General:
1. Process excavated material to meet specified gradation requirements.
2. Adjust moisture content as necessary to obtain specified compaction.
3. Do not allow backfill to freefall into trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over top of pipe or other utilities.
4. Do not use power-driven impact-type compactors for compaction until at least 4 feet of backfill is placed over top of pipe or other utilities.
5. Backfill to grade with proper allowances for topsoil, crushed-rock surfacing, and pavement thickness, wherever applicable.
6. Backfill around structures with embankment fill unless otherwise shown or specified.

B. Excavation: Excavate for installation of piping, utilities, and appurtenances. Remove obstructions, such as tree roots, stumps, and other material of any type.

C. Trench Excavation: Trench excavation is unclassified. Remove all material regardless of nature, type, or condition of material encountered.

D. Trench Width: Provide minimum width of unsheeted trenches in which pipe is to be laid 18 inches greater than outside diameter of pipe or cradle. The maximum clear width at top of pipe or above pipe will not be limited except in cases where excess width of excavation would cause damage to adjacent structures, utilities or other improvements.

E. Grade: Carry bottom of trench to line and grade shown. Allow for pipe thickness and for pipe base or special bedding when specified. Backfill any part of the trench excavated below grade with embankment fill and compact to not less than 95 percent relative compaction as determined by ASTM D1557.

F. Removal of Water: Remove water as specified in Specification 31 23 19-A.

G. Trench Stabilization: If in the opinion of the Engineer, material in bottom of trench is unsuitable for supporting pipe, excavate to remove unsuitable material and backfill to required grade with trench stabilization material as specified. Compact as required by the Engineer. Removal of unsuitable material and replacement fill as specified in this paragraph and as reviewed by the Owner is paid for by an adjustment of the Contract price in accordance with the provisions of additional work.

3.11 FINISH SITE GRADING

A. Perform earthwork to lines and grades as shown on Drawings and/or established by the Engineer, with proper allowance for topsoil where specified or shown. Shape, trim, and finish slopes of channels to conform to lines, grades, and cross section shown. Make slopes free of exposed roots and stones exceeding 3-inch diameter. Round tops of banks to circular curves, in general, not less than a 6-foot radius unless otherwise shown on the Drawings. Trim rounded surfaces neatly and smoothly. Neatly blend new grading into surrounding existing terrain. Finished site grading will be reviewed by the Engineer.

3.12 INSTALLATION OF RIPRAP

A. Foundation Preparation for Riprap:
   1. Place riprap to lines and grades as shown on Drawings.
   2. Trim surfaces above grade to neat line. Fill areas below grade by increasing thickness of riprap.
   3. Place no material until foundation has been reviewed by the Engineer.

B. Place geotextile as specified on Drawings.

C. Placing Riprap:
   1. Place riprap to a depth as shown on Drawings.
   2. Intermix the sizes of riprap material to provide uniform gradation between small and large material. Prevent damage to pipe or other facilities.
   3. Repair damage to pipe or coating at Contractor’s sole expense.

3.13 TOLERANCES

A. Construct material limits within a tolerance of 0.1 foot except where dimensions or grades are shown or specified as minimum. Perform grading to maintain slopes and drainage as shown on Drawings. No reverse slopes will be permitted.

B. Maintain constant uniform slopes between finish grade contour lines and spot elevations shown on the Drawings.

C. Collect survey data points for all embedded features in the dam embankments and foundations.

3.14 FIELD QUALITY CONTROL

A. Field Density and Moisture Tests: The independent testing laboratory representative will determine in-place density and moisture content by any one or combination of the

following methods ASTM D6938, D1556, D2216, or other methods selected by the Engineer. Cooperate with this testing work by leveling small test areas designated by Owner's testing representative. Backfill test areas at Contractor's sole expense. Frequency and location of testing determined solely by the Independent Testing Agency.

3.15 ADJUSTING AND CLEANING

A. Disposal of Excess Excavation: Dispose of all excess excavated materials not suitable for site berms, backfill, or fills offsite. Make arrangements for disposal of excavated material. Dispose in accordance with applicable federal, state, and local requirements.

3.16 SUBMITTAL SCHEDULE

ITEM NO.	SUBMITTAL REQUIREMENT	WITH BID	NO. OF WEEKS AFTER AWARD	AS INDICATED
31 00 00-A -01	Earthwork Plan			Provide 30 days in advance of planned earthwork activities
31 00 00-A -02	Certification, sieve analysis, other test results, source, for all imported materials.			Provide the following information 10 calendar days prior to first use.
31 00 00-A -03	Certification, sieve analysis, other test results, source, for all on-site materials anticipated to be used as embankment fill.			Provide the following information 10 calendar days prior to first use.
31 00 00-A -02	Certification and mill certificates for geotextile.			Provide the following information 10 calendar days prior to shipment.
31 00 00-A -04	Copies of permits obtained for excavation, dewatering, etc., that are required by state and local governing authorities prior to start of work.			Provide the following within 4 weeks after award or upon receipt from local jurisdiction.
31 00 00-A -05	Certified truckload weight bills			Upon Delivery

END OF SECTION

SECTION 31 23 19-A

DEWATERING

SUMMARY OF CHANGE(S):

Rev	Date	Package	DESCRIPTION / JUSTIFICATION	AUTHOR

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Provisions for dewatering excavations and removing temporary dewatering systems.

B. Related Sections:
1. Section 31 00 00-A – Earthwork

C. In the event of conflict regarding earthwork requirements between this Section and another section, the provisions of this Section govern.

D. Shallow groundwater is anticipated in all excavations. For installation of dams in DP-01 (SMP-01, SMP-11, TEMP-SMP-01, TEMP-SMP-02), groundwater shall be controlled to facilitate construction in dry conditions. The contractor is responsible for maintaining a dry construction site during the process of construction.

E. Design Requirements:
1. Maintain excavations, fill placement areas, and other parts of the Work free from water.

F. Performance Requirements:
1. Dewater by lowering and keeping groundwater level at least 2 feet below the general bottom of excavations. If site conditions or other sections warrant, the Engineer may require the groundwater level to be at least 3 feet below the general bottom of excavations. The system shall have sufficient capacity to accomplish the desired result, allowing for normal variation in soil properties and foundation conditions. The Contractor shall use means necessary to lower the groundwater table and maintain a dry excavation by means including, but not limited to, deep or shallow well points, wells, ditches, sumps, and pumps.
2. No upward, vertical, nor lateral flow of groundwater into a cut area will be permitted at any time. If groundwater is encountered in an excavation, the

excavation shall be immediately backfilled, and dewatering measures put in place.

3. Dewater in a manner that will prevent loss of fines, will maintain stability of any excavated slopes and bottom of excavations, and will allow the Work to be performed in dry conditions.
   Methods of dewatering and controlling groundwater, including designs and implementations, are the full responsibility of the Contractor.

1.2 REFERENCES

A. In addition to compliance with industry standards and Owner requirements, ensure that the following government acts and regulations (as applicable for any particular equipment or material) are complied with in design, fabrication, testing and shipment of equipment and materials.

B. New York State Department of Transportation Standard Specifications, 2025 edition

1.3 MAINTENTANCE

A. Maintain adequate dewatering equipment to remove surface water and groundwater entering excavations.

B. Operate the dewatering system and maintain each excavation in a dry condition until the Work is completed to the extent that no damage will result from encroachment of water.

1.4 SUBMITTALS

A. Refer to Submittal Schedule at end of Part 3 for a list of submittal requirements for this Section.

B. Dewatering Work Plan:
   1. Submit a Dewatering Work Plan for approval prior to start of dewatering activities, describing all facets of the work to adequately dewater excavations and maintain groundwater levels at least 2 feet below the general bottom of excavations. The plan should include, at a minimum, the following:
   2. Designer qualifications: The designer shall be a registered Professional Engineer with a minimum of 5 years of relevant experience.
   3. Locations of proposed dewatering activities (intake and discharge points, equipment staging, etc.).
   4. Proposed equipment catalog cuts (pumps, conduit, intake structures, erosion prevention at discharge points).
   5. Methods for preventing loss of fines by dewatering operations.
   6. Methods for dewatering following rain events.
   7. Methods for dewatering sediment-laden water.

1.5 QUALITY ASSURANCE

A. Perform work in conformance, except as modified in this Section, with current edition of New York State Department of Transportation Standard Specifications, referred to here as Standard Specification.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide and operate equipment adequate to keep all excavations and trenches free of water. Remove all water during periods when concrete is being deposited, when pipe is being laid, during placing of backfill, and as required for efficient and safe execution of work.

B. Avoid settlement or damage to adjacent property. When dewatering open excavations, dewater from outside structural limits and from a point below bottom of excavation when possible. Design, install, and operate dewatering systems to prevent removal of fines from existing ground.

C. Continuously monitor and maintain dewatering operations until the completion of construction.

D. Remove dewatering system at completion of construction.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify that adjacent facilities and Work will not be damaged by dewatering operations.

3.2 FIELD PREPARATION

A. Layout and install dewatering equipment in such a manner as to avoid interference with access or construction activity.

B. Provide protection for critical parts from accidental damage or freezing.

C. Erect signs and barricades to isolate hazardous areas.

3.3 INSTALLATION

A. Perform dewatering operations so that below-grade Work is performed or installed in dry conditions, unless otherwise specified or approved for installation in wet conditions.

B. Dewatering systems shall be installed in accordance with the approved Dewatering Work Plan. If changes are necessary to meet requirements of this specification, a new plan shall be submitted.

3.4 PROTECTON OF WORK

A. Take all necessary precautions, through dewatering to preserve the material below and beyond the established lines of all excavations. Any damage to the Work due to the Contractor's operations shall be repaired as directed by the Engineer at the expense of and by the Contractor and at no cost to the Owner

3.5 FIELD QUALITY CONTROL

A. Repair damage caused by dewatering operations at no cost to the Owner.

B. Inspect, maintain, and promptly repair damage to dewatering facilities.

3.6 CLEANING

A. After having served their purpose, relocate and/or remove dewatering facilities so as not to interfere with the operation of the Work.

B. Return disturbed and adjacent areas to the condition existing prior to the start of Work.

3.7 SUBMITTAL SCHEDULE

ITEM NO.	SUBMITTAL REQUIREMENT	WITH BID	NO. OF WEEKS AFTER AWARD	AS INDICATED
31 23 19-A -01	Dewatering Work Plan			Provide the following information 10 calendar days prior to first use.

END OF SECTION

SECTION 32 92 00-A

TOPSOIL AND SEEDING

SUMMARY OF CHANGE(S):

Rev	Date	Package	DESCRIPTION / JUSTIFICATION	AUTHOR

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. The work addressed in this section includes topsoil and seeding for dam embankments (SMP-01, SMP-11, TEMP-SMP-01, TEMP-SMP-02).

1.2 REFERENCES

A. Section 731-01 of the Standard Specifications.

A. ASTM International (ASTM)

1. D6913 Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

2. D2976 Standard Test Methods for pH of Peat Materials

3. D4972 Standard Test Methods for pH of Soils

4. G51 Standard Test Methods for Measuring pH of Soil for use in Corrosion Testing

1.3 SUBMITTALS

A. Refer to Submittal Schedule at end of Part 3 for a list of submittal requirements for this Section.

B. Submit Product Data for seed mix, fertilizer, mulch, and other products to be used, including recommended application rates for lime and fertilizer.

C. Topsoil: Topsoil used on this project shall be tested by a certified soils laboratory for organic matter, pH value, and gradation, and must be approved before placement. The soils laboratory shall provide recommendations for modifying and amending the material as necessary to properly support the vegetation.

D. Submit Manufacturer's Certificate certifying that products meet or exceed specified requirements.

E. As part of closeout of the Project, provide maintenance instructions; cutting method and maximum grass height; and types, application frequency, and recommended coverage of fertilizer, as appropriate.

F. Soil Testing Laboratory Qualifications: An independent laboratory recognized by the State Department of Agriculture, with experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

G. Topsoil Test Results – Submit written report from laboratory of topsoil laboratory test results for the organic matter, pH value, and gradation per ASTM D6913. Tests shall be performed and certified by a certified soils testing laboratory. One set of test results shall be provided for each topsoil stockpile source to be used on the project.
   1. A minimum of three representative samples shall be taken from varied locations of proposed topsoil.
   2. Report suitability of tested soil for turf growth and provide recommendations for soil treatments and soil amendments to be incorporated.
   3. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem minerals are present, provide additional recommendations for corrective action.

1.4 QUALITY ASSURANCE

A. Perform work in conformance, except as modified in this Section, with current edition of New York State Department of Transportation Standard Specifications, referred to here as Standard Specification.

B. Topsoil used on this project shall be tested and approved before placement.

C. Secure approval before acquiring topsoil to be furnished or delivering topsoil to the project site.

PART 2 PRODUCTS

2.1 GENERAL MATERIALS

A. The Contractor shall be responsible for calculation of the required quantity and volume of each material based on the Drawings, test results, estimates of wastage during delivery, stockpiling, haulage and placement, experience with similar materials, and other factors as identified by the Contractor.

B. The Contractor shall be responsible for all costs associated with delays or material quantity or volume shortfalls due to miscalculation, or required rework resulting from not meeting material or placement specifications.

C. All products, including but not limited to seed, fertilizers, mulch, lime, and herbicides, shall be approved for use by the Owner prior to application at the site. All products must comply with applicable Federal, State, and local requirements for products used within close proximity of drinking water supply reservoirs.

2.2 TOPSOIL

A. Topsoil shall meet the requirements of Section 713-01 of the NYS DOT Standard Specifications, Construction and Materials. Reuse of topsoil from on-site stripping shall comply with Section 713-01.A. Imported topsoil, if required, shall meet the requirements of Section 713-01.B.2.1 (Topsoil – Roadside).

B. Utilizing stockpiled material from initial stripping or importing topsoil from offsite, the Contractor shall ensure that sufficient quantities exist to allow placement of 6 inches (after settlement) of topsoil over all graded earthen areas and over any other areas to be seeded.

C. Topsoil shall be a friable loam containing a large amount of humus and shall be original surface soil of good, rich, uniform quality, free from any material such as hard clods, stiff clay, hardpan, partially disintegrated stone, pebbles larger than ½ inch in diameter, lime, cement, bricks, ashes, cinders, slag, concrete, bitumen or its residue, boards, stocks, chips, or other undesirable material harmful or unnecessary to plant growth. Maximum particle size shall be 2 inches.

D. Topsoil shall be natural topsoil without admixture of subsoil material, and shall be classifiable as loam, silt loam, clay loam, sandy loam, or a combination thereof.

E. The pH shall range from 5.5 to 7.6.

F. If used, imported topsoil shall contain not less than 3% nor more than 8% by weight organic matter as determined by loss on ignition of oven-dried samples to 65 degrees C.

G. Topsoil shall be free from refuse, material toxic or otherwise deleterious to plant growth, subsoil, sod clumps, seeds or other viable propagules of invasive plants, woody vegetation and stumps, roots, brush, refuse, stones, clay lumps, or similar objects. Construction and demolition debris as classified under 6 NYCRR Part 360, other than

uncontaminated land clearing debris, shall not be used to manufacture or amend topsoil. Sod and herbaceous growth such as grass and noninvasive weeds need not be removed, but shall be thoroughly broken up and mixed with the soil during handling or manufacturing operations.

2.3 SEED MIXTURES

A. Temporary seeding should be performed for area where construction activities have temporarily or permanently ceased. Temporary seeding as soil stabilization should begin by the end of the next business day and be completed within three business days. Seed should be placed at 75 lbs/acre pure live seed (PLS) of the species listed below:
   1. Kentucky Bluegrass, Reed Canary Grass, Tall Fescue (Endophyte-Free)
   2. Or equal, as approved by the Engineer.

B. The permanent seed mixture is shown in the table below for all areas where topsoil is placed pertaining to TEMP-SMP-01, TEMP-SMP-02, SMP-01, and SMP-11 dams:

Seed	Rate (lb/acre)	Percent by weight (%)	Notes
Fine Fescues	20	60-70%	Minimum 2 varieties, must be 50% or more of Creeping Red Fescue
Perennial Ryegrass	4	10-15%	Minimum 2 varieties, “turf” type
Redtop	2	5-10%	
White Clover	4	10-15%	

A. A permanent seed mixture may be submitted to the Engineer at any time for approval and placement on Dam Structures TEMP-SMP-01, TEMP-SMP-02, SMP-01, SMP-11.
   1. Permanent seeding shall be applied as soon as the Dam Structures achieve final grade.
   2. An alternative seed mixture may be submitted to the Engineer for review.

2.4 MULCH

A. Temporary mulch shall meet the requirements of the New York State Standards and Specifications for Erosion and Sediment Control.

B. Temporary mulching as soil stabilization should begin by the end of the next business day and be completed within three business days.

C. Temporary mulch may be straw, matting, netting, bark, wood chips, or other suitable material as approved by the Engineer, and shall be reasonably clean and free of noxious weeds and deleterious material. Hydraulically applied fiber mulch shall be biodegradable,

dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

D. Tackifier for hydroseeding shall be a colloidal tackifier recommended by the fiber-mulch manufacturer for slurry application; nontoxic and free of plant growth or germination inhibitors.

E. For seeded areas, mulch shall consist of small grain straw applied at a rate of 4 tons/acre and anchored with fiber hydromulch at the rate of 500 to 750 pounds/acre. The wood fiber mulch shall be applied through a hydroseeder immediately after seeding. A flexible growth medium with seed may be used in lieu of wood fiber as approved by the Engineer.

2.5 EQUIPMENT

A. Other Materials and Equipment: Select other materials and equipment not specifically described but required for a complete and proper installation subject to review by A/E prior to use.

PART 3 EXECUTION

3.1 PREPARATION

A. Before liming, fertilizing, and seeding, the topsoil surfaces of disturbed areas, excluding wetlands, shall be trimmed and worked to true line from unsightly variation, bumps, ridges, and depressions; and all detrimental material, roots, and stones larger than 2 inches in any dimension shall be removed from the soil.

B. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.

C. Not earlier than 24 hours before the seed is to be sown, the soil surface to be seeded, excluding wetlands, shall be thoroughly cultivated to a depth of not less than 2 inches with a weighted disc, tiller, pulvimixer, or other equipment until the surface is smooth and, in a condition, acceptable to the Engineer.

D. If the prepared surface becomes eroded as a result of rain or for any other reason, or becomes crusted before the seed is sown, the surface shall again be cultivated for seeding.

E. Ground preparation operations shall be performed only when the ground is in a tillable and workable condition, as determined by the Engineer.

F. Provide protection as needed to maintain these materials dry.

3.2 FIELD QUALITY CONTROL

A. Areas requiring rework due to failure of the grass to thrive shall be the responsibility of the Contractor, at the discretion and direction of the Engineer.

B. Such rework shall be completed by the Contractor as directed by the Engineer at no cost to the Owner.

3.3 TOPSOILING

A. In the areas to be topsoiled, complete all grading necessary to bring the surface to the lines indicated on the Drawings and parallel to the proposed finished grade. The finished grade shown on the plans includes a topsoil depth of 6 inches after placement and settlement. Topsoil shall not be placed until the area to be covered has been shaped, trimmed, finished, and all other construction work in the area has been completed.

B. These areas are to be free from rock or other foreign material of 2 inches or greater in any dimension.

C. Immediately prior to placing Topsoil, the areas shall be loosened by discing or scarifying to a depth of at least 2 inches to permit proper bonding of the Topsoil to the ground on which it is placed.

D. Topsoil shall not be placed when the ground is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to the proposed planting or to proper grading.

E. Topsoil shall be placed and spread to a depth sufficiently greater than the minimum thickness specified so that after natural settlement, the completed work shall conform to the lines, grades, and elevations indicated on the Drawings. Unless specified otherwise, the thickness of topsoil after settlement shall be 6 inches minimum.

F. After spreading the topsoil, all large stiff clods, hard lumps, large rocks, stumps, litter, or other foreign matter shall be raked up and removed from the topsoil area and disposed of offsite.

G. The area shall then be rolled with a light roller weighing not less than 100 pounds and not over 210 pounds per foot of width with an approved cultipacker.

H. If soil or weather conditions are unsuitable, cease topsoil operations and resume operations when conditions permit.

3.4 LIME APPLICATION

A. Apply lime at application rate recommended by soil analysis. Only apply lime if pH is below 5.5.

3.5 SEEDING

A. Seeding and mulching shall be done on all earth areas disturbed by construction or as designated by the Engineer.

B. Seeding and mulching shall be carried out immediately behind construction and shall be considered a part of construction. Deviations from this procedure shall be only with the written authorization of the Engineer.

C. Apply types and rates as specified herein and in Section 713 of the NYS DOT Standard Specifications, Construction and Materials, or according to seed manufacturer recommendations, as applicable.

3.6 MANUAL SEEDING, AND MULCHING

A. Apply all amendments to topsoil prior to manual seeding.

B. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
   1. Evenly distribute seed by sowing equal quantities in 2 directions at right angles to each other.
   2. Do not use wet seed or seed that is moldy or otherwise damaged.
   3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Apply mulch as required to retain soil and grass.

E. Mulch areas by spreading light cover of mulch over seeded area at a rate of not less than 2.0 tons per acre.

3.7 HYDROSEEDING

A. Mix specified seed and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
   1. Mix slurry with fiber-mulch manufacturer's recommended tackifier.
   2. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1,500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.
   3. Spray-apply slurry uniformly to all areas to be seeded in a 2-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre.

3.8 MAINTENANCE

A. The Contractor shall be responsible for the establishment of permanent turf. The Contractor shall be responsible for erosion control until turf is established and accepted. Areas of sparse growth shall be reseeded at no additional cost to the Owner.

B. Once permanent turf is established, the Owner will mow grass at the direction of the Contractor. The Contractor shall witness mowing and direct the Owner to stop as needed. Rutting or damage shall be repaired by the Contractor.

C. Maintain seeded areas for 3 months from Date of Substantial Completion or as otherwise provided for during turnover of the Project from the Contractor to the Owner.

D. Mow grass at regular intervals to maintain at maximum height of 12 inches. Do not cut more than ⅓ of grass blade at each mowing. Perform first mowing when seedlings are 40 percent higher than desired height.

E. Water to prevent grass and soil from drying out.

F. Control growth of weeds. Apply herbicides, as needed, in accordance with applicable requirements of the NYS DOT Standard Specification, Construction and Materials and as approved by the Owner. Remedy damage resulting from improper use of herbicides.

G. Immediately reseed areas showing bare spots. The Contractor is responsible for establishing a thick stand of grass and shall repair and reseed washouts, gullies, and eroded areas as necessary until grass is established.

H. Protect seeded areas with warning signs during maintenance period.

3.9 TOLERANCES

A. Construct material limits within a tolerance of 0.1 foot except where dimensions or grades are shown or specified as minimum. Perform grading to maintain slopes and drainage as shown on Drawings. No reverse slopes will be permitted.

B. Maintain constant uniform slopes between finish grade contour lines and spot elevations shown on the Drawings.

3.10 ADJUSTING AND CLEANING

A. Removal of Erosion Control Measures: Remove temporary erosion control measures at completion of construction activities, and when permitted to do so by authority having jurisdiction. Dispose in accordance with applicable federal, state and local requirements.

3.11 SUBMITTAL SCHEDULE

ITEM NO.	SUBMITTAL REQUIREMENT	WITH BID	NO. OF WEEKS AFTER AWARD	AS INDICATED
32 92 00-A -01	Certification, sieve analysis, other test results, source, for all imported materials.			Provide the following information 10 calendar days prior to first use.
32 92 00-A -02	Manufacturer's certification of seed mixture, fertilizer, mulch.			Provide the following information 10 calendar days prior to first use.
32 92 00-A -03	Maintenance instructions for cutting method and maximum grass height, recommended coverage of fertilizers.			Provide the following information 10 calendar days prior to first use.

END OF SECTION

SECTION 32 99 00–A

HYDROTURF CS

SUMMARY OF CHANGE(S):

Rev	Date	Package	DESCRIPTION / JUSTIFICATION	AUTHOR

PART 1 GENERAL

1.1 SUMMARY

A. Section includes provisions for dams structures (SMP-01, SMP-11, TEMP-SMP-01, TEMP-SMP-02).

B. Section Includes:
1. References and Definitions related to the HydroTurf® CS product.
2. Specifications for HydroTurf Subgrade Preparation
3. Specifications for HydroTurf CS Structured Geomembrane
4. Specifications for HydroTurf CS Engineered Turf Component (Turf Type 2)
5. Specifications for HydroTurf HydroBinder Infill Component
6. Specifications for Penetrating Catalyzed Colloidal Silicate Concrete Treatment for the HydroTurf System

1.2 REFERENCES

A. ASTM International (ASTM):

1.	ASTM C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
2.	ASTM C150	Standard Specification for Portland Cement
3.	ASTM C387	Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar ASTM D792 – Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement
4.	ASTM D1004	Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting
5.	ASTM D1204	Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
6.	ASTM D1238	Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer

7.	ASTM D1505	Standard Test Method for Density of Plastics by Density-Gradient Technique
8.	ASTM D1603	Standard Test Method for Carbon Black Content in Olefin Plastics
9.	ASTM D1693	Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
10.	ASTM D1907	Standard Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method
11.	ASTM D2256	Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method
12.	ASTM D3218	Standard Specification for Polyolefin Monofilaments
13.	ASTM D3895	Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
14.	ASTM D4218	Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds By the Muffle-Furnace Technique
15.	ASTM D4833	Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
16.	ASTM D5261	Standard Test Method for Measuring Mass per Unit Area of Geotextiles
17.	ASTM D5321	Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method
18.	ASTM D5323	Standard Test Method for Determination of 2% Secant Modulus for Polyethylene Geomembranes
19.	ASTM D5397	Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
20.	ASTM D5596	Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
21.	ASTM D5617	Standard Test Method for Multi-Axial Tension Test for Geosynthetics
22.	ASTM D5721	Standard Practice for Air-Oven Aging of Polyolefin Geomembranes
23.	ASTM D5885	Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry
24.	ASTM D5994	Standard Test Method for Measuring Core Thickness of Textured Geomembrane
25.	ASTM D6392	Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods

26.	ASTM D6693	Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
27.	ASTM D6913	Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
28.	ASTM D7007	Standard Practices for Electrical Methods for Locating Leaks in Geomembranes Covered with Water or Earth Materials
29.	ASTM C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
30.	ASTM C150	Standard Specification for Portland Cement
31.	ASTM C387	Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar
32.	ASTM D1335	Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings
33.	ASTM D1577	Standard Test Methods for Linear Density of Textile Fibers
34.	ASTM D4595	Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
35.	ASTM D5793	Standard Test Method for Binding Sites per Unit Length or Width of Pile Yarn Floor Coverings
36.	ASTM D5823	Standard Test Method for Tuft Height of Pile Floor Coverings
37.	ASTM D5848	Standard Test Method for Mass per Unit Area of Pile Yarn Floor Coverings
38.	ASTM D6241	Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

B. American Concrete Institute (ACI) - 306R-10 Guide to Cold Weather Concreting

C. Geosynthetics Research Institute (GRI) testing methods:

1.	GRI-GM11	Accelerated Weathering of Geomembranes Using a Fluorescent UVA Device.
2.	GRI-GM12	Measurement of the Asperity Height of Textured Geomembranes Using a Depth Gage
3.	GRI-GM13	Test Methods, Test Properties, and Testing Frequency and for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes
4.	GRI-GM19	Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes

1.3 DEFINITIONS

The definitions below are as related to the HydroTurf® Product and the Construction Quality Assurance (CQA) Plan definitions for the product. Whenever the terms listed below are used, the intent and meaning will be

interpreted as indicated.

Acclimation - Physiological/thermal adjustment. Required in the geomembrane deployment process.

HydroTurf® CS - HydroTurf CS is a composite system of a structured geomembrane overlain by an engineered synthetic turf which is infilled with a cementitious mix (HydroBinder).

Construction Quality Assurance (CQA) - Construction Quality Assurance includes but is not limited to observations and documentation of materials and workmanship necessary to show that a particular project is being constructed according to site-specific specifications and within regulatory guidelines.

Construction Quality Assurance (CQA) Personnel - Construction Quality Assurance (CQA) personnel are representatives of the Professional of Record (POR) who work under direct supervision of the POR. The CQA personnel are responsible for quality assurance monitoring, applicable conformance sampling and performing onsite tests and observations.

Construction Quality Assurance Professional of Record (POR) - The POR is an authorized representative of the Owner and has overall responsibility for CQA efforts and to confirm the project was constructed in general accordance with site-specific specifications approved by the regulatory authority and contract documents. The POR must be licensed as a Professional Engineer in the State the project is located and experienced in geosynthetics.

Construction Quality Control (CQC) Personnel - CQC Personnel are representatives of the Geosynthetics Installer who work under direct supervision of the Geosynthetics Installer. The Geosynthetics Installers' CQC Personnel are responsible for construction quality control, applicable conformance sampling and performing onsite tests and observations.

Engineered Turf - Component 3 of the HydroTurf® System. A synthetic structured material consisting of one or more geotextiles tufted with polyethylene yarns that resemble grass blades.

Final Cover System Evaluation Report (FCSER) - Upon substantial completion of closure activities, the POR is responsible for the documentation of construction activities relating to the project, and any other inspections or verifications required by the regulatory authority. The FCSER will be signed and stamped by the POR and include documentation necessary for certification closure.

Fish Mouth - A semi-conical opening of the seam that is formed by an edge wrinkle in one sheet of the geomembrane component.

Geomembrane - A synthetic lining material that is also known as Component 2

and/or Agru Super Gripnet® HDPE Geomembrane Liner as it relates to the HydroTurf® System. Used as the primary barrier to infiltration and exfiltration of covered materials. Also referred to as the geomembrane component throughout this document.

HydroBinder® - A proprietary cementitious infill utilized as an infill where higher surface water velocities may occur as well as in anchor trenches where specified.

Manufacturing Quality Control (MQC) - A planned system of inspection and verification to ensure the quality of the final product.

Representative Sample - (With respect to geomembrane destructive testing) - A random specimen of either Component 2 – Agru Super Gripnet HDPE Geomembrane or Component 3 – Engineered Turf material consisting of 1 or more cut pieces (commonly referred to as coupons) from the same rectangular portion of material, oriented along a seam that is removed for field or laboratory testing purposes.

Ripple - Smaller in nature than a wrinkle. A result of thermal/or manufacturing that cannot be folded over.

Snapping - A manual method to an open ended seam to remove tenting as a result of the welding of the geomembrane seams.

Spike - A systematic design for interface friction located on the bottom of the Super Gripnet®.

Specimen - (With respect to geomembrane destructive testing) - A specimen is the individual test strip (sometimes called coupon) from a sample location. A sample location can consist of many specimens.

Studs - A systematic design for drainage located on the top side of the Super Gripnet®.

Tenting - A vertical ridge that is caused by wedge welding geomembrane.

Wrinkle - A portion of the geomembrane that does not lay relatively flat and is not a result of subgrade irregularity and which can be folded over.

1.4 SUBMITTALS

A. Refer to Submittal Schedule at end of Part 3 for a list of submittal requirements for this Section.

B. MANUFACTURER
1. Geomembrane Pre-Production Manufacturer's Product Data
    a. Submit to the OWNER'S REPRESENTATIVE prior to ordering of

geomembrane component:

1.) Certificate of Compliance that shows that the proposed material for this project will meet the project specifications;
2.) Indicate tentative product order date and manufacturer location;
3.) Provide representative Product Data Sheets;
4.) Provide one (1) representative product sample; and
5.) Provide manufacturer's quality control program, including test procedures and frequencies for this product.

2. Pre-Shipment Manufacturer Quality Control (MQC) Data
   a. Submit to the OWNER'S REPRESENTATIVE prior to shipment of geomembrane component:
   1.) A copy of the MQC test results;
   2.) Statement that MQC testing has been done in accordance with manufacturer's quality control program;
   3.) Certificate of Compliance stating;
      a.) Production dates and origin of resin;
      b.) All resin is from same manufacturer;
      c.) Reclaimed resin does not exceed 10 percent by weight; and
      d.) Any additional MQC certifications required by the CONTRACT.
   4.) MQC Certifications shall include:
      a.) Geomembrane roll numbers and identification;
      b.) Sampling procedures; and
      c.) Results of MQC tests, and the test methods used.
3. Conformance Testing
   1.) Sampling required at Manufacturer's Plant prior to shipment:
      1. OWNER'S REPRESENTATIVE shall collect samples at the specified interval and sizes listed below; and OWNER'S REPRESENTATIVE may also have a 3rd party collect the samples and have them shipped to an INDEPENDENT TESTING LABORATORY for testing.
      2. Take samples across entire roll width;
      3. Sample size: 15 inches x roll width;
         a. Indicate machine direction;
         b. Indicate roll identification number;
         c. Assign a unique conformance test number to the sample; and
         d. Mark sample with date listed above.
      4. Conformance frequency samples
         a. Obtain for each resin lot; and Each 100,000 sq. ft. of geomembrane.
      5. Forward samples to the Independent Testing Lab for the following tests (refer to Table 1):
         a. Density (ASTM D 792, Method B);
         b. Carbon black content (ASTM D 4218);
         c. Carbon black dispersion (ASTM D 5596);
         d. Thickness (ASTM D 5994); and

e. Tensile properties (ASTM D 6693/Type IV Specimen).

4. Limitations
   1.) No material will be delivered to the site until Independent Testing Lab results show conformance with the products specifications; and
   2.) The DESIGN ENGINEER will inform the INDEPENDENT TESTING LABORATORY in writing if additional tests are required.

C. GEOSYNTHETICS INSTALLER

1. Prior to beginning the installation of the HydroTurf CS System and its components, GEOSYNTHETICS INSTALLER shall submit the following to the OWNER'S REPRESENTATIVE as it relates to the Geomembrane Component:
   a. Current HydroTurf CS System approved installer certificate;
   b. Shop drawings indicating panel layout and field seams 14 calendar days prior to installation of geomembrane component;
   c. HydroTurf CS system, including geomembrane, installation schedule;
   d. Installation capabilities, including:
      1) Information on equipment proposed for this project; and
      2) Construction Quality Control (CQC) procedures.
   b. Submit to OWNER'S REPRESENTATIVE:
      a. Signed Subgrade Acceptance Certificates for each area to be covered by the geomembrane component;
      b. A flow chart showing GEOSYNTHETICS PERSONNEL responsible positions for this project; and
      c. Resumes of (Include date hired and duration of employment)
         i. Project designated GEOSYNTHETICS SEAMING SUPERVISOR;
         ii. CQC SUPERVISOR if other than above; All personnel who will perform seaming operations;

      d.) Verify in writing that GEOSYNTHETICS INSTALLER'S PERSONNEL have the following experience:
         i. CQC SUPERVISOR and the MASTER GEOMEMBRANE SEAMER;
            i.) Shall have installed at least 5,000,000 square feet of like geosynthetics materials.
         ii. All other GEOSYNTHETICS INSTALLER SEAMING PERSONNEL:
            i.) Shall have seemed at least 1,000,000 sf. of polyethylene geomembrane; and
            ii.) Personnel who have seamed less than 1,000,000 sf. of polyethylene geomembrane will be allowed to seam only under the direct supervision of the MASTER GEOMEMBRANE SEAMER or CQC SUPERVISOR.
      e.) OWNER'S REPRESENTATIVE shall be responsible for approving resumes and qualifications of GEOSYNTHETICS INSTALLER PERSONNEL; and
      f.) GEOSYNTHETICS INSTALLER PERSONNEL shall attend HydroTurf CS orientation prior to beginning the installation.

D. HYDROBINDER INSTALLER
1. submit a certificate stating that the HydroBinder meets or exceeds the requirements outlined in the project specifications, including:
a. That the type of cement meets the requirements of ASTM C150 (AASHTO M85) Type I or Type II, or the type of cement meets the requirements of ASTM C595 (AASHTO M240) Type IL and
b. That the cementitious infill mix shall have a minimum 28-day compressive strength of 5000 psi in accordance with ASTM C 387 as tested in accordance with ASTM C 109

E. CLOSEOUT SUBMITTALS:
1. GEOSYNTHETICS INSTALLER shall furnish to the OWNER upon completion of the project:
a. One year warranty against defects in workmanship;
b. As-built Geomembrane Panel Drawings; and
c. As-built Drawings shall include: Panel locations, Panel identification numbers, Geomembrane roll numbers for each panel, Seam cap, Destructive sample locations, and Location of large repairs.

1.5 DELIVERY, STORAGE AND HANDLING

A. Conform to the manufacturer's recommendations to prevent damage to the materials;

B. Deliver materials to the site only after the OWNER'S REPRESENTATIVE and the OWNER approve required submittals;
1. CQA PERSONNEL shall observe and document that all rolls of geomembrane delivered to the site have been properly identified (at the manufacturer's location) along with the following:
a. Manufacturer's name,
b. Product identification,
c. Lot number,
d. Roll number, and
e. Roll dimensions.
2. CQA PERSONNEL shall observe and document the following:
a. Rolls are wrapped with protective covering; and
b. Rolls are protected from any outside source that could degrade or damage the product.

C. Storage and Handling Requirements
1. On-Site Storage
a. Store in space allocated by the OWNER;
b. Store on level prepared surface (not on wooden pallets) graded to drain away from HydroTurf CS components; and
c. Stack no more than three rolls high.
2. On-Site Handling
a. The GEOSYNTHETICS INSTALLER is responsible for storage and transporting material from storage area to installation area;
b. Use appropriate handling equipment approved by the OWNER'S REPRESENTATIVE;
c. Dragging panels on ground surface will not be permitted; and
d. Do not fold geomembrane component material.

e. Packaging and Waste Management

3. GEOSYNTHETICS INSTALLER shall be responsible for proper containment, collection and disposal of:
   a. Waste and packaging; and
   b. All waste products produced by the installation of the HydroTurf CS System.

1.6 SITE CONDITIONS

A. Ambient Conditions
   1. Excessive heat or cold, ambient temperatures less than 35°F and greater than 104°F, will require additional testing as indicated below; and
   2. The acceptable ambient temperature range may vary from parameters shown in Article 1.06A-1 only if field test seams can pass at the specific ambient temperature at which welding will take place.

1.7 QUALITY ASSURANCE

A. Perform work in conformance, except as modified in this Section, with current edition of New York State Department of Transportation Standard Specifications, referred to here as Standard Specification.

PART 2 PRODUCTS

2.1 MATERIALS

A. GEOMEMBRANE COMPONENT OF HYDROTURF CS SYSTEM
   1. AGRU 50 mil Super Gripnet® HDPE Geomembrane
      a. Manufacturer: AGRU America, Inc.
         1) The geomembrane shall meet or exceed the property values listed in Table 1.
         2) AGRU Super Gripnet HDPE Geomembrane shall be supplied by Watershed Geosynthetics as a component of the HydroTurf CS Revetment System.
      b. SUBSTITUTIONS
         1) Submit an equivalent material for approval that meets or exceeds the property values listed in Table 1

Table 1 – HydroTurf CS Super Gripnet Geomembrane Component Properties

Property	Test Method	HDPE Values
Thickness, nominal, mil (mm)	ASTM D5994	50 (1.25)
Thickness, min avg, mil (mm)		47.5 (1.19)
Thickness (8 out of 10), mil (mm)		45 (1.12)
Thickness, lowest individual., mil (mm)		42.5 (1.06)
Drainage Stud Height, min. avg., mil (mm)	ASTM D7466	130 (3.3)
Friction Spike Height, min. avg., mil (mm)	ASTM D7466	175 (4.45)
Density, g/cc	ASTM D792, Method B	0.94 (min)
Tensile Properties, avg., both directions	ASTM D6693, Type IV	
Strength @ Yield, min. avg., lb/in (N/mm)		110 (19.3)
Elongation @ Yield, min. avg., %, GL=1.3 in		12
Strength @ Break, min. avg., lb/in (N/mm)		110 (19.3)
Elongation @ Break, min., %, GL=2.0 in		200
Tear Resistance, min., avg., lbs (N)	ASTM D1004	38 (169)
Puncture Resistance, min. avg., lbs (N)	ASTM D4833	80 (356)
Carbon Black Content, range in %	ASTM D4218	2-3
Carbon Black Dispersion, Category	ASTM D5596	Only spherical agglomerates for 10 views in Cat. 1 or 2
Stress Crack Resistance, Single Point NCTL, hours	ASTM D5397, Appendix	500
Oxidative Induction Time, minutes	ASTM D 3895, 200°C, 1 atm O_2	≥140
PART 2 Standard Roll Dimensions	PART 3 23-ft (7.0-m) Wide by 500-ft (152-m) Long	
PART 4 Roll Area (approximate)	PART 5 11,500 ft^2 (1,068m^2)	

B. HydroTurf HydroBinder Cementitious Infill

1. HydroBinder is a proprietary cementious product used as the infill component of the HydroTurf system.
   a. The infill material may be delivered in either pallet form of 80 lb. bags or 3000 lb. bulk bag super sacks;
   b. Cement, except as otherwise specified herein, will be a brand of Portland Cement, meeting ASTM C 150 and will be Type I or Type II or meeting ASTM C595 and will be Type IL;
   c. The cementitious infill mix will conform to the requirements of ASTM C 387 for high strength mortars;
   d. The cementitious infill mix will have a minimum 28-day compressive strength of 5000 psi as measured in accordance with ASTM C 109;

e. Freeze-thaw properties of the HydroTurf® system with the HydroBinder® infill treated with the Catalyzed Colloidal Silicate Concrete Treatment shall have been tested in accordance to ASTM C666 with the results of 0.2% loss (avg.) at 100 cycles and <3.0% loss (avg.) at 300 cycles.

2.2 EQUIPMENT

A. Other Materials and Equipment: Select other materials and equipment not specifically described but required for a complete and proper installation subject to review by A/E prior to use.

PART 3 EXECUTION

3.1 INSTALLERS

A. The installer is to be selected from the list of certified installers provided by Watershed Geosynthetics, LLC.

B. Certified Installers:
1. Exact Stormwater: Sean Simonpietri, 804-627-3260
2. Hallaton Environmental Linings: Kennedy Garber, 410-800-8982
3. Chenango Contracting: Nick Brechko, 607-729-8500, x 233
4. Integrity Lining: Charles Parks, 607-745-8592
5. New England Liner: David Welch, 860-426-1880
6. An alternative installer may be selected if approved by Watershed Geosynthetics.

C. Responsibilities for the approval and maintenance of the subgrade are as follows:
1. Keep the accepted subgrade surface in a condition conducive to the deployment of all HydroTurf components.
2. Subgrade acceptance is determined when the deployment of the product, or its components, begins.
3. Maintain the previously accepted subgrade at or above the accepted condition.
4. Identify any part of the subgrade that becomes non-compliant to the specifications during the course of construction.
5. Ensure a timely submission to the OWNER'S REPRESENTATIVE of subgrade acceptance certificates.

3.2 INSPECTION

A. The complete installation will be inspected by the OWNER'S REPRESENTATIVE and the GEOSYNTHETICS INSTALLER'S CONSTRUCTION QUALITY CONTROL SUPERVISOR.

B. The GEOSYNTHETICS INSTALLER'S CONSTRUCTION QUALITY CONTROL SUPERVISOR must submit a letter certifying proper installation to the Engineer.

C. A Watershed Geosynthetics Field Team Representative is required to be on site for each step of the installation process. The Contractor shall be responsible for all costs associated with visits from the manufacturer.
   1. Provide at minimum a 2 weeks notice of the beginning of scheduled work
   2. Submit to the Engineer the manufacturers field report following installation

3.3 SUBGRADE PREPARATION

A. Surface Preparation:
   1. Subgrade shall be smooth (free from ruts, depressions, etc.), uniform, firm and unyielding, and free from rocks, roots or other debris.
   2. No rocks or protrusions greater than 0.75 inch in diameter will be exposed at the subgrade surface.
   3. Approved subgrade shall be capable of supporting the weight of the product, installation equipment, and maintenance equipment.
   4. Daily evaluation shall be performed to show that no changes have occurred that would render the subgrade unacceptable. This may include observations of equipment traversing the work area that would be typical of required construction activities. If subgrade is found to be yielding or unsuitable, the Contractor shall be responsible for measures to bring the subgrade into compliance with this specification.
   5. Compaction requirements may be imposed by the Engineer as required for the project.

B. Anchor Trench Preparation
   1. Anchor trenches shall be excavated to the grades and dimensions as specified on the construction plans.
   2. Anchor trenches shall be straight and uniform with no rough edges.
   3. The inside edge of the anchor trench shall be rounded and smooth.
   4. Anchor trenches shall be free of sharp objects and other deleterious material.

C. Non-Conforming Work
   1. Subgrade not meeting specifications either before or during deployment of the HydroTurf, or its components, will be reported to the OWNER'S REPRESENTATIVE and corrected as required.

3.4 EXAMINATION OF GEOMEMBRANE:

A. Pre-Installation Testing
   1. FIELD TRIAL SEAM TESTING – TRIAL WELDS
      a. Prior to geomembrane component welding, CQA personnel shall observe and document the following:
      b. Welding apparatus (both wedge and extrusion welder) are tested; At daily start-up; Immediately after any break; and Anytime the machine is turned off for more than 30 minutes.
   2. Procedures
      a. The trial weld will be completed under conditions similar to those under which the panels that will be welded;

b. If at any time, the CQA PERSONNEL believe that an operator or welding apparatus is not functioning properly, a Field Trial Seam Test must be performed;
c. Any dispute concerning proper installation techniques or the proper function of welding equipment shall be resolved by the OWNER'S REPRESENTATIVE;
d. The trial weld must be allowed to cool to ambient temperature before testing; and
e. Trial weld samples must comply with "PASSING CRITERIA FOR WELDS" included in Section 3..
f. Field Seam Test Failure
    1) Unacceptable locus-of-break codes per their description in ASTM D6392:
        a) Hot Wedge: AD and AD-Brk>25%
        b) Extrusion Fillet: AD1, AD2, AD-WLD (unless strength is achieved)
    2) There shall be no apparent weld separation (i.e., greater than 1/8 inch); and
    3) The INDEPENDENT TESTING LABORATORY strength tests must:
        a) Meet the manufacturer's specifications for the sample sheets; or
        b) Percentage of the manufacturer's parent sheet strength as determined by the manufacturer; and
        c) For dual-track fusion welds, both sides (the inner and outer weld) must meet the minimum requirements for a satisfactory peel test.

3. Additional Field Seam Testing Requirements:
    a. A trial weld will also be obtained prior to welding tie-ins;
    b. The trial weld sample must be 3 feet long and 12 inches wide, with the seam centered lengthwise;
    c. If a welding apparatus exceeds 5 hours in the second half of the day, another trial seam must be performed;
    d. Required number of specimens per trial weld:
        1) Two coupons for shear and two coupons for peel; and
        2) Both the inner and outer welds of dual track fusion welds: must be tested for each peel test coupon; or additional coupons may be required.
4. CQA documentation of trial seam procedures will include the following:
    a. The names of the seaming personnel;
    b. The name of the welding technician;
    c. The welding apparatus number, time, date;
    d. Ambient air temperature; and
    e. Welding apparatus temperature.

3.5 INTALLATION OF GEOMEMBRANE:

A. Geomembrane Component will not be deployed under following conditions:

1. During precipitation;
2. In the presence of excessive moisture as determined by the CQA Personnel onsite;
3. In areas of ponded water; and
4. In the presence of excessive winds (sustained winds greater than 25 MPH) or at the discretion of the POR.

B. CQA PERSONNEL shall observe the following while the geomembrane component is being deployed:
1. Use equipment which will not damage geomembrane;
2. Observe that personnel working on geomembrane do not engage in activities that could damage HydroTurf CS Components;
3. Smoking on the liner is prohibited;
4. Clamps and other metal tools are not tossed or thrown;
5. Geomembrane component has had adequate time to acclimate to ambient temperature prior to welding;
6. Panels are deployed with the spike down and the stud side up;
7. The deployment method will protect both the geomembrane component as well as the underlying subgrade;
8. Adequate anchoring techniques are placed to prevent uplift by wind;
9. Anchoring techniques are used that will not damage the geomembrane component;
10. Continuous anchors are used along leading edges of the geomembrane to reduce wind flow under panels;
11. Panels will be deployed perpendicular to slope elevation contours;
12. Generation of seams will be reduced where possible;
13. Protect geomembrane in heavy traffic areas using methods approved by the POR;
14. Rubber tired ATV's are acceptable if specified wheel pressure limitation is specifically observed and provided to the POR by the GEOSYNTHETICS INSTALLER in writing;
15. The bottom and side anchor trenches are left open until the engineered turf and sand infill placement are complete;
16. Top anchor trenches are backfilled as soon as practical to avoid creeping of the geomembrane;
17. Verify that the HydroTurf CS system is properly deployed into the anchor trench prior to backfilling;
18. Where possible, anchor trenches are filled when temperatures are coolest to reduce bridging of the geomembrane component;
19. Material placed in anchor trenches are placed in uniform lifts, not to exceed 12 inches loose thickness and are compacted;
20. In-place moisture/density tests in anchor trenches may be taken at the discretion of the POR; and
21. Slightly rounded corners will be provided in anchor trenches.

C. Wrinkles
1. The CQA PERSONNEL shall:
2. Inspect geomembrane for wrinkles;

a. Notify the GEOSYNTHETICS INSTALLER if wrinkles are present above the maximum tolerance level as described below;
b. Document corrective actions taken to reduce the wrinkles;
c. Observe that wrinkles are reduced prior to field seaming; and
d. Observe that snapping procedures described in Article 3.5 SPECIAL TECHNIQUES are followed.

3. Any wrinkles that can fold over must be repaired if:
a. Overnight temperature reduction does not contract the geomembrane to an acceptable level as determined by the CQA PERSONNEL; and
b. Time constraints do not allow for an overnight wait time to be observed whether wrinkles were reduced adequately.

D. Geomembrane Component Field Seaming

1. CQA PERSONNEL must observe the following:
a. Prior to geomembrane seaming operations;
b. Panel layout drawing has been accepted by the POR;
c. A seam numbering system has been incorporated as agreed upon by the POR and GEOSYNTHETICS INSTALLER prior to the start of seaming operations;
d. The GEOSYNTHETICS INSTALLER shall have a previously agreed upon number of welding apparatus and spare parts necessary to perform the work;
e. Verify that equipment used for welding will not damage any HydroTurf CS® system components;
f. The extrusion welding machine is purged to remove heat degraded extrudate;
g. Seam grinding has been completed less than one hour before seam welding;
h. The upper sheet is beveled (extrusion welding only);
i. The ambient temperature requirements (Section 1.6 SITE CONDITIONS), are met;
j. The contact surfaces of the sheets are clean, free of dust, grease, dirt, debris, and moisture prior to welding;
k. The weld area is substantially free of dust, rocks, and other debris;
l. The seams are overlapped a minimum of 3 inches for extrusion and hot wedge welding, or in accordance with manufacturer's recommendations, whichever is more stringent;
m. Panels will be overlapped (shingled) in the downgrade direction;
n. No solvents or adhesives are present in the seam area;
o. The procedure used to temporarily hold the panels together does not damage the panels and does not preclude CQA testing;
p. The panels to be welded are in accordance with the plans and site specific specifications;
q. There is no obvious free moisture in the weld area;
r. Measure and document surface sheet temperature every two hours; and
s. At the end of each day or installation segment, un-seamed edges are anchored with sandbags or other approved anchoring device.

2. During Geomembrane Seaming Operations;

a. At the end of previously placed welds, (with a cooling time longer than 5 minutes), grinding is required to expose new material before restarting a weld (extrusion welding only).

E. Special Techniques
1. During field seaming operations special attention will be given to the following:
a. Once two panels have been seamed together or at the approx. 1/3 seaming process, a seam snapping process shall be applied;
1) Perform with manual labor by utilizing 3-4 technicians on the open side of the panel applying a pulling pressure to snap out the tented welded seam.

F. Testing Concurrent with Installation
1. DESTRUCTIVE AND NON-DESTRUCTIVE TESTING
a. NON-DESTRUCTIVE SEAM TESTING
1) GEOSYNTHETICS INSTALLER shall:
a) Non-destructively test field welds for continuity over their full length using vacuum test units; and
(1) Perform concurrently with seaming work progress; and
(2) Repair seam defects in accordance with Article 3.8 REPAIR PROCEDURES.
b) Non-destructive testing procedures - Vacuum Box Testing for Extrusion Welds
(1) Vacuum box testing equipment for extrusion welds will have:
(a) A rigid housing;
(b) Transparent viewing window;
(c) A soft rubber gasket attached to bottom of housing;
(d) Porthole or valve assembly; and
(e) A vacuum gauge.
(f) Be capable of applying 5 psi gage pressure of vacuum to the box.
(g) Have a soapy solution.
(2) Vacuum Box testing procedures:
(a) Clean window, gasket surfaces, and check for leaks;
(b) Energize vacuum pump and reduce tank pressure to approximately 5 psi;
(c) Wet a strip of geomembrane approximately 12 inches by 30 inches (or length of box) with soapy solution;
(d) Place box over wetted area and compress;
(e) Close bleed valve and open vacuum valve;
(f) Ensure that a leak tight seal is created;

(g) Examine length of weld through viewing window for presence of soap bubbles for a period of not less than 10 seconds; and

(h) If no bubbles appear after 10 seconds, close vacuum valve and open bleed valve, move box over next adjoining area with minimum three inches overlap and repeat process.

(3) Defects:

(a) Mark with a defect code;

(b) Repair the area in accordance with Section 38 REPAIR PROCEDURES; and

(c) Retest the repaired area.

c) Non-destructive testing procedures - Air Pressure Testing equipment for Double Fusion Welds:

(1) Air Pressure Testing equipment for double fusion seams:

(a) An air pump, equipped with pressure gauge having an accuracy of 1 psi, capable of generating and sustaining a pressure between 25 to 30 psi and mounted on a cushion;

(b) Rubber hose with fittings and connections; and

(c) Sharp hollow needle or other pressure feed device approved by the Owner.

(2) Air Pressure testing procedures:

(a) Seal both ends of the seam to be tested;

(b) Insert a needle or other approved pressure feed device into tunnel created by double hot wedge seaming and insert a protective cushion between air pump and geomembrane;

(c) Energize air pump to 25 to 30 psi, close valve, and sustain pressure for a minimum of five minutes;

(d) If loss of pressure exceeds 2 psi or does not stabilize, locate faulty area and repair in accordance with Article 3.8 REPAIR PROCEDURES;

(e) Release pressure at opposite end of seam from gauge to verify that the seam is not blocked; and

(f) Remove approved pressure feed device and seal penetration holes by extrusion welding.

2) DESTRUCTIVE SEAM TESTING Geomembrane Component:
a) GEOSYNTHETICS INSTALLER shall:
(1) Cut destructive samples 12 inches wide by 48 inches long with seam centered lengthwise;
(2) Repair holes in geomembrane resulting from obtaining destructive samples and vacuum test patches;
(3) Obtain two 1-inch wide specimens from each side of the sample, test for peel and shear in the field;
Provide OWNER'S REPRESENTATIVE with One sample per 500 feet of seam length per welding apparatus prior to completion of liner installation.
b) OWNER'S REPRESENTATIVE shall:
(1) Mark destructive samples with:
(a) Consecutive numbering;
(b) Location;
(c) Apparatus I.D.;
(d) Technician I.D.;
(e) Engineer I.D.;
(f) Apparatus settings; and
(g) Date;
(2) Record, in written form:
(a) Weld and test date;
(b) Time;
(c) Location;
(d) Seam number;
(e) Ambient temperatures;
(f) Machine settings;
(g) Technician I.D.;
(h) Apparatus I.D.; and
(i) Pass or fail description.

2. PASSING CRITERIA FOR WELDS
a. Passing criteria are based on Geosynthetic Institute Test Method GM-19 for geomembrane seams.
1) An extrusion or fusion-welded seam will pass when the following values are met:
a) Shear and peel strengths for 4 out of 5 test specimens (the 5^{th} specimen can be as low as 80 percent of the listed values) for 50-mil HDPE geomembrane:
(1) Shear strength (lb./in) 100
(2) Shear elongation at break (%) 50
(3) Peel strength (lb./in) 75 (65 extrusion weld), and
(4) Peel separation (%) 25
2) A geomembrane seam sample passes the field testing when:
a) The break is a film tear bond (FTB);

b) The seam strength meets the required strength values for peel and shear given above; and
c) For dual track welds, both welds pass.

3) Elongation measurements should be omitted for field-testing.

3.6 INSTALLATION OF ENGINEERED TURF COMPONENT:

A. CQA PERSONNEL shall verify that:
1. Engineered Turf tufts are not excessively pulled out by the installation process; and
2. After the first panel is deployed, all subsequent panels are deployed on top of the previous panel, seamed, and then flipped into position.

3.7 ENGINEERED TURF COMPONENT DEPLOYMENT

A. Prior to installation of Engineered Turf Component, the CQA PERSONNEL must observe the following:
1. HydroTurf CS geomembrane component has been seamed, tested, approved, and is released for further component deployment by the POR; and
2. The supporting surface (e.g., the geomembrane) is substantially free of debris or large scraps.

B. During deployment of Engineered Turf, the CQA personnel must observe the following:
1. Observe the turf as it is deployed and record defects and disposition of the defects (i.e., panel rejected, patch installed, etc.);
2. That repairs are made in accordance with the HydroTurf Installation Guidelines;
3. Equipment used does not damage the turf or underlying geomembrane;
4. That all panels are deployed from the top of the slope in a way that the Engineered Turf filaments are pointing upslope after deployment is complete;
5. That the turf is anchored to prevent movement by the wind (the GEOSYNTHETICS INSTALLER is responsible for any damage resulting to or from windblown Engineered Turf);
6. That the turf remains substantially free of contaminants;
7. That the turf is laid substantially smooth;
8. That on slopes, the turf is secured with sandbag anchoring at the top of the slope after deployment;
9. Fusion Seaming Method
a. Engineered Turf fusion seaming device will be a DemTech VM20/4/A (Model No. VM-20/4/A Pro-Wedge Welder 120V, VM20 Outfitted with 100-KIT/4S/VC/A.2 Welding Kit, 4-in, 220V, S.S.) fusion welder only.
b. Fusion seams require a minimum of 5 inches of overlap.
c. Demonstrate the preparation methods and equipment utilized for removal of the salvage from the outside edge of the rolls of turf (i.e. trimming & cutting devices). Mechanical trimming and cutting devices will be utilized for salvage trimming. Box blades and knives shall not be utilized for salvage preparations. Fraying of geotextile strands when performing the removal of salvage is not acceptable.
d. Frayed or loose edges and/or geotextile strands shall be cut off or removed.

e. Since the temperature and speed controls of the DemTech VM-20 wedge welder are variable and can be increased / decreased depending on weather and environment conditions, the temperature and speed shall be confirmed with a trial seam. This trial seam shall be field tested. Trial seams shall be performed at the being of each day and during the day when the weather (i.e., temperature, humidity, etc.) conditions change.
f. Trial seams shall be performed as outlined in the HydroTurf Installation Guidelines (most recent revision).
g. Production fusion seams shall be continuous and have no gaps.
h. Any damage and defects (including burnouts) that occur during production seaming will be repaired as outlined in the
i. HydroTurf Installation Guidelines (most recent revision).
j. All seams not passing the visual inspection shall be repaired.
k. After seaming operations, the edges of the synthetic turf panels shall be sufficiently anchored with sandbags in the top of slope perimeter anchor trenches unless otherwise noted on the construction drawings.

C. EQUIPMENT ON THE TURF:
1. Construction equipment on the deployed synthetic turf shall be minimized to reduce the potential for synthetic turf material puncture. Small equipment such as generators shall be placed on scrap synthetic turf / geosynthetic material (rub sheets) above engineered synthetic turf.
2. During Construction:
   a. On slopes exceeding 15%
      1) No equipment will be allowed until HydroBinder Infill is in place.
   b. On slopes less than 15%
      1) ATV type vehicles and/or rubber tracked skid steer machines will be allowed prior to infill placement if the tire / track ground pressure is less than 5 psi.
   c. Equipment operators shall inspect equipment rubber tires or tracks for sharp protrusions from foreign matter or tire/track damage, embedded rocks, or other foreign materials protruding from tires/track prior to driving on the synthetic turf. Equipment travel paths driven on synthetic turf shall be as straight as possible with no sharp turns, sudden stops or quick starts.
   d. Damage caused by having equipment on the engineered synthetic turf (i.e., tears, rips, punctures, wrinkles, ripples, movement, etc.) shall be the responsibility of the installer to repair.
3. Post installation, no equipment shall be allowed on the HydroTurf until HydroBinder Infill is fully cured for 28 days:
   a. Driving should be limited and only in areas where the subgrade under the HydroTurf is well-compacted, firm and unyielding.
   b. Drivability tire / track (ground) pressures should be limited to less than 35 psi. Rubber tire and/or tracked vehicles or equipment only.
   c. On slopes flatter than 10%, allowable ground pressures may only be increased with the written approval of the POR.

4. Any activity that may be identified during the course of construction by the POR, OWNER'S REPRESENTATIVE, or CQA PERSONNEL as being a possible danger to the integrity of the HydroTurf CS system will prohibited regardless of any prior approval.

D. Any activity that may be identified during the course of construction by the POR, OWNER'S REPRESENTATIVE, or CQA PERSONNEL as being a possible danger to the integrity of the HydroTurf CS system will prohibited regardless of any prior approval.

3.8 REPAIR AND TIE-IN PROCEDURES

A. GEOMEMBRANE COMPONENT:
1. The GEOSYNTHETICS INSTALLER shall be responsible for repair of damaged or defective areas;
   a. The appropriate repair method shall be decided between the OWNER'S REPRESENTATIVE and the GEOSYNTHETICS INSTALLER.
2. Procedures available include:
   a. Patching: Used to repair holes (over 1/4-inch diameter), tears (over 1/4 inch long), undispersed raw materials, and contamination by foreign matter.
   b. Grinding and welding: Used to repair pinholes, and blemishes.
   c. Capping: Used to repair large lengths of seams.
   d. Removing the seam and replacing with a strip of new material.
3. The CQA Personnel will observe and document the following:
   a. The surface of the geomembrane component is clean at the time of inspection;
   b. Non-conforming geomembrane component is removed and replaced;
   c. Any portion of the geomembrane component exhibiting a flaw identified as defective by the POR or CQA PERSONNEL is replaced;
   d. Repair areas are distinctively marked and the required type of repair is indicated.
4. Repair Methods:
   a. Geomembrane surfaces to be repaired will be abraded (extrusion welds only) no more than 1/2 hour prior to the repair;
   b. All geomembrane surfaces will be clean and dry at the time of repair;
   c. The repair procedures, materials, and techniques will be approved in advance of the specific repair by the OWNER'S REPRESENTATIVE;
   d. Patch Requirements:
      1) Will be a minimum of 12 inches in diameter with all corners rounded;
      2) Will extend at least 6 inches beyond the edge of the defect;
      3) Temporarily bond the patch to the geomembrane with an approved method;
      4) Extrusion weld the patch; and
      5) Vacuum test the repair.
   e. Repair Verification:
      1) CQA PERSONNEL shall number and log each patch repair;

2) CQC REPRESENTATIVE shall non-destructively test each repair using methods specified in this Section; and
3) Provide daily documentation of non-destructive and destructive testing to the OWNER'S REPRESENTATIVE.
4) The documentation will identify; Seams that initially failed the test; and include the evidence that these seams were repaired and retested successfully.

B. ENGINEERED TURF COMPONENT:
1. When Repairs and Tie-Ins of Engineered Turf occur, the CQA PERSONNEL must observe the following:
a. Repairs to Engineered Turf are completed by using a 4-in overlapped heat-bonded seam;
b. All tie-in seams along flatter slopes (i.e. 15% or less) with length greater than 25 feet will use an approved fusion welding machine so that consistent pressure is achieved throughout the seam; and
c. A hand-held heat gun or leister with hand pressure will be used in smaller/concentrated areas. Passing trial seams using the hand-held heat gun shall be performed prior to production seaming. Trial seams shall be performed as outlined in the HydroTurf Installation Guidelines (most recent revision).
2. GEOSYNTHETICS INSTALLER may also demonstrate techniques and practices as follows:
a. Field demonstration and approval by the OWNER'S REPRESENTATIVE is required before incorporating any alternative technique.

3.9 PLACEMENT OF HYDROBINDER

A. Placement of HydroBinder® infill shall be performed as follows:
1. HydroBinder is typically delivered to the jobsite on pallets in either 3000# bulk bags (1 per pallet) or 80# bags (42 per pallet). It is delivered on a flatbed with 16 pallets (typical) per truckload.
2. The HydroBinder shall be installed into the turf while it is in a dry state.
3. Prior to placing the HydroBinder, the engineered turf shall be dry. If the turf is wet from rain or dew, the installer shall wait until it is dry. The installer may attempt to speed up the drying process by using a blower (i.e., leaf blower, industrial blower, etc.).
4. HydroBinder® shall not be installed in inclement, wet or rainy weather, or the threat of inclement weather. Also, the HydroBinder shall not be installed in cold weather as defined by American Concrete Institute (ACI) 306.
5. The HydroBinder infill shall be placed at a minimum thickness of 7/8-inch minimum dry thickness and a ¾-inch minimum finished thickness after hydration and curing. Typically, this thickness is achieved by placing between 6.5 and 7.0 lbs/sf of the dry HydroBinder over the engineered synthetic turf.
6. The infill is to be placed / spread using a manual drop spreader, top-dresser and/or drop spreader attached to low ground pressure equipment with adequate dust control. Alternative methods can be used to spread and place the infill as

approved by the Owner's Representative and/or Engineer. Contractor shall explain in detail in the pre-construction meeting the method of infill deployment to be used. The Owner's Representative and/or Engineer shall approve the method.

7. Manual hand spreading is acceptable when equipment is not practical.

B. The HydroBinder infill will need to be worked into the turfs of the engineered turf such that the turf fibers are in an upright position. This can be achieved as follows:
   1. The infill shall be worked into the turf fibers, so the turf fibers are in an upright position with the infill at a measurable 7/8-inch minimum depth in the dry state. This is typically achieved with common mechanical turf broom, power broom, shop broom, yard rakes, or greens groomer rakes.
   2. Brushing of the HydroBinder infill shall be performed such that the fibers of the engineered turf are upright and trapped fibers are minimal. This shall be confirmed by visual inspection. Multiple brushing passes in multiple directions may be required to achieve this.
   3. The HydroBinder may need to be placed in 2 to 4 lifts with brushing in between lifts to effectively work the material into the tufts and achieve fibers that are upright.
   4. Thickness measurements of the HydroBinder infill shall be taken using a caliper or equivalent device. Measurements shall be taken at a minimum frequency of 5 measurements per 1,000 sf (for smaller projects) or 20 per acre (for larger projects) of installed area.
   5. The desired HydroBinder infill thickness shall be achieved prior to the hydration process.

C. The HydroBinder® infill shall be hydrated in place as follows:
   1. The hydration process shall occur on the same day as the HydroBinder infill placement.
   2. The infill shall be hydrated thoroughly with a light and consistent spray of water to avoid displacement of the non-hydrated infill. Estimated application rate is between 0.12 and 0.20 gallons per square foot of area. During hot temperatures and/or in dry climates, additional water may be needed.
   3. The installer shall not overhydrate the infill so that water begins to runoff and cause loss of cement infill during the process. The general objective is to soak the area to start the hydration process but not to inundate with water beyond saturation of the infill.
   4. The Owner's Representative shall visually verify that the HydroBinder infill has been fully hydrated, and not over hydrated. Visually observe that the top of the HydroBinder has a wet sheen (denoting saturation) but that water is not ponding on top. Also, excavate (with finger or small tool) into the HydroBinder to confirm full hydration of the section has been achieved.
   5. To improve curing, the hydrated area may be covered with plastic sheeting.
   6. If cold weather temperatures are expected, the hydrated area should be covered with heated blankets and plastic sheeting. Procedures in ACI 306 shall be followed for cold weather HydroBinder installation.

7. The HydroBinder infill shall harden within 24 hours following hydration, and shall reach its maximum compressive strength at 28 days. If the HydroBinder has not hardened in 24 hours, it will need to be removed and replaced.
8. Personnel access on the HydroTurf shall be prohibited following the hydration of the HydroBinder until it sets up hard.

D. Once hydration is completed and the HydroBinder has set up (min. 24 hours); backfill and compaction of the remaining perimeter anchor trenches may be performed. The HydroBinder infill layer may be placed using appropriate equipment capable of completing the work;

E. Manual hand spreading and raking is acceptable when mechanical equipment is not practical;

F. For projects where Catalyzed Colloidal Silicate Concrete Treatment is required. Once hydration has been completed, and the HydroBinder® has cured for a minimum of 24 hours and has fully set up; the HydroBinder Catalyzed Colloidal Silicate Concrete Treatment shall be sprayed onto the HydroTurf System in accordance with Section 03 05 59 of these Specifications.

G. CQA PERSONNEL shall verify the following:
1. INSTALLER shall explain in detail in the pre-construction meeting the method of HydroBinder® infill deployment;
2. Installation of HydroBinder infill will only be performed by a Watershed Geosynthetics®' trained installer;
3. HydroBinder shall not be installed in inclement, wet or rainy weather, or the threat of inclement weather;
4. The HydroBinder shall not be installed in freezing temperatures;
5. The HydroBinder will be installed into the turf while it is in a dry state;
6. The HydroBinder will be worked into the tufts so the tufts are in an upright position;
7. The HydroBinder infill will be placed dry at a minimum thickness of 7/8 inch;
8. Do not backfill anchor trenches until turf has been infilled with HydroBinder infill;
9. The hydration process must occur the day of the HydroBinder infill placement;
10. The desired HydroBinder infill thickness will be achieved and confirmed by measurements prior to the hydration process;
11. The cemented infill is hydrated thoroughly however care must be taken to avoid displacement of the non-hydrated infill;
12. Hydration shall start at the upstream or upslope portion and move downstream or downslope;
13. The objective is to soak the area to start the hydration process but not to inundate with water beyond saturation;
14. Once hydration is completed as described, backfill and compaction of the anchor trenches should take place;
15. HydroBinder® that does not set up within 24 hours on account of improper hydration shall be removed and replaced;

16. Cold weather installation of HydroBinder shall be performed in accordance with American Concrete Institute (ACI) - 306R-10 Guide to Cold Weather Concreting; and,
17. For projects where Catalyzed Colloidal Silicate Concrete Treatment is required. Once hydration has been completed, and the HydroBinder has cured for a minimum of 24 hours and has fully set up; the HydroBinder Catalyzed Colloidal Silicate Concrete Treatment shall be sprayed onto the HydroTurf® System in accordance with Section 03 05 59 of these Specifications.

3.10 APPLICATION OF COLLOIDAL CONCRETE TREATMENT

A. P3 Protect product is a green-tinted (dries clear), odorless, non-toxic, and non-flammable penetrant in a colloidal liquid base.

B. Apply P3 Protect treatment as soon as the concrete is hard enough to walk on without damage to the surface (min. 24 hours). Use a 1,500 psi (10 MPa) airless sprayer set at a pressure that will not damage the surface [i.e. – approximately 500 to 1,000 psi (3.5 to 7.0 MPa)]. Apply at a rate of approximately one gallon per140 ft2 (max). For small to medium surface areas, a pump sprayer may be used.

C. If necessary, spray a second application of P3 Protect on the HydroBinder using a 1,500 psi (10MPa) airless sprayer or a pump sprayer at the rate of one quart per 42 ft2 (1 liter per 4 m2).

3.11 INSTALLATION ACCEPTANCE

A. The Geosynthetics Installer retains all ownership and responsibility for the HydroTurf CS system until acceptance by the Owner.
   1. After HydroTurf CS components are deployed, seamed, has passed required testing successfully, and any repairs are made;
      a. The completed installation will be inspected by the OWNER'S REPRESENTATIVE and the GEOSYNTHETICS INSTALLER'S CONSTRUCTION QUALITY CONTROL SUPERVISOR;
      b. Damage and/or defects found during this inspection will be repaired by the GEOSYNTHETICS INSTALLER; and
      c. The installation will not be accepted until it meets the requirements of these specifications and any applicable State, Federal or Local Regulations.

B. Installation of the HydroTurf CS system will be accepted by the POR only when the following has been completed:
   1. The installation is complete;
   2. Seams have been observed and documented by the CQA PERSONNEL and accepted by the POR;
   3. Required independent testing laboratory and field tests have been completed, reviewed and approved;
   4. Required GEOSYNTHETICS INSTALLER supplied documentation has been received, reviewed and approved; and
   5. As built record drawings have been completed and verified by the POR.

C. Imported Material Acceptance: Imported materials specified in this Section are subject to the following requirements:

1. Test acceptable sources for each imported material. Submit certification that material conforms to Specification requirements along with copies of test results from a qualified commercial testing laboratory as required by Submittals Schedule. Furnish material samples by Contract or at Contractor's sole expense. Clearly mark samples to show source of material and intended use on project. Perform sampling of material source in accordance with ASTM D75. Coordinate sampling schedule at least 24 hours in advance with A/E and Owner so they observe sampling procedures.
2. Tentative acceptance of material source based on observation of source by Owner and/or certified test results submitted by Contractor to Owner at Owner's discretion.
3. Deliver no imported materials to site until proposed source and material test submittal(s) has been reviewed by A/E and returned marked "No Exceptions Noted".
4. Final acceptance will be based on tests made on samples of material taken from a completed and compacted course.
5. Testing for final acceptance will be performed by Owner or Owner's representative.
6. If tests conducted by Contractor or Owner indicate that material does not meet Specification requirements, material placement will be terminated until corrective measures are taken.
7. Remove and replace material which does not conform to Specification requirements at the Contractor's sole expense.
8. Sampling and testing performed by Contractor at Contractor's sole expense.

3.12 PROTECTON OF WORK

A. Use all means necessary to prevent erosion of graded areas during construction and until such time as permanent drainage and erosion measures have been installed.

B. Comply with all stipulations and regulations within NYSDEC SPDES General Permit and all other local, state, and federal agencies.]

C. Excavation Safety: Perform excavations in a safe manner. Provide appropriate measures to retain excavation side slopes and prevent cave-ins and rock falls to ensure that persons working in or near the excavation are protected.

D. For trench excavation exceeding 5 feet in depth, provide adequate safety system meeting requirements for applicable state and local codes, rules, regulations, construction safety orders, and federal requirements.

E. A/E has not designed or reviewed, is not responsible for, and does not certify any aspect of trench safety systems and/or safety systems for trench excavation which may be described, shown, or depicted, directly or indirectly, in these plans and specifications.

F. Protect trees, shrubs, lawns, walkways, curbs, vaults, manholes, valve boxes, and other features remaining as a portion of final facilities or landscaping.

G. Protect benchmarks, existing structures, fences, utilities, sidewalks, paving, and curbs from equipment and vehicular traffic.

H. Protect above and below grade utilities that are to remain.

I. Notify A/E of unexpected subsurface conditions and discontinue work in affected area until notified to resume work.

J. Grade top perimeter of excavations to prevent surface water runoff from flowing into excavation.

K. Install erosion control materials or silt fence at toe of fill slopes and around catch basins so as to prevent soil particles from entering the existing adjacent area or the existing storm drain system in accordance with NYSDEC SPDES General Permit on file at Owner's field office.

L. Identify significant landscape features from the Drawings on site with tags and appropriately protect.

3.13 SUBMITTAL SCHEDULE

ITEM NO.	SUBMITTAL REQUIREMENT	WITH BID	NO. OF WEEKS AFTER AWARD	AS INDICATED
32 99 00-A-01	Certification of installer			Provide the following information 10 calendar days prior to first use.
32 99 00-A-02	Certification of geomembrane			Provide the following information 10 calendar days prior to shipment.
32 99 00-A-03	Manufacturer's material data for HydroTurf CS Structured Geomembrane, HydroTurf CS Engineered Turf Component (Turf Type 2), HydroTurf HydroBinder Infill Component, and Penetrating Catalyzed Colloidal Silicate Concrete Treatment			Provide the following information 10 calendar days prior to first use.

ITEM NO.	SUBMITTAL REQUIREMENT	WITH BID	NO. OF WEEKS AFTER AWARD	AS INDICATED
32 99 00-A-04	Installation Report from Construction Quality Control Representative			Provide the following information 10 calendar days after installation.
32-99-00-A-05	Manufacturer's Field Report from Watershed Geosynthetics Field Representatives site visits.			Provide the following information 10 calendar days after installation.

END OF SECTION

SECTION 33 05 13-A

MANHOLES, CLEANOUTS, AND CONCRETE STRUCTURES

SUMMARY OF CHANGE(S):

Rev	Date	Package	DESCRIPTION / JUSTIFICATION	AUTHOR

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes manholes, cleanouts, and concrete structures for dams (SMP-01, SMP-11, TEMP-SMP-01, TEMP-SMP-02).

B. Related Sections:
1. Section 31 00 00-A – Earthwork
2. Section 33 41 00-A – Storm Drainage

C. Use of this Section without including the above-listed items results in omission of basic requirements.

D. In the event of conflict regarding Manholes, Cleanouts, and Concrete Structures requirements between this Section and another section, the provisions of this Section govern.

1.2 REFERENCES

A. In addition to compliance with industry standards and Owner requirements, ensure that the following government acts and regulations (as applicable for any equipment or material) are complied with in design, fabrication, testing and shipment of equipment and materials.

B. Meet or exceed the requirements of the latest edition of the following codes, regulations and standards.

C. American Concrete Institute (ACI):
1. ACI 318 - Building Code Requirements for Structural Concrete.

D. American Society for Testing and Materials (ASTM):
1. ASTM A48/A48M – Standard Specification for Gray Iron Castings.
2. ASTM A123/A123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A536 – Standard Specification for Ductile Iron Castings.

4. ASTM C33/C33M – Standard Specification for Concrete Aggregates.
5. ASTM C387/C387M – Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar.
6. ASTM C443/443M – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
7. ASTM C478/478M – Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.
8. ASTM C497/497M – Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
9. ASTM A615/615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
10. ASTM C891 – Standard Practice for Installation of Underground Precast Concrete Utility Structures.
11. ASTM C923/C923M – Standard Specification for Resilient Connectors Between Reinforced Concrete Manholes Structures, Pipes, and Laterals.
12. ASTM C990/990M – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
13. ASTM C1244/C1244M – Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
14. ASTM D3034 – Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
15. ASTM D3753 – Standard Specification for Glass Fiber (Glass-Fiber-Reinforced Thermosetting-Resin) Manholes and Wetwells.
16. ASTM D4101 – Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials.

E. American Water Works Association (AWWA):
1. AWWA C104 / ANSI A21.4 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C110 / ANSI A21.10 – Ductile-Iron and Gray-Iron Fittings.

F. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO M 199 – Standard Specification for Precast Reinforced Concrete

G. Occupational Health and Safety Administration
1. 1910.27 Scaffolds and Rope Descent Systems

H. New York State Department of Transportation Standard Specifications

1.3 DESIGN REQUIREMENTS

A. Precast Manhole Sections: Conforming to requirements specified in ASTM C478/C478M.

B. Manhole Steps: Capable of withstanding vertical and horizontal load test specified in ASTM C497/497M.

1.4 SUBMITTALS

A. Refer to Submittal Schedule at end of Part 3 for a list of submittal requirements for this Section.

PART 2 PRODUCTS

2.1 PRECAST UNITS

A. Precast Manhole Sections: Conform to ASTM C478/C478M.
   1. Grade Ring: Maximum 6 inches high. Same quality as riser.
   2. Risers:
      a. Minimum Diameter: 48 inches minimum, increase diameter to suit incoming pipe diameter and orientation.
      b. Minimum Wall Thickness: 6 inches or 1/12 times inside diameter, whichever is greater.
   3. Cones: Eccentric with same wall thickness and reinforcement as riser section.
   4. Flat Slab Tops: Concentric with either 24 inch or 35 inch opening, as indicated.
   5. Base Bottoms: 8-inch minimum thickness.
   6. Openings: As shown on Drawings
   7. Joints: Confined O-ring with rubber gaskets meeting ASTM C443 or Preformed Flexible Plastic Gasket, ASTM C990.
   8. Resilient Connector Boots: ASTM C923/C923M.
   9. Manhole Steps: Conform to ASTM C478/C478M. Attachment provisions for steps are cast in sections provided by manufacturer.
   10. Lift Holes: Lifting holes cannot penetrate manhole wall.
   11. Cement Type: Provide Type III cement.
   12. Precast Invert: Precast inverts from the manhole manufacturer are acceptable.

B. Precast Base Extension Sections (ASTM C478/C478M):
   1. Base Slab with Extension:
      a. Integral with monolithic sidewall.
      b. Minimum 6 inches thick and 6-inch minimum sidewall extension.
      c. Cast with holes to receive pipe as indicated.

2.2 DROP ASSEMBLIES

A. Exterior:
   1. Piping Tees, Ells, Wye, and Drop: As indicated in Section 33 31 01 or 33 41 00.
   2. Connection to Entering Pipe:
      a. Pipe: As indicated in Section 33 31 01 or Section 33 41 00.
      b. Connection Coupling Between Dissimilar Pipe: Mechanical clamp ring type, stainless steel expanding, and contracting sleeve with neoprene rubber gasket for positive seal.
   3. Concrete Encasement: 3,000 psi concrete at 28 days, 6-inch-thick minimum, surrounding tees, ells, wye, and vertical piping.

B. Interior:
   1. Piping Bend and Drop: As indicated in Section 33 31 01 or 33 41 00.
   2. Attachment: Use 1/2 inch stainless steel all threaded rod and anchor to wall. Secure pipe with 1/4 inch by 1-1/2 inch stainless steel flat bars bent to match pipe diameter. Use all stainless steel Type 316 hardware.

2.3 PIPE STUBOUTS FOR FUTURE] SERVICE CONNECTIONS

A. Minimum Length: Extend from manhole 18 inches for small service connections and 48 inches of pipes large than 6 inches.

B. Pipe: As indicated in Section 33 31 01 or 33 41 00. Where there are two different classes of pipe at a manhole, higher-strength pipe will govern.

C. Plug: Match pipe material, rubber-gasketed, watertight, and removable. Choose plug to pass all hydrostatic or air tests.

2.4 PVC PIPE TO MANHOLE ADAPTOR

A. Suitable for connecting and sealing PVC pipe to manhole.

B. As recommended by manufacturer of PVC pipe.

2.5 MANHOLE STEPS

A. Material: ASTM D4101, Copolymer Polypropylene Plastic with Grade 60 Steel Reinforcement.

B. Standards: OSHA CFR 1910.27, ASTM C478/C478M, AASHTO M-199.

2.6 MANHOLE FRAMES AND COVERS

A. Castings:
   1. Manhole Frames and Covers: ASTM A48/A48M, Class 35B, heavy duty, gray iron, sound, smooth, clean, designed to withstand 16,000 pound wheel load plus impact.
   2. Venting: Vented.
   3. Produced: Manufactured from materials produced in United States.
   4. Defects: Free from blisters, blowholes, shrinkage cracks, cold shuts, and defects.
   5. Bearing Surface: Machine or grind bearing surfaces to ensure flat, true surfaces that will not rattle when driven across.
   6. Identification: Provide label indicating “Sanitary Sewer”, “Industrial Sewer” or “Storm Sewer”, as applicable, in 2-inch raised letters.

2.7 CLEANOUT FRAMES AND COVERS

A. Cleanout Castings:
   1. Frame and Cover: ASTM A48/A48M, Class 35B, extra heavy duty, gray iron, sound, smooth, clean.

2. Produced: Manufactured from materials produced in United States.
3. Defects: Free from blisters, blowholes, shrinkage cracks, cold shuts, and defects.
4. Bearing Surface: Machine or grind bearing surfaces to ensure flat, true surfaces that will not rattle when driven across.

B. Pipe Materials:
1. Same as mainline piping. Use ductile iron for depths greater than 10 feet.

2.8 MORTAR:

A. Standard premixed meeting ASTM C387/C387M or proportion one part Portland cement to two parts clean, well-graded sand or fine aggregate per ASTM C33/C33M.

B. Admixtures - May be included, but do not exceed the following percentages of weight of cement:
1. Hydrated Lime: 10 percent.
2. Diatomaceous Earth or Other Inert Material: 5 percent.

C. Consistency of mortar will readily adhere to concrete.

2.9 STEEL

A. Conform to ASTM A615, Grade 60, deformed bars.

PART 3 EXECUTION

3.1 PREPARATORY WORK

A. Inspection:
1. Inspect materials prior to installation.
2. Do not install materials not conforming to this Section.
3. Remove or repair unacceptable materials regardless of being stockpiled or installed at no additional cost.
4. Design of shoring systems where space for proper layback of excavation is not available and design of strapping and support plans for existing utilities and structures exposed by the excavation is to be provided by the Contractor as part of “construction means and methods”.

B. Notification:
1. Contact utility locator service at least 3 days prior to beginning excavation.
2. Coordinate with Owner to determine locations of private onsite existing utilities at least 7 days prior to beginning excavation.
3. Coordinate to determine and mark location of utilities within limits of Work in advance to allow for relocation or adjustment of utilities.

3.2 EXCAVATION AND BACKFILL

A. Excavation: As specified in Section 31 00 00-A – Earthwork.

B. Dewatering: Remove water from excavation as specified in Section 31 00 00 – Earthwork.

C. Inspection:
   1. Engineer shall approve subgrade prior to placement of backfill.
   2. If bottom of trench is unsuitable for supporting manhole, excavate as directed by Engineer.
   3. Backfill to required grade with material specified in Section 31 00 00 – Earthwork.

D. Backfill Around Manholes: As specified for trenches in Section 31 00 00 – Earthwork. Use highest class of trench backfill immediately adjacent as shown.

3.3 BASE ROCK

A. Stone Base: Place a minimum of 6 inches of crushed stone or base rock and thoroughly compact with a mechanical vibrating or power tamper as specified.

3.4 CAST-IN-PLACE CONCRETE BASE

A. Deposit sufficient mortar on base to ensure watertight seal between base and manhole wall or place first precast section of manhole in concrete base before concrete has set. Properly locate and plumb first section.
   1. General: Construct indicated.
   2. Forms: Construct forms to dimensions and elevations required. Provide tight and well-braced forms. Chamfer corners of forms. Prior to placing concrete, remove water and debris from forms. Moisten forms just prior to placing concrete. No standing water, ice, snow, mud, or other deleterious material in forms.
   3. Concrete: Handle concrete from transporting vehicle to forms without segregation or loss of ingredients. Immediately after placing, densify concrete with a mechanical vibrator. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation.
   4. Finishing: Screed top surface of exposed slabs and walls. When initial water has been absorbed, float surfaces with a magnesium float and lightly trowel with a steel trowel to a smooth finish free from marks or irregularities. Finish exposed edges with a steel edging tool.
   5. Form Removal: Remove forms and patch any defects in concrete with mortar mixed in same proportions as original concrete mix.
   6. Curing: Cure concrete by preventing loss of moisture for a period of 7 days. Apply membrane-forming curing compound immediately after removal of forms or finishing of slabs. Protect concrete from damage during 7-day curing period.

3.5 PLACING PRECAST MANHOLE BASE

A. General:
   1. Install underground precast concrete utility structures per ASTM C891.
   2. Examine manhole sections prior to installation.
   3. Grade bottom of excavation to provide a firm and level base for precast section.

4. Place wall sections accurately and with care using lubricated rubber gaskets and install in accordance with the manufacturer's recommendations.
5. Reconstruct joints having torn, displaced, or otherwise damaged gaskets or incorrectly installed.
6. Replace damaged gaskets.
7. Replace cracked, chipped or otherwise damaged precast sections, which will endanger watertightness or soundness of manholes or not meet specified requirements.

3.6 MANHOLE INVERT

A. Field Constructed Invert:
1. Construct as indicated with smooth transitions.
2. Form manhole invert and bench with grout, cement brick, and concrete as continuation of lower half of arc of sewers entering manhole.
3. Form inverts where more than one sewer enters manhole as smooth curves to their intersection at center of manhole and curve towards exit sewer. Smoothly form curves at intersections to avoid deposition of sewage solids.
4. Where a full section of pipe is laid through a manhole, break out top section and completely cover exposed edge of pipe with mortar. Trowel mortar surfaces smooth.
5. Slope surface of grout or concrete outside valley formed for passage of sewage at slope of 1:6 to manhole wall.
6. Free Flow: Remove sharp edges or rough sections that tend to obstruct flow. Invert flow path should be smooth and unobstructed.

B. Precast Invert:
1. Comply with manhole manufacturers requirements.

C. Cast In-Place Slide:
1. Where the invert of the incoming pipe is higher than the crown of the outgoing pipe, then a cast in place concrete invert slide is required. Use drop outside connections instead of slide where slide height exceeds 24 inches.
2. Cast in place slide to match requirements of invert section above.

3.7 PLACING PRECAST MANHOLE SECTIONS

A. Confined O-Ring Joints:
1. Carefully inspect precast manhole sections. Do not use sections with chips or cracks.
2. Place manhole in accordance with manufacturer's instructions.
3. Provide gasket lubricant in accordance with manufacturer's recommendation.

B. Preformed Flexible Plastic Gasket Joint:
1. Carefully inspect precast manhole sections. Do not use sections with chips or cracks.
2. Install in conformance with manufacturer's recommendation.
3. Use only pipe primer furnished by gasket manufacturer.

3.8 DROP ASSEMBLIES

A. Piping:
   1. Construct drop assemblies as indicated.
   2. Extend pipe 3 feet to undisturbed earth and connected to sewer pipe with coupling.
   3. Support lower elbow by concrete poured monolithically with manhole base.
   4. Plug top entrance pipe with removable stopper or brick and mortar.

B. Concrete Encasement:
   1. Verify piping is connected and fully supported.
   2. Pour 3000 psi concrete around the base elbow up to the top elevation of the mainline pipe. Provide a minimum of 6 inches of concrete encasement around piping.

3.9 RIGID CONNECTIONS

A. Provide joints in clay pipe sewers not more than 1-1/2 feet from manhole walls. Lay pipes entering manholes on firmly compacted base rock.

B. Where last joint of line laid up to manhole is more than 1-1/2 feet from manhole base, construct a 6-inch concrete encasement around entire pipe from manhole base to within 1-1/2 feet of pipe joint. Construct encasement monolithically with manhole base. Shorten pipes laid out of manhole to ensure that first joint is no more than 1-1/2 feet from manhole base.

3.10 PIPE STUBOUTS FOR SERVICE SEWER CONNECTIONS

A. General:
   1. Provide stubouts with a watertight gasketed pipe plug suitably braced against internal and external pressures.
   2. Terminate sewers entering manhole at 2 maximum inches inside face of manhole wall and connect to manhole by flexible compression sleeve (rubber boot).
   3. Fill void between pipe and manhole wall with compression sleeve.
   4. Clamp securely around pipe forming watertight joint when subjected to vacuum test per ASTM C1244/C1244M. Perform testing prior to backfilling.
   5. Enclose connections to manholes with concrete. Grout joints inside and outside after passing vacuum test.
   6. Install semi-permanent plugs in end of stubouts with gasket joints similar to sewer pipe being used. Provide plugs capable of withstanding all internal or external pressures without leakage.
   7. Brace plugs to prevent blowoffs.

B. Service Connections:
   1. Install service connection stubouts in manholes as indicated.
   2. Place service connection stubouts in manhole base and construct invert channels.
   3. Provide maximum length of 2 feet.
   4. Unless otherwise shown on Drawings, match elevation of crown of service connection pipe to elevation of crown of outlet pipe.

C. Future Sewer Connections:
   1. Install stubouts from manholes for future sewer connections as indicated.
   2. Construct invert channels in accordance with details shown.

3.11 PERMANENT PLUGS

A. Preparation: Clean interior contact surfaces of all pipes cut off or abandoned.

B. Plug:
   1. Construct concrete plug in end of pipe 18 inches or less in diameter.
   2. Provide concrete plugs a minimum length of 8 inches. For pipe 21 inches and larger, plugs may be constructed of common brick or concrete block.
   3. Plaster exposed face of block or brick plugs with mortar.
   4. Provide watertight plugs capable of withstanding internal and external pressures without leakage.

3.12 TEMPORARY PLUGS

A. Install 1/2-inch plywood temporary plugs in pipe stubouts as indicated. Backfill against plugs to provide temporary seal.

3.13 MANHOLE EXTENSIONS

A. Grade Ring Adjustment:
   1. Install extensions to height not exceeding 12 inches with precast concrete grade rings. Make adjustment greater than 12 inches with precast concrete riser sections.
   2. Lay grade rings on top of preformed flexible plastic gasket joint material with sides plumb and tops level. Seal exterior joints with mortar. Provide watertight extensions.

3.14 MANHOLE FRAMES AND COVERS

A. General:
   1. Install frames and covers on top of manholes to prevent infiltration of surface or groundwater.
   2. Set top elevation of frame and cover same as adjacent pavement when in paved areas, flush with ground surface in lawns, grass plots, and 18 inches minimum above ground in fields and wooded areas.

B. Frame:
   1. Place manhole frame and cover, concentric with top opening unless indicated otherwise. Set frames in a bed of mortar with mortar carried over flange of ring.
   2. Set frames so tops of covers are flush with surface of adjoining pavement or ground surface unless otherwise indicated.
   3. Provide grout bed for frame, and secure in place by grouting around lower flange and sidewall of frame, extending to outside of precast top section.

C. Cover:
   1. Place layer of filter fabric (4-foot by 4-foot sheet) between frame and cover to prevent entrance of dirt and debris into manhole during construction.
   2. Verify cover fits snuggly within frame. Cover should not rattle when crossed by vehicles.

3.15 MANHOLES OVER EXISTING SEWERS

A. Maintain flow through existing sewer lines or by diverting sewage flow.

B. Construct manholes over existing operating sewer lines at locations shown as follows:
   1. Locate position of manhole.
   2. Perform necessary excavation to construct manhole. Over excavate below the bottom of pipe to allow installation of stone base and concrete base slab.
   3. Protected existing piping and structures for damage by excavation equipment.
   4. Grade bottom of excavation to provide a firm and level base for precast section.
   5. Place concrete blocks in bottom of excavation to support precast units. Allow 6-inch minimum clearance between top of concrete block and top of base stone.
   6. Place #4 rebar at 12 inches on center each way in the center of concrete base slab.
   7. Lower precast units and support on concrete blocks.
   8. Place precast section as specified. Verify structure is level.
   9. Apply a bonding agent on all surfaces in contact with concrete and construct new base under existing sewer.
   10. Pour concrete bottom slab no higher than the spring line (horizontal midline) of existing pipe. Invert shelf may be constructed in same pour. Concrete base slab to extend a minimum of 6 inches beyond the outside of the precast structure.
   11. If existing line is plastic material, wipe on a solvent recommended by pipe manufacturer to soften pipe wall and apply a dense coating of clean sand over all areas in contact with concrete. Allow pipe to harden prior to applying bonding agent.
   12. Break out existing pipe within new manhole, cover edges with mortar, and trowel smooth.
   13. Construct manhole invert and benches as specified.
   14. Protect new concrete and mortar for 7 days after placement.

3.16 CONNECTION TO EXISTING MANHOLES

A. Flow Diversion: Provide diversion facilities and perform work necessary to maintain sewage flow during connection to manholes.

B. Connection: Connect sewers to existing manholes at locations shown.
   1. Core a circular hole in existing manhole.
   2. Clean all surfaces and apply a bonding agent.
   3. Terminate sewers entering manhole at 2 maximum inches inside face of manhole wall and connect to manhole by resilient watertight connector (boot connector).
   4. Fill void between pipe and manhole wall with compression sleeve.

5. Clamp securely around pipe forming watertight joint when subjected to vacuum test per ASTM C1244/C1244M. Perform testing prior to backfilling.
6. Enclose connections to manholes with concrete. Grout joints inside and outside after passing testing requirements.

3.1 CLEAN-OUTS

A. Location:
1. Piping: As indicated. Install ductile iron pipe in paved and traffic areas.
2. Provide clean-outs at every turn.
3. Provide turns of sufficient radius to accommodate rodding equipment.
4. Provide clean-outs no greater than 100 feet apart on long run service piping.
5. Provide clean-outs accessible and capped.

B. Box:
1. Cap: Use threaded clean-out caps at end of each clean-out.
2. Concrete Collar: Install concrete collar and threaded plug at finished level.
3. Acceptance: Clean out boxes must be installed to finished grade before final inspection and acceptance.
4. Manholes: Use manholes in lieu of clean-out on all service lines greater than 8 inches in diameter.

3.2 ACCEPTANCE

A. Post-Installation Inspection:
1. All manholes/structures to be fully clean and dry.
2. Manhole section joints to be grouted clean and smooth. No cracks or joints seeping water. Joint material not protruding out of joint.
3. All manhole benches and channels to be formed smooth to convey the flow cleanly through structure.
4. All castings centered on openings, grouted, and secure.
5. No settlement or misalignment.
6. Passed vacuum test per ASTM C1244/C1244M. Provide a single field test log for each structure including date, time, manhole number, description of test, test duration, test pressure, test pass/fail, name and signature of test witness, and name and signature of installer, and name and signature of Owner's Representative approving manhole for use.

B. Post Installation Inspection Report:
1. Provide completed and signed off Post Installation Inspection Report for all manholes or other structures indicating a passing result.
2. As-built (redline) markups of the Drawings indicating actual installation.
3. Survey as-built for all piping and structures provided in an AutoCAD file indicating top elevations, centerline coordinates of structure locations, pipe size, material type and class, and invert elevations.
4. Submit Post Installation Report for approval.

3.3 SUBMITTAL SCHEDULE

ITEM NO.	SUBMITTAL REQUIREMENT	WITH BID	AS INDICATED
33 05 13-A-01	Shop Drawings for precast units		Provide 2 weeks prior to purchase
33 05 01-A-02	Shop Drawings for cast-in-place units.		Provide 2 weeks prior to casting
33 05 13-A-03	Manhole steps.		Provide 2 weeks prior to purchase
33 05 13-A-04	Product data for preformed plastic gaskets and O-ring gaskets.		Provide 2 weeks prior to purchase
33 05 13-A-05	Product data for frames and covers.		Provide 2 weeks prior to purchase
33 05 13-A-06	Product data for adapter coupling between dissimilar pipes.		Provide 2 weeks prior to purchase
33 05 13-A-07	Product data for adapter coupling between manhole and PVC pipe.		Provide 2 weeks prior to installation
33 05 13-A-08	Certificates of Manufacturer’s Compliance for precast units.		Provide 2 weeks prior to installation
33 05 13-A-09	Certificates of Manufacturer’s Compliance for manhole steps.		Provide 2 weeks prior to installation
33 05 13-A-10	Certificates of Manufacturer’s Compliance for frames and covers.		Provide 2 weeks prior to installation
33 05 13-A-11	Post Installation Inspection Report		Provide 1 week after installation

END OF SECTION

SECTION 33 10 13-A

WATER DISTRIBUTION

SUMMARY OF CHANGE(S):

Rev	Date	Package	DESCRIPTION / JUSTIFICATION	AUTHOR

PART 1 GENERAL

1.1 SUMMARY

A. Section includes installation of water distribution piping in or near dam structures (SMP-01, SMP-11, TEMP-SMP-01, TEMP-SMP-02).

B. Water distribution piping installed within dam structures shall be installed with cast in place concrete cradles following details provided in the drawings.

C. Related Sections:
1. Section 31 00 00-A – Earthwork
2. Section 03 30 00-A – Cast-in-Place Concrete

D. CAUTION: Use of this Section without including the above-listed items results in omission of basic requirements.

1.2 REFERENCES

A. In addition to compliance with industry standards and Owner requirements, ensure that government acts and regulations (as applicable for any particular equipment or material) are complied with in design, fabrication, testing and shipment of equipment and materials.

B. Meet or exceed the requirements of the latest edition of the following codes, regulations and standards.

C. American Society of Testing Materials (ASTM):
1. ASTM A48 – Standard Specification for Gray Iron Castings.
2. ASTM A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
3. ASTM A536 – Standard Specification for Ductile Iron Castings.
4. ASTM C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

5. ASTM D1785 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
6. ASTM D2466 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
7. ASTM D2855 – Standard Practice for the Two-Step (Primer and Solvent) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
8. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

D. American Water Works Association (AWWA):
1. AWWA C104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C110/ANSI A21.10 – Ductile-Iron and Gray-Iron Fittings.
3. AWWA C111/ANSI A21.11 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C115/ANSI A21.15 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
5. AWWA C151 – Ductile-Iron Pipe, Centrifugally Cast.
6. AWWA C153 – Ductile-Iron Compact Fittings.
7. AWWA C207 – Steel Pipe Flanges for Waterworks Service, Sizes 4 In. through 144 In. (100 mm through 3,600 mm).
8. AWWA C210 – Liquid-Epoxy Coatings and Linings for Steel Water Pipe and Fittings
9. AWWA C502 – Dry-Barrel Fire Hydrants.
10. AWWA C504 – Rubber-Seated Butterfly Valves, 3 In. (75 mm) Through 72 In. (1,800 mm).
11. AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service.
12. AWWA C600 – Installation of Ductile-Iron Mains and Their Appurtenances.
13. AWWA C606 – Grooved and Shouldered Joints.
14. AWWA C651 – Disinfecting Water Mains.
15. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
16. AWWA C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm through 300 mm), for Water Distribution.

E. National Fire Protection Association (NFPA):
1. NFPA 24 – Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
2. NFPA 1963 – Standard for Fire Hose Connections.

F. National Sanitation Foundation (NSF)
1. NSF/ANSI 61 – Drinking Water System Components – Health Effects

1.3 DESIGN CRITERIA

A. Design fire water distribution systems buried outside buildings in accordance with NFPA 24.

B. Design Drawings are provided by the Engineer to assist in layout of system, but it will be Contractor's responsibility to determine and obtain exact layout and dimensions for design of system. Modifications to the layout within the dam structures must be approved by the Engineer in writing prior to installation. If any serious omissions are noted on Drawings, or in Specifications, it is intended that Contractor will call attention thereto.

C. Tests upon completion of work will be conducted in presence of and for approval of Owner and Fire Department Inspector for applicable system. Provide required parties minimum 24 hours advance notice.

1.4 COORDINATION

A. Campus water meters will be supplied and installed offsite by Onondaga County Water Authority (OCWA). Coordinate pipe connections to campus in locations indicated.

1.5 SUSTAINABLE DESIGN REQUIREMENTS

A. Comply with Section 01 81 13 – Sustainable Design Requirements.

1.6 SUBMITTALS

A. Refer to Submittal Schedule at end of Part 3 for a list of submittal requirements for this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
1. Protect pipe and accessories from damage during transport.
2. Unload in manner to prevent crushing or damage of pipe ends.
3. Do not drop, roll, or drag pipe.
4. Replace damaged material at no additional cost.

B. Storage:
1. Stockpile pipe where bell or spigot ends are not supporting weight of pipe.
2. Stack pipe not greater than 3 feet high.
3. Place quantity of pipe required for each day's work along trench line.
4. Do not place or store pipe to create a hazard to pedestrians or traffic.
5. Prevent damage to pipe and joint materials by proper storage.
6. Store joint materials in dry place out of direct sun and not left inside pipe prior to installation.

C. Handling:
1. Inspect pipe for defects during unloading and stockpiling.
2. Unload packaged units using mechanical equipment.
3. Prohibited actions include:
   a. Rolling, sliding, or dropping pipe from truck or into trenches.
   b. Transporting pipe in bucket of equipment.
4. Insert hooks with broad, well-padded contact surfaces into pipe ends.

5. Replace damaged materials whether stockpiled or installed at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 PIPE AND PIPE JOINTS

A. General: For pipe greater than 12 inches in diameter, use ductile iron pipe. For pipe 12 inches or less in diameter, use either ductile iron or PVC water pipe as hereinafter specified. PVC pipe shall not be used for underground fire distribution systems. Pipe for potable water systems shall be NSF/ANSI 61 certified.

B. Ductile Iron Pipe (DIP):
   1. Pipe Size 14 inch to 64 inch: ASTM A716.
      a. Pipe Joints:
         1) Below Ground: Push-on. Do not use multiple types of joints.
         2) Above Ground: Flanged joint (AWWA C115) or when exposed in pits or trenches.
         3) Gaskets: AWWA C111 (rubber), flanged joint rubber, full face, 1/8-inch thick.
      b. Outside Coating: 1 mil minimum thick petroleum asphaltic coating.
      c. Inside Coating: AWWA C104, cement lined with petroleum asphaltic seal coat.
      d. Fittings:
         1) Pressure Rating: 350 psi for 6-inch through 48-inch sizes.
         2) Joints: Match pipe.
         3) Inside Coating: Cement lined with petroleum asphaltic seal coat.

C. PVC Pressure Pipe:
   a. For diameters of 4 inches through 12 inches, conform to requirements of AWWA C900. Provide pipe with working pressure Class 165 psi (DR25) for domestic water system.

2.2 FITTINGS AND JOINTS

A. Ductile Iron Pipe Fittings
   1. Fittings Conforming to AWWA C110, or AWWA C153 as applicable.
   2. Cement mortar lined and seal coated conforming to ANSI A21.4 and AWWA C104.
   3. Flanged Fittings:
      a. Ductile iron conforming to AWWA C115 and AWWA C153.
      b. Rated Working Pressure: 350 psi.
      c. Cement mortar lined to same thickness specified for pipe.
   4. Provide mechanical joint, ductile iron fittings for PVC pipe with a diameter of 4 inches through 12 inches, as specified above.

B. Ductile Iron Pipe Joints

1. Rubber gaskets for joints conforming to requirements of AWWA C111.
2. Provide flanges flat-faced and drilled per ASME B16.1, Class 125.
3. Provide steel pipe flanges up to 24 inches per AWWA C207, Class D, flat faced and drilled per ASME B16.1, Class 125.
4. Gaskets for Flanged Joints:
    a. Sheet rubber, 1/8 inch thick, suitable for potable water and conforming to AWWA C111.
    b. Full face gaskets for pipe diameters through 24 inches.
    c. Ring gaskets are acceptable for 26 inch-diameter and larger pipe flanges.
5. Gaskets for Push-on and Mechanical Joints:
    a. Molded rubber ring gasket of two hardnesses, shaped to fit configuration of gasket socket conforming to ANSI A21.11 and AWWA C111.
    b. Gaskets made of SBR (Styrene Butadiene Rubber) are standard.
    c. Use gaskets with metal contact strips when cathodic protection is required.
6. Joint Lubricant:
    a. Tested and approved for potable water service.
    b. Lubricant shall not harbor bacteria or damage gaskets.
    c. Provide Type 304 stainless steel nuts and bolts, except for mechanical joints, smaller than 3/4 inch diameter and utilized for buried pipe connections (flanges, couplings, restrainers, etc.) per ASTM A743. Provide bolts 3/4 inch and larger with either high-strength cast iron containing a minimum of 0.50 percent copper per AWWA C111 or high-strength, low-alloy structural steel per ASTM A242 and AWWA C111.

C. PVC Pipe Joints:
1. For diameter 4 inch through 12 inch, provide push-on in accordance with AWWA C900. Provide elastomeric gaskets in accordance with ASTM F477.

D. Valves:
1. Gate Valves:
    a. Nonrising Stem (NRS) Valves: Gate valves 4 inches to 12 inches in diameter with iron body, bronze mounted, with resilient seat, water working pressure 175 psig, inside screw and O-ring seal turning counterclockwise to open, complying with AWWA C509.
        1) Resilient seat: Mechanically retained or bonded (ASTM D429) on valve wedge disc or gate which closes against a corrosion-resistant surface.
        2) Valve stem: Brass or bronze with minimum yield strength of 20,000 psi and minimum tensile strength of 60,000 psi.
        3) Valve Operators: Except for use with post-indicators, furnish buried valves with 2-inch nut for socket wrench operation. Provide hand wheel for exposed valves.

4) Construct valves used with post-indicators for connection thereto.
5) End of valves to accommodate or be adapted to pipe installed.

b. Outside Screw and Yoke Valves (OS&Y): OS&Y resilient seat gate valves used where shown on Drawings.

2. Butterfly Valves:

a. Provide butterfly valves 4 inches and larger with cast iron short body with either flanged or mechanical joint ends and in conformance with AWWA C504, Class 150B.
1) Buna-N seat: Mechanically retained or bonded to valve body and field replaceable for valves 24 inches and larger.
2) Valve disc: Cast iron, ductile iron, or Ni-Resist per ASTM A48, Class 40; ASTM A536, Grade 65-45-12; ASTM A436, Type 1; or ASTM A126, Class B.
3) Valve shafts: Type 304 or 316 stainless steel per ASTM A276; stub shaft or a one-piece unit extending completely through valve disc.
4) Exposed-body bolts, nuts, and cap screws: Stainless steel, Type 304 or 316.
5) Maximum operating torque: accordance with AWWA C504, Table 1, Class 150B.
6) Install valves with shaft in a horizontal position.
7) Equip valve gear operator with a 2-inch-square operating nut for buried valves. Provide hand wheel for exposed valves. Lever-operated valves are not acceptable.

E. Polyethylene Encasement for Ductile Iron Pipe Systems: Linear low-density (LLD) polyethylene film with a nominal thickness of 8 mil or a high-density, cross-laminated (HDCL) polyethylene film with a nominal thickness of 4 mil conforming to ANSI A21.5 and AWWA C105.

F. Valve Box: Cast iron extension box 5-1/4-inch shaft with screw or slide adjustment and flared base. Minimum 3/16-inch metal thickness. Adapt box without full extension to depth of cover required over pipe at valve location. Cast word “WATER” in cover. Provide three T-handle socket wrenches of 5/8-inch round stock long enough to extend 2 feet above top of deepest valve box. Where depth of operating nut is more than 4 feet, provide operating extension to bring operating nut to a point 6 inches below surface of ground or pavement.

G. Backflow Preventers:
1. Domestic Water Backflow Preventer for Potentially Hazardous Service: Reduced pressure type; Model MasterSeries LF860 Large by Febco or approved equivalent.
2. Provide upstream wye strainer to protect backflow preventers. Provide cast iron body strainer with a 20-mesh stainless steel screen and equipped with a flushing blowdown valve.
3. Furnish backflow preventers with chain and padlock to prevent operation of valves when in locked position. Provide pin tumbler mechanism padlock, five or more pins, 2-inch solid brass case, steel shackle, and with chain and shackle,

length as required. Route chain through valve handwheels. Provide same keyed padlocks. Provide four sets of keys to Owner.

H. Dry-Barrel Fire Hydrant:
1. Nominal 5-1/4-inch main valve opening with 6-inch bottom connection. Equip with two 2-1/2-inch hose nozzles and one 4-1/2-inch pumper nozzle. Operating nut 1-1/2-inch National Standard pentagon nut. Main valve equipped with O-ring seals and opened when turned to left (counterclockwise). Provide hydrants of break-flange or safety-top type. Provide barrel extension sections to set hydrant at proper grade. Hydrants conforming to AWWA C502 and this Specification. Provide 4 feet minimum depth of bury. Nozzle threads per National Standard (American) per NFPA 1963. Paint hydrants color red enamel above ground line.
2. Concrete pier block having nominal dimensions of 8-inch thickness by 16-inch-square base.
3. Provide washed 3/4-inch gradation drain rock, free of organic matter, sand, loam, clay, and other small particles. Provide minimum volume of gravel of 1 cubic foot.

I. Concrete for Thrust Blocking: Provide concrete having a minimum compressive strength of 2,500 psi at 28 days. Use Type III (ASTM C150) high-early cement to allow hydrostatic testing 5 days following installation of thrust blocking.

J. Thrust Ties: Galvanized, 3/4-inch-diameter steel rods and Duc-Lugs.

K. Mechanical Joint Restraints:
1. For PVC pipe (AWWA C900), use Tyler Pipe/Utilities Division MJR pipe restraint system on Uni-Flange Block Buster Pipe Restraint by Ford Meter Box Company.
2. For ductile iron pipe, use either above-mentioned pipe restraint systems or U.S. Pipe Field-Lok joint restraint for their Tyton joint pipe and fittings.

PART 3 EXECUTION

3.1 PREPARATION OF TRENCH

A. Trenching: As specified in Section 31 00 00-A – Earthwork.

B. Provide minimum pipe cover below finished grade of 4 feet.

C. Bedding Material: As specified in Section 31 00 00-A – Earthwork.

3.2 PIPE PREPARATION AND HANDLING

A. Inspect pipe and fittings prior to lowering into trench. Reject cracked, broken, or otherwise defective materials. Remove damaged pipe from jobsite.

B. Use proper implements, tools, and facilities for safe and proper protection of work. Lower pipe into trench in such a manner as to avoid physical damage to pipe. Do not drop pipe.

3.3 TOLERANCES

A. Pipe invert may deviate up to 1/2 inch for line and 1/8 inch for grade, provided that such variation does not result in a level or reverse sloping invert.

3.4 INSTALLATION OF PIPE AND FITTINGS

A. Ductile Iron Pipe:
   1. Install in accordance with AWWA C600.
   2. Provide all special tools and devices, such as special jacks, chokers, and similar items required for installation.

B. During construction and when laying operations are not in progress, prevent excavated or other foreign material from entering pipe. At end of workday, close and block open end of last laid section of pipe to prevent entry of foreign material.

C. Pipe – General:
   1. Preparation of Pipe: Carefully inspect pipe and fittings before laying. Do not use cracked, broken, or defective pieces.
   2. Handling Pipe: Use only implements, tools, and facilities for safe and proper protection of materials and workers. Do not use chains or cables for lifting or moving materials. Carefully lower pipe and fittings into trench to prevent damage. Do not dump or drop pipe and fittings on ground or into trenches.
   3. Cut pipe for inserting valves, fittings, or closure pieces in a neat and workmanlike manner without damaging pipe or lining. Leave a smooth end at right angles to axis of pipe. Provide special tools and equipment required or recommended by pipe manufacturer. Cut PVC or ductile iron pipe with milling type cutter or saw. Do not flame cut or use chain-type cutters.
   4. After joint has been made, align pipe and check for grade. Do not exceed 1/2 inch deviation of any section of pipe from line and grade shown.
   5. Pipe Protection: Prevent foreign material from entering pipe. When laying is not in progress, plug ends of pipe to prevent trench water and foreign materials from entering. Prevent pipe from floating. Replace all damaged pipe.
   6. Unless otherwise directed, lay pipe with bell facing in direction of laying. For lines on an appreciable slope, face bells upgrade at discretion of the Engineer.
   7. Permissible Deflection at Joints: In accordance with manufacturer's recommendation.
   8. Clearance:
      a. Separate water lines from underground structures, 12 inches minimum, unless otherwise shown.
      b. Lay water lines at least 10 feet laterally from existing or proposed sewers, unless otherwise shown.
      c. When storm sewers are encountered, maintain a 12-inch minimum vertical separation and a 5-foot minimum lateral separation, unless otherwise shown.

D. Ductile Iron Pipe and Fittings:

1. Cleaning Pipe and Fittings:
   a. Remove lumps, blisters, and excess coating from bell-and-spigot ends of each pipe. Wire brush outside of spigot and inside of bell.
   b. Clean ends of pipe and fittings of dirt, grease, and foreign matter.
   c. Dress cut end pipe to remove sharp edges or projections which may damage rubber gasket as recommended by manufacturer.
2. Placing Pipe in Trench:
   a. In accordance with manufacturer's recommendations.
   b. Pipe will include a concrete cradle within dam structures.
   c. Engineer must approve all subgrades prior to placement of pipe and cradle.
   d. Carefully backfill the pipe in accordance with the specifications.
3. Retainer Glands: Install retainer glands and tighten torque limiting, twist-off nuts in accordance with manufacturer's instructions.
4. Pipe Coating: Apply epoxy coating on exposed surfaces of DIP beyond the extents of pipe cradles in accordance with AWWA C210.
5. Mechanical Joint Pipe and Mechanical Joint: Install per manufacturer's recommendations. Torque ranges applied to bolts as follows:

Diameter of Bolt	Torque Range
5/8 inch	40 to 60 foot-pounds
3/4 inch	60 to 90 foot-pounds
1 inch	70 to 100 foot-pounds
1-1/4 inches	90 to 120 foot-pounds

6. Flanged Pipe and Fittings:
   a. Tighten bolts so that pressure on gasket is uniform.
   b. Use torque-limiting wrenches to ensure uniform bearing.
   c. If joints leak when hydrostatic test is applied, remove and reset gaskets and retighten bolts.

E. Installation of PVC Pipe:

1. Inspect inside and outside surface of each length of pipe are free from nicks, scratches, and other surface defects and blemishes. Inspect pipe is homogeneous throughout, free of any bubbles, voids, or inclusions.
2. Inspect jointing areas of barrel of each length of pipe are free from dents and gouges.
3. Inspect each shipment of pipe and fittings and make provisions for a timely replacement of any damaged material. Unload by hand or use canvas slings to avoid scratching pipe. Do not slide or drag PVC pipe over any abrasive surface. Reject and remove pipe with deep scratches from site and replaced with new pipe.
4. Stack pipes no higher than 5 feet and provide support for barrel to prevent bending of pipe. Cover pipe to protect it from sun's rays. Provide for air circulation through stockpile.

F. Valves, Stems, and Boxes:

1. Valves:
   a. Before installation, thoroughly clean valves of foreign material with attention to removing oils and grease from valves' interior waterway, discs, and seats.
   b. Install with stems vertical unless directed otherwise.
2. Extension Stems:
   a. Provide stem extension such that operating nut is not deeper than 3 feet below finish grade. For extensions greater than 2 feet in length, provide an extension centering plate of sufficient diameter to maintain operating nut over valve wrench nut.
   b. Fasten stem or extension to valve operating nut using cap screw or other fastening device.
3. Valve Boxes: Center and set plumb over wrench nuts of valves. Set so they do not transmit shock or stress to valves. Set valve box covers flush with surface of finished pavement or ground as shown or such other elevation as may be directed. Cut extensions to proper length so valve box does not ride on extension when set at grade.
4. Backfill Around Valve Boxes: Place backfill around valve boxes and thoroughly compact to a density equal to that specified for adjacent trench and in such a manner that will not damage or displace valve box from proper alignment or grade. Re-excavate, plumb, and backfill misaligned valve boxes at Contractor's expense.
5. Testing: Test valves at same time that adjacent pipeline is tested. Show no visible leakage at joints under test. Repair joints that show signs of leakage prior to final acceptance. Properly protect any special parts of operators that might be damaged by pipeline test. Contractor will be held responsible for any damage caused by testing.

G. Fire Hydrant:

1. Install hydrant in conformance to provisions of Sections 4.3.7 and 4.3.8 of AWWA C600, except where otherwise specified.
2. Locate hydrants as shown to provide complete accessibility and minimize possibility of damage from vehicles or injury to pedestrians. Disconnect and relocate improperly located hydrants at Contractor's sole expense.
3. Set hydrants so that safety flange is a minimum of 2 inches and maximum of 6 inches above finished ground or sidewalk level to clear bolts and nuts.
4. Place base block on firm, level drain gravel to ensure uniform support.
5. Place hydrant carefully on base block to prevent base block from breaking. Follow jointing procedures conforming to Section 4.3.4 of AWWA C600. After hydrant is in place and connected to pipeline, place temporary blocks to maintain hydrant in a plumb position during subsequent work.
6. Place drain gravel around base block and hydrant bottom as specified in Section 4.3.7 of AWWA C600.
7. Place concrete thrust blocking after hydrant is blocked in its final position and hydrant is joined to pipe. Provide concrete thrust block having a minimum of 4 square feet of bearing area against undisturbed earth.

8. Provide thrust ties on fire hydrants in lieu of concrete thrust blocking when top of existing ground behind fire hydrant is less than 2 feet above top of hydrant base. Where such conditions exist, provide two 3/4-inch Type 304 stainless steel tie rods between gate valve and hydrant and between water main tee and gate valve, or use mechanical thrust restraint fittings in joints between fire hydrant and main line tee inclusive.

H. Post-Indicators:
1. Turn valve status viewing window of post-indicators so that it is viewed from nearest adjacent roadway.

I. Air Valve:
1. Tapping Pipe: Tap pipe and install service saddle by experienced workers using tools in good repair with proper adapters for size being tapped. Install service saddle as recommended by manufacturer.
2. Copper Tubing: Cut copper tubing with ends square, ream and flare with proper size flaring tool, clean, and made up tightly. Install tubing with upward slope from top of main to air valve and prevent tube from kinking or buckling on short-radius bends. Cut out kinked or buckled sections of copper tube and splice tube with proper brass fitting at Contractor's sole expense.

J. Backflow Preventers: Install backflow preventers in accordance with manufacturer's instruction. Meet final installation requirements of local officials.

3.5 TESTING

A. Hydrostatic Pressure Testing:
1. Pressure Testing shall be performed by the Contractor and in the presence of the Engineer. Provide a minimum of 48 hours notice prior to performance of the pressure testing.
2. Perform pressure and leakage tests on newly laid pipe. Furnish necessary equipment and material, make taps in pipe as required, and conduct tests. Conduct test between valved sections of pipeline or as reviewed by the Engineer. The Engineer will monitor tests.
3. Furnish the following equipment and materials for tests:

Amount	Description
Two	Graduated containers
Two	Pressure gauges
One	Hydraulic force pump reviewed in advance by A/E
	Suitable hose and suction pump as required

4. All labor, equipment and materials shall be provided by and performed by the Contractor.
5. Any pipe segment that fails the pressure testing shall be repaired by the Contractor at no cost to the Owner.

6. Pressure testing shall be repeated by the Contractor at no cost to the Owner until successfully passed and accepted by the Engineer after repairs are satisfactorily made due to previously failed pressure tests until the entire pipeline or pipeline segment passes the pressure test to the satisfaction of the Engineer.
7. Conduct tests after trench has been backfilled or partially backfilled with joints left exposed for inspection or when completely backfilled as permitted by the Engineer. Where any section of pipe is provided with concrete thrust blocking, do not make pressure test until at least 5 days have elapsed after concrete thrust blocking is installed. If high-early-strength cement is used for concrete thrust blocking, time may be cut to 3 days.
8. Conduct pressure test in following manner unless otherwise reviewed by the Engineer: After trench has been backfilled or partially backfilled as hereinbefore specified, fill pipe with water, expelling all air during filling. Test pressure at lowest point in system as follows:
    a. Domestic Water, County Water, Non-Potable Water, and Reclaim Water Systems: 1-1/2 times working pressure or pressure class on pipe but not less than 50 psi
    b. Fire Water System: 200 psi or 50 psi in excess of system working pressure, whichever is greater.
9. Duration: Perform each pressure test for 2 hours duration unless otherwise directed by the Engineer.
10. Procedure: Slowly fill pipe with water and allow to stand for 24 hours. Expel all air from pipe by installing 3/4 inch manual air release valves at all high points whether shown on Drawings or not. Apply and maintain specified test pressure by continuous pumping if necessary for entire test period. Calculate test pressure at point of lowest elevation or as specified by A/E. Place pump suction in a barrel or similar device or metered so that amount of water required to maintain test pressure is measured accurately.
11. Leakage: Leakage is be defined as quantity of water necessary to hold specified test pressure for duration of test period. No pipe installation is accepted if leakage is greater than number of gallons per hour as determined by following formula:

$$L = \frac{ND\sqrt{P}}{7{,}400}$$

In above formula:

L = allowable leakage in gallons per hour.
N = number of joints in length of pipe tested.
D = nominal diameter of pipe in inches.
P = average test pressure during leakage test in pound-per-square-inch gauge.

12. Correction of Excessive Leakage: Repair and retest visible leaks and leakage in excess of allowances stated above until satisfactory results are obtained. Correct defects as a result of this test at Contractor’s expense.

3.6 FINAL CLEANING

A. Prior to final acceptance and final manhole-to-manhole inspection of storm drain system by Owner, flush and clean system parts. Remove accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from storm drain system at or near closest downstream manhole. If necessary, use mechanical rodding or bucketing equipment.

B. Upon Owner's final manhole-to-manhole inspection of storm drain system, if foreign matter is still present, reflush and clean sections and portions of lines as required.

C. Defective Piping Sections: Repair or replace as specified at no additional cost to the Owner.

3.7 FLUSHING AND SYSTEM STERILIZATION

A. General:
1. All waterlines shall be flushed and sterilized by the Contractor in the presence of the Engineer.
2. Use this Specification to sterilize potable water systems prior to being placed in service.
3. Sterilize pipelines intended to carry potable water before being placed in service. Perform sterilizing procedures in conformance to AWWA C651 as hereinafter modified or expanded.

B. Flushing:
1. Before sterilizing, flush foreign matter from pipeline. Provide hoses, temporary pipes, ditches, etc., as required to dispose of flushing water without damage to adjacent properties. Specified flushing flows specified in following table:

Flushing Flows	
Pipe Size (Inches)	**Flow Rate (gpm)**
2	50
4	250
6	550
8	1,000
10	1,500
12	2,000

a. In cases where water supply to system does not produce stipulated flow rate, use maximum flow rate available.
b. If water is supplied from more than one source or from a looped system, close divisional valves to produce a high-velocity flow through each single line.

C. Sterilizing Mixture:

1. Provide sterilized mixture of chlorine-water solution having a minimum free chlorine residual of 40 to 50 ppm. Prepare sterilizing mixture by injecting a liquid chlorine gas-water mixture or a calcium or sodium hypochlorite and water mixture into pipeline at a measured rate while fresh water is allowed to flow through pipeline at a measured rate so that combined mixture of fresh water and chlorine solution or gas is of specified strength.
2. Apply liquid chlorine gas-water mixture by means of an approved solution feed-chlorinating device and provide means of preventing backflow of water into chlorine cylinder.
3. If calcium hypochlorite procedure is used, first mix dry powder with water to make a thick paste, then thin to approximately a 1 percent solution (10,000-ppm chlorine). If sodium hypochlorite procedure is used, dilute liquid with water to obtain a 1 percent solution. Follow required proportions of hypochlorite to water:

Product	Quantity	Water
Calcium hypochlorite* (65 to 70 percent Cl)	1 pound	7.50 gallons
Sodium hypochlorite**	1 pound	4.25 gallons

* Comparable to commercial products known as HTH, Perchloron, and Pittchlor.
** Known as liquid laundry bleach, Clorox, Purex, etc.

D. Point of Application:

1. Inject chlorine mixture into pipeline to be treated within five pipe diameters of water line isolation valve at upstream end of line and at all extremities of line through a suitable tap in top of pipeline. Control water from existing system or other approved source so as to flow slowly into newly installed piping during application of chlorine. Proportion rate of chlorine mixture flow to rate of water entering pipe that combined mixture contain 40 to 50 ppm of free available chlorine. Manipulate valves so that strong chlorine solution in line being treated does not flow back into line supplying water. Use check valves if necessary.
2. Retention Period:
   a. Retain treated water in pipeline for no less than 24 hours or long enough to destroy all nonspore-forming bacteria, whichever is greater. At end of retention period, show sterilizing mixture having a strength of at least 10 ppm of chlorine.
   b. Operate valves, hydrants, and other appurtenances during sterilization to ensure sterilizing mixture is dispersed into all parts of line, including dead ends, new services, and similar areas that otherwise may not receive sterilizing solution.
   c. Do not place concentrated quantities of commercial sterilizers in line before it is filled with water.
   d. After chlorination, flush water from permanent source of supply until water through line is equal chemically and bacteriologically to permanent source of supply.

3. Disposal of Sterilizing Water: Do not allow sterilizing water to flow into a waterway or storm drainage system as discharge of water into these systems may be in violation of National Pollutant Discharge Eliminating System (NPDES). Schedule and coordinate rates of flow and locations of discharge of sterilizing and flushing water with Owner and cognizant state and local regulatory agencies to ensure compliance with applicable rules and regulations.

E. Bacteriologic Tests: Collect two samples. Deliver to a certified laboratory within 6 hours of obtaining samples and obtain a bacteriologic quality test to demonstrate absence of coliform organisms in each separate section of pipeline after chlorination and refilling. For lines longer than 2 miles, obtain one additional test each mile.

3.8 ACCEPTANCE

A. Post Installation Inspection: Inspect 100 percent of pipe and structures:
1. Deflection less than specified.
2. No open pipe joints.
3. No soil entering through pipe or catch basins joints.
4. Pipe penetrations grouted and water tight.
5. No settlement or misalignment.
6. Piping system clean of debris and sediments.

B. Post Installation Inspection Report:
1. Results of deflection testing.
2. Equipment used for testing.
3. Name of inspector.
4. Digital photographs of items inspected.
5. As-built survey of piping and stormwater management basin(s) including outlet structure elevations from register land surveyor.

3.9 SUBMITTAL SCHEDULE

ITEM NO.	SUBMITTAL REQUIREMENT	WITH BID	AS INDICATED
33 10 13-A -01	Product Data: Product data and manufacturer instructions for all pipe, adapters, fittings, and hardware to be installed.		Provide 2 weeks prior to delivery to the project site.
33 10 13-A -02	Product Data: DIP Epoxy coating material complying with AWWA C210.		Provide 2 weeks prior to delivery to the project site.
33 10 13-A -03	Certificate of Manufacturer's Compliance: Pipe and Fittings.		Provide 2 weeks prior to installation.
33 10 13-A -04	Post Installation Inspection Report		Provide 1 week after installation.
33 10 13-A -05	Coordinate submittal requirements with Section 01 81 13 – Sustainable Design Requirements.		Per construction schedule.

END OF SECTION

SECTION 33 41 00-A

STORM DRAINAGE

SUMMARY OF CHANGE(S):

Rev	Date	Package	DESCRIPTION / JUSTIFICATION	AUTHOR

PART 1 GENERAL

1.1 SUMMARY

A. Section includes storm drainage features and spillway conduits for dams structures (SMP-01, SMP-11, TEMP-SMP-01, TEMP-SMP-02).

B. Related Sections:
1. Section 31 00 00-A – Earthwork.
2. Section 33 46 01-A – Dam Subdrainage Systems

C. CAUTION: Use of this Section without including the above-listed items results in omission of basic requirements.

D. In the event of conflict regarding Storm Drainage requirements between this Section and another section, the provisions of this Section govern. Fire Line pipe and Industrial Waste pipe are in design with Jacobs and will be released in a future Design Package.

1.2 REFERENCES

A. In addition to compliance with industry standards and Owner requirements, ensure that the following government acts and regulations (as applicable for any particular equipment or material) are complied with in design, fabrication, testing and shipment of equipment and materials.

B. Meet or exceed the requirements of the latest edition of the following codes, regulations and standards.

C. American Society of Testing Materials (ASTM):
1. ASTM C76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
2. ASTM C387 – Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar.
3. ASTM C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

4. ASTM C507 - Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.
5. ASTM D1056 – Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
6. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
7. ASTM F1668 - Standard Guide for Construction Procedures for Buried Plastic Pipe.
8. ASTM F2881 – Standard Specification for 12 to 60 in Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications

1.3 SUSTAINABLE DESIGN REQUIREMENTS

A. Comply with Section 01 81 13 – Sustainable Design Requirements.

1.4 SUBMITTALS

A. Refer to Submittal Schedule at end of Part 3 for a list of submittal requirements for this Section.

PART 2 PRODUCTS

2.1 PIPE AND PIPE JOINTS

A. Rubber Gasketed Reinforced Concrete Pipe (RGRCP):
1. Referenced on drawings as Reinforced Concrete Pipe (RCP)
2. Circular: ASTM C76, Class III with Wall B design unless shown otherwise. Elliptical reinforcement is not permitted.
3. Horizontal Elliptical: ASTM C507. Class HE-III minimum.
4. Joints: Rubber gasket type conforming to ASTM C443.
5. Joint Lubricant: Furnished by pipe manufacturer.
6. End Sections: Precast concrete with same joint type as pipe, same quality as pipe.

B. HDPE DRAIN PIPE: In accordance with specification 33 46 01-A Dam Subdrainage Systems.

2.2 FITTINGS

A. Rubber Gasketed Reinforced Concrete Pipe:
1. Joint: Gasketed type or approved adapter to join service pipe connection.
2. 18 inches and smaller pipe: Shop fabricated.
3. 21 inches and larger pipe: Field or shop fabricated.
4. For tees fabricated by inserting a stub into a hole cut in pipe, grout with a non-shrinking grout. Prior to grouting, coat surface with epoxy bonding agent. Ensure tee stubs don’t protrude inside of pipe.

2.3 MORTAR

A. Standard premix mortar conforming to ASTM C387, Type N, or proportioned one part Portland cement to two parts of clean, well-graded sand which will pass a 1/8-inch screen.

B. Admixtures: May be used not exceeding following percentages by weight of cement:
   1. Hydrated Lime: 10 percent.
   2. Diatomaceous Earth or Other Inert Materials: 5 percent.

C. Consistency: Adhere readily to pipe. Don't use mortar mixed for longer than 30 minutes.

PART 3 EXECUTION

3.1 PREPARATION OF TRENCH

A. Trenching: As specified in Section 31 00 00-A – Earthwork.

B. Bedding Material: As specified in Section 31 00 00-A – Earthwork.

3.2 PIPE PREPARATION AND HANDLING

A. Inspect pipe and fittings prior to lowering into trench. Reject cracked, broken, or otherwise defective materials. Remove damaged pipe from jobsite.

B. Use proper implements, tools, and facilities for safe and proper protection of work. Lower pipe into trench in such a manner as to avoid physical damage to pipe. Do not drop pipe.

3.3 TOLERANCES

A. Pipe invert may deviate up to 1/2 inch for line and 1/8 inch for grade, provided that such variation does not result in a level or reverse sloping invert.

3.4 INSTALLATION OF PIPE AND FITTINGS

A. RGRCP General Installation:
   1. Proceed upgrade when laying pipe with socket or collar ends at upgrade end.
   2. Clean end of pipe to be joined, inside of joint, and rubber ring (when required) immediately before joining pipe.
   3. Assemble joint in accordance with recommendations of pipe manufacturer.
   4. Ensure pipe bedding has a continuous and uniform bearing and pipe support at every point between joints.
   5. Prevent pipe joints from pulling apart when moving trench shield.
   6. Plug or close off pipes that are stubbed off for manhole construction or for connection by others with temporary plugs.
   7. Prevent uplift or floating of line prior to completion of backfilling operation.

8. When cutting or machining pipe is necessary, use tools and methods recommended by pipe manufacturer.

B. During construction and when laying operations are not in progress, prevent excavated or other foreign material from entering pipe. At end of workday, close and block open end of last laid section of pipe to prevent entry of foreign material.

C. Rubber Gasketed Reinforced Concrete Pipe: Install concrete pipe with spigot end pointing in direction of flow.

3.5 TESTING

A. Visual Inspection:
1. When inspected with reflected light, show a clear, unobstructed view between manholes. Show a practically full circle of light is seen when viewed from adjoining end of line.
2. Correct defects as a result of this test at Contractor's expense.

3.6 FINAL CLEANING

A. Prior to final acceptance and final manhole-to-manhole inspection of storm drain system by Owner, flush and clean system parts. Remove accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from storm drain system at or near closest downstream manhole. If necessary, use mechanical rodding or bucketing equipment.

B. Upon Owner's final manhole-to-manhole inspection of storm drain system, if foreign matter is still present, reflush and clean sections and portions of lines as required.

C. Defective Piping Sections: Repair or replace as specified.

3.7 ACCEPTANCE

A. Post Installation Inspection: Inspect 100 percent of pipe and structures:
1. Deflection less than specified.
2. No open pipe joints.
3. No soil entering through pipe or catch basins joints.
4. Pipe penetrations grouted and water tight.
5. No settlement or misalignment.
6. Piping system clean of debris and sediments.

B. Post Installation Inspection Report:
1. Results of deflection testing.
2. Equipment used for testing.
3. Name of inspector.
4. Digital photographs of items inspected.
5. As-built survey of piping and stormwater management basin(s) including outlet structure elevations from register land surveyor.

3.8 SUBMITTAL SCHEDULE

ITEM NO.	SUBMITTAL REQUIREMENT	WITH BID	AS INDICATED
33 41 00-A -01	Product Data: Coupling for joining dissimilar or plain end pipes.		Provide 2 weeks prior to installation.
33 41 00-A -02	Product Data: Adapter for connecting piping to manholes or concrete structures.		Provide 2 weeks prior to installation.
33 41 00-A -03	Certificate of Manufacturer's Compliance: Pipe and Fittings.		Provide 2 weeks prior to installation.
33 41 00-A -04	Post Installation Inspection Report		Provide 1 week after installation.
33 41 00-A -05	Coordinate submittal requirements with Section 01 81 13 – Sustainable Design Requirements.		Per construction schedule.

END OF SECTION

SECTION 33 46 01-A

DAM SUBDRAINAGE SYSTEMS

SUMMARY OF CHANGE(S):

Rev	Date	Package	DESCRIPTION / JUSTIFICATION	AUTHOR

PART 1 GENERAL

1.1 SUMMARY

A. Section includes provisions for installing subsurface drainage systems for dams (SMP-01, SMP-11, TEMP-SMP-01, TEMP-SMP-02) and includes the following items:
   1. Furnishing, placing, and compacting filter sand for filter diaphragms and strip drains.
   2. Furnishing, placing, and compacting drain stone for filter diaphragm drainage.
   3. Furnishing and installing drain pipe including slotted and solid High-Density Polyethylene (HDPE) drain pipes and associated ancillary features as shown on the Drawings.
   4. Video inspection of completed drain pipes upon completion of backfilling.

1.2 REFERENCES

A. Meet or exceed the requirements of the latest edition of the following codes, regulations, and standards.

B. ASTM International (ASTM)

1.	ASTM C33/C33M	Standard Specification for Concrete Aggregates
2.	ASTM C117	Standard Test Method for Materials finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
3.	ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
4.	ASTM D75/D75M	Standard Practice for Sampling Aggregates
5.	ASTM D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
6.	ASTM D2488	Standard Practice for Description and Identification of Soils (Visual Manual Procedures)
7.	ASTM D6913/D6913M	Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

8.	ASTM D1140	Standard Test Method for Determining Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing
9.	ASTM D4253	Standard Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
10.	ASTM D4254	Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
11.	ASTM D6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
12.	ASTM D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
13.	ASTM D3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
14.	ASTM F714	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
15.	ASTM F2620	Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

1.3 DEFINITIONS

A. Fines: Soil particles finer than the No. 200 sieve size.

B. Prepared Ground Surface: Ground surface after clearing, grubbing, stripping, excavation, demolition, and scarification and/or compaction.

C. Coverage: One coverage is defined as the result of successive passes by a piece of compaction equipment, which by means of sufficient overlap, will ensure that all areas of the layer or lift being compacted have been subjected to one pass of the compaction equipment.

D. Relative Density: The relative density in-place shall be calculated as described in ASTM D4254 using the following equation:

$$R_d(\%) = \frac{\gamma_{d,max}(\gamma_{d,measured}-\gamma_{d,min})}{\gamma_{d,measured}(\gamma_{d,max}-\gamma_{d,min})} * 100$$ where γ_d is dry density

E. Unsuitable Materials: Materials that contain waste, debris, roots, organic matter, frozen matter, or any other materials determined by the Engineer to not meet the specifications for the required fill.

1.4 SUSTAINABLE DESIGN REQUIREMENTS

A. Comply with Section 01 81 13 – Sustainable Design Requirements.

1.5 SUBMITTALS

A. Refer to Submittal Schedule at end of Part 3 for a list of submittal requirements for this Section.

1.6 QUALITY ASSURANCE

A. Perform work in conformance, except as modified in this Section, with current edition of New York State Department of Transportation Standard Specifications, referred to here as Standard Specifications.

PART 2 PRODUCTS

2.1 MATERIALS

A. HDPE DRAIN PIPE
   1. Manufacturers shall have a minimum of five years of experience in the design and manufacture of the specific pipe to be supplied.
   2. Furnish pipe in the nominal sizes shown on the Drawings. All HDPE pipes shall have a designation code of PE4710 or higher. The material shall meet or exceed a cell classification of 445574C/E as defined in ASTM D3350.
      a. Slotted Pipe: Slotted pipe shall conform to ASTM F714, Dimension Ratio (DR) 17 circular pipe sized using Ductile Iron Pipe Sizing (DIPS) criteria. Slots shall be clean and completely free of burrs, cuttings, frayed edges, tears and cracks, and other defects. Slot geometry, spacing, and quantity are as specified on the Drawings. Pipe not meeting these requirements will be rejected. Fabrication of slotted HDPE pipe shall be completed by the supplier before delivery to the site. Pipe shall be homogeneous throughout and free of visible cracks, holes, inclusions, or other defects. It shall be uniform in color, opacity, density, and other physical characteristics.
      b. Solid Pipe: Solid pipe shall conform to ASTM F714, Dimension Ratio (DR) 17 circular pipe sized using Ductile Iron Pipe Sizing (DIPS) criteria. Pipe shall be homogeneous throughout and free of visible cracks, holes, inclusions, or other defects. It shall be uniform in color, opacity, density, and other physical characteristics.
   3. Fittings: HDPE pipes to be fused using butt fusion techniques, as appropriate, in accordance with ASTM F2620. All fittings are to be supplied by pipe manufacturer and may not be fabricated on site.
   4. Slots: perforated pipe sections shall be shop fabricated in accordance with the slotted conduit detail in the drawings.
   5. End Plugs or Caps: End plugs or caps shall be the manufacturer’s standard end plugs or caps to provide a watertight seal suitable for use in perforated and non-perforated drain pipe, subject to the approval of the Engineer.

2.2 ANIMAL GUARDS

A. As specified on the Drawings.

B. Provide ARGI Drain Corporation 6-inch Stainless Steel Rat Guard or Approved Equal.

2.3 FILTER SAND

A. Designed Filter Sand based on NYSDOT Mortar Sand, with a tighter filter band at the No. 50 sieve and allowing 5 percent fines passing the No. 200 sieve. Comparison of the designed filter sand and NYSDOT Mortar Sand filter bands is in the table below. This gradation represents the in-place gradation after placement and compaction at the project site.

Sieve Size	NYSDOT Mortar Sand Gradation) (Percent Passing)		Designed Filter Gradation (Percent Passing)	
	Coarse	Fine	Coarse	Fine
No.4 (4.75 mm)	100	100	100	100
No. 8 (2.36 mm)	95	100	95	100
No. 50 (0.3 mm)	10	40	25[1]	40
No. 100 (0.15 mm)	0	15	0	15
No. 200 (0.075 mm)	-	-	0	5[1]

[1]Modified from NYSDOT Mortar Sand gradation

B. Filter sand shall be imported, natural (not manufactured), processed, granular material.

C. A list of required material approval testing for Filter Sand is presented below. The tests shall be conducted by the Contractor's independent testing firm at the frequencies designated unless otherwise directed by the Engineer.

Test	Test Method (Current Version)	Test Frequency
Classification	ASTM D2487	Minimum 4 tests per source
Gradation with No. 200 Wash	ASTM D6913 and D1140	Minimum 4 tests per source
Laboratory Moisture-Density (Relative Density)	ASTM D4253 and D4254	Minimum 2 tests per ASTM test method per material

2.4 DRAIN STONE

A. Drain Stone in accordance with ASTM C33 No. 8 Coarse Aggregate utilized for drainage material. This gradation includes a maximum limit for fines content in addition to the requirements from the standard gradation. The table below represents the in-place gradation after placement and compaction.

U.S. Standard Sieve Size	ASTM C33 No. 8 Coarse Aggregate	
	Coarse	Fine
1/2 inch	100	100
3/8 inch	85	100
No. 4	10	30
No. 8	0	10
No. 16	0	5
No. 200 (0.075 mm)	0	3

B. A list of required material approval testing for Drain Stone is presented below. The tests shall be conducted by the Contractor's independent testing firm at the frequencies designated unless otherwise directed by the Engineer.

Test	Test Method (Current Version)	Test Frequency
Classification	ASTM D2487	Minimum 4 tests per source

Gradation with No. 200 Wash	ASTM D6913 and D1140	Minimum 4 tests per source

2.5 EQUIPMENT

A. Compaction Equipment: Use suitable compaction equipment to obtain specified relative density. Operate compaction equipment in strict accordance with manufacturer's instructions and recommendations. Maintain equipment in such condition that it will deliver manufacturer's rated compactive effort. If inadequate densities are obtained, provide larger and/or different types of additional equipment appropriate for the materials being compacted.

B. Moisture Control Equipment: Use equipment for applying water of a type and quality adequate for work, that does not leak and is equipped with a distributor bar or other approved device to assure uniform application. Use equipment consisting of blades, discs, or other approved equipment for mixing and drying out material.

C. Other Materials and Equipment: Select other materials and equipment not specifically described but required for a complete and proper installation subject to review by the Engineer prior to use.

PART 3 EXECUTION

3.1 INSPECTION

A. Imported Material Acceptance: Imported materials specified in this Section are subject to the following requirements:
   1. Test acceptable sources for each imported material. Submit certification that material conforms to Specification requirements along with copies of test results from a qualified commercial testing laboratory as required by Submittals Schedule. Furnish material samples by Contract or at Contractor's sole expense. Clearly mark samples to show source of material and intended use on project. Perform sampling of material source in accordance with ASTM D75. Coordinate sampling schedule at least 24 hours in advance with the Engineer and Owner so they observe sampling procedures.
   2. Tentative acceptance of material source based on observation of source by Owner and/or certified test results submitted by Contractor to Owner at Owner's discretion.
   3. Deliver no imported materials to site until proposed source and material test submittal(s) has been reviewed by A/E and returned marked "No Exceptions Noted".
   4. Final acceptance will be based on tests made on samples of material taken from a completed and compacted course.
   5. Testing for final acceptance will be performed by Owner or Owner's representative.
   6. If tests conducted by Contractor or Owner indicate that material does not meet Specification requirements, material placement will be terminated until corrective measures are taken.
   7. Remove and replace material which does not conform to Specification requirements at the Contractor's sole expense.
   8. Sampling and testing performed by Contractor at Contractor's sole expense.

3.2 FILTER SAND AND DRAIN STONE

A. Excavation required for drains shall be in accordance with Section 31 00 00-A “Earthwork.”

B. Before placing filter sand material, verify that the prepared foundation has been inspected by the Engineer. Do not place fill without approval from the Engineer.

C. Control and conduct all operations including but not limited to transporting, stockpiling, excavating, producing, and placing the materials to minimize waste, contamination, segregation, and particle breakdown.

D. Place filter sand and drain stone to the locations, lines, grades, and thicknesses shown on the drawings. Install filter sand and drain stone materials in loose lifts not exceeding 10 inches in thickness prior to compaction for full size compaction equipment and 4 inches in thickness prior to compaction for smaller walk-behind compaction equipment.

E. Do not place drain materials when filter sand, drain stone, or the foundation on which it would be placed is frozen. Stop fill placement temporarily during unsuitable weather conditions, as directed by the Engineer.

F. Filter Sand and Drain Stone Compaction Equipment: Hand-operated vibrating plate compactors having a minimum static weight of 300 pounds and a minimum dynamic force of 1,000 pounds, or other compaction equipment acceptable to the Engineer. All compaction equipment used for filter sand and drain stone should be maintained clean and shall be restricted to operation only on the filter sand and drain stone zones. Other compaction equipment may be approved if demonstrated by the Contractor to achieve suitable results. Proposed compaction equipment for filter sand and drain stone must be submitted to the Engineer before use.

G. Thoroughly wet filter sand immediately before compaction using moisture application procedures as approved by the Engineer. Moisture conditioning is not required for drain stone. The moisture content of the filter sand and drain stone shall be distributed uniformly throughout each layer of material prior to and during compaction.

H. Compact with a smooth drum vibratory roller or hand-operated tamper to achieve a relative density of at least 50 percent and not more than 70 percent. A test section must be performed, either separate from the work or part of the work, to demonstrate the proposed placement, watering, and compaction methods to achieve suitable compaction results (in-place density testing and gradation results). Visual observation of compaction may be deemed acceptable by the Engineer in confined areas on a case-by-case basis. Hand-operated equipment is required within two feet of all structures.

I. Coordinate filter sand and drain stone material installation with other conduit construction including spillways and inlets/outlets.

J. Filter sand and drain stone shall be tested for gradation and density in-situ in accordance with the following requirements.

Test	Test Method (Current Version)	Test Frequency
Gradation with No. 200 Wash	ASTM D6913 and D1140(1)	One (1) test for every 100 cubic yards of sand placed and compacted. The test shall be performed on compacted material. If any change is noted in placement methods, an additional test will be performed at no cost to the Owner. Coordinate gradation testing with in-place density testing.
In-place Density	ASTM D6938	Minimum of one (1) test for every 100 cubic yards of filter sand or drain stone placed and compacted. A minimum of one (1) test shall be performed for each day of placement regardless of quantity of material placed.

3.3 DRAIN PIPE

A. Construct HDPE drain pipes in accordance with this Section, manufacturer's recommendations, and ASTM D2321. In case of a conflict, this specification shall govern.

B. Fusion Joining Methods:

1. Use only appropriately sized and outfitted fusion machines that have been approved by the manufacturer in the fusion process.

2. All fusion joints shall be made in accordance with the manufacturer's recommendations.

3. All fusion joints shall be made by a qualified fusion technician as determined by the manufacturer.

4. Any fusion joints made by non-qualified technicians will be rejected and replaced at no additional cost to the Owner.

C. Install pipes to the lines and grades shown on the Drawings. Installed pipe shall not deviate from the design grade by more than 1 inch per 100 feet unless approved by the Engineer. Record grade and alignment measurements for each piece of pipe installed and at each turn, junction, or change in grade. Furnish measurements to the Engineer upon completion of the Work.

D. Drain stone material shall be carefully placed about the drain pipes so as not to disturb the drain pipe and to hold it securely in position while the overlying material is being placed. Blocking or wedging of the pipe is not allowed. Adjustments shall be done by scraping away or filling the material beneath the pipe.

E. Due to the drain pipe's light weight and buoyancy, special care shall be exercised in laying the drain pipe and placing materials adjacent to the pipe to ensure that the pipe is laid, and remains, on grade and in alignment.

F. The method of laying the drain pipe shall prevent stretching of the pipe during laying operations.

G. Any drain pipe which is broken, cracked, or otherwise unsuitable for use, as determined by the Engineer, shall be removed and replaced at the cost of and by the Contractor and at no additional cost to the Owner. HDPE pipe sections with gouges, scrapes, or other damage resulting in a loss of 10 percent of the wall thickness shall be cut out, removed, and replaced at no additional cost to the Owner.

H. Keep the drain pipe free from deposits of snow, ice, mud, sand, gravel, concrete, or other foreign matter, and in good working condition until the contract is complete and accepted. Do not store pipe materials in direct sunlight. Drain pipe that is improperly stored will be rejected by the Engineer and replaced at no additional cost to the Owner.

I. The Contractor is responsible for any damages to any installed drains. Damaged sections of drains or outfall pipe shall be removed and replaced at the cost of and by the Contractor and at no additional cost to the Owner.

J. Handle materials to ensure delivery to installation locations in sound, undamaged condition. Do not drag pipe.

K. Use straight pipe sections and elbows not exceeding 22.5° unless otherwise shown on the Drawings.

L. Do not drop drain materials directly on pipe.

M. Do not compact drain material or fill material with full-sized compaction equipment for at least 2 feet directly over the drain pipe.

N. Support drain pipe circumferentially with drain material prior to backfilling above pipe.

O. Prevent introduction of contaminants into the drain material.

P. Install animal guards as indicated on the Drawings after completion of cleaning and video inspection and with the approval of the Engineer.

3.4 SUBDRAINAGE INSPECTIONS AND TESTS

A. Do not place fill over the embankment subdrain system until it has been inspected, and approved by the Engineer.

B. Video Inspection of Completed Drain Pipe

1. After all drain elements are installed, backfilled, cleaned, and in good working order, perform cleaning and video inspection performed using equipment with the ability to pan and tilt to a 90-degree angle with the axis of the pipe and rotate 360 degrees. During the video inspection provide a continuous 360 degree pan of every pipe joint.

2. Document locations of all observed defects and distresses including cracking, exposed reinforcing steel, sags, joint offsets, joint separations, deflections, improper joints/connections, blockages, leaks, rips, tears, buckling, deviation from line and grade, and other anomalies not consistent with a properly installed pipe.

3. Submit all recorded video files.

3.5 SUBMITTAL SCHEDULE

ITEM NO.	SUBMITTAL REQUIREMENT	WITH BID	AS INDICATED
33 46 01-A-01	HDPE PIPE MANUFACTURER CERTIFICATIONS		Provide 2 weeks prior to installation.
33 46 01-A-02	FILTER SAND AND DRAIN STONE MANUFACTUERS CERTIFICATION		Provide 2 weeks prior to delivery to site.
33 46 01-A-03	FILTER SAND AND DRAIN STONE MATERIAL SAMPLES AND LAB TEST RESULTS		Provide 2 weeks prior to delivery to site.
33 46 01-A-04	FILTER SAND AND DRAIN STONE INSTALLATION PLAN		Provide 2 weeks prior to installation.
33 46 01-A-05	CERTIFIED TRUCKLOAD WEIGH BILLS		Provide 2 weeks prior to installation.
33 46 01-A-06	VIDEO INSPECTION RESULTS AND VIDEO FILES		Provide 24 hours after completion.
33 46 01-A-07	ANIMAL GUARD PRODUCT DATA		Provide 2 weeks prior to installation.

END OF SECTION