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DIVISION 02 - SITE WORK

SECTION 02300

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SECTION 02300

EARTHWORK

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 422	(1998) Standard Test Method for Particle-Size Analysis of Soils
ASTM D 1140	(1997) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(2000) Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2000) Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³ (2,700 kN-m/m ³))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2216	(1992) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 2487	(2000) Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(2001) Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2937	(1994) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 3017	(2001) Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3080	(1990) Direct Shear Test of Soils under

Consolidated, Drained Conditions

ASTM D 4318

(2000) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1

(1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Excavation plan; G, RE
Methods proposed for transporting material; G, RE
Haul route plan; G, RE

SD-07 Certificates

Testing; G, RE

Qualifications of the commercial testing laboratory or Contractor's testing facilities.

SD-09 Manufacturer's Field Reports

Testing; G, RE

Within 24 hours of conclusion of physical tests, 2 copies of test results, including calibration curves and results of calibration tests.

1.3 SUBSURFACE DATA

Subsurface soil boring logs are shown on the drawings. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.4 BLASTING

Blasting will not be permitted.

1.5 UTILIZATION OF EXCAVATED MATERIALS

1.5.1 Topsoil

Topsoil excavated within the construction limits shall be stockpiled for backfilling environmental corridor and to cover soil cement embankments as shown on the construction plans.

Topsoil shall consist of fertile, friable soil of loamy character, and shall contain an amount of organic matter normal to the region. It shall be

obtained from well-drained arable land and shall be reasonably free from subsoil, refuse, roots, heavy or stiff clay, stones larger than one inch in size, coarse sand, noxious seeds, sticks, brush, litter, and other deleterious substances.

1.5.2 Soil Cement Mix

The Contractor's attention is directed to the fact that not all materials excavated from the channel or its banks is suitable for use as the soil component of a soil cement mixture. The gradation requirements of the soil component of a soil cement mixture is included in SECTION 03702: SOIL CEMENT. The Contractor shall stockpile the excavated material of best quality for soil cement mixing, prior to using this material for backfilling earthen levee and other common fills. The Contractor shall satisfy himself that there is sufficient material stockpiled for soil cement mixture before allocating the excavated material to other construction items or dispose of outside of project limits.

1.5.3 Fill Material

The excavated material which is not suitable for soil cement mixture may be suitable to backfill the proposed bank protection or grade control structures, and to construct the earthen portion of levees. No excavated material shall be disposed of to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

There are buried debris, asphalt, concrete rubble, riprap, and boulders in the channel banks, invert, and overbank areas within excavation limits of the project. The concrete rubble, riprap and boulders, if free from contaminants or organic matters, will be allowed for backfilling the temporary excavation pit required for the construction of soil cement embankment toedown immediately downstream of drop structures.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL EXCAVATION

The Contractor shall perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Grading shall be in conformity with the typical sections shown and the tolerances specified in paragraph FINISHING. Satisfactory excavated materials shall be used in the soil cement construction or transported to and placed in fill or embankment within the limits of the work. Unsatisfactory materials encountered within the limits of the work shall be excavated below grade and replaced with satisfactory materials as directed. Such excavated material and the satisfactory material ordered as replacement shall be included in excavation. Surplus satisfactory excavated material not required for soil cement construction, fill or embankment shall be disposed of offsite. Unsatisfactory excavated material shall be disposed of offsite. During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times.

3.1.1 Ditches, Gutters, and Channels

Excavation of ditches, gutters, and channels shall be accomplished by

cutting accurately to the cross sections, grades, and elevations shown. Ditches, gutters and channels shall not be excavated below grades shown. Excessive excavation shall be backfilled with material meeting the requirements of compacted fill, buttress and compacted to the requirements of compacted fill, buttress, to grades shown. Material excavated shall be disposed of offsite. The Contractor shall maintain excavations free from detrimental quantities of brush, sticks, trash, and other debris until final acceptance of the work.

3.1.2 Drainage Structures

Excavations shall be made to the lines, grades, and elevations shown, or as directed. Trenches and foundation pits shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Foundation material shall be cleaned of loose debris and cut to a firm, level, stepped, or serrated surface. Loose disintegrated rock and thin strata shall be removed. When concrete or masonry is to be placed in an excavated area, the bottom of the excavation shall not be disturbed. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.1.3 Opening and Drainage of Excavation

The Contractor shall notify the Contracting Officer sufficiently in advance of the opening of any excavation to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of offsite. The Contractor shall ensure that excavation of any area, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.1.4 GRADING AREAS

Where indicated, work will be divided into grading areas within which satisfactory excavated material shall be placed in embankments, fills, and required backfills. The Contractor shall not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing.

3.2 SURFACE AND BURIED DEBRIS

Surface and buried debris is present within the project limits. Major known areas of surface debris are shown on Sheets G1 through G8 of 14. The Contractor shall prepare an excavation plan that shows the sequence of quantity surveys and schedule for excavation of the various materials to be excavated. Any excavation greater than the excavation lines shall be in two-foot increments and only with the approval of the Contracting Officer. Buried debris excavation shall only be to the depth where native soil is encountered. The various source and buried debris is generalized as follows:

a. Refuse - Refuse would consist of trash, garbage, tires, construction debris, and various types of debris.

b. Concrete and asphalt rubble - Rubble would consist of mixtures of various percentage of concrete, asphalt, bricks, and areas of grouted stone.

Boulders - Boulders would consist of boulders, cobbles, and riprap, up

to four feet in size.

3.3 PRESERVATION OF PROPERTY

All excavation operations shall be conducted in such a manner that concrete structures, roads, sidewalks, curbs, gutters, private properties (i.e. backyards, swimming pool, patio, and etc.), utilities, or other facilities and improvements which are to remain in place permanently will not be subjected to settlement or horizontal movement. The Contractor shall furnish and install sheet piling, cribbing, bulkheads, shores, or whatever means may be necessary to adequately support material carrying such improvements or to support the improvements themselves and shall maintain such means in position until they are no longer needed. Temporary sheet piling, cribbing, bulkheads, shores or other protective means shall remain the property of the Contractor and when no longer needed shall be removed from the site. All shoring and bracing shall be designed so that it is effective to the bottom of the excavation, and shall be based upon calculation of pressures exerted by (and the condition and nature of) the materials to be retained, including surcharge imparted to the side of the trench by equipment and stored materials. Removal of temporary shoring shall be performed in such manner as not to disturb or damage the utilities, finished soil cement or concrete or other facility.

3.4 EXCAVATION FOR STRUCTURES

Excavation within the vicinity of existing structures, utilities, roads, drainage pipes and any other improvements to remain in place shall be performed in a manner to prevent damage to the structure. 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 shall be in accordance with EM 385-1-1.

3.5 HAULED EXCAVATION MATERIAL

The Contractor shall have a haul route plan for removal of required excavated materials and for placing required fill materials. This haul route plan shall be submitted to the Contracting Officer for approval. The Contractor will be responsible for obtaining all permits and licenses necessary to haul material offsite. The Contractor will provide to the Contracting Officer three copies of the proposed street haul route plan for transport of all excess and unsatisfactory excavated material.

3.6 DISPOSAL OF HAZARDOUS AND TOXIC WASTE

Any materials encountered in work areas which are suspected of having characteristics of hazardous and/or toxic waste shall be handled in a manner conforming to the requirements of Section 01354 ENVIRONMENTAL PROTECTION.

3.7 OVERCUT

Except as otherwise specified or as may be ordered in writing, any overcut or excavation made outside the lines indicated on the drawings or directed shall be backfilled with compacted fill conforming to this Section 02300 EARTHWORK. If this overcutting occurs and impacts existing roads, facilities, private property, or sensitive biological habitats, the impacted structures/property shall be reconstructed in-kind. All excavating, backfilling, and compacting of backfill, reconstruction, or restoration of native habitats occasioned thereby shall be by the

Contractor at no additional cost to the Government.

3.8 DISPOSAL OF CONTRACTOR GENERAL HAZARDOUS WASTE

If hazardous material is encountered during construction, construction will cease in the vicinity of the contaminated area. The Contracting Officer will perform an assessment to determine the extent and type of contamination. If necessary, the contaminated site will be remediated to minimize the potential for exposure of the public and to allow the project to be safely constructed. All appropriate authorities (including EPA and the Corps) shall be notified.

3.9 COMPACTION EQUIPMENT

Compaction shall be accomplished by tamping roller, rubber tired roller vibratory compactor or mechanical tampers. All equipment, tools, and machines shall be maintained in satisfactory working condition at all times. Compaction equipment shall be suitable for consistently producing uniform soil densities.

3.10 FILL MATERIAL

Material performance requirements have been selected for fill material. The intention is to use the specified materials obtainable from the on-site excavation; the suitability of the material shall be subject to approval of the Contracting Officer. Materials considered unsuitable for use as compacted fill include but are not limited to those materials containing roots and other organic matter, spongy and saturated materials, trash, debris, chunks or clumps of cemented material, and stone whose greatest dimension is more than 1/3 the lift thickness. Materials classified in ASTM D 2487 as MH, CH, Pt, OH, and OL are also considered unsuitable for use. Stones larger than 4 inches shall not be allowed within 12 inches of concrete surfaces. Fill material shall be excavated with an inclined or vertical cut face for the full depth of excavation. Moisture shall be added before the excavation and during the blending if mixing plants are used. All excavated material shall be blended and moistened for the full depth of excavation prior to placing the compacted fill materials. The Contractor is expected to use discretion while excavating within the project area to ensure his excavation operations are producing adequate amounts of all specified materials in a timely manner for fill construction.

3.10.1 Placement

3.10.1.1 Common Fill Materials

Fill and backfill material shall be placed within the lines and grades indicated in the drawings. Fill material shall not be placed against concrete which has not been in place at least 14 days or until the concrete has developed not less than the specified 28-day compressive strength when tested in accordance with the Section 03301 CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS. Heavy equipment shall not be operated over pipes, subdrain pipes and buried structures until at least 2 feet of fill material has been placed and compacted over them. Material from the top of the pipe or buried structure to 2 feet above pipe or buried structure shall be compacted by mechanical tampers or other equipment approved by the Contracting Officer. Buried structures damaged by the Contractor's operations shall be repaired or replaced at the Contractor's own expense. Compacted fill and backfill shall be placed with suitable equipment in horizontal layers which before compaction, shall not exceed 12 inches in

depth for rubber-tired or vibratory rollers, 8 inches in depth for tamping rollers, and 4 inches in depth when mechanical tampers are used. The Contractor may vary the layer thickness within these limits for most efficient operations. Material containing stones shall be placed in a manner to prevent the stones from striking the concrete structures and to prevent the formation of voids.

3.10.1.2 Other Fill Materials

Concrete rubble, riprap and boulders originating from the project may be incorporated in the backfill of the excavation pit downstream of drop structures. These materials shall be buried a minimum of 5 feet below the finish basin invert and a minimum of 5 feet away from any structures. When fill material contains by volume over 25% of rock larger than 6 inches in greatest dimension, the fill may be constructed in layers of a loose thickness before compaction up to the maximum size of rock in the material, but not exceeding 3 feet in thickness. The interstices around the concrete rubble, riprap and boulders in each layer shall be filled with earth or other fine material and compacted. "Nesting" of pieces will not be allowed. Asphalt pieces and refuse will not be allowed. Compaction other than that obtained by controlled movement of hauling and spreading equipment over the area will not be required.

3.10.2 Moisture Content

shall have a uniform moisture content while being placed and compacted. Water shall be added at the source, if required, and/or by sprinkling each layer of material during placement. Uniform distribution of moisture shall be obtained by disking, harrowing, or otherwise manipulating the soil during and after the time water is added. Material containing an excess of moisture shall be manipulated with suitable implements to facilitate maximum aeration and shall be permitted to dry to the proper consistency before being compacted. Fill shall have a maximum moisture content of not more than 2 percent above optimum and a minimum moisture content of not less than 2 percent below optimum. If, in the opinion of the Contracting Officer, the top or contact surfaces of the partial fill section become too dry to permit suitable bond between these surfaces and the additional fill to be placed thereon, the Contractor shall loosen the dried materials by scarifying or discing to such depths as required, shall dampen the loosened material to an acceptable moisture content, and shall compact this layer in accordance with the applicable requirements specified hereinafter. If the top or contact surfaces of a partial fill section become too wet to permit suitable bond between these surfaces and the additional fill to be placed thereon, the wet material shall be scarified and permitted to dry, assisted by discing or harrowing, if necessary, to such depths as required. The material shall be dried to an acceptable moisture content and recompacted in accordance with the applicable requirements specified herein.

3.10.3 Compaction

No layer of fill shall be compacted before the practicable uniform moisture content has been obtained. Scarified areas shall be compacted as specified for the fill placed thereon. Rollers will not be permitted to operate within 12 inches of buried structures until the compacted fill over the top of the structures has reached a depth of 2 feet. Compaction equipment shall be so operated that structures are not damaged nor overstressed during compaction operations. Mechanical tampers shall be used for compaction of fill material adjacent to structures and in other inaccessible areas where rolling equipment is impracticable for use in

compaction.

3.11 COMPACTED FILL

3.11.1 Preparation for Placing

Before placing material for compacted fill, toe (i.e. select and general) and compacted fill, Permanent access road, the foundation surface shall be cleared of all existing obstructions, vegetation and debris. Any trash or debris shall be removed in accordance with Section 02230 CLEARING AND GRUBBING. Unsuitable or unstable (too wet) material not meeting the requirements for fill material shall be removed where directed.

3.11.2 Compaction

Each layer of the materials shall be compacted to not less than 90 percent of maximum density, per ASTM D 1557.

3.12 EARTH EMBANKMENTS

3.12.1 Preparation of Ground Surface

Ground surface on which fill is to be placed shall be stripped of live, dead, or decayed vegetation, rubbish, debris, and other unsatisfactory material; plowed, disked, or otherwise broken up to a depth of 6 inches; pulverized; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. The prepared ground surface shall be scarified and moistened or aerated as required just prior to placement of embankment materials to assure adequate bond between embankment material and the prepared ground surface.

3.12.2 Compaction

Earth embankments shall be constructed from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 9 inches. The material shall be placed in successive horizontal layers of loose material not more than 15 inches in depth. Each layer shall be spread uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, each layer shall be plowed, disked, or otherwise broken up; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements shall be identical with those requirements specified in paragraph SUBGRADE PREPARATION. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.13 STRUCTURAL BACKFILL

3.13.1 Location

Backfill shall consist of all fill against and/or around structures.

3.13.2 Placing

Backfill material shall not be placed against concrete which has not been in place at least 14 days or until the concrete has attained the 28-day design strength when tested in accordance with Section 03301 CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS. Backfill shall be placed in 4-inch layers.

3.13.3 Compaction

Compaction shall be not less than 90 percent of maximum density, per ASTM D 1557. Compaction requirements for backfill materials shall also conform to the applicable portions of Section 02630 STORM-DRAINAGE SYSTEM.

3.14 SUBGRADE PREPARATION

Subgrade preparation for areas to receive soil cement embankments, aggregate base and asphalt, aggregate base for access roads, maintenance roads and turnarounds shall be cleared of all existing obstructions, vegetation and debris. All trash and debris shall be removed in accordance with Section 02230 CLEARING AND GRUBBING. After excavation to rough grade, the entire subgrade for areas indicated above shall be scarified, moisture conditioned and compacted with the compaction equipment. The subgrade shall be compacted to a density of 95 percent of maximum density, per ASTM D 1557.

If the subgrade is disturbed by the Contractor's operations or is overexcavated, or is soft or yielding, the subgrade shall be restored to grade and compacted to a density of 95 percent of maximum density, per ASTM D 1557. The finished surface of the subgrade shall not be more than 1/2 inches from the indicated grade at any point when tested with a 10 feet straightedge. Areas on which stone/riprap is to be placed shall be graded and/or dressed to conform to cross section shown on the contract drawings within an allowable tolerance of plus or minus 1 inch from the theoretical lines and grades.

3.15 FINISHING

The surface of excavations, embankments, and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for graded areas shall be within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades shall be specified in paragraph SUBGRADE PREPARATION. Gutters and ditches shall be finished in a manner that will result in effective drainage.

3.16 TESTING

Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. If the Contractor elects to establish testing facilities, no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved by the Contracting Officer. Field in-place density shall be determined in accordance with ASTM D 1556 and ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017; the calibration checks of

both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, the material shall be removed, replaced and recompacted to meet specification requirements. Tests on recompacted areas shall be performed to determine conformance with specification requirements. Inspections and test results shall be certified by a registered professional civil engineer. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.16.1 Fill and Backfill Material Gradation

One test per 10,000 cubic yards stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM D 422.

3.16.2 In-Place Densities

a. One test per 500 cubic yards, for the first 5,000 cubic yards of material and 1 test for each 1,000 cubic yards thereafter, or fraction thereof, of fill or backfill areas compacted by other than hand-operated machines.

b. One test per 200 cubic yards, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

3.16.3 Moisture Content

In the stockpile and excavation, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions shall be performed. During unstable weather, tests shall be made as dictated by local conditions and approved by the Contracting Officer.

3.16.4 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 10,000 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.17 SUBGRADE AND EMBANKMENT PROTECTION

During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition until ballast, subbase, base, or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No subbase, base course, ballast, or pavement shall be laid until the subgrade has been checked and approved, and in no case shall subbase, base, surfacing, or pavement be placed on a muddy, spongy, or frozen subgrade.

-- End of Section --