

Procurement Specification Cover Sheet

1. Title			
Saltstone Vault #2 Including Excavation, Liner and Backfill (U) Total Pages 118			
2. Specification No.		3. Revision	4. Page
C-SPP-Z-00006		1	1 of 3
5. Functional Classification	6. Requester Dept.	7. Requester Division	
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ENGINEERING DOC. CONTROL-SRS



00881253

Procurement Specification Revision History Sheet

1. Specification No		2. Revision	3. Page
C-SPP-Z-00006 Saltstone Vault #2 Including Excavation, Liner and Backfill		1	<u>2</u> of <u>3</u>
4. Date	5. Revision No.	6. Paragraph No	7. Description of Changes
	0	N/A	Issue for use
6/13/2008	1	Section 01004	Updated drawings.
		Section 01100	Updated references and work scope.
		Section 01250	Updated definition; clarified RFI & SDDR req'ts; deleted SDDR form & instructions
		Section 01320	Updated scope & references; clarified marker & monument req'ts; clarified submittal req'ts.
		Section 01330	Clarified submittal req'ts; updated EDR; added QVDR
		Section 01400	Clarified independent verification req'ts.
		Section 01450	Updated references; clarified qualifications.
		Section 01600	Clarified storage & handling req'ts.
		Section 02310	Clarified excavation & submittal req'ts; updated references.
		Section 02320	Updated references; clarified notification, submittal & test req'ts.
		Section 02370	Updated references; clarified submittal, material & work scope req'ts.
		Section 02378	Clarified work scope; updated references; clarified submittal and work scope req'ts.
		Section 02379	Clarified work scope, submittal and material req'ts; updated references.
		Section 02630	Updated references; clarified submittal & material req'ts.
		Section 02900	Updated references; clarified material & work scope req'ts.
Section 03300	Clarified work scope; updated references.		
Section 013210	Added entire new section for tank installation. (No rev bars appear in margin)		

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INDEX OF DRAWINGS

SECTION 01004

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. List of drawings associated with Saltstone Vault #2 Excavation, Liner and Backfill.

1.2 CONSTRUCTION DRAWINGS

- A. C-CG-Z-00026, Overall Site Plan
- B. C-CG-Z-00027, Excavation and Stockpile Plan
- C. C-CG-Z-00028, Excavation and Stockpile Cross Sections
- D. C-CG-Z-00029, Excavation Sections & Details
- E. C-CG-Z-00030, Finish Grading Plan
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- H. C-CH-Z-00014, Sheets 1 & 2, Drain Water Collection System, Piping Arrangement & Pipe Support
- I. QB00485K-010-D-MDM, Title Sheet (Sheet 1 of 13)
- J. QB00485K-011-D-MDM, Section-Elevation and Notes (Sheet 2 of 13)
- K. QB00485K-012-D-MDM, Floor Plan - North Tank (Sheet 3 of 13)
- L. QB00485K-013-D-MDM, Tank 2A Roof Plan - North Tank (Sheet 4 of 13)
- M. QB00485K-014-D-MDM, Typical Wall Section (Sheet 6 of 13)
- N. QB00485K-015-D-MDM, Pre-Stressing Schedule (Sheet 7 of 13)
- O. QB00485K-016-D-MDM, Wall Joint, Floor Joint and Closure Strip Details (Sheet 8 of 13)
- P. QB00485K-017-D-MDM, Penetration Plugs, Grout Fill Line and Roof Sleeves (Sheet 9 of 13)
- Q. QB00485K-018-D-MDM, Vent Port and Camera Port Plug (Sheet 10 of 13)
- R. QB00485K-019-D-MDM, Flat Roof Floor Embed Plates and Hatch Cover (Sheet 11 of 13)
- S. QB00485K-020-D-MDM, Seismic Restraint Cables (Sheet of 12 of 13)
- T. QB00485K-021-D-MDM, Mud Mat, 8" X 8" Concrete Curb and Construction Manhole (Sheet 13 of 13)
- U. QB00485K-034-C-MDM, Tank 2B Roof Plan (Sheet 5 of 13)

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SUMMARY OF WORK

SECTION 01100

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. References
- B. Definitions
- C. Location of the Work
- D. Project Summary
- E. Work by Others
- F. Work Sequence
- G. General Requirements
- H. Site Requirements
- I. Existing Conditions
- J. Administration
- K. Acceptance and Inspection
- L. Specification Conventions

1.2 RELATED SECTIONS

- A. All Sections in this Specification

1.3 REFERENCES:

- A. National Codes / Standards:
 - 1. Obtain BSRI prior acceptance for other editions and/or addenda of National Codes / Standards required by this specification before use.
- B. Required National Codes / Standards
 - 1. American Association State Highway Transportation Officials (AASHTO)
 - a. M 294, 2004, Standard Specification for Corrugated Polyethylene Pipe, 300- to 1200- mm Diameter-HM-22; Part 1B
 - 2. American Concrete Institute (ACI)
 - a. 117, 2006, Specifications for Tolerances for Concrete Construction and Materials and Commentary
 - b. 211.1, 1991, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
 - c. 229R, 1999 (R 2005), Controlled Low-Strength Materials
 - d. 301, 1999, Specifications for Structural Concrete
 - e. 318/318R, 2005, Building Code Requirements for Structural Concrete (ACI 318-05) and Commentary (ACI 318R-05)
 - f. 347, 2004, Guide to Formwork for Concrete

- g. CP-60, 2002, Craftsman Workbook for ACI Certification of Shotcrete Nozzleman
- 3. American Society for Testing and Materials (ASTM)
 - a. A 36/A 36M, 2005, Standard Specification for Carbon Structural Steel
 - b. A 48, 2003, Standard Specification for Gray Iron Casting
 - c. A 193 /A 193M, 2007, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications
 - d. A 194 /A 194M, 2007, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
 - e. A 563 REV A, 2007, Standard Specification for Carbons and Alloy Steel Nuts
 - f. A 615/A 615M, 2007, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - g. A 821/A 821M, 2005, Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Tanks
 - h. A 992/A 992M REV A, 2006, Standard Specification for Structural Steel Shapes
 - i. A 1008/A 1008M REV A, 2007, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
 - j. C 31/C 31M, 2006, Standard Practice for Making and Curing Concrete Test Specimens in the Field
 - k. C 39/C 39M, 2005 (E 2006), Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - l. C 94/C 94M, 2007, Standard Specification for Ready-Mixed Concrete
 - m. C 109/C 109M, 2007, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
 - n. C 138/C 138M, REV A, 2001, Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
 - o. C 143/C 143M, 2008, Standard Test Method for Slump of Hydraulic-Cement Concrete
 - p. C 172 REV A, 2007, Standard Practice for Sampling Freshly Mixed Concrete
 - q. C 231, 2004, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
 - r. C 443, 2005, Standard Specification for Joints Circular Sewer and Culvert Pipe Using Rubber Gaskets
 - s. C 602 REV A, 1995 (R 2001), Standard Specification for Agricultural Liming Materials
 - t. C 685/C 685 M, 2007, Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
 - u. C 913, 2002, Standard Specification for Pre-cast Concrete water and Wastewater Structures
 - v. D 422, 1963 (R 2002), Standard Test Method for Particle-Size Analysis of Soils
 - w. D 792, 2000, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

- x. D 1004, 2003, Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting
- y. D 1248, 2004, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
- z. D 1505, 2003, Standard Test Method for Density of Plastics by the Density-Gradient Technique
- aa. D 1556, 2000, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
- bb. D 1557, 2002 (E 2003), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft³ (2,700 kN-m/m³))
- cc. D 1603, 2001, Standard Test Method for Carbon Black in Olefin Plastics
- dd. D1785, 2006, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- ee. D 2216, 2005, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ff. D 2487, 2006, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- gg. D 3212-A, 2004, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- hh. D 3350, 2004, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
- ii. D 3786, 2006, Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics Diaphragm Bursting Strength Tester Method
- jj. D 3895, 2004, Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
- kk. D 4218, 1996 (R 2001), Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
- ll. D 4318, 2005, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- mm. D 4354, 1999 (R 2004), Standard Practice for Sampling of Geosynthetics for Testing
- nn. D 4437, 1999, Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes
- oo. D 4632, 1991 (R 2003), Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- pp. D 4633, 2005, Standard Test Method for Energy Measurement for Dynamic Penetrometers-Reinstated
- qq. D 4643, 2000, Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method
- rr. D 4751, 2004, Standard Test Method for Determining Apparent Opening Size of a Geotextile
- ss. D 4832, 2002, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders
- tt. D 4833, 2000 (E 2002), Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

- uu. D 4873, 2002, Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
- vv. D 4972, 2001, Standard Test Method for pH of Soils
- ww. D 5199, 2001, Standard Test Method for Measuring Nominal Thickness of Geosynthetics
- xx. D 5261, 2003, Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
- yy. D 5268, 2007, Standard Specification for Topsoil Used for Landscaping Purposes
- zz. D 5297, 1995 (R 2004), Standard Test Methods for Rubber Chemical Accelerator-Purity by High Performance Liquid Chromatography
- aaa. D 5887, 2004, Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter
- bbb. D 5890, 2002, Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners
- ccc. D 5891, 2002, Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners
- ddd. D 5971, 2007, Standard Practice for Sampling Freshly Mixed Controlled Low-Strength Material
- eee. D 5993, 1999 (R 2004), Standard Test Method for Measuring Mass Per Unit of Geosynthetic Clay Liners
- fff. D 6243, 1998, Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method
- ggg. D 6392, 1999, Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
- hhh. D 6495, 2002, Standard Guide for Acceptance Testing Requirements for Geosynthetic Clay Liners
- iii. D 6693, 2004, Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
- jjj. D 6938, 2008, Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- kkk. E 329, 2003, Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
- lll. F 436 REV A, 2007, Standard Specification for Hardened Steel Washers
- mmm. F 1417, 1998, Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.
- nnn. F 1866, 2007, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Schedule 40 Drainage and DWV Fabricated Fittings

4. American Water Works Association (AWWA)
 - a. D110, 1995, Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks
 - b. D115, 1995, Circular Prestressed Concrete Water Tanks with Circumferential Tendons
5. American Welding Society (AWS)
 - a. D1.1/D1.1M, 2006, Structural Welding Code - Steel - 20th Edition; Incorporated Errata 1
- C. Regulations
 1. 29 CFR PT 1926, Safety And Health Regulations For Construction
 2. EPA/600/R-93/182, Quality Assurance and Quality Control of Containment Facility EPA Technical Guidance Document
 3. FGDC-STD-007.4, Geospatial Positioning Accuracy Standard, Part 2, Geodetic Control Networks
 4. Federal Geographic Data Committee, FGDC-STD-007.4-2002, Geospatial Positioning Accuracy Standards PART 4: Standards for Architecture, Engineering, Construction (A/E/C) and Facility Management
 5. Permit no. 05-11-Z-14.5, Grading Permit
 6. SC R.72-300, Standards for Storm Water Management and Sediment Reduction
 7. SCDHEC 61-107.19, Solid Waste Management; Waste Landfills and Structural Fill
 8. SCR 100000, Storm Water General Permit
- D. Documents
 1. C-ESR-Z-00004, Stormwater Pollution Prevention Plan (SWPPP) for Z –Area Saltstone Disposal Site Vault No. 2
 2. QB00485K-007-C-MDM, Tank Calculations
 3. QB00485K-008-B-MDM, Column Slenderness Effects Calculations
 4. QB00485K-009-B-MDM, Column Supported Roof By Direct Design Method
- E. Drawings
 1. C-CG-Z-00026, Overall Site Plan
 2. See Section 01004.

1.4 DEFINITIONS

- A. See individual sections for definitions related to scope of work in the section.
- B. Acronyms common to all sections of this Specification
 1. BSRI Bechtel Savannah River, Incorporated
 2. SRS Savannah River Site
 3. WSRC Washington Savannah River Company

1.5 LOCATION OF THE WORK

- A. The work is located in Z-Area of the Savannah River Site, a Department of Energy site south of Aiken, South Carolina.
- B. See Overall Site Plan – Drawing C-CG-Z-00026.

1.6 PROJECT SUMMARY

- A. Overview:
 - 1. Subcontractor scope includes, but is not limited to, excavation, mud mats, tank erection, hydrostatic testing, geosynthetic liner installation, backfill, internal coating application, drainwater collection installation and site finishing.
- B. Scope includes:
 - 1. Installation of interim erosion and storm water controls.
 - 2. Excavation of the vault working area and stockpiling excavated soil.
 - 3. Heave/settlement monitoring and installation of markers
 - 4. Maintenance of all erosion and storm water controls.
 - 5. Extend existing 30 foot wide crushed stone / gravel road to meet new ramp into excavation.
 - 6. Construction of concrete mud mats for the future tanks.
 - 7. Tank construction
 - 8. Perform tank water tightness test
 - 9. Apply internal coating
 - 10. Apply external roof coating
 - 11. Installation of drain water collection systems
 - 12. Installation of Geosynthetic Liners.
 - a. Between mudmats prior to tank construction.
 - b. Around tanks after tank construction.
 - c. Tank top liner (HDPE) is excluded – Future installation by others.
 - 13. Backfill after tank construction and exterior liner installation.
 - 14. Site finish grading for erosion control including grassing .

1.7 WORK BY OTHERS

- A. Clearing of working area in preparation for excavation (Complete).
- B. Temporary benchmarks and heave marker installation (Ref. Section 01320)
- C. Installation of Sedimentation Pond at marked location (Complete).
- D. Installation of initial storm water management and sediment/erosion control measures (Complete).
- E. Installation of Process Grout line, electrical power, instrumentation and drainwater return after tank construction and backfill.
- F. Furnishing Type V concrete.

1.8 WORK SEQUENCE

- A. The following sequence is anticipated to coordinate the earthwork (excavation and backfill) and erosion control with the tank construction.
 - 1. Installation and maintenance of erosion and storm water controls.
 - 2. Gravel road installation and maintenance.
 - 3. Excavation (including surveys)
 - 4. Preparation of foundation including mudmats and sub-base liners prior to tank construction.
 - 5. Tank Construction
 - 6. Install Hilti bolts (for internal drainwater collection system)
 - 7. Perform tank water tightness test
 - 8. Apply internal coating
 - 9. Installation of drain water collection and return systems
 - 10. Complete liner installation around tanks after tank construction.
 - 11. Backfill, finish grade, and seeding.
 - 12. Apply external coating
 - 13. Installation of Process Grout line, electrical power, and instrumentation (by others) after the finish grading is completed.

1.9 GENERAL REQUIREMENTS

- A. Requirements in Division 1 of this Specification apply to all sections of this Specification.
- B. Maintain an on-site copy of the latest design documents, drawings and specifications for the duration of the project at all times.
- C. Perform excavation, erosion / storm water control, and construction activities in accordance with governing codes, regulations, technical and functional requirements set forth in the Subcontract Documents.
- D. Confirm and coordinate all aspects of the work including;
 - 1. Work by subtier contractors,
 - 2. Fabrication processes,
 - 3. Methods and sequences of construction.
 - 4. Delivery of BSRI supplied concrete.
- E. Provide required testing as identified in the Subcontractor Documents.

1.10 SITE REQUIREMENTS

- A. General Provisions, Special Provisions, and Subcontract Field Conditions, are described in the procurement documents.

1.11 EXISTING CONDITIONS

- A. Verify existing conditions, utilities, dimensions, and details affecting the work prior to performing other field activities.
- B. Report any discrepancies or deviations from Subcontract Documents to BSRI as soon as conditions are identified using a Request for Information or Supplier Deviation Disposition Request in accordance with Section 01330 – Submittal Procedures.

1.12 ADMINISTRATION

- A. The BSRI Subcontract Technical Representative for this effort will be identified at award of the subcontract.
- B. The Subcontract Technical Representative is the BSRI representative responsible for all technical communication and direction between BSRI and the Subcontractor.
- C. All technical correspondence shall be directed to the Subcontract Technical Representative with a transmittal copy to the Procurement Representative.

1.13 ACCEPTANCE AND INSPECTION

- A. Prior to final acceptance, work will be inspected and accepted by BSRI for conformance to Subcontract Document requirements.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

CHANGE PROCEDURES

SECTION 01250

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Request for Information
 - 2. Supplier Deviation Disposition Request
 - 3. Change Notice
- B. Definitions
 - 1. Minor Change: Change to the project or clarifications of the Subcontract Documents in which the change does not impact the subcontract, including cost and schedule.
 - a. Changes are initiated by the BSRI Subcontract Technical Representative or the Subcontractor's Point of Contact.
 - b. Level of quality shall be maintained with a minor change.
 - 2. Deviation: Subcontractor initiated change for which the scope, cost and/or schedule of the Subcontract may be impacted.
 - 3. Subcontractor Authorized Representative: Individual within Subcontractor's organization authorized to receive change documents and responsible for informing others in Subcontractor's employ or Subtier contractors of changes to the Work Scope.

1.2 REFERENCES

- A. National Codes / Standards:
 - 1. Obtain BSRI prior acceptance for other editions and/or addenda of National Codes / Standards required by this specification before use.
- B. Required National Codes / Standards
None
- C. Regulations
None
- D. Documents
None
- E. Drawings
None

1.3 REQUEST FOR INFORMATION (RFI)

- A. Identify questions needing clarification or request services from BSRI using a Request for Information (RFI).
 - 1. RFI forms will be available from the BSRI Subcontract Technical Representative (STR).

- B. Transmit the RFI to the BSRI STR.
- C. RFI issues which, at any time during the course of the subcontract, result in changes to or deviations from the technical or quality requirements or otherwise impact the cost / schedule require the use of an SDDR prior to continuing the affected work.
- D. Maintain a tracking log of RFI documents.

1.4 SUPPLIER DEVIATION DISPOSITION REQUEST (SDDR)

- A. Prepare a Supplier Deviation Disposition Request for Subcontractor proposed deviations from the technical or quality requirements of this procurement.
- B. Applies to proposed deviations that are not Minor Changes after award of subcontract.
 - 1. RFI issues subsequently determined to be non-minor changes to the technical or quality requirements or otherwise impact the cost / schedule require implementation and completion of the SDDR process prior to continuing.
- C. For each deviation:
 - 1. Identify the following, as applicable:
 - a. Specification and revision number
 - b. Affected drawing number, revision number, section or detail.
 - 2. Identify criteria that cannot be met by item and specification section number.
 - 3. Present explanation for the deviation.
 - 4. Present proposal for resolution of the deviation.
 - 5. Present price and schedule adjustment for the proposed resolution of the deviation.
- D. Nonconforming Conditions
 - 1. Nonconforming conditions are subcontractor installed conditions which do not meet the technical or quality requirements of this subcontract.
 - 2. Document nonconforming conditions on a Supplier Deviation Disposition Request.
 - a. Include supporting technical justification when requesting acceptance of a "Use-As-Is" or "Repair" disposition.
- E. Transmit Supplier Deviation Disposition Request for review and disposition in accordance with Section 01330 - Submittal Procedures.
- F. Do not perform work on affected scope or make delivery of any item for which a SDDR is submitted until a written disposition of the SDDR is received from BSRI.
 - 1. Continue the work in accordance with the written BSRI disposition of the SDDR.

1.5 CHANGE NOTICE

- A. BSRI will issue a Change Notice to identify additional scope, including a detailed description of proposed change with supplementary or revised drawings and/or specifications.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SITE SURVEYS
SECTION 01320

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Site survey services in support of construction
- B. Maintain control of vertical and horizontal location of constructed items
- C. Bench marks and heave markers

1.2 RELATED SECTIONS

- A. Division 1 - All Sections
- B. Section 02310, Excavation and Foundation Preparation
- C. Section 02320, Backfill and Finish Surface
- D. Section 13210, Storage Tanks

1.3 REFERENCES

- A. National Codes / Standards:
 - 1. Obtain BSRI prior acceptance for other editions and/or addenda of National Codes / Standards required by this specification before use.
- B. Required National Codes / Standards
None
- C. Regulations
 - 1. FGDC-STD-007.4, Geospatial Positioning Accuracy Standard, Part 2, Geodetic Control Networks
 - 2. Federal Geographic Data Committee, FGDC-STD-007.4-2002, Geospatial Positioning Accuracy Standards PART 4: Standards for Architecture, Engineering, Construction (A/E/C) and Facility Management
 - 3. Use the National Geodetic Vertical Datum of 1929 to reference the temporary bench mark elevations.
- D. Documents
None
- E. Drawings
 - 1. C-CG-Z-00026, Overall Site Plan
 - 2. C-CG-Z-00027, Excavation & Stockpile Plan
 - 3. C-CG-Z-00030, Finish Grading Plan

1.4 DEFINITIONS / ACRONYMS

- A. See Section 01100.

1.5 TEMPORARY BENCH MARKS AND HEAVE MARKERS

- A. BSRI will provide and install temporary bench marks as indicated on Drawing C-CG-Z-00026 and Phase I heave markers as identified on Drawing C-CG-Z-00027.

B. Mud Mat Markers and Settlement Markers

1. BSRI will materially provide Phase II mud mat markers and Phase III settlement markers (for Subcontractor installation) as indicated on Drawings C-CG-Z-00027 and C-CG-Z-00030.

1.6 QUALITY ASSURANCE

- A. See Section 01400.
- B. Perform survey work under the direction of a Professional Land Surveyor registered and licensed to practice in the state of South Carolina.
- C. Survey drawings, reports and any other official documents submitted shall be in accordance with the laws and regulations governing the practice of land surveying in the State of South Carolina.
- D. BSRI reserves the right to perform independent surveys as needed.

1.7 NOTIFICATION AND COORDINATION

- A. Coordinate required surveys through the BSRI STR.
- B. Notify the BSRI STR at least 10 days in advance prior to initiating a required survey.
- C. Contact BSRI at least 6 weeks prior to installation of mud mat or roof settlement markers.

1.8 SUBMITTALS

- A. Maps and Drawings
 1. Submit electronic files for maps and drawings that are compatible with Microstation Version J.
 2. Where hard copies are required for submittals, provide as ANSI D size, 22-inch by 32-inch sheets.
 3. Where electronic media is required for submittals, provide in Microstation format on Compact Disk (CD ROM or equivalent). Include a list of levels used and the line weights, line codes, and colors used with each design file.
- B. See specification Section 3.10 for submittal requirements for surveys, maps and drawings.
- C. Submit the following Quality Verification documents in accordance with Sections 01330 and 01400:
 1. Settlement Data, 3.10.E

1.9 PERFORMANCE REQUIREMENTS

- A. Maintain sufficient equipment, materials, parts, tools, and supplies to meet the requirements of the work. Inspect and calibrate surveying equipment at intervals specified by the manufacturer.

1.10 PROJECT RECORD DOCUMENTS

- A. Maintain a complete and accurate log of control and survey work as it progresses. This log shall be available for review by BSRI upon request.

PART 2 PRODUCTS

2.1 MARKERS

- A. BSRI will materially provide Phase II mud mat markers and Phase III settlement markers per Drawings C-CG-Z-00027 and C-CG-Z-00030.

PART 3 EXECUTION

3.1 ACCURACY

- A. Use Third Order/Class I survey accuracy as specified in FGDC-STD-007.4 by the Federal Geographic Data Committee. As-built survey shots shall be recorded to the nearest 0.01 feet.
- B. Indicate the degree of accuracy of submitted data and the latest calibration date of equipment used on survey drawings, or submitted in a certified report. Certify by a Professional Land Surveyor registered in the State of South Carolina.

3.2 PREPARATION

- A. Use the BSRI temporary bench marks for the survey data.
- B. Resolve any discrepancies noted on the topographic surveys prior to initiation of construction activities.
- C. Locate and protect survey control and reference points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report in writing to BSRI the loss or destruction of any reference point or relocation required due to changes in grades or other reason.

3.3 PROTECTION

- A. Install three guard posts with reflective paint striping adjacent to temporary benchmarks in high traffic areas to prevent vehicular damage. Inform BSRI, in writing, if Subcontractor considers a temporary benchmark not to be in a high traffic area (i.e. guard posts are not installed).

3.4 CONSTRUCTION LAYOUT

- A. Perform pre-construction survey to set lines, grades, and/or any other survey controls to aid in locating the proposed construction areas. This includes physical layout for the equipment and structure locations, roads, drainage, grading, etc.
- B. Where location tolerances for structure and yard articles are not specified on Contract Drawings, use tolerance of ± 0.10 feet in horizontal and vertical direction.

3.5 MEASUREMENT OF QUANTITIES

- A. Survey work required, to determine in-progress quantities and field measurement, includes topographic surveys, field measurements of drainage areas, etc.
- B. Place survey controls for future extensions of the survey where portions of a completed section require measurement during construction.

3.6 AS-BUILT SURVEY CRITERIA

- A. Perform final topographic surveys, measurements, and recording required to document construction. Include as-built locations and elevations of all disturbed areas and features such as cover boundaries, channels, drainage structures, utilities, high points, change in slope, etc.

3.7 REFERENCE ELEVATION MONUMENTS

A. Temporary Bench Marks

1. Temporary bench marks will be installed per Drawing C-CG-Z-00026 by BSRI. The bench marks will be similar to those used by the United States Geological Survey (USGS) with the bench mark component location indicator number (provided by BSRI) punched on brass caps embedded in concrete. The base datum Mean Sea Level (MSL) will be indicated on the bench marks.
2. The elevation of the temporary bench marks will be set from the nearest bench mark established by the National Geodetic Society (NGS), USGS, or other nationally acceptable surveying standards or agencies.
3. All temporary bench marks shall be protected from damage.
4. Temporary bench marks shall be checked against the NGS, USGS, or SRS accepted bench marks at 6-month intervals during construction. A complete elevation survey closing at the starting point shall be made. The maximum permissible error shall be $\pm 3 \text{ mm } \sqrt{\text{distance in kilometers}}$ (First order Class I leveling, Ref. 1.3.C.2)

3.8 SETTLEMENT, HEAVE AND MUD MAT MARKERS

A. Settlement, heave and mud mat markers are elevation references placed on major structural elements such as columns, walls, chimneys, foundations, or foundation soils.

B. Three types of settlement markers will be used:

1. Heave marker: Heave marker will be a Borros anchor or equivalent installed per Manufacturer's instructions.
 - a. Installation by BSRI and monitored by Subcontractor.
2. Mud mat marker: Each mud mat marker shall consist of a 9/16" diameter 3 feet long stainless steel rod monument with a cone-shaped point, a 3/4" bronze domed cap (Bernsten No. RBS325BR or equal), a 6-inch long 6-inch diameter schedule 40 PVC pipe, and a benchmark access cover for schedule 40, 6" PVC pipe with recessed hinge (Bernsten No. BMAC6 or equal) installed per manufacturer's instructions.
3. Horizontal settlement marker: Horizontal marker shall be a 3-1/2" diameter domed bronze concrete survey marker (Bernsten No. C35DB or equal), cast-in place during concrete placement.
4. All markers shall be identified in the field with a unique facility CLI number supplied by BSRI. CLI tags will be provided by BSRI. The tags shall be affixed adjacent to the marker for the period of time the marker is being monitored. The only "permanent" markers will be the tank roof settlement markers. The CLI tags for those will be epoxyed to the roof after elastomeric coating is applied.
5. Any marker that is destroyed, damaged, or becomes inaccessible shall be replaced or relocated in the same area where possible, before the next scheduled survey. The elevation of a replaced or relocated marker shall be tied to that of the old marker, if possible. An adjusted initial elevation shall be established for the new marker so that an uninterrupted settlement observation of the marker can be maintained.
6. It may be necessary to establish temporary settlement markers for facilities under construction, and/or relocate permanent settlement markers during construction

activities due to interferences or for ease of survey. New markers should be installed and monitored prior to removal or relocation of the old marker to maintain a constant settlement record.

3.9 FREQUENCY OF MONITORING

1. After the initial settlement (or heave) marker elevation is established, surveys shall be scheduled at weekly intervals during construction, or as required by BSRI.

3.10 RECORDING OF DATA

- A. A complete set of field notes (hard copy and/or electronic files) shall be kept and maintained for the following:
 1. Descriptive location of settlement markers.
 2. Records of elevation and settlement each time a survey is made.
 3. Relocation of settlement markers.
 4. Location and elevation of bench marks and control monuments.
- B. After installing the settlement (or heave) markers, the initial elevations and date shall be recorded as soon as possible. A complete elevation survey closing at the starting point (i.e., control monument) shall be made and repeated the same day to establish initial marker elevations. The maximum permissive error shall be $\pm 3 \text{ mm} \sqrt{\text{distance in kilometers}}$ (First Order Class I Leveling, Ref.C.2).
- C. In addition to elevation data, the following information shall also be recorded for each survey:
 1. Date and time;
 2. Survey crew names;
 3. Equipment used (including identification numbers and calibration date);
 4. Weather conditions;
 5. Temperature;
 6. Description of any unusual conditions or damage of a marker/monument
 7. Relocation of settlement markers
 8. Excavation level (if applicable, for heave measurements);
 9. During placement of concrete, total weight of concrete computed per design, and an estimate of cumulative amount of concrete placed;
 10. After placement of concrete, any major equipment and commodity loads and estimated percentage of total foundation load;
 11. Current construction operations or any other unusual conditions.
- D. Depending on the settlement results, a re-survey may be necessary. This will be determined by BSRI following review of settlement data.
- E. Transmittal of Settlement Data
 1. Submit Settlement Data
 2. All settlement data shall be transmitted at the recommended survey interval.

END OF SECTION

SUBMITTAL PROCEDURES

SECTION 01330

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements for submittal of information for BSRI review and/or acceptance.

1.2 SUBMITTAL PROCEDURES

- A. Required Submittals:

1. Specified in the individual specification sections and listed on the Engineering Document Requirements (EDR) form, Attachment 01330-A and Quality Verification Documents Requirement (QVDR) form, Attachment 01330-B.
2. Review prior to submission.
3. Certify conformance of documents to specification requirements by signature of the Subcontractor's Authorized Engineering Representative.
4. List the following on each submittal transmittal cover letter:
 - a. Document category number, and applicable specification Section and Article number (Ref. Columns 1 and 2 of Attachment 01300-A).
 - b. Document description

- B. Correspondence, submittals and Supplier Deviation Disposition Request forms:

1. Uniquely identify with a control number
2. Reference the following information:
 - a. Subcontractor Name,
 - b. Subcontractor's Order Reference Number,
 - c. BSRI Purchase Order No.: (Defined on Award),
 - d. BSRI Project Number and Title: (Defined on Award),
 - e. Date of transmittal,
 - f. Sequence page number and total number of pages on each page.
3. Transmit with a completed Transmittal Letter.

- C. Transmit EDR and QVDR submittals, and original Supplier Deviation Disposition Request forms to:

Westinghouse Savannah River Company
Document Control Center
Building 704-1N
Aiken, SC 29808
Project: Saltstone Vault #2 Excavation, Liner, and Backfill

- D. Transmit a copy of submittals, a copy of Supplier Deviation Disposition Request forms, and all Request For Information forms to:
 - Subcontract Technical Representative.
 - Name: (Defined on Award)
 - Savannah River Site
 - Building / Room: (Defined on Award)
 - Aiken, SC 29808
- E. Transmit correspondence and a copy of all transmittal letters to:
 - Procurement Representative
 - Name: (Defined on Award)
 - Savannah River Site
 - Location: (Defined on Award)
 - Aiken, SC 29808
- F. Mark "RESUBMITTAL" on resubmitted documents and include the previous submittal document number provided with submittal review comments.
- G. Paper submittals with less than 25% recycled content is acceptable.
- H. Durations provided for submittal and review cycles are calendar days.
- I. Where duration "after award" is provided, duration is measured in calendar days after notification of award is given for this Subcontract, rather than any subtier subcontracts.

1.3 REVIEW, ACCEPTANCE AND STATUS OF SUBMITTALS

- A. Submit documents listed on the Engineering Document Requirements form, Attachment 01330-A, on or before the submittal schedule identified in column 5.
- B. Provide an 8 x 3 inch blank space for status review stamp on the first page of each required submittal.
- C. Unless noted otherwise, submittals will be statused and returned to the Subcontractor within 14 days of receipt with status as follows:
 - 1. Status 1: Work may proceed.
 - 2. Status 2: Submit final documentation. Work may proceed.
 - 3. Status 3: Revise and resubmit. Work may proceed subject to resolution of indicated comments.
 - 4. Status 4: Revise and resubmit. Work may not proceed.
 - 5. Status 5: Permission to proceed not required.
- D. Incorporate changes as required in accordance with BSRI comments.
 - 1. Clearly indicate revisions on all resubmitted documents.
 - 2. Resubmit corrected Engineering Documents for review within 14 days of the date of receipt.
- E. Assignment of Status 1 or Status 5 to the Engineering Documents by BSRI does not relieve the Subcontractor of any part of their obligation to meet all requirements of this Specification or their responsibility for the correctness of such Engineering Documents, and the adequacy and suitability of material and equipment represented thereon for the intended function.
- F. Do not change previously accepted, Status 1 or Status 5, documents without notification to the Subcontract Technical Representative

1.4 QVDR SUBMITTALS

- A. Submit the Quality Verification Document Requirements (QVDR) in accordance with Attachment 01300-B.
 - 1. Unless otherwise noted within the division sections, submit Attachment 01300-B documents on a weekly basis.
 - 2. Develop an itemized list according to the listing in Attachment 01300-B and include with the transmitted document set.
 - 3. Retain copies of QVDR records in accordance with Quality Assurance Program requirements for records.
 - a. Retain records until demobilization.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

Engineering Document Requirements

Attachment No. 01330-A
 Revision No. 1
 Spec/Req'n No. C-SPP-Z-00006
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1. Document Category Number	2. Specification Paragraph Reference	3. Document Description	4. Permission to Proceed Required		5. Submittal Schedule	6. Quantity Required		7. Kind of copies	8. Remarks
			Yes	No		Init	Final		
28.0	01450 1.10 A.	Inspection and Testing Laboratory Business Information		N	With Proposal		3	Repro	
1.0	02310 3.5 D. 1.	Shoring Design	Y		4 Weeks Prior to Use		3	Repro	Submit when shoring is required by OSHA
1.0	02320 3.13 B.	Post Construction As-Built Topographic Survey		N	2 Weeks After Substantial Completion		3	Repro	
28.0	02370 1.7 B.	Construction Subcontractor Co-Permittee Certification		N	2 Weeks Prior to Work		3	Repro	
11.0	02378 1.5 C.2	HPDE Liner LOC & Mat'l Quality Control Test Data		N	With Material Delivery		3	Repro	
1.0	02378 1.6 B. 2.	HDPE Liner Design	Y		8 Weeks Prior to Use		3	Repro	
6.0	02378 1.6 D. 9.	Quality Control and Inspection Plan and Procedures	Y		8 Weeks Prior to Use		3	Repro	
1.0	02378 1.6 F.	As-Built drawing(s) of the HDPE Liner Layout		N	2 Weeks After Completion		3	Repro	
28.0	02378 1.7 B.	Subcontractor HDPE Qualification Documentation		N	With Proposal		3	Repro	
28.0	02378 1.7 C. 1.	Field Supervisor's or Superintendent's Resume & References		N	2 Weeks Prior to Work		3	Repro	
28.0	02378 1.7 D.1	Filed Crew's Resumes & References		N	4 Weeks Prior to Work		3	Repro	
28.0	02378 1.7 E.3	Quality Control Person's Resume & Certification		N	4 Weeks Prior to Work		3	Repro	
4.4	02378 1.8 B. 1.	HDPE Liner Storage and Handling Instructions		N	2 Weeks Prior to Receipt		3	Repro	
11.0	02378 2.3 C.	HDPE Liner Product Data and Material Specifications	Y		8 Weeks Prior to Use		3	Repro	With Product Samples
4.1	02378 2.3 D.	HDPE Liner Installation Specifications	Y		8 Weeks Prior to Use		3	Repro	
1.0	02378 3.1 A. 5.	HDPE Liner Installation Drawings	Y		8 Weeks Prior to Use		3	Repro	
1.0	02379 1.6 B. 2.	Geosynthetic Clay Liner Design Detail Drawings	Y		8 Weeks Prior to Use		3	Repro	
6.0	02379 1.6 D. 9.	Quality Control and Inspection Plan and Procedures	Y		8 Weeks Prior to Use		3	Repro	
1.0	02379 1.6 F.	As-Built drawing(s) of the GCL Layout		N	2 Weeks After Completion		3	Repro	
28.0	02379 1.7 B.	Subcontractor GCL Qualification Documentation		N	With Proposal		3	Repro	
28.0	02379 1.7 C.	Field Supervisor's or Superintendent's Resume & References		N	2 Weeks Prior to Work		3	Repro	
28.0	02379 1.7 E.4	Quality Control Person's Resume & Certification		N	4 Weeks Prior to Work		3	Repro	
11.0	02379 1.5 C.2 & 2.3 D	HPDE Liner LOC & Mat'l Quality Control Test Data		N	With Material Delivery		3	Repro	
4.4	02379 1.8 B. 1.	GCL Storage and Handling Instructions		N	2 Weeks Prior to Receipt		3	Repro	
11.0	02379 2.3 E.	GCL Product Data and Material Specifications	Y		8 Weeks Prior to Use		3	Repro	With Product Samples
4.1	02379 2.3 F.	GCL Installation Specifications	Y		8 Weeks Prior to Use		3	Repro	

Engineering Document Requirements

Attachment No. 01330-A
 Revision No. 1
 Spec/Req'n No. C-SPP-Z-00006
 Page 5 of 9

1. Document Category Number	2. Specification Paragraph Reference	3. Document Description	4. Permission to Proceed Required		5. Submittal Schedule	6. Quantity Required		7. Kind of copies	8. Remarks
			Yes	No		Init	Final		
1.0	02379 3.1 A. 3.	GCL Liner Installation Drawings	Y		8 Weeks Prior to Use		3	Repro	
14.0	02379 3.3 F. 5.	Alternate Repair Procedures		N	4 Weeks Prior to Use		3	Repro	
1.3	02630 3.2 B. 1.	Cast-In-Place Junction Box Shop Drawing	Y		4 Weeks Prior to Use		3	Repro	Submit if cast-in-place box is used
8.0	03300 1.7 C.	Concrete & CLSM Information	Y		4 Weeks Prior to Use		3	Repro	
4.1	03300 3.2 A.	Proposed Construction Joint Plan		N	2 Weeks Prior to Placement		3	Repro	
1.0	13210 1.5 C	Revised Tank Drawings	Y		4 Weeks ARO		3	Repro	ARO = After Receipt of Order
8.0	13210 1.5 D	Revised Tank Calculations	Y		4 Weeks ARO		3	Repro	
4.1	13210 1.5 E.1.	Tank Installation Instructions	Y		4 Weeks Prior to Installation		3	Repro	
4.1	13210 1.5 E.2	Tank Surface Preparation, Coating Application & Testing Instructions	Y		6 Weeks ARO		3	Repro	
11.0	13210 1.5 E.3	Shotcrete Information	Y		6 Weeks ARO		3	Repro	
28.0	13210 1.8 A.2	Shotcrete Nozzlemen Certification	Y		4 Weeks Prior to Installation		3	Repro	
28.0	13210 1.8 B.2	Coating System Installer Qualifications	Y		6 Weeks ARO		3	Repro	
11.0	13210 2.1 C.2	Steel Coating System Product Data		N	6 Weeks ARO		3	Repro	
25.0	13210 2.2 A.1.c	Tank Weld Examination Procedure	Y		4 Weeks Prior to Welding		3	Repro	
25.0	13210 3.4 A.1.h	Visual Tank Examination Procedures	Y		4 Weeks Prior to Examination		3	Repro	
26.0	13210 3.4 B.2.b	Concrete Moisture Testing Procedure	Y		Prior To Testing		3	Repro	
24.0	13210 3.4 B.4.c	Tank Water Tightness Test Procedure	Y		Prior to Test		3	Repro	
14.0	13210 3.4 B.4.d	Tank Repair Procedure	Y		Prior to Test		3	Repro	

Engineering Document Requirements Instructions

Attachment No. 01330-A
 Revision No. 1
 Spec/Req'n No. C-SPP-Z-00006
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Purpose The Engineering Document Requirements (EDR) form is prepared by the originator, establishes a basis for actions required of a Supplier and provides the schedule for the submittal of engineering documents by the Supplier.

Legend Entry

No.	Information Required
1	Document category number – see below.
2	Applicable specification number and appropriate paragraph.
3	Description corresponding to document category number.
4	Permission to proceed with fabrication or other specific processes is marked yes, if required.
5	List a milestone after award i.e., prior to fabrication, prior to test, prior to shipment, or with shipment that the listed document is to be submitted by Supplier.
6	Number of copies required for submittal.
7	Reproducible, Mylar, Vellum, etc.
8	Enter remarks when appropriate.

Document Category Number and Descriptions

- 1.0 Drawings
 - 1.1 Outline Dimensions, Services, Foundations and Mounting Details – Drawings providing external envelope, including lugs, centerline(s), location and size for electrical cable, conduit, fluid, and other service connections, isometrics and details related to foundations and mountings.
 - 1.2 Assembly Drawings – Detailed drawings indicating sufficient information to facilitate assembly of the component parts of an equipment item.
 - 1.3 Shop Detail Drawings – Drawings which provide sufficient detail to facilitate fabrication, manufacture, or installation. This includes pipe spool drawings, internal piping and wiring details, cross-section details and structural and architectural details.
 - 1.4 Wiring Diagrams – Drawings which show schematic diagram equipment, internal wiring diagrams, and interconnection wiring diagram for electrical items.
 - 1.5 Control Logic Diagrams – Drawings which show paths which input signals must follow to accomplish the required responses.
 - 1.6 Piping and Instrumentation Diagrams – Drawings which show piping system scheme and control elements.
- 2.0 Parts Lists and Costs – Sectional view with identified parts and recommended spare parts for one year's operation and specified with unit cost.
- 3.0 Complete WSRC Data Sheets – Information provided by Supplier on data sheets furnished by WSRC.
- 4.0 Instructions
 - 4.1 Erection/Installation – Detailed written procedures, instructions, and drawings required to erect or install material or equipment.
 - 4.2 Operations – Detailed written instructions describing how an item or system should be operated.
 - 4.3 Maintenance – Detailed written instructions required to disassemble, reassemble and maintain items or systems in an operating condition.
 - 4.4 Site Storage and Handling – Detailed written instructions, requirements and time period for lubrication, rotation, heating, lifting or other handling requirements to prevent damage or deterioration during storage and handling at jobsite. This includes shipping instruction for return.
- 5.0 Schedules: Engineering and Fabrication/Erection – Bar charts or critical path method diagram which detail the chronological sequence of activities, i.e., Engineering submittals, fabrication and shipment.
- 6.0 Quality Assurance Manual/Procedures – The document(s) which describe(s) the planned and systematic measures that are used to assure that structures, systems, and components will meet the requirements of the procurement documents.
- 7.0 Seismic Data Reports – The analytical or test report which provides information and demonstrates suitability of material, component or system in relation to the conditions imposed by the stated seismic criteria.
- 8.0 Analysis and Design Reports – The analytical data (stress, electrical loading, fluid dynamics, design verification reports, etc.) which demonstrate that an item satisfies specified requirements.
- 9.0 Acoustic Data Reports – The noise, sound and other acoustic vibration data required by the procurement documents.
- 10.0 Samples
 - 10.1 Typical Quality Verification Documents – A representative data package which will be submitted for the items furnished as required in the procurement documents.
 - 10.2 Typical Material Used – a representative example of the material to be used.
- 11.0 Material Descriptions – The technical data describing a material which a Supplier proposes to use. This usually applies to architectural items, e.g., metal siding, decking, doors, paints, coatings.
- 12.0 Welding Procedures and Qualifications – The welding procedure, specification and supporting qualification records required for welding, hard facing, overlaying, brazing and soldering.
- 13.0 Material Control Procedures – The procedures for controlling issuance, handling, storage and traceability of materials such as weld rod.
- 14.0 Repair Procedures – The procedures for controlling materials removal and replacement by welding, brazing, etc., subsequent thermal treatments, and final acceptance inspection.
- 15.0 Cleaning and Coating Procedures – The procedures for removal of dirt, grease or other surface contamination, and preparation and application of protective coatings.
- 16.0 Heat Treatment Procedures – The procedures for controlling temperatures and time at temperature as a function of thickness, furnace atmosphere, cooling rate and methods, etc.
- 19.0 UT – Ultrasonic Examination Procedures – Procedures for detecting discontinuities and inclusions in materials by the use of high frequency acoustic energy.
- 20.0 RT – Radiographic Examination Procedures – Procedures for detecting discontinuities and inclusions in materials by x-ray or gamma ray expose of photographic film.
- 21.0 MT – Magnetic Particle Examination Procedures – Procedures for detecting surface or near surface discontinuities in magnetic materials by the distortion of an applied magnetic field.
- 22.0 PT – Liquid Penetrant Examination Procedures – Procedures for detecting discontinuities in materials by the application of a penetrating liquid in conjunction with suitable developing materials.
- 23.0 Eddy Current Examination Procedures – Procedures for detecting discontinuities in materials by distortion of an applied electromagnetic field.
- 24.0 Pressure Test – Hydro, Air, Leak, Bubble or Vacuum Test Procedures – Procedures for performing hydrostatic or pneumatic structural integrity and leakage tests.
- 25.0 Inspection Procedures – Organized process followed for the purpose of determining that specified requirements (dimensions, properties, performance results, etc.) are met.
- 26.0 Performance Test Procedures – Test performed to demonstrate that functional design and operational parameters are met.
 - 26.1 Mechanical Tests – e.g., pump performance, data valve stroking, load, temperature rise, calibration, environmental, etc.
 - 26.2 Electrical Test – e.g., impulse, overload, continuity, voltage, temperature rise, calibration, saturation, loss, etc.
- 27.0 Prototype Test Reports – Reports of a test which is performed on a standard or typical examination of equipment or item, and which is not required for each item produced in order to substantiate the acceptability of equal items. This may include tests which result in damage to the item(s) tested.
- 28.0 Personnel Qualification Procedures – Procedures for qualifying welders, inspectors and other special process personnel.
- 29.0 Supplier Shipping Preparation Procedures – Procedures used by a Supplier to prepare finished materials or equipment for shipment from its facility to the jobsite.

Quality Verification Document Requirements

Attachment No. 01330-B
 Revision No. 1
 Spec/Req'n No. C-SPP-Z-00006
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1. Document Category Number	2. Specification Paragraph Reference.	3. Document Description	4. SSR Release.	5. WSRC Receipt Inspection Check-In	6. Remarks	7. DOC Supplier Page Count
N/A	01320 3.10 E	Settlement Data				
26.0	02320 3.14 A. 4.	Fill Material Laboratory Test Reports				
25.0	02320 3.14 B. 3.	Field Inspection Reports				
26.0	02320 3.14 C. 2.	In-Place Moisture Content Test Reports				
26.0	02320 3.14 D. 6.	In-Place Density Test Reports				
25.0	02370 3.4 D.	Stormwater Pollution Prevention Plan Inspection Forms				
26.0	02378 1.6 E. 1.	Field Test Reports				
25.0	02378 3.1 D. 2.	Written Acceptance of the Surface				
25.0	02378 3.4 B.4	Installation Test Reports of All Filed Tests & Inspection Reports				
25.0	02378 3.4 C.2	Final Acceptance & Inspection Report				
25.0	02379 1.5 D. 3.	Geosynthetic Clay Liner Inspection and Acceptance Report				
26.0	02379 1.6 E.	GCL Test Reports				
25.0	02379 3.1 D. 2.	Written Acceptance of the Surface				
25.0	02379 3.4 A.3	Final Acceptance & Inspection Report				
8. Supplier's Order No.		9. Supplier's Part		10. Supplier's Part Name		11. Quantity
12. PO No.		13. WSRC Line/Equip Tag or Code No.		14. WSRC Part Name		
15. Supplier's Conformance Statement We certify that the work and required documents meet the requirements of the procuring documents.						
_____ Authorized Supplier Signature			_____ Title		_____ Date	
16. Source Surveillance Representative at Supplier's Facility Work was released based on satisfactory completion of quality surveillance and review of documentation.						
<input type="checkbox"/> With Authorized Deviations Noted in Column 6 <input type="checkbox"/> No Deviations						
_____ Signature of SSR			_____ Date			
17. Receiving Inspection at SRS This form and the quality verification documents referenced hereon have been received and their relationship to the hardware verified.						
_____ Signature of WSRC Inspector			_____ Date			

Quality Verification Document Requirements

Attachment No. 01330-B
 Revision No. 1
 Spec/Req'n No. C-SPP-Z-00006
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1. Document Category Number	2. Specification Paragraph Reference	3. Document Description	4. SSR Release	5. WSRC Receipt Inspection Check-In	6. Remarks	7. DOC Supplier Page Count
25.0	02630 3.2 H.1	Junction Box Inspection & Test Data				
25.0	02630 3.4 D.1	Initial Backfill Inspection & Compaction test Data				
25.0	02630 3.5 C.1	Final Backfill Inspection & Compaction Test Data				
25.0	03300 3.7 B.	Concrete & CLSM Inspection Reports				
26.0	03300 3.7 C	Concrete & CLSM Test Reports				
25.0	13210 2.2 A.1.d	Tank Weld Examination Reports				
17.0	13210 2.2 B.5	Material Test Reports for Concrete & Shotcrete				
25.0	13210 3.4 A.1.i	Visual Tank Examination Reports				
25.0	13210 3.4 A.2.b	Anchor Inspection Reports				
26.1	13210 3.4 B.1.b	Anchor Test Reports				
26.0	13210 3.4 B.2.c	Concrete Moisture Testing Procedure				
26.0	13210 3.4 B.3.b	Internal Coating Test Reports				
26.1	13210 3.4 B.4.e	Tank Water Tightness Test Report				
26.1	13210 3.4 B.5.b	Pre-Stress Wire Measurement Reports				
8. Supplier's Order No.		9. Supplier's Part		10. Supplier's Part Name		11. Quantity
12. PO No.		13. WSRC Line/Equip Tag or Code No.		14. WSRC Part Name		
15. Supplier's Conformance Statement We certify that the work and required documents meet the requirements of the procuring documents. _____ Authorized Supplier Signature Title Date						
16. Source Surveillance Representative at Supplier's Facility Work was released based on satisfactory completion of quality surveillance and review of documentation. <input type="checkbox"/> With Authorized Deviations Noted in Column 6 <input type="checkbox"/> No Deviations _____ Signature of SSR Date						
17. Receiving Inspection at SRS This form and the quality verification documents referenced hereon have been received and their relationship to the hardware verified. _____ Signature of WSRC Inspector Date						

Quality Verification Document Requirements Instructions

Attachment No. 01330-B
 Revision No. 1
 Spec/Req'n No. C-SPP-Z-00006
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Purpose The Quality Verification document Requirements (QVDR) is initiated by SRS and completed by the Supplier when providing quality verification documents. The QVDR is a multipurpose form to

Transmit quality verification documents from the Supplier,
 Provide evidence of SSR release of documentation and/or work, and
 Provide evidence of an SRS inspection check of documentation received at SRS.

WSRC Entries		Supplier Entries	
Entry No.	Information Required	Entry No.	Information Required
1	Enter Document Category Number – see below.	7	Enter number of pages of quality verification document being submitted.
2	Enter Specification Number and Paragraph Reference.	8	Enter information required.
3	Enter Description corresponding to the Document Category Number.	9	Enter information required.
4	SSR to initial upon item release.	10	Enter information required.
6	Enter Remarks: as appropriate.	11	Enter the quantity of units covered by the documents submitted. For each item on Entry No. 12 being released, provide a separate copy of this completed form and the supporting quality verification documents.
16	SSR and dates release.	12	Enter information required.
Field Entries		13	Enter information required.
5	SRS inspector at the jobsite to complete check-in.	14	Enter information required.
17	The SRS inspector will review the quality verification documentation package. If found satisfactory, he signs and dates the check-in statement.	15	Supplier – Signature of an employee authorized to sign such documents.

Document Category Numbers and Descriptions

- 12.0 Welding Verification Reports – Reports of welding performed to include weld identification, and certification that qualified welding procedures and welders were used.
- 13.0 Material Verification Reports – Reports relative to material which confirm, substantiate or assure that an activity or condition has been implemented in conformance with code and material specifications imposed by the procurement documents.
- 14.0 Major Repair Verification Reports – Reports may include weld repair locations (maps), material test reports for filler metal, pre- and post-weld heat treatment records, NDE records, etc. The resolution of whether a repair is major or not is an SRS responsibility.
- 15.0 Cleaning and Coating Verification Reports – Reports include a certification of visual examination for surface preparation, surface profile, materials, etc.; and also humidity data, temperature data and coating thickness data as required by the procurement documents.
- 16.0 Heat Treat Reports – Reports normally include furnace charts and similar records which identify and certify the item(s) treated, the procedure used, furnace atmosphere, time at temperature, cooling rate, etc.
- 17.0 Material Property Reports
- 17.1 MTR (Material Test Reports) – These reports include all chemical, physical, mechanical, and electrical property test data required by the material specification and applicable codes. These are applicable to cement, concrete, metals, cable jacket materials, rebar, rebar splices, etc.
- 17.2 Impact Test Data – Reports of Charpy or drop weight tests including specimen configuration, test temperature and fracture data.
- 17.3 Ferrite Data – Reports of the ferrite percentage for stainless steel materials used, including castings and welding filler metals as deposited.
- 17.4 Materials Certificate of Conformance – Documents which certify conformance to the requirements of the applicable material specification.
- 17.5 Electrical Property Reports – Reports of electrical characteristics, e.g., dielectric, impedance, resistance, flame tests, corona, etc.
- 18.0 Code Compliance – Verifying documents (such as data Forms U-1, M-2, State, etc.), which are prepared by the manufacturer or installer and certified by the Authorized Code Inspector.
- 19.0 UT – Ultrasonic Examination and Verification Reports – Examination results of certain characteristics of discontinuities and inclusions in material by the use of high frequency acoustic energy.
- 20.0 RT – Radiographic Examination and Verification Reports – Examination results of certain characteristics of discontinuities and inclusions in materials by x-ray or gamma ray exposure of photographic film, including film itself.
- 21.0 MT – Magnetic Particle Examination and Verification Reports – Examination results of surface (or near surface) discontinuities in magnetic materials by distortion of an applied magnetic field.
- 22.0 PT – Liquid Penetrant Examination and Verification Reports – Examination results of surface discontinuities in materials by application of a penetrating liquid in conjunction with suitable developing techniques.
- 23.0 Eddy Current Examination and Verification Reports – Examination results of discontinuities in material by distortion of an applied electromagnetic field.
- 24.0 Pressure Test – Hydro, Air, Leak, Bubble or Vacuum Test and Verification Reports – Results of hydrostatic or pneumatic structural integrity and leakage tests.
- 25.0 Inspection and Verification Reports – Documented findings resulting from an inspection.
- 26.0 Performance Test and Verification Reports – Reports of Test Results
- 26.1 Mechanical Test, e.g., pump, performance data, valve stroking, load, temperature rise, calibration, environment, etc.
- 26.2 Electrical Tests, e.g., load, impulse, overload, continuity, voltage, temperature rise, calibration, saturation, loss, etc.
- 27.0 Prototype Test Report – Report of the test which is performed on a standard or typical example of equipment, material or item, and which is not required for each item produced in order to substantiate the acceptability of equal items. This normally includes tests which may, or could be expected to, result in damage to the item(s) tested.
- 28.0 Certificate of Conformance – A document signed or otherwise authenticated by an authorized individual certifying the degree to which items or services meet specified requirements.

QUALITY REQUIREMENTS

SECTION 01400

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General.
- B. Site inspection and oversight requirements.

1.2 RELATED SECTIONS

- A. Section 01250, Change Procedures
- B. Section 01450, Inspection and Testing Laboratory Services

1.3 GENERAL REQUIREMENTS

- A. Individual specification sections contain inspection and testing requirements, including associated test and inspection documentation the Subcontractor is required to prepare, retain and/or transmit to BSRI.

1.4 QUALITY ASSURANCE

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship to produce work of specified quality.
- B. Comply with manufacturer's instructions.
- C. Utilize personnel qualified to produce specified quality of work.
- D. Secure products in place with anchorage devices designed to withstand stresses, vibration, physical distortion, and/or disfigurement.
- E. Coordinate clarifications and changes with BSRI in accordance with Section 01250.

1.5 TOLERANCES

- A. Monitor construction and installation tolerance control to produce acceptable work.
- B. Allowing tolerances to accumulate is unacceptable.

1.6 SITE INSPECTION AND OVERSIGHT REQUIREMENTS

- A. Work is subject to BSRI inspection and testing at all places and at all reasonable times before acceptance in order to ensure strict compliance with the terms of the Subcontract.
- B. BSRI involvement is intended to verify that specified work meets specification requirements.
- C. If the work is determined to be inadequate, the Subcontractor shall implement repairs/modifications/replacements required to bring the work into compliance with the Subcontract Documents.
- D. The system for notifying BSRI and the details for actual verification of work shall be coordinated by the Subcontractor and the BSRI Subcontract Technical Representative.
- E. Any inspections, testing, and/or approval of work performed by BSRI shall not relieve the Subcontractor of the responsibility of performing work in accordance with the Subcontract Documents.

1.7 SUBCONTRACTOR'S INSPECTION AND TESTING SERVICES

- A. Inspections and tests indicated in individual specification sections shall be the responsibility of the Subcontractor.

1. Obtain the specified services of independent firm(s)/agency(s) to perform examinations, inspections, and testing of soil, concrete, geotextiles and geosynthetic clay liners as indicated in individual specification sections.
 - a. Ensure compliance with the requirements of Section 01450.
 2. Perform inspection/testing as required by the individual specification sections.
 3. Inspections/tests may occur on or off the project site.
- B. Submit inspection and test reports as required in the individual specification sections.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that existing site conditions are acceptable for subsequent work.
 1. Beginning new work means acceptance of existing conditions.
- B. Examine and verify specific conditions described in individual specification sections.

END OF SECTION

INSPECTION AND TESTING LABORATORY SERVICES

SECTION 01450

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Independent inspection and testing laboratory services.

1.2 RELATED SECTIONS

- A. Section 01330, Submittal Procedures
- B. Section 01400, Quality Requirements
- C. Section 02310, Excavation and Foundation Preparation
- D. Section 02320, Backfill and Finish Surface
- E. Section 02378, High Density Polyethylene Liner
- F. Section 02379, Geosynthetic Clay Liner
- G. Section 03300, Concrete

1.3 REFERENCES

- A. Reference individual sections for applicable references.
- B. National Codes / Standards:
 - 1. Obtain BSRI prior acceptance for other editions and/or addenda of National Codes / Standards required by this specification before use.
- C. Required National Codes / Standards
 - 1. American Society for Testing and Materials (ASTM)
 - a. E 329, 2003, Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
- D. Regulations
None
- E. Documents
None
- F. Drawings
None

1.4 QUALITY ASSURANCE

- A. Reference Section 01400.
- B. Conform to ASTM E.329 requirements for testing of construction materials.

1.5 NOTIFICATION AND COORDINATION

- A. Notify the BSRI STR at least 48 hours prior to expected time for testing operations unless specified otherwise.

1.6 SUBMITTALS

- A. Submit the following Engineering Documents in accordance with Section 01330.
 - 1. Inspection and Testing Laboratory Business Information, With Proposal, 1.10 A.

1.7 LABORATORY PERFORMANCE REQUIREMENTS

- A. Provide testing laboratory services from a firm authorized to operate in the State of South Carolina.
- B. Perform testing in accordance with the requirements specified in the individual sections.
- C. Perform specified inspection, sampling, and testing of products in accordance with referenced codes, standards, and the requirements of this specification.
- D. Ascertain compliance of physical and chemical properties of materials in accordance with the requirements of the Subcontract documents.
- E. Notify BSRI of observed irregularities or nonconformance of work or materials.

1.8 QUALIFICATIONS

- A. Staff: Maintain technical engineer(s) on staff for review services experienced in the designated discipline. Engineer(s) shall have a minimum of five years experience on similar projects and hold a license to practice as a Professional Engineer in the State of South Carolina.
- B. Testing Laboratory performing the testing of geosynthetic materials shall be accredited by the Geosynthetic Accreditation Institute (GAI).
 - 1. Laboratory staff performing geosynthetic testing shall meet the requirements set forth by GAI.

1.9 REPORTS

- A. After performance of an inspection or test, submit laboratory test reports identified in the individual specification sections in accordance with Section 01330.
- B. As a minimum, include the following information on each report;
 - 1. Date issued,
 - 2. BSRI Project Title and Purchase Order Number,
 - 3. Name and signature of on-site inspection / sampling / testing personnel,
 - 4. Acceptability when acceptance criteria have been specified,
 - 5. Date and time of on-site inspection, sampling, or test,
 - 6. Identification of Specification number, section and paragraph,
 - 7. Inspection, sample or test location on the project work site,
 - 8. Type of inspection or test,
 - 9. Any deviation from the test method or procedure specified,

10. Name and signature of laboratory inspector or test technician,
11. Measurement and date of laboratory test or inspection,
12. Result of laboratory inspection or test,
13. Observations, sketches, drawings, plots, etc. as required by test standards,
14. Standards used, including the date / revision designation,
15. Each criterion tested,
16. Specific acceptance criteria for each criterion tested,
17. Specific result of test for each criterion,
18. Identification and serial number of test apparatus used,
19. Certification of conformance with subcontract documents,
20. Name and Signature of individual checking / reviewing the inspection / test results.

1.10 RESPONSIBILITY

- A. Submit Inspection and Testing Laboratory Business Information including:
 1. Business name, address, telephone number
 2. Resumes of the technicians on staff, the responsible engineer(s), and the responsible officer including personnel qualifications and certifications.
- B. Update business information for any changes in personnel.
- C. Employment of inspection and testing laboratory shall in no way relieve Subcontractor of any obligation to perform work in accordance with requirements of the Subcontract documents.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

MATERIAL AND EQUIPMENT

SECTION 01600

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Products
 - 2. Manufacturer's names
 - 3. Product Options
 - 4. Substitutions
 - 5. Transportation, handling, shipping, and storage
- B. RELATED SECTIONS
 - 1. Division 1 – All Sections

1.2 REFERENCES

- A. National Codes / Standards:
 - 1. Obtain BSRI prior acceptance for other editions and/or addenda of National Codes / Standards required by this specification before use.
- B. Required National Codes / Standards
None
- C. Regulations
None
- D. Documents
None
- E. Drawings
None

1.3 DEFINITION OF PRODUCTS

- A. Definition of Products:
 - 1. New material and components forming the work.
 - 2. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the work.
- B. Where two or more units of the same component class are furnished, supply interchangeable components from the same manufacturer.

1.4 MANUFACTURER'S NAMES

- A. Reference in this specification to equipment, material, articles, or patented processes by trade name, make, or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition.

- B. The Subcontractor, at its option, may utilize any equipment, material, article, or process that, in the determination of BSRI, is equivalent to that named in this specification, unless specifically provided in the Subcontract Documents.

1.5 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description are acceptable.
- B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions (identified as "or equal"): Submit request for substitution for any manufacturer not named in accordance with the following article.

1.6 SUBSTITUTIONS

- A. Approval of Substitutions After Award of Subcontract:
 - 1. Process Supplier Deviation Disposition Requests for the substitution of specified products in accordance with Section 01250 – Change Procedures.
 - 2. A substitution request represents that the Subcontractor has performed the following:
 - a. Investigated the proposed product substitution and determined that it meets or exceeds the quality level of the specified product.
 - b. Provide the same warranty for the substitution as for the specified product.
 - c. Coordinate the proposed product installation and make changes to other work which may be required for the work to be completed, but with no additional time extensions or additional costs to BSRI.
 - 3. Provide documentation such as product data, test reports, etc. including above representations in support of substitution request.
 - 4. Substitutions will not be considered if they are indicated or implied on shop drawing submissions without a previous formal substitution approval or if their implementation will require substantial BSRI review or revision of the Subcontract Documents.

1.7 TRANSPORTATION, HANDLING, SHIPPING, AND STORAGE

- A. Transport, handle, store, and protect products in accordance with manufacturer's instructions. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- B. Provide equipment and personnel to handle products and store by methods to prevent soiling, discoloration, staining, disfigurement, or damage.
 - 1. Use of damaged items is unacceptable.
- C. Storage - General:
 - 1. Arrange storage of products to permit access for inspection.
 - 2. Periodically inspect to ensure products are not damaged and are maintained under specified conditions.

3. Promptly remove damaged material and unsuitable items from the job site and replace with material meeting the specified requirements.
- D. Exterior storage of fabricated products;
 1. Place on sloped supports,
 2. Above ground,
 3. Ensure drainage,
 4. Prevent entrance of debris,
 5. Cover products subject to deterioration or exposure to water vapor with impervious sheet covering,
 - a. This includes materials sensitive to UV deterioration.
 6. Provide ventilation to prevent condensation and product degradation.
- E. Deliver products in manufacturer's original containers, dry, with seals and labels intact.
- F. The BSRI Subcontract Technical Representative may reject as non-complying, any materials or products which do not bear product identification satisfactory to the BSRI Subcontract Technical Representative as to manufacturer, grade, quality, or any additional product information required for product verification.
- G. Store materials in environments as recommended by the manufacturer.
- H. Stack pre-formed and pre-finished material to prevent twisting, bending, or abrasion per manufacturer's instructions.
- I. Wrap and/or crate finished components and assemblies at factory to prevent damage or marring of surfaces during shipping and handling.
- J. Neatly stack sheet materials lying flat to prevent sagging or damage to edges, ends, and surfaces.
 1. All materials shall be stacked in such a manner as to allow safe management and maintenance of storage requirements and safe removal for use.
 2. Where manufacturer's recommendations are available for stacking configurations (i.e., dunnage spacing, maximum safe stacking heights, etc.) they shall be utilized.
- K. Protect against dirt, water, chemical, mechanical damage, and construction traffic.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

EXCAVATION AND FOUNDATION PREPARATION

SECTION 02310

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Excavation and Foundation Preparation.

1.2 RELATED SECTIONS

- A. Division 1 - All Sections
 - 1. See Section 01004, Index of Drawings.
- B. Section 02320, Backfill and Finish Surface
- C. Section 02370, Erosion and Sedimentation Control
- D. Section 03300, Cast-In Place Concrete

1.3 REFERENCES

- A. National Codes / Standards:
 - 1. Obtain BSRl prior acceptance for other editions and/or addenda of National Codes / Standards required by this specification before use.
- B. Required National Codes / Standards
 - 1. American Society for Testing and Materials (ASTM)
 - a. D 1557, 2002 (E 2003), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
- C. Regulations
 - 1. 29 CFR PT 1926, Safety and Health Regulations for Construction
- D. Documents
 - None
- E. Drawings
 - None
- F. Definitions / Acronyms
 - 1. CLSM: Controlled Low Strength Material
 - 2. Degree of Compaction: Maximum dry unit weight of representative soil sample is determined by the laboratory test procedure performed in accordance with ASTM D 1557.
 - a. The degree of compaction of in-place soils is described as a percentage of this maximum dry unit weight and is hereinafter referred to as percent maximum density.

3. Moisture Content: Optimum water content of representative soil sample is determined by the laboratory test procedure performed in accordance with ASTM D 1557.
 - a. The moisture content of in-place soils is described as within defined percentage points of this optimum water content.
4. Over Excavation: Removal of in-situ materials beyond the limits required by the specification or shown on the Subcontract Documents and not authorized in writing by BSRI.
5. Subgrade: The exposed undisturbed surface of naturally deposited inorganic soils upon which soil fill, aggregate base, or concrete foundations/slabs are to be placed.
6. Topsoil is the upper-most layer commonly characterized by dark-colored, organically rich, friable materials.
7. Unsuitable Subgrade Materials: Materials encountered at the design excavation limits or compacted fill surfaces that are determined to be soft or unstable by means of inspections or other specified test methods.

1.4 QUALITY ASSURANCE

- A. See Section 01400.
- B. Provide the services of an Independent Inspection and Testing Laboratory, in accordance with Section 01450, for the inspections, examinations, and testing required in this section.

1.5 NOTIFICATION AND COORDINATION

- A. Notify the BSRI Subcontract Technical Representative in the event that non-compliant soils are encountered
 1. At the subgrade construction elevation
 2. Material to be used to reestablish the subgrade construction elevation.

1.6 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330:
 1. Shoring Design, 4 Weeks Prior to Use, 3.5 D. 1.

1.7 QUALIFICATIONS

- A. See Section 01450 for Inspection and Testing Laboratory Services.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. See Section 02320

PART 3 EXECUTION

3.1 PREPARATION

- A. Confirm existing conditions are as shown on the design drawings prior to beginning earthwork activities.
- B. Ensure all erosion and sediment control measures are in place and functional in accordance with Section 02370 prior to commencing any land disturbing activities.
- C. Control and maintain runoff, excavation drainage, and dewatering in accordance with Section 02370.

3.2 CLEARING AND STRIPPING

- A. Project site consists of existing newly grassed cover. General site preparation was completed in the summer of 2007.
- B. Strip the areas required for extending the roadway, mud mats and drain pipes of vegetative matter and debris to a minimum depth of four (4) inches.
- C. Stockpile existing top soil for reuse.

3.3 REMOVAL OF DEBRIS

- A. Remove rubble, debris, rock, inert wastes, unsuitable soils and extracted plant life from site and transport to disposal site in accordance with Subcontract Documents.
- B. Continuously clean-up waste materials and remove from site. Do not allow materials to accumulate on site.
- C. Do not burn or bury materials on site.
- D. Leave site in clean condition.

3.4 DEWATERING DURING CONSTRUCTION

- A. Ensure that excavation is dewatered such that the sides and base of excavated slope remain stable and that the excavation bottom provides a satisfactory base for the intended use. Dispose of excess water in accordance with the Best Management Practice, Section 02370.

3.5 EXCAVATION

- A. Perform excavations, within the excavation limits, to the lines, contours, grades, and elevations and tolerances shown on the Subcontract Documents and/or specified herein.
 - 1. BSRI approval, via SDDR, is required for excavation outside the excavation limits.
- B. Protect and support existing or new structures under construction and utilities or parts thereof from weakening or damage during earthwork operations.
- C. Provide stable and safe excavated slopes or continuously shored slope in accordance with OSHA Standard 29 CFR PT 1926, Subpart P.
 - 1. When shoring is required by OSHA Standards, submit Shoring Design to the Subcontract Technical Representative.

2. Shoring design - stamped and signed by a licensed Professional Engineer per OSHA Standard, 29 CFR PT 1926, Subpart P (Excavations) prior to submittal.
- D. Maintain a smooth grade and provide positive drainage at all times.
- E. Prevent surface drainage from entering open excavations by constructing temporary diversion swales or berms to redirect the surface run-off.
- F. Protect subgrade from surface drainage accumulation and remove subgrade that has been allowed to soften.
- G. Maintain areas being excavated and areas being filled in a clean condition free from leaves, brush, sticks, trash and other debris.
- H. Remove the final six (6) inches of excavation to the subgrade construction elevation beneath load bearing surfaces with either smooth blade equipment or hand excavation.
- I. Over excavation is not allowed except for removal of unsuitable subgrade materials.
 1. Remove unsuitable subgrade materials to a disposal site in accordance with Subcontract Documents.
- J. Reestablish subgrade construction elevation under load bearing surface with compacted Structural Fill or Controlled Low Strength Material.
- K. The bearing surface for mats, roadway, and pavement shall bear upon undisturbed naturally deposited proof rolled inorganic soil, or compacted Structural Fill, or Controlled Low Strength Material.
- L. Inspect and approve the subgrade condition prior to placement of concrete forms, bedding material, or crusher run.
 1. The BSRI Subcontract Technical Representative reserves the right to disapprove the subgrade condition after initial approval if the subgrade condition has deteriorated or softened.
 - a. The BSRI STR will provide an SRS Geotech Representative to perform the final inspection and acceptance the subgrade condition.
 - b. The Subcontractor is required to provide a 3 working day advanced notification for request of final Geotech inspection.

3.6 STOCKPILING

- A. Stockpile excavated materials in areas designated in Subcontract Documents.
- B. Separate and segregate excavated materials into stockpiles containing Common Fill, Structural Fill and Topsoil and protect from erosion.
 1. Locate stockpiles per the direction of the Subcontract Technical Representative.
- C. Intermixing of organic or other deleterious materials with stockpiled materials intended for use as fill material is prohibited.
- D. Stockpile excavated material in lifts by dumping and then spreading by rolling.
- E. Provide stockpile with stable slopes and neat appearance. Grade stockpiles to prevent erosion and facilitate runoff. Install temporary vegetation seeding over unused stockpile areas during construction period.

3.7 PROOFROLLING

- A. Proof roll in-situ soil subgrade for areas under pavement / roadways, structures or other load bearing surfaces prior to placement of structural fill or foundation preparation to identify potential unsuitable subgrade materials.
 - 1. Conduct in the presence of the Independent Testing Laboratory Inspector.
 - 2. The SRS Geotech Representative will provide the final acceptance.
- B. Use a roller of not less than 20 tons, or its equivalent, making a minimum of four passes, two in each of the two directions at right angles.
- C. Excavate the top two feet of any areas that "pump" or appear soft. Replace soil in soft areas with compacted structural fill / CLSM.

3.8 PLACEMENT OF FILL

- A. See Section 02320.

3.9 GRADING

- A. Rough Grading
 - 1. Contour site areas to lines and grades required to support other earthwork operations. Use excavated material when additional fill is needed.
 - 2. Maintain positive drainage in all areas to prevent ponding or flooding of completed work.
 - 3. Construct temporary drainage swales and/or ditches as necessary. Coordinate with storm water management and sediment and erosion control requirements as specified in Section 02370.

3.10 EXCAVATION TOLERANCES

- A. Top surface of subgrade to receive compacted fill or roadway aggregate base: Plus 0.10 feet or Minus 0.25 feet from specified elevations.
- B. Top surface of subgrade to receive foundations/slabs and finish grading: Plus or Minus 0.10 feet from specified elevations (Ref. Section 02320).

END OF SECTION

BACKFILL AND FINISH SURFACE

SECTION 02320

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Excavation from stockpile.
- B. Backfill and compaction with lighter equipment around tank.
- C. Backfill and compaction with finish grade.

1.2 RELATED SECTIONS

- A. Division 1 - All Sections
 - 1. Section 01004, Index of Drawings
 - 2. Section 01320, Site Surveys
- B. Section 02310 - Excavation and Foundation Preparation
- C. Section 02370 - Erosion and Sedimentation Control
- D. Section 02900 – Soil Preparation and Seeding
- E. Section 03300 - Cast-In Place Concrete

1.3 REFERENCES

- A. National Codes / Standards:
 - 1. Obtain BSRI prior acceptance for other editions and/or addenda of National Codes / Standards required by this specification before use.
- B. Required National Codes / Standards
 - 1. American Society for Testing and Materials (ASTM)
 - a. D 422, 1963 (R 2002), Standard Test Method for Particle-Size Analysis of Soils
 - b. D 1556, 2000, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
 - c. D 1557, 2002 (E 2003), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
 - d. D 2216, 2005. Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
 - e. D 2487, 2006, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System
 - f. D 4318, 2005, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
 - g. D 4643, 2000, Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method
 - h. D 6938, 2008, Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

- C. Regulations
 - 1. 29 CFR PT 1926, Safety And Health Regulations For Construction
- D. Documents
 - None
- E. Drawings
 - None
- F. Definitions / Acronyms
 - 1. CLSM: Controlled Low Strength Material
 - 2. Degree of Compaction: Maximum dry unit weight of representative soil sample is determined by the laboratory test procedure performed in accordance with ASTM D 1557.
 - a. The degree of compaction of in-place soils is described as a percentage of this maximum dry unit weight and is hereinafter referred to as percent maximum density.
 - 3. Moisture Content: Optimum water content of representative soil sample is determined by the laboratory test procedure performed in accordance with ASTM D 1557.
 - a. The moisture content of in-place soils is described as within defined percentage points of this optimum water content.
 - 4. Over Excavation: Removal of in-situ materials beyond the limits required by the specification or shown on the Subcontract Documents and not authorized in writing by BSRI.
 - 5. Subgrade: The exposed undisturbed surface of naturally deposited inorganic soils upon which soil fill, aggregate base, or concrete foundations/slabs are to be placed.
 - 6. Topsoil is the upper-most layer commonly characterized by dark-colored, organically rich, friable materials.
 - 7. Unsuitable Subgrade Materials: Materials encountered at the design excavation limits or compacted fill surfaces that are determined to be soft or unstable by means of inspections or other specified test methods.

1.4 QUALITY ASSURANCE

- A. See Section 01400.
- B. Provide the services of an Independent Testing Laboratory, in accordance with Section 01450, for the inspections, examinations, and testing required in this section.

1.5 NOTIFICATION AND COORDINATION

- A. Notify the Subcontract Technical Representative in the event that non-compliant soils are encountered
 - 1. At the subgrade construction elevation
 - 2. Material to be used to reestablish the subgrade construction elevation.

1.6 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330.
 - 1. Post Construction As-Built Topographic Survey, 2 Weeks After Substantial Completion, 3.13 B.
- B. Submit the following Quality Verification documents in accordance with Sections 01330 and 01400:
 - 1. Fill Material Laboratory Test Reports, 2 Weeks Prior to Use, 3.14 A.4.
 - 2. Field Inspection Reports, Each Following Monday, 3.14 B.3.
 - 3. In-Place Moisture Content Test Reports, Each Following Monday, 3.14 C.2.
 - 4. In-Place Density Test Reports, Each Following Monday, 3.14 D.6.

1.7 QUALIFICATIONS

- A. See Section 01450 for Inspection and Testing Laboratory Services.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Use of materials containing brush, weeds, sticks, roots, peat, sod, loam, other organic material, ice, snow, frozen soils, trash, litter, refuse or any deleterious or objectionable material is unacceptable.
- B. Common Fill
 - 1. Existing excavated material (stockpile).
- C. Structural Fill
 - 1. Well-graded sands (SW) or silty sands (SM) as defined by ASTM D 2487.
 - 2. Existing excavated material (stockpile) that meets structural fill requirements.
 - 3. Free of rocks greater than 2 inches diameter and greater than ½ inch at the exposed surface.
 - 4. Plasticity index less than 15 percent as determined by ASTM D 4318.
 - 5. Well graded within following limits as determined in accordance with ASTM D 422 :

Sieve Size	Percent Passing by Weight
3/8 inch	100
No. 4	95 to 100
No. 10	85 to 100
No. 20	70 to 95
No. 40	35 to 85
No. 60	15 to 70
No. 140	2 to 20
No. 200	0 to 15

- D. Controlled Low Strength Material (CLSM)
 - 1. Meet requirements specified in Section 03300.

2. As a construction option, CLSM may be used in lieu of Structural Fill and common fill.
- E. Fill Materials Source
1. Use common fill and structural fill materials from the segregated stockpiles. Provide additional fill materials from the borrow area specified in the Subcontract Field Conditions.

PART 3 EXECUTION

3.1 PREPARATION

- A. Confirm existing conditions are as shown on the design drawings prior to beginning earthwork activities.
- B. Ensure all erosion and sediment control measures are in place and functional in accordance with Section 02370 prior to commencing any land disturbing activities.
- C. Control and maintain runoff, excavation drainage, and dewatering in accordance with Section 02370.

3.2 REMOVAL OF DEBRIS

- A. Remove rubble, debris, rock, inert wastes, unsuitable soils and extracted plant life from site and transport to disposal site in accordance with Subcontract Documents.
- B. Continuously clean-up waste materials and remove from site. Do not allow materials to accumulate on site.
- C. Do not burn or bury materials on site.
- D. Leave site in clean condition.

3.3 EXCAVATION FROM STOCKPILE

- A. Perform excavations, within the excavation limits, to the lines, contours, grades, and elevations.
- B. Protect and support existing or new structures under construction and utilities or parts thereof from weakening or damage during earthwork operations.
- C. Provide stable and safe excavated slopes in accordance with OSHA Standard 29 CFR PT 1926, Subpart P.
- D. Maintain a smooth grade and provide positive drainage at all times.
- E. Prevent surface drainage from entering open excavations by constructing temporary diversion swales or berms to redirect the surface run-off.
- F. Protect subgrade from surface drainage accumulation and remove subgrade that has been allowed to soften.
- G. Maintain areas being excavated and areas being filled in a clean condition free from leaves, brush, sticks, trash and other debris.
- H. Reestablish subgrade construction elevation under load bearing surface with compacted Structural Fill or Controlled Low Strength Material.

- I. The bearing surface for mats, floor slabs, and pavement shall bear upon undisturbed naturally deposited inorganic soil, or compacted Structural Fill, or Controlled Low Strength Material.
- J. Inspect and approve the subgrade condition prior to placement of rebar, concrete forms, bedding material, or crusher run.
 - 1. SRS Geotech Representative will inspect and accept the subgrade condition.
 - a. The Subcontractor is required to provide a 3 working day advanced notification for request of Geotech inspection.
 - 2. The BSRI Subcontract Technical Representative reserves the right to disapprove the subgrade condition if the subgrade condition has deteriorated or softened.

3.4 STOCKPILING

- A. Refer to Section 02310.

3.5 PROOFROLLING

- A. Proof roll in-situ soil subgrade for areas under pavement / roadways, structures or other load bearing surfaces prior to placement of structural fill or foundations to identify potential unsuitable subgrade materials.
 - 1. Conduct in the presence of the Independent Testing Laboratory Inspector.
 - 2. SRS Geotech Representative will provide final acceptance of the subgrades under mud mats prior to placement of mud mats.
- B. Use a roller of not less than 20 tons, or its equivalent, making a minimum of four passes, two in each of the two directions at right angles.
- C. Excavate the top two feet of any areas that "pump" or appear soft. Replace soil in soft areas with fill material and compact.

3.6 PLACEMENT OF FILL

- A. General
 - 1. Remove leaves, brush, trash, existing erosion control coverings, and other debris prior to placement of fill materials.
 - 2. An Independent Testing Laboratory Inspector shall inspect and approve the subgrade prior to placement of fill, concrete, crusher run or pavement.
 - a. SRS Geotech Representative will provide final acceptance.
 - 3. Do not place fill against concrete structures until the concrete forms have been removed and concrete has attained 80 percent of the design strength.
 - 4. Suspend material placement and compaction activities when moisture conditioning is required and the ambient temperature is 35 degrees F or less.
 - 5. Do not place fill material on top of frost, snow, ice, or soil that has been permitted to freeze prior to compaction.
 - 6. Do not incorporate any ice or frozen earth in the fill material.
 - 7. Before placing fill, replace material that is soft and yielding, as result of excess water, with suitable material or scarify and allow the soil to dry to the specified moisture content before compacting.

8. Track in place loose fill material quantities on a weekly basis.

B. Placement of Fill Materials

1. Placement of structural fill under load bearing structures shall extend out to a point five (5) feet, minimum, from a building or structure limits; in fills for roadways; and where indicated in the Subcontract Documents.

2. Place in successive uniform loose layers not to exceed 8 inches where hand-operated compaction equipment is used and 12 inches where self-propelled or towed mechanical equipment is used.

3. Do not leave a lift in an uncompacted state at the close of a day's operation.

3.7 MOISTURE CONTROL OF FILL MATERIAL

A. Determine material in-place moisture content in accordance with ASTM D 6938.

B. Moisture content during compaction shall be within plus or minus 3 percent of the optimum water content for the material being placed.

C. Moisture condition the fill material that is out of moisture content tolerance.

1. Moisture content is a guidance criterion and should not be a basis for acceptance or rejection for compaction of fill material.

D. Determine the natural moisture content of the fill materials in accordance with ASTM D 2216 or ASTM D 4643 immediately prior to compaction.

E. Adjust the moisture content of loose soil after placement prior to compaction to bring the moisture content of the soil within the specified limits. Use standard industry practices to moisture condition soil materials. Verify moisture content in accordance with ASTM D 4643.

F. Do not compact any fill materials containing soil that is too wet or too dry to be compacted. Work the soil until the moisture content of the material is adjusted within the specified limits.

3.8 COMPACTION OF FILL MATERIALS

A. Bring fill up uniformly around below-grade structures.

B. Compact fill material systematically on all portions of each area.

C. Provide compaction equipment suitable for the type of soil, magnitude of compaction and moisture control required.

D. In areas not accessible to roller compaction equipment, compact fill material with power tampers or vibratory compactors.

E. In areas within 10 feet out from tank walls, compact fill material with power tamper and lighter compaction equipment not to exceed 10,000 lbs.

F. Sloped ground surfaces steeper than one vertical to four horizontal require fill to be placed in a stepped or benched fashion.

G. Roll the final layer of compacted fill placed at the end of each day with a smooth-wheeled roller to eliminate ridges of soil left by earthwork equipment prior to terminating work for the day.

H. Degree of Compaction for Structural Fill: Not less than 95 percent of maximum dry density determined in accordance with ASTM D 1557.

- I. Degree of Compaction for Common Fill: Not less than 90 percent of maximum dry density determined in accordance with ASTM D 1557.

3.9 CONTROLLED LOW STRENGTH MATERIAL

- A. If CLSM is used in place of Common or Structural Fill, prepare the subgrade, in the same manner required for backfill.
- B. CLSM may be screeded, if required, to provide a uniform grade, but shall not be vibrated.
- C. CLSM is not designed to resist freeze and thaw or erosive weathering and requires erosion control. Place a minimum of 6 inches of soil fill, select aggregate base coarse, or a protective wearing surface such as asphalt or concrete over the CLSM.
- D. In areas where the native soil is highly impervious and standing water does not cause sloughing or penetrates the surface more than 1 inch, the CLSM may be deposited directly into 3 inches or less of standing water. Drainage must be provided to allow the displaced water to runoff.

3.10 GRADING

- A. Rough Grading
 1. Contour site areas to lines and grades required to support other earthwork operations.
 2. Maintain positive drainage in all areas to prevent ponding or flooding of completed work.
 3. Construct temporary drainage swales and/or ditches as necessary. Coordinate with storm water management and sediment and erosion control requirements as specified in Section 02370.
- B. Finish Grading
 1. Smoothly and uniformly grade the finished areas and conform to lines, grades, and elevations as shown on the Subcontract Documents within the specified tolerances.
 2. Shape finished areas to provide a smooth and compact surface, free of irregular surface changes. Provide a smooth transition between final and existing grades at the perimeter of the construction site. Make grade changes gradual by blending slopes into level areas.
 3. Slope finish grade away from buildings and structures a minimum of 2% or as noted in the Subcontract Documents.

3.11 FINISH TOLERANCES

- A. Top of Finish Grade: Plus or minus 0.10 feet from specified elevations. However, maintain a smooth grade to provide positive drainage at all times and provide minimum thickness of fill materials as required by Contract Drawings

3.12 TOPSOIL PLACEMENT

- A. Refer to Section 02900.

3.13 TOPOGRAPHIC SURVEYS

- A. Comply with Section 01320.
- B. Submit a Post Construction As-Built Topographic Survey of the project site. Indicate contour elevations of the final grades and elevations of structures or utilities (cables, conduits, piping, etc) remaining or discovered during the work activities s upon completion of the Work on the As-Built. Include a written statement of verifying the final grades are within the specified tolerances.

3.14 FIELD QUALITY CONTROL

- A. Fill Material Laboratory Test:
 - 1. Perform the following tests prior to initial use of the fill material area, from location as specified in the Subcontract Documents.
 - a. Soil particle size analysis in accordance with ASTM D 422.
 - b. Laboratory maximum density in accordance with ASTM D 1557.
 - c. Moisture content in accordance with ASTM D 2216 or ASTM D 4643.
 - d. Liquid Limit (LL), Plastic Limit (PL), and Plasticity Index (PI) in accordance with ASTM D 4318.
 - 2. Testing frequency: One (1) set of tests as follows:
 - a. Prior to initial use of fill material.
 - b. Each time a change in color and / or texture of the fill material becomes evident. Change in color and texture shall be determined by an experienced soil technician.
 - c. Every 1000 yards of material obtained from the fill material source.
 - d. When tests indicate the materials do not meet specified requirements, replace the materials and retest. Notify the BSR/ STR immediately of failed test.
 - 3. Use of the microwave oven test method for determining moisture content in accordance with ASTM D 4643 requires a correlation between microwave and oven drying tests.
 - a. Establish a correlation between microwave and oven drying tests.
 - b. Perform a minimum of five (5) tests in accordance with both the ASTM D 2216 method and the ASTM D 4643 method.
 - c. After the correlation has been establish, perform one (1) oven drying test for every ten (10) microwave oven tests.
 - 4. Submit Fill Material Laboratory Test Reports from the Independent Testing Laboratory.
- B. Field Inspections
 - 1. Subgrade:
 - a. Inspect prior to each fill, concrete, crusher run or pavement placement
 - b. Acceptance Criteria:
 - i. No soft or yielding soil as result of excess water with suitable material
 - ii. No unsuitable material
 - iii. No leaves, brush, trash, debris or other deleterious materials
 - iv. Concrete forms have been removed

- v. Concrete contiguous with fill has attained 80 percent of the design strength
 2. When inspections indicate the materials do not meet specified requirements, replace the materials and re-inspect. Notify the BSRI STR immediately of failed inspection.
 3. Submit Field Inspection Reports from the Independent Testing Laboratory to the BSRI Subcontract Technical Representative for the work completed in the previous seven (7) calendar days on each following Monday.
- C. In-Place Moisture Content Tests
 1. Perform Moisture Content Tests of Fill Materials
 - a. Perform tests in accordance with ASTM D 6938.
 - b. Fill material should be within plus or minus 3 percent of the optimum water content for the material to be placed.
 - c. Frequency of Testing:
 - i. One (1) initial test, prior to first fill placement from each stockpile
 - ii. Structural Fill: Minimum one (1) test per 500 cubic yards of materials placed or one test per day which ever is greater.
 - iii. Subcontractor shall track placed fill weekly by compacted CY volume.
 2. Submit In-Place Moisture Content Test Reports from the Independent Testing Laboratory to the BSRI Subcontract Technical Representative for the work completed in the previous seven (7) calendar days on each following Monday.
- D. In-Place Density Testing
 1. Perform field density tests in accordance with ASTM D 1556 or ASTM D 6938.
 2. Testing frequency: One (1) test after first lift is compacted on each shift and one (1) test per 500 cubic yards of material placed subsequently or one test per day which ever is greater.
 - a. Subcontractor shall track placed fill weekly by compacted CY volume.
 3. Perform additional density tests if initial or subsequent test results do not meet specified requirements.
 - a. Perform two additional tests within a ten (10) foot radius of the failed test.
 - b. Determine a new compaction value by averaging the test results from the two additional test and the failed original test.
 - c. If the average of the three (3) tests does not meet the specified requirements, the entire non-conforming fill lift shall be reworked and retested.
 4. If nuclear methods are used for density determination in accordance with ASTM D 6938, the testing will require additional field calibration testing, as follows.
 - a. Establish a correlation between nuclear density tests and in-place sand cone density tests per ASTM D 1556 for fill materials.
 - b. For each of the first ten (10) nuclear density tests performed per ASTM D 6938, perform an in-place sand-cone density test per ASTM D 1556, to establish a site-specific relationship between the two test methods during the construction activities.

- c. After the correlation has been established, perform one (1) in-place sand-cone density test per ASTM D 1556, for every ten (10) nuclear density tests performed per ASTM D 6938.
- 5. When tests indicate the materials do not meet specified requirements, replace the materials and retest. Notify STR immediately of failed test.
- 6. Submit In-Place Density Test Reports from the Independent Testing Laboratory to the BSRI Subcontract Technical Representative for the work completed in the previous seven (7) calendar days on each following Monday.

END OF SECTION

EROSION AND SEDIMENT CONTROL

SECTION 02370

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide erosion and sedimentation control measures including miscellaneous berms, diversion swales, silt fences, hay bale, sediment traps, rock check dams, and erosion control matting in accordance with the Construction Drawings.
- B. Maintain erosion control measures, including those installed prior to the start of the Work and installed during all phases of construction, until the completion of construction activities and until disturbed areas have been stabilized.
- C. Provide erosion control measures, as required by the execution of the Work, to protect sloping areas from erosion. Locate and size these measures as required to prevent surface runoff from entering the excavation.
- D. Dewater areas within the Limits of Construction which collect stormwater.

1.2 RELATED SECTIONS

- A. Division 1 - All Sections
- B. Section 02300, Earthwork
- C. Section 02900, Soil Preparation and Seeding

1.3 REFERENCES

- A. National Codes / Standards:
 - 1. Obtain BSRI prior acceptance for other editions and/or addenda of National Codes / Standards required by this specification before use.
- B. Required National Codes / Standards
 - 1. American Society for Testing and Materials (ASTM)
 - a. D 4751, 2004, Standard Test Method for Determining Apparent Opening Size of a Geotextile
- C. Regulations
 - 1. Permit no. 05-11-Z-14.5, Grading Permit
 - 2. SC R.72-300, Standards for Storm Water Management and Sediment Reduction
 - 3. SCDHEC 61-107.19, Solid Waste Management; Waste Landfills and Structural Fill
 - 4. SCR 100000, Storm Water General Permit
- D. Documents
 - None
- E. Drawings
 - None

F. WSRC Documents

1. C-ESR-Z-00004 Stormwater Pollution Prevention Plan

1.4 QUALITY ASSURANCE

- A. Section 01400 – Quality Requirements.

1.5 NOTIFICATION AND COORDINATION

- A. Notify the Subcontract Technical Representative prior to initiation of dewatering activities. The Subcontract Technical Representative will assure appropriate notifications are made to the responsible Environmental Compliance Authority.

1.6 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330:
1. Construction Subcontractor Co-Permittee Certification, 2 Weeks Prior to Work, 1.7 B.
- B. Submit the following Quality Verification documents in accordance with Sections 01330 and 01400:
1. Stormwater Pollution Prevention Plan Inspection Forms, Following Monday, 3.4 D.

1.7 PERFORMANCE REQUIREMENT

- A. The management of stormwater and the implementation of erosion and sediment control measures shall comply with SC R.72-300, SCR 100000, Grading Permit no. 05-11-Z-14.5, and SCDHEC 61-107.19.
- B. Sign and submit the Construction Subcontractor Co-Permittee Certification.
- C. Implement and maintain temporary and permanent stormwater erosion and sediment control measures in accordance with Best Management Practices (BMPs) as defined by SC R.72-300.
- D. Implement necessary measures for the duration of construction to control erosion and to avoid silting of streams, wetlands, and impoundments.
- E. In cases where land disturbing activities will be discontinued for 21 days or more, in any area within the Limits of Construction, hydroseed the area within 14 days of last disturbance.
- F. No solid materials, including building materials, shall be discharged to the Waters of the State except as authorized by a Section 404 permit. Follow state and local waste disposal regulations.
- G. Minimize the tracking of sediments off-site and the generation of dust by vehicles.

PART 2 PRODUCTS

2.1 SILT FENCE

- A. Prefabricated system consisting of wood posts, filter fabric and fabric support system.
- B. Filter fabric: Non-woven synthetic polymer, 36 inch wide minimum, US sieve #30 apparent opening size in accordance with ASTM D 4751.

2.2 HAY BALES

- A. Commercially available, sturdy bales.

2.3 STONE SURFACING

- A. A mixture of clean, sound, durable particles of crushed stone or gravel, together with sand and screenings, commonly referred to as "crusher run".

2.4 EROSION CONTROL MATTING

- A. Coconut fiber or recycled nylon fiber matrix sewn between two nets with a weight of at least 0.5 lbs. per sq. ft. or equivalent, capable of withstanding flow velocities up to 7 ft/sec.

2.5 EMULSIFIED ASPHALT

- A. Use commercially available sprayed-on emulsified asphalt.

PART 3 EXECUTION

3.1 INITIATION OF EROSION CONTROL

- A. Install erosion and sedimentation control measures in accordance with the Construction Drawings.
- B. Install erosion control features, as required during the execution of the Work, to protect sloping areas from erosion. Locate and size these measures as required to prevent surface runoff from entering the excavation.
- C. Install silt fencing around the base of all stockpiles of excavated material within the Stockpile Area indicated on the Construction Drawings.
- D. For swales, berms and all slopes greater than 4H:1V install temporary/long-term vegetation seeding with erosion control matting to minimize erosion. Apply sprayed-on emulsified asphalt per manufacturer's instructions in lieu of vegetation seeding with erosion control matting.

3.2 MAINTENANCE AND INSPECTION

- A. Maintain temporary erosion and sedimentation control devices, including features installed prior to the start of the Work and installed during all phases of construction.
- B. Maintain stabilized slopes of graded areas by repairing washes and rills.
- C. Dewater areas within the Limits of Construction which collect stormwater.
- D. Relocate and / or replace erosion and sedimentation control measures to account for changes in the vegetation coverage, site contours and drainage patterns as excavation and grading operations progress.
- E. Maintenance of erosion control features includes areas of soil disturbance, areas affected by natural or manmade drainage or runoff, as well as removal of silt buildup in culverts, pipes, excavations, ditches and adjacent watercourses.
- F. If changes during the construction phase render the installed erosion and sediment control measures ineffective, provide and install additional measures and / or modify existing measures as required to meet the intent of the Stormwater Pollution Prevention Plan.

- G. Maintain erosion and sedimentation control devices until disturbed areas are stabilized, permanent erosion control measures are completed, and permanent erosion control measures are accepted at the closure of the subcontract.

3.3 DEWATERING REQUIREMENTS (IF REQUIRED)

- A. Discharge water to a level area at a non-erosive velocity.
- B. Protect downslope of the discharge point with silt fencing or hay bale barrier
- C. Monitor the discharge activity.
- D. Discontinue the dewatering activity and install additional controls if protective measures prove to be insufficient.

3.4 INSPECTION

- A. Inspect erosion and sediment control devices (new and existing) once every 7 calendar days and within 24 hours following each rainfall event of 0.5 inch or greater, to determine condition and verify effectiveness.
- B. Immediately repair existing ineffective device or install additional devices (silt fencing, hay bales, etc.) necessary to control erosion and sedimentation.
- C. Inspect areas of land disturbance and areas used for storage of materials that are exposed to precipitation for evidence of or the potential for, pollutants entering the drainage system or entering the environment.
- D. Submit Stormwater Pollution Prevention Plan Inspection Forms, Attachment 02370-A.
- E. Record the inspections in the Subcontractor Daily Activity Report and address the conditions and effectiveness of existing installed measures, installation or removal of measures, maintenance activities performed, and problems identified. Generalized statements are not acceptable.
- F. Subcontractor personnel that will perform the inspection of erosion control measures shall meet the qualifications and requirements set forth in the South Carolina NPDES General Permit for Stormwater Discharge from Large and Small Construction Activities, Permit SCR 100000.

END OF SECTION

Saltstone Vault #2 Excavation, Liner, and Backfill

Attachment No. 02370 - A
 Revision No. 1
 Spec/Req'n No. C-SPP-Z-00006
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Attachment 02370-A
Stormwater Pollution Prevention Plan Inspection Form

Outfall No.: _____		Construction Project No.: _____			
Project Inspector: _____		Delegated Authority: _____			
Inspection Frequency: <input type="checkbox"/> Weekly <input type="checkbox"/> Monthly <input type="checkbox"/> Quarterly <input type="checkbox"/> 0.5" Rain <input type="checkbox"/> Other, Specify _____					
INSPECTION ATTRIBUTES			ACCEPT	REJECT	N/A
1. HOUSEKEEPING					
a) General Area					
b) Material Storage Area					
2. VEGETATION AND SURFACE TREATMENT					
a) Installed in accordance with Subcontract Documents					
b) Wash out of vegetative cover					
c) Vegetation established over 80% of coverage area within 20 days					
3. EROSION AND SEDIMENT MEASURES					
a) General area in accordance with Subcontract Documents					
b) Sediment load no greater than 50% of barrier height					
c) Signs of sediment loading in receiving areas not listed in plan					
4. CHANNELS AND CULVERTS					
a) Installed in accordance with Subcontract Documents					
b) Sediment load no greater than 20% of channel depth or culvert diameter					
c) Erosion (scour) in the area is minimal					
d) Other obstructions identified					
e) Signs of any significant spills in the area					
5. INLET AND OUTLET PROTECTION					
a) Installed in accordance with Subcontract Documents					
b) Adequate protection					
c) Protective liner is acceptable					
6. SEDIMENT TRAPS AND BASINS					
a) Installed in accordance with Subcontract Documents					
b) Remaining capacity of the basin is adequate					
7. PERIMETER PROTECTION					
a) Outside areas are not being impacted					
8. SPILLWAYS					
a) Installed in accordance with Subcontract Documents					
b) Maintenance is adequate					
9. SMSCP CONFORMANCE					
a) Significant changes in activity or material stored in the area since the inspection					
b) Best Management Practices have been implemented					
c) Other items which could affect compliance with applicable permits/plans					
10. Note observations or resolutions of deficiencies: _____					
Inspector (Signature)		Job Title		Date	
BSRI Representative (Signature)		Job Title		Date	
Other Approver (Signature)		Job Title		Date	
CERTIFICATION STATEMENT					
I certify that I am familiar with the information contained in this inspection report and that to the best of my knowledge and belief, the information is true, complete, and accurate.					
Delegated Authority (signature)				Date	

**Saltstone Vault #2 Excavation, Liner, and
Backfill**

Attachment No. 02370 - A
Revision No. 1
Spec/Req'n No. C-SPP-Z-00006
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**INSTRUCTIONS FOR STORMWATER POLLUTION PREVENTION PLAN
INSPECTION FORM**

Outfall No.: Enter the outfall number, if applicable.
Construction Project No.: Enter the SRS Project Number
Project Inspector: Enter the person performing the inspection.
Delegated Authority: Enter the name of the person with delegated authority from SCDHEC.
Inspection Frequency: Frequency shall be per the requirements of this specification and/or as specific in the SWPPP. Circle the appropriate type of inspection.
Inspection Attributes: Check the appropriate box for the following questions.

1. a) Is the housekeeping of the general area maintained in an orderly manner?
b) Is the housekeeping of the material storage area maintained in an orderly manner?
2. a) Are vegetation and surface treatments installed per the requirements of the Subcontract Documents?
b) Is there evidence of washout of the vegetative cover? If so, is it kept to a minimum?
c) Has the vegetation been established over 80% of the exposed area within a 20 day time period?
3. a) Are the erosion and sediment control measures of the general area installed per requirements of the Subcontract Documents?
b) Are the sediment loads on the erosion and sediment control measures up to 50% of the barrier height?
c) Are there signs of sediment loading in receiving areas not listed in the plan? Sediment loading in these areas is not acceptable.
4. a) Are channels and culverts installed per the requirements of the Subcontract Documents?
b) Are the sediment loads on the channels and culverts less than 20% of channel depth or culvert diameter?
c) Is erosion (scour) in the area kept to a minimum?
d) Are there any other obstructions in the channels and culvert which are affecting their serviceability?
e) Are there any signs of significant spills in the area? Spills are not acceptable and will require cleanup.
5. a) Are inlet and outlet protection measures installed per the requirements of the Subcontract Documents?
b) Are inlet and outlet protection measures providing adequate protection?
c) Is the protective liner acceptable?
6. a) Are sediment traps and basins installed per the requirements of the Subcontract Documents?
b) Is the remaining capacity of the sediment basin adequate?
7. a) Are perimeter protection measures protecting the outside areas from being adversely impacted by the construction activities?
8. a) Are spillways installed per the requirements of the Subcontract Documents?
b) Are spillways adequately maintained?
9. a) Have there been significant changes in activity or materials in the area since the last inspection? If so, do these changes conform to the requirements of the Subcontract Documents?
b) Are best management practices being implemented and followed?
c) Are all other items/activities that could affect compliance with the applicable permits/plans being identified and implemented to the requirements of the Subcontract Documents and other applicable permits?
10. Indicate observations and/or resolutions of deficiencies from above.

HIGH DENSITY POLYETHYLENE LINER

SECTION 02378

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements for the procurement, transportation, storage, testing, and installation of the 100 mil thick, High Density Polyethylene (HDPE) Geomembrane Liner.
 - 1. First stage - Under tank foundation, between the mud mats.
 - 2. Second stage – Around the tank walls, 2 tanks.
 - 3. Future third stage – Above roof, spliced to wall liner ,by Others
- B. Interface with and provide protection for the Geosynthetic Clay Liner (GCL).

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 02310, Excavation and Foundation Preparation
- C. Section 02320, Backfill and Finish Surface
- D. Section 02379, Geosynthetic Clay Liner
- E. Section 03300, Cast-In-Place Concrete

1.3 REFERENCES

- A. National Codes / Standards:
 - 1. Obtain BSRI prior acceptance for other editions and/or addenda of National Codes / Standards required by this specification before use.
- B. Required National Codes / Standards
 - 1. American Society for Testing and Materials (ASTM)
 - a. D 792, 2000, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
 - b. D 1004, 2003, Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting
 - c. D 1505, 2003, Standard Test Method for Density of Plastics by the Density-Gradient Technique
 - d. D 1603, 2001, Standard Test Method for Carbon Black in Olefin Plastics
 - e. D 3895, 2004, Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
 - f. D 4218, 1996 (R 2001), Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
 - g. D 4437, 1999, Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes
 - h. D 4633, 2005, Standard Test Method for Energy Measurement for Dynamic Penetrometers-Reinstated

- i. D 4833, 2000 (E 2002), Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
- j. D 4873, 2002, Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
- k. D 5199, 2001, Standard Test Method for Measuring Nominal Thickness of Geosynthetics
- l. D 5297, 1995 (R 2004), Standard Test Methods for Rubber Chemical Accelerator-Purity by High Performance Liquid Chromatography
- m. D 6392, 1999, Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
- n. D 6693, 2004, Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

C. Regulations

- 1. EPA/600/R-93/182, Quality Assurance and Quality Control of Containment Facility EPA Technical Guidance Document

D. Documents

None

E. Drawings

None

1.4 SUBMITTALS

A. Submit the following Engineering documents in accordance with Section 01330:

- 1. HDPE Liner Letter of Compliance and Material Quality Control Test Data, With Material Delivery, 1.5 C.2
- 2. HDPE Liner Design, 8 Weeks Prior to Use, 1.6 B.2.
- 3. Quality Control and Inspection Plan and Procedures, 8 Weeks Prior to Use, 1.6 D.9.
- 4. As-Built Drawing(s) of the HDPE Liner Layout, 2 Weeks After Completion, 1.6 F.
- 5. Subcontractor HDPE Qualification Documentation, With Proposal, 1.7 B.
- 6. Field Supervisor's or Superintendent's Resume and References, 4 Weeks Prior to Work, 1.7 C.1.
- 7. Field Crew's Resumes and References, 4 Weeks prior to Work, 1.7 D.1.
- 8. Quality Control Person's Resume and Certification, 4 Weeks prior to Work, 1.7 E.3.
- 9. HDPE Liner Storage and Handling Instructions, 2 Weeks Prior to Receipt, 1.8 B.1.
- 10. HDPE Liner Product Data and Material Specifications, 8 Weeks Prior to Use, 2.3 C.
- 11. HDPE Liner Installation Specifications, 8 Weeks Prior to Use, 2.3 D.
- 12. HDPE Liner Installation Drawings, 8 Weeks Prior to Use, 3.1 A.5.

- B. Submit the following Quality Verification documents in accordance with Sections 01330 and 01400:
 - 1. Field Test Reports, 2 Weeks After Test, 1.6 E.1.
 - 2. Written Acceptance of the Surface, Prior to Installation, 3.1 D.2.
 - 3. Installation Test Reports of all Field Tests and Inspection Reports, 2 Weeks after Test/Inspection, 3.4 B.4.
 - 4. Final Acceptance and Inspection Report, 2 weeks After Inspection, 3.4 C.2.

1.5 TESTING/INSPECTION REQUIREMENTS

- A. Utilize Inspection and Testing laboratory services in accordance with Section 01450.
- B. Subcontractor Inspection
 - 1. Inspect the HDPE Liner rolls delivered to the site for conformance with the requirements of this Specification.
 - 2. Inspect the HDPE Liner for damage such as cuts, tears, holes, blisters, undispersed raw materials, and other deleterious conditions.
 - 3. Replaced damaged or non-conforming materials.
- C. Conformance Testing
 - 1. Field conformance testing of the geomembrane material is not required.
 - 2. Submit Letter of Compliance (LOC) referenced to the batch, lot, and roll numbers and Manufacturing Quality Control (MQC) test data for the materials delivered at the project site.
- D. Inspection and Acceptance of Installed HDPE Liner
 - 1. Visually inspect the installed HDPE Liner, noting conditions such as overlaps and seams, damaged areas, adequacy of repairs, and quality of installation, in particular where the potential for damage or failure exists.

1.6 SUBCONTRACTOR RESPONSIBILITIES

- A. Provide and install leak tight HDPE Liner as indicated on the Installation drawings and follow the Liner manufacturer's procedures.
- B. Perform material selection and prepare the design of all details such as, but not limited to, overlap locations, penetration seals, corners, panel layouts, anchorage, and other necessary details implied or required for the HDPE Liner.
 - 1. The design details drawings shall be verified, reviewed, signed and sealed by a Registered Professional Engineer from the Subcontractor and/or lower tier Specialty Contractors' organization.
 - 2. Submit the HDPE Liner Design Details Drawings for BSRI acceptance.
- C. Utilize the services of an independent inspector per Article 1.7.E and Section 01450 to monitor installation and document testing, placement details, and repair associated with the HDPE Liner.
- D. Prepare and execute a Quality Control and Inspection Plan that addresses the following:
 - 1. Quality Control Testing and Inspection;

2. Construction and repair procedures applicable to the fabrication, installation, and repair process.
 3. HDPE Liner deployment,
 4. Panel identification coding system.
 5. Describe in detail how the HDPE Liner materials will be deployed, the equipment that will be used, how it will be coordinated with the GCL and backfill, and precautions that will be taken during installation.
 6. Precautions to protect the GCL.
 7. Compliance with EPA Guidance document EPA/600/R-93/182.
 8. Check list for field use.
 9. Submit the Quality Control and Inspection Plan and Procedures to BSRI.
- E. Utilize the services of a qualified laboratory, per Section 01450, and technicians to sample, test, and prepare test reports for the tests required in this Section.
1. Submit Field Test Reports to BSRI.
- F. Prepare and submit As-Built drawing(s) of the HDPE Liner layout to BSRI in accordance with the requirements of Section 01330.

1.7 QUALIFICATIONS / CERTIFICATIONS

- A. Qualifications and certifications of individuals shall adhere to Section 01450 and the requirements of this Section.
- B. Subcontractor: Minimum of two similar projects installing HDPE Liner on no less than a combined total of 10 acres in the last 5 years. Submit Subcontractor HDPE Documentation, including references, which verifies the installation qualifications.
- C. Field Supervisor or Superintendent: Minimum of two similar projects installing HDPE Liner on no less than a combined total of 10 acres.
1. Submit Field Supervisor's or Superintendent's resume and references documenting their qualifications.
- D. Field Crew: Knowledgeable and skilled in HDPE Liner installation methods and shall have installed, collectively, at least 25 acres of HDPE Liner which shall include HDPE installation on a minimum of 100,000 sq. ft. vertical surfaces similar to this project.
1. Submit Field Crew Resumes and References documenting their qualifications.
- E. Independent Quality Control Inspector
1. The quality control inspector for geosynthetic materials shall function independently and shall not be involved with the performance of construction activities or directly supervise the work being inspected.
 2. The inspector shall:
 - a. Be responsible for inspections, observation, surveillance, and monitoring of field testing and installation of all geosynthetic materials.
 - b. Produce and submit documented evidence of completion of required tasks of this Specification in accordance with approved plans, procedures and inspection reports specified in Section 01450 and the contract documents.
 - c. Meet the following qualifications and requirements:

- i. National Institute for Certification (NICET) Level III in geosynthetics material testing and installation tasks for all geosynthetic related work activities,
 - ii. Construction and inspection experience for a minimum of two projects of similar complexity using geosynthetic materials.
 - iii. Proven familiarity with construction quality assurance, field inspection and monitoring practices, field and laboratory testing procedures required for geosynthetic materials of the project and implementation, monitoring, and application of analytical techniques required for successful laboratory testing programs.
 3. Submit Quality Control Person's Resume and Certification, including references documenting their qualifications.

1.8 PACKAGING, HANDLING, SHIPPING, AND STORAGE

- A. Comply with the requirements of Section 01600.
- B. Assure the HDPE Liner is shipped, stored, stacked, and handled at the SRS in accordance with the manufacturer's recommendations and as specified herein.
 1. Submit the manufacturer's HDPE Liner Storage and Handling Instructions to BSRI.
- C. Notify BSRI at least twenty-four (24) hours prior to scheduled delivery.
- D. Inspect the HDPE Liner rolls delivered to the site for damage.
- E. Unload and store with minimal handling.
- F. Wrap the HDPE Liner in plastic to protect it from moisture and degradation during shipment and storage.
- G. Separate damaged rolls from undamaged rolls.
 1. BSRI will be the final authority on the determination of damage and functionality of the damaged material.
 2. Remove rejected HDPE Liner from the SRS.
- H. Folded, twisted, or dragged HDPE Liner is not acceptable.
 1. Treat the HDPE Liner in accordance with ASTM D 4873, the manufacturer's recommendations, and this Specification.
- I. Mark and identify the individual roll labels with the following information:
 1. Manufacturer's name
 2. Product identification
 3. Batch, lot, and roll numbers
 4. Roll dimensions and weight
 5. Date of manufacture

1.9 QUALITY CONTROL REQUIREMENTS

- A. Implement the following quality control attributes for the inspection and verification of materials and workmanship:
 1. Prior to Installation of HDPE Liner;

- a. Ensure that the foundation layer is prepared in accordance with the Project Drawings.
- b. Ensure that the surfaces of the mud mat and concrete walls are in accordance with Article 3.1.
- c. Ensure that the HDPE Liner has been stored in accordance with the manufacturer's recommendations and Article 1.8, and that the integrity of the HDPE Liner has not been compromised during storage. Periodic inspections of the storage area shall be performed in accordance with Article 1.8.

2. During Installation of HDPE Liner

- a. Ensure that HDPE Liner is handled and installed according to manufacturer's recommendations and Articles 1.8 and 3.2.
- b. Install panels and overlap in accordance with the layout drawings and details.
- c. Ensure overlaps are of required dimensions.
- d. Ensure that HDPE Liner is dry during placement and is protected from exposure per Articles 3.2 and 3.6.
- e. Ensure that HDPE Liner is protected from equipment, foot traffic, and other vehicles in accordance with Article 3.3.
- f. Ensure that the HDPE Liner is protected from weather and wind damage per Article 3.6.
- g. Repair damaged HDPE Liner in accordance with Article 3.3.

- B. Notify BSRi prior to and following installation of HDPE Liner material.

1.10 PROJECT SITE CONDITIONS

- A. The HDPE Liner is part of the closure cover system.
 - 1. The purpose of this layer is to impede infiltration and seepage of stored material.
 - 2. The HDPE Liner shall function as a low permeability barrier and shall be anchored at the top of the tank wall per the details to be developed by the Liner manufacturer.
- B. Coordinate HDPE Liner installation with the GCL installation of Section 02379.

1.11 MAINTENANCE

- A. Maintain the installed and uninstalled HDPE Liner and protect it from damage and degradation until project completion.
- B. Remove excess HDPE Liner brought to the site offsite after project closure and prior to demobilization.

PART 2 PRODUCTS

2.1 PERFORMANCE

- A. The installed HDPE Liner shall act as part of the lower-permeability cover system to impede the infiltration of surface and stormwater and the seepage of the stored material.

2.2 REQUIREMENTS

- A. The HDPE Liner shall be fabricated at a manufacturing facility.

- B. The HDPE Liner shall be manufactured as a uniform layer.

2.3 CRITERIA

A. HDPE Geomembrane

1. The geomembrane shall be smooth, black, high density polyethylene geomembrane manufactured from virgin, first quality polyethylene resin manufactured in the United States.
2. The surfaces of the HDPE shall be free of holes, blisters, undispersed raw materials, or any contamination by foreign matter.
3. At a minimum, 2% of the rolls delivered to the project site shall be tested by the Manufacturer Quality Control (MQC) test data from the manufacturer as proof that the HDPE geomembrane components were appropriately tested by the manufacturer, and meet the test values specified in Article 2.3.B.
4. Include test data from the manufacturer, with the Product Data and Material Specifications, as proof the geosynthetic components and the finished HDPE material were appropriately tested by the manufacturer for the properties shown in Article 2.3.B.

B. The HDPE Liner shall meet the following criteria;

1. Thickness – 100 mils, minimum average per ASTM D 5199
2. Density – 0.940 g/cc, minimum per ASTM D 1505 or ASTM D 792
3. Tensile Properties, minimum average per ASTM D 6693 Type IV
 - a. Yield Strength – 210 lb/in
 - b. Break Strength – 380 lb/in
 - c. Yield elongation – 12%
 - d. Break Elongation – 700%
4. Tear Resistance – 70 lb, minimum average per ASTM D 1004
5. Puncture Resistance – 130 lb, minimum average per ASTM D 4833
6. Stress Crack Resistance – 200 hr minimum per ASTM D 5297 Appendix
7. Carbon Black Content – 2.0% – 3.0%, per ASTM D 1603 or ASTM D 4218
8. Oxidative Induction Time – 100 minutes, per ASTM D 3895

C. Submit HDPE Liner Product Data and Material Specifications, with product samples.

D. Submit HDPE Liner Installation Specifications.

PART 3 EXECUTION

3.1 PREPARATION

- A. Prepare HDPE Liner Installation Drawings,
 - 1. Show the proposed location, orientation, overlap, penetration, tie-in, and anchor details and all associated materials and work necessary for the HDPE Liner installation.
 - 2. The design for anchorage (including top of tank wall), splicing, layout, placement, repairs, patching, seams, penetrations, overlaps and other system requirements shall be in accordance with manufacturer's recommendations.
 - 3. Include splicing detail at top of tank wall for future use by others.
 - a. This detail shall assure that the joint will prevent rain water intrusion between the liner and tank wall.
 - 4. The splice joint discussed in Article 3.1 A.3 shall also be protected by a rain diversion to channel water away from the joint. The diverter shall be designed to remain in place for at least 20 years until final roof/wall splice joint is complete.
 - 5. Submit the HDPE Liner Installation Drawings to BSRI.
- B. No metal battens, straps, or hardware shall be used for HDPE Liner handling and installation.
- C. Surfaces to be covered with HDPE Liner shall be smooth and free of sharp stones, sharp objects, or debris of any kind. There shall not be any materials/foreign objects between the GCL and HDPE liner materials.

Provide special attention to the detail at changes of direction; e.g. at base and top of tank..
- D. Perform a visual inspection of the surfaces to receive the HDPE Liner.
 - 1. Prepare, clean, or repair unacceptable areas as required.
 - 2. Submit a Written Acceptance of the Surface prior to commencing installation.
- E. Repair any deficiencies in the supporting subgrade that have appeared since the acceptance of the soil subgrade.

3.2 INSTALLATION

- A. Install the HDPE Liner in a relaxed condition and free of tension, stress, or waves at completion of the installation.
 - 1. Stretching of the HDPE Liner to fit is not acceptable.
 - 2. Straighten the HDPE Liner to smooth out creases or irregularities in the runs.
 - 3. The Subcontractor Quality Control Person shall document installation activities in detail and submit daily logs to BSRI.
- B. Seal the HDPE Liner overlaps or seams per the manufacturer's recommendations.
- C. Install the HDPE Liner in the orientation recommended by the manufacturer.
 - 1. Anchor the HDPE Liner installed on sides, at the top of walls and then unroll so as to keep the material free of wrinkles and folds.

2. A controlled roll-out shall be used.
- D. Mark each panel with an "identification code" (numeric or alphanumeric) consistent with the panel layout plan. The identification code shall be simple and logical for BSRI use.
- E. Deploy material from the higher elevation to the lower elevation to protect the HDPE Liner against the adverse effect of precipitation during deployment.
 1. Place the HDPE on vertical surface such that field seams are in vertical direction.
 2. Shingle panels in a down slope direction to facilitate runoff on top of the new HDPE Liner rather than below it.
- F. The number of panels deployed and the area of exposed panels shall not exceed the area that can be installed and protected from moisture on the same day.
- G. Take the necessary precautions to protect materials underlying the HDPE Liner.
- H. The HDPE Liner material shall be marked with waterproof overlap marks longitudinally on both faces by the manufacturer to assist in obtaining the proper overlap during installation.
 1. Overlap distances shall be per the manufacturer's recommendation.
 2. Overlap seams shall be placed to assure the upper panel aligns with the match line on the lower panel.

3.3 INSTALLATION CONTROL

- A. The HDPE Liner shall not be deployed during precipitation, in the presence of excessive moisture, in areas of ponded water, or in the presence of excessive winds. The HDPE Liner installation shall halt during any form of precipitation and exposed HDPE Liner shall be protected and covered immediately.
- B. Protect the HDPE Liner against wind in accordance with manufacturer's recommendations. Construction methods shall employ a means of protecting material from sudden wind damage during installation.
- C. Provide earthen berms, swales, sand bags, or other means as required to direct stormwater flows away from the installed HDPE Liner. Implement and maintain erosion reduction measures during HDPE Liner installation process.
- D. Method of Deployment
 1. Use equipment which does not damage the HDPE Liner or the supporting subgrade surface including the mudmats.
 2. All personnel working on the HDPE Liner shall wear shoes that do not damage the HDPE Liner.
 3. Clamps and other metal tools used in the work area shall have rounded edges (no sharp) corners. Tools shall not be tossed or thrown.
 4. Panels shall be unrolled with a method that protects the HDPE Liner from scratches and crimps and protects the soil subgrade from damage including the mudmats.
 5. Protect the HDPE Liner in heavy traffic areas by geotextile, extra HDPE Liner, or other suitable materials.
 - a. Materials used for protection shall be temporary and shall not be used as any part of the permanent installation.

- b. Heavy traffic areas shall not exceed the manufacturer's recommendations for travel over the HDPE Liner.
- 6. Do not allow vehicle traffic directly on the HDPE Liner surface.
- 7. After installation, the HDPE Liner surface shall be visually inspected to ensure that no potentially damaging objects are present, such as stones, cutting blades, small tools, sandbags, etc.
- 8. Avoid any sudden stops, starts, or turns by construction equipment on backfill placed atop any HDPE Liner material.
- E. Overlap seams shall be detailed to have the same hydraulic conductivity as required throughout the body of the HDPE Liner. Follow additional recommendations by the manufacturer regarding overlap and seaming to achieve the equivalent hydraulic conductivity.
- F. REPAIR HOLES, TEARS, OR RIPS IN HDPE LINER USING A HDPE patch per Quality Control and Inspection Plan and procedures.
 - 1. Patches shall overlap the damaged area a minimum of 12 inches in all directions. Nails and staples are not allowed.

3.4 INSTALLATION TESTS

- A. Types of Installation Tests
 - 1. The types of HDPE installation tests shall include the following:
 - a. Visual tests,
 - b. Nondestructive tests (NDT), and
 - c. Destructive tests.
- B. The frequency of testing and the specific test shall be as outlined in the following Articles:
 - 1. Trial Seam Tests
 - a. Tests may be made on scrap pieces of HDPE to verify that seams and seaming conditions are adequate.
 - b. Trial seams shall be made at the beginning of each shift and at the end of each shift for each seaming apparatus used that day, any time the seaming operation or environment is significantly modified, and at the request of BSRI,
 - c. Each seamer shall make at least one trial seam each day,
 - d. Trial seams shall be made under the same conditions as the production seams,
 - e. The trial seam sample shall be at least 5 feet long by 1 foot wide (after seaming) with the seam centered lengthwise,
 - f. Adjoining specimens, each 1 inch wide, shall be cut from the trial seam sample:
 - i. The specimens shall be tested in shear and peel using a field tensiometer and shall not fail in the seam. Testing shall be per ASTM D 6392.
 - ii. The minimum allowable seam strengths required for the liner are:
 - Shear: 200 lbs/in
 - Fusion Peel: 130 lbs/in
 - iii. If a specimen fails, a new trial seam shall be tested.

- iv. If the additional specimen fails, the seaming apparatus or seamer shall not be used for seaming until the deficiencies are corrected and two consecutive successful trial seams are achieved.
 - g. All testing apparatus shall be provided by the Subcontractor and calibrated to the manufacturer's requirements.
 - 2. Nondestructive Seam Testing
 - a. All seams shall be nondestructively tested over their full length.
 - b. Testing shall conform to ASTM D 4437. Use an Air Lance or Vacuum Box test for single fusion weld and extrusion weld seams. Use a Vacuum Box or other test method recommended by manufacturer and BSRI approved method for double fusion weld seams. Perform testing as the seaming work progresses.
 - c. Testing of Defects and Repairs
 - i. Each location which fails the nondestructive testing shall be marked by the independent quality control person and repaired by the Subcontractor.
 - ii. The procedure for seam remediation shall be either (a) to repair the entire seam between acceptable sampling locations, or (b) to retest the seam by splitting the distance between acceptable test locations until the faulty area can be isolated and repaired.
 - iii. Repaired areas shall not be covered until these areas pass the appropriate tests.
 - 3. Destructive Testing
 - a. Destructive test of the field seam is not required; however BSRI reserves the right to independently test the seam.
 - 4. Submit Installation Test Reports of all field tests and inspection reports.
- C. Final Acceptance of Installed HDPE
 - 1. Acceptance of the installed HDPE shall be based on visual inspection by BSRI and the results of conformance and installation testing per criteria given in the Specification. The visual inspection shall note conditions such as overlaps and seams, damaged areas, adequacy of repairs, and the quality of installation, in particular where the potential for damage or failure exists.
 - 2. Submit a Final Acceptance and Inspection Report.

3.5 AS BUILTS

- A. Document the HDPE as-built information per Article 1.6. and Section 1330. The drawing(s) shall include, but not limited to, the following information:
 - 1. Overlap or seam location and date made
 - a. The amount of overlap for adjacent HDPE Liners.
 - b. The overlap distance is sometimes different for the roll ends versus the roll edges. Twice the recommended overlap distances should be used and the in-place distances documented.
 - 2. Damaged and failed areas
 - 3. Dimensions and type of repair and date repaired
 - 4. Material batch, roll number, and location of the panel and date installed

5. Batch and roll number of repair patches.

3.6 PROTECTION

- A. Protect the HDPE Liner during transportation, storage, and installation to prevent damage and degradation.
- B. Protect the HDPE Liner from UV light exposure and damage.
- C. Protect the HDPE Liner against wind in accordance with manufacturer's recommendations. Construction methods shall employ a means of protecting material from sudden wind damage during installation.
- D. Provide earthen berms, swales, sandbags, or other means as required to direct stormwater flows away from the installed HDPE Liner.
- E. Implement and maintain erosion reduction measures during HDPE Liner installation process.
- F. Loads placed on the HDPE Liner shall not exceed the manufacturer's recommendations and shall not cause tearing, puncturing, shoving, or thinning.
- G. Equipment used for the deployment of the HDPE Liner shall be as recommended by the manufacturer and shall not damage the HDPE Liner or other materials.

3.7 CLEANING

- A. Maintain a clean worksite.
- B. Upon completion of the HDPE Liner installation, clean the work areas and transport and dispose of waste materials.
- C. Remove any debris, trash, or leftover HDPE Liner pieces, damaged or unsatisfactory HDPE Liner material following construction activities.

END OF SECTION

GEOSYNTHETIC CLAY LINER

SECTION 02379

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements for the procurement, transportation, storage, testing, and installation of the Geosynthetic Clay Liner (GCL)
 - 1. First stage - Under tank foundation, between the mud mats.
 - 2. Second stage - Around the tank walls, 2 tanks (minimum 2 feet above base tank floor/wall joint).
 - 3. Future third stage - above tank roof, by others.
- B. Interface with and provide protection for the High Density Polyethylene (HDPE) Geomembrane Liner.

1.2 RELATED SECTIONS

- A. Division 1 - All Sections
- B. Section 02310, Excavation and Foundation Preparation
- C. Section 02320, Backfill and Finish Surface
- D. Section 02378, High Density Polyethylene Liner
- E. Section 03300, Cast-In-Place Concrete

1.3 REFERENCES

- A. National Codes / Standards:
 - 1. Obtain BSRI prior acceptance for other editions and/or addenda of National Codes / Standards required by this specification before use.
- B. Required National Codes / Standards
 - 1. American Society for Testing and Materials (ASTM)
 - a. D 2216, 2005, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
 - b. D 4354, 1999 (R 2004), Standard Practice for Sampling of Geosynthetics for Testing
 - c. D 4632, 1991 (R 2003), Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
 - d. D 4873, 2002, Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
 - e. D 5199, 2001, Standard Test Method for Measuring Nominal Thickness of Geosynthetics
 - f. D 5887, 2004, Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter

- g. D 5890, 2002. Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners
- h. D 5891, 2002, Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners
- i. D 5993, 1999 (R 2004), Standard Test Method for Measuring Mass Per Unit of Geosynthetic Clay Liners
- j. D 6243, 1998. Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method
- k. D 6495, 2002, Standard Guide for Acceptance Testing Requirements for Geosynthetic Clay Liners

C. Regulations

- 1. EPA/600/R-93/182, Quality Assurance and Quality Control of Containment Facility EPA Technical Guidance Document

D. Documents

None

E. Drawings

- 1. QB00485K-021-D-MDM, Mud Mat, 8" X 8" Concrete Curb and Construction Manhole (Sheet 13 of 13)

1.4 SUBMITTALS

A. Submit the following Engineering documents in accordance with Section 01330.

- 1. Geosynthetic Clay Liner Design Details Drawings, 8 Weeks Prior to Use, 1.6 B. 2.
- 2. Quality Control and Inspection Plan and Procedures, 8 Weeks Prior to Use, 02379 1.6 D. 9.
- 3. As-Built Drawing(s) of the GCL Layout, 2 Weeks After Completion, 1.6 F.
- 4. Subcontractor GCL Qualification Documentation, With Proposal, 1.7 B.
- 5. Field Supervisor's or Superintendent's Resume and References, 4 Weeks Prior to Work, 1.7 C.
- 6. Quality Control Person's Resume and Certification, 4 Weeks Prior to Work, 1.7.E.4.
- 7. GCL Storage and Handling Instructions, 2 Weeks Prior to Receipt, 1.8 B. 1.
- 8. GCL Letter of Compliance (LOC) and Manufacturing Quality Control Test Data, With Delivery, 1.5.C and 2.3.D.
- 9. GCL Product Data and Material Specifications, 8 Weeks Prior to Ordering, 2.3. E.
- 10. GCL Installation Specifications, 8 Weeks Prior to Use, 2.3 F.
- 11. GCL Liner Installation Drawings, 8 Weeks Prior to Use, 3.1 A. 3.
- 12. Alternate Repair Procedures, 4 Weeks Prior to Use, 3.3 H. 5.

B. Submit the following Quality Verification documents in accordance with Sections 01330 and 01400:

1. Geosynthetic Clay Liner Inspection and Acceptance Report, 2 Weeks After Installation, 1.5 D. 3.
2. GCL Test Reports, 2 Weeks After Test and With the Delivery, 1.6 E.
3. Written Acceptance of the Surface. Prior to Installation, 3.1 D. 2.
4. Final Acceptance and Inspection Report, 2 weeks After Inspection, 3.4.A.3

1.5 TESTING/INSPECTION REQUIREMENTS

- A. Inspection and Testing laboratory services shall be in accordance with Section 01450.
- B. Subcontractor Inspection
 1. Inspect the GCL delivered to the site for conformance with the requirements of this Specification.
 2. Inspect the GCL for damage such as cuts, tears, holes, blisters, undispersed raw materials, and other deleterious conditions.
 3. Replaced damaged or non-conforming materials.
- C. Conformance Testing
 1. Field conformance testing of the GCL material is not required.
 2. Submit Letter of Compliance (LOC) referenced to the batch, lot, and roll numbers and Manufacturing Quality Control (MQC) test data for the materials delivered at the project site.
- D. Inspection and Acceptance of Installed GCL
 1. Visually inspect the installed GCL, noting conditions such as overlaps and seams, damaged areas, adequacy of repairs, and quality of installation, in particular where the potential for damage or failure exists.
 2. Submit Geosynthetic Clay Liner Inspection and Acceptance Report.

1.6 SUBCONTRACTOR RESPONSIBILITIES

- A. Provide and install GCL as indicated on the project drawings and follow the Liner manufacturer's procedures.
- B. Perform material selection and prepare the design of all details such as, but not limited to, overlap locations, penetration seals, corners, panel layouts, anchorage, and other necessary details implied or required for the GCL.
 1. The design details drawings shall be verified, reviewed, signed and sealed by a Registered Professional Engineer from the Subcontractor and/or lower tier Specialty Contractors' organization.
 2. Submit the Geosynthetic Clay Liner Design Details Drawings for BSRI acceptance.
- C. Utilize the services of an independent inspector per Article 1.7. E and Section 01450 to monitor installation and document all testing, placement details, and repair associated with the GCL.
- D. Prepare and execute a Quality Control and Inspection Plan that addresses the following:
 1. Quality Control Testing and Inspection;

2. Construction and repair procedures applicable to the fabrication, installation, and repair process,
 3. GCL deployment,
 4. Panel identification coding system.
 5. Describe in detail how the geosynthetic materials will be deployed, the equipment that will be used, how it will be coordinated with the HDPE installation and backfill operations, and precautions that will be taken during installation.
 6. Precautions to protect the GCL.
 7. Compliance with EPA Guidance document EPA/600/R-93/182.
 8. Check list for field use.
 9. Submit the Quality Control and Inspection Plan and procedures to BSRI.
- E. Utilizing the services of a qualified laboratory per Section 01450 and technicians to sample, test, and prepare test reports for the tests required in this Section. Submit Field Test Reports shall be subject for review and acceptance by BSRI.
- F. Submit As-Built drawing(s) of the GCL layout to BSRI in accordance with the requirements of Section 01330.

1.7 QUALIFICATIONS / CERTIFICATIONS

- A. Qualifications and certifications of individuals shall adhere to Section 01450 and the requirements of this Section.
- B. Subcontractor: Minimum of two similar projects installing GCL on no less than a combined total of 10 acres in the last 5 years. Submit Subcontractor GCL Documentation, including references, which verifies the installation qualifications.
- C. Field Supervisor or Superintendent: Minimum of two similar projects installing GCL on no less than a combined total of 10 acres. Submit Field Supervisor's or Superintendent's resume and references documenting their qualifications.
- D. Field Crew: Knowledgeable and skilled in GCL installation methods and shall have installed, collectively, at least 25 acres of GCL.
- E. Independent Quality Control Inspector
1. The quality control person for geosynthetic materials shall function independently and shall not be involved with the performance of construction activities or directly supervise the work being inspected.
 2. The inspector shall:
 - a. Be responsible for inspections, observation, surveillance, and monitoring of field testing and installation of all geosynthetic materials.
 - b. Produce and submit documented evidence of completion of required tasks of the Project Specification in accordance with approved plans, procedures and inspection reports specified in Section 01450 and the contract documents.
 - c. Meet the following qualifications and requirements:
 - i. National Institute for Certification (NICET) Level III in geosynthetics material testing and installation tasks for all geosynthetic related work activities,

- ii. Construction and inspection experience for a minimum of two projects of similar complexity using geosynthetic materials.
 - iii. Proven familiarity with construction quality assurance, field inspection and monitoring practices, field and laboratory testing procedures required for geosynthetic materials of the project and implementation, monitoring, and application of analytical techniques required for successful laboratory testing programs.
3. Submit Quality Control Person's Resume, Certification and References documenting their qualifications.

1.8 PACKAGING, HANDLING, SHIPPING, AND STORAGE

- A. Comply with the requirements of Section 01600.
- B. Assure the GCL is shipped, stored, stacked, and handled at the SRS in accordance with the manufacturer's recommendations and as specified herein.
 1. Submit the manufacturer's GCL Storage and Handling Instructions to BSRI.
- C. Notify BSRI at least twenty-four (24) hours prior to scheduled delivery.
- D. Inspect the GCL rolls delivered to the site for damage.
- E. Unload and store with minimal handling.
- F. Wrap the GCL in plastic to protect it from moisture and degradation during shipment and storage.
- G. Separate damaged rolls from undamaged rolls.
 1. BSRI will be the final authority on the determination of damage and functionality of the damaged material.
 2. Remove rejected GCL from the SRS.
- H. Folded, twisted, or dragged GCL is not acceptable.
 1. Treat the GCL in accordance with ASTM D 4873, the manufacturer's recommendations, and this Specification.
- I. Mark and identify the individual roll labels with the following information:
 1. Manufacturer's name
 2. Product identification
 3. Batch, lot, and roll numbers
 4. Roll dimensions and weight
 5. Date of manufacture

1.9 QUALITY CONTROL REQUIREMENTS

- A. Implement the following quality control attributes for the inspection and verification of materials and workmanship:
 1. Prior to Installation of GCL
 - a. Ensure that the foundation layer is prepared in accordance with the Project Drawings.

- i. The topographic survey of the foundation layer shall be reviewed and accepted in accordance with Section 02310 and Section 02320.
 - b. Ensure that the foundation layer has been placed and compacted in accordance with Section 02310.
 - i. All testing of the foundation layer shall be complete.
 - ii. Ensure mud mat has been placed in accordance with Section 03300.
 - iii. All test results must be reviewed and accepted by BSRI prior to GCL placement.
 - c. Ensure that the surface of the foundation layer is in accordance with Article 3.1.
 - d. Ensure that Manufacturer testing of the GCL has been completed in accordance with Article 2.3.
 - i. All test results must be reviewed and accepted by BSRI prior to GCL placement.
 - e. Ensure that the GCL has been stored in accordance with the manufacturer's recommendations and Article 1.8, and that the integrity of the GCL has not been compromised during storage.
 - i. Periodic inspections of the storage area shall be performed in accordance with Article 1.8.
2. During Installation of GCL
 - a. Ensure that GCL is handled and installed according to manufacturer's recommendations and Articles 1.8 and 3.2.
 - b. Install panels and overlap in accordance with the layout drawings and details.
 - c. Ensure overlaps are of required dimensions and are adequately sealed with dry bentonite.
 - d. Ensure that GCL is dry during placement and is protected from exposure per Articles 3.2 and 3.6.
 - e. Ensure that overlaps are located in accordance with Article 3.2.
 - f. Ensure that GCL is protected from equipment, foot traffic, and other vehicles in accordance with Article 3.3.
 - g. Ensure that the GCL is protected from weather and wind damage per Article 3.5.
 - h. Repair damaged GCL in accordance with Article 3.3.
 - i. Replace GCL that becomes saturated in accordance with Article 3.2.
- B. Notify BSRI prior to and following installation of GCL material.

1.10 PROJECT SITE CONDITIONS

- A. The GCL is part of the closure cover system.
 - 1. The purpose of this layer is to impede infiltration and seepage of stored material.
 - 2. The GCL shall function as a low permeability barrier and be placed over the first of two 4 inch mudmats as depicted on Drawing QB00485K-021-D-MDM. The GCL shall also, extend up to a minimum 2 feet height above the tank floor and wall joint per details to be developed by the liner manufacturer.

- B. Coordinate GCL installation with the HDPE Liner installation, Section 02378.

1.11 MAINTENANCE

- A. Maintain the installed and uninstalled GCL and protect it from damage and degradation until project completion.
- B. Remove excess GCL brought to the site offsite after project closure and prior to demobilization.

PART 2 PRODUCTS

2.1 PERFORMANCE

- A. The installed GCL shall act as part of the lower-permeability cover system to impede the infiltration of surface and stormwater and seepage of stored material.

2.2 REQUIREMENTS

- A. The GCL shall be fabricated at a manufacturing facility.
- B. The GCL shall contain a uniform layer of natural sodium bentonite captured between two layers of supporting geotextile that does not displace when cut.
- C. Use Reinforced (needle punched or stitch bonded) GCL. Any adhesives used to manufacture the GCL shall not interfere with the swelling, self-healing, or low permeability properties of the sodium bentonite.

2.3 CRITERIA

- A. Geotextile Raw Materials
 1. The geotextile shall be fabricated from new, first quality resin and synthetic fibers. The upper and lower geotextiles shall be nonwoven.
 2. The surfaces of the GCL shall be free of holes, blisters, undispersed raw materials, or any contamination by foreign matter.
 3. The Subcontractor shall include test data from the manufacturer, with the Product Data and Material Specifications, as proof the bentonite, geosynthetic components, and the finished GCL's were appropriately tested by the manufacturer for the properties shown on Article 2.3.C.
- B. Geotextile Material Requirements
 1. The geotextile shall provide the following functional requirements:
 - a. Prevent the bentonite from displacement during shipping, handling, and installation of the GCL,
 - b. Protect the bentonite from exposure and mass loss, and
 - c. Maintain a minimum puncture resistance.
 - d. Improve interface shear friction angle between geosynthetic materials.
- C. Geosynthetic Clay Liner Criteria
 1. The sodium bentonite of the GCL material shall meet following requirements:
 - a. Moisture Content: Test Method - ASTM D 2216, Acceptance Criterion - 20% maximum

- b. Swell Index: Test Method - ASTM D 5890, Acceptance Criterion - 24ml / 2 gm minimum
- 2. The GCL shall meet following requirements:
 - a. Bentonite Mass per Unit Area (moisture content 0%): Test Method - ASTM D 5993, Acceptance Criterion – 0.75lb/sf Minimum Average Roll Value (MARV)
 - b. Thickness: Test Method - ASTM D 5199, Acceptance Criterion – 0.2in typical
 - c. Grab Tensile: Test Method - ASTM D 4632, Acceptance Criterion - 90lbs MARV
 - d. Peel Strength: Test Method - ASTM D 4632, Acceptance Criterion - 15 lbs. minimum (modified for 180degree peel of GCL)
 - e. Hydrated Internal Shear Strength: Test Method - ASTM D 6243, Acceptance Criterion - 500lb/sf typical (sample hydrated under 250 psf for 24 hours prior to shear @0.04 in. per min.)
 - f. Fluid Loss: Test Method - ASTM D 5891, Acceptance Criterion - 18ml maximum
 - g. Index Flux: Test Method - ASTM D 5887, Acceptance Criterion - 1×10^{-8} m³/m²/sec (1×10^{-6} cm³/cm²/sec) maximum and 5×10^{-9} cm/sec maximum for saturated hydraulic conductivity.
- D. At a minimum, 2% of the rolls to be delivered to the project site shall be tested per ASTM D 6495 by the Manufacturer Quality Control (MQC) test data from the manufacturer as proof that the GCL components were appropriately tested by the manufacturer, and meet the test values specified in Article 2.3.C. The tests sample section shall be in accordance with ASTM D 4354, Procedure 3. Submit MQC test data.
- E. Submit GCL Product Data and Material Specifications, with product samples.
- F. Submit GCL Installation Specifications.

PART 3 EXECUTION

3.1 PREPARATION

- A. Prepare the GCL installation drawings;
 - 1. Show the proposed location, orientation, overlap, penetration, tie-in, and anchor details and all associated materials and work necessary for the GCL installation.
 - 2. The design for anchorage (including on tank wall), splicing, layout, placement, repairs, patching, seams, penetrations, overlaps and other system requirements shall be in accordance with manufacturer's recommendations.
 - 3. Submit the GCL Liner Installation Drawings to BSRI.
- B. No metal battens, straps, or hardware shall be used for GCL handling and installation.
- C. Surfaces to be covered with GCL shall be smooth and free of sharp stones, sharp objects, or debris of any kind. There shall not be any foreign materials/objects between the mudmats and GCL or between GCL and HDPE liner materials.
 - 1. The mudmats surface shall provide a firm unyielding foundation for the GCL with no sudden, sharp, or abrupt changes or breaks in grade.

- D. Perform a visual inspection of the surfaces to receive the GCL and provide BSRI with a written acceptance of the surface prior to commencing installation.
 - 1. Prepare, clean, or repair unacceptable areas as required.
 - 2. Submit a written Acceptance of the Surface prior to commencing installation.
- E. Provide non-angular, gradual, and rounded edges for GCL placement.
- F. Repair any deficiencies in the supporting subgrade/mudmats that have appeared since the acceptance.

3.2 INSTALLATION

- A. Install the GCL in a relaxed condition and free of tension, stress, or waves at completion of the installation.
 - 1. Stretching of the GCL to fit is not acceptable.
 - 2. Straighten the GCL to smooth out creases or irregularities in the runs.
 - 3. The Subcontractor Quality Control Person shall document installation activities in detail and submit daily logs to BSRI.
- B. Seal the GCL overlaps or seams per the manufacturer's recommendations.
 - 1. The upper and lower geotextile layers shall protect the bentonite from dispersion.
- C. Install the GCL in the orientation recommended by the manufacturer. Keep the installed materials free of wrinkles and folds.
- D. Mark each panel with an "identification code" (numeric or alphanumeric) consistent with the panel layout plan. The identification code shall be simple and logical for BSRI use.
- E. Place the GCL material such that the seams are in vertical direction against the tank wall.
- F. Install GCL material such that there is no end-of-roll horizontal seam against the vertical wall of the tank wall.
- G. The GCL seams on horizontal surface shall be a minimum of 5 feet apart from each other.
- H. The number of panels deployed and the area of exposed panels shall not exceed the area that can be installed and protected from moisture on the same day.
- I. Take the necessary precautions to protect materials underlying the GCL. Do not drive construction equipment on top of GCL after its placement.
- J. The GCL material shall be marked with waterproof overlap marks longitudinally on both faces by the manufacturer to assist in obtaining the proper overlap during installation.
 - 1. Overlap distances shall be per the manufacturer's recommendation.
 - 2. Bentonite shall be placed into the overlap per the manufacturer's recommendations.
 - 3. Overlap seams shall be placed to assure the upper panel aligns with the match line on the lower panel.

- K. During placement, care must be taken not to entrap loose bentonite, stones, or sand in or beneath the GCL, which can hamper subsequent seaming of materials either beneath or above the GCL.
- L. Trimming of the GCL should be done with care to minimize loss or shifting of bentonite.
- M. Provide measures, such as plastic, to protect GCL from being hydrated during installation.
 - 1. In the event the GCL becomes wet for any reason, the GCL shall be replaced.

3.3 INSTALLATION CONTROL

- A. The GCL shall not be deployed during precipitation, in the presence of excessive moisture, in areas of ponded water, or in the presence of excessive winds. The GCL installation shall halt during any form of precipitation and exposed GCL shall be protected and covered immediately.
- B. Protect the GCL against wind in accordance with manufacturer's recommendations. Construction methods shall employ a means of protecting material from sudden wind damage during installation.
- C. Take precautions and protect GCL from it being damaged during placement on the tank vertical walls. Use appropriate straps to keep GCL in vertical position during placement of HDPE liner.
- D. Use protection board or other construction aid materials to protect installed GCL and HDPE materials from being damaged during backfill operations.
- E. Provide earthen berms, swales, sand bags, or other means as required to direct stormwater flows away from the installed GCL. Implement and maintain erosion reduction measures during GCL installation process.
- F. Method of Deployment
 - 1. Use equipment which does not damage the GCL or the supporting subgrade/mudmat surface.
 - 2. All personnel working on the GCL shall wear shoes that do not damage the GCL.
 - 3. Clamps and other metal tools used in the work area shall have rounded edges (no sharp) corners. Tools shall not be tossed or thrown.
 - 4. Panels shall be unrolled with a method that protects the GCL from scratches and crimps and protects the subgrade/mudmat from damage.
 - 5. Protect the GCL in heavy traffic areas by geotextile, extra GCL, or other suitable materials.
 - a. Materials used for protection shall be temporary and shall not be used as any part of the permanent installation.
 - b. Heavy traffic areas shall not exceed the manufacturer's recommendations for travel over the GCL.
 - 6. Do not allow vehicle traffic directly on the GCL surface.
 - 7. GCL exhibiting shoving, shifting, thinning, or rutting shall be replaced.
 - 8. After installation, the GCL surface shall be visually inspected to ensure that no potentially damaging objects are present, such as stones, cutting blades, small tools, sandbags, etc.

9. Avoid any sudden stops, starts, or turns by construction equipment on backfill placed atop any geosynthetic material.
- G. Overlap seams shall be detailed to have the same hydraulic conductivity as required throughout the body of the GCL. Follow additional recommendations by the manufacturer regarding overlap and seaming to achieve the equivalent hydraulic conductivity.
- H. Repair holes, tears, or rips in geotextiles using a geotextile patch per Quality Control and Inspection Plan and procedures..
 1. Bentonite loss or shifting shall require a full GCL patch of the same GCL product.
 2. Patches shall overlap the damaged area a minimum of 12 inches in all directions.
 3. Carefully place the loose Bentonite to seal the patch.
 4. Nails and staples are not allowed.
 5. Submit Alternate Repair Procedures to BSRI.

3.4 INSTALLATION TESTS

- A. Installation Tests
 1. No field tests shall be performed for the Installed GCL Layer. However, the installed GCL shall be visually inspected to comply with all attributes of Articles 1.9, and per the Quality Control and Inspection and procedures.
 2. The visual inspection shall note conditions such as overlaps, damaged areas, adequacy of repairs, and all the quality of installation, in particular where the potential for damage or failure exists.
 3. Submit a Final Acceptance And Inspection Report.

3.5 AS-BUILTS

- A. Document the GCL as-built information per Article 1.6. The drawing(s) shall include, but is not limited to, the following information:
 1. Overlap or seam location and date made
 - a. The amount of overlap for adjacent GCL's shall be documented and adhered to in-field placement of the materials.
 - b. The overlap distance is sometimes different for the roll ends versus the roll edges. Twice the recommended overlap distances should be used and the in-place distances documented.
 - c. If dry or moistened bentonite (or other material) is to be placed in the overlapped region as stated above, the type and amount shall be documented.
 2. Damaged and failed areas
 3. Dimensions and type of repair and date repaired
 4. Material batch, roll number, and location of the panel and date installed
 5. Batch and roll number of repair patches.

3.6 PROTECTION

- A. Protect the GCL during transportation, storage, and installation to prevent damage and degradation.
- B. Protect the GCL from UV light exposure and damage.
- C. Protect the GCL against wind in accordance with manufacturer's recommendations. Construction methods shall employ a means of protecting material from sudden wind damage during installation.
- D. Provide earthen berms, swales, sandbags, or other means as required to direct stormwater flows away from the installed GCL.
- E. Implement and maintain erosion reduction measures during GCL installation process.
- F. Loads placed on the GCL shall not exceed the manufacturer's recommendations and shall not cause tearing, puncturing, bentonite extrusion, shoving, or thinning.
- G. Equipment used for the deployment of the GCL shall be as recommended by the manufacturer and shall not damage the GCL or other materials.
- H. Provide necessary measures such as plastic to prevent GCL from being hydrated by rainwater, stormwater, or groundwater, prior to it being covered by HDPE liner and/or other materials.

3.7 CLEANING

- A. Maintain a clean worksite.
- B. Upon completion of the GCL installation, clean the work areas and transport and dispose of waste materials.
- C. The Subcontractor shall remove any debris, trash, or leftover GCL pieces, damaged or unsatisfactory GCL material following construction activities.

END OF SECTION

STORM DRAINAGE

SECTION 02630

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Storm drainage pipe, cuiverts, and appurtenances
- B. Junction Box and appurtenances

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 02370, Erosion & Sediment Control

1.3 REFERENCES

- A. National Codes / Standards:
 - 1. Obtain BSRI prior acceptance for other editions and/or addenda of National Codes / Standards required by this specification before use.
- B. Required National Codes / Standards
 - 1. American Society for Testing and Materials (ASTM)
 - a. A 48, 2003, Standard Specification for Gray Iron Casting
 - b. C 443, 2005, Standard Specification for Joints Circular Sewer and Culvert Pipe Using Rubber Gaskets.
 - c. C 913, 2002, Standard Specification for Pre-cast Concrete water and Wastewater Structures
 - d. D 1248, 2004, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
 - e. D1557, 2002 (E2003), Standard Test Methods for Laboratory Compaction Characteristics of soil Using Modified Effort
 - f. D 3212-A, 2004, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
 - g. D 3350, 2004, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
 - h. D 3786, 2006, Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics Diaphragm Bursting Strength Tester Method
 - i. D 4751, 2004, Standard Test Method for Determining Apparent Opening Size of a Geotextile
 - j. D 4833, 2007, Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembrane and Related Products.
 - k. D 5261, 2003, Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
 - l. F 1417, 1998, Standard Test Method for installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.

2. American Association State Highway Transportation Officials (AASHTO)
 - a. M 294, 2004, Standard Specification for Corrugated Polyethylene Pipe, 300- to 1200- mm Diameter-HM-22; Part 1B

C. Regulations

None

D. Documents

None

E. Drawings

None

1.4 DEFINITIONS

- A. Bedding – Fill materials placed from the subgrade of the excavation to the bottom of the pipe.
- B. Final Backfill – Fill material placed above initial backfill to finish grade.
- C. Initial Backfill – Fill material placed around the pipe and up to a point one foot above the top of the pipe.
- D. Over Excavation: Removal of in-situ materials beyond the limits required by the specification or shown on the Construction Drawings and not authorized in writing by BSRI.

1.5 QUALITY ASSURANCE

- A. Reference Section 01400 – Quality Requirements.

1.6 SUBMITTALS

- A. Submit the following Engineering Documents in accordance with Section 01330:
 1. Storm Drainage Product Data/Catalog Cuts, 4 Weeks Prior to Use, 2.1 A.5
- B. Submit the following Quality Verification documents in accordance with Sections 01330 and 01400:
 1. Junction Box Inspection And Compaction Test Data, 3.2.H.1
 2. Initial Backfill Inspection and Compaction Test Data, 3.4.D.1
 3. Final Backfill Inspection and Compaction Test Data, 3.5.C.1

1.7 PACKAGING, HANDLING, SHIPPING, AND STORAGE

- A. Package, handle, ship, store and protect products in accordance with Section 01600.

PART 2 PRODUCTS

2.1 PIPE AND ACCESSORIES

- A. Corrugated Plastic Pipe and Fittings:
 1. Material: Perforated and non-Perforated (French drain) pipes- High Density Polyethylene ASTM D 3350 minimum cell classification 335420C, or ASTM D 1248 Type III, Class S, Category 4, Grade P33 meeting AASHTO M 294, Type S.

2. French Drain Perforations: Class S pipe with Class 1 perforations
3. Fittings: AASHTO M 294, Fabricated fittings shall be welded on the interior and exterior at all junctions.
4. Joint for Storm Drain: Bell and Spigot joints per ASSHTO M 294 with elastomeric rubber gasket for water tightness per ASTM D 3212-A and/or ASTM F 1417..
5. Submit Storm Drainage Product Data /Catalog Cuts
 - a. Provide for pipes, fittings, joint materials, and associated accessories.

2.2 BACKFILL MATERIALS:

- A. Bedding material and initial backfill materials for the storm drain shall be CLSM per Section 03300 or Structural Fill material per Section 02320.
- B. Final backfill material for the storm drain can be common fill or structural fill material per Section 02320.

2.3 GEOTEXTILE FILTER

- A. Material shall be a non-woven, spun bonded 100 percent continuous filament polypropylene, unit weight of 8 ounces per square yard as determined by ASTM D 5261.
- B. Equivalent apparent opening size of 70 to 120 sieve as determined by ASTM D 4751.
- C. Puncture resistance of 100 pounds as determined by ASTM D 4833
- D. Bursting Strength of 300 psi as determined by ASTM D 3786.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

- A. General:
 1. Verify existing conditions before starting work. Verify excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on Construction Drawings.
 2. Provide methods to carry the pipe to final location for placement. Do not drop or drag the pipe.
 3. Divert drainage or dewater trenches/excavations during construction as necessary.
- B. Excavation:
 1. Excavate in accordance Contract Drawings. Trenches excavated shall be maintained in clean condition and shall be free from leaves, brush, trash and other debris.
 2. Where unyielding material is encountered in the bottom of trench, remove material 4 inches below the required grade and replace with CLSM or structural fill material.
 3. Do not compact CLSM layer. Compact the structural fill material to not less than 95% of the laboratory maximum dry density as determined by ASTM D 1557.
- C. Pipe Placement:
 1. Inspect pipe for damage or defects prior to placement. Replace damaged items.

2. Lay pipe to the location, line, grade and slope gradients noted on Construction Drawings Remove and reinstall if grade is disturbed after laying.
 3. Laying pipe in water or when trench conditions are unacceptable is prohibited.
- D. Pumping:
1. Provide pumping necessary for dewatering trenches and to maintain proper work conditions for installation of pipe.

3.2 JUNCTION BOX INSTALLATION

- A. Install pre-fabricated junction box as shown on drawing C-CG-Z-00029.
- B. Pre-cast junction box shall conform to ASTM C 913 and shall be able to withstand AASHTO HS-20 loading.
- C. Joints for pre-cast junction stacks shall be tongue and groove with rubber-type gaskets meeting the requirements of ASTM C 443. Openings in the junction box walls for incoming and outgoing pipes shall be pre-cast and, after installation, sealed with a non-shrink grout.
- D. Castings for the junction box shall conform to the requirements of ASTM A 48, Class 35B.
- E. Install junction box atop 12 inches thick compacted gravel base.
- F. Use structural fill or CLSM as backfill material around junction box.
- G. Place structural fill material uniformly along each side of the junction box in loose layers not exceeding six (6) inches, and compact fill material with hand held compactor taking care not to damage the junction box, piping or piping accessories.
- H. Compact initial fill material to not less than 95% of the laboratory maximum dry density as determined by ASTM D 1557.
 1. Submit Junction Box Inspection And Compaction Test Data.

3.3 BEDDING

- A. Use CLSM as bedding material.
- B. CLSM may be screeded, if required, to provide a uniform grade but shall not be vibrated.
- C. Care shall be taken to prevent floating or displacement of the pipe. Place CLSM only to the pipe spring line and allow CLSM to set until no longer fluid. There are no compaction or lift thickness requirements with use of CLSM.

3.4 INITIAL BACKFILL

- A. Use CLSM or structural fill material for initial backfill.
- B. Prevent floating or displacement of the pipe when CLSM is used as initial fills material.
- C. Place structural fill material uniformly along each side of the pipe in loose layers not exceeding six (6) inches, and compact fill material with hand held compactor taking care not to damage the piping or piping accessories.
- D. Compact initial fill material to not less than 95% of the laboratory maximum dry density as determined by ASTM D 1557.
 1. Submit Initial Backfill Inspection and Compaction Test Data.

3.5 FINAL BACKFILL

- A. Use common fill or structural fill material for final backfill.
- B. Place fill material uniformly along each side of the pipe in loose layers not exceeding twelve (12) inches, and mechanically compact.
- C. Compact final backfill material to not less than 90% of the laboratory maximum dry density as determined by ASTM D 1557.
 - 1. Submit Final Backfill Inspection and Compaction Test Data.
- D. Repeat placement of fill and compaction to depth noted on Construction Drawings.

3.6 INSTALLATION TOLERANCES

- A. Horizontal alignment: Plus or Minus 2 inches.
- B. Vertical alignment: Plus or Minus 0.10 feet.

3.7 INSPECTION

- A. Inspection Requirements
 - 1. Inspect work to confirm that the following attributes meet specified requirements:
 - a. Excavation and trenching within specified requirements.
 - b. Proper materials utilized.
 - c. Installation meets specified requirements.

END OF SECTION

SOIL PREPARATION AND SEEDING

SECTION 02900

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Seeding and hydroseeding.
- C. Erosion control matting
- D. Maintenance.

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 02310, Excavation and Foundation Preparation
- C. Section 02320, Backfill and Finish Surface
- D. Section 02370, Erosion and Sediment Control

1.3 REFERENCES

- A. National Codes / Standards:
 - 1. Obtain BSRI prior acceptance for other editions and/or addenda of National Codes / Standards required by this specification before use.
- B. Required National Codes / Standards
 - 1. American Society for Testing and Materials (ASTM)
 - a. C 602 REV A, 1995 (R 2001), Standard Specification for Agricultural Liming Materials
 - b. D 4972, 2001, Standard Test Method for pH of Soils
 - c. D 5268, 2007, Standard Specification for Topsoil Used for Landscaping Purposes
- C. Regulations
None
- D. Documents
 - 1. C-ESR-Z-00004, Stormwater Pollution Prevention Plan (SWPPP) for Z –Area Saltstone Disposal Site Vault No. 2
- E. Drawings
None

1.4 QUALITY ASSURANCE

- A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.

1.5 NOTIFICATION AND COORDINATION

None

1.6 SUBMITTALS

A. Submit the following Quality Verification documents in accordance with Sections 01300, 01330 and 01400: .

1. Topsoil Properties Test Data. 2.1.D.1

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Product storage and handling requirements.

B. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

C. Tag seed containers to show weight, seed analysis, percent germination, and vendor name.

D. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

E. Handle and store products in accordance with the manufacturer's recommendations.

1.8 COORDINATION

A. Coordinate installation of ground cover with cessation of earthwork activities.

1.9 ACCEPTANCE OF LONG TERM VEGETATION

A. Provide a satisfactory stand of perennial grass whose root system has developed sufficiently to survive dry periods, winter weather conditions, and be capable of reestablishment in the spring.

1. Acceptance is based on ESS/SCDHEC and Natural Resources Conservation Service (NRCS) standards and field walk downs.

2. Minimum acceptance criteria for establishment of vegetation shall be:

a. A uniform 70 percent cover of long term vegetation over the area requiring vegetation, and

b. Minimal quantity of bare spots as noted below.

B. Rectify conditions as noted if criteria is not met.

1.10 MAINTENANCE AND SERVICES

A. Comply with the requirements of the Stormwater Pollution Prevention Plan (SWPPP), Document, C-ESR-Z-00004.

B. Maintain the seeded/sodded area until final acceptance of controls and water as necessary to promote growth until establishment and acceptance of long term grass. Sources of water are specified in the Subcontract Field Conditions.

1. Perform reseeding and re-fertilizing of areas where required during the maintenance period.

2. Maintenance period shall be defined as the period between commencement of seeding and/or sodding and acceptance per Article 1.9.

3. Mowing shall be performed as necessary to maintain and promote the establishment of grasses. Mowing shall be performed in a manner and frequency such that cut grass does not significantly clump and/or cover underlying grasses to a point that it expires.
- C. Repair and maintain areas that have eroded due to runoff until completion of all construction activities. Erosion control measures per Section 02370 shall be implemented as necessary.
- D. Refer to Subcontract Field Conditions for additional turnover requirements.

PART 2 PRODUCTS

2.1 SOIL PREPARATION MATERIALS

- A. Topsoil: Use existing topsoil that was excavated and stockpiled. Provide additional topsoil as required from offsite source.
- B. Topsoil: Friable soil capable of supporting vegetative growth that is free from trash, debris, stones larger than 1-1/2 inches, weeds, roots, sticks, brush, and other vegetation not suitable for subsequent seeding operations and maintenance.
- C. Topsoil shall be medium-textured soil such as loam or sandy loam that complies with requirements of ASTM D 5268 with following properties:
 1. Organic matter content greater than 3 percent by weight
 2. pH greater than 5
 3. Soluble salts less than 500 ppm
 4. Sodium adsorption less than 12
- D. Perform a minimum one (1) test for the above parameters (Article 2.1.C) from a composite sample for every 500 CY of topsoil to be installed.
 1. Submit Topsoil Properties Test Data.
- E. Use commercially available products to adjust the Organic matter content, pH, soluble Salts and Sodium adsorption content within specified limits, if their values are not within the specified limits. Blend the additives and topsoil, as required such that the topsoil will result with uniform consistency of additives.
- F. Mulch Binder: Commercially available organic glue type tackifier or chemical mulch binder.
- G. Fertilizer: Commercial grade 10-10-10; uniform in composition, dry and free flowing to the following proportions: Nitrogen ten (10) percent, phosphoric acid ten (10) percent, soluble potash ten (10) percent .
- H. Lime: ASTM C 602 REV A, Class T or Class O agricultural limestone containing a minimum 80 percent calcium carbonate equivalent.
- I. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.

2.2 TEMPORARY SEEDING

- A. Fall and Winter Planting: Use Annual Ryegrass at rate of 56 pounds per acre.
- B. Spring and Summer Planting: Use Brown top Millet at a rate of 40 pounds per acre.

2.3 PERMANENT/LONG TERM SEEDING

A. September – February:

Seed	Rate (Pounds per Acre)
Rye (Grain)	10
Common Bermuda (unhulled)	130

1. Seeding planted during the months from September to February may fail to provide adequate vegetative cover. If it is determined that permanent vegetation is sparse and not adequately established, then re-fertilization of the affected areas and over seeding shall be performed at the following rates: The topsoil shall be scarified prior to re-seeding or over seeding.

a. Early March:

Seed	Rate (Pounds per Acre)
Rye (Grain)	10
Common Bermuda (hulled)	86

b. Late March:

Seed	Rate (Pounds per Acre)
Brown Top Millet	10
Common Bermuda (hulled)	86

B. March:

Seed	Rate (Pounds per Acre)
Rye (Grain)	10
Common Bermuda (hulled)	90

C. April - July:

Seed	Rate (Pounds per Acre)
Browntop Millet	10
Common Bermuda (hulled)	45
Centipede	5

NOTE: Carpetgrass at a rate of 40 pounds per acre may be used in lieu of centipede.

D. August:

Seed	Rate (Pounds per Acre)
Browntop Millet	10
Common Bermuda (hulled)	65
Common Bermuda (unhulled)	65
Centipede	5

NOTE: Carpetgrass at a rate of 40 pounds per acre may be used in lieu of centipede

E. July – August:

1. Seeding requirement in Articles 2.3.C and 2.3.D are the minimum recommended for bidding purposes only. These months are marginal for planting and establishing permanent vegetation. Therefore the seeding shall be as recommended by the NRCS. The Subcontractor may plant temporary vegetation during this time frame and wait to plant long term vegetation during a more optimal planting season. In either case, acceptance and maintenance per Articles 1.9 and 1.10 shall apply.

2.4 MULCH

- A. Straw: Long stem rye, wheat, oats, or barley that is not rotten or brittle.
- B. Hydromulch: Natural wood cellulose with no bark; may contain 100 percent recycled material.

2.5 EROSION CONTROL MATTING

- A. Coconut fiber or recycled nylon fiber matrix sewn between two nets with a weight of at least 0.50 lbs per sq. ft. or equivalent capable of withstanding flow velocities up to 7 ft/sec.

2.6 SOD

- A. Sod shall be commercially available Centipede or Bermuda sod.

PART 3 EXECUTION

3.1 GENERAL

- A. Temporary Vegetation
 1. Install temporary vegetation seeding with erosion control matting or sprayed-on emulsified asphalt on the side slopes of the excavated area.
 2. Install temporary vegetation seeding all temporary berms, cut and fill slopes, and diversion channels.
 3. Install temporary vegetation seeding on stock pile.
- B. Permanent/Long-Term Vegetation
 1. Install long term vegetation seeding over all finish grades of disturbed areas including stock pile area.

2. Install sod in permanent channels and their side slopes and on all graded areas with side slopes greater than 4H:1V.

3.2 PREPARATION OF SUBSOIL

- A. Prior to the placement of topsoil on excavated and filled slopes, roughen the slope surface by creating shallow groves to depth of 1.5 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted sub-soil.

3.3 PLACING TOPSOIL

- A. Place topsoil to minimum depth of 4 inches over area to be seeded with long term vegetation.
 1. Use existing stockpiled topsoil and/or from offsite source.
 2. Rake until smooth.
 3. Lightly compact the topsoil to ensure good contact with the underlying soil, but avoid excessive compaction by utilizing a roller.
- B. Place topsoil during dry weather and on dry unfrozen subgrade.
- C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.
- D. Grade topsoil to the grades indicated on the contract drawings to eliminate rough, low or soft areas, and to ensure positive drainage.
- E. Scarify the topsoil to a depth of 1-1/2 inches and water with a fine spray.
- F. Place lime, fertilizer, seed and mulch within 72 hours of topsoil placement.

3.4 FERTILIZER AND LIME

- A. Determine pH of soils in accordance with ASTM D 4972, Method B. Apply fertilizer and lime at planting in accordance with the soil analysis recommendations.
- B. Apply fertilizer and lime at the following rates at time of planting when soil analysis recommendations are not available:
 1. 10-10-10 fertilizer or equal at a maximum rate of 1000 pounds per acre when the fertilizer is worked into the soil and lime at 1.5 tons per acre.
 2. 10-10-10 fertilizer or equal at a maximum rate of 500 pounds per acre at time of seeding and 500 pounds per acres after the seed has germinated when the fertilizer is not worked into the soil and lime at 1.5 tons per acre.
- C. Place soil nutrients in direct contact with the soil. Adjust the soil nutrient equipment to ensure the applications are within 10 percent of the specified rates. Do not clean soil nutrient equipment within an environmentally sensitive area.

3.5 MECHANICAL SEEDING

- A. Apply seed as shown on the Contract Drawings. Additionally, apply seed on areas disturbed during construction.
- B. Apply seed at the rates noted in Articles 2.2 and/or 2.3 using a mechanical spreader.

- C. Place straw mulch at a rate of 4000 pounds per acre within 24 hours after seed placement. Straw mulch should be anchored 3 inches into soil with special implement or a farm disc set straight.
- D. Wet thoroughly.
- E. Maintain the area in a moist condition after seeding is complete until final acceptance of permanent controls. Use fine spray techniques for watering to avoid soil erosion.

3.6 HYDROSEEDING

- A. Hydroseed disturbed areas after placement of topsoil.
- B. Use a slurry application rate of 2500 gal/acre.
- C. Slurry Mix
 - 1. 1200 pounds per acre hydromulch.
 - 2. Organic tackifier or chemical mulch binder (rate per manufacturer's recommendations).
 - 3. 500 pounds per acre fertilizer.
 - 4. Seed mix as specified in Articles 2.2 and/or 2.3.
- D. Use a follow-up application of fertilizer at a rate of 500 pounds per acre of fertilizer after germination of the seedlings.
- E. Maintain the area in a moist condition after seeding is complete until final acceptance of permanent controls. Use fine spray techniques for watering to avoid soil erosion.

3.7 EROSION CONTROL MATTING

- A. After seeding, install erosion control matting in accordance with the manufacturer's instructions for the anchor trench at the top of slope, lap splices, and staple patterns.
- B. Install staple checks horizontally along slopes exceeding 2:1 in grade, one row to be located one-third of the distance below the top of slope.
- C. Each staple check consists of two row of staples spaced 4 inches apart, with the horizontal spacing in each row being also 4 inches between staples. Stager the rows.

3.8 SODDING

- A. Install sod in accordance with the guidelines indicated below. Use the manufacturer's recommendation when they exceed the guidelines indicated below.
- B. Place centipede or bermuda sod in all channels/swales, and on backfill areas with slope greater than 4H:1V.
- C. Prepare soil before installing sod, including application of lime, fertilizer, and other corrective agents to adjust the soil pH as required. Soak area to be sodded prior to placing sod.
- D. Stagger joints in each row in a brick laying fashion. Avoid gaps and overlaps.
- E. Avoid placing small trimmed pieces along the edge as they will not retain moisture. Avoid repeated walking or kneeling on the sodded area while it's being installed or after watering.

- F. Butt or push edges and ends against each other tightly, without stretching. Don't drag sod into place as this damages exposed roots and promotes separation of soil and roots.
- G. Roll the sod in the entire area immediately after it has been transplanted using a lawn roller one third full of water or other BSRI accepted methods to improve sod to soil contact and to remove air pockets. Roll perpendicular to the direction of the sod was laid.
- H. Do not install sod if ground is frozen or when the ambient temperature is 32 degrees and falling. Apply seed in accordance with the requirements of this Section.
- I. Installation on Slopes and in Channels/Swales
 - 1. Prior to sod placement proof roll topsoil on side slopes and channels/swales. Begin at the top of the slope. Extend a minimum of 5 feet beyond the top of the slope. Install strips of sod with their longest dimension perpendicular to the slope or flow direction in the drainage channels/swales.
 - 2. Place sod over the compacted trench and down the slope.
 - 3. On slopes 4 to 1 or steeper, anchor sod with wire staples in a 2-foot by 2-foot pattern across the entire slope. Stagger placement of staples across the slope. Place a second row 4 inches down slope of the first row in a staggered pattern.
 - 4. Staple bottom end on a 4-inch spacing. Staple sod between edges on a 2-foot by 2-foot pattern. Maintain sod to soil contact over entire area.
 - 5. In channels, begin at top of the channel (direction of flow). Anchor sod with wire staples in a 2-foot by 2-foot pattern. Ensure sod to soil contact is maintained.
 - 6. Install a staple check slot (line) at intervals of 30 to 40 feet. The staple check slot shall extend the entire width of the channel. Staple check slots are installed by placing a row of staples 4 inches apart across the entire channel and then placing a second row 4 inches down stream of the first row in a staggered pattern.
- J. Water newly transplanted sod immediately to wet the soil below to a 3 inch depth to enhance rooting. Water the sod daily for a continuous one hour (excluding rain days) during maintenance and establishment period to allow the sod roots to mature. Minimal watering rate shall be ½-inch of water over the entire sodded area each day. If sodded area does not meet acceptance criteria per Article 1.9 and Subcontractor is unable to transfer the site maintenance and custodianship to BSRI at the end of the four (4) weeks after sod placement, Subcontractor shall continue watering on alternate days at the same rate until the site responsibility is transferred to BSRI.

3.9 CLEANING

- A. Do not leave any waste, debris, or other surplus material upon completion of this construction activity. Restore any areas inadvertently disturbed to their original condition.

END OF SECTION

CAST-IN-PLACE CONCRETE

SECTION 03300

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cast-in-place concrete lower mud mats
- B. Cast-in-place junction box
- C. Form Work
- D. Controlled Low Strength Material (CLSM)

1.2 RELATED SECTIONS

- A. Division 1 - All Sections
- B. Section 02310, Excavation and Foundation Preparation
- C. Section 02320, Backfill and Finish Surface
- D. Section 02378, High Density Polyethylene Liner
- E. Section 02379, Geosynthetic Clay Liner

1.3 REFERENCES

- A. National Codes / Standards:
 - 1. Obtain BSRI prior acceptance for other editions and/or addenda of National Codes / Standards required by this specification before use.
- B. Required National Codes / Standards
 - 1. American Concrete Institute (ACI)
 - a. 117, 2006, Specifications for Tolerances for Concrete Construction and Materials and Commentary
 - b. 211.1, 1991, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
 - c. 229R, 1999 (R 2005), Controlled Low-Strength Materials
 - d. 301, 1999, Specifications for Structural Concrete
 - e. 318/318R, 2005, Building Code Requirements for Structural Concrete (ACI 318-05) and Commentary (ACI 318R-05)
 - 2. American Society for Testing and Materials (ASTM)
 - a. C 31/C 31M, 2006, Standard Practice for Making and Curing Concrete Test Specimens in the Field
 - b. C 94/C 94M REV A, 2007, Standard Specification for Ready-Mixed Concrete
 - c. C 172 REV A, 2007, Standard Practice for Sampling Freshly Mixed Concrete
 - d. D 4832, 2002, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders
 - e. D 5971, 2007, Standard Practice for Sampling Freshly Mixed Controlled Low-Strength Material

- C. Regulations
None
- D. Documents
None
- E. Drawings
None

1.4 QUALITY REQUIREMENTS

- A. See Section 01400 – Quality Requirements
- B. Perform work under this section in accordance with ACI 301 and ACI 318.
- C. Provide independent testing agency for testing of concrete in accordance with Section 01450.
- D. Protect GCL and HDPE Liner during mud mat placement.

1.5 NOTIFICATION AND COORDINATION

- A. Notify the BSRI STR 48 hours prior to placement of concrete or CLSM.

1.6 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330:
 - 1. Concrete and CLSM Information, 4 Weeks Prior to Use, 1.7 C.
 - 2. Proposed Construction Joint Plan, 2 Weeks Prior to Placement, 3.2 A.
- B. Submit the following Quality Verification documents in accordance with Sections 01330 and 01400:
 - 1. Concrete and CLSM Inspection Reports, 1 Week After Placement, 3.7 B
 - 2. Concrete and CLSM Test Reports, 7 Days After Test, 3.7 C

1.7 DESIGN REQUIREMENTS

- A. Concrete Design
 - 1. Prepare concrete mix designs including separate mix designs when admixtures are required for hot and cold weather concrete work.
 - 2. Identify mix ingredients and proportions, including admixtures.
 - 3. Design and proportion concrete mixes in accordance with ACI 211.1.
 - 4. Include in the mix design the dry weight of cement, weight of pozzolans, saturated surface dry weights of fine and coarse aggregates, and quantity of admixtures and water per cubic yard of concrete for each concrete mix.
 - 5. Provide concrete to the following mix design criteria:
 - a. Compressive Strength (7 day): 1400 psi
 - b. Compressive Strength (28 day): 2000 psi
- B. CLSM Design
 - 1. Prepare CLSM Mix Designs including separate mix designs when admixtures are required for hot and cold weather concrete work.

2. Identify mix ingredients and proportions, including admixtures.
 3. Design and proportion CLSM mixes in accordance with ACI 229R.
 4. Include in the mix design the dry weight of cement, weight of pozzolans, saturated surface dry weights of fine and coarse aggregates, and quantity of admixtures and water per cubic yard of concrete for each concrete mix.
 5. 28-Day Compression Strength: 30 psi minimum, 150 psi maximum
 6. Density: 115 to 145 lb/ft³
- C. Submit Concrete and CLSM Information, which includes.
1. Mix designs
 2. Characteristics of components
 3. Concrete and structural CLSM Inspection and Testing Plan
 - a. Identify applicable national codes and standards that will be applied to accomplish inspection and testing

PART 2 PRODUCTS

2.1 CONCRETE AND CLSM

- A. Provide concrete and CLSM in accordance with BSRI accepted mix design.
- B. Deliver concrete and CLSM in accordance with ASTM C 94/C 94M REV A.

PART 3 EXECUTION

3.1 FORMWORK

- A. Earth forms are not acceptable.
- B. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and positions under imposed loads from construction operations.
- C. Complete wedging and bracing before placing concrete.
- D. Verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.

3.2 PLACING CONCRETE

- A. Prior to the first concrete placement, submit a Proposed Construction Joint Plan, include marked-up design drawings showing proposed construction joints and locations.
- B. Place concrete in accordance with ACI 301 and ACI 318/318R.
- C. Consolidate concrete by mechanical vibrators.
- D. Maximum drop height shall not exceed 5 feet and lifts shall not exceed 18" in depth.
- E. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- F. Place concrete continuously between predetermined expansion, control, and construction joints.
- G. Screed slabs on grade level, maintaining surface flatness of maximum 1/4 inch in 10 ft.

3.3 CONCRETE FINISHING

- A. Finish concrete surfaces in accordance with ACI 301. Lower mudmat shall have a floated finish in accordance with ACI 301 and meet the moderately flat requirements of ACI 117 using the straight-edged tolerance requirements. No abrupt changes in the surface finish are allowed.

3.4 CURING AND PROTECTION

- A. Cure and protect in accordance with ACI 301, Section 5.3.6.
- B. Additional construction activities (other than concrete related repair, surfacing, curing or protection) are permitted on the concrete only after curing is complete.

3.5 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed in accordance with ACI 301 and under provisions of Section 01400 and Section 01450.
- B. Collect and maintain the batch ticket for each delivery truck. Batch tickets in accordance with the requirements of ASTM C 94/C 94M REV A.
- C. Maintain a record of the date, placement location, quantity, ambient temperature, and test cylinder samples taken for each concrete placement.
- D. Sample concrete in accordance with ASTM C 172 REV A.
- E. Sample structural CLSM in accordance with ASTM D 5971.
- F. Prepare concrete test cylinders in accordance with ASTM C 31/C 31M.
- G. Prepare structural CLSM test cylinders in accordance with ASTM D 4832.

3.6 DEFECTIVE CONCRETE

- A. Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements is to be removed and replaced.
- B. Do not patch, fill, touch-up, or repair exposed concrete except upon express direction of BSRI STR for each individual area.

3.7 INSPECTION AND TESTING REQUIREMENTS

- A. Inspect and test concrete in accordance with BSRI accepted Concrete and CLSM Inspection and Testing Plan.
- B. Submit Concrete and CLSM Inspection Reports
- C. Submit Concrete and CLSM Test Reports

END OF SECTION

STORAGE TANKS

SECTION 13210

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Two pre-stressed, concrete storage tanks, including upper mud mat.
- B. Associated drain water collection system.
- C. Internal coatings and external roof coatings

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 02310, Excavation and Foundation Preparation
- C. Section 02320, Backfill and Finish Surface
- D. Section 02370, Erosion and Sediment Control
- E. Section 02378, High Density Polyethylene Liner
- F. Section 02379, Geosynthetic Clay Liner
- G. Section 03300, Cast-In-Place Concrete

1.3 REFERENCES

- A. National Codes and Standards
 - 1. American Concrete Institute (ACI)
 - a. 347, 2004, Guide to Formwork for Concrete
 - b. CP-60, 2002, Craftsman Workbook for ACI Certification of Shotcrete Nozzleman
 - 2. American Society for Testing and Materials (ASTM)
 - a. A 1008/A 1008M REV A, 2007, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
 - b. A 193 /A 193M, 2007, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications
 - c. A 194 /A 194M, 2007, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
 - d. A 36/A 36M, 2005, Standard Specification for Carbon Structural Steel
 - e. A 563 REV A, 2007, Standard Specification for Carbons and Alloy Steel Nuts
 - f. A 615/A 615M, 2007, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

- g. A 821/A 821M, 2005, Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Tanks
 - h. A 992/A 992M REV A, 2006, Standard Specification for Structural Steel Shapes
 - i. C 109/C 109M, 2007, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
 - j. C 138/C 138M REV A, 2001, Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete - AASHTO No.: T121
 - k. C 143/C 143M, 2008, Standard Test Method for Slump of Hydraulic - Cement Concrete
 - l. C 231, 2004, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
 - m. C 31/C 31M, 2006, Standard Practice for Making and Curing Concrete Test Specimens in the Field
 - n. C 39/C 39M, 2005 (E 2006), Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - o. C 685/C 685 M, 2007, Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
 - p. C 94/C 94M, 2007, Standard Specification for Ready-Mixed Concrete
 - q. D1785, 2006, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
 - r. F 1866, 2007, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Schedule 40 Drainage and DWV Fabricated Fittings
 - s. F 436 REV A, 2007, Standard Specification for Hardened Steel Washers
- 3. American Welding Society (AWS)
 - a. D1.1/D1.1M, 2006, Structural Welding Code - Steel - 20th Edition; Incorporated Errata 1
 - 4. American Water Works Association (AWWA)
 - a. D110, 1995, Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks
 - b. D115, 1995, Circular Prestressed Concrete Water Tanks with Circumferential Tendons
- B. Regulations
None
- C. Documents
- 1. QB00485K-007-C-MDM, Tank Calculations
 - 2. QB00485K-008-B-MDM, Column Slenderness Effects Calculations
 - 3. QB00485K-009-B-MDM, Column Supported Roof By Direct Design Method
- D. Drawings
- 1. C-CH-Z-00014, Sheets 1 & 2, Drain Water Collection System, Piping Arrangement & Pipe Support

2. QB00485K-010-D-MDM, Title Sheet (Sheet 1 of 13)
3. QB00485K-011-D-MDM, Section-Elevation and Notes (Sheet 2 of 13)
4. QB00485K-012-D-MDM, Floor Plan - North Tank (Sheet 3 of 13)
5. QB00485K-013-D-MDM, Tank 2A Roof Plan - North Tank (Sheet 4 of 13)
6. QB00485K-014-D-MDM, Typical Wall Section (Sheet 6 of 13)
7. QB00485K-015-D-MDM, Pre-Stressing Schedule (Sheet 7 of 13)
8. QB00485K-016-D-MDM, Wall Joint, Floor Joint and Closure Strip Details (Sheet 8 of 13)
9. QB00485K-017-D-MDM, Penetration Plugs, Grout Fill Line and Roof Sleeves (Sheet 9 of 13)
10. QB00485K-018-D-MDM, Vent Port and Camera Port Plug (Sheet 10 of 13)
11. QB00485K-019-D-MDM, Flat Roof Floor Embed Plates and Hatch Cover (Sheet 11 of 13)
12. QB00485K-020-D-MDM, Seismic Restraint Cables (Sheet of 12 of 13)
13. QB00485K-021-D-MDM, Mud Mat, 8" X 8" Concrete Curb and Construction Manhole (Sheet 13 of 13)
14. QB00485K-034-C-MDM, Tank 2B Roof Plan (Sheet 5 of 13)

1.4 DEFINITIONS

- A. See Section 01110
- B. Existing Tank Design: previously developed design documents (drawings and calculations) identified in Articles 1.5 A.2 and 1.5 A.3.
- C. Revised Tank Drawings (and Calculations): existing tank design documents (drawings and calculations) that are modified to incorporate the technical requirements of this specification section.

1.5 DESIGN REQUIREMENTS

- A. Existing Tank Design
 1. Existing tank design was previously generated by:
 - a. The Crom Corporation
250 S.W. 36th Terrace
Gainesville, FL, 32607
Telephone: (352) 372-3436
Fax: (352) 372-6209
www.cromcorp.com
 - i. Crom Job Number: 06059
 - ii. BSRI PO Number: QB00485K
 2. Existing tank design is depicted in the following Contract Drawings:
 - a. QB00485K-010-D-MDM
 - b. QB00485K-011-D-MDM
 - c. QB00485K-012-D-MDM
 - d. QB00485K-013-D-MDM

- e. QB00485K-014-D-MDM
 - f. QB00485K-015-D-MDM
 - g. QB00485K-016-D-MDM
 - h. QB00485K-017-D-MDM
 - i. QB00485K-018-D-MDM
 - j. QB00485K-019-D-MDM
 - k. QB00485K-020-D-MDM
 - l. QB00485K-021-D-MDM
 - m. QB00485K-034-C-MDM
3. Existing tank design calculations associated with the tank drawings are provided in the following Contract Documents:
- a. QB00485K-007-C-MDM
 - b. QB00485K-008-B-MDM
 - c. QB00485K-009-B-MDM
4. Existing tank design was based on the requirements of AWWA D110 and AWWA D115, and was completed under the contract listed in 1.5.A.1.a.ii above. Design changes to be incorporated as a result of this specification shall meet the requirements of this specification section, as well as those required by the previous contract. Should there be any conflict between the previous requirements and those for the new design changes, notify BSRI for resolution. (Design criteria that formed the basis for the existing tank design is available upon request).
- B. Employ the services of the Crom Corporation to revise the aforementioned Contract Drawings and associated calculations to reflect:
1. The addition of one of the following coating systems applied to the walls, floor of the tanks and a minimum of 1 foot up each of the roof support columns. The coating system selected shall incorporate a conductive primer to support holiday testing.
- a. 68 Tank Lining System (Ceilcote), consisting of:
 - i. 680 Primer with C-1 powder at 7-10 mils.
 - ii. Trowel basecoat with silica filler (68 lining + S-1 powder) (40-60 mils)
 - iii. 1 reinforcing mat/ 1 nexus veil layer (45 mils), saturated with 68 lining resin
 - iv. 662 Flakeline topcoat (20-25 mils)
 - v. Total system thickness of 110-130 mils
 - b. TL-45-S High Build Novolac Epoxy Tank Lining (Blome International), consisting of:
 - i. Surface out with 83 MP (if needed, check primer sequence with vendor)
 - ii. Prime with 75 (2-4 mils) – add carbon to create conductive primer
 - iii. 2 coats of TL-45S with fabric embed between coats; film thickness 30-40 per coat. Use .5-.75 chopped strand mat.
 - c. Semstone 245AFRC (Carboline), consisting of:
 - i. Carboguard 510 surfacer (if needed)
 - ii. Semstone 110 Primer (now 110/110EP) - 4-6 mils

- iii. Semstone 245 basecoat (25-35 mils) - For a vertical surface, the base coat should be mixed with Cab-O-Sil (TS 720) at a 1:1 volume ratio
- iv. Semstone Scrim Cloth (lay cloth into basecoat)
- v. Semstone 245 mortar at 90-100 mils
- vi. Nominal system thickness: 125 mils
- d. Expresscoat HCR/Sher-Tuff Epoxy (Sherwin-Williams), consisting of:
 - i. Surfacer if needed (Kem Cati-Coat or equal)
 - ii. Corobond Conductive Epoxy Primer @ 4.0-6.0 DFT
 - iii. Putty: Steel Seam FT910 (for repairs and transitions)
 - iv. Base Coat: Sher-Tuff Epoxy @ 20.0-30.0 mils (80%el)
 - v. Laminate Coat: Cor-Cote HP Clear Resin @ 20.0-30.0 mils with 1.0 oz Chopped Strand Mat
 - vi. Topcoat: ExpressCote HCR @ 20.0-30.0 mils DFT (total system = 64.0 -96.0 mils DFT)
2. The addition of a drain water collection system as depicted in the drawings C-CH-Z-00014, Sheets 1 & 2.
 - a. Design output documents shall include anchor requirements of Attachment 13210-B.
 - b. Anchors shall be installed and masked prior to coating application of Article 1.5 B.1.
3. The addition of the following for steel items:
 - a. Applicable ASTM material standards
 - b. Coating requirements for exposed surfaces
4. The replacement of references to MDM with the identity of the Subcontractor awarded the contract associated with this specification.
5. The change of column material for roof supports to Type V concrete construction.
6. Redesign of roof sleeves/plugs to prevent rainwater intrusion.
 - a. Those that require redesign are the hatch cover, sample port, inspection port and camera port.
 - b. Thermowell port, vent port and grout fill line are acceptable as currently designed.
 - c. No plugs are required for the thermowell sleeves other than temporary covers which will be removed by BSRI upon installation of the thermocouple trees.
 - i. Inspection ports may be as simple as pipe sleeves internally threaded to accept a male pipe plug.
- C. Submit Revised Tank Drawings
- D. Submit Revised Tank Calculations
- E. Employ the services of the Crom Corporation to:
 1. Submit Tank Installation Instructions, including:
 - a. Requirements from Section 03300 relative to formwork, placing, finishing, curing, protecting and defective concrete.

- b. Sequencing, required equipment, shotcrete application, pre-stressing, rigging, bracing, shoring, etc. for all tank activities.
- 2. Submit Tank Surface Preparation, Coating Application and Testing Instructions
 - a. Include coating components and any special details.
 - b. As a minimum, address storage areas, environmental conditions, dry film thickness inspections, holiday testing, etc.
- 3. Submit Shotcrete Information, including:
 - a. Mix Design
 - b. Characteristics of components
 - c. Inspection and Testing Plan
 - i. Identify applicable national codes/standards that will be applied to accomplish inspection and testing

1.6 QUALITY ASSURANCE

- A. See Section 01400.

1.7 NOTIFICATION AND COORDINATION

- A. Coordinate with Subcontract Technical Representative for the following:
 - 1. Concrete delivery.
 - a. BSRI will be responsible for supplying Type V concrete in accordance with "Materials & Services Furnished by SRS" notes displayed on drawing QB00485K-011-D-MDM.
 - b. Subcontractor shall be responsible for supplying and testing balance of concrete types in accordance with other notes on displayed drawing QB00485K-011-D-MDM and Section 03300.
 - 2. Water for field testing of tanks as described in Part 3.

1.8 QUALIFICATIONS

- A. Shotcrete Nozzlemen
 - 1. Qualified per Note 1 of Drawing QB00485K-015-D-MDM.
 - 2. Submit Shotcrete Nozzlemen Certification
- B. Interior Coating System Installers
 - 1. Interior coating systems shall be installed by qualified personnel experienced in the lining of secondary containments, tanks, vaults and other specialty applications.
 - a. Experience with the specific products involved is required in order to minimize errors.
 - 2. Submit Coating System Installer Qualifications

1.9 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330.
 - 1. Revised Tank Drawings, 1.5 C.
 - 2. Revised Tank Calculations, 1.5 D.

3. Tank Installation Instructions, 1.5 E. 1.
 4. Tank Surface Preparation, Coating Application and Testing Instructions, 1.5 E. 2.
 5. Shotcrete Information, 1.5 E. 3.
 6. Shotcrete Nozzlemen Certification, 1.8 A. 2.
 7. Coating System Installer Qualifications, 1.8 B. 2.
 8. Steel Coating System Product Data, 2.1 C. 2.
 9. Tank Weld Examination Procedure, 2.2 A. 1.c.
 10. Visual Tank Examination Procedure, 3.4 A. 1.h.
 11. Concrete Moisture Testing Procedure, 3.4 B. 2.b.
 12. Tank Water Tightness Test Procedure, 3.4 B. 4.b.
 13. Tank Repair Procedure, 3.4 B. 4.c.
- B. Submit the following Quality Verification documents in accordance with Sections 01330 and 01400:
1. Tank Weld Examination Reports, 2.2 A. 1.d.
 2. Material Test Reports for Concrete and Shotcrete, 2.2 B. 5.
 3. Visual Tank Examination Reports, 3.4 A. 1.i.
 4. Anchor Inspection Reports, 3.4 A. 2.b.
 5. Anchor Test Reports, 3.4 B. 1.b.
 6. Concrete Moisture Testing Report, 3.4 B. 2.c.
 7. Internal Coating Test Reports, 3.4 B. 3.b.
 8. Tank Water Tightness Test Report, 3.4 B. 4.d.
 9. Pre-Stress Wire Measurement Reports, 3.4 B. 5.b.

1.10 DELIVERY, STORAGE AND HANDLING

- A. See Section 01600.

PART 2 PRODUCTS

2.1 DESCRIPTION

- A. Materials
1. Except for SRS furnished Type V concrete, furnish all materials identified on BSRI accepted Revised Tank Drawings
 2. Except for items designated "By Others", furnish all materials identified on Drawing C-CH-Z-00014, Sheets 1 & 2
 3. SRS furnished Type V concrete will be supplied from one of the following LaFarge batch plant facilities:
 - a. 111 Laney Walker Boulevard., Augusta, GA 30901
 - b. 50 Main Street, Jackson, SC 24831

- B. Welding of Carbon Steel
 - 1. Comply with AWS D1.1/D1.1M
- C. Coating of Exposed Carbon Steel Surfaces
 - 1. Coating: Supplier's standard shop primer or galvanized finish.
 - a. Surface preparation: In accordance with manufacturer instructions.
 - b. Application: In accordance with manufacturer instructions.
 - 2. Submit Steel Coating System Product Data
 - a. Include manufacturer's surface preparation and application instructions.
- D. Concrete and Shotcrete Requirements
 - 1. Use concrete and shotcrete in accordance with:
 - a. BSRI accepted Revised Tank Drawings.
 - b. BSRI accepted Shotcrete Information
- E. Surface Finish Requirements
 - 1. Remove surface discontinuities 1/8 inch or greater in height from surfaces of pre-cast components which are from casting, formwork mismatches, grouting or other fabrication processes.
 - 2. Break sharp edges and corners.
 - 3. Formwork seam lines or metal to concrete interface discontinuities are not acceptable.
 - 4. Burrs, weld splatter, and arc strikes are not acceptable.

2.2 INSPECTION / EXAMINATION / TESTING

- A. Examinations
 - 1. Visual Examination
 - a. Comply with the requirements of AWS D1.1/D1.1M for structural carbon steel
 - b. Visually examine 100 % of structural welds.
 - c. Submit Tank Weld Examination Procedure.
 - d. Submit Tank Weld Examination Reports
 - 2. Comply with BSRI accepted Inspection and Testing Plans
- B. Testing
 - 1. Responsibilities
 - a. BSRI is responsible for batch plant testing of concrete for Type V concrete and associated concrete components.
 - b. Subcontractor is responsible for:
 - i. Batch plant testing of concrete for balance of concrete.
 - ii. Field testing of all concrete (including BSRI supplied concrete).

2. Field Testing Requirements for BSRI Supplied Type V Concrete
 - a. Perform field tests on the fresh concrete samples for the following attributes and acceptable values:
 - i. Temperature: 50°F to 90°F
 - ii. Slump or Flow Consistency: 3 to 6
 - iii. Air Content: 2% to 5%
 - iv. Bulk Density or Unit Weight: 135 lbs/ft³ (reference)
 - b. Size of cylinders shall be in accordance with ASTM C 31/C 31M.
 - c. In addition to the requirements of the Contract Drawings, BSRI requires:
 - i. One additional hold cylinder
 - ii. Two cylinders shipped to BSRI for future testing.
3. Testing Requirements for Balance of Concrete and Shotcrete
 - a. Comply with BSRI accepted Inspected and Testing Plans
4. Material Test Reports for Concrete and Shotcrete shall include:
 - i. A separate report for each batch sampled which includes the field tests results, the laboratory tests results and the batch tickets.
 - ii. Batch ticket per Section 13 of ASTM C 94/C 94M or per Section 15 of ASTM C 685/C 685 M, irregardless of whether the material was used in pre-cast fabrication or rejected and not used.
 - iii. Provide all the batch tickets from each delivery since the previous sample.
 - iv. Document the field test results.
5. Submit Material Test Reports for Concrete and Shotcrete
 - a. Include 28 day compressive strength results test with a complete set of previous test results.

PART 3 EXECUTION

3.1 GENERAL

- A. Crom Corporation Services
 1. Employ the services of the Crom Corporation to provide the following during tank erection activities:
 - a. Technical Supervision
 - b. As needed specialty equipment for tank fabrication/erection

3.2 PREPARATION

- A. Prior to tank erection, verify completion of the following:
 1. Excavation and foundation preparation in accordance with Sections 02310 and 03300.
 2. The first stage of geotextile installation in accordance with Section 02378.
 3. The first stage of geosynthetic clay lining installation in accordance with Section 02379
- B. Comply with applicable "Field Verification" notes of BSRI accepted Revised Tank Drawings.

3.3 FABRICATION / CONSTRUCTION / INSTALLATION REQUIREMENTS

- A. Fabricate pre-cast tank sections at a location within acceptable ASTM travel times for concrete delivery.
- B. Fabricate and erect tanks in accordance with:
 - 1. BSRI accepted:
 - a. Revised Tank Drawings.
 - b. Tank Installation Instructions
 - c. Tank Surface Preparation and Coating Application Instructions
 - 2. C-CH-Z-00014, Sheets 1 & 2
- C. Grout Level Markings
 - 1. Provide saltstone grout level markings on the internal surface of the tank wall at three equally spaced ($\approx 120^\circ$ increments) locations on each tank in accordance with Attachment 13210-A.
 - a. Material selected for these markings shall be compatible with coating selected of Article 1.5 B.1.
- D. Protect and maintain existing facilities and temporary structures during construction / installation activities through final acceptance. This includes:
 - 1. Existing structures / systems
 - 2. Liner buried at perimeter of the mud mat
 - 3. Erosion control features within the work area
 - 4. Passive dewatering features within the excavated area
 - 5. Graveled access road
 - 6. Surveying monuments in the vicinity of tank's site used by subcontractor to maintain elevation and horizontal controls of his work.
- E. Welding of Carbon Steel
 - 1. Comply with AWS D1.1/D1.1M
- F. Formwork

NOTE: The Formwork requirements of this Article are in addition to those of Section 03300.

- 1. Responsibility: Design and construction of formwork is sole responsibility of Subcontractor.
- 2. Design Criteria:
 - a. Design formwork system with adequate bracing, strength, and stability to ensure finished concrete within tolerances specified in ACI 347.
 - b. Provide formwork sufficiently tight to prevent leakage of mortar.
- 3. Coating Forms:
 - a. Coat forms with bond breaker before placing reinforcing steel.
 - b. Do not allow excess form coating material to stand in puddles in forms or to come in contact with concrete against which fresh concrete is to be placed.

- c. Clean reinforcing steel contaminated with bond breaker before placing concrete.
 4. Embedded Items:
 - a. Clean items to be embedded in concrete free from oil or foreign matter capable of reducing bond of concrete to these items.
 - b. Install inserts, anchors, sleeves, and other items specified under other sections of these specifications.
 - c. Close ends of conduits, piping, and sleeves embedded in concrete with caps or plugs.
 5. Waterstops:
 - a. Install waterstops in accordance with manufacturer's instructions.
 - b. Support and protect portion of waterstop extending beyond bulkhead during placing of concrete and subsequent removal of forms.
 - c. Make watertight field splices by heat-sealing. Maintain continuity of ribs and bulbs. Allow splice to cool before stressing reinforcement.
 - d. Repair damaged waterstops before placing concrete.
 - G. Removal of Forms
 1. Do not remove forms until members have acquired sufficient strength to support their own weight and imposed loads safely.
 2. In cold weather, retain forms in place for 5 days.
 - H. Maintain erosion control measures in accordance with Section 02370.
 - I. Backfill and finish in accordance with Section 02320.
 - J. Install the second stage of:
 1. Geotextiles in accordance with Section 02378
 2. Geosynthetic clay liner in accordance with Section 02379.
 - K. Apply an elastomeric coating, Duracool 1 (white) or approved equal, to the exterior roof surface of each tank. Surface preparation and coating installation shall be in accordance with manufacturers instructions
 - L. Interior Coating System Installation
 1. Verify moisture testing of concrete is performed prior to applying coating.
 2. Apply coating in accordance with BSRI accepted Tank Surface Preparation, Coating Application and Testing Instructions.
- 3.4 INSPECTION / EXAMINATION AND TESTING
- A. Examinations
 1. Visual Examination
 - a. Comply with the requirements of AWS D1.1/D1.1M for structural carbon steel welds.
 - i. Visually examine 100 % of structural welds.
 - b. Verify dimensional configuration of tank field components are in accordance with BSRI accepted Revised Tank Drawings.
 - c. Visually inspect 100% of the waterstop joints.

- d. Verify embedded items are in proper location in accordance with BSRI accepted Revised Tank Drawings.
 - e. Tank Installation Examinations: Verify tank is installed in accordance with:
 - i. BSRI accepted Revised Tank Drawings
 - ii. BSRI accepted Tank Installation Instructions
 - f. Coating Examinations: verify coating was installed per design and accepted submittal requirements.
 - i. Provide for on-site inspections performed by the coating manufacturer's representative to insure satisfactory results.
 - ii. On-site inspections shall include pre-job visit, visit during application and acceptance of completed results.
 - g. Drain Water Collection System Examinations
 - i. Verify system was in installed per drawing requirements.
 - ii. Verify system is obstruction free
 - h. Submit Visual Tank Examination Procedure.
 - i. Submit Visual Tank Examination Reports
2. Anchor Inspections
- a. Comply with the requirements of 13210-B.
 - b. Submit Anchor Inspection Reports
- B. Tests
1. Anchor Tests
- a. Comply with the requirements of 13210-B.
 - b. Submit Anchor Test Reports
2. Moisture Testing of Concrete
- a. Prior to coating application, moisture testing of the concrete shall be performed. Surfaces shall be free of contaminates
 - b. Submit Concrete Moisture Testing Procedure. Procedure shall: address the following:
 - i. Moisture vapor transmission
 - ii. Presence of surface contaminates
 - c. Submit Concrete Moisture Testing Report
3. Internal Coating Tests
- a. Test internal coating in accordance with BSRI accepted Tank Surface Preparation, Coating Application and Testing Instructions.
 - b. Submit Internal Coating Test Reports.
4. Water Tightness Tests
- a. On completion of a tank and prior to any specified backfill placement at the footing or wall, perform the following to determine water tightness:
 - i. Preparation: Fill the tank with water to the maximum level and let it stand for at least 24 hours.
 - ii. Measurement: Measure the drop in liquid level over the next 72 hours to determine the liquid volume loss. Evaporation losses

shall be measured or calculated and deducted from the measured loss to determine the net liquid loss (leakage). The net liquid loss for a period of 72 hours shall be zero.

- iii. Damp Spots: Damp spots on the exterior wall surface or measurable leakage of water at the wall base is not permitted. Damp spots are defined as spots where moisture can be picked up on a dry hand. The source of water movement through the wall shall be located and permanently sealed in an acceptable manner. Leakage through the wall-base joint or footing shall likewise be corrected.
- iv. Repairs: Make all necessary repairs if the tank fails the water tightness test or is otherwise defective.

- b. Submit the Tank Water Tightness Test Procedure.
- c. Submit the Tank Repair Procedure.
- d. Submit the Tank Water Tightness Test Report

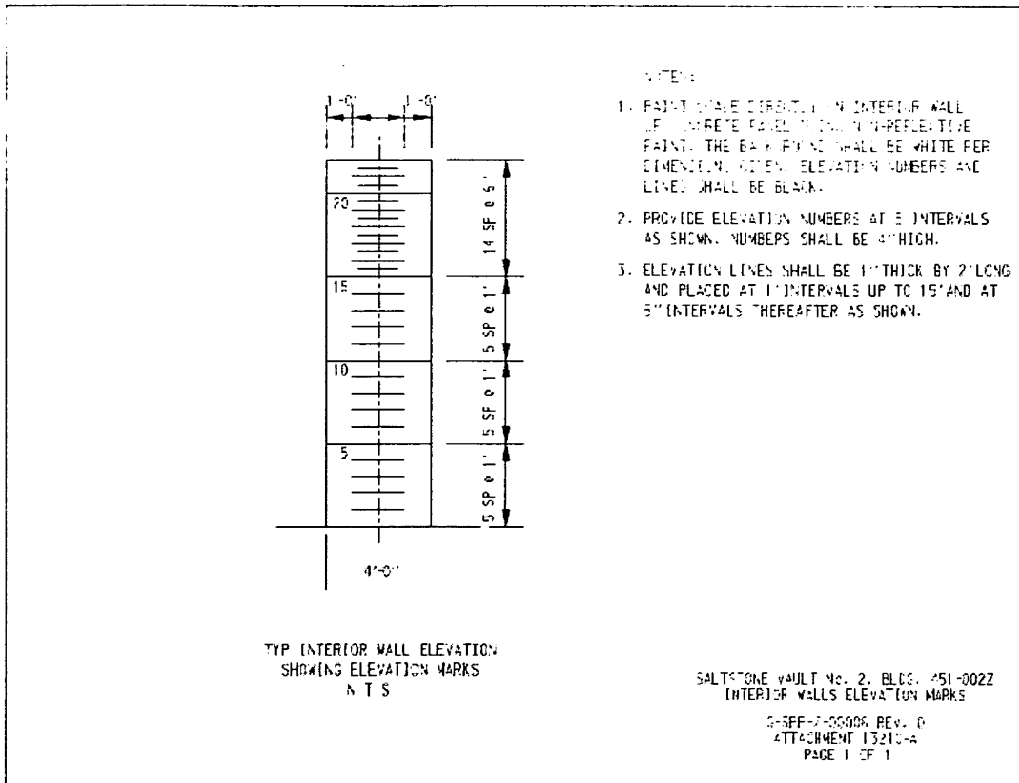
5. Wire Pre-Stress Tests

- a. Pre-stress wire in accordance with BSRI accepted Revised Tank Drawings.
- b. Submit Pre-Stress Wire Measurement Reports

3.5 ATTACHMENTS

- A. 13210-A: Level Marking Sketch
- B. 13210-B: Anchor Requirements

END OF SECTION



Attachment 13210-B: Anchor Requirements

Drilling of Holes in Concrete

Locations of post-installed anchors shall be as shown on the Contract Drawings. The hole diameters and depths shall be as recommended in the manufacturer's instructions unless otherwise specified. Subcontractor shall verify depth of the member before drilling holes. The embedment depth of the post-installed anchor shall not exceed the greater of 2/3 of the concrete thickness or the concrete thickness less 4 inches except the embedment depth for a Maxi-bolt, installed in concrete 9 inches thick or less, shall not exceed the member thickness less 3 inches.

Note: Hole depths for Drillco Maxi-bolts are 1 to 2 inches deeper than the embedment depth, depending on the diameter. This may limit the embedment depth.

Drilling Equipment

All drilling in concrete shall be accomplished utilizing carbide tipped tools and a drill stop. Drilling holes for post-installed anchors and rock bolts may be made with equipment specifically recommended by the anchor manufacturer, but with carbide tipped tools and a drill stop. The use of a diamond bit shall be permitted only when BSRI has consented in writing to the cutting of the rebar or embedded construction aids.

The use of a drill stop device is mandatory. Just before use, the drill stop device shall be tested by touching the drill bit to a ground source to ensure it trips. The drill stop device may be deactivated while the bit or the coring tool is in contact with a bar or embedded construction aids approved to be cut.

Installation of Post-installed Anchors

Post-installed anchors shall be installed in accordance with the manufacturer's specifications, unless stated otherwise in the following sections. Anchor installers shall be trained and made fully familiar with the manufacturer's installation procedures including additional requirements as noted in this document.

Post-installed anchors shall be properly seated and expanded to achieve a good "grip" in the concrete by three to four turns of the nut, but in any case, the tightening torque shall be within the range specified by the manufacturer. The torque shall be applied with a manually operated torque wrench, or the anchor tensioned with a hydraulic tensioner, calibrated in accordance with an approved site calibration procedure. The torque wrench used shall have a range so that the tightening torque value is near the middle range of the wrench. Where no range for the torque is specified, the specified torque shall be the minimum value for the torque wrench, with a tolerance of -0%, +5%. Installation equipment shall be checked on a periodic basis, and shall include a calibration program.

The tightening torque specified by the manufacturer corresponds to the minimum embedment depth and/or minimum concrete strength specified by the manufacturer. Torque values for embedment depth less than the specified minimum, or for other concrete strengths, shall be determined the Subcontractor.

For torquing of 1/4 in dia Maxi-bolts, a click or breakaway type torque wrench shall be used to prevent bolt damage by overtorquing.

Attachment 13210-B: Anchor Requirements

Flat washers supplied with post-installed anchors shall be used in all cases except where details on the Contract Drawings specify the use of another washer under the nuts. A washer may be trimmed to clear interferences. The trimmed edge shall not be closer than $7/8$ of the bolt diameter from the center of the washer.

Post-installed anchors installed within 5 degrees of perpendicular to the nominal concrete surface are acceptable. Care shall be exercised to avoid bending anchors to match baseplate holes, or loosening of anchors by prying sideways after tightening. Care shall also be exercised to ensure that the cone nut of an undercut anchor does not become loose from the stud during the setting or tensioning operation.

The center to center distance between two load bearing post-installed anchors shall not be less than three times the embedment depth. Unless otherwise noted on the drawings, the center to center distance between a new post-installed anchor hole and an exploratory or unused hole or an abandoned cut-off anchor shall not be less than three times the diameter of the larger hole or 1" of clear concrete between the holes, whichever is greater. Unused holes shall be grouted with non-shrink grout. When exploratory or unused holes are grouted with non-shrink grout and the grout has attained the strength of the concrete, the clear distance requirement is waived.

INSPECTION AND TESTING OF CONCRETE ANCHORS

Visual Inspection

Inspection of anchors shall be performed as specified in Table 1. All anchors shall be visually inspected and documented for correct installation. The visual inspection of drilled holes shall be in accordance with Manufacturer's instructions. The visual inspection of post-installed anchors shall be documented according to Table 1 and the following:

- The projection shall be measured from the exposed end of the anchor to concrete surface to verify embedment depth.
- If visual inspection reveals that the installed anchor does not meet the requirements of this document, the anchor shall be relocated as permitted by this document, or shall be removed and replaced by another anchor, or referred to BSRI for evaluation.

Testing of Post-installed Anchors

The testing of post-installed anchors for permanent plant installation is mandatory. The following two methods of testing are acceptable for post-installed anchors. One or both may be used in a single test program. The testing of post-installed anchors may be completed prior to or after installation of the attachment/baseplate.

Torque Method

The installed post-installed anchors shall be tested with a manually operated calibrated torque wrench. Acceptable test torque values for anchors tested after installation shall not be less than 80% of the tightening torque as specified by the manufacturer, or project documents. Post-installed anchors may be tested at the time of installation, by utilizing the torque values specified by the manufacturer, or the project documents.

Proof-Load Method

The installed post-installed anchors shall be tested with a tensioner using tensioning loads specified by the manufacturer. This tensioning load corresponds to the minimum embedment

Attachment 13210-B: Anchor Requirements

depth and/or minimum strength of concrete specified by the vendor. If the actual embedment is smaller than the specified minimum, or the concrete strength is lower than the specified minimum, the tensioning load needs to be adjusted, contact BSRI or the Vendor.

After satisfactory installation and testing, if the attachment is removed, or the nut loosened, the threads shall be cleaned, and the nut tightened to snug tight**. The anchor then shall be re-tightened to the installation torque. If the torque is attained within ¼ turn, the anchor is acceptable. If the torque is eventually achieved with more than ¼ turn, repeat the procedure after 7 days. If at that time the installation torque is achieved within ¼ turn, the anchor is acceptable. If not, the anchor shall be replaced.

*** Snug tight may be attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench.*

Testing Frequency of Post-installed Anchors

The number of test anchors shall be as per Table 1. Test anchors shall be randomly selected so that they are representative of the anchors and installation conditions in the group in which they are located. If the selected test anchors meet the torque/test load requirements, and the concrete around the anchors did not break out nor did the anchors fail, the remaining anchors in the group shall be considered satisfactory.

If one of the test anchors fails, the test percentage as shown in Table 1 shall be doubled. If another one fails, all remaining anchors in the group shall be tested. The anchors that exhibit a low torque value as well as the remainder of the anchors in the connection shall be re-tightened no more than once to achieve the "torque at installation."

Documentation

The following information for installation and testing shall be verified:

- Brand, type, diameter, identification mark of anchor
- General location of anchor and group represented
- Method of test or verification
- Test results, accepted or rejected
- Inspector's name
- Date of test
- For anchors that have failed, include location of failed anchors and type of failure

All repairs of expansion anchors and undercut anchors that have failed under test shall be in accordance with Manufacturer's instructions.

Attachment 13210-B: Anchor Requirements

TABLE 1
INSPECTION OF ANCHOR INSTALLATION,
TESTING OF CONCRETE ANCHORS, AND DOCUMENTATION

INSPECTION ACTIVITY
APPROVED ANCHOR TYPE
CONDITION OF HOLE
NUMBER OF ANCHORS
SIZE OF ANCHORS
MIN EMBEDMENT DEPTH
FULL NUT THREAD ENGAGEMENT
MIN CONCRETE STRENGTH PRIOR TO INSTALLATION OF ANCHOR
TIGHTENING TORQUE AFTER INSTALLATION OF ATTACHMENT
SPACING
EDGE DISTANCE
NO REBAR CUTTING UNLESS AUTHORIZED
*TORQUE OR PROOF LOAD FOR POST-INSTALLED ANCHORS (5%).
DATE OF TEST
INSPECTOR'S NAME
DOCUMENTATION

* The group of anchors to be tested shall consist of randomly selected anchors that are representative of a homogeneous population by their design and installation conditions. When the number of test anchors is less than one, a minimum of one anchor shall be tested.

If one of the test anchors fails, double the specified percentage shall be tested; if another one fails, all anchors in the population shall be tested.