

**SOUTHWEST REGION 03
CORONADO NATIONAL FOREST
PIMA COUNTY**

PALISADES ADMINISTRATIVE SITE

**LAGOON LINER AND EFFLUENT SPRINKLER SYSTEM
REPLACEMENT**

SPECIFICATIONS



U.S. FOREST SERVICE
March 2026

CSI SPECIFICATION INDEX

FOR

CORONADO NATIONAL FOREST
CATALINA RANGER DISTRICT
PIMA COUNTY

PALISADES ADMINISTRATIVE SITE
LAGOON LINER & EFFLUENT SPRINKLER SYSTEM REPLACEMENT

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STANDARD SPECIFICATIONS FOR CONSTRUCTION OF ROADS AND BRIDGES ON FEDERAL HIGHWAY PROJECTS (FP-14 U.S. CUSTOMARY UNITS) (2014)

The *Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects* (FP-14 U.S. Customary Units), 2014 are included by reference. The requirements contained in these specifications are hereby made a part of this solicitation and any resultant contract.

The 746-page book entitled "Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects (FP-14 U.S. Customary Units), is available from:

Research & Technology Product Distribution Center (RTPDC)
U.S. Department of Transportation
Federal Highway Administration
1200 New Jersey Avenue, SE
Washington, DC 20590
Email: report.center@dot.gov
Phone 814-239-1160
Fax 814-239-2156
<https://highways.dot.gov/federal-lands/specs>

Applicable sections include (1) Sections designated in the following list and (2) Sections referenced therein.

<u>Section No.</u>	<u>Title</u>
204	Excavation and Embankment
251	Riprap
301	Untreated Aggregate Courses
FSSS 301	Untreated Aggregate Courses
303	Road Reconditioning
703	Aggregate
FSSS 703	Aggregate
705	Rock

FOREST SERVICE SUPPLEMENTAL SPECIFICATIONS (FSSS) TO THE STANDARD SPECIFICATIONS FOR CONSTRUCTION OF ROADS AND BRIDGES ON FEDERAL HIGHWAY PROJECTS

Forest service supplemental specifications (FSSS) may add to, delete from, or modify the Forest Service Standard Specifications (FP-14). FSSS are applicable to this project and are included in full text as an attachment.

CSI SPECIFICATION

CSI Specifications are applicable to all construction, included within this solicitation and any resultant contract, and are included in full text as an attachment.

DIVISION 1 – GENERAL REQUIREMENTS

SECTION 01 11 00 – SUMMARY OF WORK

PART 1 GENERAL

1.1 SUMMARY

A. Project Identification: Palisades Administrative Complex

1. Wastewater Lagoon Liner & Effluent Sprinkler System Replacement.

B. Project Location: The Palisades Administrative Complex is located on the Santa Catalina Ranger District of the Coronado National Forest, Pima County, Arizona, approximately 20 miles north of Tucson, AZ. Approximate coordinates to the Site are: N 32.4099°, W 110.714°. The elevation is 7,950 feet and surrounded by forest. The Site can be reached by following Mt. Lemmon Highway. In the winter, Mt. Lemmon receives snow in the months of December through February and may cause temporary road closures or require snow chains or four-wheel drive.

C. Project Summary: This project consists of wastewater treatment system maintenance work for the Palisades Administrative Complex. The work associated with this project includes:

1. **Wastewater Components:**

- **Lagoon:** Replacement of lagoon liner with double geomembrane lining with geotextile drainage system including new concrete supply pipe supports, outlet baffle, leak detection layer with pipe and gravel pit system.
- **Effluent sprinkler system:** Install the entire new effluent sprinkler system and all associated appurtenances AS SHOWN ON DRAWINGS.
- **Lagoon Pumphouse Plumbing:** Replace the entire plumbing system within the pumphouse. All components shall be replaced with EXCEPTION of 2-inch suction line in lagoon slope embankment. All plumbing work shall comply with all current applicable codes.
- **Temporary Wastewater Collection System:** Provide and install a temporary wastewater collection system for the duration of the contract. Contractor will be responsible for operating and managing the wastewater collection system.
- **Electrical:** Assess existing electrical capability and controls to extend temporary electrical line to provide power to temporary wastewater collection system. Additional work includes all related electrical work during replacement of pumphouse plumbing to disconnect / reconnect equipment and/or switches and return to proper operation.

2. **Access Road:**

- Recondition and reshape the existing access road to the lagoon which is approximately 660 lineal feet.
- Install rip rap at inlet and outlet of existing culverts.
- Install roll dip at location(s) shown on drawings.
- Clean culvert and provide fill on exposed outlet side of existing culvert.

- Construct ditches as shown on drawings.



Existing Access Road – Lagoon in the background

3. Temporary Wastewater Collection Use Area

- Reconstruct an existing temporary access area along the existing access road to provide a clear area approximately 18' wide x 58' in length to place the above ground temporary wastewater collection system.
 - 1) Location of temporary wastewater collection area on left side along the Service Access Road, AS SHOWN ON DRAWINGS and in photo below.



Temporary Wastewater Collection Use Area (left of access road)

D. Selective Demolition and Proper Disposal:

1. Wastewater System:

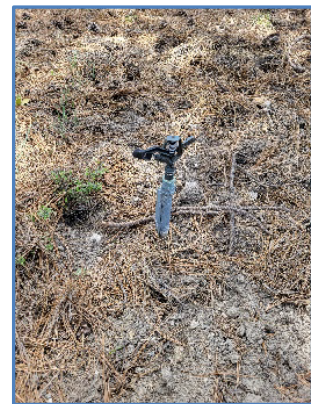
- Properly remove and dispose of existing double lagoon liner system, including but

not limited to the primary and secondary liners and the geocomposite layer in the existing lining system. The top layer is a 36-mil polypropylene liner and the bottom layer is a 30-mil pvc liner.



Palisades Administrative Site - Lagoon

- Properly remove and dispose of existing entire leak detection pipe and all associated components of the leak detection pit, including but not limited to the $\frac{3}{4}$ " gravel, pipe boot and straps.
- Properly remove and dispose of the four existing outlet pipe concrete pipe supports and the concrete outlet baffle, including but not limited to all the fasteners, brackets on the concrete pipe supports. Provide and place temporary supports at the same pipe support locations until new concrete supports are installed.
- Properly remove and dispose of the remaining lagoon contents, including all the effluent and sludge, according to ADEQ requirements.
- Properly cut, remove and dispose of exposed above grade sections of the existing effluent sprinkler system and all associated appurtenances in the "disposal area". The existing effluent sprinkler distribution system will be abandoned in place and any components above grade shall be cut just below grade with a proper cap/plug to seal the opening. Remove and dispose of all existing supporting components (ie. angle channels).
- Source of electrical power is at the existing lagoon pumphouse building. Properly de-energize power before any work is started.



Existing Sprinkler Head

- Properly remove and dispose of all existing lagoon pumphouse plumbing, including pump, fittings, pipe, and all related accessories.
- Properly remove and dispose of all vegetation within 8-feet of keyed-in edges of the perimeter of the lagoon AS SHOWN ON DRAWINGS.
- Properly remove and dispose of trees growing between the lagoon and the chainlink perimeter fencing and trim any branches extending into the lagoon area past the perimeter fencing, including all felled trees and/or branches across the fence.



Lagoon Pumphouse

E. Maintenance Improvement Work:

1. Wastewater System:

- Prepare the floor grade of the existing lagoon cell to receive the new double liner system and install as recommended by liner manufacturer. All unacceptable soil shall be properly removed and disposed.
 - 1) If unacceptable soil is found, do not disturb, immediately notify the Contracting Officer (CO). Discuss, if testing shall be necessary, to determine if there is contaminated soil. Any contaminated soil shall be properly removed and disposed and will be removed by Government under a separate contract.
- Provide clean acceptable borrow / import fill material, approved by CO, to place in all voids to limit ruts, ridges, sharp and loose material created from unacceptable soil or disturbance.
- Prepare surface, re-grade, and compact the lagoon floor and slopes throughout and prepare for inspection by manufacturer for approval, prior to placing the secondary geomembrane/liner. The final grades of the lagoon shall be graded to match the finish elevations AS SHOWN ON THE DRAWINGS.
- Provide and place the new double liner system throughout with the new geomembrane liners per manufacturer's recommendations by **approved installers**. New lagoon geomembrane liner shall be installed by certified installers approved by the manufacturer or an approved manufacturer's representative shall be on-site to provide supervision of proper installation to certify requirements for warranty.
- Provide and place geocomposite (geotextile) drainage layer between the primary and secondary geomembrane liners, AS SHOWN ON DRAWINGS. Install per manufacturer's recommendations.
- Provide and place 8-oz non-woven geotextile per manufacturer's recommendations beneath concrete pipe support slabs, concrete baffle, leak detection pipe and pit and all other concrete structures/slabs, AS SHOWN ON DRAWINGS.

- Provide and place all new components of the leak detection system, including the 8-inch PVC (SDR 35) pipe, threaded cap, straps, gravel and other components.
 - Provide and install boots over the existing 8-inch ductile iron outlet pipe, the 2-inch PVC Sch80 suction line, and the new 8-inch PVC (SDR 35) leak detection pipe. Pipe boots shall be of the same material as the primary geomembrane.
 - Provide and install new effluent sprinkler system, including but not limited to foot valve (in lagoon), suction hose, exterior plumbing pre-pumphouse and post-pumphouse, centrifugal pump, interior plumbing, effluent line, sprinkler heads, fittings, valves, valve boxes, L-angle posts, and all associated components.
 - Provide and install new flow switch and connect to existing electrical system. Check for proper operation. All electrical work shall comply with the most recent version of National Electrical Code (NEC).
 - Design, furnish, and install complete temporary above-grade wastewater collection system for the flows for this site until project is complete. Estimated average design flows are provided in the Section 01 51 20 – Temporary Conveyance of Wastewater. The expected active buildings include the two (2) sheriff modular buildings and the main office. The temporary collection system shall remain until project is completed. At end of project, entire temporary system shall be disconnected and removed after work has been completed.
 - Work shall include monitoring the above-grade wastewater collection tanks to properly remove and dispose contents when near full. This task shall continue until the project is completed or when lagoon has been completed and approved for use to start and all contents have been removed from the temporary collection tanks.
 - At end of project, entire temporary above-grade wastewater collection system and all the related components shall be disconnected and removed after work has been completed and temporary site(s) shall return to clean condition.
 - Assess the existing electrical system at the pumphouse electrical panel to make necessary changes to extend temporary electrical power to the temporary wastewater collection site.
- F. Construction Schedule: A proposed schedule of work for the project construction shall be submitted to the COR for approval at the Pre-Work Conference.
- G. Timing of Work: The Palisades Administrative Site is operated year-round and the Visitor Center provides limited hours during the winter to the public from 10:00 am to 4 pm Friday through Sunday.
- H. Work Sequence: The construction activities shall be confined to construction limits as defined by the COR. Sequence construction activities to minimize impact to the administrative site. The work sequence will be clearly defined by the contractor's progress schedule.
- I. Storage of Materials: The Contractor may store materials and equipment at the work site at his/her own risk. All materials must be kept in an area designated by the COR and be neat and orderly.

J. Construction Access and Protection:

1. The Contractor shall be responsible for securing the project area from the public. This includes providing the necessary security for protection of the Contractor's materials, equipment, tools and work until final acceptance by the Government. The Contractor shall also provide sufficient signs, barriers, barricades, markers, etc. to warn the public of hazardous conditions and to protect the public from injury.

K. Environmental Protection

1. Design and locate equipment repair shops, stationary refueling sites, or other facilities to minimize the potential and impacts of hazardous material spills on Government land.
2. Before beginning any work, submit an Emergency Spill Response Plan at the Pre Work Conference. List actions to be taken in the event of a spill. Incorporate preventive measures to be taken, such as the location of mobile refueling facilities, storage and handling of hazardous materials, and similar information. Immediately notify the CO of all hazardous material spills. Provide a written narrative report form no later than 24 hours after the initial report and include the following:
 - Description of the item spilled (including identity, quantity, manifest number, and other identifying information).
 - Whether amount spilled is EPA or state reportable, and if so whether it was reported, and to whom.
 - Exact time and location of spill including a description of the area involved.
3. Description of clean-up procedures employed or to be employed at the site including final disposition and disposal location of spill residue.
4. The Contractor is solely responsible for all spills or leaks that occur during the performance of this contract. Clean up spills or leaks to the satisfaction of the CO and in a manner that complies with Federal, state, and local laws and regulations.

L. Existing Facilities:

1. Sanitary Facilities: There will be no sanitary facilities during this contract.
2. Potable water: Is available at administrative site. Contractor will be responsible in furnishing, hauling, and supplying all water required for compaction, the control of dust and any construction activities requiring potable water. Contractor shall provide at least 48-hour notice to CO prior to hauling water from Forest Service supply.
3. Potable water: Water is available at the administrative site. Contractor will be responsible for furnishing and supplying all water required for employees.
4. Electrical: There is electrical service available for tools and equipment from the wastewater treatment building on-site and an exterior duplex receptacle

mounted on electrical pole. The electrical pole is approximately 6-feet from existing pumphouse. Contractor shall investigate and make determination if power is sufficient.

- M. Sanitation: The Contractor shall provide and maintain a portable toilet for construction personnel during the Contract period. The Contractor shall pick up trash at least once daily or more often as needed.
- N. Codes and Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO)
 - 2. American Society for Testing and Materials (ASTM)
 - 3. American National Standards Institute (ANSI)
 - 4. Occupational Health and Safety Administration (OSHA) standards
 - 5. Arizona Department of Environmental Quality (ADEQ)

PART 2 PRODUCTS - Not Applicable To This Section

PART 3 EXECUTION - Not Applicable To This Section

END OF SECTION 01 11 00

DIVISION 1 – GENERAL REQUIREMENT
SECTION 01 20 00 – MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Measurement and payment for contract work will be made only for and under those pay items included in the SCHEDULE OF ITEMS. All other work and materials will be considered incidental to the completion of the items shown and no separate payment will be made.

1.2 DETERMINATION OF QUANTITIES

- A. For individual construction items, all longitudinal and lateral measurements for area computations shall be made horizontally or corrected to horizontal measurement unless otherwise specified.
- B. Measurements for geotextile and liner will be along slope lines.
- C. Structures will be measured according to neat lines SHOWN ON THE DRAWINGS or as altered by the COR in writing to fit field conditions.
- D. For items that are measured by the linear foot, such as pipe, fencing, guardrail, concrete curb & gutter and underdrains, measurements will be made parallel to the base or foundation upon which the structure is to be placed. Pipe shall be measured along center of invert.
- E. For vehicular shipments, net certified scale weights will be used as a basis of measurement. Measurements will be adjusted when material has been lost from the vehicle, has been wasted, or has otherwise not been incorporated into the work. Determining true weights of hauling vehicles shall be made by weighing the empty vehicles at least once a day as directed by the Government. Each vehicle shall bear a plainly legible identification mark.

1.3 UNITS OF MEASUREMENT

- A. Payment will be by units defined and determined according to the U.S. Standard measure and by following:
 - 1. Cubic Yard. Measurements computed by the average end area method from measurements made longitudinally along a centerline or reference line or by means of a computer generated digital terrain model. For concrete, measurements computed from the actual length, width, and thickness with no reduction for reinforcing steel.
 - 2. Each. One complete unit, which may consist of one or more parts.
 - 3. Ton. Short ton consisting of 2,000 pounds.
 - 4. Lump Sum. The quantity is designated as “1”.

1.4 METHODS OF MEASUREMENT

- A. One of the following methods of measurement for determining the final payment is

designated in the contract for each Pay Item.

1. Contract Quantities (CQ). These quantities denote the final number or units to be paid for under the terms of the contract. They are based upon original design data available prior to advertising the project. This data includes the preliminary survey information, drawings design assumptions, calculations, and the presentation in the contract. Authorization for changes in the number of units SHOWN in the contract may be given under any of the following conditions:
 - A. As a result of changes in the work authorized by the Contracting Officer.
 - B. As a result of the Contracting Officer determining that errors exist in the original design that may cause a Pay Item quantity to change by 15% or more.
 - C. As a result of the Contractor submitting a written request showing evidence of errors in the original design that cause a Pay Item quantity to change by 15% or more. The evidence must be verifiable and consist of calculations, drawings and/or other data that shows how the designed quantity is believed to be in error.
2. Actual Quantity (AQ). These quantities are determined from measurements of completed work.
3. Vehicular Quantities (VQ). These quantities are measured or weighed in hauling vehicles.
4. Lump Sum Quantities (LS). These quantities denote one complete unit of work as required by or described in the contract, including necessary materials, equipment, and labor needed to complete the job. They will not be measured.

PART 2 PRODUCTS - Not Applicable to This Section

PART 3 EXECUTION - Not Applicable to This Section

END OF SECTION 01 20 00

DIVISION 1 – GENERAL REQUIREMENT
SECTION 01 31 00 – PROJECT MANAGEMENT AND COORDINATION

PART 1 GENERAL

1.1 SUMMARY

- A. This work shall consist of coordination with government agencies including federal, state, local and public.
- B. Any disruption of services, including vehicular access, electrical, water and/or wastewater, shall be communicated and coordinated with COR.
- C. Critical event includes the installation of temporary above ground sewage collection and/or installation of temporary water service which will disrupt continuous services to accommodate installation.
- D. Contractor shall provide at least 72 hour notice to CO prior to any scheduled events of any disruption of services. This will allow time for CO to inform the employees and residents.

1.2 RELATED SECTIONS

- A. 01 11 00 SUMMARY OF WORK

PART 2 PRODUCTS – None

PART 3 EXECUTION

3.1 STATE AGENCY

- A. All permits necessary for construction and occupancy of the project shall be obtained by the contractor,
- B. Lagoon has existing Type 1.09 general Aquifer Protection Permit (APP) which allows limited disposal quantity per day. Any necessary disposals during the contract to be released through the existing effluent sprinkler system shall be requested to the COR for approval. Provide quantity and expected disposal volume. All disposals shall be reviewed and approved prior to any disposal.
- C. There are no permits required by Arizona Department of Environmental Quality (ADEQ). This is considered routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of the facility. See A.A.C. R18-9-A902(B)(8)(c)(iii).

3.2 COUNTY AND LOCAL AGENCY

- A. Pima County: All work shall comply with local regulations for proper disposal of the lagoon contents.

3.3 COUNTY ON-SITE RESIDENTS

- A. There are two sheriff residents on these premises. The Contractor shall inform and

maintain communication, with the COR, regarding any critical events throughout the contract.

3.4 GOVERNMENT ON-SITE OCCUPANTS (Employees & Public)

- A. Cabin Rental (public): The cabin rental will be made unavailable during the contract period. This will be executed by Forest Service.
- B. Palisades Apartment Complex (4 Units - employees): Will not be occupied during the contract period.
- C. Trailer Pads (employees): The (4) four trailer pads will not be made available during the contract period.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

- A. Work under this section will not be measured for payment but is included in all other items in the contract.

4.2 PAYMENT

- A. Separate payment will not be made.

END OF SECTION 01 31 00

DIVISION 1 – GENERAL REQUIREMENT

SECTION 01 33 00 – SUBMITTALS

PART 1 GENERAL

1.1 REQUIREMENTS

Procedures

- A. Manufacturer's Instructions
- B. Manufacturer's Certificates
- C. Certified Installer Certificate by Manufacturer

1.2 PROCEDURES

- A. Submittals shall be furnished & approved in writing by the COR before fabrication or installation occurs. All submittals shall be evaluated and either approved or rejected by the COR within 10 business days after their receipt.
- B. If the Contractor intends to provide or install an item that is an "or equal" that meets or exceeds from that which is specified or shown on the drawings, he/she shall submit all product data, revised drawings or new drawings to the COR for approval. This submittal shall include:
 - 1. Product name and model number
 - 2. Manufacturer
 - 3. Product description
 - 4. Technical data
 - 5. Any differences

1.3 MANUFACTURER'S PRODUCT DATA

- A. Contractor shall provide two (2) copies of all manufacturer's data for all items furnished under this contract. This submittal shall include at a minimum product name and model number, product description, technical data and color samples (if required).

1.4 MANUFACTURER'S INSTRUCTIONS

- A. The Contractor shall provide two (2) copies of all of the manufacturer's installation and maintenance instructions (written and/or drawings) to the COR prior to installation.

1.5 MANUFACTURER'S CERTIFICATES

- A. The Contractor shall provide all guarantees, certificates of performance, material of

workmanship or warranties provided by the manufacturer or required by the specifications to the COR.

1.6 CERTIFIED INSTALLER CERTIFICATE BY MANUFACTURER

- A. The Contractor shall provide Certified/Authorized Installer Certificate as recommended by the Manufacturer.
- B. If installation is not performed by certified/authorized installer, Contractor shall coordinate manufacturer's field representative to be present during the liner installation at no cost to the Government. Contractor will bear the expense of this field service representative.

1.7 EMERGENCY SPILL RESPONSE PLAN

- A. Information on When to Report depending on quantity of spill.
- B. Provide Contact Information. Who to Report to?
- C. Provide Information on Spill.
 - 1. Where is the Spill?
 - 2. What Spilled?
 - 3. How much spilled?
 - 4. How concentrated is the spilled material?
 - 5. Who spilled the material?
 - 6. Is anyone cleaning up the spill?
 - 7. Are there resource damages (e.g. dead fish or oiled birds)?
 - 8. Who is reporting the spill?
 - 9. How can we contact you?

1.8 SUBMITTALS REQUIRED

- A. Section 01 45 00 Quality Control
 - 1. Contractor's Designation of Superintendent
 - 2. Construction Schedule
 - 3. Quality Control Plan
- B. Section 01 51 20 Temporary Conveyance of Wastewater
 - 1. Detailed Plan of Proposed Pumping System
 - 2. Product Data – Pumps, Piping, Plugs
 - 3. Emergency Procedures and Contact – product data for the secondary containment.
 - 4. Operating Guide to Monitor, Manage the System
 - 5. Notification of wastewater disposal site
 - 6. Location of Approved Disposal Site
- C. Section 32 80 00 Effluent Sprinkler System
 - 1. Product Data – Pump, Foot Valve, PVC Pipe, Galvanized Steel Pipe, Sch 80 PVC, Sch 40 PVC, Sprinkler Heads, drain valves, curb stops, meter box, curb box, insect screen and steel angle support, detectable underground

warning tape , plastic-to-metal transition fittings, suction hose and all related accessories.

2. Installation instructions
3. Warranty

D. Section 03 30 00 Cast-in-Place Concrete | Pre-cast Concrete

1. Concrete: Design mix, product data, compressive strength, air content, etc.
2. Staff Gauge - Product data, specifications, fasteners, size, material, marking, etc.
3. Coal Tar Epoxy Coating – product data and specifications.
4. Pre-cast concrete for baffle and concrete supply pipe supports – Product data and specifications.
5. Reinforcement – Product data, Specifications

E. Section 33 36 00 Geotextile

1. Product Data – Geotextile
2. Installation instructions and layout design
3. Warranty, if applicable.

F. Section 33 38 00 Subdrainage

1. Product Data
2. Installation instructions and layout design

G. Section 33 46 00 Geomembrane Liner (Primary & Secondary)

1. Product, Properties, Pipe Boots, Berm Vents and any other accessories
2. Certification of Installer from Manufacturer
3. Letter from approved manufacturer representative for on-site inspection
4. Installation instructions and layout design
5. Warranty

H. Bedding Material

1. Material Certification

I. Section 251 – Class 1 Rip Rap

1. Material Certification
2. Color
3. Sample

J. Section 301 – Crushed Aggregate – Table 703-3 Grading Designation H

1. Material Certification

PART 2 PRODUCTS - Not Applicable To This Section

PART 3 EXECUTION - Not Applicable To This Section

END OF SECTION 01 33 00

DIVISION 1 – GENERAL REQUIREMENT

SECTION 01 45 00 – QUALITY CONTROL

PART 1 GENERAL

1.1 SUMMARY

- A. The work shall consist of providing quality control in conformance with the Inspection of Construction provisions of this contract to ensure compliance with the drawings, specifications, and provisions of the contract and measuring the quantities of completed work in conformance with the provisions of the applicable specifications. The Contractor shall provide all personnel, equipment, tests, and reports to meet the requirements of this specification.

PART 2 PRODUCTS - Not Applicable To This Section

PART 3 EXECUTION

3.1 QUALITY CONTROL SYSTEM

- A. The Contractor shall provide and maintain a quality control system that will ensure that all services, supplies, and construction required under this contract conform to the contract requirements. The contractor shall perform, or cause to be performed, the sampling, inspection, and testing required to substantiate that all supplies, services, and construction conform to the contract requirements.

3.2 QUALITY CONTROL PLAN

- A. The contractor shall submit in writing the following:
 - 1. Authorities and responsibilities of inspection and testing personnel.
 - 2. Experience and qualifications of inspection and testing personnel to be assigned and location of any (for hire) testing facility to be used.
- B. The contractors proposed quality control plan shall be submitted to the COR for review prior to the contractor commencing work. The COR shall approve or disapprove the plan within 10 business days. Construction work shall not begin prior to the contractor's receipt of written approval of the quality control plan.
- C. The contractor shall submit to the COR in writing any proposed changes to the approved plan. Proposed changes shall not be put into effect until approved in writing by the COR.

3.3 SAMPLING & TESTING

- A. The contractor shall provide and maintain appropriate measuring and testing devices, equipment, and supplies to accomplish the required measurement, testing and inspection in a timely manner. The contractor shall take samples and perform inspections and tests necessary to achieve the quality of construction required by the

contract and manufacturer. Sampling and testing frequency for specific items shall be as defined in the specifications.

3.4 RECORDS

- A. The contractor shall maintain current records of all inspections and tests performed at the jobsite & make them available to the COR upon request.
- B. The contractor shall certify in writing that all inspections were performed in accordance with specifications. All testing and inspection records shall be submitted to the COR upon completion of the project.

3.5 CERTIFICATIONS & MEASUREMENTS

- A. Offsite Produced Materials. The Contractor shall furnish certificates executed by the manufacturer, supplier, or vendor, stipulating that all offsite produced materials incorporated into the work meet the applicable requirements as shown on the drawings or specifications.
- B. Quantity Measurement. The Contractor shall make all measurements for computation of quantities for all work items except those specified for payment by Contract Quantity (CQ) or Lump Sum (LS). The Contractor shall compute the quantities for periodic progress payments; the COR will compute the quantities for final payment based on measurements taken by the Contractor. All measurements are subject to verification. The Contractor shall submit all field notes, calculation sheets, and other data used to determine quantities. The Contractor shall certify in writing as to the accuracy of the measurements and computations submitted.

END OF SECTION 01 45 00

DIVISION 1 – GENERAL REQUIREMENT
SECTION 01 50 00 – TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION REQUIREMENTS

- A. Use Charges – There will be no charge for electrical or water use to build the temporary wastewater system and/or use to power tools and equipment.
- B. Water and Electric Power: Available from existing system without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Assess existing electrical system to extend temporary power from the lagoon pumphouse to the temporary wastewater collection system to provide power to pump and any associated equipment and controls.
- D. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- E. Protect any electrical sections crossing the road by burial and traffic rated plates.
- F. Accessible Temporary Egress: Comply with applicable provisions in ICC A117.1.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Safety Fencing: Highly visible, 48 inches, polyethylene, orange.
- B. Wood Enclosure: Plywood
- C. Safety Cones: Reflective Traffic Cones, Channelizer Cone, Delineator Posts with 10-lb Base

2.2 TEMPORARY FACILITIES

- A. Provide temporary storage and use areas, and other support facilities as necessary for construction operations.

PART 3 EXECUTION

3.1 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company and C.O., for time when service can be interrupted, if necessary, to make connections for temporary services.

3.2 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Provide protection, operate temporary system, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and

subsoil contamination or pollution or other undesirable effects.

- B. Provide measure to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas.
- C. Tree Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root system from damage, flooding, and erosion.
- D. Furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering open areas, such as the manhole selected for pumping.
- E. Barricades: Comply with requirements of authorities having jurisdiction for erecting adequate barricades.
- F. Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.

3.3 OPERATION, TERMINATION, AND REMOVAL

- A. Minimize waste and abuse, limit availability of temporary system/facilities to essential and intended uses.
- B. Remove each temporary system/facility when need for its service has ended, when it has been replaced by authorized use of a permanent system, or no later than Substantial Completion.
- C. At Substantial Completion, repair, and clean permanent facilities used during construction period.

PART 4 BASIS OF PAYMENT

<u>PAY ITEM</u>	<u>DESCRIPTION</u>	<u>PAY UNIT</u>
015000(01)	Temporary Facilities and Control - Electrical.....	Lump Sum

END OF SECTION 01 50 00

DIVISION 1 – GENERAL REQUIREMENT
SECTION 01 51 20 – TEMPORARY CONVEYANCE OF WASTEWATER

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Designing, furnishing, and installation of temporary aboveground wastewater conveyance system to allow the continuity of sewer services for the employees and residents at Palisades Administrative Site. The temporary system will intercept, divert and pump the sewer collected from existing manhole to temporary wastewater collection system to be managed throughout the construction period until Work is completed.
2. Temporary wastewater collection system shall be removed at end of construction and all components shall be returned to normal operations.
3. Temporary wastewater collection system shall be sized to allow collection for at least one week and half (11 days) with frequent disposals throughout the contract.
4. Temporary collection tanks shall be placed in secondary containment to capture accidental spillage.
5. Design shall include electrical equipment to automatically operate the pump(s) to manage flow from manhole to aboveground collection tanks with appropriate switches and/or controls. The installation of the electrical work necessary will be paid under Section 01 50 00
6. Collection tanks shall be equipped with exterior liquid level gauges to monitor the tank level.
7. Contractor will be responsible to schedule and coordinate proper disposal of the sewage in the temporary collection tank(s) at approved disposal site as recommended by ADEQ. Provide info of disposal site to CO.
8. New permanent effluent sprinkler distribution pump can be installed for use as the temporary pump, if pump can be installed under those conditions. Provide documentation for review and approval to the C.O. If approved, the new permanent effluent sprinkler distribution pump shall be installed after temporary wastewater system is no longer needed.
9. Other types of temporary pump for this application shall be designed after field investigation is completed and manhole is selected.
10. Contractor responsible for placing all necessary temporary supports and/or housing for all the temporary pump equipment and controls.

- B. Pima County has a list of certified entities permitted to deposit wastewater contents into their Tres Rios Water Reclamation Facility (WRF). The Tres Rios Water Reclamation facility serves the metropolitan Tucson area and treats approximately 30 million gallons of wastewater per day (MGD).**

1. Contractor responsible for proper disposal of temporary wastewater collection

tank when container is near capacity.

2. Temporary collection system shall not overflow or have any spillage events throughout the contract.
3. Temporary secondary containment system shall be placed beneath the collection tank(s). Sizing the secondary containment shall be sufficient to hold at least one day of storage.

1.2 EXISTING SYSTEM COMPONENTS

- A. Existing wastewater system is expecting an estimated daily flow of 1,770 gallons per day during the anticipated construction period of September to December, 2025. The Government can provide the necessary facility/occupancy data for the wastewater design flow calculations. The following is list of buildings on-site.
 1. Visitor Center – average of 3 employees daily.
 2. Rental Cabin – will not be occupied during contract.
 3. Modulares – 2 for Family Occupancy
 4. RV Connections – 4 connections. These will not be occupied during contract.
 5. Apartments – will not be occupied during contract.
- B. Existing Effluent Sprinkler Disposal Area: The general aquifer protection permit requirements shall be followed throughout the contract period for the disposal of effluent, if needed. Contractor can request a copy of the General Aquifer Protection Permit.
- C. Service Access Road – The existing service access road will be reconditioned under this project.
- D. Temporary Use Area for the Wastewater Collection System – The temporary use area is included in this work to be reconstructed. Area will be cleared and graded to provide an area for the aboveground temporary wastewater collection system.
- E. Existing lagoon pumphouse plumbing – All existing plumbing connections remain in the building.
 1. PUMP: Griswold Pump, H-Series Self-Priming Centrifugal pump, Model 5HLS-G22361, Suction 3" NPT, Discharge 2" NPT
 2. MOTOR: Marathon Electric, Model 8VH184TCDR7011DR, FRAME-184JM, 5HP, 230V, 1PH, 60Hz, 3510 RPM.
- F. Existing Administrative Site Manhole: Contractor shall select a manhole and prepare and utilize selected manhole AS SHOWN ON DRAWINGS to divert wastewater flow. Contractor shall temporarily plug downstream flow in the selected manhole and install pump, hoses, pipes, and necessary controls to start diversion and pump into temporary wastewater collection system.
- G. Electrical – Contractor shall assess the existing electrical system to extend temporary power as needed from the lagoon pumphouse to the temporary collection access site. All temporary electrical installations shall be installed as such to be protected from traffic and/or wildlife.

1.3 QUALITY ASSURANCE

- A. Follow local and national standards as specified herein
- B. Perform leakage and pressure tests on suction and discharge piping using clean water, before operation. Provide notice 48 hours prior to testing.
- C. Keep and maintain spare parts for pumps and piping on site, as needed.

1.4 SUBMITTALS

- A. Contractor shall submit the following per Section 01 33 00.
 - 1. Detailed plan and description of proposed temporary pumping system. Indicate number, size, material, location and method of installation of suction and discharge piping, size of pipeline or conveyance system, staging area for pumps, site access point, and expected flow.
 - Access points for suction and discharge hose or piping.
 - Sections showing suction and discharge pipe depth, embedment, select fill and special backfill, if buried.
 - Temporary pipe supports and anchoring required.
 - Thrust and restraint block sizes and locations.
 - Sewer plugging method and type of plugs.
 - Pump size, capacity, number of each size to be on site and power requirements.
 - Include check valves, ball valves, gate valves, pressure gauges, etc.
 - Bypass pump sizes, capacity, number of each size to be on site and power requirements.
 - Calculations of static lift, friction losses, and flow velocity. Pump curves showing pump operating range.
 - Method of protecting source manhole from damage, infiltration, and/or foreign objects, including local rodents or wildlife.
 - Procedure to monitor upstream mains for backup impacts.
 - Procedures to setup and breakdown of pumping operations.
 - Emergency plan detailing procedures to be followed in event of pump failures, sewer overflows, service backups, sewage spillage.
 - 2. Emergency Spill Response Plan.
 - Contractor shall provide contact information for technical assistance to be available all times for Forest Service personnel.
 - If a spill occurs that results in an unplanned wastewater discharge, then the Contractor shall make immediate repairs and clean up the spill site.
 - Contractor shall issue a report to the COR on the date and time of the incident, the estimated spill quantity, the cause of the incident, the action taken, including both the corrective action and the clean-up activities.

1.5 DELIVERY AND STORAGE

- A. Transport, deliver, and store pipe, fittings, pumps, ancillary equipment and materials to prevent damage per manufacturer's recommendations.
 - 1. Inspect all material and equipment for proper operation before initiating work.

PART 2 PRODUCTS

2.1 DISCHARGE AND SUCTION PIPES

- A. Discharge piping to be determined according to flow and operating calculations.
- B. Suction piping to be determined according to pump size, flow calculations and manhole depth following manufacturer's recommendations.

2.2 POLYETHYLENE PLASTIC PIPE

- A. High density solid wall and following ASTM F714 Polyethylene (PE) Plastic Pipe (SDR-DR) based on outside diameter, ASTM D1248 and ASTM D3550.
- B. Homogenous throughout, free of visible cracks, discoloration, pitting, varying wall thickness, holes, foreign material, blisters, or other deleterious faults.

2.3 HIGH DENSITY POLYETHYLENE (HDPE)

- A. Homogenous throughout, free of visible cracks, discoloration, pitting, varying wall thickness, holes, foreign material, blisters, or other deleterious faults.
 - 1. Defective areas of pipe: Cut out and joint fuse to complete repairs.
- B. Assemble and join using couplings, flanges or butt-fusion method to provide leak proof joint. Follow manufacturer's instructions and ASTM D2657.
 - 1. Threaded or solvent joints and connections are not permitted.
- C. Fusing: Fusing shall be completed by qualified technicians.
- D. Butt-fused joint: True alignment and uniform roll-back beads resulting from use of proper temperature and pressure.
 - 1. Allow adequate cooling time before removal of pressure.
 - 2. Watertight and have tensile strength equal to that of pipe.

2.4 FLEXIBLE HOSES AND ASSOCIATED COUPLINGS AND CONNECTORS:

- 1. Abrasion resistant
- 2. Suitable for intended service
- 3. Rated for external and internal loads anticipated, including test pressure.
 - External loading design: incorporate anticipated traffic loadings, including traffic impact loading.
- 4. When subject to traffic loading, compose system, such as traffic ramps or covers.

2.5 VALVES AND FITTINGS: Determined according to flow calculations, pump sizes previously determined, and system operating pressures.

2.6 MANHOLE PLUG: Selected and installed according to size of line to be plugged per manufacturer's recommendations.

- A. Additional Plugs: Available in the event plug fails. Plugs will be inspected before use for defects which may lead to failure.

2.7 SUMP PUMP

- A. Pumps for suction and discharge:
 - 1. Fully automatic self-priming units, self-contained.
 - 2. Sewage pump shall be able to pass 2-inch diameter solids.
 - 3. Pump shall allow dry running for long periods of time due to the nature of the effluent flows.
 - 4. Provide necessary stop/start controls for each pump.
- B. Submersible, Fixed Position, Single-Seal Sump Pumps:
 - 1. Dayton, Zoeller, Superior, Goulds and/or an approved equal.
- C. Factory assembled and tested, end suction, centrifugal sump pumps for automatic operation, with 72-inch minimum power cord and plug.
 - 1. Casing and Impeller: Cast-iron or plastic casing with inlet strainer and metal or plastic impeller.
 - 2. Pump and Motor Shaft: Steel, with factory-sealed, grease-lubricated ball bearings and double-mechanical seals.
 - 3. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection, three-conductor waterproof power cable of length required, with grounding plug and cable-sealing assembly.
 - 4. Pump Discharge Piping: Factory or field-fabricated, ASTM A 53/A 53M, Schedule 40 galvanized steel pipe.
 - 5. Controls: NEMA 250, Type 1 enclosure, pedestal-mounted float switch with float rod and rod buttons.
- D. Wet-Pit Volute Sump Pumps:
 - 1. Dayton, Zoeller, Superior, Goulds and/or an approved equal.
- E. Wet-pit-Volute, single-stage, separately coupled, overhung-impeller, centrifugal sump pump.
 - 1. Casing: Cast iron; with screened inlet and threaded or flanged connection.
 - 2. Impeller: [**ASTM A 48/A 48M, Class No. 25 A or higher cast iron**] [**ASTM A 532/A 532M, abrasion-resistant cast iron**] [**ASTM B 584, cast bronze**]; statically and dynamically balanced nonclog design; overhung, single suction, keyed and secured to shaft.
 - 3. Pump Shaft and Sleeve Bearings: Stainless-steel or steel shaft, with bronze sleeve bearings. Include oil-lubricated, intermediate sleeve bearings at 48-inch (1200-mm) maximum intervals if basin depth is more than 48 inches (1200 mm); and grease-lubricated, ball-type thrust bearings.
 - 4. Pump Discharge Piping: Manufacturer's standard galvanized-steel or bronze pipe.
 - 5. Cover Shaft Seal: Stuffing box, with graphite-impregnated braided-yarn rings and bronze packing gland.
 - 6. Motor Mount: On vertical, cast-iron pedestal.
 - 7. Controls: NEMA 250, Type 1 enclosure, pedestal-mounted float switches with float rods and rod buttons.
 - 8. Float Guide: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches (1500 mm).
 - 9. High-Water Alarm: Cover-mounted alarm with electric bell; 120-V ac, with

transformer and contacts for remote alarm bell.

2.8 SUMP-PUMP BASINS AND BASIN COVERS

- A. Basins: Factory-fabricated, [cast-iron] [fiberglass] [polyethylene], watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.
- B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.

2.9 MOTORS

- A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
 - 1. Duty: Continuous duty at ambient temperature of 80 deg F to 10 deg F and at altitude of 7,850 feet (1000 m) above sea level.

2.10 POLYPHASE MOTORS:

- A. Description: NEMA MG 1, Design B, medium induction motor.
 - 1. Service Factor: 1.15.
- B. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- C. Multispeed Motors: Variable Torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- D. Less Than 1/2 HP (373 W): Built-in thermal-overload protection.
- E. 1/2 to 3 HP (373 to 2238 W): Permanently lubricated ball bearings.
- F. 5 HP (3.73 kW) and Larger: Grease-lubricated ball bearings.
- G. Motor shall be non-overloading within full range of pump performance.
- H. Rotor: Random-wound, squirrel cage.
- I. Bearings: Regreaseable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- J. Temperature Rise: Match insulation rating.
- K. Insulation: Class F
- L. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors smaller than 15 HP: Manufacturer's standard starting characteristic.

- M. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.11 DESIGN REQUIREMENTS

A. Temporary pumping system:

- Sufficient capacity to pump average daily design flow during winter operating period of 1,770 gpd. Winter operating period is December through February.
- Sufficient capacity to pump average daily design flow during summer operating period of 2,754 gpd. Summer operating period is from March 1 – November 30.

B. Operate 24 hours per day.

C. Provide and install pipeline, plugs and pumps of adequate size to handle flow to ensure total flow of main can be safely conveyed and collected to the temporary wastewater collection system.

PART 3 EXECUTION

3.1 GENERAL

- A. Minimize the length of time the entire temporary system is utilized.
- B. Do not begin temporary conveyance of wastewater without the COR's approval.
- C. All required system shutdowns shall be coordinated with the COR at least four days in advance of the shutdown.
- D. Do not begin temporary conveyance of wastewater until all equipment and materials necessary for the installation and proper operation of the new temporary wastewater collection system is properly operating.
- E. Do not terminate temporary conveyance of wastewater without COR approval.

3.2 INSTALLATION AND REMOVAL

- A. Provisions and requirements must be reviewed by the COR prior to starting construction.
- B. Make connections to existing sewer and construct the temporary conveyance system at temporary access location AS SHOWN ON DRAWINGS and provide adequate suction connection.
- C. Plugging or blocking of sewage flows shall incorporate a primary and secondary plugging device. When plugging or blocking is no longer needed for performance, remove in a manner that permits the sewage flow to slowly return to normal without surge, to prevent causing other major disturbances downstream.
- D. When working inside manhole, exercise caution. Follow OSHA, local, state, and federal requirements. Take required measures to protect workforce against sewer gases and/or combustible or oxygen-deficient atmosphere.
- E. Installation of temporary conveyance pipelines:
1. Pipeline may be placed along shoulder of roads.

2. When pipeline crosses service road, place in roadway ramps or in trenches and provide adequate traffic rated coverplates.

F. Protect conveyance lines from damage from equipment.

G. Upon completion, remove piping, restore areas of use to like pre-construction condition.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

- A. For the Design & Install – all work shall include the design of the temporary system including all pump sizing, plumbing connections, sizing of tank(s), pump controls, tube on exterior to monitor level or other visible means, and any enclosures. Plans to be submitted to CO for review and approval. All installation shall be included in this line item.
- B. For Management & Disposal – all work included in the management and disposal of the wastewater

4.2 PAYMENT

<u>PAY ITEM</u>	<u>DESCRIPTION</u>	<u>PAY UNIT</u>
015120(01)	Temporary Wastewater Collection System – Design & Install	Lump Sum
015120(02)	Management & Disposal of Wastewater In Collection Tanks	Lump Sum
015120(03)	Temporary Tank & Pump System Rental	Week

END OF SECTION 01 51 20

DIVISION 1 – GENERAL REQUIREMENT
SECTION 01 71 13 – MOBILIZATION

PART 1 GENERAL

1.1 SUMMARY

- A. The work shall consist of preparatory work and operations necessary for the movement of personnel, equipment, supplies and incidentals to the project site. This includes all work and operations that must be performed or that cause costs to be incurred prior to beginning work on the various items on the project site.

PART 2 PRODUCTS - Not Applicable To This Section

PART 3 EXECUTION – Not Applicable To This Section

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

- A. Progress payments will be made as follows:

The Contractor can request payment for performance and payment bonds. The amount of the premium, including coinsurance and reinsurance agreements, will be paid upon receipt of evidence of full payment to the surety. When separate payment for bonding cost is made, the bonding cost will be subtracted from the total contract amount for this pay item and the balance paid in accordance with the progress payment schedule outlined below:

- (a) When 5 percent or more of the original contract amount is earned from other pay items, 50 percent of the amount for mobilization, or 5 percent of the original contract amount, whichever is less, will be paid.
- (b) When 10 percent or more of the original contract amount is earned from other pay items, 100 percent of the amount for mobilization, or 10 percent of the original contract amount, whichever is less, will be paid.
- (c) Upon completion of all work on the project, any unpaid amount for mobilization will be paid.

Any bonding costs in excess of the total contract amount of this pay item will be paid under one or more other pay items under this contract as determined by the Contracting Officer. In no circumstance will the total amount of this contract be increased as a result of bonding costs exceeding the total contract amount of this pay item.

The total of all payments shall not exceed the original contract amount for this item.

4.2 BASIS OF PAYMENT

<u>PAY ITEM</u>	<u>DESCRIPTION</u>	<u>PAY UNIT</u>
017113(01)	Mobilization.....	Lump Sum

END OF SECTION 01 71 13

DIVISION 2 – EXISTING CONDITIONS

SECTION 02 14 19 – SELECTIVE DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

- A. The work shall consist of the removal and proper disposal of the existing lagoon liner(s), lagoon effluent, lagoon solids/sludge, lagoon concrete baffle pad, lagoon concrete supply pipe supports, lagoon leak detection pipe, lagoon leak detection pit, above grade effluent sprinkler components, all existing lagoon pumphouse plumbing, pump, flow switch, including all associated fasteners & other items as shown on the drawings and specified herein.
- B. Other work includes cutting and removal of two flagged ponderosa pine trees. Cut shall be made close to grade as possible.



Existing Lagoon Liner – Trees and Vegetation

- C. Remove vegetation within 8-feet of lagoon berm top edges throughout the perimeter. Clear and provide final grades AS SHOWN ON DRAWINGS.
- D. Properly remove and dispose of trees growing between the lagoon and the chainlink perimeter fencing and trim all branches extending into the lagoon area throughout the interior perimeter of the fence, including all felled trees and/or branches across the fence.
- E. Other work includes furnishing and placing temporary jacks or supports to maintain the existing 8-inch DIP supply pipe to replace the concrete supply pipe supports.



Broken Tree Limbs Along Fence / Vegetation



Existing Leak Detection Pipe

PART 2 PRODUCTS - Not Applicable To This Section

PART 3 EXECUTION

3.1 PROTECTION

- A. Execute all demolition work in a way to not damage adjacent facilities designated to remain.

3.2 REMOVAL

- A. All materials scheduled for demolition must be completely removed and disposed of legally off Government land.
- B. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate onsite.

3.3 LAGOON WORK

- A. All liquid and sludge(solids) shall be pumped by a licensed septage pumper prior to demolition. All effluent and sludge shall be disposed of in accordance with AZDEQ requirements.
- B. Remove and properly dispose of all liner materials, including associated items such as geotextile fabric, old leak detection pipe, and boots.
- C. All voids left after removal of the existing lagoon lining system shall be backfilled and compacted in accordance with Section 31 22 00 Earthwork. **An estimate of 88 tons (63 cy)**, in Section 31 22 00 Earthwork is included for borrow, fill, or import material. This work is assumed to replace any shifted and/or void areas.
- D. Contaminated Soil – Contractor shall notify COR if contaminated soil is discovered. This will necessitate a modification to the contract on the proper removal and

disposal of the contaminated soil.

3.4 EFFLUENT SPRINKLER SYSTEM

- A. Existing system consists of buried distribution effluent sprinkler lines consisting of 2-inch sch 40 pvc with $\frac{3}{4}$ " galvanized steel pipe risers, and L-angle supports, and 1-inch drainlines with valves and valve boxes. There are 10 sprinkler heads throughout the system, AS SHOWN ON THE DRAWINGS.
- B. The existing components above grade shall be cut just below grade and removed and disposed.
- C. The cut, open ends of the existing sprinkler pipes shall be capped and plugged during demolition activities. All buried components of the existing effluent sprinkler system shall be abandoned.
- D. Any existing effluent sprinkler system components cut during new installation shall be capped and plugged and buried.

PART 4 BASIS OF PAYMENT

<u>PAY ITEM</u>	<u>PAY UNIT</u>
021419 (01) Effluent Disposal in Lagoon.....	Gallon
021419 (02) Sludge Disposal in Lagoon.....	Gallon
021419 (03) Removal & Disposal - Existing Lagoon..... Liner System	Lump Sum
021419 (04) Removal & Disposal – Existing Effluent..... Sprinkler System	Lump Sum

END OF SECTION 02 14 19

DIVISION 3 - CONCRETE
SECTION 03 20 00 – CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel reinforcement bars.
 - 2. Welded-wire reinforcement.

1.2 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
 - 1. Store reinforcement to avoid contact with earth.
 - 2. Do not allow epoxy-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, [**Grade 60**], deformed.

2.2 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions:
 - 1. Do not cut or puncture geomembrane liner or the geotextile.
 - 2. Repair damage and reseal geomembrane liner or geotextile before placing concrete according to manufacturer's recommendation.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
 - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.

2. Do not tack weld crossing reinforcing bars.

END OF SECTION 03 20 00

DIVISION 3 – CONCRETE
SECTION 03 30 00 – CAST-IN-PLACE CONCRETE AND STAFF GAUGE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. The work specified herein includes purchase, delivery, construction and installation of materials to replace the concrete baffle (6'L x 4'W x 6"THK) and all the concrete pipe supports (base – 1.5'L x 1.5'W x 6"THK) with varying post heights. Work includes rebars and fasteners.
2. Shapes and dimensions shown on the drawings, and to the lines and grades established, in conformance with the requirements of these specifications.
3. When the concrete structures or parts of concrete structures are precast, the work shall also include transporting, installing, and as required, erecting the units.
4. New staff gauge appropriate in size and for distance with large number size shall be furnished and installed on the new concrete pipe support, including all the necessary fasteners.

B. Submittals:

1. Product Data and Design Mixture
 - Minimum 28-day compressive strength, 3,000 psi
 - Durability exposure class: Exposure category S: Sulfate exposure
 - Air content
 - Nominal maximum aggregate size: Course size #67 Aggregate
2. Pre-cast Concrete
 - Submit data information for review and approval, prior to ordering.

C. Ready-Mixed Concrete Manufacturer Qualifications: Complies with ASTM C94/C94M.

1.2 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40°F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35°F other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95°F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 PRODUCTS

2.1 CONCRETE, GENERAL

- A. Comply with ACI 301, "Specification for Structural Concrete" and ACI 201.2R "Guide to Durable Concrete".
- B. Cement:
 1. Type II Portland cement, ASTM C-150, shall be used for this application to exhibit increased resistance to sulfates.
 2. All new concrete components will be submerged in sewage environment. Exposure Category S: Sulfate Exposure.
- C. Aggregate: Aggregate shall meet the requirements of ASTM C-33, "Specifications for Concrete Aggregate". Coarse aggregate shall be size number 67, as specified therein.
- D. Reinforcing Bars: ASTM A 615/A 615 M, Grade 60, deformed.
- E. Admixtures for Concrete
 1. Air Entrainment: Air entraining admixtures shall meet the requirements of ASTM C-260.
 2. Water Reducers: Water reducing, set retarding, and set-accelerating admixtures shall meet the requirements of ASTM C-494.
- F. Water: Potable water shall be used for mixing, curing, or other applications.
- G. Proportioning Concrete
 1. Minimum compressive strength of concrete shall be 3,000 psi. Proportion concrete within the limits below:
 - Minimum Cement Content 5.5 sacks/cubic yard
 - Maximum Water Content 6 gallons/sack
 - Entrained Air 3 to 6 percent
 - Slump 1 to 4 inches

2.2 CONCRETE MATERIALS

- A. Source Limitations:
 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for project.
 2. Obtain each type or class of cementitious material, each type of admixture, and aggregate from single source or same brand from same manufacturer's plant.

2.3 MIXING

- A. Plant Batched and Transit Mixed
 1. Batch at a central plant and mix in route to the project in transit mix trucks in compliance with ASTM C-94.
 2. Place concrete within a maximum of 1.5 hrs after introduction of cement into the

batch.

3. Time interval between placement of batches shall not exceed 30 minutes.

2.4 RELATED MATERIALS

A. GEOMEMBRANE PROTECTIVE COVERING:

1. Place additional layers of both the GEOMEMBRANE and NON-WOVEN GEOTEXTILE under each concrete feature with a minimum of 12-inches past the edges of concrete features, AS SHOWN ON DRAWINGS.

B. COAL TAR OR COAL TAR EPOXY

1. Coal tar epoxy shall be applied per manufacturer's recommendations over all the exposed surfaces of all concrete components to prevent gas deteriorating the concrete interior components.

2.5 STAFF GAUGE

- A. Gauge shall resist rust with protective coating for use in lagoons. Acceptable material is recycled HDPE plastic profile, or iron gauges with special porcelain enamel to resist rust and discoloration.
- B. Gauge shall be sized and installed to show low to maximum depth (0 – 6.5 feet). A recommended type is from Outdoor Numbers, Type F, or an approved equal.
- C. Gauge number size and with graduated markings every 0.1 feet or other approved marking.
- D. Gauge readability shall have clear markings that are highly visible.
- E. Staff gauge location shall clearly indicate the following elevations:
 1. **Maximum operating level** (top of the operational volume). Elevation = 7,859.25
 2. **Emergency level** (Freeboard minus 1.25 ft) = 7,861.00
- F. Staff gauge shall be marked to show the "Maximum Operating Level"
- G. Dimension of lettering shall be easily read from gate entrance to lagoon.
- H. **Submit** product data to COR for review and approval prior to ordering.

2.6 STAFF GAUGE SUPPORTING POST

- A. Ensure the staff gauge is vertical and well-secured to a stationary object such as a round or square pipe.
- B. Utilize 2" pipe or an approved solid, rigid, tubular secured pipe with stainless steel attached to the concrete support pipe.

2.7 PRE-CAST CONCRETE

- A. Pipe supports shall be dimensioned to match existing concrete supports.
- B. Construct concrete supports per the requirements of this section.

PART 3 EXECUTION

3.1 CONCRETING

- A. Construct formwork according to ACI 301 and maintain tolerances and surface irregularities within ACI 347R limits of Class A, 1/8-inch for concrete exposed to view and Class B, 1/4-inch for other concrete surfaces.

- B. Install construction, isolation, and contraction joints where indicated. Install full-depth joint filler strips at isolation joints.
- C. Protect concrete from physical damage, premature drying, and reduced strength due to hot or cold weather during mixing, placing, and curing.
- D. Formed Surface Finish: Smooth-formed finish for concrete exposed to coated or covered by protective direct-applied material.
- E. Cure formed surfaces by moisture curing for at least seven days. Begin curing concrete slabs and pipe supports after finishing.
- F. Protect concrete from damage. Repair and patch defective areas.

3.2 PRE-CAST CONCRETE STRUCTURES

- A. Install and place the concrete structures AS SHOWN ON DRAWINGS.

3.3 STAFF GAUGE INSTALLATION

- A. Install AS SHOWN ON DRAWINGS on the first concrete support facing north to be read from gate. Install per manufacturer's recommendation. Properly secure and fasten the gauge with stainless steel fasteners to 2-inch square or round pipe.
- B. Place staff gauge in the waste treatment lagoon to clearly indicate the following elevations:
 - 1. **Freeboard** Volume for Palisades Lagoon is 3-ft.
 - Elevation = 7,862.25 to 7,859.25
 - At elevation 7,859.00 label or place staff gauge to show 3.5'
 - At elevation 7,862.00 label or place staff gauge to show 6.5'
 - 2. **Maximum Operating Level** = The maximum operating level for liquid storage lagoon structure is the level that provides the operational volume.
 - Elevation = 7,859.00.
 - Place staff gauge to show this as maximum operating level at 3.5'
 - 3. **Emergency Level** = Top of freeboard minus 1.0 ft
 - Elevation = 7,861.00
 - At this elevation, label or place staff gauge to show this level.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

- A. The work specified herein will be measured as described above as one lump sum payment.

4.2 Payment

PAY ITEM

PAY UNIT

033000(01) Concrete Pipe Supports, Baffle & Staff Gauge..... Lump Sum

END OF SECTION 03 30 00

DIVISION 31 – EARTHWORK
SECTION 31 11 00 – CLEARING AND GRUBBING

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes requirements for clearing and grubbing operations before and during construction.

1.2 SECTION REQUIREMENTS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
- B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on-site at location approved by COR.
- C. Utility Locator Service: Notify Blue Stake for area where Project is located before site clearing.
- D. Do not commence site-clearing operations until temporary erosion- and sedimentation- control and plant protection measures are in place, if applicable.
- E. Soil Stripping, Handling, and Stockpiling: Perform only when topsoil is dry or slightly moist.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- C. Protect remaining trees and shrubs from damage and maintain vegetation. Restore damaged vegetation. Replace damaged trees that cannot be restored to full growth, as determined by the COR.
- D. Do not store materials or equipment or permit excavation within drip line of remaining trees.
- E. Protect site improvements to remain from damage. Restore damaged improvements to condition existing before start of site clearing.
- F. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

- G. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed or abandoned in place.
 - 1. Arrange with utility companies to shut off indicated utilities.
- H. Protect existing utility lines that are indicated to remain from damage. Notify the Contracting Officer immediately of damage to or an encounter with an unknown existing utility line. Repair damage to existing utility lines that are indicated or made known prior to the start of clearing and grubbing operations at no cost to the Government.

3.2 SITE CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass and other vegetation to permit installation of new construction.
 - 1. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 - 2. Chip brush, branches, and trees and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
- C. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- D. Dispose of waste materials off Government property. Burning waste materials on-site is not permitted.

END OF SECTION 31 10 00

DIVISION 31 – EARTHWORK

SECTION 31 22 00 – EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

- A. This section covers earthen sewage lagoon reconstruction, including excavation, disposing of excess unsuitable material, grading, borrow/fill/imported material placement and compaction as specified herein.
- B. Additional work shall include providing a cleared temporary access area with approximate dimensions for 18' wide x 58' length for the temporary wastewater collection system, AS SHOWN ON THE DRAWINGS. This work will be paid under Section 204(01).
- C. The lagoon berm slopes shall be renovated to return the facility to the original design to the elevations, AS SHOWN ON DRAWINGS.
- D. Contractor shall be responsible for providing an inspection by the manufacturer's representative to inspect the final grading of the lagoon floor/side slopes, key trenches and all final surfaces, prior to any installations.
- E. Material to be excavated is unclassified. Contractor is advised to classify the material to their satisfaction.

PART 2 PRODUCTS

- A. Backfill materials shall be readily compactible excavated material free of frozen or organic material, highly plastic clay or other objectionable material and shall be free from sharp, angular stones, and the surface free from oversized particles, or any objects that could damage the liner and contain no rock.

PART 3 EXECUTION

3.1 EXCAVATION

- A. GENERAL
 - 1. The floor grade of the lagoon shall be graded to the slopes AS SHOWN ON THE DRAWINGS. The surface shall provide a firm, unyielding foundation for the liner with no sharp or abrupt changes in grade.
 - 2. The final surface shall be free from sharp stones, sticks, roots, vegetation, and any other material that could puncture the reinforced polypropylene liner.
- B. EXCAVATION AROUND STRUCTURES
 - 1. Excavation within the vicinity of existing structures, utilities, and drainage pipes to remain in-place shall be performed in a manner to prevent damage to the structures.
 - 2. Earth banks and facilities to remain in-place shall be supported as

necessary during excavation. In general, unless otherwise shown or specified, the actual side slopes will be at the Contractor's option. Exposed slope surfaces shall be kept moist during construction to minimize local sloughing.

C. EXCESS MATERIAL (SUITABLE AND UNSUITABLE)

1. All suitable excavated material shall be used as backfill.
2. All excavated material not required or unsuitable for backfill shall be utilized on the site or removed to waste areas as directed by the COR.

D. BORROW

1. Suitable fill material from required excavations shall be exhausted before using imported fill material.

E. IMPORTED FILL MATERIAL

1. Lagoon Subgrade: Furnish a suitable, well-graded compactable material free from sharp, angular stones, and the surface free from oversized particles, or any objects that could damage the liner. The subgrade surface must provide a smooth, flat, and unyielding foundation for the liner.

F. COMPACTION

1. Equipment: Compaction shall be accomplished by tamping roller, rubber-tired roller, vibrating compactor or mechanical tamper. It is the responsibility of the Contractor to determine the appropriate compaction equipment based on his interpretation of the site conditions and materials to be handled. All equipment, tools and machines shall be always maintained in satisfactorily working condition. Compaction equipment shall be suitable for consistently producing uniform densities.
2. Compaction: All surfaces receiving the new lagoon lining system (geomembrane | geotextile) shall be compacted to no visible displacement. No testing is required.

PART 4 BASIS OF PAYMENT

<u>PAY ITEM</u>	<u>DESCRIPTION</u>	<u>PAY UNIT</u>
312200(01)	Site Grading (Grading & Compaction: Lagoon Floor, Berm, And Embankment)	CY

END OF SECTION 31 22 00

DIVISION 31 – EARTHWORK

SECTION 31 23 33 – TRENCHING AND BACKFILL

PART 1 GENERAL

1.1 DESCRIPTION

This section covers trenching, clearing and grubbing, excavation, backfilling, bedding, and compaction for underground utilities including wastewater, effluent and electrical lines, gravel pad, marking tape, waste material disposal, trench resurfacing, finishing and area cleanup. All utility installations in the trenches will be covered under separate sections.

PART 2 – PRODUCTS

2.1 Marking Tape -

- A. Over Metallic Utility – Marking tape in trenches over metallic utilities shall be a 4 mil thickness of inert plastic film. The tape shall be brightly colored to contrast with soil and shall bear an imprint identifying the type of line buried below. Marking tape shall be "Standard Terra Tape" as manufactured by the Griffolyn Company of Houston, Texas, or "Identoline" as manufactured by the W.H. Brady Company of Milwaukee, Wisconsin, or an approved equal.
- B. Over Non-Metallic Utility – Marking tape in trenches over non-metallic utilities shall be an inert plastic film as described above bonded to a 1-1/2 mil metallic backing. Marking tape shall be "Detectatape" as manufactured by Allen Systems, Inc., of Wheaton, Illinois, or "Terra Tape - Detectible" as manufactured by the Griffolyn Company of Houston, Texas, or an approved equal.

- 2.2 Unsatisfactory Material, Bedding and Backfill Material, and Surfacing Materials - See Paragraphs 3.3B; 3.6, A1, B1 and C; and 3.8 of this section.

PART 3 – EXECUTION

- 3.1 Clearing and Grubbing – Final Location of the new effluent sprinkler line will be subject to approval by the CO.
- 3.2 Conserving Topsoil - When shown on the drawings that it is necessary to conserve topsoil, the following will apply:

Topsoil shall be removed from the area to be excavated and from the area where trench excavated material will be piled, prior to excavating the trench. Topsoil shall be kept separate from trench-excavated material by either stockpiling or by windrowing on the opposite side of the trench from which the trench excavated material will be placed. Topsoil will be reused after backfilling on those areas from which it came.

When topsoil is shown on the drawings to be kept separate and respread over the backfilled trench, it shall not be measured or paid for separately.

3.3 Trench Excavation - All trench excavation shall conform, as near as possible, to the lines and grades illustrated on the drawings.

- A. Classification of Excavation Material - Excavation will be unclassified as to materials and shall include all materials which are encountered in the required excavation.
- B. Unsatisfactory Material - During excavation, if material which does not meet the backfill requirements of Paragraph 3.6A (such as structurally unstable material, solid rock, over-sized rock, angular or sharp rock), as determined by the Contracting Officer, is encountered at the grade line for the pipe or lagoon subgrade, which will not permit proper bedding of the pipe or lagoon, the unsatisfactory material shall be removed to a minimum depth of 6 inches below the utility line. Trenching shall be performed by any acceptable method, excluding the use of explosives, as permitted by the Contract General Provisions.
- C. Trenching by Machine or by Hand - The use of trench digging machines will be permitted, except in places where machines may cause damage to existing structures, utilities, or trees, in which case, hand methods shall be employed. Machines shall be of the proper size to operate within the specified working limits. Areas specifically to be trenched by hand will be as indicated on the drawings.
- D. Depth - Trench excavation shall be such as to provide a uniform (for all utilities) or gently changing (for all utilities except gravity flow sewer lines) flow line.
- E. Alignment and Grade – All trenches shall conform with the lines and grades illustrated on the drawings.

3.4 Safety, Shoring, and Protection - The Contractor shall meet the provisions of the Occupational Safety and Health Administration (OSHA): 29 CFR Part 1926.650-.652 Subpart P. Walls of trenches, 4 feet or more in depth, shall be supported by bracing, shoring, or other methods, unless the sides of the trench are sloped to a safe angle, from the bottom of the trench or from the top edge of a steel cage when same is used. All existing improvements, either on public or private property, will be fully protected from damage.

All supports shall be removed after construction is completed and shall be withdrawn in a manner that will prevent the caving of the sides of the excavation. All openings in the ground, caused by the removal of supports, shall be filled with suitable material properly compacted.

3.5 Removal of Water - The Contractor shall provide and maintain, at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water entering the excavations or other parts of the work without damage to adjacent property. All excavations shall be kept free from standing water. Any

damage caused by water in the trench shall be repaired by the Contractor at his expense.

- 3.6 Backfill Operations - Backfilling will be permitted only after all inspections of piping and/or cable have been performed and tests completed, when required, and the work to be covered has been approved by the Contracting Officer. Backfill, which has been improperly placed and/or compacted, shall be corrected, if directed by the Contracting Officer, by reopening the trench to the depth required to obtain proper compaction. Then the trench shall be refilled and compacted according to specifications.

A. Backfill at Pipe Zone

1. Pipe Zone Material – Backfill material for electrical cable and all types of pipe, except ductile iron pipe and galvanized steel pipe, shall consist of soil, sand, or fine granular material free of stones, 3/4 inch or larger and free of organic material.

Backfill material for all ductile iron or galvanized steel pipe shall consist of soil, sand, or rock smaller than two inches in largest dimension and free of organic material.

Frozen material will not be allowed.

Backfill material shall be trench-excavated material whenever it meets specification requirements. Whenever material meeting the requirements for pipe zone backfill is not readily available from trench excavation, the Contractor will be required to import pipe zone material from a designated or approved source. Imported pipe zone material shall be paid for as such.

2. Procedure – Any backfill in trench bottom where over excavation was performed by the Contractor for his convenience, shall be brought back to the pipe grade indicated at his own expense. If the trench bottom is prepared in the wet, special bedding conforming to Paragraph 3.6C shall be used if determined necessary by the Contracting Officer.
3. The bottom of trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe along its entire length, except for portions of the pipe sections where it is necessary to excavate for pipe joints. Depressions for joints shall be made in accordance with the manufacturer's recommendations for the particular joint used. The bedding shall be a minimum of 3 inches in depth under the pipe and be of either special bedding or pipe zone material as conditions dictate. Trench bottom preparation shall be such that when final placement of pipe has been made, pipe will be true to line and grade. All adjustment to line and grade shall be made by scraping away or filling in with pipe zone material or special bedding material, as conditions dictate, under the body of the pipe and not by wedging or blocking.
4. Pipe zone material shall be deposited in the trench uniformly on both sides of the pipe for the full width of the trench in 6-inch horizontal layers (loose measurement)

and compacted from the bottom of the trench to a depth of 1 foot over the top of the pipe.

5. An exception to this is on waterlines and sewer lines where the Contractor elects to hydrostatically pressure test the pipe. Joints, couplings, fittings, and valves shall then be left uncovered until after the pipe has been tested. After testing proves the pipe installation to be satisfactory, pipe zone material shall then be placed carefully and compacted around the joints, couplings, fittings, and valves to a depth of 1 foot above the pipe, after which the remainder of the trench shall be backfilled in accordance with Paragraph 3.6B.
6. Where electrical conduit is buried in the same trench as the waterline or sewer line, the backfill procedure for the conduit shall be performed as outlined in the preceding paragraphs. Location, with respect to other utilities in a trench, shall be as indicated on the trench cross-section detail, as shown on the drawings.
7. When an electrical conduit is buried singly in a trench, or if only conduit is buried in a trench, the bedding shall be a minimum of 3 inches in depth under the conduit. After the conduit is placed, pipe zone material shall be deposited in the trench uniformly for the full width of the trench and compacted from the bottom of the trench to a depth of 6 inches over the top of the conduit.
8. All compaction within the pipe zone (electrical conduit area is considered as pipe zone), shall meet the following: Material shall be compacted to not less than 95 percent of the maximum dry unit weight, as determined by AASHTO T-99, Method D.

B. Backfill Above-Pipe-Zone

1. Above-Pipe-Zone Material – Backfill material shall be free from brush, perishable material, trash, rocks, or boulders larger than 6 inches in greatest dimension, or frozen material.
2. Backfill material shall be trench-excavated material whenever it meets specification requirements. Whenever trench excavated material contains less than 10 percent of oversized material, the Contractor will be required to remove boulders larger than 6 inches from the trench excavated material at no additional compensation and utilize it as backfill material. If, after all suitable trench excavated material has been used as backfill, the trench is not filled to the required grade, the Contractor shall delay his backfill operations until the Contracting Officer can obtain profile elevations of the top of the partially filled trench. These elevations shall be used in computing the cubic yards for which payment will be made for imported material. Whenever material meeting the specification requirements for backfill above the pipe zone is not available from trench excavation, the Contractor will be required to import material from a designated or approved source. Imported above-pipe-zone material shall be paid for as such.

3. Procedure – When shown on the drawings as being required, marking tape shall be installed six to ten inches below the ground surface and shall run the full length of the trenches.
4. Backfill in trenches in area other than under roadways and parking areas shall be placed in horizontal layers 12-inches thick or less (loose measurement), and compacted before the succeeding lift is placed with at least three passes of an approved mechanical compaction device.

C. Bedding/Shading Material/Special Bedding

1. Imported – Fine sand or soil with a maximum P.I. of 10, 100% passing the 3/8" sieve, without sharp chips or points.
2. Special bedding shall be placed, as directed by the Contracting Officer, in trenches, as necessary, to provide a minimum of 3 inches firm bedding on which to set the pipe in areas where relatively unstable conditions exist, due to seeping ground water or mud caused by ground water, or by water from any other source which cannot be diverted. After the material is placed in the trench, leveled, and consolidated, it shall be trimmed to proper sub grade and shaped to receive the pipe.

D. Imported Material – Any trench excavated material that can be transported less than 300 feet to other areas along the trench and used, in accordance with specifications, shall not be considered as imported material. When the Contractor is required to import material, it shall be from a designated or approved source.

E. Trenches in Embankments - When pipelines are to be placed in trenches excavated in embankments, the excavation of each trench shall be performed after the embankment has been constructed to a place at least 3 feet over the pipe or to finish grade, whichever is least.

F. Surface Restoration in Areas Other Than Roads – All surfaces shall be restored to the required grade (usually original ground line), mounded over or smoothed off as directed, and left in a uniform and neat condition, to the satisfaction of the Contracting Officer. Surface drainage shall be diverted so that it will not follow along a trench. In areas where natural revegetation is designated (no planting to be done), the Contractor shall scarify all disturbed or compacted areas and right-of-ways such that the surface of the ground is loose to a depth of at least one inch.

G. Water – Water shall be reasonably clean and free of injurious substances.

3.7 Waste Material Disposal – Any excess excavated material that can be transported less than 300 feet within the total project area and used in accordance with other project specifications will not be paid for separately.

- 3.8 Finishing and Cleanup - After the pipeline installation and backfill has been completed, the disturbed area along the pipeline shall be finish graded to present as near a natural appearance as possible and cleaned up by removing all debris and materials not utilized. Stockpiled topsoil shall be smoothly distributed over disturbed areas

END OF SECTION 31 23 33

DIVISION 32 – EXTERIOR IMPROVEMENTS
SECTION 32 80 00 – EFFLUENT SPRINKLER SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. The work shall consist of furnishing and installing equipment & components for a complete effluent sprinkler system in accordance with the approved drawings and these specifications.
- B. The new effluent sprinkler system starts from the 3" foot valve in the lagoon, float with hose section, new quick disconnect, all plumbing components throughout pumphouse, including pump, valves, back-up priming assembly, flow switch, fittings in the pumphouse, to the effluent sprinkler distribution system, including all the sprinkler heads, risers, drain lines, valves, valve boxes, and all related components.
- C. The short, existing 2" pump suction line within the existing lagoon slope embankment will not be replaced, AS SHOWN ON DRAWINGS.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

PART 2 PRODUCTS

2.1 PUMP

- A. Self-Priming Centrifugal Electrical Sewage/Trash Pump, 5 HP.
- B. Griswold Pump, H-Series Self-Priming Centrifugal Pump, Model 5HLS-G22361, Suction 3" NPT, Discharge 2" NPT or approved equal.
- C. Motor: 5HP Marathon Electric, Close Coupled Motor Frame-184JM or approved equal.
- D. Check valve: Cast Iron, Model 208 shall be bronze swing type, or approved equal.

2.2 FOOT VALVE

- A. Sure-flo, 3-inch with 45-degree OD tubing, Model SFV3-FP, or approved equal.
- B. Provide necessary adapters to provide proper connection.

2.3 FLOAT FOR FOOT VALVE

- A. Float for foot valve shall be as recommended by manufacturer by Foot Valve.
- B. Float shall be installed per manufacturer's recommendations
- C. A rope shall be fastened to provide a good retrieval to swing the foot valve back to embankment out of the lagoon.

2.4 SPRINKLERS

- A. Sprinkler heads shall be full circle impact heads w/ 1/8" nozzle delivery rate of 2.68 gpm @ 35 psi, RAINBIRD 20JH Straight Bore Nozzle (SBN-1) or approved equal.
- B. Risers shall be 3/4" Galvanized Steel Pipe (GSP), ASTM A53, Schedule 40.

SPRINKLER SYSTEM DESIGN DATA	
<u>PUMP</u>	CENTRIFUGAL, "STA-RITE E SERIES", BRONZE IMPELLER NO. CS-192 3 MIN. HP, 3500 RPM, DELIVERY 30 GPM @ 130' TDH, SINGLE STAGE SINGLE PHASE, 230 VOLTS
<u>PIPING SYSTEM</u>	2" DIAMETER SCH 40 PVC w/ 3/4" RISERS (GALV. STEEL)
<u>SPRINKLER HEADS</u>	RAINBIRD FULL CIRCLE IMPACT SPRINKLER HEADS (10 REQ'D.) w/ 1/8" NOZZLE DELIVERY RATE IS 2.47 GPM @ 30 P.S.I. DIAMETER OF SPRAY IS 74', EFFECTIVE DIAMETER OF SPRAY IS $74' \times 0.6 = 44.4'$ SPACE SPRINKLER HEADS 50' ON CENTERS w/ EXCEPTION THAT DISTANCE FROM SPRINKLE NO. 7 TO SPRINKLER NO. 8 IS 75'
<u>APPLICATION RATE</u>	$0.0543 \text{ IN./HR. / S.F.} \times 168 \text{ HRS. / WK. (MAX. PUMPING TIME)} =$ $9.12 \text{ IN./S.F. / WK. MAX. APPLICATION RATE.}$
<u>VOLUME OF LAGOONS:</u> <u>EFFLUENT TO BE</u> <u>DISPOSED OF EARLY</u>	500,000 GAL. / YR. @ 1,428 GAL. / HR. = 350 HRS. OF PUMPING TIME REQ'D. / YR.
<u>AREA WITHIN EFFLUENT</u> <u>RELIEF AREA</u>	1.75 ACRES
<u>AREA OF COVERAGE OF</u> <u>SYSTEM USING 10 SPRINKLER</u> <u>HEADS</u>	1.00 ACRES

Effluent Sprinkler System Design Data

2.5 SPRINKLER SYSTEM PIPING & VALVES

- A. Piping system shall be 2" diameter Sch 40 PVC.
- B. Daylight drains shall be 1" diameter Sch 40 PVC & 1" diameter GSP, ASTM A53, Schedule 40.
- C. Daylight drain valves shall be 1" ball style "stop and waste" curb stops, BC-11-44SW-NL by Ford Meter Box or approved equal. Provide a minimum of 2 operating wrenches.
- D. Valve boxes shall be Arch pattern curb boxes, EA1-30-40-18R SEWER by Ford Meter Box, or approved equal.
- E. Insect screen shall be #16 non-corrodible mesh screen over the opening with stainless steel clamp.
- F. Daylight drains shall receive (1) one cubic foot gravel pack beneath the outlets **AS SHOWN ON DRAWING.**

2.6 L-SHAPED GALVANIZED ANGLE POSTS

- A. Steel Angles shall be galvanized or zinc coated, ASTM A36 Steel, G90 galvanized.
- B. Dimensions: Minimum size (Leg x Leg x Thickness) shall be at least 1" x 1" x 1/8" and 18-inches in length.
- C. Utilize galvanized ties to secure the steel angle to galvanized steel riser AS SHOWN ON DRAWINGS. Ties shall be placed at three sections spaced evenly along the riser (bottom, mid, and upper sections).

2.7 DETECTABLE UNDERGROUND WARNING TAPE:

- A. Polyethylene plastic tape, 6 inches wide by 5 mils thick, reading "CAUTION BURIED SEWER LINE BELOW".

2.8 PIPE AND FITTINGS

- A. PVC Socket Fittings: Schedule 40/80, ASTM D 2466.
- B. Solvent Cement for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- C. Transition Fittings: Manufactured piping coupling or specified piping system fitting. Same size as pipes to be joined and pressure rating at least equal to pipes to be joined.
 - 1. Plastic-to-Metal Transition Fittings:
 - Description:
 - 1) PVC one piece fitting with manufacturer's Schedule 80 equivalent dimensions.
 - 2) One end with threaded brass insert and one solvent-cement-socket end.
 - Joints between different types of plastic pipe shall be made with an **approved** adapter fitting.
- D. Joints between Dissimilar Materials
 - 1. Use flanges, couplings, unions, or other transition fittings manufactured specifically for the types of pipe being joined and having a minimum pressure rating, or pressure class (as applicable) equal to or greater than the lower pressure rating or class of the pipes being joined.
- E. Suction, Non-collapsible Hose for Foot Valve
 - 1. 3" Suction hose shall be equipped with camlock (cam & groove type) fittings to connect two sections of suction hose for easy disconnection to foot valve.
 - 2. Installation shall be AS SHOWN ON DRAWINGS.
 - 3. Length of first section of suction hose shall be long enough to swing the foot valve to reach the embankment for easy retrieval out of the lagoon for maintenance and winterization.

2.9 PIPE SUPPORTS IN PUMPHOUSE

- A. Cast iron saddle, locknut nipple and reducer to provide vertical adjustment.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Contractor shall stake proposed layout of effluent distribution system for COR approval prior to installation.
- B. Installation shall be in accordance with the manufacturer's recommendations.

3.2 DAYLIGHT DRAINS

- A. Transition from PVC to GSP 10 feet from atmospheric outlet of daylight drain.
- B. Install insect screens on the atmospheric outlet of daylight drains with one 304 stainless steel hose clamps.
- C. Provide and place 1 cubic foot of gravel under each of the drain line outlets.

3.3 PUMP INSTALLATION

- A. The complete pumping system shall be installed in accordance with the manufacturer's written recommendations. Install union & valve on discharge piping per manufacturer's instructions.
- B. All electrical connections shall be in strict accordance with the latest version of the National Electric Code. Verify condition and proper parameters of existing control panel & flow switch before connecting.
- C. Prior to final acceptance the system shall be tested under operating conditions.

3.4 FOOT VALVE INSTALLATION

- A. Install foot valve per manufacturer's recommendations.
- B. Construct and install proper float to allow proper operation of the 45-degree foot valve and strainer. Foot Valve Float shall allow the foot valve to be placed above the sludge level, but not above the 1-foot maximum water level.
- C. The foot valve shall be connected to flexible, non-collapsible hose.
- D. For maintenance purposes, the non-collapsible hose shall be connected to the existing 2" PVC suction pipe with a 3" adapter. The 3" adapter shall be connected to a 10' section of non-collapsible hose with a 3" stainless steel camlock (cam and groove type). A third section of 5' non-collapsible hose shall have the 3" camlock cam and groove fitting for quick disconnect and will have the float with 45-degree foot valve attached.
- E. The last section shall have a strong, durable rope attached to provide easy pull to bring foot valve to embankment out of the lagoon.

PART 4 MEASUREMENT AND PAYMENT

<u>PAY ITEM</u>	<u>DESCRIPTION</u>	<u>PAY UNIT</u>
328000(01)	Effluent Sprinkler System Piping – 2" PVC, 1" PVC, 1" GSP	Lineal Feet
328000(02)	Effluent Sprinkler Fittings, Risers & Sprinkler Heads Assembly	Each

328000(03) Effluent Sprinkler System Daylight Drains (includes valves & valve boxes)	Each
328000(04) Effluent Sprinkler System, Pump & Plumbing System, . Including Foot Valve	Lump Sum

END OF SECTION 32 80 00

DIVISION 33 – UTILITIES
SECTION 33 36 00 – GEOTEXTILE

PART 1 GENERAL

1.1 SUMMARY

- A. The work shall consist of furnishing and installing non-woven geotextile in accordance with the approved drawings and these specifications. The work shall consist of furnishing and installing a geotextile drainage layer to be placed in between the double geomembrane lining system (primary and secondary) to place for the leakage detection layer.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Geotextile shall be a medium-weight, 8.0 oz/sy nonwoven needle-punched geotextile made of 100% polypropylene staple filaments. A recommended 8 oz Geotextile by Western Environmental Liner or approved equal.
- B. Physical Description – The non-woven geotextile shall meet or exceed the physical property values as shown in the table below:

PROPERTY	TEST METHOD	NOMINAL UNIT SPECIFICATIONS
Weight (typical)	ASTM D 5261	8.0 oz/yd
Grab Tensile	ASTM D 4632	205 - 225 lbs
Grab Elongation	ASTM D 4632	50%
Trapezoid Tear Strength	ASTM D 4533	85 - 95 lbs
Puncture Resistance	ASTM D 4833	120 lbs
Puncture Resistance	ASTM D 6241	535 - 600 lbs
Mullen Burst	ASTM D 3786	350 psi
Permittivity*	ASTM D 4491	1.30 - 1.35 sec. ₁
Water Flow*	ASTM D 4491	90 - 95 gpm

AOS*	ASTM D 4751	80 US Sieve
UV Resistance @ 500 hrs	ASTM D 4355	70 %

PART 3 EXECUTION

3.1 WEATHER LIMITATIONS

- A. Nonwoven geotextile fabric shall not be placed in wet or snowy conditions, heavy rainfall, or extreme heat or cold.

3.2 INSTALLATION

- A. Surface preparation shall be in accordance with 31 22 00 EARTHWORK. Contractor shall check measurements and grades before starting geotextile installation.
- B. The nonwoven geotextile fabric shall be unrolled on the finished surface and laid smooth without wrinkles.
- C. The placement of fabric by dragging across the finished surface will not be allowed.
- D. The geotextile fabric shall be prefabricated from supplier and may be overlapped at joints a minimum 24 inches for longitudinal and transverse joints.
- E. Any damage to the fabric occurring during placement must be repaired immediately.
- F. Mechanical or laydown equipment shall be capable of handling full rolls of fabric. The equipment shall be in accordance with the fabric manufacturer's recommendations or as approved by the COR.

3.3 Placement of the geotextile

- A. Geotextile installation shall be placed after the secondary geomembrane has been installed, tested and approved by the CO.
- B. Weighted sandbags shall be used to prevent movement and/or uplift during installation. These sandbags shall be installed during placement and shall remain until replaced with cover material.
- C. The rolls shall be placed in a trench so that pull out or slippage is prevented, AS SHOWN ON DRAWINGS. The rolls shall be placed from top to bottom and hand tightened to remove any wrinkles.
- D. Each continuous panel shall be extended through the bottom of the anchor trenches, transition areas, and/or pipe drain collection trenches prior to collection pipe or gravel placement.
- E. There shall be no end panel seams in these transition areas, only side to side panel (seams oriented perpendicular to pipe trench) seams.

3.4 CONCRETE STRUCTURES

A. Baffle and Pipe Supports:

1. An additional layer system of 8-oz non-woven geotextile and geomembrane shall be placed under each of the concrete structures to provide additional protection.
2. The dimensions of the additional “padded” protection areas are AS SHOWN ON DRAWINGS.
3. The new concrete structures will be placed in the center of the “padded” areas at the original locations.
4. The “padded” areas shall be fastened similarly to “boot” installation to weld the pieces together.

PART 4 BASIS OF PAYMENT

- A. The 8-oz non-woven geotextile media system work, including any accessories necessary for installation, as specified in this section, will be measured as one Lump Sum quantity.

<u>PAY ITEM</u>	<u>DESCRIPTION</u>	<u>PAY UNIT</u>
333600(01)	Geotextile, 8-oz/sy Non-woven	Lump Sum

END OF SECTION 33 36 00

DIVISION 33 – UTILITIES
SECTION 33 46 00 – GEOMEMBRANE LINER

PART 1 GENERAL

1.1 SUMMARY

- A. The work shall consist of furnishing and installing a double geomembrane lining system including a geocomposite drainage layer with a leak detection pit. The primary and secondary liners shall be properly installed per manufacturer's recommendations and in accordance with the drawings and these specifications. The primary geomembrane shall be either a 45-mil thick Reinforced Polypropylene (RPP) liner OR 60-mil High Density Polyethylene (HDPE) liner. The secondary geomembrane shall be a 60-mil HDPE liner.

1.2 SUBMITTALS

- A. Manufacturer's product data and installation instructions, including field seam methods
- B. Shop Drawings of the proposed geomembrane panel layout
- C. Certification that factory seams were inspected and tested in accordance with manufacturer's recommendations.
- D. Warranty information for each material and product used.

1.3 MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall obtain the services of a person with full authority to represent the lining manufacturer during the installation of the liner unless they are an authorized installer. All work involved in the installation of the liner shall be in strict accordance with the manufacturer's recommendation.
- B. Installation shall be performed by an authorized installation contractor who has previously installed 2,000,000 square feet (minimum) of this material or by a contractor who has a manufacturer's field representative in attendance.
- C. A manufacturer's field representative will be required during the liner installation if the installation is not done by an authorized installer. The Contractor will bear the expense of this field service representative. The field service representative is not directly responsible for the work quality; such responsibility shall be solely that of the Contractor.

PART 2 PRODUCTS

2.1 MATERIALS

Type	Name	Minimum Thickness (mil)	Wastewater
RPP	Reinforced Polypropylene	45	Yes
HDPE	High Density Polyethylene	60	Yes

- A. The primary geomembrane shall be color Tan.

2.2 BERM VENTS

- A. Contractor shall supply the liner manufacturer's recommended air/gas berm vents. Typical spacing is 50 feet on center at the crest of the side slopes.

2.3 PIPE BOOTS

- A. Contractor shall supply the liner manufacturer's factory fabricated pipe boots for all liner penetrations. Contractor shall verify the following schedule of liner penetrations requiring pipe boots:
 - 1. One 8-inch D.I.P. inflow pipe
 - 2. One 2-inch PVC outflow pipe
 - 3. One 8-inch SDR 35 leak detection pipe
 - Full cover support for length of pipe. The leak detection pipe shall be covered from bottom end of submerged pipe to top of slope installation.
 - The leak detection pipe is placed over the new lining system and boot is over the 8-inch SDR 35 pipe which lies along the slope of the lagoon side.

2.4 MINOR CONCRETE STRUCTURES

- A. Contractor shall supply and place additional "padding" for the following concrete structures:
 - 1. (3) three or (4) four 1.5' x 1.5' concrete pipe supports
 - 2. (1) one 4' x 6' concrete outlet baffle

2.5 MINOR CONCRETE STRUCTURES "PADDING"

- A. The "PADDING" system shall consist of an additional lining system of both the geotextile & geomembrane.
- B. The "padding" shall be centered and placed at the original locations. Contractor is responsible for locating the original sites. New concrete structures will be placed on top of the padded areas for additional protection of lining system.
- C. Each of the "padding" installations shall be placed over the initial lining system.
- D. Each of the "padding" areas shall be adhered or welded similarly to a boot installation per manufacturer's recommendations.
- E. Dimensions of "PADDED" areas:
 - 1. Concrete Pipe Supports – Each pipe support shall receive a 3' x 3' additional lining system (geomembrane and geotextile).
 - 2. Concrete Outflow Baffle – Baffle shall receive a 6' x 8' additional lining system beneath the concrete structure.

2.6 SANDBAGS

- A. Recommended to temporarily anchor the liner to prevent uplift due to wind or slippage down the side slope.
- B. For HDPE, allow minimum 24 hours of thermal relaxation before backfilling the anchor trench, or follow manufacturer's recommendations, to allow for thermal

expansion and contraction.

PART 3 EXECUTION

3.1 PREPARATION

- A. The surface to receive the liner shall be maintained in a firm, clean, dry, and smooth condition during the lining installation.
- B. All surfaces shall be compacted and smooth graded with anchor trenches provided as required and detailed.
- C. All surfaces shall be free from sharp objects that could puncture the lining during the lining installation including rocks, roots, gravel or debris.
- D. The surface to receive the liner shall be approved by the COR before installation. Provide a minimum of 2 business days' notice prior to installation. Any erosion or other damage to the base material shall be corrected.
- E. Anchor trenches shall be excavated according to the manufacturer's instructions. Soil excavated from the trench shall always be placed away from the side slope.

3.2 INSTALLATION

- A. Installation shall be placed over the prepared surfaces in such a manner as to ensure minimum handling.
- B. The lining shall be closely fitted and sealed around all inlets, outlets and other projections through the lining, using prefabricated fittings where possible as shown in the drawings.
- C. Liner sheets, damaged from any cause, shall be removed, repaired or covered with additional sheeting.
- D. Only those geomembrane sheets of lining material which can be anchored and seamed together the same day shall be unpackaged and placed into position.
- E. Anchor trenches shall be excavated according to the manufacturer's instructions. Soil excavated from the trench shall always be placed away from the side slope.
- F. Contractor to supply sandbags to hold down the liner during high winds. The leading edges of the liner material left exposed after the day's work shall be anchored to prevent damage or displacement due to high wind.
- G. Materials, equipment or other items shall not be dragged across the surface of the geomembrane liner or be allowed to slide down slopes on the lining.
- H. All personnel walking on the geomembrane liner shall have smooth soled shoes. Personnel working on the geomembrane liner shall not smoke and shall not engage in activities that could damage the liner.
- I. Vehicles shall not be allowed on the new geomembrane liner unless approved by the manufacturer's representative.
- J. Cements and adhesives shall be kept from extreme heat and cold.

3.3 FIELD SEAMS

- A. Lap joints shall be used to seal factory fabricated geomembrane sheets together in the field. The lap joints shall be formed as directed by the manufacturer's field representative or according to the manufacturer's written instructions. The contact surfaces of the sheets shall be wiped clean of all dirt, dust, moisture, and other foreign matter. A minimum 1-1/2 in. bond shall apply to all field seams.

- B. Extreme care should be taken throughout the work to avoid fishmouths, wrinkles, folds or pleats in the seam area. Where fishmouths do occur, they should be slit out far enough from the seam to dissipate them, lapped, seamed together in the lapped area and patched.
- C. Field seams shall have at least 80% of the specified sheet strength.

3.4 PIPE PENETRATIONS

- A. Penetrations shall be factory fabricated pipe seals and constructed using the same material as the specified geomembrane liner. For reinforced material, the tube section of the pipe seal can be constructed using non-reinforced parent material.

3.5 INSPECTING AND TESTING FIELD SEAMS

- A. Inspection: Upon completion of the liner installation, all seams shall be visually inspected for compliance with these specifications.
- B. In addition to visual inspection, all field seams shall be checked using a non-destructive test method for quality.
- C. On completion of work, all field seams shall be tightly bonded. Any liner surface showing injury due to scuffing, penetration by foreign objects, or distress from other causes shall, as directed by the COR, be replaced or repaired. All exposed scrim edges shall be sealed with an approved extrudate, or repaired by manufacturer recommendation.
- D. Testing geomembrane Field Seams: Use the recommended test methods acceptable by the manufacturer for non-destructive testing of field seams.

3.6 REPAIRS TO GEOMEMBRANE

- A. Any necessary repairs shall be made as directed by the manufacturer's field representative or according to the manufacturer's written instructions. The entire surface of the patch shall be bonded to the lining material. If reinforced patches are used, the cut edges of the patch must be sealed with an approved extrudate.

3.7 WARRANTY

- A. The GEOMBEMBRANE liner manufacturer shall confirm in writing that the material to be furnished will be free of defects at the time of sale, and against deterioration due to the effects of ozone, ultraviolet or other normal weathering on a pro-rata basis for year from the data of completed installation.
- B. The geomembrane liner manufacturer shall furnish a sample warranty for review and approval prior to shipment. Warranty of the geomembrane product shall be a minimum 20-year warranty.
- C. The Contractor shall submit the written warranty to the COR

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

- A. The PRIMARY geomembrane work, including all pipe boots, berm vents, and all accessories necessary for installation, as specified in this section and AS SHOWN ON THE DRAWINGS, will be measured as one Lump Sum Quantity (LSQ).
- B. The SECONDARY geomembrane work, as specified in this section and AS SHOWN

ON THE DRAWINGS, will be measured as one Lump Sum Quantity (LSQ).

4.2 PAYMENT

- A. Payment will be made at the contract lump sum unit price as listed in the “Schedule of Items” for quantities measured and accepted as follows:

<u>PAY ITEM</u>	<u>DESCRIPTION</u>	<u>PAY UNIT</u>
334600(01)	Geomembrane Liner (Primary Liner)..... (Includes Pipe Boots, Berm Vents, Padding & All Accessories & Installation)	Lump Sum
334600(02)	Geomembrane Liner (Secondary Liner) (Includes Installation)	Lump Sum

END OF SECTION 33 46 00

FSSS 204 - Excavation and Embankment Borrow Excavation

204.00_National_11_4_2016

- (1) Delete Section 204 in its entirety and replace with the following.

Section 204. — EXCAVATION AND EMBANKMENT

Description

204.01 This work consists of excavating material and constructing embankments. This work also includes furnishing, hauling, stockpiling, placing, disposing, sloping, shaping, compacting, and finishing earthen and rocky material.

204.02 Definitions.

- (a) **Excavation.** Excavation consists of the following:

(1) **Roadway excavation.** Material excavated from within the right-of-way or easement areas, except subexcavation covered in Subsection 204.02(a)(2) and structure excavation covered in Sections 208 and 209. Roadway excavation includes all material encountered regardless of its nature or characteristics.

(2) **Subexcavation.** Material excavated from below subgrade elevation in cut sections or from below the original ground-line in embankment sections. Subexcavation excludes the work required by Subsection 204.05 or 204.06.

(3) **Borrow excavation.** Material used for embankment construction that is obtained from outside the roadway prism. Borrow excavation includes unclassified borrow, and topping.

- (b) **Embankment construction.** Embankment construction consists of placing and compacting roadway or borrow excavation. This work includes:

(1) Preparing foundation for embankment;

- (2) Constructing roadway embankments;
- (3) Benching for side-hill embankments;
- (4) Constructing dikes, ramps, mounds, and berms; and
- (5) Backfilling subexcavated areas, holes, pits, and other depressions.

(c) **Conserved topsoil.** Excavated material conserved from the roadway excavation and embankment foundation areas that is suitable for growth of grass, cover crops, or native vegetation.

(d) **Waste.** Excess and unsuitable roadway excavation and subexcavation that cannot be used.

Material

204.03 Conform to the following Subsections:

Topping	704.05
Unclassified borrow	704.06
Water	725.01(c)

Construction Requirements

204.04 Preparation for Roadway Excavation and Embankment Construction. Clear the area of vegetation and obstructions according to Sections 201 and 203.

Road pioneering, slash disposal, and grubbing of stumps may proceed concurrently with excavation and embankment. Maintain drainage during pioneering operations.

204.05 Conserved Topsoil. When designated, conserve topsoil from roadway excavation and embankment foundation areas. Stockpile conserved topsoil in low windrows immediately beyond the rounding limits of cut and embankment slopes or in other approved locations. Separate conserved topsoil from other excavated material. When designated, place conserved topsoil on completed slopes according to Section 624.

204.06 Roadway Excavation. Excavate as follows:

(a) **Rock cuts.** Blast rock according to Section 205. Excavate rock cuts to 6 inches (150 millimeters) below subgrade within the roadbed limits. Backfill to subgrade with topping or other suitable material. Compact the material according to Subsection 204.11.

(b) **Earth cuts.** Scarify earth cuts to 6 inches (150 millimeters) below subgrade within the roadbed limits. Compact the scarified material according to Subsection 204.11.

(c) **Pioneer Roads.** Conduct excavation and placement operations so material to be treated under Section 201 will not be incorporated into the roadway unless specified in the slash treatment method. Maintain drainage during pioneering operations.

Remove snow and ice in advance of the work and deposit beyond the roadway limits in a manner that will not waste material or generate sediment. Do not incorporate snow and ice into embankments. Place snow or ice in a manner to prevent resource damage.

(d) **Drainage Feature.** Drainage feature includes construction of all ditches, minor channel changes, drainage dips, catch basins, surface water deflectors, and other minor drainage structures. Compact the material according to Subsection 204.11. Excavate on a uniform grade between control points.

Do not disturb material and vegetation outside the construction limits. Retrieve material deposited outside the construction limits. Dispose of unsuitable or excess excavation material according to Subsection 204.14.

Replace shortage of suitable material caused by premature disposal of roadway excavation.

Shape to drain and compact the work area to a uniform cross-section at the end of each day's operations.

204.07 Subexcavation. Excavate material to the required limits. Dispose of unsuitable material according to Subsection 204.14. Take cross-sections according to Section 152. Backfill subexcavated area with suitable material in horizontal layers not exceeding 12 inches (300 millimeters) in compacted thickness and compact according to Subsection 204.11. Prevent unsuitable material from mixing with suitable backfill material.

204.08 Borrow Excavation. Use suitable roadway excavation in embankment construction. Do not use borrow excavation when it results in excess roadway excavation. Deduct excess borrow excavation from the total borrow excavation quantity.

Obtain borrow source approval according to Subsection 105.02. Develop and restore borrow sources according to Subsections 105.03 and 105.06. Do not excavate beyond the established limits. When applicable, shape the borrow source to permit accurate measurements when excavation is complete.

204.09 Preparing Foundation for Embankment Construction. Prepare foundation for embankment construction as follows:

(a) Embankment over natural ground. Remove topsoil and break up the ground surface to a minimum depth of 6 inches (150 millimeters) by plowing or scarifying. Compact the ground surface according to Subsection 204.11.

(b) Embankments over an existing asphalt, concrete, or gravel road surface. Scarify gravel roads to a minimum depth of 6 inches (150 millimeters). Scarify or pulverize asphalt and concrete roads to 6 inches (150 millimeters) below the pavement. Reduce particles to a maximum size of 6 inches (150 millimeters) and produce a uniform material. Compact the surface according to Subsection 204.11.

(c) Embankment across ground not capable of supporting equipment. Dump successive loads of embankment material in a uniformly distributed layer to construct the lower portion of the embankment. Limit the layer thickness to the minimum depth necessary to support the equipment.

(d) Embankment on an existing slope steeper than 1V:3H. Cut horizontal steps in the existing slope to a sufficient width to accommodate placement and compaction operations and equipment. Step the slope as the embankment is placed and compacted in layers. Begin each step at the intersection of the original ground and the vertical cut of the previous step.

204.10 Embankment Construction. Incorporate only suitable roadway excavation material into the embankment. When the supply of suitable roadway excavation is exhausted, furnish unclassified borrow to complete the embankment. Obtain written approval before beginning construction of embankments over 6 feet (2 meters) high at subgrade centerline. Construct embankments as follows:

(a) General. At the end of each day's operations, shape to drain and compact the embankment surface to a uniform cross-section. Eliminate ruts and low spots that could hold water.

During all stages of construction, route and distribute hauling and leveling equipment over the width and length of each layer of material.

Compact embankment side slopes with a tamping foot roller, by walking with a dozer, or by over-building the fill and then removing excess material to the final slope line. For slopes 1V:1¾H or steeper, compact the slopes as embankment construction progresses.

(b) Embankment within the roadway prism. Place embankment material in horizontal layers not exceeding 12 inches (300 millimeters) in compacted thickness. Incorporate oversize boulders or rock fragments into the 12-inch (300-millimeter) layers by reducing them in size or placing them individually as required below. Compact each layer according to Subsection 204.11 before placing the next layer.

Material composed predominately of boulders or rock fragments too large for 12-inch (300-millimeter) layers may be placed in layers up to 24 inches (600 millimeters) thick. Incorporate oversize boulders or rock fragments into the 24-inch (600-millimeter) layer by reducing them in size or placing individual rock fragments and boulders greater than 24 inches (600 millimeters) in diameter as follows:

- (1) Reduce rock to less than 48 inches (1200 millimeters) in the largest dimension;
- (2) Distribute rock within the embankment to prevent nesting;
- (3) Place layers of embankment material around each rock to a depth not greater than that permitted above. Fill voids between rocks; and
- (4) Compact each layer according to Subsection 204.11(a) before placing the next layer.

(c) Embankment outside of roadway prism. When placing embankment outside the staked roadway prism, place material in horizontal layers not exceeding 24 inches (600 millimeters) in compacted thickness. Compact each layer according to Subsection 204.11.

204.11 Compaction. Compact the embankment using one of the following methods as specified.

(a) Placement Method 1. Use AASHTO T 27 to determine the quantity of material retained on a No. 4 (4.75-millimeter) sieve. Compact as follows:

(1) More than 80 percent retained on a No. 4 (4.75-millimeter) sieve. Adjust the moisture content to a level suitable for compaction. Fill the interstices around rock with earth or other fine material as practical. Use compression-type rollers at speeds less than 6 feet (1.8 meters) per second and vibratory rollers at speeds less than 3 feet (1 meter) per second. Compact each layer of material full width with one of the following and until there is no visible evidence of further consolidation:

- (a) Four roller passes of a vibratory roller having a minimum dynamic force of 40,000 pounds (180 kilonewtons) impact per vibration and a minimum frequency of 1000 vibrations per minute;
- (b) Eight roller passes of a 20-ton (20-metric ton) compression-type roller; or
- (c) Eight roller passes of a vibratory roller having a minimum dynamic force of 30,000 pounds (130 kilonewtons) impact per vibration and a minimum frequency of 1000 vibrations per minute.

Increase the compactive effort for layers deeper than 12 inches (300 millimeters) as follows:

- For each additional 6 inches (150 millimeters) or fraction thereof, increase the number of roller passes in Subsection 204.11(a)(1)(a), by four passes; or
- For each additional 6 inches (150 millimeters) or fraction thereof, increase the number of roller passes in Subsection 204.11(a)(1)(b) and (c), by eight passes.

(2) 50 to 80 percent retained on a No. 4 (4.75-millimeter) sieve. Classify the material according to AASHTO M 145. Adjust the moisture content of material classified A-1 through A-5 to a moisture content suitable for compaction. Adjust the moisture content of material classified A-6 and A-7 to within 2 percent of the optimum moisture content. Use AASHTO T 99 to determine the optimum moisture content of the portion of the material passing a No. 4 (4.75-millimeter) sieve. Multiply this number by the percentage of material passing a No. 4 (4.75-millimeter) sieve, and add 2 percent to determine the optimum moisture content of the material.

Use nonvibratory rollers at speeds less than 6 feet (1.8 meters) per second and vibratory rollers at speeds less than 3 feet (1 meter) per second. Compact each layer of material full width according to Subsection 204.11(a)(1).

(3) Less than 50 percent retained on a No. 4 (4.75-millimeter) sieve. Classify the material according to AASHTO M 145. For material classified A-1 or A-2-4, determine the maximum density according to AASHTO T 99, Method C.

Adjust the moisture content of material classified A-1 through A-5 to a moisture content suitable for compaction. Adjust the moisture content of material classified A-6 and A-7 to within 2 percent of the optimum moisture content.

Use compression-type or vibratory rollers. Compact each layer of material full width to at least 95 percent of the maximum density. Determine the in-place density and moisture content according to AASHTO T 310 or other approved test procedures. When required, use AASHTO T 224 to correct for coarse particles.

(b) Placement Method 2. Adjust the moisture content of the material to a moisture content suitable for compaction. Fill the interstices around rock with earth or other fine material as practical. Operate roller compaction equipment over the full width of each layer until there is no visible evidence of further consolidation or, if when a sheepsfoot roller is used, the roller “walks out” of the layer. Make at least three complete passes. Use compression-type rollers at speeds less than 6 feet (1.8 meters) per second and vibratory rollers at speeds less than 3 feet (1 meter) per second. Ensure rollers meet the following requirements:

(1) Steel wheeled rollers, other than vibratory, capable of exerting a force of not less than 250 pounds per inch (4.5 kilogram/millimeter) of width of the compression roll or rolls.

(2) Vibratory steel wheeled rollers equipped with amplitude and frequency controls with a minimum dynamic force of 30,000 pounds (130 kilonewtons) impact per vibration, specifically designed to compact the material on which it is used.

(3) Pneumatic-tired rollers with smooth tread tires of equal size that will provide a uniform compacting pressure for the full width of the roller and capable of exerting a ground pressure of at least 80 psi (550 Kilopascals).

(4) Sheepsfoot, tamping, or grid rollers capable of exerting a force of 250 pounds per inch (4.5 kilogram/millimeter) of width of roller drum.

(c) Placement Method 3. Adjust the moisture content of the material to a moisture content suitable for compaction. Fill the interstices around rock with earth or other fine material as practical. Operate hauling and spreading equipment uniformly over the full width of each layer until there is no visible evidence of further consolidation. Make at least three complete passes.

(d) Placement Method 4. Adjust the moisture content of the material to a moisture content suitable

for compaction. Fill the interstices around rock with earth or other fine material as practical. Operate hauling and spreading equipment uniformly over the full width of each layer.

(e) Placement Method 5. Adjust the moisture content of the material to a moisture content suitable for compaction. Compact the complete surface with a bucket of an excavator larger than 39,000 pounds (18 metric ton) Gross Vehicle Weight using a minimum of three blows. Overlap compaction by $\frac{1}{2}$ width of bucket.

(f) Placement Method 6. Adjust the moisture content of the material to a moisture content suitable for compaction. Compact using an approved mechanical tamper for a minimum of three complete passes.

When compacting with rollers or hauling and spreading equipment is not practical, use approved mechanical tampers for a minimum of three complete passes.

204.12 Drainage Features. Slope, grade, and shape all drainage features. Remove projecting roots, stumps, rock, or similar matter. Maintain all drainage features in an open condition and without sticks, and other debris.

Form furrow ditches by plowing or using other acceptable methods to produce a continuous furrow. Place excavated material on the downhill side so the bottom of the ditch is approximately 18 inches (450 millimeters) below the crest of the loose material. Clean the ditch using a hand shovel or other suitable method. Shape to provide drainage without overflow.

204.13 Sloping, Shaping, and Finishing. Complete subgrade, slopes, drainage features, culverts, riprap, and other underground minor structures before placing aggregate courses. Slope, shape, and finish to the designated tolerance class as defined in Table 204-2 as follows:

(a) Sloping. Leave earth slopes with uniform roughened surfaces, except as described in Subsection 204.13(b), with no noticeable break as viewed from the road. Except in solid rock, round tops and bottoms of slopes including the slopes of drainage ditches. Round material overlaying solid rock to the extent practical. Scale rock slopes. Slope rounding is not required on tolerance class D through M roads.

If a slide or slipout occurs on a cut or embankment slope, remove or replace the material and repair or restore damage to the work. Bench or key the slope to stabilize the slide. Reshape the cut or embankment slope to an acceptable condition.

(b) Stepped slopes. Where required, construct steps on slopes of $1\frac{1}{3}V:1H$ to $1V:2H$. Construct the steps approximately 18 inches (450 millimeters) high. Blend the steps into natural ground at the end of the cut. If the slope contains non-rippable rock outcrops, blend steps into the rock. Remove loose material found in transitional area. Except for removing large rocks that may fall, scaling stepped slopes is not required.

(c) Shaping. Shape the subgrade to a smooth surface and to the cross-section required. Shape slopes to gradually transition into slope adjustments without noticeable breaks. At the ends of cuts and at intersections of cuts and embankments, adjust slopes in the horizontal and vertical planes to blend into each other or into the natural ground.

(d) Finishing. Ensure that the subgrade is visibly moist during shaping and dressing; smooth and uniform, and shaped to conform to the typical sections. Remove material larger than 6 inches (150 millimeters) from the top 6 inches (150 millimeters) of the roadbed. Remove unsuitable material from the roadbed, and replace it with suitable material. Scarify to 6 inches (150 millimeters) below the bottom of low sections, holes, cracks, or depressions and bring back to grade with suitable material. Maintain proper ditch drainage.

204.14 Disposal of Unsuitable or Excess Material. Dispose of unsuitable or excess material at designated sites or according to Subsection 203.05(a)

When there is a pay item for waste, shape and compact the waste material in its final location. Do not mix clearing or other material not subject to payment with the waste material.

204.15 Acceptance. See Table 204-1 for sampling, testing, and acceptance requirements.

Material for embankment and conserved topsoil will be evaluated under Subsections 106.02 and 106.04.

Excavation and embankment construction will be evaluated under Subsections 106.02 and 106.04.

Subexcavation will be evaluated under Subsections 106.02 and 106.04.

Measurement

204.16 Measure the Section 204 pay items listed in the bid schedule according to Subsection 109.02 and the following as applicable:

(a) Roadway excavation. Measure roadway excavation in its original position as follows:

(1) Include the following volumes in roadway excavation:

- (a)* Roadway prism excavation;
- (b)* Rock material excavated and removed from below subgrade in cut sections;
- (c)* Unsuitable material below subgrade and unsuitable material beneath embankment areas when a pay item for subexcavation is not listed in the bid schedule;
- (d)* Ditches, except furrow ditches measured under a separate pay item;
- (e)* Conserved topsoil;
- (f)* Borrow material used in the work when a pay item for borrow is not listed in the bid schedule;
- (g)* Loose scattered rocks removed and placed as required within the roadway;
- (h)* Conserved material taken from pre-existing stockpiles and used in Section 204 work, except topsoil measured under 624; and
- (i)* Slide and slipout material not attributable to the Contractor's method of operation.

(2) Do not include the following in roadway excavation:

- (a)* Overburden and other spoil material from borrow sources;
- (b)* Overbreakage from the backslope in rock excavation;
- (c)* Water or other liquid material;
- (d)* Material used for purposes other than required;

- (e) Roadbed material scarified in place and not removed;
 - (f) Material excavated when stepping cut slopes;
 - (g) Material excavated when rounding cut slopes;
 - (h) Preparing foundations for embankment construction;
 - (i) Material excavated when benching for embankments;
 - (j) Slide or slipout material attributable to the Contractor's method of operation;
 - (k) Conserved material taken from stockpiles constructed at the option of the Contractor;
 - (l) Material excavated outside the established slope limits; and
 - (m) Road pioneering for the convenience of the Contractor.
- (3)** When both roadway excavation and embankment construction pay items are listed in the bid schedule, measure roadway excavation only for the following:
- (a) Unsuitable material below subgrade in cuts and unsuitable material beneath embankment areas when a pay item for subexcavation is not listed in the bid schedule;
 - (b) Slide and slipout material not attributable to the Contractor's method of operations; and
 - (c) Drainage ditches, channel changes, and diversion ditches.

(b) Unclassified borrow, and topping. When measuring by the cubic yard (cubic meter) measure in its original position. If borrow excavation is measured by the cubic yard (cubic meter) in-place, take initial cross-sections of the ground surface after stripping overburden. Upon completion of excavation and after the borrow source waste material is returned to the source, retake cross-sections before replacing the overburden. Do not measure borrow excavation until suitable roadway excavation is depleted.

(c) Embankment construction. Measure embankment construction in its final position. Do not make deductions from the embankment construction quantity for the volume of minor structures.

(1) Include the following volumes in embankment construction:

- (a) Roadway embankments;
- (b) Material used to backfill subexcavated areas, holes, pits, and other depressions;
- (c) Material used to restore obliterated roadbeds to original contours; and
- (d) Material used for dikes, ramps, mounds, and berms.

(2) Do not include the following in embankment construction:

- (a) Preparing foundations for embankment construction;

(b) Adjustments for subsidence or settlement of the embankment or of the foundation on which the embankment is placed; and

(c) Material used to round fill slopes.

(d) Rounding cut slopes. If a pay item for slope rounding is included in the bid schedule measure rounding cut slopes horizontally along the centerline of the roadway. If a pay item is not included for slope rounding is not included in the bid schedule payment will be considered indirect to roadway excavation.

(e) Waste. Measure waste by the cubic yard (cubic meter) in its final position. Take initial cross-sections of the ground surface after stripping over-burden. Upon completion of the waste placement, retake cross-sections before replacing overburden.

(f) Slope scaling. Measure slope scaling by the cubic yard (cubic meter) in the hauling vehicle.

(g) Subexcavation. Measure subexcavation by the cubic yard (cubic meter) in its original position.

(h) Drainage features. Measurement includes all excavation, embankment, shaping, and grading necessary for a completed drainage feature.

Payment

204.17 The accepted quantities will be paid at the contract price per unit of measurement for the Section 204 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Table 204-1

Sampling, Testing, and Acceptance Requirements

Material or Product (Subsection)	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Source								
Topping (704.05)	Measured and tested for conformance (106.04 & 105)	Classification ⁽¹⁾	—	AASHTO M 145	1 per soil type and source of material	Source of material	Yes	Before using in work
Unclassified borrow (704.06)	"	"	—	"	"	"	"	"
Select borrow (704.07)	"	"	—	"	"	"	"	"
		Gradation	—	AASHTO T 27 & T 11	"	"	"	"
		Liquid limit	—	AASHTO R 58 & T 89, Method A	"	"	"	"

Table 204-1 (continued)

Sampling, Testing, and Acceptance Requirements

Material or Product (Subsection)	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Production								
Topping (704.05)	Measured and tested for conformance (106.04)	Moisture-density	–	AASHTO T 180, Method D ⁽²⁾ or T 99, Method C ⁽²⁾	1 per soil type, but not less than 1 per each 13,000 yd ³ (10,000 m ³)	Processed material	Yes	Before using in work
		Density	–	AASHTO T 310 or other approved procedures	1 per 3500 yd ² (3000 m ²), but not less than 1 per layer	In-place	No	Before placement of next layer
Unclassified borrow (704.06)	"	Moisture-density	–	AASHTO T 180, Method D ⁽²⁾ or T 99, Method C ⁽²⁾	1 per soil type, but not less than 1 per each 13,000 yd ³ (10,000 m ³)	Processed material	Yes	Before using in work
		Density	–	AASHTO T 310 or other approved procedures	1 per 3500 yd ² (3000 m ²), but not less than 1 per layer	In-place	No	Before placement of next layer

Table 204-1 (continued)

Sampling, Testing, and Acceptance Requirements

Material or Product (Subsection)	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Production (continued)								
Select borrow (704.07)	Measured and tested for conformance (106.04)	Classification	—	AASHTO M 145	1 per soil type, but not less than 1 for each day of production	Processed material	Yes	Before using in work
		Gradation	—	AASHTO T 27 & T 11	"	"	"	"
		Liquid limit	—	AASHTO R 58 & T 89, Method A	"	"	"	"
		Moisture-density	—	AASHTO T 180, Method D ⁽²⁾ or T 99, Method C ⁽²⁾	1 per soil type, but not less than 1 per each 13,000 yd ³ (10,000 m ³)	"	"	"
		Density	—	AASHTO T 310 or other approved procedures	1 per 3500 yd ² (3000 m ²), but not less than 1 per layer	In-place	No	Before placement of next layer

Table 204-1 (continued)

Sampling, Testing, and Acceptance Requirements

Material or Product (Subsection)	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Production (continued)								
Earth embankment (204.11)	Measured and tested for conformance (106.04)	Classification	–	AASHTO M 145	1 per soil type	Source of material	Yes	Before using in work
		Moisture-density	–	AASHTO T 180, Method D ⁽²⁾ or T 99, Method C ⁽²⁾	1 per soil type, but not less than 1 per each 13,000 yd ³ (10,000 m ³)	"	"	"
		Density	–	AASHTO T 310 or other approved procedures	1 per 3500 yd ² (3000 m ²), but not less than 1 per layer	In-place	No	Before placement of next layer
Top of subgrade (204.11)	"	Density	–	AASHTO T 310 or other approved procedures	1 per 2500 yd ² (2000 m ²), but not less than 1 per layer	In-place	No	Before placement of next layer
Finished Product								
Roadbed (204.13)	Measured and tested for conformance (106.04)	Final line & grade	–	Field measured	Determined by the CO	Determined by the CO	No	Before placement of next layer

(1) Not required when using Government-provided source.

(2) Minimum 5 points per proctor.

Section 251. — RIPRAP

Description

251.01 This work consists of furnishing and placing riprap for bank protection, slope protection, drainage structures, and erosion control.

Riprap acceptance methods are designated according to Table 251-1. If no acceptance method is designated, use Method A.

Riprap classes are designated according to Table 705-1.

Geotextile filters are designated according to Table 714-1.

Material

251.02 Conform to the following Subsections:

Geotextile	714.01
Neat hydraulic cement grout	725.13(a)(2)
Riprap	705.02

Construction Requirements

251.03 General. Perform the work under Section 209. Dress the slope to produce a smooth surface. If geotextile filter is required, place according to Section 207.

251.04 Placed Riprap. Placed riprap is rock placed on a prepared surface to form a well-graded mass.

Place riprap to its full thickness in one operation to avoid displacing the underlying material. Do not place riprap material by methods that cause segregation or damage to the prepared surface. Place or rearrange individual rocks by mechanical or hand methods to obtain a dense uniform blanket with a reasonably smooth surface.

251.05 Keyed Riprap. Keyed riprap is rock placed on a prepared surface and set into place by impact pressure.

Place rock for keyed riprap according to Subsection 251.04. Set the riprap into place by exerting impact pressure with a hydraulic-powered bucket or an approximate 5000-pound (2000-kilogram) flat-faced mass. Repeated impacts should be made until the rock is firmly seated and forms a reasonably uniform surface without reducing the effective sizes of the rocks. Do not use impact pressure on riprap below the water surface.

251.06 Grouted Riprap. Grouted riprap is rock placed or keyed on a prepared surface with the voids filled with grout.

Place rock for grouted riprap according to Subsection 251.04 or 251.05. Thoroughly moisten the rocks and wash excess fines from the riprap or to the underside of the riprap. Do not place grout unless the air temperature is at or above 35 °F (1 °C) within the near-surface voids of the riprap. Place the grout in a manner to prevent segregation. Begin placing grout at the lowest elevation of the riprap. Fill voids without unseating the rocks. Do not exceed 5-foot (1.5-meter) thickness for each layer of grouted riprap. Allow 3 days curing time before adding the next layer of riprap and grout. Provide weep holes through the grouted riprap as required. Keep the grouted riprap moist for 3 days after the work is completed and protect it from freezing for at least 7 days after grouting.

251.07 Acceptance. See Table 251-1 for sampling, testing, and acceptance requirements.

Rock for riprap will be evaluated under Subsections 106.02 and 106.04.

Material for grout will be evaluated under Subsections 106.02 and 106.03.

Acceptance Method A riprap construction will be evaluated under Subsection 106.02.

Acceptance Method B riprap construction will be evaluated under Subsections 106.02 and 106.04.

Placing grout will be evaluated under Subsection 106.02.

Geotextile filters will be evaluated under Section 207.

Structure excavation and backfill will be evaluated under Section 209.

Measurement

251.08 Measure the Section 251 pay items listed in the bid schedule according to Subsection 109.02 and the following as applicable:

When measuring riprap by the cubic yard (cubic meter), measure in place.

Payment

251.09 The accepted quantities will be paid at the contract price per unit of measurement for the Section 251 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05

Table 251-1

Sampling, Testing, and Acceptance Requirements

Material or Product (Subsection)	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time	Remarks
Source									
Riprap (705.02)	Measured and tested for conformance (106.04 & 105)	Apparent specific gravity & absorption	—	AASHTO T 85	1 per material type	Source of material	Yes	Before using in work	—
		Soundness using sodium sulfate	—	AASHTO T 104	"	"	"	"	—
		LA abrasion	—	AASHTO T 96	"	"	"	"	—
Production									
Riprap (705.02)	Process control (153.03)	Size Methods A & B	—	See Note (2)	1 per 100 yd³ (80 m³) per Class	In-place	"	"	—
	Measured and tested for conformance (106.02 & 106.04)	Gradation ⁽¹⁾ Method B	—	FLH T 521	1 per 1000 yd³ (800 m³) per Class	Stockpile or in-place ⁽³⁾	No	24 hours	—

(1) Notify CO at least 7 days before performing test.

(2) Verify riprap class by confirming that the largest accessible rock has an intermediate dimension greater than the upper limit of the D85 size range specified in Table 705-1.

(3) Point of sampling to be approved by CO.

Section 301. — UNTREATED AGGREGATE COURSES

Description

301.01 This work consists of constructing one or more courses of aggregate on a prepared surface.

Subbase and base aggregate grading is designated according to Table 703-2. Surface course aggregate grading is designated according to Table 703-3.

Material

301.02 Conform to the following Subsections:

Subbase, base, and surface course aggregate	703.05
Water	725.01(c)

Construction Requirements

301.03 General. Prepare the surface on which the aggregate course is placed according to Section 204 or 303 as applicable.

After a representative quantity of aggregate is produced, submit proposed target values for the appropriate sieve sizes along with a representative 300-pound (150-kilogram) sample at least 14 days before incorporating the aggregate into the work.

Set target values within the gradation ranges shown in Table 703-2 or 703-3 for the required grading.

301.04 Mixing and Spreading. Determine the optimum moisture content according to AASHTO T 180, Method D. Mix the aggregate and adjust the moisture content to obtain a uniform mixture with a moisture content within 2 percent of the optimum moisture content. Spread and shape the mixture on the prepared surface in a uniform layer.

Do not place the mixture in a layer exceeding 6 inches (150 millimeters) in compacted thickness. When more than one layer is necessary, compact each layer according to Subsection 301.05 before placing the next layer. Route hauling equipment uniformly over the full width of the surface to minimize rutting or uneven compaction.

301.05 Compacting. Determine the maximum density of the mixture according to AASHTO T 180, Method D.

Compact each layer full width. Roll from the sides to the center, parallel to the centerline of the road. Along curbs, headers, walls, and places not accessible to the roller, compact the material with approved tampers or compactors.

Compact each layer to at least 95.0 percent of maximum density. Determine the in-place density and moisture content according to AASHTO T 310 or other approved test procedures.

301.06 Surface Tolerance. If grade finishing stakes are required, finish the surface to within ± 0.05 feet (± 10 millimeters) from staked line and grade elevation.

If grade finishing stakes are not required, shape the surface to the required template and check the surface with a 10-foot (3-meter) straightedge. Defective areas are surface deviations in excess of $\frac{1}{2}$ inch (13 millimeters) in 10 feet (3 meters) between two contacts of the straightedge with the surface.

Correct defective areas by loosening the material, adding or removing material, reshaping, and compacting.

301.07 Maintenance. Maintain the aggregate course to the correct line, grade, and cross-section by blading, watering, rolling, or combination thereof until placement of the next course. Correct defects according to Subsection 301.06.

301.08 Acceptance. See Table 301-1 for sampling, testing, and acceptance requirements; including the category for quality characteristics.

Aggregate gradation and surface course plasticity index will be evaluated under Subsection 106.05. Other aggregate quality properties will be evaluated under Subsections 106.02 and 106.04.

(a) Aggregate gradation. The upper and lower specification limits are equal to the calculated mean of all test results plus or minus the allowable deviations shown in Tables 703-2 and 703-3, except as follows:

(1) If the calculated mean value for a tested sieve exceeds the maximum gradation value shown in Table 703-2 or 703-3, then the upper specification is equal to the maximum gradation value plus the allowable deviation, and the lower specification is equal to the maximum gradation value minus the allowable deviation.

(2) If the calculated mean value for a tested sieve is less than the minimum gradation value shown in Table 703-2 or 703-3, then the upper specification is equal to the minimum gradation value plus the allowable deviation and the lower specification is equal to the minimum gradation value minus the allowable deviation.

(b) Plasticity index. The upper and lower specification limits for surface courses are shown in Subsection 703.05(c)(3).

Construction of untreated aggregate courses will be evaluated under Subsections 106.02 and 106.04.

Measurement

301.09 Measure the Section 301 pay items listed in the bid schedule according to Subsection 109.02 and the following as applicable:

When measuring aggregate by the cubic yard (cubic meter), measure in place.

When measuring aggregate by the square yard (square meter), measure the length horizontally along the centerline of the roadway. Measure the width horizontally to include the top of aggregate width, including designed widenings.

Payment

301.10 The accepted quantities will be paid at the contract price per unit of measurement adjusted according to Subsection 106.05 for the Section 301 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Table 301-1

Sampling, Testing, and Acceptance Requirements

Material or Product (Subsection)	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time	Remarks
Source									
Aggregate quality (703.05(a) (b) (c))	Measured and tested for conformance (106.04 & 105)	LA abrasion (coarse)	1	AASHTO T 96	1 per type & source of material	Source of material	Yes	Before using in work	Not required when using Government-provided sources
		Soundness using sodium sulfate (coarse & fine)	1	AASHTO T 104	"	"	"	"	"
		Fractured faces	1	ASTM D5821	"	"	"	"	"
		Liquid limit	1	AASHTO R58 & T 89, Method A	"	"	"	"	"
Surface course aggregate (703.05(c))	"	Plasticity index	1	AASHTO R 58, T 89, & T 90	"	Crusher belt or after processing	"	"	"

Table 301-1 (continued)
Sampling, Testing, and Acceptance Requirements

Material or Product (Subsection)	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time	Remarks
Source (continued)									
Subbase, base, or surface course aggregate (703.05(b)(c))	Process control (153.03)	Gradation	I	AASHTO T 11 & T 27	2 per day per stockpile (minimum)	Crusher belt	No	24 hours	Not required when using a pre-crushed commercial source
		Fractured faces	I	ASTM D5821	"	"	"	"	"
Surface course aggregate (703.05(c))	"	Plasticity index	I	AASHTO R 58, T 89, & T 90	"	Crusher belt or after processing	"	"	"
Production									
Subbase course Grading A & B	Statistical (106.05)	Gradation No. 4 (4.75 mm)	I	AASHTO T 27 & T 11	1 per 1000 tons (900 metric tons)	From windrow or roadbed after processing	Yes	4 hours	I
		No. 200 (75µm)	I						
		Other specified sieves	II						

Table 301-1 (continued)
Sampling, Testing, and Acceptance Requirements

Material or Product (Subsection)	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time	Remarks
Production (continued)									
Base course Grading C, D, & E	Statistical (106.05)	Gradation ½ inch (9.5 mm)	I	AASHTO T 27 & T 11	1 per 1000 tons (900 metric tons)	From windrow or roadbed after processing	Yes	4 hours	1
		No. 4 (4.75 mm)	I						
		No. 200 (75µm)	I						
		Other specified sieves	II						
Subbase & base course Grading A, B, C, D, & E	Measured and tested for conformance (106.04)	Liquid limit	1	AASHTO R 58 & T 89, Method A	1 per 1000 tons (900 metric tons)	From windrow or roadbed after processing	Yes	4 hours "	1
		Moisture-density (max density)	1	AASHTO T 180, Method D ⁽¹⁾	1 per type & source of material	Stockpile or production output	"		1
		Density	1	AASHTO T 310 or other approved procedures	1 per 500 tons (450 metric tons)	In-place after compaction	No	End of shift	1
		Moisture content (in-place)	1	"	"	"	"	"	1

Table 301-1 (continued)
Sampling, Testing, and Acceptance Requirements

Material or Product (Subsection)	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time	Remarks
Production (continued)									
Surface course aggregate	Statistical (106.05)	Gradation		AASHTO T 27 & T 11	1 per 1000 tons (900 metric tons)	From windrow or roadbed after processing	Yes	4 hours	1
		No. 4 (4.75 mm)	I						
		No. 40 (4.75 µm)	I						
		No. 200 (75 µm)	I						
		Other specified sieves	II						
		Plasticity index	I	AASHTO R 58, T 89, & T 90	"	"	"	"	1
	Measured and tested for conformance (106.04)	Moisture-density (max density)	1	AASHTO T 180, Method D ⁽¹⁾	1 per type & source of material	Stockpile or production output	Yes	"	1
		Density	1	AASHTO T 310 or other approved procedures	1 per 500 tons (450 metric tons)	In-place after compaction	No	End of shift	1
		Moisture content (in-place)	1	"	"	"	"	"	1
		Fractured faces	1	ASTM D5821	1 per 1000 tons (900 metric tons)	From windrow on roadbed after processing	Yes	4 hours	1

Table 301-1 (continued)
Sampling, Testing, and Acceptance Requirements

Material or Product (Subsection)	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time	Remarks
Finished Product									
Subbase, base, and surface course	Measured and tested for conformance (106.04)	Surface tolerance & grade	1	Subsection 301.06	Determined by the CO	Surface of final course	No	Before placement of next layer or as requested	1

(1) Minimum of 5 points per proctor.

FSSS 301 - Untreated Aggregate Courses

301.03_National_7_17_2017

Add the following to Subsection 301.03:

301.03 General.

Written approval of the roadbed is required before placing aggregate.

For pit run or grid-rolled material, furnish material smaller than the maximum size, no gradation will be required otherwise. After processing on the road, remove all oversize material from the road and dispose as directed by the CO.

Provide additives or binder, if required, at the proportions specified. Develop and use

Government furnished sources according to Section 105.

If the aggregate is produced and stockpiled before placement, handle and stockpile according to Section 314.

301.05_National_7_17_2017

Delete Subsection 301.05 and replace with the following:

301.05 Compacting.

Compact each layer full width. Roll from the sides to the center, parallel to the centerline of the road. Along curbs, headers, walls, and all places not accessible to the roller, compact the material with approved tampers or compactors. Compaction B shall be used for subbase and surface course.

Compact the aggregate using one of the following methods as specified:

- (a) **Compaction A.** Operating spreading and hauling equipment over the full width of the travelway.
- (b) **Compaction B.** Operate rollers and compact as specified in Subsection 204.11(a)(1).
- (c) **Compaction C.** Moisten or dry the aggregate to a uniform moisture content between 5 and 7 percent based on total dry weight of the mixture. Operate rollers and compact as specified in Subsection 204.11(a)(1).
- (d) **Compaction D.** Compact to a density of at least 95 percent of the maximum density, as determined by AASHTO T 99, method C or D.
- (e) **Compaction E.** Compact to a density of at least 95 per-cent of the maximum density, as determined by AASHTO T 180, method C or D. For all compaction methods, blade the surface of each layer during the compaction operations to remove irregularities and produce a smooth, even surface. When a density requirement is specified, determine the in place density and moisture content according to AASHTO T 310 or other approved test procedures.

Section 303. — ROAD RECONDITIONING

Description

303.01 This work consists of reconditioning ditches, shoulders, roadbeds, aggregate surfaces, temporary access areas and the service access road AS SHOWN ON DRAWINGS.

Material

303.02 Conform to the following Subsection:

Water 725.01(c)

Construction Requirements

303.03 Ditch Reconditioning. Remove slide material, sediment, vegetation, and other debris from existing ditches and culvert inlets/outlets. Reshape ditches and culvert inlets/outlets to achieve positive drainage and uniform ditch width, depth, and grade. Dispose of waste at designated sites or according to Subsection 204.14.

303.04 Shoulder Reconditioning. Remove slide material, vegetation, and other debris from existing shoulders including shoulders in parking areas, turnouts, and other widened areas. Repair soft and unstable areas according to Subsection 204.07. Reshape shoulders to the widths and slopes shown in the plans. Dispose of waste at designated sites or according to Subsection 204.14.

303.05 Roadbed Reconditioning. Remove organic, deleterious, and material larger than 6 inches (150 millimeters) from the top 6 inches (150 millimeters) of subgrade. Dispose of waste according to Subsection 204.14. Repair soft and unstable areas according to Subsection 204.07. Scarify surface to a 6-inch (150-millimeter) depth. Remove irregularities and shape to a uniform surface. Finish earth surfaces to within 0.05 feet (15 millimeters) and rock surfaces to within 0.10 feet (30 millimeters) of required line, grade, and cross-section. Compact according to Subsection 204.11.

303.06 Aggregate Surface Reconditioning. Repair soft and unstable areas to the full aggregate surface depth and according to Subsection 204.07. Scarify the thickness of aggregate surfacing material or to 6 inches (150 millimeters), whichever is less. Remove irregularities and shape to a uniform surface. Finish and compact the surface according to Subsection 302.05.

303.07 Roadway Reconditioning. Perform applicable work described in Subsections 303.03 through 303.06. Maintain existing cross slope and crown or as shown in the plans.

303.08 Acceptance. See Table 303-1 for sampling, testing, and acceptance requirements.

Road reconditioning work will be evaluated under Subsections 106.02 and 106.04.

Measurement

303.09 Measure the Section 303 pay items listed in the bid schedule according to Subsection 109.02 and the following as applicable:

Measure waste under Section 204.

Payment

303.10 The accepted quantities will be paid at the contract price per unit of measurement for the Section 303 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05

Section 703. — AGGREGATE

703.01 Fine Aggregate for Concrete. Furnish sand conforming to AASHTO M 6, Class B, except as amended or supplemented by the following:

- | | |
|--|---|
| (a) Material passing No. 200 (75- μ m) sieve, AASHTO T 11 | 3.0 percent max. |
|
(b) Alkali-silica reactivity. Test the aggregate for alkali silica reaction and conform to one of the following (1) through (5): | |
| (1) Alkali-silica reactivity, ASTM C1260 | :S 0.10 percent at 16 days after casting |
| (2) Alkali-silica reactivity, ASTM C1260 | 0.11 percent to 0.20 percent at 16 days after casting |

And one of the following examinations:

- | | |
|--|--|
| (a) Petrographic examination of aggregates, ASTM C295, performed within 1 year from time of submittal | Favorable report for use |
| (b) Petrographic examination of hardened concrete, ASTM C856, performed on ASTM C1260 specimens after test | Favorable report for use |
| (3) Alkali-silica reactivity with cementitious material, ASTM C1567, performed on approved mix design mass percent combinations. Do not use lithium compounds as mitigation measures | :S 0.10 percent at 16 days after casting |
| (4) Alkali silica reaction, ASTM C1293 | < 0.04 percent at 12 months |
| (5) Alkali-silica reaction with cementitious material, ASTM C1293, performed on approved mix design mass percent combinations | < 0.04 percent at 24 months |

For lightweight fine aggregate, conform to AASHTO M 195.

703.02 Coarse Aggregate for Concrete. Conform to AASHTO M 80, Class A, except as amended or supplemented by the following:

- | | |
|---------------------------------------|--|
| (a) Los Angeles abrasion, AASHTO T 96 | 40 percent max. |
| (b) Grading, AASHTO M 43 | All sizes, except Size Numbers 8, 89, 9, or 10 |
| (c) Alkali-silica reactivity | See Subsection 703.01(b) |

For bridge decks or surface courses, do not use aggregates known to polish or carbonate aggregates containing less than 25 percent by mass of insoluble residue as determined by ASTM D3042.

For lightweight coarse aggregate, conform to AASHTO M 195.

703.03 Granular Backfill. Furnish aggregate for the following installations.

(a) Underdrain pipe with geotextile. Furnish granular backfill conforming to AASHTO M 80, Class E and AASHTO M 43, Size Number 3, 4, 5, 57, 67, or 7.

(b) Underdrain pipe without geotextile. Furnish granular backfill conforming to AASHTO M 6, except the soundness test is not required.

703.04 Reserved.

703.05 Subbase, Base, and Surface Course Aggregate.

(a) General. Furnish hard, durable particles or fragments of crushed stone, crushed slag, or crushed gravel conforming the following:

- | | |
|---|----------------------|
| (1) Los Angeles abrasion, AASHTO T 96 | 50 percent max. |
| (2) Soundness of aggregate using sodium sulfate, AASHTO T 104 (5 cycles) | 12 percent loss max. |
| (3) Durability index (coarse), AASHTO T 210 | 35 min. |
| (4) Durability index (fine), AASHTO T 210 | 35 min. |
| (5) Fractured faces, ASTM D5821 | 50 percent min. |
| (6) Without organic matter and lumps or balls of clay. | |

(b) Subbase or base aggregate. In addition to Subsection 703.05(a), conform to the following:

- | | |
|--------------------------------------|-------------|
| (1) Gradation | Table 703-2 |
| (2) Liquid limit, AASHTO T 89 | 25 max. |

Table 703-2**Target Value Ranges for Subbase and Base Gradation**

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 and T 11)				
	Grading Designation				
	A (Subbase)	B (Subbase)	C (Base)	D (Base)	E (Base)
2½ inch (63 mm)	100 ⁽¹⁾				
2 inch (50 mm)	97 – 100 ⁽¹⁾	100 ⁽¹⁾	100 ⁽¹⁾		
1½ inch (37.5 mm)		97 – 100 ⁽¹⁾			
1 inch (25 mm)	65 – 79 (6)		80 – 100 (6)	100 ⁽¹⁾	
¾ inch (19 mm)			64 – 94 (6)	86 – 100 (6)	100 ⁽¹⁾
½ inch (12.5 mm)	45 – 59 (7)				
¾ inch (9.5 mm)			40 – 69 (6)	51 – 82 (6)	62 – 90 (6)
No. 4 (4.75 mm)	28 – 42 (6)	40 – 60 (8)	31 – 54 (6)	36 – 64 (6)	36 – 74 (6)
No. 40 (425 µm)	9 – 17 (4)			12 – 26 (4)	12 – 26 (4)
No. 200 (75 µm)	4.0 – 8.0 (3)	4.0 – 12.0 (4)	4.0 – 7.0 (3)	4.0 – 7.0 (3)	4.0 – 7.0 (3)

(1) Statistical procedures do not apply.

() The value in the parentheses is the allowable deviation (±) from the target values.

(a) Surface course aggregate. In addition to Subsection 703.05(a), conform to the following:

- | | |
|---|-------------|
| (1) Gradation | Table 703-3 |
| (2) Liquid limit, AASHTO T 89, Method A | 35 max. |
| (3) Plasticity index, AASHTO T 90 | 10±3 |

Do not furnish material that contains asbestos fibers.

Table 703-3**Target Value Ranges for Surface Course Gradations**

Sieve Size	Percent by Mass Passing Designate Sieve (AASHTO T 27 & AASHTO T 11)
1 inch (25 mm)	100 ⁽¹⁾
½ inch (12.5 mm)	70 – 80 (5)
No. 4 (4.75 mm)	40 – 50 (7)
No. 10 (2.0 mm)	25 – 40 (6)
No. 40 (425 µm)	15 – 25 (5)
No. 200 (75 µm)	8.0 – 14.0 (4)

(1) Statistical procedures do not apply.

() The value in the parentheses is the allowable deviation (±) from the target values.

703.06 Crushed Aggregate. Furnish hard, durable particles or fragments of crushed stone or gravel conforming to the size and quality requirements for crushed aggregate material normally used locally in the construction and maintenance of highways by Federal or state agencies. Furnish crushed aggregate with a maximum size of 1 inch (25 millimeters) as determined by AASHTO T 27 and AASHTO T 11. Furnish crushed aggregate uniformly graded from coarse to fine and free of organic matter, lumps or balls of clay, and other deleterious material.

703.07 Asphalt Concrete Aggregate. Furnish hard, durable particles or fragments of crushed stone, crushed slag, or crushed gravel conforming to the following:

- | | |
|--|----------------------|
| (a) Los Angeles abrasion, AASHTO T 96 | 35 percent max. |
| (b) Soundness of aggregate using sodium sulfate, AASHTO T 104 (5 cycles): | |
| (1) Coarse aggregate | 12 percent loss max. |
| (2) Fine aggregate | 12 percent loss max. |
| (c) Fractured faces, ASTM D5821 | 90 percent min. |
| (d) Fine aggregate angularity, AASHTO T 304, Method A | 40.0 percent min. |
| (e) Flat and elongated particles, ASTM D4791 (1:5 ratio, plus ¾-inch (9.5-mm) sieve, calculated by mass, weighted average) | 10 percent max. |
| (f) Sand equivalent, AASHTO T 176, Alternative Method No. 2, Reference Method | 45 min. |
| (g) Gradation. Size, grade and combine the aggregate fractions in mix proportions that result in a composite blend conforming to the specified gradation. Nominal maximum size is one sieve size greater than the first sieve to retain more than 10 percent of the combined aggregate. Test according to AASHTO T 27 and AASHTO T 11. Volumetric asphalt concrete aggregate gradation. See Table 703-4. | |

For the surface course, do not use aggregates known to polish or carbonate aggregates containing less than 25 percent by mass of insoluble residue when tested according to ASTM D3042.

Table 703-4
Asphalt Concrete Aggregate Gradation

Sieve Size	Nominal Maximum Aggregate Size – Percent Passing									
	Grading Designation									
	1 inch (25 mm)		¾ inch (19 mm)		½ inch (12.5 mm)		¾ inch (9.5 mm)		No. 4 (4.75 mm)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
2 inch (50 mm)										
1½ inch (37.5 mm)	100									
1 inch (25 mm)	90	100	100							
¾ inch (19 mm)	*	90	90	100	100					
½ inch (12.5 mm)	*	*	*	90	90	100	100			
¾ inch (9.5 mm)	*	*	*	*	*	90	90	100	100	
No. 4 (4.75 mm)	*	*	*	*	*	*	*	90	95	100
No. 8 (2.36 mm)	19	45	23	49	28	58	32	67	70	80
No. 16 (1.18 mm)	*	*	*	*	*	*	*	*	*	*
No. 30 (600 µm)	*	*	*	*	*	*	*	*	*	*
No. 50 (300 µm)	*	*	*	*	*	*	*	*	*	*
No. 200 (75 µm)	1.0	7.0	2.0	8.0	2.0	10.0	2.0	10.0	4.0	10.0

* Contractor specified target values. See Table 703-5 for allowable deviations.

Table 703-5
Allowable Deviation Based on Target Value

Percent by Mass Passing		Allowable Deviation
Minimum	Maximum	
70.1	89.9	4
60.1	70.0	5
55.1	60.0	6
45.1	55.0	7
40.1	45.0	6
30.1	40.0	5
21.1	30.0	4
8.1	21.0	3
0	8.0	2

703.08 Open-Graded Asphalt Friction Course Aggregate. Furnish hard, durable particles or fragments of crushed stone, crushed slag, or crushed gravel conforming to the following:

- | | |
|--|----------------------|
| (a) Los Angeles abrasion, AASHTO T 96 | 35 percent max. |
| (b) Soundness of aggregate using sodium sulfate, AASHTO T 104 (5 cycles), coarse aggregate | 12 percent loss max. |
| (c) Fractured faces, ASTM D5821 (two or more) | 75 percent min. |
| (d) Gradation | Table 703-6 |

Table 703-6
Target Value Ranges for
Open Graded Friction Course Aggregate Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & T 11)	
	Grading Designation	
	A	B
½ inch (12.5 mm)	—	100
¾ inch (9.5 mm)	100	95 – 100
No. 4 (4.75 mm)*	30 – 45	50 – 70
No. 8 (2.36 mm)*	5 – 15	5 – 15
No. 200 (75 µm)*	2.0 – 5.0	2.0 – 5.0

* Contractor specified target values. See Table 703-5 for allowable deviations.

703.09 Chip Seal Aggregate. Furnish hard durable particles or fragments of crushed gravel, crushed stone, crushed slag, or lightweight aggregates. Use only one type of aggregate on the surface treatment. Conform to the following:

- | | |
|--|----------------------|
| (a) Gradation | Table 703-7 |
| (b) Clay lumps and friable particles, AASHTO T 112 | 1.0 percent max. |
| (c) Flat and elongated particles, ASTM D4791
(1:3 ratio, plus ¾-inch (9.5-mm) sieve, calculated
by mass, weighted average) | 10 percent max. |
| (d) Fractured faces, ASTM D5821 | 90 percent min. |
| (e) Los Angeles abrasion, AASHTO T 96 | 40 percent max. |
| (f) Soundness of aggregate using sodium sulfate,
AASHTO T 104 (5 cycles) | 12 percent loss max. |

Table 703-7
Target Value Ranges for
Single and Double Course Chip Seal Aggregate Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & AASHTO T 11)			
	Grading Designation			
	A	B	C	D
1½ inch (37.5 mm)				
1 inch (25 mm)	100 ⁽¹⁾			
¾ inch (19 mm)	90 – 100 (3)	100 ⁽¹⁾		
½ inch (12.5 mm)	0 – 35 (5)	90 – 100 (3)	100 ⁽¹⁾	
¾ inch (9.5 mm)	0 – 12 (3)	0 – 35 (5)	85 – 100 (3)	100 ⁽¹⁾
No. 4 (4.75 mm)	–	0 – 12 (3)	0 – 35 (5)	85 – 100 (3)
No. 8 (2.36 mm)	–	–	0 – 8 (3)	0 – 23 (4)
No. 200 (75 µm)	0.0 – 1.0 (0.5)	0.0 – 1.0 (0.5)	0.0 – 1.0 (0.5)	0.0 – 1.0 (0.5)

(1) Statistical procedures do not apply.

() The value in the parentheses is the allowable deviation (±) from the target values.

703.10 Slurry Seal and Micro Surfacing Aggregate. Furnish hard durable particles or fragments of crushed gravel or crushed stone.

- (a) **Slurry seal aggregate.** Conform to ISSA A105 and the following:

- | | |
|--|-----------------|
| (1) Gradation | Table 703-8 |
| (2) Los Angeles abrasion, AASHTO T 96, Grading D | 35 percent max. |

- (3) Sand equivalent, AASHTO T 176, 45 min.
Alternate Method No. 2, Reference Method
- (4) Soundness of aggregate using sodium sulfate, 15 percent loss max.
AASHTO T 104 (5 cycles)

(b) Micro surfacing aggregate. Conform to ISSA A143 and the following:

- (1) Gradation Table 703-8
- (2) Los Angeles abrasion, AASHTO T 96, Grading D 30 percent max.
- (3) Sand equivalent AASHTO T 176, 65 min.
Alternate Method No. 2, Reference Method
- (4) Soundness of aggregate using sodium sulfate, 15 percent loss max.
AASHTO T 104 (5 cycles)

Table 703-8
Micro Surfacing and Slurry Seal Aggregate
Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & AASHTO T 11)		
	Grading Designation		
	I	II	III
¾ inch (9.5 mm)	–	100	100
No. 4 (4.75 mm)	100	90 – 100	70 – 90
No. 8 (2.36 mm)	90 – 100	65 – 90	45 – 70
No. 16 (1.18 mm)	65 – 90	45 – 70	28 – 50
No. 30 (600 µm)	40 – 65	30 – 50	19 – 34
No. 50 (300 µm)	25 – 42	18 – 30	12 – 25
No. 100 (150 µm)	15 – 30	10 – 21	7 – 18
No. 200 (75 µm)	10.0 – 20.0	5.0 – 15.0	5.0 – 15.0

703.11 Reserved.

703.12 Blotter. Furnish sound durable particles of gravel or crushed stone conforming to the following:

- (a) Material passing ¾-inch (9.5-mm) sieve, 100 percent
AASHTO T 27
- (b) Liquid limit, AASHTO T 89, Method A 25 max.
- (c) Without organic matter and clay balls.

703.13 Aggregate for Aggregate-Topsoil Course. Conform to AASHTO M 80, Class E and AASHTO M 43, Size Number 57.

703.14 Sand. Furnish clean material conforming to the following:

- | | |
|--------------------------|---------------------|
| (a) Gradation | AASHTO M 6 |
| (b) Deleterious material | AASHTO M 6, Class B |

703.15 Aggregate for Lean Concrete Backfill. Furnish hard, clean, durable, nonplastic, nonorganic, nonreactive aggregate to meet the designated gradation in Table 703-10.

Table 703-10
Aggregate for Lean Concrete Backfill

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & T 11)
1 inch (25 mm)	100
No. 200 (75 µm)	0.0 – 10.0

703.16 Shotcrete Aggregate. Combine fine and coarse aggregates to meet the designated gradation in Table 703-11.

Table 703-11
Shotcrete Gradation Limits for Combined Aggregates

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & AASHTO T 11)	
	Grading Designation	
	A	B
½ inch (12.5 mm)	—	100
¾ inch (9.5 mm)	100	90 – 100
No. 4 (4.75 mm)	95 – 100	70 – 85
No. 8 (2.36 mm)	80 – 98	50 – 70
No. 16 (1.18 mm)	50 – 85	35 – 55
No. 30 (600 µm)	25 – 60	20 – 35
No. 50 (300 µm)	10 – 30	8 – 20
No. 100 (150 µm)	2.0 – 10.0	2.0 – 10.0

(a) Fine aggregate. Conform to AASHTO M 6, Class B, except as amended or supplemented by the following:

- | | |
|---|--------------------------|
| (1) Material passing No. 200 (75-µm) sieve, AASHTO T 11 | 3.0 percent max. |
| (2) Sand equivalent value, AASHTO T 176, Alternate Method No. 2, Reference Method | 75 min. |
| (3) Alkali-silica reactivity | See Subsection 703.01(b) |

(b) Coarse aggregate. Conform to AASHTO M 80, Class A, except as amended or supplemented by the following:

(1) Los Angeles abrasion, AASHTO T 96

40 percent max.

(2) Alkali-silica reactivity

See Subsection 703.01(b)

703.17 Granular Rock Backdrain. Furnish hard, durable rock conforming to the following:

- (a) Los Angeles abrasion, AASHTO T 96 50 percent max.
- (b) Apparent specific gravity, AASHTO T 85 2.50 min.
- (c) Absorption, AASHTO T 85 4.0 percent max.
- (d) Durability index (course), AASHTO T 210 50 min.
- (e) Gradation Table 703-12

Table 703-12
Granular Rock Backdrain Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & AASHTO T 11)
6 inch (150 mm)	100
4 inch (100 mm)	0 – 25
No. 200 (75µm)	0.0 – 5.0

FSSS 703 - Aggregate

Delete Subsection 703.05(c)(3) and Replace with the following:

703.05 (c) Surface course aggregate. (3) Plastic Index

(3) Plastic Index, AASHTO T 90

If the percent passing the No. 200 sieve is less than 12% 2 to 9

If the percent passing the No. 200 sieve is greater than 12% Less than 2

703.05_National_12_15_2016

Delete 703.05 and replace with the following:

703.05 Subbase, Base, Surface Course, and Screened Aggregate.

(a) Subbase or base aggregate. Furnish hard, durable particles or fragments of crushed stone, crushed slag, or crushed gravel conforming the following:

(1) Gradation	Table 703-2
(2) Liquid limit, AASHTO T 89	25 max.
(3) Plastic limit, AASHTO T 90	Nonplastic
(4) Los Angeles abrasion, AASHTO T 96	40% max.
(5) Sodium sulfate soundness loss (5 cycles), AASHTO T 104	12% max.
(6) Durability index (coarse), AASHTO T 210	35 min.
(7) Durability index (fine), AASHTO T 210	35 min.
(8) Fractured faces, ASTM D 5821	50% min.
(9) Free from organic matter and lumps or balls of clay	

Do not use material that breaks up when alternately frozen and thawed or wetted and dried.

Obtain the aggregate gradation by crushing, screening, and blending processes as necessary. Fine aggregate, material passing the No. 4 sieve, shall consist of natural or crushed sand and fine mineral particles.

(b) Surface course aggregate. Furnish hard, durable particles or fragments of crushed stone, crushed slag, or crushed gravel conforming the following:

(1) Gradation	Table 703-3
(2) Liquid limit, AASHTO T 89	35 max.
(3) Plastic Index, AASHTO T 90	

- | | |
|---|-------------|
| a) If the percent passing the No. 200 sieve is less than 12% | 2 to 9 |
| b) If the percent passing the No. 200 sieve is greater than 12% | Less than 2 |
| (4) Los Angeles abrasion, AASHTO T 96 | 40% max. |
| (5) Sodium sulfate soundness loss (5 cycles),
AASHTO T 104 | 12% max. |
| (6) Durability index (coarse), AASHTO T 210 | 35 min. |
| (7) Durability index (fine), AASHTO T 210 | 35 min. |
| (8) Fractured faces, ASTM D 5821 | 75% min. |
| (9) Free from organic matter and lumps or balls of clay | |

Do not use material that breaks up when alternately frozen and thawed or wetted and dried. Do not furnish material that contains asbestos fibers.

Obtain the aggregate gradation by crushing, screening, and blending processes as necessary. Fine aggregate, material passing the No. 4 sieve, shall consist of natural or crushed sand and fine mineral particles.

(c) Screened aggregate – Furnish hard, durable particles or fragments of stone, slag, or gravel conforming the following:

(1) Gradation	Table 703-16
(2) Plastic Index, AASHTO T 90	Less than 9
(3) Los Angeles abrasion, AASHTO T 96	55% max.
(4) Free from organic matter and lumps or balls of clay.	

Do not use material that breaks up when alternately frozen and thawed or wetted and dried. Obtain the aggregate gradation by crushing, screening, and blending processes as necessary.

Delete Table 703-2 and replace with the following:

Table 703-2

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 and T 11)				
	Grading Designation				
	A (Subbase)	B (Subbase)	C (Base)	D (Base)	E (Base)
2½ inch	100				
2 inch	97 – 100	100	100		
1½ inch		97 – 100			
1 inch	65 – 79 (6)		80 – 100 (6)	100	
¾ inch			64 – 94 (6)	86 – 100 (6)	100
½ inch	45 – 59 (7)				
⅜ inch			40 – 69 (6)	51 – 82 (6)	62 – 90 (6)
No. 4	28 – 42 (6)	40 – 60 (8)	31 – 54 (6)	36 – 64 (6)	36 – 74 (6)
No. 40	9 – 17 (4)			12 – 26 (4)	12 – 26 (4)
No. 200	4.0 – 8.0 (3)	4.0 – 12.0 (4)	4.0 – 7.0 (3)	4.0 – 7.0 (3)	4.0 – 7.0 (3)

() The value in the parentheses is the allowable deviation ($\pm$) from the target values..

Table 703-3

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 and T 11)					
	Grading Designation					
	F	G	H	S	T	U
1 1/2 inch	100			100		
1 inch	97-100	100		72 – 92 (6)	100	
3/4 inch	76-89 (6)	97 - 100	97 - 100			100
1/2 inch					71 – 91 (6)	
3/8 inch	56-68 (6)	70 – 80 (6)	80 – 92 (6)	51 – 71 (6)		71 – 90 (6)
No. 4	43-53 (7)	51 – 63 (7)	58 – 70 (7)	36 – 53 (7)	43 – 60 (7)	50 – 68 (7)
No. 8				26 – 40 (6)	30 – 46 (6)	34 – 51 (6)
No. 16	23-32 (6)	28 – 39 (6)	28 – 40 (6)			
No. 40	15-23 (5)	19 – 27 (5)	16 – 26 (5)	14 – 25 (5)	16 – 28 (5)	19 – 30 (5)
No. 200	10.0-16.0 (4)	10.0 – 16.0 (4)	9.0 – 14.0 (4)	8.0 – 15.0 (4)	8.0 – 15.0 (4)	8.0 – 15.0 (4)

() The value in the parentheses is the allowable deviation ($\pm$) from the target values.

If the plasticity index (PI) is greater than 0, the TV range for the No. 200 sieve size is 8-12 (4).

Add Table 703-13:

**Table 703-16
Gradation Requirements for Screened Aggregate**

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 and T 11)						
	Grading Designation						
	L	M	N	O	P	Q	R
6 inch	100	100					
4 inch			100	100			
3 inch					100	100	
2 inch							100
No. 4		15-45		15-45		15-45	

703.09_National_11_8_2016

Make the following changes to Subsection 703.09:

703.09 Chip Seal Aggregate.

Delete Subsection 703.09(c) and replace with the following:

(c) Flakiness Index, FLH T 508 30% max.

Add the following to Subsection 703.09:

(g) Adherent coating on the aggregate, 0.5% max.

FLH T 512

Section 705. — ROCK

705.01 Gabion and Revet Mattress Rock. Furnish angular stone from a rock quarry or cut that is hard, durable, free of organic and spoil material, and resistant to weathering and water action. Do not use crushed river rock or rock with rounded surfaces. Conform to the following:

- (a) Durability index (course), AASHTO T 210 50 min.
- (b) Density of a filled basket 100 lb/ft³ (1600 kg/m³) min.
- (c) Gradation. Furnish rock with breadth and thickness at least one-third its length.
 - (1) Baskets 1 foot (300 millimeters) or greater in the vertical dimension.
 - (a) Maximum dimension 8 in (200 mm)
 - (b) Minimum dimension 4 in (100 mm)
 - (2) Baskets less than 1 foot (300 millimeters) in the vertical dimension.
 - (a) Maximum dimension 6 in (150 mm)
 - (b) Minimum dimension 3 in (75 mm)
- (d) Los Angeles abrasion, AASHTO T 96 50 percent max.

705.02 Riprap. Furnish hard, durable, angular rock that is resistant to weathering and water action and free of organic or other unsuitable material. Angular rock is characterized by sharp, clean edges at the intersections of relatively flat surfaces. Do not use shale, rock with shale seams, or other fissile or fissured rock that may break into smaller pieces in the process of handling and placing. Conform to the following:

- (a) Apparent specific gravity, AASHTO T 85 2.40 min.
- (b) Absorption, AASHTO T 85 4.0 percent max.
- (c) Soundness of aggregate using sodium sulfate, AASHTO T 104 (5 cycles) 12 percent loss max.
- (d) Los Angeles abrasion, AASHTO T 96 50 percent max.
- (e) Rock particle intermediate dimension (width) and minimum dimension (thickness) ½ longest dimension (length) min.
- (f) Gradation, FLH T 521 Table 705-1

Table 705-1**Gradation Requirements for Riprap⁽¹⁾**

Class	% of Rock Equal or Smaller by Count, D_x	Range of Intermediate Dimensions,⁽²⁾ inches (millimeters)	Range of Rock Mass,⁽³⁾ pounds (kilograms)
1	100	9 – 15 (230 – 380)	59 – 270 (27 – 120)
	85	7 – 11 (180 – 280)	28 – 110 (13 – 50)
	50	5 – 8 (130 – 200)	10 – 42 (5 – 19)
	15	3 – 6 (80 – 150)	2 – 18 (1 – 8)
2	100	15 – 21 (380 – 530)	270 – 750 (120 – 340)
	85	11 – 15 (280 – 380)	110 – 270 (50 – 120)
	50	8 – 11 (200 – 280)	42 – 110 (19 – 50)
	15	6 – 8 (130 – 200)	10 – 42 (6 – 19)
3	100	21 – 27 (530 – 690)	750 – 1600 (340 – 730)
	85	15 – 19 (380 – 480)	270 – 560 (120 – 250)
	50	11 – 14 (280 – 360)	110 – 220 (50 – 100)
	15	8 – 10 (200 – 250)	42 – 81 (19 – 37)
4	100	27 – 33 (690 – 840)	1600 – 2900 (730 – 1300)
	85	19 – 23 (480 – 580)	560 – 990 (250 – 450)
	50	14 – 17 (360 – 430)	220 – 400 (100 – 180)
	15	9 – 12 (230 – 300)	59 – 140 (27 – 64)
5	100	33 – 39 (840 – 990)	2900 – 4850 (1300 – 2200)
	85	23 – 28 (580 – 710)	990 – 1800 (450 – 820)
	50	17 – 20 (430 – 510)	400 – 650 (180 – 290)
	15	11 – 15 (280 – 380)	110 – 270 (50 – 120)
6	100	39 – 45 (990 – 1140)	4850 – 7400 (2200 – 3350)
	85	28 – 32 (710 – 810)	1800 – 2650 (820 – 1200)
	50	20 – 23 (510 – 580)	650 – 990 (290 – 450)
	15	13 – 17 (330 – 430)	180 – 400 (82 – 180)
7	100	45 – 54 (1140 – 1370)	7400 – 12,800 (3350 – 5800)
	85	32 – 38 (810 – 970)	2650 – 4450 (1200 – 2000)
	50	23 – 28 (580 – 710)	990 – 1800 (450 – 820)
	15	15 – 20 (380 – 510)	270 – 650 (120 – 290)
8	100	54 – 66 (1370 – 1680)	12,800 – 23,400 (5800 – 10,600)
	85	38 – 47 (970 – 1190)	4450 – 8450 (2000 – 3850)
	50	28 – 35 (710 – 890)	1800 – 3500 (820 – 1600)
	15	19 – 25 (480 – 640)	560 – 250 (250 – 570)
9	100	66 – 78 (1680 – 1980)	23,400 – 38,600 (10,600 – 17,500)
	85	47 – 55 (1190 – 1400)	8450 – 13,500 (3850 – 6100)
	50	35 – 41 (890 – 1040)	3500 – 5600 (1600 – 2550)
	15	22 – 30 (560 – 760)	870 – 2200 (390 – 1000)
10	100	78 – 90 (1980 – 2290)	38,600 – 59,300 (17,500 – 26,900)
	85	55 – 64 (1400 – 1630)	13,500 – 21,300 (6100 – 9650)
	50	41 – 48 (1040 – 1220)	5600 – 9000 (2550 – 4100)
	15	26 – 36 (660 – 910)	1450 – 3800 (660 – 1700)

(1) Gradation includes spalls and rock fragments to provide a stable, dense mass.

(2) The intermediate dimension is the longest straight-line distance across the rock that is perpendicular to the rock's longest axis on the rock face with the largest projection plane.

(3) Rock mass is based on a specific gravity of 2.65 and 85 percent of the cubic volume as calculated using the intermediate dimension.

705.03 Rock for Masonry Structures. Conform to the size and shape specified. Furnish sound, durable rock of the texture and color specified and has been proven satisfactory for the intended use. Do not furnish rock containing reeds, rifts, seams, laminations, and minerals that may cause discoloration or deterioration from weathering.

705.04 Rock for Special Rock Embankment. Furnish angular stone that is hard, durable, resistant to abrasion and weathering, and that is free of weak cleavages that may cause the rock to disintegrate during handling and placing.

(a) Mechanically-placed embankments. Furnish rock conforming to Table 705-2.

Table 705-2

Range of Mechanically-Placed Rock

Percent of Rock Fragments by Mass	Range of Intermediate Dimensions, ⁽¹⁾ inches (millimeters)	Range of Rock Mass, ⁽²⁾ pounds (kilograms)
50	> 29 (725)	> 2000 (900)
50	10 – 29 (250 – 725)	90 – 2000 (40 – 900)

(1) The intermediate dimension is the longest straight-line distance across the rock that is perpendicular to the rock's longest axis on the rock face with the largest projection plane.

(2) Rock mass is based on a specific gravity of 2.65.

(b) Hand-placed embankments. Furnish rock conforming to Table 705-3.

Table 705-3

Range of Hand-Placed Rock

Percent of Rock Fragments by Mass	Range of Intermediate Dimensions, ⁽¹⁾ inches (millimeters)	Range of Rock Mass, ⁽²⁾ pounds (kilograms)
75	> 14 (350)	> 165 (75)
25	10 – 14 (250 – 350)	90 – 165 (40 – 75)

(1) The intermediate dimension is the longest straight-line distance across the rock that is perpendicular to the rock's longest axis on the rock face with the largest projection plane.

(2) Rock mass is based on a specific gravity of 2.65.

705.05 Rock for Buttresses.

(a) General. Furnish angular stone that is hard, durable, free of organic and spoil material, and resistant to weathering and water action. Conform to the following:

- | | |
|---|---------------------------------------|
| (1) Rock breadth and thickness | At least one-third of the rock length |
| (2) Apparent specific gravity, AASHTO T 85 | 2.40 min. |
| (3) Absorption, AASHTO T 85 | 4.0 percent max. |
| (4) Durability index (course), AASHTO T 210 | 52 min. |

(b) Mechanically-placed buttresses. In addition to Subsection 705.05(a), furnish rock conforming

to Table 705-2.

- (c) **Hand-placed buttresses.** In addition to Subsection 705.05(a), furnish rock conforming to Table 705-3.

705.06 Rock for Rockeries. Furnish hard, angular, and durable rock that consists of a solid mass without open fractures, foliation, or other planes of weakness that are generally cubical, tabular, or rectangular in shape. Do not furnish crushed river rock or rock with rounded surfaces. Conform to the following:

(a) Apparent specific gravity, AASHTO T 85	2.40 min.
(b) Absorption, AASHTO T 85	4.0 percent max.
(c) Los Angeles abrasion, AASHTO T 96	50 percent max.
(d) Durability index (course), AASHTO T 210	52 min.
(e) Soundness of aggregate using sodium sulfate, max. AASHTO T 104 (5 cycles)	12 percent loss
(f) Size and shape.	
(1) Rock length	See plans
(2) Rock breadth and thickness	At least one-third of rock length
(3) Rock dimension	18 in (460 mm) min.
(4) Cap rock mass	200 lb (90 kg) min.

705.07 Rock Mulch. Furnish hard, durable native rock that is resistant to weathering and free of excess moisture, muck, frozen lumps, roots, sod, or other deleterious material conforming to the following:

(a) Maximum particle size	6 in (150 mm)
(b) Minimum particle size	2 in (50 mm)
(c) Apparent specific gravity, AASHTO T 85	2.40 min.
(d) Absorption, AASHTO T 85	4.0 percent max.
(e) Soundness of aggregate using sodium sulfate, max. AASHTO T 104 (5 cycles)	12 percent loss
(f) Los Angeles abrasion, AASHTO T 96	50 percent max.