

SECTION TABLE OF CONTENTS

SITE WORK

SECTION 02100

DIVERSION AND CONTROL OF WATER

PART 1 GENERAL.....1
 1.1 DIVERSION AND CONTROL OF SURFACE WATER.....1
 1.2 PERCHED WATER.....1
 1.3 DRAINAGE.....1
PART 2 PRODUCTS (Not Applicable).....1
PART 3 EXECUTION (Not Applicable).....1

-- End of Table of Contents --

SECTION 02100

DIVERSION AND CONTROL OF WATER

PART 1 GENERAL

1.1 DIVERSION AND CONTROL OF SURFACE WATER

1.1.1 All permanent construction shall be carried on in areas free from water. Water in varying quantities may be flowing in Santa Paula Creek during the entire period of construction as a result of either ground water seepage, rainfall or snowmelt. Runoff from the watersheds is rapid, and, during periods of rain, intermittent freshets may be expected. At all locations where construction work is at a lower elevation than the elevation of the stream or ground water at the time of doing the work, suitable cofferdams or dikes, if necessary, shall be constructed, the construction area shall be dewatered prior to commencement of work, and all subgrades, whether for earth fill, stone, or concrete, shall be kept drained and free of water throughout the working period. Within 10 days after receipt of Notice to Proceed, the Contractor shall submit plans showing the method that he proposes to use to dewater each working area and control the water from rain, sheet flow, stream flow, and any other surface or ground water. The plans shall show the scheme of operations and a complete layout of drainage pipes, pumps, diversion channels, cofferdams, etc.

1.1.2 The Contractor shall provide for diversion and control of water to protect all construction from all flood flows for the entire duration of the construction period. The Contractor shall also insure that the diversion and control of water facilities that are constructed shall have no adverse impact on the capacity of the channel. The flows will include water originating from upstream of the work; adjacent drainages; and in addition any and all ground water originating within the work. Any construction that is damaged during the construction period shall be replaced at the Contractor's expense.

1.2 PERCHED WATER

The Contractor shall provide for drainage of any localized perched water resulting from seepage from adjacent irrigation ponds.

1.3 DRAINAGE

Surface water shall be directed away from excavation and construction sites so as to prevent erosion and undermining of foundations. Diversion ditches, dikes and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site and the areas immediately surrounding the site and affecting operations at the site shall be continually and effectively drained.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION TABLE OF CONTENTS

SITE WORK

SECTION 02150

CLEAR SITE AND REMOVE OBSTRUCTIONS

PART 1 GENERAL.....1
1.1 PROTECTION OF EXISTING WORK.....1
1.2 ENVIRONMENTAL PROTECTION.....1
1.3 BURNING.....1
1.4 EXPLOSIVES.....1
PART 2 PRODUCTS (Not Applicable).....1
PART 3 EXECUTION.....1
3.1 REQUIREMENTS.....1
3.2 CLEARING.....2
3.3 GRUBBING.....2
3.4 EXISTING STRUCTURES AND OBSTRUCTIONS.....2
 3.4.1 General.....2
 3.4.2 Removal.....2
 3.4.3 Utilities.....2
3.5 FILLING OF HOLES.....2
3.6 DISPOSAL OF MATERIAL.....3

-- End of Table of Contents --

SECTION 02150

CLEAR SITE AND REMOVE OBSTRUCTIONS

PART 1 GENERAL

1.1 PROTECTION OF EXISTING WORK

Before beginning any cutting or demolition work for removals, the Contractor shall carefully survey the existing work and examine the drawings and specifications to determine the extent of the work. The contractor shall take all necessary precautions to insure against damage to existing work to remain in place or to be reused, and any damage to such work shall be repaired or replaced as approved by the Contracting Officer at no additional cost to the Government. The Contractor shall carefully coordinate the work of this section with all other work and construct and maintain shoring, bracing and supports, as required. The Contractor shall insure that structural elements are not overloaded and be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under any part of this contract.

1.2 ENVIRONMENTAL PROTECTION

All work and Contractor operations shall comply with the requirements of SECTION 01130: ENVIRONMENTAL PROTECTION.

1.3 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.4 EXPLOSIVES

Use of explosives will not be permitted.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 REQUIREMENTS

Except as otherwise specified, and/or indicated, areas to be cleared shall be limited to actual excavation areas and areas on which fills and/or structures are to be placed. The removal of trees, shrubs, turf, and other vegetation outside of these areas shall be held to a minimum and care shall be exercised not to damage any trees, shrubs, turf, or vegetation which can be left in place.

3.2 CLEARING

Trees smaller than 40 millimeter in diameter, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off 150 millimeters below the indicated structure subgrade or at the original ground surface, whichever is lower, except as specified. Other vegetation shall be cut off flush or slightly below the original ground surface. Clearing operations shall be conducted so as to prevent damage to trees, structures, and installations under construction or to remain in place.

3.3 GRUBBING

Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 450 millimeters below the original surface level of the ground in areas indicated as construction areas under this contract, such as areas for structures, fills and areas to be paved.

3.4 EXISTING STRUCTURES AND OBSTRUCTIONS

3.4.1 General

The Contractor shall clear the site, and remove and dispose of all existing structures and obstructions for project construction, except as otherwise noted on the drawings. Obstructions which are designated or specified to be removed but which are not designated or specified to be removed by others shall be removed by the Contractor. Except as otherwise specified, obstructions designated to be removed by others will be removed in sufficient time to preclude interference with the Contractor's operations.

3.4.2 Removal

Grouted stone, stone, asphalt concrete, guard rail, miscellaneous structures, and fencing shall be removed, where indicated.

3.4.3 Utilities

Prior to removing an obstruction, all applicable utility relocations shall have been coordinated in accordance with SECTION 01200: GENERAL REQUIREMENTS, paragraph: PUBLIC UTILITIES, NOTICES, AND RESTRICTIONS. Pipes designated by owners as "abandoned" shall be removed within the limits of the project as necessary for clearing. All pipes shall be plugged at the cut ends.

3.5 FILLING OF HOLES

Holes made by removal of obstructions and grubbing operations shall be refilled to subgrade with compacted fill material as specified in the SECTION 02200: EXCAVATION, FILLING AND BACKFILLING.

3.6 DISPOSAL OF MATERIAL

All material removed, except material specified and/or indicated to be salvaged, is designated as scrap and shall become the property of the Contractor and shall be removed from the site. The Contractor shall be responsible for compliance with all Federal and State laws and regulations. Disposal of refuse and debris and any accidental loss or damage attendant thereto shall be the Contractor's responsibility.

-- End of Section --

SECTION 02200

EXCAVATION, FILLING AND BACKFILLING

PART 1.	GENERAL.....	1
1.1	REFERENCES	1
1.2	DEFINITIONS	1
1.2.1	Excavation.....	1
1.2.2	Compacted Fill.....	1
1.2.3	Miscellaneous Fill.....	1
1.2.4	Degree of Compaction.....	2
1.3	PRESERVATION OF PROPERTY	2
1.4	deleted	2
1.5	SUBMITTALS	2
PART 2.	PRODUCTS.....	3
2.1	MATERIALS	3
2.1.1	Compacted Fill.....	3
2.1.2	Satisfactory Materials For Fills and Backfills.....	3
2.1.3	Satisfactory Materials For Backfill Around Structures And Trenches.....	3
2.1.4	Select Granular Material.....	3
2.1.5	Initial Backfill Material.....	3
2.1.6	Unsatisfactory Materials.....	3
PART 3.	EXECUTION.....	4
3.1	CLEARING SITE	4
3.2	EXCAVATION	4
3.3	DIVERSION AND CONTROL OF WATER	4
3.4	SHORING	4
3.5	CLASSIFICATION OF EXCAVATION	5
3.6	BLASTING	5
3.7	UTILITY AND DRAIN TRENCHING	5
3.7.1	Trench Excavation.....	5
3.7.1.1	Bottom Preparation.....	5
3.7.1.2	Removal of Unyielding Material.....	6
3.7.1.3	Removal of Unstable Material.....	6
3.7.1.4	Excavation for Appurtenances.....	6
3.8	EXCAVATED MATERIALS	6
3.9	FINAL GRADE OF SURFACES TO SUPPORT CONCRETE	6
3.10	SUBGRADE PREPARATION	6
3.10.1	Subgrade Preparation for Fills and Excavated Areas	
3.10.2	Subgrade Preparation for Access Roads	
3.11	FILLING AND STRUCTURAL BACKFILLING	7
3.12	TESTING	8
3.12.1	In-Place Densities.....	9
3.12.1.1	In-Place Density of Subgrades.....	9
3.12.1.2	In-Place Density of Fills and Backfills.....	9
3.12.2	Moisture Content.....	9
3.12.3	Optimum Moisture and Laboratory Maximum Density.....	9
3.13	UTILITY AND STORM DRAIN BACKFILLING	9
3.13.1	Trench Backfill.....	9
3.13.1.1	Replacement of Unyielding Material.....	9
3.13.1.2	Replacement of Unstable Material.....	10
3.13.1.3	Bedding and Initial Backfill.....	10
3.13.1.4	Final Backfill.....	10

3.13.1.5 Backfill for Appurtenances.....10
3.14 GRADING10
3.15 PROTECTION10

-- End Table of Contents --

SECTION 02200

EXCAVATION, FILLING AND BACKFILLING

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 D 422 (1963; R 1990) Particle-Size Analysis of Soils
- ASTM D 1556 (1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
- ASTM D 1557 (1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (2,700 kN-m/cu.m.)
- ASTM D 2216 (1992) Laboratory Determination of Water (Moisture) Content of Soil, and Rock
- ASTM D 2487 (1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)

STATE OF CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH ACT

- CAL/OSHA (1996) State of California Construction Safety Orders

1.2 DEFINITIONS

1.2.1 Excavation

Excavation shall consist of the removal of every type of material encountered except materials covered by the provisions of Section 02150 CLEAR SITE AND REMOVE OBSTRUCTIONS in the designated areas or from areas directed. The material to be removed may include but is not limited to earth, hardpan, silt, clay, gravel, cemented sand and gravel, cobble and boulders, adobe, detached pieces of stone and concrete, riprap rock fills, existing fills of miscellaneous debris and rubbish and other unsuitable materials.

1.2.2 Compacted Fill

Compacted fill shall consist of placement of fill material as required for the grading and construction of the channel, service roadway, fish ladder and all other areas.

1.2.3 Miscellaneous Fill

Miscellaneous fill shall consist of material from the required excavation, placed in the area indicated and shall be placed with suitable equipment in

layers which shall not exceed 600 millimeters in depth before consolidation. Broken concrete and rock to be wasted may be buried outside the channel in the larger miscellaneous fill areas, provided such material is less than 600 millimeters in its largest dimensions and is placed in such a manner that will prevent the formation of voids and provided it is placed not less than 600 millimeters below finished grade and not less than 600 millimeters horizontally from concrete construction. No depressions in which water might pond shall be left in miscellaneous fill areas. The finished areas shall be sloped to drain. Compaction other than that obtained by the controlled movement of the construction equipment will not be required. Miscellaneous fill shall not be used beneath grouted stone protection or for foundations and other structures.

1.2.4 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated hereinafter as percent maximum density.

1.3 PRESERVATION OF PROPERTY

1.3.1 All excavation operations shall be conducted in such manner that street pavements, bridges, utilities, or other facilities and improvements which are to remain in place permanently will not be subjected to settlement or horizontal movement.

1.3.2 The Contractor shall furnish and install sheet piling, cribbing, bulkheads, shores, or whatever means may be necessary to adequately support material supporting such facilities or improvements or to support the facilities or 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. Removal of shoring shall be performed in such manner as not to disturb or damage the finished concrete or other facility.

1.3.3 All shoring and bracing shall be designed in accordance with COE Safety Manual EM 385-1-1 and CAL/OSHA. Calculations and drawings for all shoring required by CAL/OSHA to be designed by a Registered Professional Engineer shall be submitted for approval.

1.4 deleted

1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS, paragraph SUBMITTAL PROCEDURES:

SD-01 Data

Shoring calculations; GA.

SD-04 Drawings

Dewatering/drainage plans; FIO. Shoring drawings; GA.

SD-09 Reports

Field Density Tests; FIO. Testing of Backfill Materials; FIO.

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

PART 2. PRODUCTS

2.1 MATERIALS

2.1.1 Compacted Fill

Fill material shall be obtained from both the required excavations and from sources approved by the Government.

2.1.2 Satisfactory Materials For Fills and Backfills

Satisfactory materials for fills and backfills shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, SW-SC, SP-SM, SP-SC, CL, ML, or CL-ML.

2.1.3 Satisfactory Materials For Backfill Around Structures And Trenches

Satisfactory materials for backfill around structures and trenches shall comprise any materials classified by ASTM D 2487 as GW, GP, SW, or SP with no stone larger than 75 mm.

2.1.4 Select Granular Material

Select granular material shall consist of well graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing 0.075 mm and no less than 95 percent by weight passing 25 mm. The maximum allowable aggregate size shall be 75 mm, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

2.1.5 Initial Backfill Material

Initial backfill shall consist of select granular material or satisfactory materials free from rocks 75 mm or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than 75 mm in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

2.1.6 Unsatisfactory Materials

The removal of soils which are unsatisfactory for foundations of the levee, structures, access roads, and side drains, may be required in certain areas. Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; material classified as satisfactory which contains root and other organic matter or frozen material, and stones larger than 3/4 of the compacted layer thickness. The Contracting Officer shall be notified of any contaminated materials."

PART 3. EXECUTION

3.1 CLEARING SITE

Clearing site is specified in Section 02150 CLEAR SITE AND REMOVE OBSTRUCTIONS.

3.2 EXCAVATION

3.2.1 Excavation shall conform to the dimensions and elevations indicated except as specified hereinafter. Excavation for permanent cuts shall be made to the slope lines indicated. Slope lines indicated on the drawings for temporary cuts do not necessarily represent the actual slope to which the excavation must be made to safely perform the work. Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms. Excavation shall be performed in a manner which will not impair the subgrade. Except as otherwise specified, the finish surface of subgrades shall be smooth and shall not vary more than 15 millimeters from indicated grade.

3.2.2 Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed and replaced with satisfactory material. Satisfactory material removed below the depths indicated without specific direction of the Contracting Officer shall be replaced at no additional cost to the Government to the indicated excavation grade with satisfactory materials. Satisfactory material shall be placed and compacted as specified in paragraph FILLING AND BACKFILLING. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

3.2.3 The Contractor shall be responsible for obtaining all permits and licenses required to haul material off site.

3.3 DIVERSION AND CONTROL OF WATER

Diversion Control of water is specified in Section 02100 DIVERSION AND CONTROL OF WATER.

3.4 SHORING

Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities.

Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.

3.5 CLASSIFICATION OF EXCAVATION

Excavation will be unclassified regardless of the nature of material encountered.

3.6 BLASTING

Blasting will not be permitted.

3.7 UTILITY AND DRAIN TRENCHING

Trenches for underground utilities systems and drain lines shall be excavated to the required alignments and depths. The bottoms of trenches shall be graded to secure the required slope and shall be tamped if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth of at least 150 mm below the bottom of the pipe, and the overdepth shall be backfilled with satisfactory material placed and compacted.

3.7.1 Trench Excavation

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 1.5 meters high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Vertical trench walls more than 1.5 meters high shall be shored. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. **The trench width below the top of pipe shall not exceed 600 mm (24 inches) plus pipe outside diameter (O.D.) for pipes of less than 600 mm (24 inches) inside diameter. Likewise, the trench width below the top of pipe shall not exceed 900 mm (36 inches) plus pipe outside diameter for sizes larger than 600 mm (24 inches) inside diameter.** Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

3.7.1.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 150 millimeters or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.7.1.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed 150 millimeters below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.7.1.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with pervious backfill as provided in paragraph 2.1 MATERIALS. When removal of unstable material is required due to the fault or neglect of the Contractor in his performance of the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

3.7.1.4 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures 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. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.8 EXCAVATED MATERIALS

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required under this section or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall become the property of the Contractor and removed from the site. No excavated material or waste of any kind shall be disposed of at any place beyond the limits of the work under this contract without express authority. Additional requirements for disposal of excess material can be found in the SPECIAL CLAUSE and SECTIONS: GENERAL REQUIREMENTS, ENVIRONMENTAL PROTECTION, and CLEAR SITE AND REMOVE OBSTRUCTIONS.

3.9 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Excavation to final grade shall not be made until just before concrete is to be placed. Concrete shall not be placed until the subgrade has been inspected and approved.

3.10 SUBGRADE PREPARATION

3.10.1 Subgrade Preparation for Fills and Excavated Areas

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials. The surface shall be scarified to a depth of 150 mm before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 150 mm, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 300 mm and compacted as specified for the adjacent fill. The finished surface of subgrade shall be smooth and shall not vary more than 15 mm from the indicated grade at any point when tested with a 3 m straightedge. Material shall not be placed on surfaces that are wet or muddy. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to plus or minus 3 percent of optimum moisture to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified in paragraph FILLING AND STRUCTURAL BACKFILLING.

3.10.2 Subgrade Preparation for Access Road

Unsatisfactory material in the subgrade shall be removed and replaced in accordance with paragraph 3.10.1. Satisfactory subgrade shall be alternately watered and scarified until the material is uniformly moistened throughout for a depth of not less than 300 mm. All stones larger than 100 mm in diameter, and hard ribs of earth shall be removed. The amount of water to be applied shall be that which is required to provide optimum results in compaction under rolling. Following the above operations, the roadbed shall be shaped to a true cross section sufficiently higher than the specified grade to allow for subsequent compaction and then be thoroughly compacted to not less than 95 percent of maximum density as determined by ASTM D 1557. After the subgrade has been prepared and complete, the surface shall be firm, hard, unyielding, with a true, even, and uniform surface conforming to the grade and cross section indicated on the drawings. All points of the finished subgrade shall be not more than 9.5 mm below or above true subgrade.

3.11 FILLING AND STRUCTURAL BACKFILLING

Satisfactory materials shall be used in bringing fills and backfills to the lines and grades indicated and for replacing unsatisfactory materials. Satisfactory materials shall be placed in horizontal layers not exceeding 200 mm in loose thickness, or 150 mm when hand-operated compactors are used. After placing, each layer shall be plowed, disked, or otherwise broken up, moistened or aerated as necessary, thoroughly mixed and compacted as specified. Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. Backfill shall not be placed in wet areas. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 600 mm above sewer lines and 300 mm above other utility lines shall be free from stones larger than 25 mm in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 100 mm in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes to avoid damage to coatings or wrappings. Backfill shall not be placed against abutments, culverts or channel walls prior to 7 days after completion of the walls or until the concrete has reached its specified 28 day compression strength, whichever is longer. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall. Each layer of fill and backfill shall be compacted to not less than the percentage of maximum density specified below:

<u>Location</u>	<u>Percent Maximum Density</u>
Fill, embankment, and backfill under wall footings and other structure foundations. Backfill for walls with service roads above. The upper 610 mm of fill on which a road is to be placed.	95
Backfill for walls without service roads above.	90
All other areas	90

Approved compacted subgrades that are disturbed by the Contractor's operations or adverse weather shall be scarified and compacted as specified herein before to the required density prior to further construction thereon. Recompeaction over underground utilities and heating lines shall be by hand tamping.

3.12 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or may be performed by the Contractor subject to approval. Field in-place density shall be determined in accordance

with ASTM D 1556. The following number of tests, if performed at the appropriate time, shall be the minimum acceptable for each type operation.

3.12.1 In-Place Densities

3.12.1.1 In-Place Density of Subgrades

One test per 2250 square meters or fraction thereof.

3.12.1.2 In-Place Density of Fills and Backfills

One test per 2250 square meters or fraction thereof of each lift for fill or backfill areas compacted by other than hand or hand-operated machines. The density for each lift of fill or backfill materials for trenches, pits, walls or other structures or areas less than 5 meters in width, which are compacted with hand or hand-operated machines shall be tested as follows: One test per each area less than 2250 square meters, or one test for each 450 linear meter of long narrow fills 1000 meters or more in length.

3.12.2 Moisture Content

In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of materials being placed is required during stable weather conditions. During unstable weather, tests shall be made as dictated by local conditions and approved moisture content shall be tested in accordance with ASTM D 2216.

3.12.3 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 750 cubic meters of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density will be made.

3.13 UTILITY AND STORM DRAIN BACKFILLING

Backfill material shall consist of satisfactory material, pervious backfill, or initial backfill material as required. Backfill shall be placed in layers not exceeding 150 mm loose thickness for compaction by hand operated machine compactors, and 200 mm loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless soils and 90 percent maximum density for cohesive soils, unless otherwise specified.

3.13.1 Trench Backfill

Trenches shall be backfilled to the grade shown.

3.13.1.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3.13.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 150 mm loose thickness.

3.13.1.3 Bedding and Initial Backfill

Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

3.13.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways, railroads and airfields, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

- a. Pavements: Backfill shall be placed up to the elevation at which the requirements in Paragraph for FILLING AND STRUCTURAL BACKFILLING. Water flooding or jetting methods of compaction will not be permitted.
- b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 300 mm loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Water flooding or jetting methods of compaction will be permitted for granular noncohesive backfill material. Water jetting shall not be allowed to penetrate the initial backfill. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

3.13.1.5 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 28 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.14 GRADING

Areas within 1.5 m outside of each structure line shall be constructed true-to-grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

3.15 PROTECTION

Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work shall be repaired and grades reestablished to the required elevations and slopes.

-- End of Section --

SECTION TABLE OF CONTENTS

SITE WORK

SECTION 02215

GEOTEXTILE

PART 1 GENERAL.....1
1.1 REFERENCES.....1
1.2 SHIPMENT, HANDLING, AND STORAGE.....1
 1.2.1 Shipment.....1
 1.2.2 Handling.....2
 1.2.3 Storage.....2
PART 2 PRODUCTS.....2
2.1 MATERIALS.....2
 2.1.1 Geotextile.....2
 2.1.1.1 General.....2
 2.1.1.2 Geotextile Fiber.....3
 2.1.2 Seams.....3
2.2 INSPECTIONS AND VERIFICATIONS.....3
 2.2.1 Manufacturing and Sampling.....3
 2.2.2 Site Verification.....3
PART 3 EXECUTION.....3
3.1 SURFACE PREPARATION.....3
3.2 INSTALLATION OF THE GEOTEXTILE.....4
 3.2.1 General.....4
 3.2.2 Placement.....4
3.3 PROTECTION.....4

-- End Table of Contents --

SECTION 02215

GEOTEXTILE

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 D 123 (1993) Standard Terminology of Terms Related to Textiles
- ASTM D 3786 (1987) Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method
- ASTM D 4354 (1989) Sampling of Geosynthetic for Testing
- ASTM D 4355 (1992) Deterioration of Geotextile from Exposure to Ultraviolet light and Water (Xenon-Arc Type Apparatus)
- ASTM D 4491 (1992) Water Permeability of Geotextiles By Permittivity
- ASTM D 4533 (1991) Trapezoid Tearing Strength of Geotextile
- ASTM D 4632 (1991) Grab Breaking Load and Elongation of Geotextiles
- ASTM D 4751 (1993) Determining the Apparent Opening Size of a Geotextile
- ASTM D 4833 (1988) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
- ASTM D 4873 (1988) Guide for Identification, Storage, and Handling of Geotextiles
- ASTM D 4884 (1990) Seam Strength of Sewn Geotextiles

1.2 SHIPMENT, HANDLING, AND STORAGE

1.2.1 Shipment

only approved geotextile rolls shall be delivered to the project site. All geotextile shall be labeled, shipped, stored, and handled in accordance with ASTM D 4873 and as specified herein. Each roll shall be wrapped in an opaque and waterproof layer of plastic during shipment and storage. The plastic wrapping shall be placed around the geotextile roll in the manufacturing facility and shall not be removed until deployment. Each roll shall be labeled with the manufacturer name, geotextile type, lot number, roll number, and roll dimensions (length, width, gross weight). Geotextile wrapping damaged as a result of delivery, storage, or handling shall be repaired or replaced, as directed at no additional cost to the Government.

1.2.2 Handling

No hooks, tongs, or other sharp instruments shall be used for handling geotextile. Geotextile shall not be dragged along the ground. Any geotextile determine to be damaged as a result of poor handling shall be removed from the site and replaced, at no additional cost to the Government, by additional geotextile meeting requirements of this specification.

1.2.3 Storage

During all periods of shipment and storage, the geotextile shall be protected from direct sunlight, ultra-violet rays, temperatures greater than 60 degrees C (or less if recommended by the manufacturer), mud, dirt, dust and debris. Geotextile shall be stored in areas where water cannot accumulate, elevated off the ground, and protected from conditions that will affect the properties or performance of the geotextile.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTALS.

Certificates, FIO

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Geotextile

2.1.1.1 General

The geotextile shall be a non-woven pervious sheet of plastic yarn as defined by ASTM D 123. The geotextile shall meet the physical requirements listed in Table 1, MINIMUM PHYSICAL REQUIREMENTS FOR GEOTEXTILE. Strength values indicated in the table are for the weaker principal direction.

TABLE 1.
MINIMUM PHYSICAL REQUIREMENTS FOR GEOTEXTILE

Property	Units	Acceptable Values	Test Method
Grab Strength	N	1000	ASTM D 4632
Puncture	N	400	ASTM D 4833
Burst Strength	kPa	3000	ASTM D 3786
Trapezoidal Tear	N	350	ASTM D 4533
Permeability	cm/sec	0.25	ASTM D 4491
Apparent Opening Size	U.S. Sieve No.	70	ASTM D 4751
Permittivity	sec ⁻¹	1.00	ASTM D 4491

Property	Units	Acceptable Values	Test Method
Ultraviolet Degradation	%	50 at 500 Hrs	ASTM D 4355

2.1.1.2 Geotextile Fiber

Fibers used in the manufacturing of the geotextile shall consist of a longchain synthetic polymer composed of at least 85 percent by weight of polyolefins, polyesters, or polyamides. Stabilizers and/or inhibitors shall be added to the base polymer if necessary to make the filaments resistant to deterioration caused by ultraviolet light and heat exposure. Reclaimed or recycled fibers or polymer shall not be added to the formulation. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. The edges of the geotextile shall be finished to prevent the outer fiber from pulling away from the geotextile.

2.1.2 Seams

Seams are allowed if the minimum overlap is 150 millimeters. Vertical seams will not be allowed, only horizontal seams. The seams of the geotextile shall be sewn with thread of a material meeting the chemical requirements given above for geotextile fiber or shall be bonded by cementing or by heat. The sheets of geotextile shall be attached at the factory or another approved location, if necessary, to form sections not less than 2 meters long. The strength of the seam shall be not less than 90 percent of the required grab tensile strength of the unaged geotextile in any principal direction.

2.2 INSPECTIONS AND VERIFICATIONS.

2.2.1 Manufacturing and Sampling

Geotextiles and factory seams shall meet the requirements specified in TABLE 1, MINIMUM PHYSICAL REQUIREMENTS FOR GEOTEXTILE. Geotextiles shall be randomly sampled in accordance with ASTM D 4354 (Procedure Method A). Factory seams shall be sampled at the frequency specified in ASTM D 4884.

2.2.2 Site Verification.

Samples shall be collected at approved locations upon delivery to the site at the request of the Contracting Officer. Samples shall be verified to meet the requirements specified in TABLE 1, MINIMUM PHYSICAL REQUIREMENTS FOR GEOTEXTILE. Samples shall be identified by manufacturers name, type of geotextile, lot number, roll number, and machine direction. Factory test results from the lot under review shall be submitted and approved prior to deployment of that lot of geotextile. Rolls which are sampled shall be immediately rewrapped in their protective covering.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surface on which the geotextile will be placed shall be prepared to a smooth surface condition, in accordance with the applicable portion of this specification and shall be free from obstruction, debris or depressions. Any irregularities will be repaired or removed so as to insure continuous, intimate contact of the geotextile with all of the surface. Any loose material will be removed before geotextile placement.

3.2 INSTALLATION OF THE GEOTEXTILE

3.2.1 General

The geotextile shall be placed in the manner and at the locations shown on the drawings. At the time of installation, the geotextile shall be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage.

3.2.2 Placement

The geotextile shall be placed with the long dimension along the vertical channel concrete joint and laid smooth and free of tension, stress, folds, wrinkles, or creases. The strips shall be placed to provide a minimum width of 500 millimeters for each joint. Tacking or pinning of the geotextile to hold it in place shall be allowed in the outer 50 millimeters of the strip. The Contractor shall adjust the actual length of the geotextile based on initial installation experience and approval of the Contracting Officer.

3.3 PROTECTION

The geotextile shall be protected at all times during construction from contamination. Any damage to the geotextile during its installation or during placement of fill or backfill shall be replaced by the Contractor at no cost to the Government. The work shall be scheduled so that the covering of the geotextile with a layer of the specified material is accomplished within 7 calendar days after placement of the geotextile. Failure to comply shall require replacement of geotextile. The geotextile shall be protected from damage prior to and during the placement of the fill or backfill materials. Before placement of fill or backfill materials, the Contractor shall demonstrate that the placement technique will not cause damage to the geotextile.

-- End of Section --

SECTION TABLE OF CONTENTS
SITE WORK
SECTION 02241
AGGREGATE BASE COURSE

PART 1	GENERAL.....	1
1.1	References.....	1
1.2	Definitions.....	1
1.2.1	Aggregate Base.....	1
1.2.2	Degree of Compaction.....	1
1.2.3	Moisture Content.....	2
1.3	General.....	2
1.4	Submittals.....	2
1.5	Straightedge.....	2
1.6	Stockpiling Materials.....	2
1.7	Sampling and Testing.....	2
1.7.1	General Requirements.....	2
1.7.2	Test Results.....	3
1.7.3	Sampling.....	3
1.7.4	Sieve Analysis.....	3
1.7.5	Liquid Limit and Plasticity Index.....	3
1.7.6	Laboratory Density.....	3
1.7.7	Wear Tests.....	3
PART 2	PRODUCTS.....	3
2.1	Materials.....	3
2.1.1	Aggregates.....	3
2.1.2	Binder Material.....	4
2.1.3	Gradation.....	4
PART 3	EXECUTION.....	5
3.1	General Requirements.....	5
3.2	Preparation Of Underlying Surface.....	5
3.2.1	General Requirements.....	5
3.2.2	Grade Control.....	5
3.3	Installation.....	5
3.3.1	Mixing and Placing.....	5
3.3.2	Edges of Base Course.....	5
3.3.3	Compaction.....	6
3.3.4	Layer Thickness.....	6
3.3.5	Finishing.....	6
3.4	Field Quality.....	6
3.4.1	Field Density.....	6
3.4.2	Smoothness.....	7
3.4.3	Thickness.....	7
3.5	Traffic.....	7
3.6	Maintenance.....	7
3.7	Disposal of Unsatisfactory.....	7

End of Table of Contents—

SECTION 02241
AGGREGATE BASE COURSE

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 127	1988; R 1993 Specific Gravity and Absorption of Course Aggregate
ASTM C 128	1993 Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	1989 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	1995a Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	1987; R 1992 Sampling Aggregates
ASTM D 422	1963; R 1990 Particle-Size Analysis of Soils
ASTM D1556	1990; Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	1991; Laboratory Compaction Characteristics of Soil Using Modified Effort 56,000 ft-lbf/cu. ft. 2,700 kN-m/cu. m.
ASTM D 2216	1990; Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock
ASTM D 4318	1993 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	1995 Wire-Cloth Sieves for Testing Purposes

1.2 Definitions

1.2.1 Aggregate Base

Aggregate base as used herein is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

1.2.2 Degree of Compaction

Degree of compaction required is the ratio of the field dry density to the maximum dry density determined in the laboratory, expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated hereinafter as percent laboratory maximum density. The field dry density shall be determined by ASTM D 1556. The laboratory maximum density

shall be determined by ASTM D 1557 Procedure C.

1.2.3 Moisture Content

Moisture content is the ratio of the weight of water to the weight of the solid matter expressed as a percent, and it is determined by ASTM D 2216.

1.3 General

The work specified herein consists of the construction of an aggregate base course. The work shall be performed in accordance with this specification and shall conform to the lines, grades, notes and typical sections shown in the plans. Sources of all materials shall be selected well in advance of the time that materials will be required in the work.

1.4 Submittals

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES.

Degree of Completion, FIO

Moisture Content, FIO

Particle Size and Gradation, GA

Liquid Limit and Plasticity Index, GA

1.5 Straightedge

The Contractor shall furnish and maintain at the site, in good condition, one 3.05 meter straightedge for each bituminous paver, for use in the testing of the finished surface. Straightedge shall be made available for Government use. Straightedges shall be constructed of aluminum or other lightweight metal and shall have blades of box or box-girder cross section with flat bottom reinforced to ensure rigidity and accuracy. The straightedge shall have handles to facilitate movement on all surfaces.

1.6 Stockpiling Materials

Materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at locations designated. Before stockpiling of material, storage sites shall be cleared, and sloped to drain. Materials obtained from different sources shall be stockpiled separately.

1.7 Sampling and Testing

1.7.1 General Requirements

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing shall be permitted until the facilities have been inspected and approved by the Contracting Officer. The first inspection shall be at the expense of the Government. Cost incurred for any subsequent inspection required because of failure of the facilities to pass the first inspection will be charged to the Contractor. Tests shall be performed in sufficient

numbers and at the locations and times directed to insure that materials and compaction meet specified requirements. Copies of test results shall be furnished to the Contracting Officer for approval 7 days prior to starting work, and thereafter at regular intervals during production as specified hereinafter.

1.7.2 Test Results

Results shall verify that materials comply with this specification. When a material source is changed, the new material will be tested for compliance. When deficiencies are found, the initial analysis shall be repeated and the material already placed shall be retested to determine the extent of unacceptable material. All in-place unacceptable material shall be replaced or modified as directed by the Contracting Officer.

1.7.3 Sampling

Aggregate samples for laboratory tests shall be taken in accordance with ASTM D 75.

1.7.4 Sieve Analysis

Before starting work, at least one sample of material shall be tested in accordance with ASTM C 136 and ASTM D 422 on sieves conforming to ASTM E 11. After the initial test, a minimum of one analysis shall be performed for each 1000 metric tons of material placed, with a minimum of three analyses for each day's run until the course is completed.

1.7.5 Liquid Limit and Plasticity Index

One liquid limit and plasticity index shall be performed for each sieve analysis. Liquid limit and plasticity index shall be in accordance with ASTM D 4318, Method A on samples prepared in accordance with ASTM D 2216.

1.7.6 Laboratory Density

Tests shall provide a moisture-density relationship for the aggregate. Tests shall be conducted in accordance with ASTM D 1557 Procedure C.

1.7.7 Wear Tests

Wear tests shall be performed in accordance with ASTM C 131. A minimum of one test per aggregate source shall be run.

PART 2. PRODUCTS

2.1 Materials

2.1.1 Aggregates

Aggregates shall consist of crushed stone or stone, gravel, crushed gravel, angular sand, or other approved material. Aggregates shall be durable and sound, free from lumps of clay, organic matter, objectionable coatings, and other foreign material. Material retained on a 4.75 mm sieve shall be known

as coarse aggregate and that passing the 4.75 mm sieve shall be known as binder material.

2.1.1.1 Coarse Aggregate

Only one type of coarse aggregate shall be used on the project. Coarse aggregates, consisting of angular fragments of uniform density and quality, shall have a percentage of wear not to exceed 50 percent after 500 revolutions when tested in accordance with ASTM C 131. The amount of flat and elongated particles shall not exceed 30 percent. A flat particle is one having a ratio of width to thickness greater than 3, and an elongated particle is one having a ratio of length to width greater than 3.

- a. Crushed Gravel: Crushed gravel shall be manufactured from gravel particles 50 percent of which by weight are retained on the maximum size gradation sieve specified.
- b. Crushed Stone: Crushed stone retained on each sieve specified shall contain at least 50 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the piece. When two fractures are adjacent, the angle between the planes of the fractures must be at least 30 degrees to count as two fractured faces.

2.1.2 Binder Material

Binder material shall consist of screenings, angular sand, or other finely divided mineral matter processed or naturally combined with the coarse aggregate. Liquid-limit and plasticity-index requirements shall apply to any component that is blended to meet the required gradation and shall also apply to the completed course. The portion of any component or of the completed course passing the 0.425 mm sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

2.1.3 Gradation

Requirements for gradation specified shall apply to the completed base course. The aggregates shall have a 25 millimeter (1 inch) maximum size and shall be continuously graded within the following limits:

Sieve Designation	Percentage by Weight Passing	
	Square mesh Sieve (a) (b)	
25 mm	100	
19 mm	90-100	
4.75 mm	35-60	
0.6 mm	10-30	
0.075 mm	2-9	

(a) Particles having diameters less than 0.02 millimeter shall not be in excess of 3 percent by weight of the total sample tested.

(b) The values are based on aggregates of uniform specific gravity, and the percentages passing the various sieves are subject to appropriate correction in accordance with ASTM C 127 and ASTM C 128 when aggregates of varying specific gravities are used.

PART 3. EXECUTION

3.1 General Requirements

When the base is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.2 Preparation Of Underlying Surface

3.2.1 General Requirements

Before constructing aggregate base course, the previously constructed subgrade shall be cleaned of foreign substances. The subgrade surface shall meet the specified compaction and surface tolerances. Subgrade shall conform to Section 02200 EXCAVATION, FILLING AND BACKFILLING. Ruts or soft, yielding spots that may appear in the subgrade, areas having inadequate compaction, and deviations of the surface from requirements specified shall be corrected to line and grade and to all specification requirements. The finished subgrade shall not be disturbed by traffic or other operations and shall be maintained in a satisfactory condition until base course is placed.

3.2.2 Grade Control

Underlying material shall be excavated to sufficient depth for the required base course thickness so that the finished base course with the subsequent surface course will meet the fixed grade. Finished and completed area shall conform to the lines, grades, cross section, and dimensions indicated.

3.3 Installation

3.3.1 Mixing and Placing

Materials shall be mixed by the stationary plant, traveling plant, or road mix method and placed in such a manner as to obtain uniformity of the aggregate base course material and at a uniform optimum water content for compaction. The Contractor shall make such adjustments in mixing or placing procedures or in equipment to obtain the true grades, to minimize segregation and degradation, to reduce or accelerate loss or increase of water, and to ensure a satisfactory base course.

3.3.2 Edges of Base Course

Approved material shall be placed along edges of aggregate base course in such quantities as will compact to thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 300 mm width of the shoulder to be rolled and compacted simultaneously with rolling and compacting of each layer of base course.

3.3.3 Compaction

Each layer of aggregate base course including shoulders shall be compacted. Water content shall be maintained near optimum (plus or minus 2 percent). Density of compacted mixture shall be at least 100 percent of laboratory maximum density. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. Areas inaccessible to the rollers shall be compacted with mechanical tampers, and shall be shaped and finished by hand methods.

3.3.4 Layer Thickness

Compacted thickness of the aggregate course shall be as indicated on the drawings.

3.3.5 Finishing

The surface of the top layer shall be finished to grade and cross section shown. Finished surface shall be of uniform texture. Light blading during compaction may be necessary for the finished surface to conform to the lines, grades, and cross sections. Should the surface for any reason become rough, corrugated, uneven in texture, or traffic marked prior to completion, such unsatisfactory portion shall be scarified, reworked, recompacted, or replaced as directed.

3.3.5.1 Smoothness

Surface of each layer shall show no deviations in excess of 9.5 mm when tested with the 3.05 meter straightedge. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting, as directed.

3.3.5.2 Thickness Control

Compacted thickness of the base course shall be within 12.7 mm of the thickness indicated. Where the measured thickness is more than 12.7 mm deficient, the base course shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 12.7 mm thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 7 mm of the thickness indicated.

3.4 Field Quality

3.4.1 Field Density

Field in-place density shall be determined in accordance with ASTM D 1556. At least one density test shall be performed for each 250 square meters of each layer of base placed.

3.4.2 Smoothness

Measurements for deviation from grade and cross section shown shall be taken in successive positions parallel to the road centerline with a 3 meter straightedge. Measurements shall also be taken perpendicular to the road centerline at 15 meter intervals.

3.4.3 Thickness

Thickness of the base course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square meters of base course. Measurements shall be made in 75 mm diameter test holes penetrating the base course.

3.5 Traffic

Completed portions of the area may be opened to traffic, provided there is no marring or distorting of the surface by the traffic. Heavy equipment shall not be permitted except when necessary to construction, and then the area shall be protected against marring or damage to the completed work.

3.6 Maintenance

The aggregate base course shall be maintained in a satisfactory condition until accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact.

3.7 Disposal of Unsatisfactory

Removed in-place materials that are unsuitable for the base course material that is removed for the required correction of defective areas, and waste material and debris shall be disposed of as directed.

--End of Section--

SECTION TABLE OF CONTENTS

SITE WORK

SECTION 02600

STONE PROTECTION

PART 1.	GENERAL.....	1
1.1	REFERENCES.....	1
PART 2	PRODUCTS.....	2
2.1	MATERIALS.....	2
2.1.1	Definitions.....	2
2.1.2	General.....	2
2.1.3	Source Authorization.....	2
2.1.4	Stone Acceptance.....	5
2.1.5	Rejected Stone.....	5
2.1.6	Salvaged Stone.....	5
2.1.7	Testing Laboratory.....	5
2.2	GRADATION SAMPLING AND TESTING FOR STONE PROTECTION.....	6
2.2.1	General.....	6
2.2.2	Testing.....	6
2.2.3	Sampling.....	6
2.2.4	Report.....	6
2.3	GRADATION.....	7
2.3.1	General.....	7
2.3.2	Stone Protection, Type 1.....	7
2.3.3	Stone Protection, Type 2 and 3.....	8
2.3.4	Stone Protection, Type 4.....	8
2.3.3	Stone Protection, Rock Mulch.....	8
PART 3.	EXECUTION.....	9
3.1	FOUNDATION PREPARATION.....	9
3.1.1	General.....	9
3.2	PLACEMENT.....	9
3.2.1	General.....	9
3.2.2	Stone Placement Procedure.....	9
3.1.1	Rock Mulch.....	10

-- End of Table of Contents --

SECTION 02600

STONE PROTECTION

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 88	(1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 127	(1988) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 131	(1989) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1992) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 295	(1990) Petrographic Examination of Aggregates for Concrete
ASTM C 535	(1989) Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM E 548	(1991) General Criteria Used for Evaluating Laboratory Competence

GEOLOGICAL SOCIETY OF AMERICA ROCK COLOR CHART

(1984) Rock Color Chart prepared by the Rock Color Committee

U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT TESTING POLICY

SPD TESTING PROCEDURE	Wetting and Drying
SPD TESTING PROCEDURE	Petrographic and X-Ray Diffraction

PART 2. PRODUCTS

2.1 MATERIALS

2.1.1 Definitions

- a. Angular Stone. Stone which is obtained from bedrock deposits at a quarry and is angular in shape.
- b. Rounded Stone. Stone which is obtained from alluvial deposits and is nearly spherical and well rounded.

2.1.2 General

The Contractor shall make all arrangements, pay all royalties, and secure all permits for the procurement, furnishing, and transporting of stone. The Contractor shall vary the quarrying, processing, loading and placing operations to produce the sizes and quality of stone specified. If the stone being furnished by the Contractor does not fully meet all the requirements of these specifications, the Contractor shall furnish, at no additional cost to the Government, other stone meeting the requirements of these specifications.

2.1.3 Source Authorization

Before any stone is produced from a source for completion of the work under this contract, the source of stone must be authorized by the Contracting Officer. Authorization of a stone source shall not be construed as a waiver of the right of the Government to require the Contractor to furnish stone which complies with these specifications. Materials produced from localized areas, zones or strata will be rejected, when such materials do not comply with the specifications.

2.1.3.1 Source Development

Before a proposed source or sources of stone will be considered for sampling and testing, the Contractor must demonstrate that the source has sufficient stone to fulfill the contract requirements. If sufficient amounts of stone conforming to these specifications are not available from a source or sources used in the work, the Contractor shall submit stone from another source for authorization.

2.1.3.2 Source Documentation

Authorization of a proposed stone source will be based on test results and/or service records. In general, current Corps of Engineers test results shall be required as outlined in paragraph: Quality Compliance Testing. In special cases, however, the Contracting Officer may elect to use either past Corps of Engineers test results or a combination of service records, along with test results from other agencies or private laboratories. A service record is considered to be acceptable, if stone from the proposed source has remained sound and functional after at least 10 years of exposure on a project similar to the one to be constructed under these specifications.

2.1.3.3 Potential Stone Sources

The following are a few sources reasonably near the project area which have either undergone recent quality compliance testing for use on Corps of Engineers projects or have acceptable service records:

<u>Source Name</u>	<u>Nearest City</u>
Fish Canyon	Azusa
San Gabriel River Rock Co.	Azusa
Slover Moutain	Colton
Corona-Pacific	Corona
Riverside Cement Co.	Oro Grande/Victorville
Otay\Hansen Southwest	San Diego/San Ysidro
Santa Paula Creek Streambed	Santa Paula

Listing of a stone source is not to be construed as current or future availability of the source, authorization of all materials from the source, nor as a waiver of inspection and testing of the source. Stone produced from any source, listed or unlisted, must meet all the requirements as set forth in these specifications. Listing of a stone source is also not to be construed as an indication that the source can produce the total quantity of stone required for the project or that the source is still operational. This table is merely a guide for the Contractor. Any other source of stone may be proposed by the Contractor if the source has sufficient quantity and the stone meets the test requirements as shown in paragraph 2.1.3.5 Stone Quality.

2.1.3.4 Quality Compliance Testing

The source or sources for stone shall be submitted a minimum of 45 days in advance of the time when the stone will be required for the work. The Contracting Officer's Representative and a Geologist from the Los Angeles District will visit the proposed stone source or sources to inspect the stone to determine if sampling and testing are necessary. If testing of a source is required to verify the compliance with the specifications, all sampling and testing shall be completed prior to shipment of stone to the project. All test samples (135 kg minimum) shall be representative of the stone source and shall be obtained by the Contractor under the supervision of the Contracting Officer's Representative. Samples shall be delivered at the Contractor's expense to a testing laboratory approved by the Contracting Officer's Representative. All testing shall be in accordance with paragraph: Stone Quality, and shall be conducted at the Contractor's expense.

2.1.3.5 Stone Quality

Stone shall meet the following test requirements.

<u>Test</u>	<u>Test Method</u>	<u>Requirement</u>
Specific Gravity (Bulk SSD)		
For Type 1 and 3 Stone	ASTM C 127	2.7 minimum
For All Other Types	ASTM C 127	2.5 minimum
Absorption	ASTM C 127	2.0% maximum ⁽⁶⁾
Wetting and Drying	SPD Test Procedure ⁽¹⁾	No fracturing ⁽³⁾
Sulfate Soundness	ASTM C 88 ⁽²⁾	10% max.loss ⁽⁴⁾
Abrasion Loss	ASTM C 535	50% max. loss
Petrographic and X-Ray	SPD Test Procedure ⁽⁵⁾	No expansive clays,

Diffraction

fresh, etc.⁽⁵⁾

NOTE: (1): Test procedure for wetting and drying test. The entire sample is carefully examined, and representative test specimens are selected. The sample should be large enough to produce two cut slabs, 25 millimeter thick (+/- 6 mm) with a minimum surface area of 18,750 square millimeters on one side. Two chunks approximately 75 by 100 millimeters are also chosen. The slabs and chunks are carefully examined under a low-power microscope, and all visible surface features are noted and recorded. The specimens are then oven-dried at 60 degrees C., for eight hours, cooled, and weighed to the nearest tenth of a gram. The test specimens are photographed to show all surface features before the test. The chunks and slabs are then subjected to fifteen cycles of wetting and drying. One slab and one chunk are soaked in fresh tap water, the other slab and chunk are soaked in salt water prepared in accordance with ASTM D 1141. Each cycle consists of soaking for sixteen hours at room temperature and then drying in an oven for eight hours at 60 degrees C. After each cycle the specimens are examined with the low-power microscope to check for opening or movement of fractures, flaking along edges, swelling of clays, softening of rock surfaces, heaving of micaceous minerals, breakdown of matrix material and any other evidence of weakness developing in the rock. The cycle in which any of these actions occurs is recorded. After fifteen cycles, the slabs and chunks are again carefully examined, and all changes in the rocks are noted and recorded. The test specimens, together with all particles sawed off during the test, are oven dried, weighed, and photographed.

NOTE: (2): The test shall be made on 50 particles, each weighing 100 grams, +/- 25 grams, in lieu of the gradation given in ASTM C 88.

NOTE: (3): Weakening and loss of individual surface particles is permissible, unless bonding of the surface grains softens and causes general disintegration of the surface material.

NOTE: (4): Stone which has a loss greater than the specified limit will be accepted, if the Contractor demonstrates that the stone has a satisfactory service record.

NOTE: (5): Test procedure for Petrographic and X-ray Diffraction is performed according to ASTM C 295, except for the following important petrographic details, which shall be included as part of the petrographic testing portion of ASTM C295.

(a) A colored stereo microscopic photograph and polarized microphotograph is made of each stone type (whether igneous, sedimentary and/or metamorphic) and the individual minerals within the stone type are identified by labels and arrows upon the photograph.

(b) A very detailed macroscopic and microscopic description is made of the stone, to include the entire mineral constituents, individual sizes, their approximate percentages and mineralogical and durability factors are also discussed.

(c) A written summary of the suitability of stone for use as rip rap and concrete aggregate based on the Petrographic and X-ray tests is presented in the final laboratory report on stone quality.

Note: (6): Sedimentary rock, such as sandstone which has a loss greater than the specified limit will be accepted if the Contractor demonstrates that the stone has a satisfactory service record.

2.1.4 Stone Acceptance

Prior to placement, all stone shall be subject to acceptance by the Contracting Officer. Acceptance of any stone shall not constitute acceptance of all stone from a source. All accepted stone shall be as follows:

- a. of the same lithology as the original stone from which test results or service records were taken, as a basis for authorization of the source;
- b. sound, durable, and hard; free from laminations, weak cleavage, undesirable weathering, or blasting or handling-induced fractures (or fracture zones, which subtend more than 1/3 of the total circumference of the stone, along the plane of fracturing);
- c. of such character that it will not disintegrate from the action of air, water, or the conditions of handling and placing;
- d. clean and free of earth, clay, refuse, or adherent coatings; and
- e. angular quarried material for the Grouted Type 1 and type 3 Stone with, a shape which assures interlocking with adjacent stone, and with the greatest dimension of each piece not greater than 3 times the least dimension.
- f. rounded to sub-rounded material for the stone protection type 2, type 4, and rock mulch.
- g. meeting the gradation requirements of paragraphs; 2.3.2 for stone protection, Type 1; or 2.3.3 for stone protection, type 2; and 3, 2.3.4 for stone protection, Type 4; and 2.3.5 for stone protection, Rock Mulch.

2.1.5 Rejected Stone

Stone of unsuitable quality and/or size gradation, as required by these specifications, shall be promptly removed from the project at no expense to the Government. Any portions of the work covered by these specifications containing rejected stone will be considered incomplete.

2.1.6 Salvaged Stone

Existing stone protection may be salvaged from clearing, excavation or demolition work, where indicated. Salvaged stone which is reused shall meet all the requirements of these specifications. Stone not meeting the requirements of these specifications shall not be used for stone protection.

2.1.7 Testing Laboratory

The testing laboratory shall be properly licensed and be under the direct supervision of a registered Civil or Geotechnical engineer, a registered Geologist or a Certified Engineering Geologist. The laboratory proposed for use

by the Contractor shall be inspected and approved by the Contracting Officer's Representative prior to its use on this job.

2.2 GRADATION SAMPLING AND TESTING FOR STONE PROTECTION

2.2.1 General

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or may be tested by the Contractor subject to approval by the Contracting Officer. If the Contractor elects to establish testing facilities, approval of such facilities shall be based on compliance with ASTM E 548, and no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved by the Contracting Officer. Testing shall be supervised by a registered Civil Engineer, experienced in soil-testing.

2.2.2 Testing

Tests shall be performed by an approved testing laboratory on samples selected by the Contracting Officer. The Government reserves the right to perform check tests and to use the Contractor's sampling and testing facilities to make the tests. One gradation test shall be required at the beginning of production prior to delivery of stone from the source to the project site. A minimum of one additional test shall be required for each 5000 metric tons of stone placed. Each gradation sample shall consist of not less than 5 metric tons of stone, selected at random from the production run for the first test or from stone placed on grade or stockpiled on-site for required additional tests. All sampling and gradation tests performed by the Contractor shall be under the supervision of the Contracting Officer.

Testing shall be conducted on stone at intervals during placement. Quality tests will be required, if it is believed that quality requirements are not met. Gradation tests shall be made in accordance with the following schedule.

2.2.3 Sampling

Sufficient stone shall be graded to be representative of size distribution, as placed. The quantity to be tested will be dependent to some extent on the methods of delivery and method of placement. The sample size shall be as deemed necessary, by the Contracting Officer, to provide a representative sample. The following is a guide.

2.2.3.1 Where well-graded stone is dumped on the slope in truck-load lots, entire truck loads of materials shall be selected for grading. Trucks shall be selected at random, and the entire load dumped in an area set aside for the gradation testing. Where maximum size is less than 450 millimeters, a load may be quartered to produce a representative sample.

2.2.3.2 Where samples are to be selected from the complete slope, stone shall be removed from a square area having a side dimension at least 5 times the thickness of the layer. All stone from the selected area must be removed to a work area set aside for the gradation test.

2.2.4 Report

The report shall contain the following:

- 2.2.4.1 The date of test and sample location;
- 2.2.4.2 The size of sample in kilograms and, where applicable, dimensions of the area sampled;
- 2.2.4.3 The greatest dimension and least dimension of each stone larger than 75 millimeters;
- 2.2.4.4 The weight of material not measured in 2.2.4.3, above;
- 2.2.4.5 The weight of each stone larger than 75 millimeters;
- 2.2.4.6 Gradation plot;
- 2.2.4.7 Calculation of the percent, by weight, of the stone with a greatest dimension 3 or more times the least dimension; and
- 2.2.4.8 Calculation of the percent, by weight, of the stone with a greatest dimension of 2-1/2 or more times the least dimension.

2.3 GRADATION

2.3.1 General

All points on individual grading curves shall be between the boundary limits as defined by smooth curves drawn through specified grading limits plotted on a mechanical analysis diagram. The individual grading curves shall not exhibit abrupt changes in slope, denoting skip grading or scalping of certain sizes. Specified grading of all material shall be met both at the source and as delivered to the project. In addition, material not meeting the required grading, due to segregation or degradation during placement, shall be rejected. If test results show that stone does not meet the required grading, the hauling operation will be stopped immediately and will not resume until processing procedures are adjusted and a gradation test is completed, showing that gradation requirements are met. All gradation tests shall be at the expense of the Contractor.

2.3.2 Stone Protection, Type 1

Type 1 Stone shall be quarried stone with a minimum specific gravity of 2.70, which is reasonably graded within the limits specified below:

Type 1 Stone

<u>Stone Size</u> <u>Millimeters</u>	<u>Percent Smaller</u> <u>(by Weight)</u>
1500	100
1200	50-90
900	20-70
300	10-30
150	0-5

2.3.3 Stone Protection, Type 2 and 3

Type 2 and 3 stone shall consist of stone which is reasonably graded within the limits specified below. Type 2 stone shall also exhibit a mixture of colors, according to the following Geological Society of America Rock Color Chart chip numbers: 10Y6/2 (pale olive); 5Y7/2 (yellowish gray); 5Y5/2 (light olive grey); and 5GY6/1 (greenish gray). Mix proportions of Geological Society of America rock colors shall resemble the color schemes of native stones and to the approval of the Contracting Officer.

Stone Protection, Type 2 and 3

<u>Stone Size</u> <u>Millimeters</u>	<u>Percent Smaller</u> <u>(by Weight)</u>
600	100
450	50-80
300	20-40
150	0-5

Note: Only rounded stone shall be used for Type 2 Stone Protection.

2.3.4 Stone Protection, Type 4

Type 4 Stone shall consist of rounded stone which is reasonably well graded within limits specified below:

Type 4 Stone

<u>Stone Size</u> <u>Millimeters</u>	<u>Percent Smaller</u> <u>(by Weight)</u>
150	100
100	60-100
37.5	30-60
19	15-40
9.5	9-20
4.75	0-10

2.3.5 Stone Protection, Rock Mulch

Rock Mulch stone shall consist of stone which is reasonably graded within the limits specified below. Rock Mulch shall also exhibit a mixture of colors, according to the following Geological Society of America Rock Color Chart chip numbers: 10Y6/2 (pale olive); 5Y7/2 (yellowish gray); 5Y5/2 (light olive grey); 5GY6/1 (greenish gray). Mix proportions of Geological Society of America Rock Color Chart rock colors shall resemble the color scheme of native stones and to the approval of the Contracting Officer.

Stone Protection, Rock Mulch

Sixty percent (60%) to one-hundred percent (100%) of rock mulch utilized on the project shall be a minimum of 356 mm in diameter in any dimension to a maximum of 458 mm in diameter in any dimension.

Twenty percent (20%) of rock mulch utilized on the project may exceed 458 mm in diameter in any dimension but not exceed 610 mm in diameter in any dimension.

Twenty percent (20%) of rock mulch utilized on the project may be smaller than 356 mm in diameter in any dimension but may not be less than 250 mm in diameter in any dimension

Note: Only rounded stone shall be used for Rock Mulch Stone Protection.

PART 3. EXECUTION

3.1 FOUNDATION PREPARATION

3.1.1 General

Subgrade for stone protection shall conform with the provisions of SECTION 02200: EXCAVATION, FILLING AND BACKFILLING. Areas on which stone is to be placed shall be trimmed and dressed to conform to cross-sections indicated or directed, within an allowable tolerance of plus or minus 25 millimeters from the theoretical slope lines and grades. Where such areas are below the allowable minus tolerance limit, they shall be brought to grade by filling with earth similar to the adjacent material and well-compacted, or by filling with approved material, and no additional payment will be made for any material thus required. Prior to placing the bedding material or stone, the prepared base shall be inspected, in sufficient time prior to each stone placement by the Contractor, in order to certify to the Contracting Officer that it is ready to receive stone. The results of each inspection shall be reported in writing.

3.2 PLACEMENT

Method of placement shall be submitted to Contracting Officer for approval prior to commencement of placement operations.

3.2.1 General

Except as otherwise specified, the limits of stone in place shall follow, with reasonable variation, the indicated lines and slopes, without continuous under- or over-building. Templates shall be placed at adequate intervals, as determined by the Contracting Officer, to accurately delineate the surfaces of the work being placed. For all stonework, the Contractor shall submit the method of placement to the Contracting Officer for approval before beginning the placement.

3.2.2 Stone Placement Procedure

Stone shall be placed in a manner to produce a reasonably well-graded mass and shall be constructed to the lines and grades indicated or directed. Stone shall be placed to its full course thickness in one operation and in such a manner to avoid displacing the underlying material. Material shall not be dropped from a height of more than 450 millimeters. The Contractor shall maintain the stone protection until accepted, and any material displaced by any cause shall be replaced at his expense, to the lines and grades indicated. Self-propelled equipment shall not be used on the levee slopes and/or toe-slopes. Hand-placing, barring, or placing by crane will be required only to the extent necessary, to secure the results specified. Placing stone by dumping into chutes or by similar methods, likely to cause segregation, will not be permitted. A tolerance of +/- 150 millimeters for Type 1 stone, 75 millimeters for Type 2, Type 3, and 15 millimeters for Type 4 stone, from the indicated slope lines and grades will be allowed in the finished surface, except that such tolerance shall not be continuous over an area greater than 20 square meters.

3.2.3 Rock Mulch

3.2.3.1 Layer Thickness

All ground (soil) surfaces throughout the rock mulch layer areas shall be completely covered with the rock mulch. The rock mulch layer shall consist of one (1) or two (2) layers of rock achieving a minimum overall rock layer of 458 mm and a maximum overall rock layer of 712 mm, resulting in a rock layer surface elevation varying between irregular and consistent. The rock mulch shall be arranged in stable positions nestled with and buttressed against adjacent rock. The edges of the rock mulch layer shall be tapered to present a sloping vertical line. Rock at toe of slopes shall be keyed into the ground to provide a stable rock mulch layer.

3.2.3.2 Weed Barrier Fabric

Prior to rock mulch placement, the entire rock mulch layer area shall be completely covered with a water permeable geotextile fabric manufactured expressly as "Weed Barrier Fabric", as approved by the Contracting Officer.

-- End of Section --

SECTION TABLE OF CONTENTS

SITE WORK

SECTION 02650

GROUTING STONE PROTECTION

PART 1	GENERAL.....	1
1.1	REFERENCES.....	1
1.2	SUBMITTALS.....	1
1.3	PROTECTION OF COMPLETED WORK.....	2
1.4	DELIVERY, STORAGE, AND HANDLING OF MATERIALS.....	2
1.4.1	Aggregates.....	2
1.4.2	Portland Cement.....	2
1.5	ACCESS TO PLANT AND EQUIPMENT.....	2
1.6	WAYBILLS AND DELIVERY TICKETS.....	2
PART 2	MATERIALS.....	2
2.1	AGGREGATE.....	2
2.1.1	Fine Aggregate Gradation.....	3
2.1.2	Coarse Aggregate Gradation.....	3
2.2	PORTLAND CEMENT.....	3
2.3	WATER.....	3
2.4	MEMBRANE CURING COMPOUND.....	3
PART 3	EXECUTION.....	3
3.1	MIXING.....	3
3.2	PLACING.....	4
3.3	WEATHER LIMITATIONS.....	4
3.3.1	Hot Weather Placing.....	4
3.3.2	Cold Weather Placing.....	4
3.4	CURING AND PROTECTION.....	5
3.4.1	Moist Curing.....	5
3.4.2	Curing Compounds.....	5
3.5	CONTRACTOR QUALITY CONTROL.....	5
3.5.1	General.....	5
3.5.2	Inspection Details and Frequency of Testing.....	5
3.5.3	Action Required.....	6
3.5.4	Reports.....	6
3.6	DEMONSTRATION.....	6
3.6.1	General.....	6

-- End of Table of Contents

SECTION 02650
GROUTING STONE PROTECTION

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 33	(1990) Concrete Aggregates
ASTM C 150	(1992) Portland Cement
ASTM C 143	(1990a) Slump of Portland Cement Concrete
ASTM C 172	(1990) Sampling freshly Mixed Concrete
ASTM C 309	(1991) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	(1986) Chemical Admixtures for Concrete

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01300: SUBMITTAL DESCRIPTIONS.

SD-09 Reports

Aggregates; FIO.

Thirty days prior to placement of grout, the contractor shall submit to the Contracting Officer the reports of aggregate quality tests.

Grout Mix Design; FIO.

Fifteen days prior to placement of grout, the contractor shall submit to the Contracting Officer the detailed mixture proportions for the specified grout.

SD-13 Certificates

Portland Cement; FIO

Certificates of compliance attesting that the concrete materials meet the requirements of the specifications shall be submitted to the Contracting Officer for approval. Cement will be accepted on the basis of a manufacturer's certificate of compliance, accompanied by mill test reports that the material meets the requirements of the specifications under which it is furnished.

Curing Materials; FIO

Certificates of compliance attesting that the curing materials meet the requirements of the specifications shall be submitted to the Contracting Officer for approval. Curing materials will be accepted on the basis of a manufacturer's certificate of compliance.

1.3 PROTECTION OF COMPLETED WORK

After completion of any panel, no workman or other load shall be permitted on the grouted surface for a period of 24 hours. The grouted surface shall be protected from injurious action of the sun; shall be protected from rain, flowing water, and mechanical injury and shall be moist cured or membrane cured at the Contractor's option.

1.4 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

1.4.1 Aggregates

Aggregates shall be delivered to the site of the grout batching and mixing plant and stockpiled in such manner as to preclude intermingling of different materials or the inclusion of foreign materials in the stockpiles or batching operations. Sufficient aggregates shall be maintained at the site at all times to permit continuous placement and completion of any lift or section of grout started.

1.4.2 Portland Cement

Cement shall be supplied in bulk. Carriers and systems for distribution of the cement will be accomplished in adequately designed weather-tight trucks, conveyors, or other means that will protect the material from exposure to moisture. All storage facilities shall permit easy access for inspection and identification. Sufficient materials shall be in storage to complete any placement of grout started.

1.5 ACCESS TO PLANT AND EQUIPMENT

The Contracting Officer shall have access at all times to all parts of the placing operation and grout production plant for checking the adequacy of the equipment in use; inspecting operation of the plant; verifying weights, proportions, and character of materials; and installation of the grout and application of curing materials.

1.6 WAYBILLS AND DELIVERY TICKETS

Before the final statement is allowed, the Contractor shall file for information with the Contracting Officer certified waybills and certified delivery tickets for all cement and grout actually used in the construction.

PART 2 MATERIALS

2.1 AGGREGATE

Aggregate shall conform to the quality requirements of ASTM C33 specified for fine aggregate of the SECTION 03307: CONCRETE FOR MINOR STRUCTURES.

2.1.1 Fine Aggregate Gradation

Fine aggregate shall conform to the gradation requirements of ASTM C 33 for Fine Aggregate.

2.1.2 Coarse Aggregate Gradation

Coarse aggregate shall conform to the following gradation:

<u>Sieve Designation</u>	<u>Cumulative Percentage By Weight Passing</u>
12.5 mm (2 inch)	100
9.5 mm (3/8 inch)	85-100
4.75 mm (No. 4)	10-30
2.36 mm (No. 8)	0-10
1.18 mm (No. 16)	0-5

2.2 PORTLAND CEMENT

Portland cement shall conform to the requirements of ASTM C 150, Type II. The alkali content of the cement shall not exceed 0.6 percent.

2.3 WATER

Water shall be fresh, clean, and potable.

2.4 MEMBRANE CURING COMPOUND

Membrane curing compound shall conform to ASTM C 309, Type 1-D for structures exposed to view, and Type 2, Class B for all other structures. Non-pigmented compound shall contain a fugitive dye. The loss of water for both pigmented and non-pigmented curing compound when tested shall be not more than 150 grams per square meter in 24 hours nor more than 450 grams pounds per square meter in 72 hours. In hot weather, grout cured with non-pigmented curing compound shall be shaded from the direct rays of the sun for the first 3 days of the curing period.

PART 3 EXECUTION

3.1 MIXING

Grout shall be composed of cement, fine aggregate, coarse aggregate, water and coloring system. The cement content requirement per cubic meter of grout shall be 10 sacks (7-1/2 sacks per cubic yard). The water content of the mix shall not exceed 32 liters per sack of cement. In calculating total water content of the mix, the amount of moisture carried on the surfaces of aggregate particles shall be included. Slump of grout mix shall be 175 millimeters. Alterations of slump to produce adequate penetration between the stone voids shall be determined in the field during the placement of the demonstration section. Coloring system for grout shall conform to U.S. Department of Agriculture Handbook 18-Soil Survey Manual with color 10 YR 6/2 of Munsell color charts or Colorful Concrete Color Code No. 3099 by Admixtures, Inc., 13651 East Live Oak Lane, Irwindale, CA 91706, (818) 357-3263 or equal. The grout shall be mixed in a concrete mixer in the manner specified for concrete, except that time of mixing shall be as long as is

required to produce a satisfactory mixture. The grout shall be used in the work within a period of 30 minutes after mixing. Retempering of grout will not be permitted. The consistency of the grout shall be such as to permit gravity flow into the interstices of the stones with the help of spading, rodding, and brooming. Grout batches in the same course shall be uniform in mix, size, and consistency.

3.2 PLACING

3.2.1 Prior to grouting, the stone shall be thoroughly washed with water to wash down the fines and to prevent the stone from absorbing water from the grout. The stone shall be kept moist just ahead of the actual placing of grout. The grout shall be brought to the place of final deposit by approved means and discharged directly on the stone with a concrete pump. The use of a concrete chute in placing grout will not be allowed. The grout shall be placed in one course for both invert and side slopes. The course shall fully penetrate the stone blanket, extending from toe of slope to top of side slopes. A splash plate of metal or wood shall be used where necessary to prevent displacement of stone directly under discharge. The flow of grout into the stone voids shall be controlled by the grout operator to assure that all voids are adequately penetrated. When necessary, grout shall be directed with brooms or other approved baffles to cover the entire area and stone voids. Sufficient barring shall be done to loosen tight pockets of stone and otherwise aid the penetration of grout. On side slopes, all brooming shall be uphill. Except for driveable ramp surfaces and the Type I Grouted Stone, placement and brooming of the grouted surface shall be such that the outer layer of rock projects 1/3 to 1/2 their diameter above the grouted surface. After completion of any strip or panel, no workmen or other load shall be permitted on the grouted surface for a period of 24 hours. The grouted surface shall be protected from injurious action of the sun, the rain, flowing water, and mechanical injury; and shall be moist cured or membrane cured at the Contractor's option.

3.2.2 The exposed surfaces of stone shall be cleaned by air-water blasting or other approved method. The air-water blasting shall be capable of producing a minimum pressure of 689 kPa and shall be of such nature as to adequately perform the work required. The grout will be allowed to set for a minimum of one hour, or other length of time as directed by the Contracting Officer before air-water blasting operation begins. The air-water blasting shall be at right angles to the surfaces of the grout. The water after blasting shall be collected by the Contractor and disposed off in accordance with the local environment laws.

3.2.3 The method used in disposing of waste water employed in cutting, washing, and rinsing of grout surfaces shall be such that the waste water does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area. The method of disposal shall be subject to approval.

3.3 WEATHER LIMITATIONS

3.3.1 Hot Weather Placing

The temperature of the grout when deposited in the proper location shall not exceed 29 degrees C except as directed by the Contracting Officer.

3.3.2 Cold Weather Placing

No grout shall be prepared except when the air temperature is at least 4 degrees C. in the shade and rising. Materials entering the mixer shall be free from ice, snow, and frozen lumps. A non-chloride based accelerating admixture, conforming to the requirements of ASTM C 494, may be used when approved in advance, by the Contracting Officer.

3.4 CURING AND PROTECTION

Curing of the grouted surface shall be accomplished by the following methods.

3.4.1 Moist Curing

Moist curing shall consist of covering the grout with a uniform thickness of 150 millimeters of sand which shall be kept continuously saturated for a period of 14 days.

3.4.2 Curing Compounds

After final brooming, curing compounds shall be applied as soon as the free water disappears and shall be applied in a 2-coat continuous operation by approved power-spraying equipment at a rate of not to exceed 5 square meters per liters for the combined coats. The second coat shall be applied to overlap the first coat in a direction approximately at right angles to the direction of the first application.

3.5 CONTRACTOR QUALITY CONTROL

3.5.1 General

The individuals who sample and test grout as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I.

3.5.2 Inspection Details and Frequency of Testing

3.5.2.1 Preparations for Placing

Stone and embedded items shall be inspected in sufficient time prior to each grout placement by the Contractor to certify to the Contracting Officer that it is ready to receive grout.

3.5.2.2 Slump

Slump shall be checked at least twice during each shift that grout is produced. Samples shall be obtained in accordance with ASTM C 172 and tested in accordance with ASTM C 143.

3.5.2.3 Consolidation and Protection

The Contractor shall ensure that the grout is properly installed, finished, protected, and cured.

3.5.3 Action Required

3.5.3.1 Placing

The placing foreman shall not permit placing to begin until he has verified that there is an adequate number of men with appropriate bars and other such tools are available for the necessary barring and adjustment of stone as required above.

3.5.3.2 Slump

Whenever a test is outside the specification limits, the results of the test shall be reported to the Contracting Officer and another test shall be immediately taken. If the results of the subsequent test indicates that the slump is not being met. The placement will cease and the contractor will readjust the mix design to achieve the proper slump. The adjusted mix will continue to meet the requirements specified above.

3.5.4 Reports

The results of all tests and inspections conducted at the project site shall be reported informally at the end of each shift and in writing weekly and shall be delivered to the Contracting Officer within 3 days after the end of each weekly reporting period.

3.6 DEMONSTRATION

3.6.1 General

Prior to placement of stonework, the Contractor shall construct a section of slope protection consisting of grouted stone to demonstrate his proposed operations for production placement. The section shall demonstrate procedure and capability of grading, placing stone, and placing grout, and curing of the grouted stone within the tolerances specified. The demonstration section shall include the entire slope from bottom of toe to top of bank and shall be a minimum of 10 meters in length and shall conform to all applicable specifications.

3.6.1.1 Method and Equipment

Methods and equipment employed for placement shall demonstrate the adequacy for use in placement of riprap and grouted stone and shall conform with the requirements specified herein. The quantities of all materials placed within the section shall be accurately tabulated and provided immediately to the Contracting Officer for comparison with the theoretical quantities.

3.6.1.2 Demonstration Section Evaluation

The Contractor shall not proceed with riprap or grouted stone placement prior to the approval of the demonstration section. Within a period of 7 days after completion of the section, the Contracting Officer shall determine the adequacy and acceptability of the section. The Contractor shall be notified as to the acceptability of the section and will be required to modify methods of construction, materials, mix design, and remove the section for noncompliance with specifications.

3.6.1.3 Removal of Demonstration Section

The unacceptable demonstration section shall be the property of the Contractor and removed from site with the requirement of SECTION 01430: ENVIRONMENTAL PROTECTION.

-- End of Section B

SECTION TABLE OF CONTENTS

SITE WORK
SECTION 02660

WATER DISTRIBUTION SYSTEM

PART 1.	GENERAL.....	1
1.1	REFERENCES.....	1
1.2	PIPING.....	2
1.2.1	Piping.....	2
1.2.2	Plastic Pipe.....	2
1.2.3	Excavation, Trenching, and Backfilling.....	2
1.3	UNIT PRICES.....	3
1.4	SUBMITTALS.....	3
1.5	HANDLING.....	3
1.5.1	Miscellaneous Plastic Pipe and Fittings.....	3
PART 2.	PRODUCTS.....	3
2.1	PIPE.....	3
2.1.1	Plastic Pipe.....	4
2.2	FITTINGS AND SPECIALS.....	4
2.2.1	Polyvinyl Chloride (PVC) Pipe.....	4
2.2.2	Galvanized-Steel Pipe.....	5
2.3	JOINTS.....	5
2.3.1	Plastic Pipe.....	5
2.3.2	Galvanized Steel Pipe.....	5
2.3.3	Isolation Joints.....	5
2.4	VALVE BOXES.....	6
2.5	MISCELLANEOUS ITEMS.....	6
2.5.1	Disinfection.....	6
2.5.2	Meters.....	6
PART 3.	EXECUTION.....	6
3.1	INSTALLATION.....	6
3.1.1	Cutting of Pipe.....	6
3.1.2	Adjacent Facilities.....	6
3.1.3	Placing and Laying.....	7
3.1.4	Jointing.....	7
3.1.5	Setting of Meters, Valves and Valve Boxes.....	8
3.1.6	Tapped Tees and Crosses.....	8
3.1.7	Thrust Blocks.....	9
3.2	HYDROSTATIC TESTS.....	9
3.2.1	Pressure Test.....	9
3.2.2	Leakage Test.....	10
3.2.3	Time for Making Test.....	10
3.2.4	Concurrent Hydrostatic Tests.....	10
3.3	DISINFECTION.....	10
3.3.1	Bacteriological Disinfection.....	11
3.3.2	Lead Residual.....	11
3.4	CLEANUP.....	11

-- End of Table of Contents --

SECTION 02660

WATER DISTRIBUTION SYSTEM

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 RAILWAY ENGINEERING ASSOCIATION (AREA)

AREA MRE (1994) Manual for Railway Engineering (Fixed Properties):
Chapter 1, Roadway and Ballast

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36 (1994a) Carbon Structural Steel

ASTM A 53 (1993a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded
and Seamless

ASTM D 1784 (1992) Rigid Poly(Vinyl Chloride) (PVC) Compounds and
Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

ASTM D 1785 (1993) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40,
80, and 120

ASTM D 2241 (1993) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR
Series)

ASTM D 2464 (1993) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe
Fittings, Schedule 80

ASTM D 2466 (1993) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings,
Schedule 40

ASTM D 2467 (1993) Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe
Fittings, Schedule 80

ASTM D 2855 (1993) Making Solvent-Cemented Joints with Poly(Vinyl
Chloride) (PVC) Pipe and Fittings

ASTM F 477 (1993) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300 (1992) Hypochlorites

AWWA B301 (1992) Liquid Chlorine

AWWA C104	(1990) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA C111	(1990) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C153	(1994) Ductile-Iron Compact Fittings, 3 In. Through 16 In., for Water and Other Liquids
AWWA C200	(1991) Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C207	(1994) Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In.
AWWA C651	(1992) Disinfecting Water Mains
AWWA C800	(1989) Underground Service Line Valves and Fittings
AWWA C900	(1989; C900a) Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution
AWWA C901	(1988; Errata Apr 1988) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. Through 3 In., for Water Service
AWWA M23	(1980) Manual: PVC Pipe - Design and Installation

NSF INTERNATIONAL (NSF)

NSF Std 14	(1965; Rev Nov 1990) Plastics Piping System Components and Related Materials
------------	--

1.2 PIPING

This section covers water service lines for irrigation. The Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the construction site at all times.

1.2.1 Piping

Piping for water service lines shall be galvanized steel or polyvinyl chloride (PVC) plastic unless otherwise shown or specified.

1.2.2 Plastic Pipe

All plastic piping system components (PVC, polyethylene, thermosetting resin and reinforced plastic mortar pressure) intended for transportation of potable water shall comply with NSF Std 14 and shall be legibly marked with their symbol.

1.2.3 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02200 EXCAVATION, FILLING, AND BACKFILLING, except as modified herein.

1.3 UNIT PRICES

Measurement and payment will be based on completed work performed in accordance with the drawings, specifications, and the contract payment schedules. Payment for work under this section will be made under Section 02811 IRRIGATION SYSTEMS.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-08 Statements

Waste Water Disposal Method, FIO.

The method proposed for disposal of waste water from hydrostatic tests and disinfection, prior to performing hydrostatic tests.

Satisfactory Installation, FIO.

A statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in accordance with the contract drawings and specifications and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

SD-09 Reports

Bacteriological Disinfection, FIO.

Test results from commercial laboratory verifying disinfection.

1.5 HANDLING

Particular care shall be taken not to injure the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor at his expense in a satisfactory manner. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.

1.5.1 Miscellaneous Plastic Pipe and Fittings

Polyvinyl Chloride (PVC) pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendations.

PART 2. PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Plastic Pipe

2.1.1.1 Polyvinyl Chloride (PVC) Plastic Pipe

Pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B.

a. Pipe Less Than 100 mm Diameter:

(1) Screw-Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 80, with joints meeting requirements of 1.03 MPa working pressure, 1.38 MPa hydrostatic test pressure, unless otherwise shown or specified. Pipe couplings when used, shall be tested as required by ASTM D 2464.

(2) Elastomeric-Gasket Joint: Pipe shall conform to dimensional requirements of ASTM D 1785. Schedule 40 with joints meeting the requirements of 1.03 MPa working pressure, 1.38 MPa hydrostatic test pressure, unless otherwise shown or specified, or it may be pipe conforming to requirements of ASTM D 2241, elastomeric joint, with the following applications:

SDR	Maximum Working Pressure (MPa)	Minimum Hydrostatic Pressure (MPa)
26	0.689	0.917
21	0.827	1.103
17	1.034	1.379
13.5	1.379	1.834

(3) Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 1.03 MPa 150 psi working pressure and 1.38 MPa hydrostatic test pressure.

b. Pipe 100 mm through 300 mm Diameter: Pipe, couplings and fittings shall conform to AWWA C900, Class 150, CIOD pipe dimensions, elastomeric-gasket joint, unless otherwise shown or specified.

c. Pipe 350 mm through 900 mm Diameter: Pipe shall conform to AWWA C905 unless otherwise shown or specified.

2.1.1.2 Galvanized-Steel Pipe

Galvanized-steel pipe shall conform to ASTM A 53, standard weight.

2.2 FITTINGS AND SPECIALS

2.2.1 Polyvinyl Chloride (PVC) Pipe

a. For pipe less than 100 mm diameter, fittings for threaded pipe shall conform to requirements of ASTM D 2464, threaded to conform to the requirements of ASME B1.20.1 for use with Schedule 80 pipe and fittings, fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467, and fittings for elastomeric-gasket joint pipe shall be iron conforming to AWWA C110 or AWWA C111. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104.

b. For pipe 100 mm diameter and larger, fittings and specials shall be iron, bell end in accordance with AWWA C110, 1.03 MPa pressure rating unless otherwise shown or specified, except that profile of bell may have special dimensions as required by the pipe manufacturer; or may be fittings and specials of the same material as the pipe with elastomeric gaskets, all in conformance with AWWA C900. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Fittings shall be bell and spigot or plain end pipe, or as applicable. Ductile iron compact fittings shall be in accordance with AWWA C153.

2.2.2 Galvanized-Steel Pipe

Steel fittings shall be galvanized. Screwed fittings shall conform to ASME B16.3. Flanged fittings shall conform to AWWA C207.

2.3 JOINTS

2.3.1 Plastic Pipe

2.3.1.1 Polyvinyl Chloride Pipe

Joints, fittings, and couplings shall be as specified for PVC pipe. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendations as approved by the Contracting Officer.

2.3.2 Galvanized Steel Pipe

Mechanical couplings for steel pipe shall be the sleeve type, or when approved, the split-sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movements caused by expansion, contraction, slight setting or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Couplings shall be of strength not less than the adjoining pipeline.

2.3.3 Isolation Joints

Isolation joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings and valves. Isolation joints shall consist of a sandwich-type flange isolation gasket of the dielectric type, isolation washers, and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

a. Sleeve-type couplings shall be used for joining plain end pipe sections. The two couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.

b. Split-sleeve type couplings may be used in aboveground installations when approved in special situations and shall consist of gaskets and a housing in two or more sections with the necessary bolts and nuts.

2.4 VALVE BOXES

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 5 mm. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "WATER" shall be cast in the cover. The box length shall adapt, without full extension, to the depth of cover required over the pipe at the valve location.

2.5 MISCELLANEOUS ITEMS

2.5.1 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

2.5.2 Meters

Meters shall be installed by the City of Santa Paula. Application for a meter installation shall be made by the Contractor.

PART 3. EXECUTION

3.1 INSTALLATION

3.1.1 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter.

3.1.2 Adjacent Facilities

3.1.2.1 Sewer Lines

Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 3 m from a sewer except where the bottom of the water pipe will be at least 300 mm above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 1.8 m from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe for a distance of at least 3 m each side

of the crossing shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 900 mm horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than 600 mm above the sewer main. Joints in the sewer main, closer horizontally than 900 mm to the crossing, shall be encased in concrete.

3.1.2.2 Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

3.1.2.3 Casing Pipe

Water pipe shall be encased in a sleeve of rigid conduit for the lengths shown. Sleeves under railroads shall be in accordance with the Union Pacific Railroad Company requirements. Where sleeves are required, in all other cases, the pipe sleeve shall be steel, manufactured in accordance with AWWA C200, ASTM A 36, with a minimum wall thickness of 3 mm. A minimum clearance of at least 50 mm between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sand bedding or suitable pipe support shall be provided for the water pipe through the sleeve.

3.1.2.4 Structures

Where water pipe is required to be installed within 1 m of existing structures, the water pipe shall be sleeved as required in Paragraph "Casing Pipe". The Contractor shall take proper precautions during installation of the water pipe and sleeve to ensure that there will be no damage to the structures and no settlement or movement of foundations or footings.

3.1.3 Placing and Laying

The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

3.1.4 Jointing

3.1.4.1 Polyvinyl Chloride (PVC) Plastic Pipe

a. Pipe less than 100 mm diameter: Threaded joints shall be made by wrapping the male threads with approved thread tape or applying an approved lubricant, then threading the joining members together. The joint shall be tightened using strap wrenches to prevent damage to the pipe and/or fitting. To avoid excessive torque, joints shall be tightened no more than one thread past hand-tight. Preformed rubber-ring gaskets for elastomeric-gasket joints shall be made in accordance with requirements of ASTM F 477 and as required herein. All pipe ends for push-on joints shall be beveled to facilitate assembly and marked

to indicate when the pipe is fully seated. The gasket shall be prelubricated to prevent displacement. The gasket and ring groove in the bell or coupling shall match. The manufacturer of the pipe or fitting shall supply the elastomeric gasket. Couplings shall be provided with stops or centering rings to assure that the coupling is centered on the joint. Solvent cement joints shall use sockets conforming to the requirements of ASTM D 2467. The solvent cement used shall meet the requirements of ASTM D 2564; the joint assembly shall be made in accordance with ASTM D 2855 and the manufacturer's specific recommendations.

b. Pipe 100 mm through 300 mm diameter: Joints shall be elastomeric-gasket as specified in AWWA C900. Jointing procedure shall be as specified for pipe less than 100 mm diameter with configuration using elastomeric ring gasket.

3.1.4.2 Galvanized-Steel Pipe

Screw joints shall be made tight with a stiff mixture of graphite and oil, inert filler and oil, or with an approved graphite compound, applied with a brush to the male threads only. Compounds shall not contain lead.

3.1.4.3 Connections

Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

3.1.5 Setting of Meters, Valves and Valve Boxes

3.1.5.1 Meters

Meters and meter boxes shall be installed at the locations shown on the drawings by the City of Santa Paula.

3.1.5.2 Valves

After delivery, valves shall be drained and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and valves shall be fully opened and fully closed to ensure that all parts are in working condition. Check, pressure reducing, vacuum, and air relief valves shall be installed in valve pits. Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be carefully tamped around each valve box or pit to a distance of 1.2 m on all sides of the box, or the undisturbed trench face if less than 1.2 m.

3.1.5.3 Service Boxes

Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

3.1.6 Tapped Tees and Crosses

Tapped tees and crosses for future connections shall be installed where shown.

3.1.7 Thrust Blocks

Plugs, caps, tees and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, on waterlines 100 mm in diameter or larger shall be provided with thrust restraints. Valves shall be securely anchored or shall be provided with thrust blocks to prevent movement.

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 14 MPa after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.2 HYDROSTATIC TESTS

Where any section of a water line is provided with concrete thrust blocking for fitting, the hydrostatic tests shall not be made until at least 5 days after installation of the concrete thrust blocking, unless otherwise approved.

3.2.1 Pressure Test

After the pipe is laid, the joints completed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 1.38 MPa . Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, and valves, discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered:

- a. Wet or unstable soil conditions in the trench.
- b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.
- c. Maintaining the trench in an open condition would delay completion of the contract.

The Contractor may request a waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in

accordance with the requirements of Section 02200 EXCAVATION, FILLING, AND BACKFILLING.

3.2.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to not less than 1.38 MPa (200 psi). Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain pressure within 34.5 kPa (5 psi) of the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

$$L = 0.0001351ND(P \text{ raised to } 1/2 \text{ power})$$

L = Allowable leakage in gallons per hour

N = Number of joints in the length of pipeline tested

D = Nominal diameter of the pipe in inches

P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

3.2.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement-mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure test and subsequent leakage test.

3.2.4 Concurrent Hydrostatic Tests

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be satisfactory as specified. All replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

a. Pressure test and leakage test may be conducted concurrently.

b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished.

3.3 DISINFECTION

3.3.1 Bacteriological Disinfection

Before acceptance of potable water operation, each unit of completed waterline to the backflow preventer shall be disinfected as prescribed by AWWA C651 and as specified herein. After pressure tests have been made, the unit to be disinfected shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material. The chlorinating material shall be either liquid chlorine, calcium hypochlorite, or sodium hypochlorite, conforming to paragraph MISCELLANEOUS ITEMS. The chlorinating material shall provide a dosage of not less than 50 ppm and shall be introduced into the water lines in an approved manner. Polyvinyl Chloride (PVC) pipe lines shall be chlorinated using only the above specified chlorinating material in solution. In no case will the agent be introduced into the line in a dry solid state. The treated water shall be retained in the pipe long enough to destroy all non-spore-forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 25 ppm of free chlorine residual throughout the line at the end of the retention period. All valves on the lines being disinfected shall be opened and closed several times during the contact period. The line shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 ppm. Personnel from the Contractor's commercial laboratory shall take at least 3 water samples from different points, approved by the Contracting Officer, in proper sterilized containers and perform a bacterial examination in accordance with state approved methods. The commercial laboratory must be certified by the state's approving authority for examination of potable water.] The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained.

3.3.2 Lead Residual

Following the bacteriological disinfection and testing, the system shall be flushed with a sufficient velocity of water and sufficient tests performed at each hot- and cold-water discharge point until no more than 15 ppb lead residuals remain in the system. All tests and samples shall be performed in accordance with state and, if applicable, Federal regulations. Samples for testing are to be collected after a 6-hour continuous period of no flushing, and will be considered first draw samples. The commercial laboratory must be certified by the state's approving authority for examination of potable water. Lead residual test results are to be submitted to the Contracting Officer. The system will not be accepted until satisfactory bacteriological results and lead residual test results have been obtained. All flushing and testing for lead residuals, including all costs, are the responsibility of the Contractor.

3.4 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

SECTION TABLE OF CONTENTS

SITE WORK

SECTION 02700

SIDE DRAINS

PART 1. GENERAL.....1
1.1 REFERENCES.....1
1.2 DELIVERY, STORAGE, AND HANDLING OF MATERIALS.....1
 1.2.1 Delivery and Storage.....1
 1.2.2 Hauling and Handling.....1
1.3 GENERAL.....2
 1.3.1 Extension of Drain Lines.....2
 1.3.2 Manufacturers Recommendations.....2
1.4 SUBMITTAL.....2
PART 2. PRODUCTS.....2
2.1 MATERIALS.....2
 2.1.1 Corrugated Metal Pipe.....2
 2.1.2 Metal Cutoff Collars.....3
 2.1.3 Flared End Sections.....3
PART 3. EXECUTION.....3
3.1 CORRUGATED METAL PIPE.....3
3.2 EXCAVATION.....3
3.3 LAYING.....3
3.4 BACKFILL.....4
3.5 REPAIR OF DAMAGED COATINGS.....4

-- End of Table of Contents --

SECTION 02700

SIDE DRAINS

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 A 760	Corrugated Steel Pipe, Metallic - Coated for Sewers and Drains
ASTM A 849	Post-Applied Coatings, Pavings, and Lining for Corrugated Steel Sewer and Drainage Pipe
ASTM C 443	(1985a; R 1990) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu.ft. (2,700 kN-m/cu.m.))

FEDERAL SPECIFICATIONS (FS)

FS HH-P-117	(Rev A; Reinstatement Notice) Packing; Jute, Twisted
FS RR-F-621	(Rev E) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole
FS SS-S-210	(Rev A; Reinstatement Notice) Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

1.2 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

1.2.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with the minimum of handling. Do not store materials directly on the ground. Inside of pipes and fittings shall be kept free of dirt and debris.

1.2.2 Hauling and Handling

Haul and handle the pipe in such a manner as to avoid damage to the galvanized coating. Do not use rope, cable, or chain slings for handling the pipe, but use canvas slings not less than 12 inches in width.

Replace and remove from the site of the work any pipe unit that, in the opinion of the Contracting Officer, is damaged beyond repair in hauling, handling, or otherwise.

1.3 GENERAL

Earthwork about the drains and structures shall conform to the applicable requirements of the SECTION 02200 EXCAVATION, FILLING, AND BACKFILLING. Welding shall conform to the requirements of the SECTION 05500: MISCELLANEOUS METALS. Removal of existing side drains is specified in the SECTION 02150: CLEAR SITE AND REMOVE OBSTRUCTIONS. Specified and/or indicated pipe thickness, D-loading, weight, or gage are the minimum acceptable and heavier pipe may be furnished at the option of the Contractor.

1.3.1 Extension of Drain Lines

Drain lines shall be extended with the same kind of pipe and shall have joints to match the existing joints unless shown otherwise on the drawings. All joints shall be watertight. Bends, elbows, and other fittings shall be standard fittings for the various types of pipe. Except as otherwise specified, all pipe and fittings shall be new. Salvaged pipe and fittings from drain removals may be used in temporary installations necessary to the work and in permanent installations, where specified.

1.3.2 Manufacturers Recommendations

Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Contracting Officer prior to installation. Installation of the item will not be allowed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-13 Certificates

Tests for Pipe; FIO

Certified copies of test reports demonstrating conformance to applicable pipe specifications shall be delivered to the Contracting Officer before pipe is installed.

PART 2. PRODUCTS

2.1 MATERIALS

2.1.1 Corrugated Metal Pipe

Provide corrugated steel pipe, including coupling bands, in accordance with ASTM A 760, type I. Provide galvanized pipe, including coupling bands. Provide beveled pipe ends where shown on the drawings.

Provide bituminous coating in according with ASTM A 849.

Where bends are required, provide shop fabricated elbows or cut and weld sections of pipe in the field to form elbow sections. Provide corrugated metal pipe for elbow sections.

2.1.1.1 Pipe Classification: Type I - full circle with single thickness of corrugated sheet and annular or helical corrugations.

2.1.2 Metal Cutoff Collars

Provide metal cutoff collars having the same composition, gauge, and coating as the pipe to which they are attached and fabricate as shown on the drawings.

2.1.3 Flared End Sections

Provide flared end sections which are prefabricated sections of standard manufacture. Provide the end sections of the same metal as the pipe to which they are attached.

PART 3. EXECUTION

3.1 CORRUGATED METAL PIPE

Furnish and lay corrugated metal pipe of the sizes and gauges shown on the plans. Furnish and lay the pipe complete with coupling bands and joint materials. Install flared end section on the inlet end of each pipe drain.

3.2 EXCAVATION

Excavate the trench in which the pipe is to be laid to the established line and grade to provide a firm and uniform bearing for the entire length of the pipe. Where directed to remove unsuitable foundation material, excavate the trench to a depth of 150 mm below the bottom of the pipe, and backfill with material approved by the Contracting Officer. Compact the material to provide a firm and uniform bearing for the pipe. Excavate the pipe trench in accordance with section 02200.

3.3 LAYING

Lay corrugated metal pipe to the lines and grades shown on the drawings or established by the Contracting Officer. Lay the pipe with outside laps of circumferential joints pointing upstream and with longitudinal joints at the sides. Draw all fastenings up tight. Lay the pipe in such manner that the departure from and return to established alignment and grade will not exceed 10 mm per meter of pipe but with not more than 25 mm total departure. Place pipe carefully so as to be fully supported at all points over the bottom quarter of the circumference. Use coupling bands where necessary to join

sections of pipe and to join elbows to sections of pipe. Install the coupling bands properly, in a manner to ensure tight joints, with the joints between sections approximately at the center of the couplings. Install flared end sections in accordance with the manufacturer's instructions.

3.4 BACKFILL

As each unit of pipe is laid, tamp sufficient backfill material about the pipe to hold it rigidly in place until the joints are completed. After the joints have been completed, place and compact backfill in accordance with sections 02200. The type of material used for backfill, the amount thereof, and the manner of depositing the material shall be subject to approval by the Contracting Officer. Insofar as practicable, obtain backfill material from material moved in required excavations for pipe or from adjacent excavation.

Place backfill to the lines and grades shown on the drawings. As each pipe unit is laid, tamp sufficient backfill material about the pipe to hold it rigidly in place until the joints are completed. After the joints are completed, place backfill carefully and spread backfill in uniform layers so that all spaces about rocks and clods will be filled. Place backfill to about the same elevation on both sides of the pipe to prevent unequal loading and displacement of the pipe. Do not exceed a difference in elevation of the backfill on both sides of the pipe 6 inches at any time.

Place, moisten, and compact all material in backfill to be compacted as directed. Equipment travel over the pipe will not be permitted until backfill has been placed and compacted to the depth recommended by the pipe manufacturer, but not less than 1 foot above the top of the pipe. Prevent damage from construction equipment loads by providing adequate earth cover over pipe.]

3.5 REPAIR OF DAMAGED COATINGS

Repair any damaged to galvanized coatings including factory or field-cut edges and welding in accordance with ASTM A 760.

Repair any damaged to bituminous coatings in accordance with ASTM A 849.

-- End of Section --

SECTION TABLE OF CONTENTS

SITE WORK

SECTION 02811

IRRIGATION SYSTEMS

PART 1.	GENERAL.....	1
1.1	REFERENCES.....	1
1.2	SUBMITTALS.....	2
1.3	DELIVERY AND STORAGE.....	3
1.4	FIELD MEASUREMENTS.....	3
PART 2.	PRODUCTS.....	4
2.1	GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS.....	4
2.1.1	Standard Products.....	4
2.1.2	Nameplates.....	4
2.1.3	Extra Stock.....	4
2.2	PIPING MATERIALS.....	4
2.2.1	Galvanized Steel Pipe and Associated Fittings.....	4
2.2.1.1	Pipe.....	4
2.2.1.2	Fittings.....	4
2.2.2	Polyvinyl Chloride (PVC) Pipe, Fittings and Solvent Cement.....	4
2.2.2.1	Pipe.....	4
2.2.2.2	Fittings.....	4
2.2.2.3	Solvent Cement.....	4
2.3	SPRINKLER HEADS.....	5
2.3.1	Bubbler Sprinkler Heads.....	5
2.4	VALVES.....	5
2.4.1	Gate Valves, Less than 80 mm (3 Inches).....	5
2.4.2	Gate Valves, 80 mm (3 Inches) and Larger.....	5
2.4.3	Quick Coupling Valves.....	5
2.4.4	Remote Control Valves, Electrical.....	5
2.4.5	Angle Hose Valve.....	5
2.4.6	Backflow Preventers.....	5
2.5	ACCESSORIES AND APPURTENANCES.....	6
2.5.1	Valve Boxes and Concrete Pads.....	6
2.5.1.1	Valve Boxes.....	6
2.5.1.2	Concrete Pads.....	6
2.6	AUTOMATIC CONTROL MODULE BATTERY OPERATIONAL WITH REMOVABLE CONTROL POCKAGE.....	6
2.6.1	ABS Plastic.....	6
2.6.2	Alkaline Battery.....	6
2.6.3	Independent Programs.....	6
2.7	FIELD TRANSMITTER.....	7
2.7.1	Field Transmitter.....	7
2.7.2	Control Modules.....	7
2.8	AUTOMATIC CONTROLLERS, ELECTRICAL.....	7
2.9	ELECTRICAL WORK.....	7
2.10	CONCRETE MATERIALS.....	7
2.13	FERTILIZER INJECTOR ASSEMBLY.....	7
PART 3	EXECUTION.....	8
3.1	INSTALLATION.....	8
3.1.1	Trenching.....	8

3.1.2	Piping System.....	8
3.1.2.1	Cover.....	8
3.1.2.2	Clearances.....	8
3.1.3	Piping Installation.....	8
3.1.3.1	Polyvinyl Chloride (PVC) Pipe.....	8
3.1.4	Valves.....	9
3.1.4.1	Gate Valves.....	9
3.1.4.2	Automatic Valves.....	9
3.1.5	Sprinklers and Quick Coupling Valves.....	9
3.1.6	Backflow Preventers.....	9
3.1.6.1	Reduced Pressure Type.....	9
3.1.7	Controller Module.....	9
3.1.8	Control Wire and Conduit.....	9
3.1.8.1	Wires.....	9
3.1.8.2	Loops.....	9
3.1.8.3	Expansion and Contraction.....	9
3.1.7.4	Splices.....	10
3.1.9	Automatic Controller.....	10
3.1.10	Thrust Blocks.....	10
3.1.11	Fertilizer Injector Assembly.....	10
3.1.12	Backfill.....	10
3.1.12.1	Minimum Cover.....	10
3.1.12.2	Restoration.....	10
3.1.13	Adjustment.....	10
3.1.14	Disinfection.....	10
3.1.15	Cleaning of Piping.....	11
3.2	FIELD TESTS.....	11
3.2.1	Hydrostatic Pressure Test.....	11
3.2.2	Operation Test.....	11
3.3	POSTING FRAMED INSTRUCTIONS.....	11
3.4	FIELD TRAINING.....	11
3.5	CLEANUP.....	12

-- End of Table of Contents --

SECTION 02811

IRRIGATION SYSTEMS

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 the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM A 53 (1993; Rev. A) Pipe, Steel, Black and hot-Dipped, Zinc-Coated Welded and Seamless
- ASTM D 1785 (1994) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- ASTM D 2241 (1994) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
- ASTM D 2464 (1994) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- ASTM D 2466 (1994a) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
- ASTM D 2564 (1993) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
- ASTM D 2774 (1972; R 1983) Underground Installation of Thermoplastic Pressure Piping
- ASTM D 2855 (1993) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- ASME B16.3 (1992) Malleable Iron Threaded Fittings, Classes 150 and 300.

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

- ASSE 1013 (1993) Reduced Pressure Principle Backflow Preventers

AMERICAN WATER WORKS ASSOCIATION (AWWA)

- AWWA C509 (1994) Resilient-Seated Gate Valves for Water and Sewerage Systems

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCHR)

FCCHR-01 (1993) Manual of Cross-Connection Control

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80 (1987) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6 (1993) Enclosures for Industrial Control and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-01 Data

Framed Instructions; FIO.

Labels, signs, and templates of operating instructions that are required to be mounted or installed on or near the product for normal, safe operation.

Field Training Data; FIO.

Information describing training to be provided, training aids to be used, samples of training materials to be provided, and schedules and notification of training.

Spare Parts; FIO.

Spare parts data for each different item of material and equipment specified, after approval of the related submittals and not later than the start of the field tests. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

SD-04 Drawings

Sprinkler System; FIO.

As-built Drawings which provide current factual information showing locations of mains, heads, valves, and controllers including deviations from and amendments to the drawings and changes in the work shall be included.

Fertilizer Injector; FIO.

Provide layout for control and irrigation routing for approval. Locate on drawing - tank refill port for review.

SD-06 Instructions

Sprinkler System; FIO.

Detailed procedures defining the Contractor's provisions for accident prevention, health protection, and other safety precautions for the work to be done.

SD-09 Reports

Field Tests; FIO.

Performance test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of control valves.

SD-13 Certificates

Sprinkler System; FIO.

The material supplier's or equipment manufacturer's statement that the supplied material or equipment meets specified requirements. Each certificate shall be signed by an official authorized to certify in behalf of material supplier or product manufacturer and shall identify quantity and date or dates of shipment or delivery to which the certificates apply.

SD-19 Operation and Maintenance Manuals

Sprinkler System; FIO.

Six copies of operation and six copies of maintenance manuals for the equipment furnished. One complete set prior to field testing and the remainder upon acceptance. Manuals shall be approved prior to the field training course. Operating manuals shall detail the step-by-step procedures required for system startup, operation, and shutdown. Operating manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout, simplified wiring and control diagrams of the system as installed, and system programming schedule.

1.3 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be protected from the weather; excessive humidity and temperature variation; direct sunlight (in the case of plastic or rubber materials); and dirt, dust, or other contaminants.

1.4 FIELD MEASUREMENTS

The Contractor shall verify all dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

PART 2 PRODUCTS

2.1 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

2.1.1 Standard Products

Materials and equipment shall be the standard products of a manufacturer who has produced similar systems which have performed well for a minimum period of 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.1.2 Nameplates

Each item of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

2.1.3 Extra Stock

The following extra stock shall be provided: Two sprinkler heads of each size and type, two valve keys for operating manual valves, two wrenches for removing and installing each type of head, two quick coupler keys and hose swivels, and four irrigation controller housing keys.

2.2 PIPING MATERIALS

2.2.1 Galvanized Steel Pipe and Associated Fittings

2.2.1.1 Pipe

Pipe shall conform to requirements of ASTM A 53, Schedule 40.

2.2.1.2 Fittings

Fittings shall be Class 150 conforming to requirements of ASME B16.3.

2.2.2 Polyvinyl Chloride (PVC) Pipe, Fittings and Solvent Cement

2.2.2.1 Pipe

Pipe shall conform to the requirements of ASTM D 1785, PVC 1120 Schedule 40 or ASTM D 2241, PVC 1120 SDR 21, Class 200.

2.2.2.2 Fittings

Solvent welded socket type fittings shall conform to requirements of ASTM D 2466, Schedule 40. Threaded type fittings shall conform to requirements of ASTM D 2464, Schedule 80.

2.2.2.3 Solvent Cement

Solvent cement shall conform to the requirements of ASTM D 2564.

2.3 SPRINKLER HEADS

2.3.1 Bubbler Sprinkler Heads

Heads shall be pressure compensating bubblers and designed for permanent aboveground mounting on risers.

2.4 VALVES

2.4.1 Gate Valves, Less than 80 mm (3 Inches)

Gate valves shall conform to the requirements of MSS SP-80, Type 1, Class 150, threaded ends.

2.4.2 Gate Valves, 80 mm (3 Inches) and Larger

Gate valves shall conform to the requirements of AWWA C509 and have encapsulated resilient wedge, parallel seats, non-rising stems, and open by counterclockwise turning. End connections shall be threaded. Interior construction of valves shall be bronze including stem containing a maximum 2 percent aluminum and maximum 16 percent zinc.

2.4.3 Quick Coupling Valves

Quick coupling valves shall have brass parts and shall be two-piece unit consisting of a coupler water seal valve assembly and a removable upper body to allow spring and key track to be serviced without shutdown of main. Lids shall be lockable yellow vinyl with spring for positive closure on key removal.

2.4.4 Remote Control Valves, Electrical

Remote control valves shall be latching type solenoid actuated globe valves of 20 to 80 mm (3/4 to 3 inch) size, suitable for 9v alkaline, and designed to provide for shut-off in event of power failure. Valve shall be cast bronze or brass or plastic housing suitable for service at 1034 kPa (150 psi) operating pressure with external flow control adjustment for shut-off capability, external plug at diaphragm chamber to enable manual operation, filter in control chamber to prevent valve body clogging with debris, durable diaphragm, and accessibility to internal parts without removing valve from system. Latching solenoid shall have two 0.75 mm² (18 gauge) wires 60 cm (23.6 inches) long with plastic adapter compatible with control module.

2.4.5 Angle Hose Valve

Angle hose valve to be 63.5 mm bronze rise with fire hose standard thread.

2.4.6 Backflow Preventers

Reduced pressure principle backflow prevention assemblies shall be tested, approved, and listed in accordance with FCCHR-01. Reduced pressure principle backflow preventers shall be in accordance with ASSE 1013.

REDUCED PRESSURE TYPE BACKFLOW PREVENTERS

Backflow preventers shall be Class 150 threaded brass mounted gate valve and strainer 304 stainless steel or bronze, internal parts. Total pressure drop through complete assembly shall be a maximum of 70 kPa (10 psi) at rated flow. Piping shall be galvanized steel pipe and fittings. Strainers shall be bronze or brass construction with gasket caps. Units shall have 200-mesh stainless steel screen elements.

2.5 ACCESSORIES AND APPURTENANCES

2.5.1 Valve Boxes and Concrete Pads

2.5.1.1 Valve Boxes

Valve boxes shall be plastic lockable for each gate valve, quick coupler and remote control valve. Box sizes shall be adjustable for valve used. See details for wording to be stamped. Shaft diameter of box shall be minimum 130 mm (5-1/4 inches). Cast iron box shall have bituminous coating.

2.5.1.2 Concrete Pads

Concrete pads shall be precast or cast-in-place reinforced concrete construction for reduced pressure type backflow preventers and booster pump pad.

2.6 AUTOMATIC CONTROL MODULE BATTERY OPERATIONAL WITH REMOVABLE CONTROL PACKAGE

BATTERY OPERATED CONTROLLER - FIELD TRANSMITTED. The irrigation controller (control module) shall be programmable by a separate transmitter device only. The program shall be communicated to the Control Module from the Field transmitter via an infrared connection. The controller shall be of a module type which may be installed in a valve box underground. The controller shall function normally if submerged in water and the communication from the transmitter shall function if submerged in water.

2.6.1 ABS Plastic

The control module shall be housed in an ABS plastic cabinet and shall be potted to insure waterproof operation. The control module shall have two mounting slots for screws allowing the module to be securely mounted inside a valve box.

2.6.2 Alkaline Battery

The controller shall operate on one nine volt alkaline battery for one full year regardless of the number of stations utilized. The controller shall operate _ (1, 2, or 4) stations either sequentially or independently.

2.6.3 Independent Programs

The controller shall have three independent programs with eight start times each, station run time capability from one minute to twelve hours in one minute increments and a seven day calendar. The controller shall turn on stations via latching solenoids installed on the valves. Manual operations shall be initiated by attaching the Field Transmitter to the Control Module and programming a manual

start. The controller shall be capable of manual single station or manual program operation.

2.7 FIELD TRANSMITTER

The irrigation controller shall be programmable by a separate transmitter device (Field Transmitter) only. The Field Transmitter shall communicate to the Control Module via an infrared connection. The Field Transmitter shall be water resistant and housed in ABS plastic and have a removable, reversible protective sheath. The Field Transmitter shall operate on one 9V alkaline battery.

2.7.1 Field Transmitter shall have a large LCD screen and a seven-key programming pad. A beep sound shall confirm every key stroke. The screen shall automatically turn off after one minute when not in use.

2.7.2 Control Modules

The Field Transmitter shall be capable of programming an unlimited number of Control Modules.

The Field Transmitter shall be as manufactured by Rain Bird Sprinkler Mfg. Corp., Glendora, California USA.

2.8 AUTOMATIC CONTROLLERS, ELECTRICAL

Controller shall conform to the requirements of NEMA ICS 2 with 120-volt single phase service, operating with indicated stations, and grounded chassis. Enclosure shall conform to NEMA ICS 6 Type 3R, with locking hinged cover, wall-mounted. Controller shall be programmed for various schedules by setting switches and dials equipped with the following features: A switch for each day of the week for three schedules, allowing each station to be scheduled individually as to days of watering; a minute switch for each station with a positive increment range of 3 to 60 minutes, set time within one percent; a switch allowing selected schedules to be repeated after each completion of initial watering schedule and allowing each operation to be scheduled throughout a 24-hour day; a circuit breaker for surge protection; and circuit for a 9-volt rechargeable NiCad battery. Controller to be mounted in approved enclosure.

2.9 ELECTRICAL WORK

Wiring and rigid conduit for electrical power shall be in accordance with NFPA 70. Point of contact for electrical work shall be Dennis Kanthock, VCFCO.

2.10 CONCRETE MATERIALS

Concrete shall have a compressive strength of 17 MPa (2500 psi) at 28 days.

2.11 FERTILIZER INJECTOR ASSEMBLY

2.11.1 Injector pump to be glass reinforced polyethylene.

2.11.2 Holding tank to be 100 gallon polyethylene with vandal-resistant lockable steel cover.

2.11.3 Batch controller to electrically convert water flow to proportional fertilizer rate at injector port based on electronic relay from flow sensor.

PART 3 EXECUTION

3.1 INSTALLATION

Sprinkler system shall be installed after site grading has been completed. Excavation, trenching, and backfilling for sprinkler system shall be in accordance with the applicable provisions of Section 02200, EXCAVATION, FILLING, AND BACKFILLING, except as modified herein.

3.1.1 Trenching

Trench around roots shall be hand excavated to pipe grade when roots of 50 mm (2 inches) diameter or greater are encountered. Trench width shall be 100 mm (4 inches) minimum or 1-1/2 times diameter of pipe, whichever is wider. Backfill shall be hand tamped over excavation. When rock is encountered, trench shall be excavated 100 mm (4 inches) deeper and backfilled with silty sand (SM) or well-graded sand (SW) to pipe grade. Trenches shall be kept free of obstructions and debris that would damage pipe. Subsoil shall not be mixed with topsoil. Existing concrete walks, drives and other obstacles shall be bored at a depth conforming to bottom of adjacent trenches. Pipe sleeves for bored pipe shall be two pipe diameters larger than sprinkler pipe. Pipe will be permitted below service road only where fence and walls limit access to areas outside road area.

3.1.2 Piping System

3.1.2.1 Cover

Underground piping shall be installed as to meet the minimum depth of backfill cover specified.

3.1.2.2 Clearances

Minimum horizontal clearances between lines shall be 100 mm (4 inches) for pipe 50 mm (2 inches) and less; 300 mm (12 inches) for 65 mm (2-1/2 inches) and larger. Minimum vertical clearances between lines shall be 25 mm. (1 inch.)

3.1.3 Piping Installation

3.1.3.1 Polyvinyl Chloride (PVC) Pipe

a. Solvent-cemented joints shall conform to the requirements of ASTM D 2855.

b. Threaded joints shall be full cut with a maximum of three threads remaining exposed on pipe and nipples. Threaded joints shall be made tight without recourse to wicks or fillers, other than polytetrafluoroethylene thread tape.

c. Piping shall be joined to conform with requirements of ASTM D 2774 or ASTM D 2855, and pipe manufacturer's instructions. Pipe shall be installed in a serpentine (snaked) manner to allow for expansion and contraction in

trench before backfilling. Pipes shall be installed at temperatures over 5 degrees C. (40 degrees F.)

3.1.4 Valves

3.1.4.1 Gate Valves

Valves shall be installed in a valve box extending from grade to below valve body, with a minimum of 100 mm (4 inches) cover measured from finish grade to top of valve stem.

3.1.4.2 Automatic Valves

Valve shall be set plumb in a valve box extending from grade to below valve body, with minimum of 100 mm (4 inch) cover measured from grade to top of valve.

3.1.5 Sprinklers and Quick Coupling Valves

Sprinklers and valves shall be installed plumb and level with terrain.

3.1.6 Backflow Preventers

Backflow preventer shall be installed in new connection to existing water distribution system, between connection and control valves. Backflow preventer shall be installed with concrete thrust blocks and pad.

3.1.6.1 Reduced Pressure Type

Reduced pressure type shall be installed as follows: Flush pipe lines prior to installing device and protect device by a strainer located upstream. Device shall not be installed in pits or where any part of device could become submerged in standing water. Provide 300 mm (12 inches) clearance above finish grade.

3.1.7 Controller Module

Control module shall be mounted inside valve box.

3.1.8 Control Wire and Conduit

3.1.8.1 Wires

Low voltage wires may be buried beside pipe in same trench. Rigid conduit shall be provided where wires run under paving. Wires shall be number tagged at key locations along main to facilitate service. One control circuit shall be provided for each zone and a circuit to control sprinkler system.

3.1.8.2 Loops

A 300 mm (12 inch) loop of wire shall be provided at each valve where controls are connected.

3.1.8.3 Expansion and Contraction

Multiple tubes or wires shall be bundled and taped together at 3 m (10 foot) intervals with 300 mm (12 inch) loop for expansion and contraction.

3.1.7.4 Splices

Electrical splices shall be waterproof.

3.1.9 Automatic Controller

Exact field location of controllers shall be determined before installation. Coordinate the electrical service to these locations. Install in accordance with manufacturers recommendations and NFPA 70.

3.1.10 Thrust Blocks

Concrete shall be placed so that sides subject to thrust or load are against undisturbed earth, and valves and fittings are serviceable after concrete has set. Thrust blocks shall be as specified in Section 02660, WATER LINES.

3.1.11 Fertilizer Injector Assembly

3.1.11.1 Install holding tank within 5 m of pump and power source in a location conducive to refill by truck

3.1.11.2 Install flow sensor and injector port downstream from backflow preventer and upstream from booster pump in lockable valve box.

3.1.11.3 Provide control wiring and piping per manufacturers criteria and/or approved layout shop drawing

3.1.12 Backfill

3.1.12.1 Minimum Cover

Depth of cover shall be 300 mm (12 inches) for 32 mm (1-1/4 inch) pipe or smaller; 600 mm (24 inches) for 40 to 50 mm (1-1/2 to 2 inch) pipe; 600 mm (24 inches) for 65 mm (2-1/2 inch) pipe or larger; and 450 mm (18 inches) for low-voltage wires. Remainder of trench or pipe cover shall be filled to .31m (3 inches) above lateral line, and soil compacted with plate hand-held compactors to same density as undisturbed adjacent soil.

3.1.12.2 Restoration

Top 80 mm (3 inches) shall be filled with topsoil and compacted with same density as surrounding soil.

3.1.13 Adjustment

After seeding, and planting, sprinkler heads shall be adjusted for application of water within basin without erosion runoff on slopes or service maintenance areas.

3.1.14 Disinfection

Sprinkler system fed from a potable water system shall be disinfected upstream of backflow preventer in accordance with Section 02660, WATER LINES.

3.1.15 Cleaning of Piping

Prior to the hydrostatic and operation tests, the interior of the pipe shall be flushed with clean water until pipe is free of all foreign materials. Flushing and cleaning out of system pipe, valves, and components shall not be considered completed until witnessed and accepted by Contracting Officer.

3.2 FIELD TESTS

All instruments, equipment, facilities, and labor required to conduct the tests shall be provided by Contractor.

3.2.1 Hydrostatic Pressure Test

Piping shall be tested hydrostatically before backfilling by pumping to a hydrostatic pressure of 1034 KPa (150 psi) and proved tight for a period of one hour with an allowable pressure drop of 35 kPa (5 psi). If hydrostatic pressure cannot be held for a minimum of 4 hours, Contractor shall make adjustments or replacements and the tests repeated until satisfactory results are achieved and accepted by the Contracting Officer.

3.2.2 Operation Test

At conclusion of pressure test, flood bubbler heads or emitter heads, quick coupling assemblies, and hose valves shall be installed and entire system tested for operation under normal operating pressure. Operation test consists of the system operating through at least one complete programmed cycle for all areas to be sprinkled.

3.3 POSTING FRAMED INSTRUCTIONS

Framed instructions containing wiring and control diagrams in laminated plastic shall be posted inside controller cabinet door. Condensed operating instructions, prepared in typed form, shall be framed as specified above and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the system. After as-built drawings are approved by Contracting Officer, controller charts and programming schedule shall be prepared. One chart for each controller shall be supplied. Chart shall be a reduced drawing of actual as-built system that will fit the maximum dimensions inside controller housing. Black line print for chart and a different pastel or transparent color shall indicate each station area of coverage. After chart is completed and approved for final acceptance, chart shall be sealed between two 0.505 mm (20 mil) (20 mil) pieces of clear plastic.

3.4 FIELD TRAINING

A field training course shall be provided for designated operating and maintenance staff members. Training shall be provided for a total period of 4 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover all of the items contained in the operating and maintenance manuals.

3.5 CLEANUP

Upon completion of installation of system, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

SECTION TABLE OF CONTENTS

SITE WORK

SECTION 02831

CHAIN-LINK FENCE

PART 1 GENERAL.....1
1.1 REFERENCES.....1
1.2 SUBMITTALS.....2
PART 2 PRODUCTS.....2
2.1 MATERIALS.....2
2.1.1 Chain Link Fence Fabric.....2
2.1.2 Gates.....2
2.1.3 Posts.....2
2.1.4 Braces and Rails.....2
2.1.5 Tension Wire.....3
2.1.6 Accessories.....3
2.1.7 Concrete.....3
PART 3 EXECUTION.....3
3.1 GENERAL.....3
3.2 EXCAVATION.....3
3.3 POSTS.....3
3.4 RAILS.....4
3.5 BRACES AND TRUSS RODS.....4
3.6 TENSION WIRES.....4
3.7 CHAIN LINK FABRIC.....4
3.8 GATES.....4

-- End Table of Contents --

SECTION 02831

CHAIN LINK FENCE

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 A 153 1996 Zinc-Coated (Hot Dip) on Iron and Steel Hardware
- ASTM A 176 1994 Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
- ASTM A 392 1996 Zinc-Coated Steel Chain-Link Fence Fabric
- ASTM A 478 1995a Chromium-Nickel Stainless and Heat-Resisting Steel Weaving and Knitting Wire
- ASTM A 491 1996 Aluminum-Coated Steel Chain-Link Fence Fabric
- ASTM A 666 1994 Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
- ASTM A 780 1993a Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
- ASTM A 824 1992 Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link Fence
- ASTM C 94 1996 Ready-Mixed Concrete
- ASTM D 4541 1995 Pull-Off Strength of Coatings Using Portable Adhesion Testers
- ASTM F 626 1996 Fence Fittings
- ASTM F 883 1990 Padlocks
- ASTM F 900 1994 Industrial and Commercial Swing Gates
- ASTM F 1043 1995 Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
- ASTM F 1083 1996 Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-13 Certificates

Chain Link Fence; FIO.

Statement signed by an official authorized to certify on behalf of the manufacturer attesting that the chain link fence and component materials meet the specified requirements.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall conform to the following:

2.1.1 Chain Link Fence Fabric

Polyvinyl chloride-coated steel fabric with 92 grams (0.3 ounces) of zinc coating per square meter in accordance with ASTM F 668. Fabric shall be fabricated of 9 gauge wire woven in 50.8 mm (2 inch) mesh. Fabric height shall be 1.83 meters (6 feet).

2.1.2 Gates

ASTM F 900. Gate shall be the type and swing shown. Gate frames shall conform to strength and coating requirements of ASTM F 1083 for Group IA, steel pipe, with external coating Type A, nominal pipe sizes as indicated. Gate fabric shall be as specified for chain-link fabric. Gate leaves more than 2.44 m wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 2.44 m wide shall have truss rods or intermediate braces. Intermediate braces shall be provided on all gate frames with an electro-mechanical lock. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for the operation of the gate. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate. Stops shall be provided for holding the gates in the open position.

2.1.3 Posts

ASTM F 1083, zinc-coated. Group IA, with external coating Type A steel pipe. Sizes shall be as shown on the drawings. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same designation throughout the fence. Gate post shall be for the gate type specified subject to the limitation specified in ASTM F 900.

2.1.4 Braces and Rails

ASTM F 1083, zinc-coated, Group IA, steel pipe, sizes as indicated.

2.1.5 Tension Wire

Tension wire shall be Type I or Type II, Class 2 coating, in accordance with ASTM A 824.

2.1.6 Accessories

ASTM F 626. Ferrous accessories shall be zinc or aluminum coated. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment. Tie wire for attaching fabric to rails, braces, and posts shall be 9 gauge steel wire and match the coating of the fence fabric. Miscellaneous hardware coatings shall conform to ASTM A 153 unless modified herein.

2.1.7 Concrete

ASTM C 94, using 19 mm maximum size aggregate, and having minimum compressive strength of 21 MPa at 28 days. Grout shall consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

PART 3 EXECUTION

3.1 GENERAL

Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared to the extent indicated. Line posts shall be spaced equidistant at intervals not exceeding 3.05 m. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 152.4 m. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A 780.

3.2 EXCAVATION

Post holes shall be cleared of loose material. Waste material shall be spread where directed. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain 50.8 mm clearance between the bottom of the fabric and finish grade.

3.3 POSTS

Posts shall be set plumb and in alignment. Except where solid rock is encountered, posts shall be set in concrete to the depth indicated on the drawings. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 457 mm in rock. Where solid rock is covered with an overburden of soil or loose rock, posts shall be set to the minimum depth indicated on the drawing unless a penetration of 457 mm in solid rock is achieved before reaching the indicated depth, in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in concrete from the rock to ground level. Posts set in concrete shall be set in holes not less than the diameter shown on the drawings. Diameters of holes in solid rock shall be at least 25.4 mm greater

than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts. Class 3 line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Driven posts shall be set to a minimum depth of 914 mm and shall be protected with drive caps when being set. Fence post rigidity shall be tested by applying a 222.4 newtons force on the post, perpendicular to the fabric, at 1.52 m above ground. Post movement measured at the point where the force is applied shall be less than or equal to 19 mm from the relaxed position. Every tenth post shall be tested for rigidity. When a post fails this test, further tests on the next four posts on either side of the failed post shall be made. All failed posts shall be removed, replaced, and retested at the Contractor's expense.

3.4 RAILS

DELETED.

3.5 BRACES AND TRUSS RODS

Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal. No bracing is required on fences 1.83 m high or less if a top rail is installed.

3.6 TENSION WIRES

Tension wires shall be installed along the top and bottom of the fence line and attached to the terminal posts of each stretch of the fence. Top tension wires shall be installed within the top 102 mm of the installed fabric. Bottom tension wire shall be installed within the bottom 152 mm of the installed fabric. Tension wire shall be pulled taut and shall be free of sag.

3.7 CHAIN LINK FABRIC

Chain link fabric shall be installed on the side of the post indicated. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 381 mm intervals. The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 381 mm intervals and fastened to all rails and tension wires at approximately 610 mm intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 50.8 mm (plus or minus) above the ground. After the fabric installation is complete, the fabric shall be exercised by applying a 222 newtons push-pull force at the center of the fabric between posts. The use of a 133 newtons pull at the center of the panel shall cause fabric deflection of not more than 63.5 mm when pulling fabric from the post side of the fence. Every second fence panel shall meet this requirement. All failed panels shall be presecured and retested at the Contractor's expense.

3.8 GATES

Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Padlocks shall be attached to gates or gate posts with chains. Hinge pins, and hardware shall be welded or otherwise secured to prevent removal.

-- End of Section --

SECTION TABLE OF CONTENTS

SITE WORK

SECTION 02935A
NATIVE PLANT HYDROSEED

PART 1	GENERAL.....	1
1.1	REFERENCES.....	1
1.2	SUBMITTALS.....	1
1.3	DELIVERY, INSPECTION, STORAGE, AND HANDLING.....	2
1.3.1	Delivery.....	2
1.3.1.1	Fertilizer.....	2
1.3.1.2	Hydroseed Material.....	2
1.3.2	Inspection.....	2
1.3.3	Storage.....	2
1.3.4	Handling.....	2
PART 2	PRODUCTS.....	2
2.1	SEED.....	2
2.1.1	Seed Classification.....	2
2.1.2	Quality.....	3
2.2	HYDROSEED PRODUCTS.....	3
2.2.1	Fertilizer.....	3
2.2.2	Hydroseed Binder.....	3
2.2.3	Ground Wood Cellulose Fiber.....	3
2.3	WATER.....	3
PART 3	EXECUTION.....	3
3.1	SEEDING, TIMES AND CONDITIONS.....	3
3.2	SITE PREPARATION.....	4
3.2.1	Fertilizer.....	4
3.2.2	Grading.....	4
3.2.3	Finished Grading.....	4
3.2.3.1	Preparation.....	4
3.2.3.2	Hydroseed Area Debris.....	4
3.2.3.3	Protection.....	4
3.3	SEEDING.....	4
3.3.1	General.....	4
3.3.2	Equipment Calibration.....	4
3.3.3	Hydroseeding.....	4
3.4	WATERING.....	5
3.5	RESTORATION AND CLEAN.....	5
3.5.1	Restoration.....	5
3.5.2	Clean Up.....	5
3.6	PROTECTION OF SEEDED AREAS.....	5
3.7	HYDROSEED ESTABLISHMENT PERIOD.....	5
3.7.1	Commencement.....	5
3.7.2	Duration.....	5
3.7.4	Maintenance During Establishment Period.....	6
3.7.4.1	General.....	6
3.7.4.2	Maintenance Report.....	6
3.7.4.3	Repair.....	6
3.7.5	Maintenance Report.....	6
3.8	FINAL ACCEPTANCE.....	6
3.8.1	Preliminary Inspection.....	6

3.8.2 Final Inspection.....7

-- End Table of Contents --

SECTION 02935A

NATIVE PLANT HYDROSEEDING

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.

AGRICULTURAL MARKETING SERVICE (AMS)

AMS-01 (Amended thru: Aug 1988) Federal Seed Act Regulations (Part 201-202)

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1909 Basic Fertilizer

FEDERAL SPECIFICATIONS (FS)

FS JJJ-S-181 REV B Seeds

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300

SUBMITTAL PROCEDURES:

SD-08 Statements

Delivery; FIO

Delivery schedule, at least 10 days prior to the intended date of the first delivery.

Application of Pesticide

No pesticide will be used in native hydroseed areas.

Maintenance Report; FIO

Written record of maintenance work performed.

Hydroseed Establishment Period; FIO

Written calendar time period for the hydroseed establishment period. When there is more than one hydroseed establishment period, describe the boundaries of the hydroseeded area covered for each period.

SD-13 Certificates

Prior to the delivery of materials, certificates of compliance certifying that materials meet the requirements specified. Certified copies of the reports for the following materials shall be included.

Seed; FIO

For mixture, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, date tested and state certification.

Fertilizer; FIO

For chemical analysis, composition percent.

1.3 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.3.1 Delivery

1.3.1.1 Fertilizer

Delivery of fertilizer to the site shall be in original, unopened containers bearing manufacturer's chemical analysis.

1.3.1.2 Hydroseed Material

Delivery of mulch and binder may be in bulk. A chemical analysis shall be provided from the manufacturer.

1.3.2 Inspection

Materials will be inspected upon arrival at the job site by the Contracting Officer for conformity to specifications.

1.3.3 Storage

Materials shall be stored in areas designated by the Contracting Officer. Seed, lime and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment materials shall not be stored with other landscape materials.

1.3.4 Handling

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Seed Classification

State-approved seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of

mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS-01 and applicable state seed laws.

2.1.2 Quality

Weed seed shall not exceed 1 percent by weight of the total mixture. Wet, moldy, or otherwise damaged seed shall be rejected.

2.2 HYDROSEED PRODUCTS

Hydroseed slurry shall consist of seed, fertilizer, binder and wood mulch meeting the following requirements. Hydroseed mix for all cut and fill slope shall consist of following:

Botonic Name	Common Name	KgPLS/HECTARE
Festuca Rubra "Molate"	California Native Red Fescue	15
Hordeum Brachyantherum	Meadow Barley	10
Lupinus Nanus	Sky Lupine	5
Nassella Pulchra	Purple Needlegrass	8
Phacelia Campanularia	California Blue Bells	3
Vulpia Microstacys	Snail Fescue	4
		KG/HECTARE
Hydroseed Binder		250
Ground Wood Fiber Mulch		2000
7-3-3 Commercial Fertilizer		350

2.2.1 Fertilizer

Fertilizer shall be commercial grade, free flowing, uniform in composition and conforming to CID A-A-1909. Granular Fertilizer: 7-3-3.

2.2.2 Hydroseed Binder

Organic based, water soluble, non-toxic binder shall not inhibit germination.

2.2.3 Ground Wood Cellulose Fiber

Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate visual metering during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 4.5 to 6.0.

2.3 WATER

Water shall not contain elements toxic to plant life.

PART 3 EXECUTION

3.1 SEEDING, TIMES AND CONDITIONS

Seed shall be sown as soon as possible after planting areas are prepared and before a crust forms. Sow seeds in between February 15 and April 15 or between October 15 and December 15 or when similar weather conditions allow.

3.2 SITE PREPARATION

3.2.1 Fertilizer

Fertilizer shall be incorporated as part of the hydroseeding operation.

3.2.2 Grading

The contracting officer shall verify that finished grades are as indicated on the drawing and that final adjustments have been completed satisfactorily prior to hydroseeding.

3.2.3 Finished Grading

3.2.3.1 Preparation

Areas to be hydroseeded shall be filled as needed or have surplus soil removed to attain the finished grade. Drainage patterns shall be maintained as indicated on drawings. Hydroseed areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of erosion or grade deficiencies shall conform to topsoil in adjacent areas. Finished grade shall be 25 mm below the adjoining grade of any paved area. New surfaces shall be blended to existing areas.

3.2.3.2 Hydroseed Area Debris

Areas to be hydroseeded shall have debris and stones larger than 100 mm (4 inches) in any dimension removed from the surface.

3.2.3.3 Protection

Finished graded areas shall be protected from damage by vehicular or pedestrian traffic and erosion. In native grass areas, stones of all sizes shall be left in place.

3.3 SEEDING

3.3.1 General

Prior to seeding, any previously prepared seedbed areas compacted or damaged by interim rain, traffic or other cause, shall be reworked to restore the ground condition previously specified. Hydroseeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

3.3.2 Equipment Calibration

The equipment to be used and the methods of hydroseeding shall be subject to the inspection and approval of the Contracting Officer prior to commencement of hydroseeding operations. Immediately prior to the commencement of hydroseeding operations, the Contractor shall conduct hydroseeding equipment calibration tests in the presence of the Contracting Officer.

3.3.3 Hydroseeding

Seed at 55 Kg per hector and fertilizer at 350 Kg per hector shall be added to water and thoroughly mixed. Wood fiber at 2,000 Kg per hector and hydroseed binder at 250 Kg per hector shall be added to the fertilizer, water, and seed after they have been thoroughly mixed into a homogeneous slurry. The slurry shall be uniformly applied under pressure over the entire area to be hydroseeded. The hydroseeded area shall not be rolled.

3.3.4 Mulch

3.3.4.1 Wood Fiber

Wood fiber mulch for use with the hydraulic application of seed fertilizer and erosion control material shall be applied as part of the hydroseeding operations.

3.4 WATERING

Watering shall be at intervals to obtain a moist soil condition to a minimum depth of ten centimeters (10 cm). Frequency of watering and quantity of water shall be adjusted in accordance with the growth of the seeded areas. Run-off, puddling, and wilting shall be prevented.

3.5 RESTORATION AND CLEAN UP

3.5.1 Restoration

Existing natural areas that have been damaged from the seeding operation shall be restored to original condition at Contractor's expense.

3.5.2 Clean Up

Excess and waste material shall be removed from the planting operation and shall be disposed of off the site. Adjacent paved areas shall be cleaned.

3.6 PROTECTION OF SEEDED AREAS

Immediately after hydroseeding, the area shall be protected against traffic or other use by erecting barricades and providing signage as required.

3.7 HYDROSEED ESTABLISHMENT PERIOD

3.7.1 Commencement

The Hydroseed Establishment Period for establishing a healthy stand of hydroseeded plants shall commence when the entire project is accepted as being hydroseeded.

3.7.2 Duration

The time period for establishment will continue from the last day of hydroseeding operations until sufficient water has germinated seeds.

3.7.3 Proper Stand of Hydroseed.

An acceptable healthy hydroseed condition is defined as follows:

Seed Mix shall have a solid soil surface growth covering with bare spots no larger than 458 mm square and with barren areas not exceeding ten percent (10%) of the total seeded area. Within this growth covering there shall be at least one (1) perennial-type plant species from the required seed mix (or as supplemented by planted stock) per 1.5 m square throughout the entire seeded area.

3.7.4 Maintenance During Establishment Period

3.7.4.1 General

Maintenance of the planted area shall include eradication of invasive weeds by removal or treatment at a level to reduce competition to allow seeded species to become established. The Contractor shall maintain the site and treat as needed for all giant reed, castor bean, tree tobacco, fennel, and all other noxious weeds and exotic plant material.

3.7.4.2 Maintenance Report

A written record shall be furnished to the Contracting Officer of the maintenance work performed.

3.7.4.3 Repair

Ninety (90) percent of the original mulch must be maintained. If the mulch falls below 90 percent, the mulch shall be re-applied to meet the original specifications. The 90 percent coverage must be maintained until the minimum proper stand is achieved at the Contractor's expense.

3.7.4.3.1 Surface Erosion

Surface erosion occurring within the plant establishment period must be repaired, re-seeded and re-mulched with the original specified amounts, technique and materials and must meet the original specified results.

3.7.4.3.2 No pesticide shall be used in native hydroseed areas. Refer to paragraph 3.7.4.1.

3.7.5 Maintenance Report

A written record shall be furnished to the Contracting Officer of the maintenance work performed.

3.8 FINAL ACCEPTANCE

3.8.1 Preliminary Inspection

Prior to the completion of the Hydroseed Establishment Period, a preliminary inspection will be held by the Contracting Officer. Time for the inspection will be established in writing. The acceptability of the hydroseeded areas in accordance with the Hydroseed Establishment Period shall be determined. An unacceptable stand of hydroseed shall be repaired or rehydroseeded as soon as hydroseeding conditions permit, as directed by the Contracting Officer.

3.8.2 Final Inspection

A final inspection will be held by the Contracting Officer to determine that deficiencies noted in the preliminary inspection have been corrected. Time for the inspection will be established in writing.

-- End of Section --

SECTION TABLE OF CONTENTS

SITE WORK

SECTION 02950

TREES, SHRUBS, GROUND COVER AND VINES

PART 1 GENERAL.....	1
1.1 REFERENCES.....	1
1.2 SUBMITTALS.....	1
1.3 SOURCE INSPECTIONS.....	2
1.3.1 Plant Materials.....	2
1.4 SHIPMENT, DELIVERY, INSPECTION, STORAGE, AND HANDLING.....	2
1.4.1 Shipment.....	3
1.4.1.1 Preparation.....	3
1.4.1.2 Antidesiccant Application.....	3
1.4.2 Delivery.....	3
1.4.2.1 Identification.....	3
1.4.2.2 Protection During Delivery.....	3
1.4.2.3 Topsoil.....	3
1.4.2.4 Soil Amendments.....	3
1.4.2.5 Herbicide.....	3
1.4.3 Inspection.....	3
1.4.4 Storage.....	4
1.4.4.1 Plant Storage.....	4
1.4.4.2 Storage of Other Materials.....	4
1.4.5 Handling.....	4
1.4.5.1 Time Limitation.....	4
1.5 WARRANTY.....	4
PART 2 PRODUCTS.....	4
2.1 PLANTS.....	4
2.1.1 Varieties.....	4
2.1.2 Substitutions.....	4
2.1.3 Growing Conditions.....	4
2.1.4 Quality.....	5
2.1.4.1 Shade and Flowering Trees.....	5
2.1.4.2 Deciduous Shrub.....	5
2.1.4.3 Broadleaf Evergreen.....	5
2.1.4.4 Groundcovers and Vines.....	5
2.1.6 Measurement.....	6
2.2 TOPSOIL.....	6
2.3 SOIL AMENDMENTS.....	6
2.3.1 Fertilizer.....	6
2.3.1.1 Dry Fertilizer.....	6
2.3.2 Organic Soil Amendments.....	6
2.3.2.1 Decomposed Wood Derivatives.....	6
2.4 MULCH.....	6
2.4.1 Inert Mulch Material.....	7
2.6 GUYING AND STAKING MATERIAL.....	7
2.6.1 Stakes.....	7
2.6.1.1 Bracing Stakes.....	7
2.6.2 Guying Material.....	7
2.6.2.1 Guying Wire.....	7

2.6.3	Chafing Guard.....	7
2.6.4	Root Cages.....	7
2.6.5	Vine ties.....	7
2.7	WATER.....	7
2.8	ANTIDESICCANT.....	7
2.9	PESTICIDE.....	7
PART 3	EXECUTION.....	8
3.1	EXAMINATION.....	8
3.1.1	Verify Grades.....	8
3.1.2	Underground Obstructions to Planting.....	8
3.1.3	Agronomic Soils Analysis.....	8
3.2	SITE PREPARATION.....	8
3.2.1	Layout.....	8
3.2.2	Protection of Existing Vegetation.....	8
3.3	EXCAVATION.....	8
3.3.1	Obstructions Below Ground or Poor Drainage.....	8
3.3.2	Plant Pits.....	8
3.4	PERCOLATION TEST.....	9
3.5	PLANTING TIMES AND CONDITIONS.....	9
3.5.1	Planting Time.....	9
3.5.2	Planting Conditions.....	9
3.6	INSTALLATION.....	9
3.6.1	Erosion Control.....	9
3.6.2	Backfill Soil Mixture.....	9
3.6.3	Setting Plants.....	9
3.6.4	Container-Grown Plants.....	10
3.6.5	Staking and Guying.....	10
3.6.5.1	One Bracing Stake.....	10
3.6.5.2	Three Guying Wires.....	10
3.6.6	Flags.....	10
3.6.7	Vines.....	10
3.7	FINISHING.....	10
3.7.1	Mulch.....	10
3.7.2	Water.....	10
3.7.3	Antidesiccant Application.....	10
3.8	MAINTENANCE DURING PLANTING OPERATION.....	11
3.9	APPLICATION OF HERBICIDE MATERIAL.....	11
3.10	RESTORATION AND CLEAN UP.....	11
3.10.1	Restoration.....	11
3.10.2	Clean Up.....	11
3.11.1	Commencement.....	11
3.11.2	Maintenance During Establishment Period.....	11
3.11.2.1	General.....	11
3.11.2.2	Water.....	12
3.11.2.3	Unhealthy Plants.....	12
3.11.2.4	Settlement.....	12
3.11.2.5	Herbicide Treatment.....	12
3.11.2.6	Maintenance Report.....	12
3.11.2.7	Maintenance Instructions.....	12
3.11.3	Replacement Plants.....	12
3.12	FINAL ACCEPTANCE.....	12
3.12.1	Preliminary Inspection.....	12
3.12.2	Final Inspection.....	13

-- End of Table of Contents --

SECTION 02950

TREES, SHRUBS, GROUND COVERS, AND VINES

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 ASSOCIATION OF NURSERYMEN (AAN)

AAN-01 (1990) American Standard for Nursery Stock

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2607 (1969) Peats, Mosses, Humus, and Related Products

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1909 (Basic; Notice 1) Fertilizer

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300

SUBMITTAL PROCEDURES:

SD-01 Data

Erosion Control Material; GA

Manufacturer's literature discussing physical characteristics, application and installation instructions for edging material and erosion control material.

SD-07 Schedules

Application of Herbicide Material; GA

A list of the proposed herbicide application equipment to be used in performance of the planting work, including descriptive data and calibration tests.

SD-08 Statements

Delivery; FIO. Application of Herbicide Material; GA

The following work plans, before work is started.

- a. Delivery Schedule at least 10 days prior to the intended date of the first delivery.
- b. Herbicide Treatment Plan, giving proposed sequence of herbicide treatment work, before work is started. The herbicide trade name, chemical composition, formulation, concentration, application rate of active ingredients and methods of application for all materials furnished, and the name and state license number of the state certified applicator shall be included.

SD-09 Reports

Agronomic Soils Analysis; FIO

Copies of laboratory reports stating the recommended fertilizer and admixtures for the type of soils and plants used for the project.

SD-13 Certificates

Soil Amendments; GA. Plants; GA. Herbicide; GA.

Certificates of compliance certifying that materials meet the requirements specified, prior to the delivery of materials. Reports for the following materials shall be included.

- a. Fertilizer: For chemical analysis and composition percent.
- b. Organic Amendment: For classification of total nitrogen and organic matter.
- c. Plant Materials: For botanical and common name, size, quantity by species, grade, nursery grown.
- d. Herbicide Material: For EPA registration number and registered uses.

SD-18 Records

Plant Establishment Period; GA. Maintenance Report; GA. Maintenance Instructions; GA.

- a. Maintenance Report. Written record of maintenance work performed and quantity of plant losses and replacements.
- b. Plant Establishment Period. Written calendar time period for the beginning of the plant establishment period.
- c. Maintenance Instruction. Written instructions for year-round care of installed plants.

1.3 SOURCE INSPECTIONS

1.3.1 Plant Materials

Plant materials shall be subject to inspection at the growing site by the Contracting Officer.

1.4 SHIPMENT, DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Shipment

1.4.1.1 Preparation

Digging and preparation for shipment shall be done in a manner that will not cause shock or damage to branches, trunk, or root systems.

- a. Container-Grown (C) Plants: Container size shall be provided as recommended by AAN-01. Plants shall be grown in a container sufficiently long for new fibrous roots to have developed and for root mass to retain its shape and hold together when removed from container. Container shall be sufficiently rigid to hold ball shape and protect root mass during shipping.

1.4.1.2 Antidesiccant Application

Plants shall be sprayed with an antidesiccant as leaf budding occurs or when plant material has soft growth.

1.4.2 Delivery

1.4.2.1 Identification

Plants shall be identified with durable waterproof labels and weather-resistant ink. Plants shall have attached labels stating the correct plant name and size.

1.4.2.2 Protection During Delivery

Plants shall be protected during delivery to prevent desiccation of the plant or damage to the roots or balls. Branches of plants shall be protected by tying-in the branches and covering all exposed branches.

1.4.2.3 Topsoil

A soil test shall be provided for topsoil delivered to the site.

1.4.2.4 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.4.2.5 Herbicide

Herbicide materials shall be delivered to the site in the original unopened containers bearing legible labels indicating the Environmental Protection Agency (EPA) registration numbers and the registered uses.

1.4.3 Inspection

Plant material shall be inspected upon arrival at the jobsite by the Contracting Officer for conformity to the paragraph PLANTS and paragraph Shipment, and any unacceptable plant material shall be removed from the jobsite.

1.4.4 Storage

1.4.4.1 Plant Storage

Plants not installed on the day of arrival at the site shall be stored and protected in areas designated by the Contracting Officer. Plants shall be protected from exposure to wind and shall be shaded from the sun. Covering that will allow air to circulate and prevent internal heat from building up shall be provided. Bare-root plants shall be heeled-in. All plants shall be kept in a moist condition by watering with a fine mist spray until planted.

1.4.4.2 Storage of Other Materials

Soil amendments shall be stored in dry locations away from contaminants. Herbicide materials shall not be stored with other landscape materials. Storage of materials shall be in areas designated or as approved by the Contracting Officer.

1.4.5 Handling

Care shall be taken to avoid injury to plants. Materials shall not be dropped from vehicles. Balled and burlapped plants shall be handled carefully to avoid cracking or breaking the earth ball and container-grown plants shall be handled by the container. Plants shall not be handled by the trunk or stems.

1.4.5.1 Time Limitation

Limitation of time between installing plant and placing mulch is 48 hours.

1.5 WARRANTY

Furnished plants shall be guaranteed to be in a vigorous growing condition for a period of 12 months regardless of the contract time period. A plant shall be replaced as necessary under this guarantee. Transplanted existing plants require no guarantee. A written calendar time period for the guarantee of plant growth shall be furnished to the Contracting Officer.

PART 2 PRODUCTS

2.1 PLANTS

2.1.1 Varieties

Plants shall be nursery grown or plantation grown stock conforming to AAN-01 and shall be of the varieties specified in the plant list bearing botanical names listed in one or more of the publications listed under "Nomenclature" in AAN-01.

2.1.2 Substitutions

Substitutions will not be permitted without written request from the Contractor for approval by the Contracting Officer.

2.1.3 Growing Conditions

Plants shall be grown under climatic conditions similar to those in the locality of the project.

2.1.4 Quality

Well shaped, well grown, vigorous, healthy plants having healthy and well branched root systems shall be provided. Plants shall be provided free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement and abrasion. Plants shall be provided that are typical of the species or variety and conforming to standards as set forth in AAN-01 and as specified herein.

2.1.4.1 Shade and Flowering Trees

A height relationship to caliper shall be provided as recommended by AAN-01. Height of branching should bear a relationship to the size and variety of tree specified and with the crown in good balance with the trunk. Trees shall not be "poled" or the leader removed.

- a. Single stem: Trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader.
- b. Multi-stem: All countable stems, in aggregate, shall average the size specified. To be considered a stem, there should be no division of the trunk which branches more than 150 mm (six inches) from ground level.
- c. Specimen: A plant shall be provided that is well branched and pruned naturally according to the species. The form of growth desired, which may not be in accordance with natural growth habit, shall be as indicated.

2.1.4.2 Deciduous Shrub

Plants shall be provided that have the height and number of primary stems as recommended by AAN-01. An acceptable plant shall be well shaped with sufficient well-spaced side branches recognized by the trade as typical for the variety grown in the region.

2.1.4.3 Broadleaf Evergreen

Plants shall be provided that have ratio of height-to-spread as recommended by AAN-01. An acceptable plant shall be well shaped and recognized by the trade as typical for the variety grown in the region.

2.1.4.4 Groundcovers and Vines

Plants shall be provided with the minimum number of runners and length of runner as recommended by AAN-01. Plants shall be furnished that have heavy, well developed and balanced top with vigorous well developed root system and shall be furnished in containers.

2.1.5 Plants shall be furnished in sizes indicated. Plants larger in size than specified may be provided at no additional cost to the Government.

2.1.6 Measurement

Plant measurements shall be in accordance with AAN-01.

2.2 TOPSOIL

Topsoil shall be the existing surface soil stripped to a depth of 20 Cm and stockpiled on the site. Additional topsoil, if required, beyond that available from stripping operations, shall be obtained on-site from areas as directed by the Contracting Officer.

2.3 SOIL AMENDMENTS

Soil amendments consist of topsoil, fertilizer, and organic soil amendments. **The recommendations resulting from the agronomic soils tests shall take precedence over the minimum amendments and fertilizer specified below.**

2.3.1 Fertilizer

Fertilizer shall be commercial grade, free flowing, uniform in composition and conforming to CID A-A-1909.

2.3.1.1 Dry Fertilizer

- a. Granular fertilizer : Consists of nitrogen-phosphorous-potassium ratio: 12 percent nitrogen 12 percent phosphorous, and 12 percent potassium.

2.3.2 Organic Soil Amendments

2.3.2.1 Decomposed Wood Derivatives

Decomposed wood derivatives shall be ground bark, sawdust, or other wood waste material free of stones, sticks, and toxic substances harmful to plants and stabilized with nitrogen and having the following properties:

Particle size	Minimum percent by weight passing
No. 4 mesh screen	95
No. 8 mesh screen	80
	Minimum percent based on dry weight
Nitrogen Content	
Redwood Sawdust	0.5
Fir Sawdust	0.7
Fir or Pine Bark	1.0

2.4 MULCH

Mulch shall be free from weeds, mold and other deleterious materials.

2.4.1 Inert Mulch Material

Inert mulch materials shall be 254 mm (10 inches) to 304 mm (12 inches) riverbank stone.

2.5 GUYING AND STAKING MATERIAL

2.5.1 Stakes

Stakes for tree support shall be rough sawn wood, free from knots, rot, cross grain, or other defects that would impair the strength. Standard stakes shall be hardwood or fir treated with pentachlorophenol.

2.5.1.1 Bracing Stakes

Bracing stakes shall be a minimum of 50 mm (2 inches) diameter by 2400 mm (8 feet) long.

2.5.2 Guying Material

2.5.2.1 Guying Wire

Guying wire shall be 12-gauge annealed galvanized steel wire.

2.5.3 Chafing Guard

Hose chafing guards shall be new or used 2-ply reinforced rubber or plastic hose and shall be all the same color on the project. Length shall be 1-1/2 times the circumference of the plant at its base.

2.5.4 Root Cages

Galvanized wire cylinder with bottom, minimum opening 50 mm (2 inches) - Size to accommodate full container - root ball size.

2.5.5 Vine ties

Vine ties shall be 4 mm wide plastic nursery tape.

2.6 WATER

Water shall not contain elements toxic to plant life.

2.7 ANTIDESICCANT

Antidesiccant shall be an emulsion that will provide a film over plant surfaces permeable enough to permit transpiration, and shall not damage the plant.

2.8 PESTICIDE

Herbicide shall be insecticide, herbicide, fungicide, nematocide, rodenticide, and miticide. Herbicide material shall be labeled for use and applied only as

registered by EPA and approved herbicide, insecticide, fungicide, nematocide, rodenticide, and miticide.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify Grades

The Contracting Officer shall verify the finished grades are as indicated on drawings, and the placing of topsoil and smooth grading has been completed in accordance with Section 02210 GRADING.

3.1.2 Underground Obstructions to Planting

The location of underground utilities and facilities shall be verified. Damage to underground utilities and facilities shall be repaired at the Contractor's expense.

3.1.3 Agronomic Soils Analysis

Contractor is required to sample soils for planting areas at the rate of one sample per two acres and conduct all the agronomic soils tests. Tests shall be performed by Wallace Laboratories (365 Coral Circle, El Segundo, CA, 90245, (310) 615-0116), or an approved equal, and the final report shall include a fertility and suitability analysis with written recommendations for soil amendments, fertilizers, chemical conditioners and application rates for soil preparation and post-maintenance fertilization program. Contractor to furnish plant list and specifications to testing laboratory along with soil samples.

3.2 SITE PREPARATION

3.2.1 Layout

Plant material locations and bed outlines shall be staked on the project site before any excavation is made. Plant material locations may be adjusted by the Contracting Officer to meet field conditions.

3.2.2 Protection of Existing Vegetation

Existing trees and shrubbery that are beyond the limits of work shall be barricaded in a manner that will effectively protect them during planting operations.

3.3 EXCAVATION

3.3.1 Obstructions Below Ground or Poor Drainage

When obstructions below ground or poor drainage affect the contract operation, proposed adjustments to plant location, type of plant and planting method or drainage correction shall be submitted to and approved by the Contracting Officer.

3.3.2 Plant Pits

Plant pits shall be dug to produce vertical sides and flat, uncompacted bottoms.

When pits are dug with an auger and the sides of the pits become glazed, the glazed surface shall be scarified. The minimum allowable dimensions of plant pits shall be 150 mm (6 inches) deeper than the depth of ball or the depth of base roots; for ball or root spreads up to 600 mm, (2 feet,) pit diameters shall be twice the root spread; for ball or root spreads from 600 to 1200 mm, (2 to 4 feet,) pit diameters shall be 600 mm (2 feet) greater; for ball or root spreads over 1200 mm, (4 feet,) pit diameters shall be 1-1/2 times the ball root spread.

3.4 PERCOLATION TEST

Test for percolation shall be done to determine positive drainage of plant pits and beds. The Contracting Officer shall be notified in writing of all soil and drainage conditions detrimental to growth of plant material and shall submit proposal for correcting the condition.

3.5 PLANTING TIMES AND CONDITIONS

3.5.1 Planting Time

When approved by the Contracting Officer, planting shall be done between November 1 and February 1.

3.5.2 Planting Conditions

Planting operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the planting operations, proposed planting times shall be submitted to and approved by the Contracting Officer.

3.6 INSTALLATION

3.6.1 Erosion Control

Where erosion control material is requested by contracting offices, material shall be installed in accordance with manufacturer's instructions. Placement of the erosion control material shall be accomplished without damage to installed material or without deviation to finished grade.

3.6.2 Backfill Soil Mixture

The backfill soil mixture shall be a proportioned mixture thoroughly mixed by volume of topsoil and selected soil amendments as follows:

Topsoil 9 parts to 1 part decomposed wood derivative with 0.5 Kg of commercial fertilizer per cubic meter or mixture. Plant tablets shall be added during backfill.

3.6.3 Setting Plants

Plants shall be set plumb and held in position and centered within root cage until sufficient soil has been firmly placed around roots or ball. Plants shall

be set in relation to surrounding grade so that they are even with the depth at which they were grown in the nursery, or container.

3.6.4 Container-Grown Plants

Non-biodegradable containers or platforms shall be removed without damage to the plant or root system. Biodegradable containers shall be split. Container stock shall be backfilled with the planting mixture to half the depth, tamped and watered. The remaining space shall be filled, tamped and watered with a 2" basin constructed.

3.6.5 Staking and Guying

3.6.5.1 One Bracing Stake

Trees 1.2 to 1.8 m (4 to 6 feet) tall shall be held in place with one bracing stake. The tree shall be held firmly to the stake with a double strand of wire.

A chafing guard shall be used where the wire contacts the tree. Bracing stakes shall be driven vertically into firm ground and shall not injure the ball or roots.

3.6.5.2 Three Guying Wires

Trees shall be held firmly in place with three guying lines of [double strand wire] [cable] spaced equidistantly around the tree. The line shall be anchored with ground stakes. The line shall be anchored to the tree at a point equal to one half its height. Chafing guards shall be used where the line contacts the tree. One turnbuckle shall be centered on each line for tree straightening purposes. Ground stakes shall be driven into firm ground outside the earth saucer and plant pit with the top of the stake flush with the ground surface.

3.6.6 Flags

A flag shall be securely fastened to each guying line to be visible by pedestrians.

3.6.7 Vines

Vines shall be tied on fences with loose plastic tape.

3.7 FINISHING

3.7.1 Mulch

River rock mulch shall be spread to a minimum thickness from 250 mm (10 inches) to 300 mm (12 inches) within 48 hours after planting. Mulch shall be kept out of the crowns of shrubs and off buildings, sidewalks and other facilities.

3.7.2 Water

Plants shall be watered as necessary to maintain an adequate supply of moisture within the root zone. Run-off, puddling and wilting shall be prevented.

3.7.3 Antidesiccant Application

Plants requiring further protection shall be sprayed with anti-desiccant in accordance with manufacturer's recommendations.

3.8 MAINTENANCE DURING PLANTING OPERATION

Installed plants shall be maintained in a healthy growing condition. Maintenance operations shall begin immediately after each plant is installed and shall continue until the plant establishment period commences. The maintenance includes watering, pruning, wound dressing, straightening and other necessary operations. Plant beds and earth saucers shall be kept free of undesired vegetation. Plants shall be checked for settlement and shall be reset proper grade as necessary. Run-off, puddling and wilting shall be prevented.

3.9 APPLICATION OF HERBICIDE MATERIAL

When herbicide becomes necessary to remove a disease or pest, a state-certified applicator shall apply required herbicide in accordance with State EPA label restrictions and recommendations. Hydraulic equipment shall be provided for the liquid application of herbicides with a leak-proof tank, positive agitation methods, controlled application pressure and metering gauges. A herbicide treatment plan shall be provided to the Contracting Officer as specified in paragraph SUBMITTALS.

3.10 RESTORATION AND CLEAN UP

3.10.1 Restoration

Natural areas, pavements and facilities that have been damaged from the planting operation shall be restored to original condition at the Contractor's expense.

3.10.2 Clean Up

Excess and waste material from the planting operation shall be removed and disposed of off the site. Adjacent paved areas shall be cleared.

3.11 PLANT ESTABLISHMENT PERIOD

3.11.1 Commencement

On completion of the last day of the planting operation, the plant establishment period for maintaining installed plants in a healthy growing condition shall commence and shall be in effect for the remaining contract time period not to exceed 60 months. When the planting operation extends over more than one season or there is a variance to the planting times, plant establishment periods shall be established for the work completed, as directed. Written calendar time period shall be furnished to the Contracting Officer for the beginning of the plant establishment period. When there is more than one plant establishment period, describe the boundaries of the planted area covered for each period.

3.11.2 Maintenance During Establishment Period

3.11.2.1 General

Maintenance of plants shall include straightening plants, tightening stakes and guying material, protecting plant areas from erosion, maintaining erosion control material, supplementing mulch, removing dead or broken tip growth by pruning, maintaining edging of beds, checking for girdling of plants and maintaining plant labels, watering, weeding, removing and replacing unhealthy plants.

3.11.2.2 Water

The plants shall be watered as necessary to maintain an adequate supply of moisture within the root zone. An adequate supply of moisture is estimated to be the equivalent of one inch of absorbed water per week delivered in the form of natural rain or augmented as required by periodic waterings. Run-off, puddling and wilting shall be prevented. Water application shall be reduced during the fourth and fifth year to match the ETO of the third year.

3.11.2.3 Unhealthy Plants

A plant shall be considered unhealthy or dead when the main leader has died back, or 25 percent of the crown is dead. Determine the cause for an unhealthy plant.

Unhealthy or dead plants shall be removed immediately and shall be replaced as soon as seasonal conditions permit.

3.11.2.4 Settlement

Topsoil shall be added to maintain grade and to maintain earth saucers. Serious settlement affecting the setting of the plant in relation to the depth at which it was grown requires replanting in accordance with paragraph INSTALLATION.

3.11.2.5 Herbicide Treatment

Treatment for diseases or pest shall be in accordance with paragraph APPLICATION OF PESTICIDE MATERIAL.

3.11.2.6 Maintenance Report

A written record shall be furnished to the Contracting Officer of the maintenance work performed, the quality of plant losses, cause for plant loss and replacements made on each site visit.

3.11.2.7 Maintenance Instructions

Written instructions shall be furnished to the Contracting Officer for year-round care of installed plants.

3.11.3 Replacement Plants

Plants shall be provided for replacement in accordance with paragraph PLANTS. Replacement plants shall be installed in accordance with paragraph INSTALLATION.

No extended plant establishment period shall be required for replacement plants.

A plant will be replaced in accordance with paragraph UNHEALTHY PLANTS.

3.12 FINAL ACCEPTANCE

3.12.1 Preliminary Inspection

Prior to completion of the plant establishment period, a preliminary inspection shall be held by the Contracting Officer. Time for the inspection will be established in writing. The quantity and type of plants installed and the acceptability of the plants in accordance with the plant establishment period shall be determined.

3.12.2 Final Inspection

A final inspection shall be held by the Contracting Officer to determine that deficiencies noted in the preliminary inspection have been corrected. Time for the inspection shall be established in writing. Acceptance of the planting operation is subject to the guarantee of plant growth.

-- End of Section --