U.S. ARMY CORPS
OF ENGINEERS
LOS ANGELES DISTRICT

Fort Irwin NTC
Storm Damage Repair

Section 3, Civil Repair
AAPB No. CAFI-1426

San Bernardino County, California

Construction Solicitation
and Specifications

Performance Oriented Contract Activity (POCA)

August 2014

SCOPE OF WORK

POCA W912PL-14-R-0089
CAFI-1426

Section 3, Civil Repair

Ft Irwin NTC
San Bernardino County, California

In accordance with the Request for Proposal, the FY14 Master POCA Specification (as amended), the County of San Bernardino Transportation Department Standard Specifications and Drawings, and the Ft. Irwin Department of Public Works requirements, the Contractor shall provide all plant, labor, equipment, and materials to complete, in-place, all work specified.

Reference is made to the attached documents, which form a part of this contract:

1. Bid Schedule
2. Submittal Register
3. Specification Sections 03 36 00, 31 00 00, 31 05 19, 32 11 23, 32 12 10, 32 12 17, 33 40 00, 35 31 19
4. Drawings

The Specification Sections listed above, supersede and replace their corresponding sections contained in the FY14 Master POCA Specification.

The Contractor will be provided an electronic copy of the USACE contract documents. The Contractor shall procure the County of San Bernardino Transportation Department Standard Specifications and Drawings, and obtain guidance from the Ft. Irwin Department of Public Works related to traffic control, detours, utility work, dig permits, etc.

The work for Section 3, Civil Repair includes, but is not limited to, clearing, excavation and embankment, grading and drainage, stonework, channel and culvert cleanouts, and guardrail installation.

BID SCHEDULE

POCA W912PL-14-R-0089
CAFI-1426

Section 3, Civil Repair

Ft Irwin NTC
San Bernardino County, California

Item No.	Description	Estimated Quantity	Unit of Measure	Unit Price	Total Price
0001	AREA NO. 14	1	JOB	Lump Sum	$
0002	AREA NO. 41	1	JOB	Lump Sum	$
0003	AREA NO. 45	1	JOB	Lump Sum	$
0004	AREA NO. 63	1	JOB	Lump Sum	$
TOTAL BID (Line Items 0001 thru 0004)					$

The submittals listed below may not include all required submittals. The Contracting officer may require additional submittals and Government approvals, as specified in the contract documents.

SUBMITTAL REGISTER

CONTRACT NO. **W912PL-14-R-0089**

TITLE AND LOCATION: Ft. Irwin – Section 3 Civil Repair, CAFI - 1426

CONTRACTOR:

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # PARAGRAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 11 00	SD-01 Preconstruction Submittals															
			Utility Outage Requests	1.10.1														
			Utility Connection Requests	1.10.1														
			Welding Permits	1.10.2														
		01 33 00	SD-01 Preconstruction Submittals															
			Submittal Register	1.10	G													
		01 35 26	SD-01 Preconstruction Submittals															
			Accident Prevention Plan (APP)	1.7	G													
			Activity Hazard Analysis (AHA)	1.8	G													
			Crane Critical Lift Plan	1.7.1	G													
			Crane Operators	1.6.1.4	G													
			SD-06 Test Reports															
			Notifications and Reports	1.12														
			Accident Reports	1.12.2	G													
			Crane Reports	1.12.3														
			Gas Protection	1.16														
			SD-07 Certificates															
			Confined Space Entry Permit	1.9														
			Hot work permit	1.9														
			License Certificates	1.14														
		01 45 00.00 10	SD-01 Preconstruction Submittals															
			Contractor Quality Control (CQC) Plan	3.2	G													

The submittals listed below may not include all required submittals. The Contracting officer may require additional submittals and Government approvals, as specified in the contract documents.

SUBMITTAL REGISTER

CONTRACT NO. . **W912PL-14-R-0089**

TITLE AND LOCATION: Ft. Irwin – Section 3 Civil Repair, CAFI - 1426

CONTRACTOR:

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)		(q)	(r)
		01 50 00	SD-01 Preconstruction Submittals																
			Construction site plan	1.3	G														
			Traffic control plan	3.3.1	G														
		01 57 20.00 10	SD-01 Preconstruction Submittals																
			Environmental Protection Plan	1.7	G														
		01 74 19	SD-01 Preconstruction Submittals																
			Waste Management Plan	1.6	G														
			SD-11 Closeout Submittals																
			Records	1.7															
		03 11 13.00 10	SD-02 Shop Drawings																
			Formwork	2.2.1	G														
			Formwork	3.1.1	G														
			Form Removal Schedule	2.2.1	G														
			SD-05 Design Data																
			Calculations	2.1															
			SD-06 Test Reports																
			Inspection	3.2															
		03 20 00.00 10	SD-01 Preconstruction Submittals																
			Butt-Splices	3.1.3.2	G														
			SD-02 Shop Drawings																
			Reinforcement	3.1	G														
			SD-03 Product Data																
			Mechanical Butt-Splices	2.3.3	G														
			Reinforcing Steel	2.3	G														
			SD-04 Samples																
			Epoxy-Coated Bars	2.3.2															
			SD-06 Test Reports																

The submittals listed below may not include all required submittals. The Contracting officer may require additional submittals and Government approvals, as specified in the contract documents.

SUBMITTAL REGISTER

CONTRACT NO. . **W912PL-14-R-0089**

TITLE AND LOCATION: Ft. Irwin – Section 3 Civil Repair, CAFI - 1426

CONTRACTOR:

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)		(q)	(r)
		03 20 00.00 10	Tests, Inspections, and	2.8	G														
			Verifications																
			SD-07 Certificates																
			Reinforcing Steel	2.3															
			Qualified Welders	1.4.1															
			Qualification of Steel Bar	1.4.2															
			Butt-Splicers																
		03 30 00.00 10	SD-01 Preconstruction Submittals																
			Quality Control Plan	1.6.2	G														
			Laboratory Accreditation	1.6.1	G														
			SD-03 Product Data																
			Cementitious Materials	2.2															
			Chemical Admixtures	2.4															
			SD-04 Samples																
			Surface Retarder	2.4.5															
			SD-05 Design Data																
			Mixture Proportions	2.1.1	G														
			Lightweight Aggregate Concrete	3.4															
			SD-06 Test Reports																
			Mixture Proportions	2.1.1	G														
			Testing and Inspection for CQC	3.13	G														
		03 30 00.00 10	Fly Ash	2.2.4															
			Aggregates	2.3															
			Air Content	3.13.5.1															
			Slump	3.13.5.3															
			Compressive Strength	3.13.5.6															

The submittals listed below may not include all required submittals. The Contracting officer may require additional submittals and Government approvals, as specified in the contract documents.

SUBMITTAL REGISTER

CONTRACT NO. . **W912PL-14-R-0089**

TITLE AND LOCATION: Ft. Irwin – Section 3 Civil Repair, CAFI - 1426

CONTRACTOR:

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVIEWER	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
			Water	2.5														
			SD-07 Certificates															
			Contractor Quality Control	1.6														
			personnel															
			Ready-Mix Plant	3.2.1														
		03 30 53	SD-02 Shop Drawings															
			Installation Drawings	1.5	G													
			SD-03 Product Data															
			Air-Entraining Admixture	2.2.3.1														
			Accelerating Admixture	2.2.3.2														
			Water-Reducing or Retarding	2.2.3.3														
			Admixture															
			Curing Materials	2.2.11														
			Expansion Joint Filler Strips,	2.2.6														
			Premolded															
			Joint Sealants - Field Molded	2.2.7														
			Sealants															
			Waterstops	2.4.1														
		03 30 53	Batching and Mixing Equipment	3.1.4.3														
			Conveying and Placing Concrete	3.2														
			Formwork	2.2.8														
			Mix Design Data	2.3	G													
			Ready-Mix Concrete	2.3														
			Curing Compound	2.4.3														
			Mechanical Reinforcing Bar	2.2.5														
			Connectors															

The submittals listed below may not include all required submittals. The Contracting officer may require additional submittals and Government approvals, as specified in the contract documents.

SUBMITTAL REGISTER

CONTRACT NO. . **W912PL-14-R-0089**

TITLE AND LOCATION: Ft. Irwin – Section 3 Civil Repair, CAFI - 1426

CONTRACTOR:

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)		(q)	(r)
			SD-06 Test Reports																
			Aggregates	2.2.2															
			Concrete Mixture Proportions	2.1.3	G														
			Measurement of Floor Tolerances	3.3.3.2															
			Compressive Strength Testing	3.9.3	G														
			Slump	3.9.3	G														
			Air Content	3.9.3															
			Water	2.2.4															
			SD-07 Certificates																
			Cementitious Materials	2.2.1															
			Pozzolan	2.2.1.2															
		03 30 53	Curing Compound	2.4.3															
		03 39 00.00 10	SD-03 Product Data																
			Curing Materials	2.1															
			SD-06 Test Reports																
			Testing and Inspection for CQC	3.2	G														
			SD-08 Manufacturer's Instructions																
			Curing Compound	2.1															
		04 20 00	SD-04 Samples																
			Concrete Masonry Units (CMU)	2.5	G														
			Expansion-Joint Materials	2.18	G														
			SD-06 Test Reports																
			Field Testing of Mortar	3.25.1	G														
			Field Testing of Grout	3.25.2	G														
			Water Penetration Test																

The submittals listed below may not include all required submittals. The Contracting officer may require additional submittals and Government approvals, as specified in the contract documents.

SUBMITTAL REGISTER

CONTRACT NO. . **W912PL-14-R-0089**

TITLE AND LOCATION: Ft. Irwin – Section 3 Civil Repair, CAFI - 1426

CONTRACTOR:

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)		(q)	(r)
		04 20 00	SD-07 Certificates																
			Concrete Masonry Units (CMU)	2.5															
		31 00 00	SD-01 Preconstruction Submittals																
			Shoring	3.5	G														
			Dewatering Work Plan	1.6.3	G														
			SD-03 Product Data																
			Utilization of Excavated Materials	3.9															
			Rock Excavation	1.6.1.2															
			Opening of any Excavation or	3.4															
			Borrow Pit																
			Shoulder Construction	3.15															
			SD-06 Test Reports																
			Testing	3.18															
			Borrow Site Testing	2.1	G														
			SD-07 Certificates																
			Testing	3.18															
		31 23 00.00 20	SD-01 Preconstruction Submittals																
			Shoring and Sheeting Plan	1.7.1															
			Dewatering work plan	1.7.2															
			SD-06 Test Reports																
			Borrow Site Testing	1.6	G														
		31 23 00.00 20	Fill and backfill	3.17.2.1															
			Select material	3.17.2.2															
			Porous fill	3.17.2.3															
			Density tests	3.17.2.4															
			Moisture Content Tests	3.17.2.5															

The submittals listed below may not include all required submittals. The Contracting officer may require additional submittals and Government approvals, as specified in the contract documents.

SUBMITTAL REGISTER

CONTRACT NO. . **W912PL-14-R-0089**

TITLE AND LOCATION
Ft. Irwin – Section 3 Civil Repair, CAFI - 1426

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 12 17	SD-04 Samples															
			Bituminous pavement	1.3.2														
			SD-05 Design Data															
			Job-mix formula	1.3.3														
			ASPHALT CEMENT BINDER	2.2														
			MIX DESIGN	2.3														
			SD-06 Test Reports															
			Specific gravity test of asphalt	2.5.1														
			Coarse aggregate tests	2.5.1														
			Weight of slag test	2.5.1														
			Percent of crushed pieces in gravel	2.5.1														
			Fine aggregate tests	2.5.1														
			Specific gravity of mineral filler	2.5.1														
			Bituminous mixture tests	2.5.1														
			Aggregates tests	3.5.2.1														
			Bituminous mix tests	3.5.2.2														
			Pavement courses	3.5.2.3														
		32 31 13	SD-02 Shop Drawings															
			Fence Assembly	1.3	G													
			Location of Gate, Corner, End, and Pull Posts	3.17.1	G													
			Erection/Installation Drawings	1.3	G													
			SD-03 Product Data															
			Fence Assembly	1.3	G													

The submittals listed below may not include all required submittals. The Contracting officer may require additional submittals and Government approvals, as specified in the contract documents.

SUBMITTAL REGISTER

CONTRACT NO. . **W912PL-14-R-0089**

TITLE AND LOCATION
Ft. Irwin – Section 3 Civil Repair, CAFI - 1426

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 31 13	Zinc Coating	2.2	G													
			Fabric	2.3	G													
			Stretcher Bars	2.14	G													
			SD-07 Certificates															
			Certificates of Compliance	1.5.2	G													
		32 92 23	SD-03 Product Data															
			Fertilizer	2.5														
			SD-06 Test Reports															
			Topsoil composition tests	2.3.3														
			SD-07 Certificates															
			sods	2.1														
		33 40 00	SD-03 Product Data															
			Placing Pipe	3.3														
			SD-04 Samples															
			Pipe for Culverts and Storm	2.1														
			Drains															
			SD-07 Certificates															
			Frame and Cover for Gratings	2.3.7														
		35 31 19	SD-03 Product Data															
			Riprap	2.4.2	G													
			Bedding Material	2.1	G													
			Ready-Mixed Concrete Grout	3.12.1.1														
			Conveying and Placing	3.12.1.3														
			Admixtures	2.5.3														
			Curing Materials	2.5.4														
			Batching and Mixing Equipment	2.5.6														

The submittals listed below may not include all required submittals. The Contracting officer may require additional submittals and Government approvals, as specified in the contract documents.

SUBMITTAL REGISTER

CONTRACT NO. . **W912PL-14-R-0089**

TITLE AND LOCATION: Ft. Irwin – Section 3 Civil Repair, CAFI - 1426

CONTRACTOR:

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)		(q)	(r)
		35 31 19	Concrete Grout Mixture	1.6.2.2	G														
			Proportions																
			SD-04 Samples																
			Stone	1.6.1	G														
			SD-06 Test Reports																
			Gradation Test	2.4.1.3	G														
			Evaluation Testing of Stone	2.4.1.1	G														
			Bedding Material	2.1															
			Bulk Specific Gravity	3.23.2.1															
			SD-07 Certificates																
			Stone	1.6.1															
			Bedding Material	2.1															
			Filter Material	2.2															
		35 31 20	SD-06 Test Reports																
			Aggregates	1.4.1															
			Mix Design	3.1															
			SD-07 Certificates																
			Portland Cement	1.4.2															
			Curing Materials	1.5															

SECTION TABLE OF CONTENTS

DIVISION 03 - CONCRETE

SECTION 03 36 00

GROUTING STONE PROTECTION

-- End of Section Table of Contents --

SECTION 03 36 00

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 and the most recent versions only.

ASTM INTERNATIONAL (ASTM)

ASTM C 33	(2007) Standard Specification for Concrete Aggregates
ASTM C 143	(2008)Slump of Hydraulic Cement Concrete
ASTM C 150	(2007) Standard Specification for Portland Cement
ASTM C 309	(2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

1.2 SUBMITTALS

Government approval is required, for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal, for the Government. The following shall be submitted, in accordance with Section 01 33 00, SUBMITTAL PROCEDURES:

SD-05 Design Data

Grout Mix Design; G, ED

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

SD-06 Test Reports

Aggregate

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

SD-07 Certificates

Portland Cement; G, ED

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; G, ED

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.

Waybills and Delivery Tickets

Copies of waybills or delivery tickets for materials during the progress of the work shall be submitted for review. Before the final payment is allowed waybills and certified delivery tickets shall be furnished for all material used in the construction.

1.3 PROTECTION OF COMPLETED WORK

After completion of any panel, no workers or anything else 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, 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 may be supplied in bulk or in bags. When transported in a bulk form, the 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, with the Contracting Officer, certified waybills and certified delivery tickets, for

all cement and grout, actually used in the construction.

PART 2 PRODUCTS

2.1 AGGREGATE

Aggregate shall conform to the quality requirements, specified in ASTM C 33. Gradatin requirements are as follows:

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:

Sieve Designation	Cumulative Percentage By Weight Passing
½-inch	100
3/8- inch	85-100
No. 4	10-30
No. 8	0-10
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 or 2, Class B. 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 0.03 pounds per square foot, in 24 hours nor more than 0.09 pounds per square foot, 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.

2.5 RIPRAP OR STONE

Riprap or stone shall confirm to the requirements of Section 03 36 00, Grouting Stone Protection.

PART 3 EXECUTION

3.1 MIXING

Grout shall be composed of cement, sand, and water. The cement content requirement per cubic yard of grout shall be 7-1/2 sacks. The water content of the mix shall not exceed 8-1/2 gallons 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 8.5 inches. Alterations of slump, to produce adequate penetration between the stone voids, shall be determined in the field, during the placement of the demonstration section. 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 45 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 shall be uniform in mix, size, and consistency.

The grout for 12 inch stone shall be placed in one course. The grout for all other stone sizes shall be placed in two courses. The slump of the grout mix for the first course shall be placed at 9 to 10 inches. High slump will provide adequate grout penetration through the stone voids and seal cracks and joints (horizontal and slope) not completely sealed during foundation preparation. The second course shall be placed at 7 to 8 inches slump. Alterations of slump, to produce adequate penetration between the stone voids, shall be determined in the field, during the placement of the demonstration section. 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 45 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 Demonstration Section

The Contractor shall provide a demonstration section of the stone work as

indicated in Section 35 31 19, Stone Protection. Upon approval of the stonework for demonstration section, the Contractor shall grout the stone to demonstrate the methodology of his grouting operation. The grouted stone shall be approved by the Contracting Officer before the grouting production shall continue. Unsatisfactory grouted stone shall be removed from the project site at the expense of the Contractor. The demonstration section shall include toe down or key-in to bedrock if required as part of this project's plans.

3.2.2 Prior to Grouting

Prior to grouting, the stone shall be thoroughly washed with water, to remove the fines, debris and foreign object and to prevent the stone from absorbing water from the grout. The stone shall be kept wet, just ahead of the actual placing of grout. Existing stone protection to be grouted, if any, shall be cleaned of all soil, vegetation, and debris to a minimum depth of 12 inches prior to washing.

3.2.3 Transportation and Placement

The grout shall be brought to the place of final deposit, by approved means and discharged directly on the stone, with a hydraulic concrete pump. The maximum diameter of the grout discharge hose shall be 5 inches, and free fall shall not exceed 3 feet in height. The use of a concrete chute for placing grout, will not be allowed.

The first course of grout (for all stone except 12 inch stone)shall fully penetrate the stone blanket as indicated in paragraph 3.1. The second course shall be placed as soon as the first course has sufficiently stiffened so that it will not flow when additional grout is added. The stone surface projection shall be rough enough to interlock with the next stone layer, where more than one layer is placed. Grouting operation shall begin from the toe of the slope and extend from the toe of the slope to the top of the slope. 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 operator, to ensure 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.

The grout for 12 inch stone shall be placed in one course, for both invert and side slopes. The course shall fully penetrate the stone blanket, extending from the toe of the slope, to top of the 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 operator, to ensure 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 performede, to loosen tight pockets of stone and otherwise aid the penetration of grout. The course shall fully penetrate the stone blanket.

3.2.4 Surface Finishing

Placing and brooming of grout shall be such that the outer layer of stone projects 1/3 to 1/4 of the stone's diameter above the grouted surface. After the top course has stiffened, the entire surface shall be rebroomed, to eliminate runs and fill voids, caused by sloughing of the layers of

grout.

3.2.5 Protection of Completed Work

After completion of any strip or panel, no workers or anything else 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, rain, flowing water, and mechanical injury and shall be moist-cured or membrane-cured, at the Contractor's option.

3.3 WEATHER LIMITATIONS

3.3.1 Hot Weather Placing

The temperature of the grout, when deposited in the proper location, shall not exceed 85 degrees F, 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 40 degrees F, in the shade. Materials entering the mixer shall be free from ice, snow, and frozen lumps.

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 6 inches 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 200 square feet per gallon, 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. In no case should debris or foreign objects be grouted with the grouted stone.

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 personnel, with appropriate bars and other such tools for the necessary barring and adjustment of stone, and curing media 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 indicate 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 Waybills and Delivery Tickets

Copies of waybills or delivery tickets shall be submitted to the Contracting Officer's Representative, during the progress of the work. The Contractor shall furnish the Contracting Officer's Representative scale tickets for each load of material weighed; these tickets shall include tare weight, identification mark of each vehicle weighed, plus date, time, and location of the loading. Tickets shall be furnished at the point and time individual loads arrive at the work site. A master log of all vehicle loading shall be furnished for each day of loading operation. The Contractor shall file with the Contracting Officer's Representative the master log of loadings, certified waybills and/or certified tickets, within 24 hours of material delivery. Prior to the final payment, the Contractor shall furnish written certification that the material recorded on the submitted waybills and/or certified tickets was actually used in the construction covered by the contract.

-- End of Section --

SECTION 31 00 00

EARTHWORK
08/08

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 within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(2010) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mrn (18-in.) Drop
AASHTO T 224	(2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(2010) Installation of Ductile-Iron Water Mains and Their Appurtenances

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010; Errata 2011) Structural Welding Code - Steel

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C 2	(2003) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA P 5	(2007) Standard for Waterborne Preservatives

ASTM INTERNATIONAL (ASTM)

ASTM A 139/A 139M	(2004; R 2010) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)
ASTM A 252	(2010) Standard Specification for Welded and Seamless Steel Pipe Piles
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTfvJ C 33/C 33M	(2013) Standard Specification for Concrete Aggregates
ASTM D 1140	(2000; R 2006) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 1883	(2007; E 2009; E 2009) CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D 2167	(2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2434	(1968; R 2006) Permeability of Granular Soils (Constant Head)
ASTM D 2487	(2011) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2937	(2010) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 422	(1963; R 2007; E 2014) Particle-Size Analysis of Soils
ASTM D 4318	(2010; E 2014) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D 698	(2012; E 2014) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 2011) Safety and Health Requirements Manual

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes
EPA SW-846.3-3	(1999, Third Edition, Update III-A) Test

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-203 (Rev C; Notice 3) Paper, Kraft, Untreated

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

Satisfactory materials 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, and SP-SC. Satisfactory materials for grading comprise stones less than 8 inches (200 mm), except for fill material for pavements and railroads which comprise stones less than 3 inches (75 mm) in any dimension.

1.2.2 Unsatisfactory Materials

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; and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the Contracting Officer when encountering any contaminated or unsatisfactory materials.

1.2.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified
as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

1.2.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch (19.0 mm) sieve, express the degree of compaction for material having more than
30 percent by weight of their particles retained on the 3/4 inch (19.0 mm) sieve as a percentage of the maximum density in accordance with AASHTO T 180 and corrected with AASHTO T 224. To maintain the same percentage of coarse material, use the "remove and replace" procedure as described in NOTE 8 of Paragraph 7.2 in AASHTO T 180.

1.2.5 Overhaul

Overhaul is the authorized transportation of satisfactory excavation or borrow materials in excess of the free-haul limit of 20 stations.
Overhau
l is the product of the quantity of materials hauled beyond the free-haul

limit, and the distance such materials are hauled beyond the free-haul limit, expressed in station feet.

1.5.6 Topsoil

Material suitable for topsoils obtained from required excavations and borrow areas is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than 4 inch (25 mm) diameter, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

1.2.7 Hard/Unyielding Materials

Hard/Unyielding materials comprise weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" with stones greater than 8 inches 203 mm in any dimension or as defined by the pipe manufacturer, whichever is smaller. These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for rem val.

1.2.8 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried
masonry, or concrete other than pavement exceeding 1 cubic yard 0.375 cubic meter in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.2.9 Unstable Material

Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.2.10 Select Granular Material

1.2.10.1 General Requirements

Select granular material consist of materials classified as GW, GP, SW, SP by ASTM O 2487 where indicated. The liquid limit of such material must not exceed 35 percent when tested in accordance with ASTM O 4318. The plasticity index must not be greater than 12 percent when tested in accordance with ASTM O 4318, and not more than 5 percent by weight may be finer than No. 200 75 micrometers sieve when tested in accordance with ASTM 01140. [Provide a minimum coefficient of permeability of 0.02 feet per minute 0.10 mm per second when tested in accordance with ASTM D 2434.

1.2.10.2 California Bearing Ratio Values

Bearing Ratio: The contractor may utilize the CBR, however Load Penetration Curves must be determined in the laboratory in accordance with ASTM O 1883 and compacted according to ASTM O 1557 shall be presented to the Corps of Engineers for review and approval.

Sieve Size	Percent Passing by Weight
63 nun2-1/2 inches	100
4.75 nunNo. 4	40 - 85
2.00 nunNo. 10	20 - 80
425 fiiDNo. 40	10 - 60

Sieve Size	Percent Passing by Weight
75 pmNo. 200	5 - 25

1.2.11 Initial Backfill Material

Initial backfill consists of select granular material or satisfactory materials free from rocks 4 inches 200 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, free the initial backfill material of stones larger than 2 inches 100 mm inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

1.2.12 Expansive Soils

Expansive soils are defined as soils meeting all four of the following: have a plasticity index equal to or greater than 15 when tested in accordance with ASTM O 4318; more than 10% passing 200; expansion index greater than 20; more than 10% less than 5 microns.

1.2.13 Nonfrost Susceptible (NFS) Material

Nonfrost susceptible material are a uniformly graded washed sand with a maximum particle size of mm3 inches and less than 5 percent passing the
0.075 mm No. 200 size sieve, and with not more than 3 percent by weight finer than 0.02 mm grain size.

1.2.14 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

1.3 SYSTEM DESCRIPTION

Subsurface soil boring logs are [shown on the drawings] [appended to the SPECIAL CONTRACT REQUIREMENTS]. The subsoil investigation report and samples of materials taken from subsurface investigations may be

examined at [ ]. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.3.1 Classification of Excavation

Finish the specified excavation on a classified basis, in accordance with the following designations and classifications.

1.3.1.1 Common Excavation

Include common excavation with the satisfactory removal and disposal of all materials not classified as rock excavation.

1.3.1.2 Rock Excavation

Submit notification of encountering rock in the project. Include rock excavation with blasting, excavating, grading, disposing of material classified as rock, and the satisfactory removal and disposal of boulders 1/2 cubic yard meter or more in volume; solid rock; rock material that is in ledges, bedded deposits, and unstratified masses, which cannot be removed without systematic drilling and blasting; firmly cemented conglomerate deposits possessing the characteristics of solid rock impossible to remove without systematic drilling and blasting; and hard materials (see Definitions). Include the removal of any concrete or masonry structures, except pavements, exceeding 1/2 cubicyardc meter in volume that may be encountered in the work in this classification. If at any time during excavation, including excavation from borrow areas, the Contractor encounters material that may be classified as rock excavation, uncover such material and notify the Contracting Officer. Do not proceed with the excavation of this material until the Contracting Officer has classified the materials as common excavation or rock excavation and has taken cross sections as required. Failure on the part of the Contractor to uncover such material, notify the Contracting Officer, and allow ample time for classification and cross sectioning of the undisturbed surface of such material will cause the forfeiture of the Contractor's right of claim to any classification or volume of material to be paid for other than that allowed by the Contracting Officer for the areas of work in which such deposits occur.

1.3.2 Blasting

Perform blasting in accordance with EM 385-1-1 and in conformance with Federal, State, and local safety regulations. Submit notice 15 days prior to starting work. Submit a Blasting Plan, prepared and

sealed by a registered professional engineer that includes calculations for overpressure and debris hazard. Provide blasting mats and use thenon-electric blasting caps. Obtain written approval prior to performing any blasting and notify the Contracting Officer 24 hours prior to blasting. Include provisions for storing, handling and transporting explosives as well as for the blasting operations in the plan. The Contractor is responsible for damage caused by blasting operations.

1.3.3 Dewatering Work Plan

Submit procedures for accomplishing dewatering work.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00
SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shoring; G
Dewatering
Work Plan;
G
Blasting;
G

SD-03
Produ
ct
Data

Utilization of Excavated Materials; GRock Excavation
Opening of any Excavation or Borrow Pit
Shoulder Construction

SD-06 Test Reports

Testing

Borrow Site Testing

Within 24 hours of conclusion of physical tests, submit 1 electronic copy of test results, including calibration curves and results of calibration tests.

SD-07 Certificates

Testing

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE SOILS

Test offsite soils brought in for use as backfill for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and full Toxicity Characteristic Leaching Procedure (TCLP) including ignitability, corrosivity and reactivity. Backfill shall contain a maximum of [100] [ ] parts per million (ppm) of total petroleum hydrocarbons (TPH) and a maximum of [10] [ ] ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall pass the TCPL test. Determine TPH concentrations by using EPA 600/4-79/020 Method 418.1. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5030/8020. Perform TCLP in accordance with EPA SW-846.3-3 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Do not bring material onsite until tests have been approved by the Contracting Officer.

2.2 BURIED WARNING AND IDENTIFICATION TAPE

Provide polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inches75 mm minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Provide permanent color and printing, unaffected by moisture or soil.

Warning Tape Color Codes	
Red	Electric
Yellow	Gas, Oil; Dangerous Materials

Warning Tape Color Codes	
Orange	Telephone and Other Communications
Blue	Water Systems
Green	Sewer Systems
White	Steam Systems
Gray	Compressed Air

2.2.1 Warning Tape for Metallic Piping

Provide acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.003 inches 0.08 mm and a minimum strength of 1500 psi 10.3 MPa lengthwise, and 1250 psi 8.6 MPa crosswise, with a maximum 350 percent elongation.

2.2.2 Detectable Warning Tape for Non-Metallic Piping

Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.004 inch 0.10 mm, and a minimum strength of 1500 psi 10.3 MPa lengthwise and 1250 psi 8.6 MPa crosswise. Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet 920 mm deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.3 DETECTION WIRE FOR NON-METALLIC PIPING

Insulate a single strand, solid copper detection wire with a minimum of 12 AWG.

2.4 MATERIAL FOR RIP-RAP

Provide Bedding material, Grout, Filter fabric, and rock conforming to the requirements indicated below.

2.4.1 6 inch Minus Bedding Material

Provide bedding material consisting of sand, gravel, or crushed rock, well graded, with a maximum particle size of 6 inches 150 mm and the following gradation. Compose material of tough, durable particles. Allow fines passing the No. 200 75 micrometers standard sieve with a plasticity index less than six.

Sieve size	Percent Smaller by Weight
6 inch	100
3 inch	45-90
1-1/2 inch	0-20

2.4.2 3 inch Minus Bedding Material

Provide bedding material consisting of sand, gravel, or crushed rock, well graded, with a maximum particle size of 3 inches 75 mm and the following gradation. Compose material of tough, durable particles. Allow fines passing the No. 200 75 micrometers standard sieve with a plasticity index less than six.

Sieve size	Percent Smaller by Weight
3 inch	100
3 inch	35-75
3/8 inch	0-15

2.4.3 Grout

Provide durable grout composed of cement, water, an air-entraining admixture, and sand mixed in proportions with the portland cement as follows: cement content per cubic yard shall be 7-1/2 sacks; water content of the mix shall not exceed 8-1/2 gallons per sack of cement. In calculating total water content of the mix, the amount of moisture carried on the surfaces of aggregate participles shall be included. The grout shall be placed in one course for the 12 inch stone and 2 courses for all stone larger then 12 inches. The slump of the grout mix for the first course shall be placed at 9 to 10 inches High slump will provide adequate grout penetration through the stone voids and seal cracks and joints (horizontal and slope) not completely sealed during foundation preparation. The second course shall be placed at 7 to 8 inches slump. Alterations of slum, to produce adequate penetration between the stone voids, shall be determined in the field, during the placement of the demonstration section. 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 45 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.

2.4.4 Rock

Provide rock fragments sufficiently durable to ensure permanence in the structure and the environment in which it is to be used. Use rock fragments free from cracks, seams, and other defects that would increase the risk of deterioration from natural causes. Provide rock with a minimum specific gravity of 2.6. Do not permit the inclusion of more than 1 percent of dirt, sand, clay, and rock fines.

2.5 CAPILLARY WATER BARRIER

Provide capillary water barrier of clean, poorly graded crushed rock, crushed gravel, or uncrushed gravel placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below. The crushed rock/gravel shall a maximum size of 2 inches, a maximum of 20 percent by weight passing the No. 44.75 mm sieve, and have a maximum of 3 percent by weight passing ASTM D 1140, No. 20075 micrometers sieve.

2.6 PIPE CASING

2.6.1 Casing Pipe

ASTM A 139/A 139M, Grade B, or ASTM A 252, Grade 2, smooth wall pipe. Match casing size to the outside diameter and wall thickness as indicated on Drawing Sheets. Protective coating is not required on casing pipe.

2.6.2 Wood Supports

Treated Yellow Pine or Douglas Fir, rough, structural grade. Provide wood with nonleaching water-borne pressure preservative (ACA or CCA) and treatment conforming to AWPA P 5 and AWPA C 2, respectively. Secure wood supports to carrier pipe with stainless steel or zinc-coated steel bands.

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, strip topsoil to a depth of [100] mm 8 inches. Spread topsoil on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 50 mm 4 inches in diameter, and other materials that would interfere with planting and maintenance operations. Stockpile in locations indicated.

3.2 GENERAL EXCAVATION

Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Perform the grading in accordance with the typical sections shown and the tolerances specified in paragraph FINISHING. Transport satisfactory excavated materials and place in fill or embankment within the limits of the work. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose surplus satisfactory excavated material not required for fill or embankment in areas approved for surplus material storage or designated waste areas. Dispose unsatisfactory excavated material in designated waste or spoil areas. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times. Excavate material required for fill or embankment in excess of that produced by excavation within the grading limits from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

3.2.1 Ditches, Gutters, and Channel Changes

Finish excavation of ditches, gutters, and channel changes by cutting accurately to the cross sections, grades, and elevations shown on the Drawings. Do not excavate ditches and gutters below grades shown. Backfill the excessive open ditch or gutter excavation with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Dispose excavated material as shown or as directed, except in no case allow material be deposited a maximum 4 feet 1 meter from edge of a ditch. Maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage Structures

Make excavations to the lines, grades, and elevations shown, or as directed. Provide trenches and foundation pits of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or other hard foundation material of loose debris and cut to a firm, level, stepped, or serrated surface. Remove loose disintegrated rock and thin strata. Do not disturb the bottom of the excavation when concrete or masonry is to be placed in an excavated area. Do not excavate to the final grade level until just before the concrete or masonry is to be placed. Where pile foundations are to be used, stop the excavation of each pit at an elevation 300 mm 1 foot above the base of the footing, as specified, before piles are driven. After the pile driving has been completed, remove loose and displaced material and complete excavation, leaving a smooth, solid, undisturbed surface to receive the concrete or masonry.

3.2.3 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

3.2.4 Dewatering

Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. Do not permit French drains, sumps, ditches or trenches within 3 feet 0.9 m of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Take control measures by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, maintain the water level continuously, at least 6 feet 2 m below the working level. Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly. Measure and record performance of dewatering system at same time each day by use of observation wells or piezometers installed in conjunction with the dewatering system. Relieve hydrostatic head in previous zones below subgrade elevation in layered soils to prevent uplift.

3.2.5 Trench Excavation Requirements

Excavate the trench as recommended by the manufacturer of the pipe to be installed. Slope trench walls below the top of the pipe, or make vertical, and of such width as recommended in the manufacturer's printed installation manual. Provide vertical trench walls where no manufacturer's printed installation manual is available. Shore vertical trench walls more than 4

feet 1.2 meters high, or provide with equivalent means of protection for employees who may be exposed to moving ground or cave in. Excavate trench walls which are cut back to at least 1.5:1 (H:V). Give special attention to slopes which may be adversely affected by weather or moisture content. Do not exceed the trench width below the pipe top of 24 inches 600 mm plus pipe outside diameter (O.D.) for pipes of less than 24 inches 600 mm inside diameter, and do not exceed 36 inches 900 mm plus pipe outside diameter for sizes larger than 24 inches 600 mm inside diameter. Where recommended trench widths are exceeded, provide redesign, stronger pipe, or special installation procedures by the Contractor. The Contractor is responsible for the cost of redesign, stronger pipe, or special installation procedures without any additional cost to the Government.

3.2.5.1 Bottom Preparation

Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing. Remove stones of 2 inches 50 mm or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, to avoid point bearing.

3.2.5.2 Removal of Unyielding Material

Where overdepth is not indicated and unyielding material is encountered in the bottom of the trench, remove such material 24 inches 600 mm below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.2.5.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the Government.

3.2.5.4 Excavation for Appurtenances

Provide excavation for manholes, catch-basins, inlets, or similar structures [sufficient to leave at least 300 mm 12 inches clear between the outer structure surfaces and the face of the excavation or support members.] [of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown.] Clean rock or loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Remove loose disintegrated rock and thin strata. Specify removal of unstable material. When concrete or masonry is to be placed in an excavated area, take special care not to disturb the bottom of the excavation. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

3.2.5.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, provide excavation by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and

properly installed and backfill can be properly compacted in such sections.

3.2.6 Underground Utilities

The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. Perform work adjacent to non-Government utilities as indicated in accordance with procedures outlined by utility company. Excavation made with power-driven equipment is not permitted within 2 feet 600 mm of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer.] Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

3.2.7 Structural Excavation

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement. Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the Contracting Officer. Backfill and compact over excavations and changes in grade due to pile driving operations to 95 percent of ASTM D698 maximum density.

3.3 SELECTION OF BORROW MATERIAL

Select borrow material to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Obtain borrow material from the borrow areas shown on Drawings. Unless otherwise provided in the contract, the Contractor is responsible for obtaining the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling from the owners. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, do not obtain borrow within the limits of the project site without prior written approval. Consider necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon related operations to the borrow excavation.

3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

Notify the Contracting Officer sufficiently in advance of the opening of any excavation or borrow pit or borrow areas to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, excavate borrow pits and other excavation areas providing adequate drainage. Transport overburden and other spoil material to designated spoil areas or otherwise dispose of as directed. Provide neatly triwrred and drained borrow pits after the excavation is completed. Ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.5 SHORING

3.5.1 General Requirements

Submit a Shoring and Sheeting plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Finish shoring, including sheet piling, and install as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Remove shoring, bracing, and sheeting as excavations are backfilled, in a manner to prevent caving.

3.5.2 Geotechnical Engineer

Hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction if groundwater is within 10 feet3 m of bottom of excavation. The Geotechnical Engineer is responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer is responsible for updating the excavationj sheeting and dewatering plans as construction progresses to reflect changing conditions and submit an updated plan if necessary. Submit a monthly written report, informing the Contractor and Contracting Officer of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Contracting Officer is responsible for arranging meetings with the Geotechnical Engineer at any time throughout the contract duration.

3.6 GRADING AREAS

Where indicated, divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills. Do not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Place and grade stockpiles of satisfactory and unsatisfactory as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

3.7 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Do not excavate to final grade until just before concrete is to be placed. [For pile foundations, stop the excavation at an elevation of from 150 to 300 mm 6 to 12 inches above the bottom of the footing before driving piles. After pile driving has been completed, complete the remainder of the excavation to the elevations shown.] Only use excavation methods that will leave the foundation rock in a solid and unshattered condition. Roughen the level surfaces, and cut the sloped surfaces, as indicated, into rough steps or benches to provide a satisfactory bond. Protect shales from slaking and all surfaces from erosion resulting from ponding or water flow.

3.8 GROUND SURFACE PREPARATION

3.8.1 General Requirements

Remove and replace unsatisfactory material with satisfactory materials, as directed by the Contracting Officer, in surfaces to receive fill or in

excavated areas. Scarify the surface to a depth of 150 *mm* 6 inches before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 150 *mm* 6 inches, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 300 *mm* 12 inches and compact it as specified for the adjacent fill.

3.8.2 Frozen Material

Do not place material on surfaces that are muddy, frozen, or contain frost. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material to plus or minus 2 percent of optimum moisture.

3.9 UTILIZATION OF EXCAVATED MATERIALS

Dispose unsatisfactory materials removing from excavations into designated waste disposal or spoil areas. Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. Submit procedure and location for disposal of unused satisfactory material. Submit proposed source of borrow material. Do not waste any satisfactory excavated material without specific written authorization. Dispose of satisfactory material, authorized to be wasted, in designated areas approved for surplus material storage or designated waste areas as directed. Clear and grub newly designated waste areas on Government-controlled land before disposal of waste material thereon. Stockpile and use coarse rock from excavations for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. Do not dispose excavated material to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

3.10 BURIED TAPE AND DETECTION WIRE

3.10.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape 300 *mm* 12 inches below finished grade; under pavements and slabs, bury tape 150 *mm* 6 inches below top of subgrade.

3.10.2 Buried Detection Wire

Bury detection wire directly above non-metallic piping at a distance not to exceed 300 mm 12 inches above the top of pipe. Extend the wire continuously and unbroken, from manhole to manhole. Terminate the ends of the wire inside the manholes at each end of the pipe, with a minimum of 0.9 m 3 feet of wire, coiled, remaining accessible in each manhole. Furnish insulated wire over it's entire length. Install wires at manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, terminate the wire in the valve pit at the pump station end of the pipe.

3.11 BACKFILLING AND COMPACTION

Place backfill adjacent to any and all types of structures, and compact to at least 95 ASTM D1557 percent laboratory maximum to prevent wedging action or eccentric loading upon or against the structure. Prepare ground surface on which backfill is to be placed and provide compaction requirements for backfill materials in conformance with the applicable portions of paragraphs GROUND SURFACE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.11.1 Trench Backfill

Backfill trenches to the grade shown. Backfill the trench to 2 feet 50 mm above the top of pipe prior to performing the required pressure tests. Leave the joints and couplings uncovered during the pressure test.

3.11.1.1 Replacement of Unyielding Material

Replace unyielding material removed from the bottom of the trench with select granular material or initial backfill material.

3.11.1.2 Replacement of Unstable Material

Replace unstable material removed from the bottom of the trench or excavation with select granular material placed in layers not exceeding 150 mm 6 inches loose thickness.

3.11.1.3 Bedding and Initial Backfill

[Provide bedding of the type and thickness shown.] Place initial backfill material and compact it with approved tampers to a height of at least 300 mm one foot above the utility pipe or conduit. Bring up the backfill evenly on both sides of the p{pe for the full length of the pipe. Take care to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Compact backfill to top of pipe to 95 percent of ASTM D698 maximum density. Provide plastic piping with bedding to spring line of pipe. Provide materials as follows:

3.11.1.3.1 Class I

Angular, 6 to 40 mm 0.25 to 1.5 inch, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

3.11.1.3.2 Class II

Coarse sands and gravels with maximum particle size of 40 mm 1.5 inch, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SPare included in this class as specified in ASTM D2487.

3.11.1.3.3 Sand

Clean, coarse-grained sand shall meet requirements of SW or SP according to ASTM D 2487 for bedding and backfill as indicated.

3.11.1.3.4 Gravel and Crushed Stone

Clean, coarsely graded natural gravel, crushed stone or a combination thereof identified as having a classification of GW or GP in accordance with ASTM D 2487 for bedding and backfill as indicated. Do not exceed maximum particle size of 2 inches 50 mm.

3.11.1.4 Final Backfill

Fill the remainder of the trench, except for special materials for roadways, railroads and airfields, with satisfactory material. Place backfill material and compact as follows:

3.11.1.4.1 Roadways, Railroads, and Airfields

Place backfill up to the required elevation as specified. Do not permit water flooding or jetting methods of compaction.

3.11.1.4.2 Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas

Deposit backfill in layers of a maximum of 12 inches 300 mm thickness, and compact it to 90 percent maximum density per ASTM D 1557. Allow water flooding or jetting methods of compaction for granular noncohesive backfill material. Do not allow water jetting to penetrate the initial backfill. Do not permit compaction by water flooding or jetting. Apply this requirement to all other areas not specifically designated above.

3.11.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed [and the concrete has been allowed to cure for 7 days, place backfill in such a manner that the structure is not be damaged by the shock of falling earth. Deposit the backfill material, compact it as specified for final backfill, and bring up the backfill evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.12 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.12.1 Gas Distribution

Excavate trenches to a depth that will provide a minimum 450 mm 18 inches of cover in rock excavation and a minimum 600 mm 24 inch of cover in other excavation.

3.12.2 Water Lines

Excavate trenches to a depth that provides a minimum cover of 4 meters feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe. For fire protection yard mains or piping, an additional mm12 inches of cover is required.

3.12.3 Heat Distribution System

Free initial backfill material of stones larger than 6.3 mm 1/4 inch in any dimension.

3.12.4 Electrical Distribution System

Provide a minimum cover of 600 mm 24 inches from the finished grade to direct burial cable and conduit or duct line, unless otherwise indicated.

3.12.5 Sewage Absorption Trenches or Pits

3.12.5.1 Porous Fill

Provide backfill material consisting of clean crushed rock or gravel having a gradation such that 100 percent passes the 2 inch 50 mm sieve and zero percent passes the 1/2 inch 12.5 mm sieve.

3.12.6 Pipeline Casing

Provide new smooth wall steel pipeline casing under new and existing railroad and pavement in a trench by the boring and jacking method of installation. Provide each new pipeline casing, where indicated and to the lengths and dimensions shown, complete and suitable for use with the new piped utility as indicated. Install pipeline casing by dry boring and jacking method as follows:

3.12.6.1 Bore Holes

Mechanically bore holes and case through the soil with a cutting head on a continuous auger mounted inside the casing pipe. Weld lengths of pipe together in accordance with AWS D1.1/D1.1M. Do not use water or other fluids in connection with the boring operation.

3.12.6.2 Cleaning

Clean inside of the pipeline casing of dirt, weld splatters, and other foreign matter which would interfere with insertion of the piped utilities by attaching a pipe cleaning plug to the boring rig and passing it through the pipe.

3.12.6.3 End Seals

After installation of piped utilities in pipeline casing, provide watertight end seals at each end of pipeline casing between pipeline casing and piping utilities. Provide watertight end seals as indicated.

3.12.7 Rip-Rap Construction

Construct rip-rap on bedding material on filter fabric with and without grout in the areas indicated. Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 0.1 foot 30 mm.

3.12.7.1 Filter Fabric

Place filter fabric to teh grades and lines shown on the Drawings. The filter fabric will act as a filter preventing native or fill material from

being mobilzed during flood events. The contractor is required to obtain a minimum of 8 gradation tests on native and fill material per ASTM D 422 to determine an appropriate filter fabric to act as a filter.

3.12.7.2 Bedding Placement

Spread bedding material uniformly over prepared subgrade or filter fabric as shown on the Drawings to a thickness of at least 3 inches 75 mm for the 12 inch riprap and a minimum of 6 inches150 mm for all riprap larger than 12 inches. Compaction of bedding is not required. Finish bedding to present even surface free from mounds and windrows.

3.12.7.3 Stone Placement

Place rock for rip-rap on prepared bedding material to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments, with dimensions extending the full depth of the rip-rap throughout the entire mass and eliminate "pockets" of small rock fragments. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above. For grouted rip-rap, hand-place surface rock with open joints to facilitate grouting and do not fill smaller spaces between surface rock with finer material. Provide at least one "weep hole" through grouted rip-rap for every 4.65 square meters 50 square feet of finished surface. Provide weep holes with columns of bedding material, 100 mm 4 inches in diameter, extending up to the rip-rap surface without grout.

3.12.7.4 Grouting

Prior to grouting, wet rip-rap surfaces. Grout rip-rap in successive longitudinal strips, approximately 10 feet 3 m in width, commencing at the lowest strip and working up the slope. Distribute grout to place of final deposit and work into place between stones with brooms, spades, trowels, or vibrating equipment. Take precautions to prevent grout from penetrating bedding layer. Protect and cure surface for a minimum of 7 days.

3.13 EMBANKMENTS

3.13.1 Earth Embankments

Construct earth embankments from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches 75 mm. Place the material in successive horizontal layers of loose material not more than12 inches 300 mm in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise brake up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 95 percent laboratory maximum density per ASTM D 1557. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.14 SUBGRADE PREPARATION

3.14.1 Proof Rolling

Finish proof rolling on an exposed subgrade free of surface water which would promote degradation of an otherwise acceptable subgrade. After all required removals, compact the existing subgrade to achieve 95 percent compaction per ASTM D 1557. Notify the Contracting Officer a minimum of 3 days prior to proof rolling.

3.14.2 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Excavate rock encountered in the cut section to a depth of 6 inches 150 mm below finished grade for the subgrade. Bring up low areas resulting from removal of unsatisfactory material or excavation of rock to required grade with satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified. After compaction, the surface of the subgrade for roadways shall not show deviations greater than 1/2 inch 13 mm when tested with a 12-foot 4 m straightedge applied both parallel and at right angles to the centerline of the area.

3.14.3 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas and railroads, compact each layer of the embankment to at least 95 percent of laboratory maximum density per ASTM D 1557.

3.14.3.1 Subgrade for Pavements

Compact subgrade for pavements to at least 95 percent laboratory maximum density per ASTM D 1557 for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, thoroughly blend, reshape, and compact the top 12 inches mm of subgrade.

3.14.3.2 Subgrade for Shoulders

Compact subgrade for shoulders to at least 90 percentage laboratory maximum density per ASTM D 1557 for the full depth of the shoulder.

3.15 SHOULDER CONSTRUCTION

Construct shoulders of satisfactory excavated or borrow material or as otherwise shown or specified.. Submit advanced notice on shoulder construction for rigid pavements. Construct shoulders immediately after adjacent paving is complete. In the case of rigid pavements, do not construct shoulders until permission of the Contracting Officer has been obtained. Compact the entire shoulder area to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Finish shoulder construction in proper sequence in such a manner that adjacent

ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. Align the completed shoulders true to grade and shaped to drain in conformity with the cross section shown.

3.16 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 30 mm 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turfing materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

3.16.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

3.16.2 Capillary Water Barrier

Place a capillary water barrier under concrete floor and area-way slabs grade directly on the subgrade and compact with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.16.3 Grading Around Structures

Construct areas within 1.5 m 5 feet outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until final inspection has been completed and the work has been accepted.

3.17 PLACING TOPSOIL

On areas to receive topsoil, prepare the compacted subgrade soil to a 50 mm 2 inches depth for bonding of topsoil with subsoil. Spread topsoil evenly to a thickness of mmB inches and grade to the elevations and slopes shown. Do not spread topsoil when frozen or excessively wet or dry. Obtain material required for topsoil in excess of that produced by excavation within the grading limits from areas indicated.

3.18 TESTING

Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. Submit qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's

facilities have been inspected, Corps validated and approved by the Contracting Officer.

a. Determine field in-place density in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 6938. When ASTM D6938 is used, check the calibration curves and adjust using only the sand cone method as described in ASTM O 1556.

b. Check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM O 6938; check the calibration of both the density and moisture gauges at the beginning of a job on each different type of material encountered and on all changes in material or once for every 10 ASTM D 1556 whichever is more. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, remove the material, replace and recompact to meet specification requirements.

c. Perform tests on recompacted areas to determine conformance with specification requirements. Appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.18.1 Fill and Backfill Material Gradation

One test per cubic 3,000 yards 2,300 meters stockpiled or in-place source material. Determine gradation of fill and backfill material in accordance with ASTM 0422.

3.18.2 In-Place Densities

a. One test per cubic 5,000 yard, or fraction thereof, of each lift of fill or backfill ar as compacted by other than hand-operated machines.

b. One test per linear meters 500 feet, or fraction thereof, of each lift of embankment or backfill for [roads]

3.18.3 Check Tests on In-Place Densities

If ASTM 06938 is used, check in-place densities by ASTM D1556 as follows:

a. One check test per lift for each cubic 5,000 yards 3,800 meters, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.

b. One check test per lift for each linear 1,000 feet 300 meters, or fraction thereof, of embankment or backfill for roads.

3.18.4 Moisture Contents

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

3.18.5 Optimum Moisture and Laboratory Maximum Density

Perform tests 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 cubic 20,000 yards 15,000 meters of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density, whichever is the greater number of tests.

3.18.6 Tolerance Tests for Subgrades

Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

3.18.7 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to 4 feet 1.2 meters above the top of the pipe, inspect the pipe to determine whether significant displacement has occurred. Conduct this inspection in the presence of the Contracting Officer. Inspect pipe sizes larger than 36 inches 900 mm, while inspecting smaller diameter pipe by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgment of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, replace or repair the defects as directed at no additional cost to the Government.

3.19 DISPOSITION OF SURPLUS MATERIAL

Remove surplus material or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber to a Government disposal area or as indicated within a haul distance of 20 miles 32 km tion approved by the Contracting Officer from the project site.

-- End of Section

SECTION 31 05 19

GEOTEXTILE
08/08

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 within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 123	(2003) Standard Terminology Relating to Textiles e
ASTM D 3786	(2001) Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method
ASTM D 4354	(2012) Sampling of Geosynthetics for Testin g
ASTM D 4355	(2007) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D 4491	(1999a; R 2014; E 2014) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(2011) Trapezoid Tearing Strength of Geotextile s
ASTM D 4632/D 4632M	(2008; R 2013; E 2013; E 2014) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(2012) Determining Apparent Opening Size of a Geotextile
ASTM D 4759	(2011) Determining the Specification Conformance of Geosynthetics
ASTM D 4833	(2000) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4873	(2002; R 2009) Identification, Storage, and Handling of Geosynthetic Rolls and Samples
ASTM D 4884	(2003) Seam Strength of Sewn Geotextiles

ASTM D 6241 (2004; R 2009; E 2014) Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

1.2 SUBMITTALS

Government approval is required for submittals with a **nGn** designation; submittals not having a **nGn** designation are for [Contractor Quality Control approval.][information only. When used, a designation following the **nGn** designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Thread
Manufacturing Quality Control Sampling and Testing

SD-04 Samples

Quality Assurance Samples and Tests

Submit geotextile samples for testing to determine compliance with the requirements in this specification. Submit samples a minimum of 30 days prior to the beginning of installation of the same textile. Upon delivery of the geotextile, submit electronic copies of the written certificate of compliance signed by a legally authorized official of the manufacturer. The certificate shall state that the geotextile shipped to the site meets the chemical requirements and exceeds the minimum average roll value listed in TABLE 1, MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE. Supply quality control and quality assurance tests for the geotextile. All samples provided shall be from the same production lot as will be supplied for the contract, and shall be the full manufactured width of the geotextile by at least 10 feet long, except that samples for seam strength may be a full width sample folded over and the edges stitched for a length of at least 5 feet. Samples submitted for testing shall be identified by manufacturers lot designation. For needle punched geotextile, the manufacturer shall certify that the geotextile has been inspected using permanent on-line metal detectors and does not contain any needles.

SD-07 Certificates

Geotextile

All brands of geotextile and all seams to be used will be accepted on the basis of mill certificates or affidavits. Submit electronic copies of the mill certificate or affidavit signed by a legally authorized official from the company manufacturing the geotextile. The mill certificate or affidavit shall attest that the geotextile meets the chemical, physical and manufacturing requirements stated in this specification.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver, store, and handle geotextile in accordance with ASTM D 4873.

1.3.1 Delivery

Notify the Contracting Officer a minimum of 24 hours prior to delivery and unloading of geotextile rolls packaged in an opaque, waterproof, protective plastic wrapping. The plastic wrapping shall not be removed until deployment. If quality assurance samples are collected, immediately rewrap rolls with the plastic wrapping. Geotextile or plastic wrapping damaged during storage or handling shall be repaired or replaced, as directed. Label each roll with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, gross weight), and date manufactured.

1.3.2 Storage

Protect rolls of geotextile from construction equipment, chemicals, sparks and flames, temperatures in excess of 71 degrees C 160 degrees F, or any other environmental condition that may damage the physical properties of the geotextile. No hooks, tongs, or other sharp instruments shall be used for handling geotextile. To protect geotextile from becoming saturated, either elevate rolls off the ground or place them on a sacrificial sheet of plastic in an area where water will not accumulate.

1.3.3 Handling

Handle and unload geotextile rolls with load carrying straps, a fork lift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

PART 2 PRODUCTS

2.1 RAW MATERIALS

A minimum of 30 days prior to scheduled use, submit manufacturer's certificate of compliance stating that the geotextile meets the requirements of this section. For needle punched geotextiles, the manufacturer shall also certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles which could damage other geosynthetic layers. The certificate of compliance shall be attested to by a person having legal authority to bind the geotextile manufacturer.

2.1.1 Geotextile

Provide geotextile that is a nonwoven pervious sheet of polymeric material consisting of long-chain synthetic polymers composed of at least 95 percent by weight polyolefins, polyesters, or polyamides. The use of woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like

character) will not be allowed. Add stabilizers and/or inhibitors to the base polymer, as needed, to make the filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure. Regrind material, which consists of edge trimmings and other scraps that have never reached the consumer, may be used to produce the geotextile. Post-consumer recycled material may also be used. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. Geotextiles shall meet the requirements specified in Table 1 except that the contractor shall determine an appropriate Apparent Opening Size. The Apparent Opening Size shall be commensurate with providing an adequate filter for fill and native soils where applicable. Table 1 property values represent minimum average roll values (MARV) in the weakest principal direction.

TABLE 1
MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE

PROPERTY	UNITS	ACCEPTABLE VALUES	TEST METHOD
GRAB STRENGTH	NLBS	700160	ASTM D 4632/D 4632M
BURST STRENGTH	PaPSI	29020kg/(sq em)	ASTM D 4632/D 4632M
PUNCTURE	NLBS	[350]80	ASTM D 6241
TRAPEZOID TEAR	NLBS	[250][55]	ASTM D 4533
APPARENT OPENING SIZE	U.S. SIEVE	Contractor must submit for approval	ASTM D 4751
PERMITTIVITY	SEC -1	1.1 to 1.8	ASTM D 4491
ULTRAVIOLET DEGRADATION	PERCENT	50 AT 500 HRS	ASTM D 4355

2.**1.**2 Thread

A minimum of 30 days prior to scheduled use, submit proposed thread type for sewn seams along with data sheets showing the physical properties of the thread. Construct sewn seams with high-strength polyester, nylon, or other approved thread type. Thread shall have ultraviolet light stability equivalent to the geotextile and the color shall contrast with the geotextile.

2.2 MANUFACTURING QUALITY CONTROL SAMPLING AND TESTING

The Manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. A minimum of 30 days prior to scheduled use, submit

manufacturer's quality control manual. Documentation describing the quality control program shall be made available upon request. Perform manufacturing quality control sampling and testing in accordance with the manufacturer's approved quality control manual. As a minimum, geotextiles shall be randomly sampled for testing in accordance with ASTM D 4354, Procedure A. Acceptance of geotextile shall be in accordance with ASTM D 4759. Tests not meeting the specified requirements will result in the rejection of applicable rolls.

PART 3 EXECUTION

3.1 QUALITY ASSURANCE SAMPLES AND TESTS

3.1.1 Quality Assurance Samples

Provide assistance to the Contracting Officer in the collection of quality assurance samples for quality assurance testing; assign 7 days in the schedule to allow for testing. Collect samples upon delivery to the site upon request by the Contracting Officer in accordance with ASTM D 4354, Procedure B. Lot size for quality assurance sampling shall be considered to be the shipment quantity of the product or a truckload of the product, whichever is smaller. The unit size shall be considered one roll of geotextile at a frequency of one per 10,000 square meters 100,000 square feet]. Identify samples with a waterproof marker by manufacturer's name, product identification, lot number, roll number, and machine direction. The date and a unique sample number shall also be noted on the sample. Discard the outer layer of the geotextile roll prior to sampling a roll. Samples shall then be collected by cutting the full-width of the geotextile sheet a minimum of 1 meter 3 feet long in the machine direction. Rolls which are sampled shall be immediately resealed in their protective covering.

3.1.2 Quality Assurance Tests

Upon request by the Contracting Officer, provide quality assurance samples to an Independent Laboratory. Samples will be tested to verify that geotextile meets the requirements specified in Table 1. Test method ASTM D 4355 shall not be performed on the collected samples. Geotextile product acceptance shall be based on ASTM D 4759. Tests not meeting the specified requirements will result in the rejection of applicable rolls.

3.2 INSTALLATION

3.2.1 Subgrade Preparation

The surface underlying the geotextile shall be smooth and free of ruts, sharp rocks, roots, trash, or protrusions which could damage the geotextile. Subgrade materials and compaction requirements shall be in accordance with Section 31 00 00 Earthwork.

3.2.2 Placement

Notify the Contracting Officer a minimum of 24 hours prior to installation of geotextile. Geotextile rolls which are damaged or contain imperfections shall be repaired or replaced as directed. The geotextile shall be laid flat and smooth so that it is in direct contact with the subgrade. The geotextile shall also be free of tensile stresses, folds, and wrinkles. On

slopes steeper than 10 horizontal on 1 vertical, lay the geotextile with the machine direction of the fabric from toe to top of slope direction. The geotextile shall be keyed in at the tops of all slopes in a trench one feet deep by two feet wide. Temporary pinning of the geotextile to help hold it in place until the bedding material or gravel drain material is placed shall be allowed. The temporary pins shall be removed as the bedding material or gravel drain material is placed to relieve high tensile stress which may occur during placement of material on the geotextile.

3.3 SEAMS

3.3.1 Overlap Seams

Continuously overlap geotextile panels a minimum of 380 mm 15 inches at all longitudinal and transverse joints. Where seams must be oriented across the slope, lap the upper panel over the lower panel. If approved, sewn seams may be used instead of overlapped seams.

3.3.2 Sewn Seams

Factory and field seams shall be continuously sewn on all slopes steeper than 1 vertical on 4 horizontal. The stitch type used shall be a 401 locking chain stitch or as recommended by the manufacturer. For field and factory seams which are sewn, provide at least a 2-meter sample of sewn seam before the geotextile is installed. For seams that are field sewn, the seams shall be sewn using the same equipment and procedures as will be used for the production seams. If seams are sewn in both the machine and cross machine direction, provide samples of seams from both directions. Upon request by the Contracting Officer, provide Quality Assurance seam samples to the Government. Seam strength shall meet the minimum requirements specified in Table 1. The thread at the end of each seam run shall be tied off to prevent unraveling. Skipped stitches or discontinuities shall be sewn with an extra line of stitching with a minimum of 450 mm 18 inches of overlap.

3.4 PROTECTION

The geotextile shall be protected at all times during construction from clogging, tears, and contamination by surface runoff and any geotextile so contaminated shall be removed and replaced with uncontaminated geotextile. Any damage to the geotextile during its installation or during placement of bedding stone 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 bedding stone , riprap or other materials. Before placement of riprap or other materials, the Contractor shall demonstrate that the placement technique will not cause damage to the geotextile. In no case shall any type of equipment be allowed on the unprotected geotextile.

3.5 REPAIRS

Repair torn or damaged geotextile. Clogged areas of geotextile shall be removed. Perform repairs by placing a patch of the same type of geotextile over the damaged area. The patch shall extend a minimum of 450 mm 18 inches

beyond the edge of the damaged area. Patches shall be continuously fastened using approved methods. The machine direction of the patch shall be aligned with the machine direction of the geotextile being repaired. Remove and replace geotextile rolls which cannot be repaired. Repairs shall be performed at no additional cost to the Government

3.6 PENETRATIONS

Construct engineered penetrations of the geotextile by methods recommended by the geotextile manufacturer.

3.7 COVERING

Do not cover geotextile prior to inspection and approval by the Contracting Officer. Place cover soil in a manner that prevents soil from entering the geotextile overlap zone, prevents tensile stress from being mobilized in the geotextile, and prevents wrinkles from folding over onto themselves. On side slopes, soil backfill shall be placed from the bottom of the slope upward. Cover soil shall not be dropped onto the geotextile from a height greater than 1 m 3 feet. No equipment shall be operated directly on top of the geotextile. A minimum of 450 mm 18 inches of soil shall be maintained between full-scale construction equipment and the geotextile. Cover soil material type, compaction, and testing requirements are described in Section 31 00 00 EARTHWORK. Equipment placing cover soil shall not stop abruptly, make sharp turns, spin their wheels, or travel at speeds exceeding 2.2 m/s 5 mph.

End of Section

SECTION 32 11 23

AGGREGATE AND/OR GRADED-CRUSHED AGGREGATE BASE COURSE
05/01

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 29/C 29M	(1997) Bulk Density ("Unit Weight") and Voids in Aggregates
ASTM C 88	(1999a) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	(1988; R 1993el) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	(1997) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1997) Sampling Aggregates
ASTM D 422	(1963; R 1998) Particle-Size Analysis of Soils
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991; R 1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2487	(2000) Classification of Soils for

	Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996el) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	(1995) Wire-Cloth Sieves for Testing Purposes

California Department of Transportation, Standard Specification.

1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.2.1 Aggregate Base Course

Aggregate base course (ABC) is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

1.2.3 Degree of Compaction

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

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools; G.

List of proposed equipment to be used in performance of construction work, including descriptive data.

Waybills and Delivery Tickets; G.

Copies of waybills and delivery tickets during the progress of the work. Before the final statement is allowed, the Contractor shall file certified waybills and certified delivery tickets for all aggregates actually used.

SD-06 Test Reports

Sampling and testing; G.
Field Density Tests; G.

Calibration curves and related test results prior to using the device or equipment being calibrated. Copies of field test results within 24 hours after the tests are performed. Certified copies of test results for approval not less than 30 days before material is required for the work.

1.5 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by a testing laboratory approved in accordance with Section 01451 CONTRACTOR QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements; testing shall be performed at the specified frequency. The Contracting Officer may specify the time and location of the tests. Copies of test results shall be furnished to the Contracting Officer within 24 hours of completion of the tests.

1.5.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.5.2 Tests

The following tests shall be performed in conformance with the applicable standards listed.

1.5.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11. Particle-size analysis of the soils shall also be completed in conformance with ASTM D 422.

1.5.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

1.5.2.3 Moisture-Density Determinations

The maximum density and optimum moisture content shall be determined in accordance with ASTM D 1557, Method C.

1.5.2.4 Field Density Tests

Density shall be field measured in accordance with ASTM D 1556 and D 2922. For the method presented in ASTM D 1556 the base plate as shown in the drawing shall be used. For the method presented in ASTM D 2922 the calibration curves shall be checked and adjusted if necessary using only the sand cone method as described in paragraph Calibration, of the ASTM

publication. Tests performed in accordance with ASTM D 2922 result in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration of ASTM D 2922, on each different type of material being tested at the beginning of a job and at intervals as directed.

1.5.2.5 Wear Test

Wear tests shall be made on aggregate base course material in conformance with ASTM C 131.

1.5.2.6 Soundness

Soundness tests shall be made on aggregate base course in accordance with ASTM C 88.

1.5.3 Testing Frequency

1.5.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.

a. Sieve Analysis.

b. Liquid limit and plasticity index.

c. Moisture-density relationship.

d. Wear.

e. Soundness.

1.5.3.2 In Place Tests

Each of the following tests shall be performed on samples taken from the placed and compacted aggregate base course. Samples shall be taken and tested at the rates indicated.

a. Density tests shall be performed on every lift of material placed and at a frequency of one set of tests for every 250 square yards, or portion thereof, of completed area.

b. Sieve Analysis shall be performed for every 500 tons, or portion thereof, of material placed.

c. Liquid limit and plasticity index tests shall be performed at the same frequency as the sieve analysis.

1.5.4 Approval of Material

The source of the material shall be selected 30 days prior to the time the material will be required in the work. Tentative approval of material will be based on initial test results. Final approval of the materials will be based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted aggregate base course.

1.6 WEATHER LIMITATIONS

Construction shall be done when the atmospheric temperature is above (35 degrees F). When the temperature falls below (35 degrees F), the Contractor shall protect all completed areas by approved methods against detrimental effects of freezing. Completed areas damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

1.7 PLANT, EQUIPMENT, AND TOOLS

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

PART 2 PRODUCTS

2.1 AGGREGATES

The ABC shall consist of clean, sound, durable particles of crushed stone, crushed gravel, crushed recycled concrete, angular sand, or other approved material. Aggregate base course shall be free of lumps of clay, organic matter, and other objectionable materials or coatings. The portion retained on the No. 4 sieve shall be known as coarse aggregate; that portion passing theNo. 4 sieve shall be known as fine aggregate.

2.1.1 Coarse Aggregate

Coarse aggregates shall be angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled separately.

a. Crushed Gravel: Crushed gravel shall be manufactured by crushing gravels, and shall meet all the requirements specified below.

b. Crushed Stone: Crushed stone shall consist of freshly mined quarry rock, and shall meet all the requirements specified below.

c. Crushed Recycled Concrete: Crushed recycled concrete shall consist of previously hardened portland cement concrete or other concrete containing pozzolanic binder material. The recycled material shall be free of all reinforcing steel, bituminous concrete surfacing, and any other foreign material and shall be crushed and processed to meet the required gradations for coarse aggregate. Crushed recycled concrete shall

meet all other applicable requirements specified below.

2.1.1.1 Aggregate Base Course

ABC coarse aggregate shall not show more than 40 percent loss when subjected to the Los Angeles abrasion test 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; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregates 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 contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces. Crushed gravel shall be manufactured from gravel particles 50 percent of which, by weight, are retained on the maximum size sieve listed in TABLE 1.

2.1.2 Fine Aggregate

Fine aggregates shall be angular particles of uniform density. When the fine aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements.

2.1.2.1 Aggregate Base Course

ABC fine aggregate shall consist of screenings, angular sand, crushed recycled concrete fines, or other finely divided mineral matter processed or naturally combined with the coarse aggregate.

2.1.3 Gradation Requirements

The specified gradation requirements shall apply to the completed base course. The aggregates shall have a maximum size of 1.5 inches and shall conform to California Department of Transportation, Class 2 Road Base. The aggregate shall be continuously well graded within the limits specified in TABLE 1. Sieves shall conform to ASTM E 11.

TABLE I. GRADATION OF AGGREGATES Percentage

by Weight Passing Square-Mesh Sieve

Sieve Designation	Percent Passing
1-1/2 inch	100
1 inch	90-100
No. 8	35-55
No. 200	0-8

NOTE 1: Particles having diameters less than 0.0008 inch shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity.

If materials from different sources are used for the coarse and fine aggregates, they shall be tested in accordance with ASTM C 127 and ASTM C 128 to determine their specific gravities. If the specific gravities vary by more than 10 percent, the percentages passing the various sieves shall be corrected as directed by the Contracting Officer.

2.1.4 Liquid Limit and Plasticity Index

Liquid limit and plasticity index requirements shall apply to the completed course and shall also apply to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the No. 40 sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the ABC 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 OPERATION OF AGGREGATE SOURCES

Aggregate sources shall be cleared, stripped and excavated to working depths producing excavation faces that are as nearly vertical as practicable for the materials being excavated. Strata of unsuitable materials overlying or occurring in the deposit shall be wasted. Methods of operating aggregate sources, and the processing and blending of the materials, shall be changed or modified if necessary to obtain material conforming to the specified requirements. Aggregates shall be obtained from offsite sources.

3.3 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

3.4 PREPARATION OF UNDERLYING COURSE

Prior to constructing the ABC the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the ABC, the subgrade course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. The underlying course shall conform to Section 02222

EXCAVATION,TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses containing sands or gravels, as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the ABC. Stabilization shall be accomplished by mixing ABC into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the ABC is placed.

3.5 INSTALLATION

3.5.1 Mixing the Materials

The coarse and fine aggregates shall be mixed in a stationary plant, or in a traveling plant or bucket loader on an approved paved working area. The Contractor shall make adjustments in mixing procedures or in equipment as directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory ABC meeting all requirements of this specification.

3.5.2 Placing

The mixed material shall be placed on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 6 inches is required, the material shall be placed in layers of equal thickness. No layer shall exceed 6 inches or less than 3 inches when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the ABC is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable ABC.

3.5.3 Grade Control

The finished and completed ABC shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required ABC thickness so that the finished ABC with the subsequent surface course will meet the designated grades.

3.5.4 Edges of Base Course

The ABC shall be placed so that the completed section will be a minimum of 5 feet wider, on all sides, than the next layer that will be placed above it. Additionally, approved fill material shall be placed along the outer edges of ABC in sufficient quantities to compact to the 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 2 foot width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of ABC. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along this edge at the same time.

3.5.5 Compaction

Each layer of the ABC shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in paragraph SAMPLING AND TESTING. 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. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer has a degree of compaction that is at least 100 percent of laboratory maximum density through the full depth of the layer. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory ABC. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

3.5.6 Thickness

Compacted thickness of the aggregate course shall be as indicated. No individual layer shall exceed 6 inches nor be less than 3 inches in compacted thickness. The total compacted thickness of the ABC shall be within 1/2 inch of the thickness indicated. Where the measured thickness is more than 1/2 inch deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 1/2 inch 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 1/4 inch of the thickness indicated. The total thickness of the ABC shall be measured at intervals in such a manner as to ensure one measurement for each 500 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

3.5.7 Proof Rolling

Proof rolling of the areas indicated shall be in addition to the compaction specified and shall consist of the application of 30 coverages with a heavy pneumatic-tired roller having four or more tires, each loaded to a minimum of 30,000 pounds and inflated to a minimum of 150 psi. In areas designated, proof rolling shall be applied to the top of the underlying material on which ABC is laid and to each layer of ABC. Water content of the underlying material shall be maintained at optimum or at the percentage directed from start of compaction to completion of proof rolling of that layer. Water content of each layer of the ABC shall be

maintained at the optimum percentage directed from start of compaction to completion of proof rolling. Any ABC materials or any underlying materials that produce unsatisfactory results by proof rolling shall be removed and replaced with satisfactory materials, recompacted and proof rolled to meet these specifications.

3.5.8 Finishing

The surface of the top layer of ABC shall be finished after final compaction by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer of ABC is 1/2 inch or more below grade, then the top layer should be scarified to a depth of at least 3 inches and new material shall be blended in and compacted to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompacted or it shall be replaced as directed.

3.5.9 Smoothness

The surface of the top layer shall show no deviations in excess of 3/8 inch when tested with a 12 foot straightedge. Measurements shall be taken in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 50 foot intervals. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.6 TRAFFIC

Completed portions of the ABC course may be opened to limited 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.

3.7 MAINTENANCE

The ABC shall be maintained in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any ABC that is not paved over prior to the onset of winter, shall be retested to verify that it still complies with the requirements of this specification. Any area of ABC that is damaged shall be reworked or replaced as necessary to comply with this specification.

3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Any unsuitable materials that must be removed shall be disposed in waste disposal areas indicated. No additional payments will be made for materials that must be replaced.

-- End of Section --

SECTION 32 12 10

BITUMINOUS TACK AND PRIME COATS
01/98

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 within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 140	(2001) Sampling Bituminous Materials
ASTM D 2027	(1997) Cutback Asphalt (Medium-Curing Type)
ASTM D 2995	(1999) Determining Application Rate of Bituminous Distributors
ASTM D 977	(2003) Emulsified Asphalt

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Waybills and Delivery Tickets

Waybills and delivery tickets, during progress of the work; G

SD-06 Test Reports

Sampling and Testing

Copies of all test results for bituminous materials, within 24 hours of completion of tests. Certified copies of the manufacturer's test reports indicating compliance with applicable specified requirements, not less than 30 days before the material is required in the work.

1.3.3 Waybills and Delivery Tickets

Before the final statement is allowed, the Contractor shall file with the Contracting Officer certified waybills and certified delivery tickets for all bituminous materials used in the construction of the pavement covered

by the contract. The Contractor shall not remove bituminous material from storage until the initial outage and temperature measurements have been taken. The delivery or storage units will not be released until the final outage has been taken.

1.4 PLANT, EQUIPMENT, MACHINES AND TOOLS

1.4.1 General Requirements

Plant, equipment, machines and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times.

1.4.2 Bituminous Distributor

The distributor shall have pneumatic tires of such size and number to prevent rutting, shoving or otherwise damaging the base surface or other layers in the pavement structure. The distributor shall be designed and equipped to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.

1.4.3 Power Brooms and Power Blowers

Power brooms and power blowers shall be suitable for cleaning the surfaces to which the bituminous coat is to be applied.

1.5 WEATHER LIMITATIONS

Bituminous coat shall be applied only when the surface to receive the bituminous coat is dry. Bituminous coat shall be applied only when the atmospheric temperature in the shade is 50 degrees F or above and when the temperature has not been below 35 degrees F for the 12 hours prior to application.

PART 2 PRODUCTS

2.1 TACK COAT

Emulsified asphalt shall conform to ASTM D 977 Grade ss-1h.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

Immediately before applying the bituminous coat, all loose material, dirt, clay, or other objectionable material shall be removed from the surface to

be treated. The surface shall be dry and clean at the time of treatment.

3.2 APPLICATION RATE

The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contracting Officer.

3.2.1 Tack Coat

Bituminous material for the tack coat shall be applied in quantities of not less than 0.05 gallon nor more than 0.15 gallon per square yard of pavement surface.

3.2.2 Prime Coat

Bituminous material for the prime coat shall be applied in quantities of not less than 0.15 gallon nor more than 0.40 gallon per square yard of pavement surface.

3.3 APPLICATION TEMPERATURE

3.3.1 Viscosity Relationship

Asphalt application temperature shall provide an application viscosity between 20 and 100 seconds, Saybolt Furol, or between 40 and 200 centistokes, kinematic. The temperature viscosity relation shall be furnished to the Contracting Officer.

3.3.2 Temperature Ranges

The viscosity requirements shall determine the application temperature to be used. The following is a normal range of application temperatures:

Liquid Asphalts	
MC-250	165-270 degrees F

3.4 APPLICATION

3.4.1 General

Following preparation and subsequent inspection of the surface, the bituminous coat shall be applied at the specified rate with uniform distribution over the surface to be treated. All areas and spots missed by the distributor shall be properly treated with the hand spray. Until the succeeding layer of pavement is placed, the surface shall be maintained by protecting the surface against damage and by repairing deficient areas at no additional cost to the Government. If required, clean dry sand shall be spread to effectively blot up any excess bituminous material. No smoking, fires, or flames other than those from the heaters that are a part of the equipment shall be permitted within 25 feet of heating, distributing, and transferring operations of bituminous material other than bituminous emulsions. All traffic, except for paving equipment used in constructing the surfacing, shall be prevented from

using the underlying material, whether primed or not, until the surfacing is completed. The bituminous coat shall conform to all requirements as described herein.

3.4.2 Prime Coat (not allowed amy more due to environmental

The prime coat will be required if it will be at least seven days before a the surfacing (Asphalt cement hot mix concrete)layer is constructed on the underlying (base course, etc)compacted material. The type of liquid asphalt and application rate will be as specified herein. The Contractor shall protect the underlying from any damage (water, traffic, etc.) until the surfacing is placed. If the Contractor places the surfacing within seven days, the choice of protection measures or actions to be taken is at the Contractor's option. Damage to the underlying material caused by lack of, or inadequate, protection shall be repaired (recompacted or replaced) by approved methods at no additional cost to the Government. If the Contractor options to use the prime coat, it shall be applied as soon as possible after consolidation of the underlying material. To obtain uniform application of the prime coat on the surface treated at the junction of previous and subsequent applications, building paper shall be spread on the surface for a sufficient distance back from the ends of each application to start and stop the prime coat on the paper. Immediately after application, the building paper shall be removed and destroyed.

3.4.3 Tack Coat

Tack coat shall be applied at the locations shown on the drawings.

3.5 CURING PERIOD

Following application of the bituminous material and prior to application of the succeeding layer of pavement, the bituminous coat shall be allowed to cure and to obtain evaporation of any volatiles or moisture. Prime coat shall be allowed to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course.

3.6 FIELD QUALITY CONTROL

Samples of the bituminous material shall be tested for compliance with the applicable specified requirements. A sample shall be obtained and tested by the Contractor for every 2,500 gallons of bituminous material used, under the supervision of the Contracting Officer.

3.7 SAMPLING AND TESTING

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved.

3.7.1 Sampling

The samples of bituminous material, unless otherwise specified, shall be in accordance with ASTM D 140. Sources from which bituminous materials

are to be obtained shall be selected and notification furnished the Contracting Officer within 15 days after the award of the contract.

3.7.2 Calibration Test

The Contractor shall furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibration shall be made with the approved job material and prior to applying the bituminous coat material to the prepared surface. Calibration of the bituminous distributor shall be in accordance with ASTM D 2995.

3.7.3 Trial Applications

Before providing the complete bituminous coat, three lengths of at least 100 feet for the full width of the distributor bar shall be applied to evaluate the amount of bituminous material that can be satisfactorily applied.

3.7.3.1 Tack Coat Trial Application Rate

Unless otherwise authorized, the trial application rate of bituminous tack coat materials shall be applied in the amount of 0.05 gallons per square yard. Other trial applications shall be made using various amounts of material as may be deemed necessary.

Unless otherwise authorized, the trial application rate of bituminous materials shall be applied in the amount of 0.25 gallon per square yard. Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.7.4 Sampling and Testing During Construction

Quality control sampling and testing shall be performed as required in paragraph FIELD QUALITY CONTROL.

-- End of Section --

SECTION 32 12 17

HOT-MIX ASPHALT (HMA) FOR ROADS
09/99

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 within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 29	(1997; R 2003) Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C 88	(1999a) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	(2003) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(2003) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2001) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 566	(1997) Total Evaporable Moisture Content of Aggregate by Drying
ASTM C 1252	(2003) Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading)
ASTM D 140	(2001) Sampling Bituminous Materials
ASTM D 242	(1995; R 2000e1) Mineral Filler for Bituminous Paving Mixtures
ASTM D 946	(1982; R 1999) Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 995	(1995b; R 2002) Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
ASTM D 1461	(1985; R 2001) Moisture or Volatile

	Distillates in Bituminous Paving Mixtures
ASTM D 1559	(1989) Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 2041	(2003) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2172	(2001e1) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2419	(2002) Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 2489	(2002) Estimating Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D 2726	(2000) Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D 2950	(1991; R 1997) Density of Bituminous Concrete in Place by Nuclear Methods
ASTM D 3381	(1992; R 1999) Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 3665	(2002) Random Sampling of Construction Materials
ASTM D 3666	(2003) Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D 4125	(1994;R 2000) Asphalt Content of Bituminous Mixtures by the Nuclear Method
ASTM D 4791	(1999) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 4867	(1996) Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D 5444	(1998) Mechanical Size Analysis of Extracted Aggregate
ASTM D 6307	(1998) Asphalt Content of Hot Mix Asphalt by Ignition Method

STATE OF ARIZONA DEPARTMENT OF TRANSPORTATION (ADOT)

CDT Test 526	(2000) Operation of California

Profilograph and Evaluation of Profiles

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 171 (1994) Standard Test Method for Determining Percentage of Crushed Particles in Aggregate

1.2 DESCRIPTION OF WORK

The work shall consist of pavement courses composed of mineral aggregate and asphalt material heated and mixed in a central mixing plant and placed on a prepared course. HMA designed and constructed in accordance with this section shall conform to the lines, grades, thicknesses, and typical cross sections shown on the drawings. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mix Design; G, ED.

Proposed JMF.

Contractor Quality Control; G; ED.

Quality control plan.

Material Acceptance and Percent Payment; G,

Acceptance test results and pay calculations.

SD-04 Samples

Asphalt Cement Binder; G, RE.

5 gallon sample for mix design verification.

Aggregates; G, RE.

Sufficient materials to produce 200 lb of blended mixture for mix design verification.

SD-06 Test Reports

Aggregates; G, RE.
QC Monitoring; G, RE.

Aggregate and QC test results.

SD-07 Certificates

Asphalt Cement Binder; G, RE.

Copies of certified test data.

Testing Laboratory; G, RE.

Certification of compliance.

Plant Scale Calibration Certification

1.6 ASPHALT MIXING PLANT

Plants used for the preparation of hot-mix asphalt shall conform to the requirements of ASTM D 995 with the following changes:

a. Truck Scales. The asphalt mixture shall be weighed on approved certified scales at the Contractor's expense. Scales shall be inspected and sealed at least annually by an approved calibration laboratory.

b. Testing Facilities. The Contractor shall provide laboratory facilities at the plant for the use of the Government's acceptance testing and the Contractor's quality control testing.

c. Inspection of Plant. The Contracting Officer shall have access at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant; verifying weights, proportions, and material properties; checking the temperatures maintained in the preparation of the mixtures and for taking samples. The Contractor shall provide assistance as requested, for the Government to procure any desired samples.

d. Storage Bins. Use of storage bins for temporary storage of hot-mix asphalt will be permitted as follows:

(1) The asphalt mixture may be stored in non-insulated storage bins for a period of time not exceeding 3 hours.

(2) The asphalt mixture may be stored in insulated storage bins for a period of time not exceeding 8 hours. The mix drawn from bins shall meet the same requirements as mix loaded directly into trucks.

1.7 HAULING EQUIPMENT

Trucks used for hauling hot-mix asphalt shall have tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material. Petroleum based products shall not be used as a release agent. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers (tarps) shall be securely fastened.

1.8 ASPHALT PAVERS

Asphalt pavers shall be self-propelled, with an activated screed, heated as necessary, and shall be capable of spreading and finishing courses of hot-mix asphalt which will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface.

1.8.1 Receiving Hopper

The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

1.8.2 Automatic Grade Controls

If an automatic grade control device is used, the paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. A transverse slope controller shall not be used to control grade. The controls shall be capable of working in conjunction with any of the following attachments:

a. Ski-type device of not less than 30 feet in length.

b. Taut stringline set to grade.

c. Short ski or shoe for joint matching.

d. Laser control.

1.9 ROLLERS

Rollers shall be in good condition and shall be operated at slow speeds to avoid displacement of the asphalt mixture. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Equipment which causes excessive crushing of the aggregate shall not be used.

1.10 STRAIGHTEDGE

The Contractor shall furnish and maintain at the site, in good condition, one 10-foot straightedge for each bituminous paver. Straightedge shall be made available for Government use. Straightedge shall be constructed of aluminum or other lightweight metal and shall have blades of box-girder cross section with flat bottom reinforced to insure rigidity and accurancy. Straightedge shall have handles to facilate movement on pavement.

1.10 WEATHER LIMITATIONS

The hot-mix asphalt shall not be placed upon a wet surface or when the surface temperature of the existing pavement or base course is below 40 degrees F.

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of crushed stone, crushed gravel, screenings, natural sand and mineral filler, as required. The portion of material retained on the No. 4 sieve is coarse aggregate. The portion of material passing the No. 4 sieve and retained on the No. 200 sieve is fine aggregate. The portion passing the No. 200 sieve is defined as mineral filler. All aggregate test results and samples shall be submitted to the Contracting Officer at least 14 days prior to start of construction.

2.1.1 Coarse Aggregate

Coarse aggregate shall consist of sound, tough, durable particles, free from films of material that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances. All individual coarse aggregate sources shall meet the following requirements:

a. The percentage of loss shall not be greater than 40 percent after 500 revolutions when tested in accordance with ASTM C 131.

b. The percentage of loss shall not be greater than 18 percent after five cycles when tested in accordance with ASTM C 88 using magnesium sulfate or 12 percent when using sodium sulfate.

c. At least 75 percent by weight of coarse aggregate shall have at least two or more fractured faces when tested in accordance with COE CRD-C 171. Fractured faces shall be produced by crushing.

d. The particle shape shall be essentially cubical and the aggregate shall not contain more than 20% percent, by weight, of flat and elongated particles (3:1 ratio of maximum to minimum) when tested in accordance with ASTM D 4791.

2.1.2 Fine Aggregate

Fine aggregate shall consist of clean, sound, tough, durable particles. The aggregate particles shall be free from coatings of clay, silt, or any objectionable material and shall contain no clay balls. All individual fine aggregate sources shall have a sand equivalent value not less than 45 when tested in accordance with ASTM D 2419.

The fine aggregate portion of the blended aggregate shall have an uncompacted void content not less than 43.0 percent when tested in accordance with ASTM C 1252 Method A.

2.1.3 Mineral Filler

Mineral filler shall be nonplastic material meeting the requirements of ASTM D 242.

2.1.4 Aggregate Gradation

The aggregate gradation shall conform to the gradation indicated in Table 1. The aggregate shall be tested in accordance with ASTM C 136and ASTM C 117, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but grade uniformly from coarse to fine.

Table 1: Sieve Size, inch	Percent Passing by Mass
3/4	100
1/2	90-100
3/8	70-85
No. 8	43-51
No. 40	12-22
No. 200	2-6

2.2 ASPHALT CEMENT BINDER

Asphalt cement binder shall conform to ASTM D 3381 Table 2, Viscosity Grade AC-20. Asphalt cement shall conform to PG 70-10. Test data indicating grade certification shall be provided by the supplier at the time of delivery of each load to the mix plant. Copies of these certifications shall be submitted to the Contracting Officer. The supplier is defined as the last source of any modification to the binder. The Contracting Officer may sample and test the binder at the mix plant at any time before or during mix production. Samples for this verification testing shall be obtained by the Contractor in accordance with ASTM D 140 and in the presence of the Contracting Officer. These samples shall be furnished to the Contracting Officer for the verification testing, which shall be at no cost to the Contractor. Samples of the asphalt cement specified shall be submitted for approval not less than 14 days before start of the test section.

2.3 MIX DESIGN

The Contractor shall develop the mix design. The asphalt mix shall be composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt material. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF). No hot-mix asphalt for payment shall be produced until a JMF has been approved. If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D 4867 is less than 75, the aggregates shall be rejected or the asphalt mixture treated with an approved anti-stripping agent. The amount of anti-stripping agent added shall be sufficient to produce a TSR of not less than 75. If an antistrip agent is required, it shall be provided by the Contractor at no additional cost. Sufficient materials to produce 200 pound of blended mixture shall be provided to the Contracting Officer for verification of mix design at least 14 days prior to construction of test section.

2.3.1 JMF Requirements

The job mix formula shall be submitted in writing by the Contractor for approval at least 14 days prior to the start of the test section and shall include as a minimum:

a. Percent passing each sieve size.

b. Percent of asphalt cement.

c. Percent of each aggregate and mineral filler to be used.

d. Asphalt viscosity grade, penetration grade, or performance grade.

e. Number of blows of hammer per side of molded specimen.

f. Laboratory mixing temperature.

g. Lab compaction temperature.

h. Temperature-viscosity relationship of the asphalt cement.

i. Plot of the combined gradation on the 0.45 power gradation chart, stating the nominal maximum size.

j. Graphical plots of stability, flow, air voids, voids in the mineral aggregate, and unit weight versus asphalt content.

k. Specific gravity and absorption of each aggregate.

l. Percent natural sand.

m. Percent particles with 2 or more fractured faces (in coarse aggregate).

n. Fine aggregate angularity.

o. Percent flat or elongated particles (in coarse aggregate).

p. Tensile Strength Ratio(TSR).

q. Antistrip agent (if required) and amount.

r. List of all modifiers and amount.

s. Percentage and properties (asphalt content, binder properties, and aggregate properties) of reclaimed asphalt pavement (RAP) in accordance with paragraph RECYCLED HOT-MIX ASPHALT, if RAP is used.

Table 2: Marshall Design Criteria

Test Property	75 Blow Mix	50 Blow Mix
Stability, pounds		

Table 2: Marshall Design Criteria

Test Property	75 Blow Mix	50 Blow Mix
minimum	*1800	*1000
Flow, 0.01 inch	8-16	8-18
Air voids, percent	3-5	3-5
Percent Voids in mineral aggregate VMA, (minimum)		
Gradation	13.0	13.0
TSR, minimum percent	75	75

* This is a minimum requirement. The average during construction shall be significantly higher than this number to ensure compliance with the specifications.
** Calculate VMA in accordance with AI MS-02, based on ASTM D 2726 bulk specific gravity for the aggregate.

2.3.2 Adjustments to Field JMF

The Laboratory JMF for each mixture shall be in effect until a new formula is approved in writing by the Contracting Officer. Should a change in sources of any materials be made, a new laboratory JMF design shall be performed and a new JMF approved before the new material is used. The Contractor will be allowed to adjust the Laboratory JMF within the limits specified below to optimize mix volumetric properties with the approval of the Contracting Officer. Adjustments to the Laboratory JMF shall be applied to the field (plant) established JMF and limited to those values as shown. Adjustments shall be targeted to produce or nearly produce 4 percent voids total mix (VTM).

TABLE 3. Field (Plant) Established JMF Tolerances

Sieves	Adjustments (plus or minus), percent
No. 4	3
No. 8	3
No. 200	1
Binder Content	0.40

If adjustments are needed that exceed these limits, a new mix design shall be developed. Tolerances given above may permit the aggregate grading to be outside the limits shown in Table 3; while not desirable, this is acceptable.

2.4 RECYCLED HOT MIX ASPHALT

Recycled HMA shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt cement. The RAP shall be of a consistent gradation and asphalt content and properties.

When RAP is fed into the plant, the maximum RAP chunk size shall not exceed 2 inches. The recycled HMA mix shall be designed using procedures contained in AI MS-02 and AI MS-22. The job mix shall meet the requirements of paragraph MIX DESIGN. The amount of RAP shall not exceed 30 percent.

2.4.1 RAP Aggregates and Asphalt Cement

The blend of aggregates used in the recycled mix shall meet the requirements of paragraph AGGREGATES. The percentage of asphalt in the RAP shall be established for the mixture design according to ASTM D 2172 using the appropriate dust correction procedure.

2.4.2 RAP Mix

The blend of new asphalt cement and the RAP asphalt binder shall meet the viscosity requirements in paragraph ASPHALT CEMENT BINDER. The virgin asphalt cement shall not be more than two standard asphalt material grades different than that specified in paragraph ASPHALT CEMENT BINDER.

PART 3 EXECUTION

3.1 PREPARATION OF ASPHALT BINDER MATERIAL

The asphalt cement material shall be heated avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 325 degrees F when added to the aggregates. Modified asphalts shall be no more than 350 degrees F when added to the aggregates.

3.2 PREPARATION OF MINERAL AGGREGATE

The aggregate for the mixture shall be heated and dried prior to mixing. No damage shall occur to the aggregates due to the maximum temperature and rate of heating used. The temperature of the aggregate and mineral filler shall not exceed 350 degrees F when the asphalt cement is added. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

3.3 PREPARATION OF HOT-MIX ASPHALT MIXTURE

The aggregates and the asphalt cement shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but no less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in ASTM D 2489, for each individual plant and for each type of aggregate used. The wet mixing time will be set to at least achieve 95 percent of coated particles. The moisture content of all hot-mix asphalt upon discharge from the plant shall not exceed 0.5 percent by total weight of mixture as measured by ASTM D 1461. The percentage of asphalt in the job-mix formula shall be between 5 and 6.

3.4 PREPARATION OF THE UNDERLYING SURFACE

Immediately before placing the hot mix asphalt, the underlying course shall be cleaned of dust and debris. Tack coat shall be applied to the surface in area to be overlayed with asphalt in accordance with the contract specifications.

3.5 TEST SECTION (This job may be too small to require a test section) Check

Prior to full production, the Contractor shall place a test section for each JMF used. The contractor shall construct a test section 250 - 500 feet long and two paver passes wide placed for two lanes, with a longitudinal cold joint. The test section shall be of the same depth as the course which it represents. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment and personnel used in construction of the test section shall be the same equipment to be used on the remainder of the course represented by the test section. The test section shall be placed as part of the project pavement as approved by the Contracting Officer.

3.5.1 Sampling and Testing for Test Section

One random sample shall be taken at the plant, triplicate specimens compacted, and tested for stability, flow, and laboratory air voids. A portion of the same sample shall be tested for aggregate gradation and asphalt content. Four randomly selected cores shall be taken from the finished pavement mat, and four from the longitudinal joint, and tested for density. Random sampling shall be in accordance with procedures contained in ASTM D 3665. The test results shall be within the tolerances shown in Table 5 for work to continue. If all test results meet the specified requirements, the test section shall remain as part of the project pavement. If test results exceed the tolerances shown, the test section shall be removed and replaced at no cost to the Government and another test section shall be constructed. The test section shall be paid for with the first lot of paving

Table 4. Test Section Requirements for Material and Mixture Properties

Property	Specification Limit
Aggregate Gradation-Percent Passing (Individual Test Result)	
No. 4 and larger	JMF plus or minus 8
No. 8, No. 16, No. 30, and No. 50	JMF plus or minus 6
No. 100 and No. 200	JMF plus or minus 2.0
Asphalt Content, Percent (Individual Test Result)	JMF plus or minus 0.5
Laboratory Air Voids, Percent (Average of 3 specimens)	JMF plus or minus 1.0

Table 4. Test Section Requirements for Material and Mixture Properties

Property	Specification Limit
VMA, Percent (Average of 3 specimens)	13 minimum
Stability, pounds (Average of 3 specimens)	1000 minimum
Flow, 0.01 inches (Average of 3 specimens)	8 - 16
Mat Density, Percent of Marshall (Average of 4 Random Cores)	97.0 - 100.5
Joint Density, Percent of Marshall (Average of 4 Random Cores)	95.5 - 100.5

3.5.2 Additional Test Sections (See note @ paragraph 3.5)

If the initial test section should prove to be unacceptable, the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made. A second test section shall then be placed. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. Full production shall not begin until an acceptable section has been constructed and accepted.

3.6 TESTING LABORATORY

The laboratory used to develop the JMF shall meet the requirements of ASTM D 3666. A certification signed by the manager of the laboratory stating that it meets these requirements or clearly listing all deficiencies shall be submitted to the Contracting Officer prior to the start of construction. The certification shall contain as a minimum:

a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.

b. A listing of equipment to be used in developing the job mix.

c. A copy of the laboratory's quality control system.

d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

3.7 TRANSPORTING AND PLACING

3.7.1 Transporting

The hot-mix asphalt shall be transported from the mixing plant to the site in clean, tight vehicles. Deliveries shall be scheduled so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Adequate artificial lighting shall be provided for night placements. Hauling over freshly placed material will not be permitted until the material has been compacted as specified, and allowed to cool to 140 degrees F. To deliver mix to the paver, the Contractor shall use a material transfer vehicle which shall be operated to produce continuous forward motion of the paver.

3.7.2 Placing

The mix shall be placed and compacted at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, the mixture shall be placed to the full width by an asphalt paver; it shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of 10 feet. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 1 foot; however, the joint in the surface course shall be at the centerline of the pavement. Transverse joints in one course shall be offset by at least 10 feet from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools. The compacted hot asphalt concrete thickness for road pavement shall be a minimum of 4 inches, and a minimum of 2 inches thick for parking lots. The minimum compaction thickness of asphalt course shall be 1.5 inches, and the maximum compacted thickness of any course shall not be be greater than 3 inches. Asphalt concrete pavement three inches thick or greater shall be placed in two courses (wearing and intermediate courses)using the same approved JMF. Where pavement of two courses is encountered, tack coat shall be applied to the intermediate course sueface prior to placing the wearing course.

3.8 COMPACTION OF MIXTURE

After placing, the mixture shall be thoroughly and uniformly compacted by rolling. The surface shall be compacted as soon as possible without causing displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once. Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened but excessive water will not be permitted. In areas not accessible to the roller, the mixture shall be thoroughly compacted with hand tampers. Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way defective shall be removed full depth, replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching will not be allowed.

3.9 JOINTS

The formation of joints shall be made ensuring a continuous bond between the courses and to obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for

smoothness and grade.

3.9.1 Transverse Joints

The roller shall not pass over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing material at the joint . The cutback material shall be removed from the project. In both methods, all contact surfaces shall be given a light tack coat of asphalt material before placing any fresh mixture against the joint.

3.9.2 Longitudinal Joints

Longitudinal joints which are irregular, damaged, uncompacted, cold (less than 175 degrees F at the time of placing adjacent lanes), or otherwise defective, shall be cut back a minimum of 2 inches from the edge with a cutting wheel to expose a clean, sound vertical surface for the full depth of the course. All cutback material shall be removed from the project. All contact surfaces shall be given a light tack coat of asphalt material prior to placing any fresh mixture against the joint. The Contractor will be allowed to use an alternate method if it can be demonstrated that density, smoothness, and texture can be met.

3.10 CONTRACTOR QUALITY CONTROL

3.10.1 General Quality Control Requirements

The Contractor shall develop an approved Quality Control Plan. Hot-mix asphalt for payment shall not be produced until the quality control plan has been approved. The plan shall address all elements which affect the quality of the pavement including, but not limited to:

a. Mix Design

b. Aggregate Grading

c. Quality of Materials

d. Stockpile Management

e. Proportioning

f. Mixing and Transportation

g. Mixture Volumetrics

h. Moisture Content of Mixtures

i. Placing and Finishing

j. Joints

k. Compaction

l.Surface Smoothness

3.10.2 Testing Laboratory

The Contractor shall provide a fully equipped asphalt laboratory located at the plant. The laboratory shall meet the requirements as required in ASTM D 3666. The effective working area of the laboratory shall be a minimum of 150 square feet with a ceiling height of not less than 7.5 feet. Lighting shall be adequate to illuminate all working areas. It shall be equipped with heating and air conditioning units to maintain a temperature of 75 degrees F plus or minus 5 degrees F. Laboratory facilities shall be kept clean and all equipment shall be maintained in proper working condition. The Contracting Officer shall be permitted unrestricted access to inspect the Contractor's laboratory facility, to witness quality control activities, and to perform any check testing desired. The Contracting Officer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to adversely affect test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are corrected.

3.10.3 Quality Control Testing

The Contractor shall perform all quality control tests applicable to these specifications and as set forth in the Quality Control Program. The testing program shall include, but shall not be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, moisture in the asphalt mixture, laboratory air voids, stability, flow, in-place density, grade and smoothness. A Quality Control Testing Plan shall be developed as part of the Quality Control Program.

3.10.3.1 Asphalt Content

A minimum of two tests to determine asphalt content will be performed per lot (a lot is defined in paragraph MATERIAL ACCEPTANCE AND PERCENT PAYMENT) by one of the following methods: the extraction method in accordance with ASTM D 2172, Method A or B, the ignition method in accordance with the AASHTO TP53or ASTM D 6307, or the nuclear method in accordance with ASTM D 4125, provided the nuclear gauge is calibrated for the specific mix being used. For the extraction method, the weight of ash, as described in ASTM D 2172, shall be determined as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture.

3.10.3.2 Gradation

Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of recovered aggregate in accordance with ASTM D 5444. When asphalt content is determined by the nuclear method, aggregate gradation shall be determined from hot bin samples on batch plants, or from the cold feed on drum mix plants. For batch plants, aggregates shall be tested in accordance with ASTM C 136 using actual batch weights to determine the combined aggregate gradation of the mixture.

3.10.3.3 Temperatures

Temperatures shall be checked at least four times per lot, at necessary locations, to determine the temperature at the dryer, the asphalt cement in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

3.10.3.4 Aggregate Moisture

The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C 566.

3.10.3.5 Moisture Content of Mixture

The moisture content of the mixture shall be determined at least once per lot in accordance with ASTM D 1461 or an approved alternate procedure.

3.10.3.6 Laboratory Air Voids, Marshall Stability and Flow

Mixture samples shall be taken at least four times per lot and compacted into specimens, using 75 blows per side with the Marshall hammer as described in ASTM D 1559. After compaction, the laboratory air voids of each specimen shall be determined, as well as the Marshall stability and flow.

3.10.3.7 In-Place Density

The Contractor shall conduct any necessary testing to ensure the specified density is achieved. A nuclear gauge may be used to monitor pavement density in accordance with ASTM D 2950.

3.10.3.8 Grade and Smoothness

The Contractor shall conduct the necessary checks to ensure the grade and smoothness requirements are met in accordance with paragraph MATERIAL ACCEPTANCE AND PERCENT PAYMENT.

3.10.3.9 Additional Testing

Any additional testing, which the Contractor deems necessary to control the process, may be performed at the Contractor's option.

3.10.3.10 QC Monitoring

The Contractor shall submit all QC test results to the Contracting Officer on a daily basis as the tests are performed. The Contracting Officer reserves the right to monitor any of the Contractor's quality control testing and to perform duplicate testing as a check to the Contractor's quality control testing.

3.10.4 Sampling

When directed by the Contracting Officer, the Contractor shall sample and test any material which appears inconsistent with similar material being produced, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

3.10.5 Control Charts

For process control, the Contractor shall establish and maintain linear control charts on both individual samples and the running average of last four samples for the parameters listed in Table 5, as a minimum. These control charts shall be posted as directed by the Contracting Officer and shall be kept current at all times. The control charts shall identify the project number, the test parameter being plotted, the individual sample numbers, the Action and Suspension Limits listed in Table 5 applicable to the test parameter being plotted, and the Contractor's test results. Target values from the JMF shall also be shown on the control charts as indicators of central tendency for the cumulative percent passing, asphalt content, and laboratory air voids parameters. When the test results exceed either applicable Action Limit, the Contractor shall take immediate steps to bring the process back in control. When the test results exceed either applicable Suspension Limit, the Contractor shall halt production until the problem is solved. The Contractor shall use the control charts as part of the process control system for identifying trends so that potential problems can be corrected before they occur. Decisions concerning mix modifications shall be made based on analysis of the results provided in the control charts. The Quality Control Plan shall indicate the appropriate action which shall be taken to bring the process into control when certain parameters exceed their Action Limits.

Table 5. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

	Running Average of Individual Samples		Last Four Samples	
Parameter to be Plotted	Action Limit	Suspension Limit	Action Limit	Suspension Limit
No. 4 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	6	8	4	5
No. 30 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	4	6	3	4
No. 200 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	1.4	2.0	1.1	1.5
Stability, pounds (minimum) 75 Blow JMF	1800	1700	1900	1800
Flow, 0.01 inches 75 Blow	8 min. 16 max.	7 min. 17 max.	9 min. 15 max.	8 min. 16 max.
50 Blow	8 min. 18 max.	7 min. 19 max.	9 min. 17 max.	8 min. 18 max.
Asphalt content, % deviation from JMF target; plus or minus value	0.4	0.5	0.2	0.3
Laboratory Air Voids, % deviation from JMF target value	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Mat Density, % of Marshall density	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Joint Density, % of Marshall density	No specific action and suspension limits set since this parameter is used to determine percent payment			

3.11 MATERIAL ACCEPTANCE AND PERCENT PAYMENT

Testing for acceptability of work will be performed by an independent laboratory hired by the Contractor. Test results and payment calculations shall be forwarded daily to the Contracting Officer. Acceptance of the plant produced mix and in-place requirements will be on a lot to lot basis. A standard lot for all requirements will be equal to 2000 tons 8 hours of production. Where appropriate, adjustment in payment for

individual lots of hot-mix asphalt will be made based on in-place density, laboratory air voids, grade and smoothness in accordance with the following paragraphs. Grade and surface smoothness determinations will be made on the lot as a whole. Exceptions or adjustments to this will be made in situations where the mix within one lot is placed as part of both the intermediate and surface courses or where one course is placed, thus grade and smoothness measurements for the entire lot cannot be made. In order to evaluate laboratory air voids and in-place (field) density, each lot will be divided into four equal sublots.

3.11.1 Percent Payment

When a lot of material fails to meet the specification requirements for 100 percent pay as outlined in the following paragraphs, that lot shall be removed and replaced, or accepted at a reduced price which will be computed by multiplying the unit price by the lot's pay factor. The lot pay factor is determined by taking the lowest computed pay factor based on either laboratory air voids, in-place density, grade or smoothness (each discussed below). At the end of the project, an average of all lot pay factors will be calculated. If this average lot pay factor exceeds 95.0 percent, then the percent payment for the entire project will be 100 percent of the unit bid price. If the average lot pay factor is less than 95.0 percent, then each lot will be paid for at the unit price multiplied by the lot's pay factor. For any lots which are less than 2000 tons, a weighted lot pay factor will be used to calculate the average lot pay factor.

3.11.2 Sublot Sampling

One random mixture sample for determining laboratory air voids, theoretical maximum density, and for any additional testing the Contracting Officer desires, will be taken from a loaded truck delivering mixture to each sublot, or other appropriate location for each sublot. All samples will be selected randomly, using commonly recognized methods of assuring randomness conforming to ASTM D 3665 and employing tables of random numbers or computer programs. Laboratory air voids will be determined from three laboratory compacted specimens of each sublot sample in accordance with ASTM D 1559. The specimens will be compacted within 2 hours of the time the mixture was loaded into trucks at the asphalt plant. Samples will not be reheated prior to compaction and insulated containers will be used as necessary to maintain the temperature.

3.11.3 Additional Sampling and Testing

The Contracting Officer reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. The cost of any additional testing will be paid for by the Government. Testing in these areas will be in addition to the lot testing, and the requirements for these areas will be the same as those for a lot.

3.11.4 Laboratory Air Voids

Laboratory air voids will be calculated by determining the Marshall density of each lab compacted specimen using ASTM D 2726 and determining the theoretical maximum density of every other sublot sample using ASTM D 2041. Laboratory air void calculations for each sublot will use the latest theoretical maximum density values obtained, either for that

sublot or the previous sublot. The mean absolute deviation of the four laboratory air void contents (one from each sublot) from the JMF air void content will be evaluated and a pay factor determined from Table 6. All laboratory air void tests will be completed and reported within 24 hours after completion of construction of each lot.

3.11.5 Mean Absolute Deviation

An example of the computation of mean absolute deviation for laboratory air voids is as follows: Assume that the laboratory air voids are determined from 4 random samples of a lot (where 3 specimens were compacted from each sample). The average laboratory air voids for each sublot sample are determined to be 3.5, 3.0, 4.0, and 3.7. Assume that the target air voids from the JMF is 4.0. The mean absolute deviation is then:

Mean Absolute Deviation = (|3.5 - 4.0| + |3.0 - 4.0| + |4.0 - 4.0| + |3.7 - 4.0|/4

= (0.5 + 1.0 + 0.0 + 0.3)/4 = (1.8)/4 = 0.45

The mean absolute deviation for laboratory air voids is determined to be 0.45. It can be seen from Table 6 that the lot's pay factor based on laboratory air voids, is 100 percent.

Table 6. Pay Factor Based on Laboratory Air Voids

Mean Absolute Deviation of Lab Air Voids from JMF	Pay Factor, %
0.60 or less	100
0.61 - 0.80	98
0.81 - 1.00	95
1.01 - 1.20	90
Above 1.20	reject (0)

3.11.6 In-place Density

3.11.6.1 General Density Requirements

For determining in-place density, one random core will be taken by the Government from the mat (interior of the lane) of each sublot, and one random core will be taken from the joint (immediately over joint) of each sublot. Each random core will be full thickness of the layer being placed. When the random core is less than 1 inch thick, it will not be included in the analysis. In this case, another random core will be taken. After air drying to a constant weight, cores obtained from the mat and from the joints will be used for in-place density determination.

3.11.6.2 Mat and Joint Densities

The average in-place mat and joint densities are expressed as a percentage of the average Marshall density for the lot. The Marshall density for each lot will be determined as the average Marshall density of the four random samples (3 specimens compacted per sample). The average in-place mat density and joint density for a lot are determined and compared with Table 7 to calculate a single pay factor per lot based on in-place density, as described below. First, a pay factor for both mat density and joint density are determined from Table 7. The area associated with the

joint is then determined and will be considered to be 10 feet wide times the length of completed longitudinal construction joint in the lot. This area will not exceed the total lot size. The length of joint to be considered will be that length where a new lane has been placed against an adjacent lane of hot-mix asphalt pavement, either an adjacent freshly paved lane or one paved at any time previously. The area associated with the joint is expressed as a percentage of the total lot area. A weighted pay factor for the joint is determined based on this percentage (see example below). The pay factor for mat density and the weighted pay factor for joint density is compared and the lowest selected. This selected pay factor is the pay factor based on density for the lot. When the Marshall density on both sides of a longitudinal joint is different, the average of these two densities will be used as the Marshall density needed to calculate the percent joint density. All density results for a lot will be completed and reported within 24 hours after the construction of that lot.

Table 7. Pay Factor Based on In-place Density

Average Mat Density (4 Cores)	Pay Factor, %	Average Joint Density (4 Cores)
97.9 or 100	100.0	96.4 or above
97.8 or 100.1	99.9	96.3
97.7	99.8	96.2
97.6 or100.2	99.6	96.1
97.5	99.4	96.0
97.4 or 100.3	99.1	95.9
97.3	98.7	95.8
97.2 or 100.4	98.3	95.7
97.1	97.8	95.6
97.0 or 100.5	97.3	95.5
96.9	96.3	95.4
96.8 or 100.6	94.1	95.3
96.7	92.2	95.2
96.6 or 100.7	90.3	95.1
96.5	87.9	95.0
96.4 or 100.8	85.7	94.9
96.3	83.3	94.8
96.2 or 100.9	80.6	94.7
96.1	78.0	94.6
96.0 or 101.0	75.0	94.5
below 96.0or above 101.0	0.0 (reject)	below 94.5

3.11.6.3 Pay Factor Based on In-place Density

An example of the computation of a pay factor (in I-P units only) based on in-place density, is as follows: Assume the following test results for field density made on the lot: (1) Average mat density = 97.2 percent (of lab density). (2) Average joint density = 95.5 percent (of lab density). (3) Total area of lot = 30,000 square feet. (4) Length of completed longitudinal construction joint = 2000 feet.

a. Step 1: Determine pay factor based on mat density and on joint density, using Table 8:

Mat density of 97.2 percent = 98.3 pay factor.

Joint density of 95.5 percent = 97.3 pay factor.

b. Step 2: Determine ratio of joint area (length of longitudinal joint x 10 ft) to mat area (total paved area in the lot): Multiply the length of completed longitudinal construction joint by the specified 10 ft. width and divide by the mat area (total paved area in the lot).

(2000 ft. x 10 ft.)/30000 sq.ft. = 0.6667 ratio of joint area to mat area (ratio).

c. Step 3: Weighted pay factor (wpf) for joint is determined as indicated below:

wpf = joint pay factor + (100 - joint pay factor) (1 - ratio)
wpf = 97.3 + (100-97.3) (1-.6667) = 98.2%

d. Step 4: Compare weighted pay factor for joint density to pay factor for mat density and select the smaller:

Pay factor for mat density: 98.3%. Weighted pay factor for joint density: 98.2%

Select the smaller of the two values as pay factor based on density: 98.2%

3.11.7 Grade

The final wearing surface of pavement shall conform to the elevations and cross sections shown and shall vary not more than 0.05 foot from the plan grade established and approved at site of work. Finished surfaces at juncture with other pavements shall coincide with finished surfaces of abutting pavements. Deviation from the plan elevation will not be permitted in areas of pavements where closer conformance with planned elevation is required for the proper functioning of drainage and other appurtenant structures involved. The final wearing surface of the pavement will be tested for conformance with specified plan grade requirements. The grade will be determined by running lines of levels at intervals of 25 feet, or less, longitudinally and transversely, to determine the elevation of the completed pavement surface. Within 5 working days, after the completion of a particular lot incorporating the final wearing surface, the Contracting Officer will inform the Contractor in writing, of the results of the grade-conformance tests. When more than 5 percent of all measurements made within a lot are outside the 0.05 foot tolerance, the pay factor based on grade for that lot will be 95 percent. In areas where the grade exceeds the tolerance by more than 50 percent, the Contractor shall remove the surface lift full depth; the Contractor shall then replace the lift with hot-mix asphalt to meet specification requirements, at no additional cost to the Government. Diamond grinding may be used to remove high spots to meet grade requirements. Skin patching for correcting low areas or planing or milling for correcting high areas will not be permitted.

3.11.8 Surface Smoothness

The Contractor shall use [one] [both] of the following methods to test and evaluate surface smoothness of the pavement. All testing shall be performed in the presence of the Contracting Officer. Detailed notes of

the results of the testing shall be kept and a copy furnished to the Government immediately after each day's testing. The profilograph method shall be used for all longitudinal and transverse testing, except where the runs would be less than 200 feet in length and the ends where the straightedge shall be used. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), the surface shall be finished to meet the approval of the Contracting Officer.

3.11.8.1 Smoothness Requirements

a. Straightedge Testing: The finished surfaces of the pavements shall have no abrupt change of 1/4 inch or more, and all pavements shall be within the tolerances specified in Table 8 when checked with an approved 12 foot straightedge.

Table 8. Straightedge Surface Smoothness--Pavements

Pavement Category	Direction of Testing	Tolerance, inches
All paved areas	Longitudinal	1/4
	Transverse	1/4

b. Profilograph Testing: The finished surfaces of the pavements shall have no abrupt change of 1/8 inch or more, and all pavement shall have a Profile Index not greater than specified in Table 9 when tested with an approved California-type profilograph. If the extent of the pavement in either direction is less than 200 feet, that direction shall be tested by the straightedge method and shall meet requirements specified above.

Table 9. Profilograph Surface Smoothness--Pavements

Pavement Category	Direction of Testing	Maximum Specified Profile Index (inch/mile)
All Paved Areas	Longitudinal	9

3.11.8.2 Testing Method

After the final rolling, but not later than 24 hours after placement, the surface of the pavement in each entire lot shall be tested by the Contractor in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. Separate testing of individual sublots is not required. If any pavement areas are ground, these areas shall be retested immediately after grinding. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines. The transverse lines shall be 25 feet or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane for lines less than 20 feet and at the third points for lanes 20 feet or greater. Other areas having obvious deviations shall also be tested. Longitudinal testing lines shall be continuous across all joints.

a. Straightedge Testing. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the

pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.

b. Profilograph Testing. Profilograph testing shall be performed using approved equipment and procedures described in CDT Test 526. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must-grind" bumps and the Profile Index for the pavement. The "blanking band" shall be 0.2 inches wide and the "bump template" shall span 1 inch with an offset of 0.4 inch. The profilograph shall be operated by an approved, factory-trained operator on the alignments specified above. A copy of the reduced tapes shall be furnished the Government at the end of each day's testing.

3.11.8.3 Payment Adjustment for Smoothness

a. Straightedge Testing. Location and deviation from straightedge for all measurements shall be recorded. When between 5.0 and 10.0 percent of all measurements made within a lot exceed the tolerance specified in paragraph Smoothness Requirements above, after any reduction of high spots or removal and replacement, the computed pay factor for that lot based on surface smoothness, will be 95 percent. When more than 10.0 percent of all measurements exceed the tolerance, the computed pay factor will be 90 percent. When between 15.0 and 20.0 percent of all measurements exceed the tolerance, the computed pay factor will be 75 percent. When 20.0 percent or more of the measurements exceed the tolerance, the lot shall be removed and replaced at no additional cost to the Government. Regardless of the above, any small individual area with surface deviation which exceeds the tolerance given above by more than 50 percent, shall be corrected by diamond grinding to meet the specification requirements above or shall be removed and replaced at no additional cost to the Government.

b. Profilograph Testing. Location and data from all profilograph measurements shall be recorded. When the Profile Index of a lot exceeds the tolerance specified in paragraph Smoothness Requirements above by 1.0 inch/mile, but less than 2.0 inches/mile, after any reduction of high spots or removal and replacement, the computed pay factor for that lot based on surface smoothness will be 95 percent. When the Profile Index exceeds the tolerance by 2.0 inches/mile, but less than 3.0 inches/mile, the computed pay factor will be 90 percent. When the Profile Index exceeds the tolerance by 3.0 inches/mile, but less than 4.0 inches/mile, the computed pay factor will be 75 percent. When the Profile Index exceeds the tolerance by 4.0 inches/mile or more, the lot shall be removed and replaced at no additional cost to the Government. Regardless of the above, any small individual area with surface deviation which exceeds the tolerance given above by more than 5.0 inches/mile or more, shall be corrected by grinding to meet the specification requirements above or shall be removed and replaced at no additional cost to the Government.

c. Bumps ("Must Grind" Areas). Any bumps ("must grind" areas) shown on the profilograph trace which exceed 0.4 inch in height shall be reduced by diamond grinding until they do not exceed 0.3 inch when retested. Such grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding. The following will not be permitted: (1) skin patching for correcting low areas, (2) planing or milling for correcting high areas. At the Contractor's option,

pavement areas, including ground areas, may be rechecked with the profilograph in order to record a lower Profile Index.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 33 - UTILITIES SECTION 33 40 00

STORM DRAINAGE UTILITIES

02/10

-- End of Section Table of Contents --

SECTION 33 40 00

STORM DRAINAGE UTILITIES
02/10

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 within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17	(2002; Errata 2003; Errata 2005, 17th Edition) Standard Specifications for Highway Bridges
AASHTO M 167M/M 167	(2009) Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
AASHTO M 190	(2004; R 2012) Standard Specification for Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTO M 219	(1992; R 2012) Standard Specification for Corrugated Aluminum Alloy Structural Plate for Field-Bolted Pipe, Pipe-Arches, and Arches
AASHTO M 243	(1996; R 2012) Standard Specification for Field-Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches
AASHTO M 294	(2013) Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 346	(2009) Specification for Cast-in-Place Concrete Pipe

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Eng Man	(2012) Manual for Railway Engineering

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A48/A48M	(2003; R 2012) Standard Specification for Gray Iron Castings
ASTM A536	(1984; R 2009) Standard Specification for Ductile Iron Castings
ASTM A716	(2008) Standard Specification for Ductile Iron Culvert Pipe
ASTM A74	(2013a) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A742/A742M	(2013) Standard Specification for Steel Sheet, Metallic Coated and Polymer Precoated for Corrugated Steel Pipe
ASTM A760/A760M	(2013) Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
ASTM A762/A762M	(2008) Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM A798/A798M	(2013) Standard Practice for Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
ASTM A807/A807M	(2013) Standard Practice for Installing Corrugated Steel Structural Plate Pipe for Sewers and Other Applications
ASTM A849	(2010) Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
ASTM A929/A929M	(2001; R 2013) Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
ASTM B26/B26M	(2012) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B745/B745M	(2012) Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
ASTM C1103	(2003; R 2009) Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C12	(2013a) Standard Practice for Installing Vitrified Clay Pipe Lines
ASTM C139	(2011) Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes

ASTM C14	(2011) Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C1433	(2014) Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
ASTM C231/C231M	(2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C270	(2012a) Standard Specification for Mortar for Unit Masonry
ASTM C32	(2013) Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C425	(2004; R 2013) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C443	(2011) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C444	(2003; R 2009) Perforated Concrete Pipe
ASTM C478	(2013) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C506	(2013a) Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C507	(2013) Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
ASTM C55	(2011) Concrete Brick
ASTM C564	(2012) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C62	(2013a) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C655	(2014) Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ASTM C700	(2013) Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C76	(2014) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

ASTM C828	(2011) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C877	(2008) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C923	(2008; R 2013) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C924	(2002; R 2009) Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C990	(2009) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1171	(1999; R 2007) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
ASTM D1557	(2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D1751	(2004; E 2013; R 2013) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2004a; R 2013) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D1784	(2011) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D2167	(2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2321	(2011) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2729	(2011) Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

ASTM D3034	(2008) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3212	(2007; R 2013) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3350	(2012) Polyethylene Plastics Pipe and Fittings Materials
ASTM D6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM F1417	(2011a) Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air
ASTM F2736	(2013) Standard Specification for 6 to 30 in. (152 To 762 mm) Polypropylene (PP) Corrugated Single Wall Pipe And Double Wall Pipe
ASTM F2764/F2764M	(2011; E 2013) Standard Specification for 30 to 60 in. [750 to 1500 mm] Polypropylene (PP) Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications
ASTM F2881	(2011) Standard Specification for 12 to 60 in. (300 to 1500 mm) Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications
ASTM F477	(2010) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F679	(2013a) Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F714	(2013) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F794	(2003; R 2009) Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F894	(2013) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F949	(2010) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Placing Pipe

Submit printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

SD-04 Samples

Pipe for Culverts and Storm Drains

SD-07 Certificates

Resin Certification
Pipeline Testing
Hydrostatic Test on Watertight Joints
Determination of Density
Frame and Cover for Gratings

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Contracting Officer.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe

Manufactured in accordance with and conforming to ASTM C76, Class V.

2.1.2 Corrugated Steel Pipe

ASTM A760/A760M, zinc or aluminum (Type 2) coated pipe of:

a. Type I pipe with helical 2-2/3 by 1/2 inch corrugations.

2.2 DRAINAGE STRUCTURES

2.2.1 Flared End Sections

Sections shall be of a standard design fabricated from zinc coated steel sheets meeting requirements of ASTM A929/A929M.

2.2.2 Precast Reinforced Concrete Box

Manufactured in accordance with and conforming to ASTM C1433.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 2500 psi concrete under Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Air content shall be determined in accordance with ASTM C231/C231M. The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring unless otherwise specified. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D1751, or ASTM D1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D1752.

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, shall conform to ASTM C270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. Water shall be clean and free of harmful acids, alkalis, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.3 Frame and Cover for Gratings

Submit certification on the ability of frame and cover or gratings to carry the imposed live load. Frame and cover for gratings shall be cast gray iron, ASTM A48/A48M, Class 35B; cast ductile iron, ASTM A536, Grade 65-45-12; or cast aluminum, ASTM B26/B26M, Alloy 356.OT6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans. The word "Storm Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.3.4 Joints

2.3.4.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for preformed flexible joint sealants shall conform to ASTM C990, and rubber-type gaskets shall conform to ASTM C443. Factory-fabricated resilient joint materials shall conform to ASTM C425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.

b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C443. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.4.2 External Sealing Bands

Requirements for external sealing bands shall conform to ASTM C877.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 31 00 00 EARTHWORK and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 24 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified, without any overexcavation. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Rock

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 8 inches or 1/2 inch for each foot of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe. Rock excavation shall be as specified and defined in Section 31 00 00 EARTHWORK.

3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in granular material minimum 6 inch in depth in trenches with soil foundation. Depth of granular bedding in trenches with rock foundation shall be 1/2 inch in depth per foot of depth of fill, minimum depth of bedding shall be 8 inch up to maximum depth of 24 inches. The middle third of the granular bedding shall be loosely placed. Bell holes and depressions for joints shall be removed and formed so entire barrel of pipe is uniformly supported. The bell hole and depressions for the joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.2.2 Corrugated Metal Pipe

Bedding for corrugated metal pipe and pipe arch shall be in accordance with ASTM A798/A798M. It is not required to shape the bedding to the pipe geometry. However, for pipe arches, either shape the bedding to the relatively flat bottom arc or fine grade the foundation to a shallow v-shape. Bedding for corrugated structural plate pipe shall meet requirements of ASTM A807/A807M.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary.

3.3.1 Concrete, Clay, PVC, Ribbed PVC, Ductile Iron and Cast-Iron Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.3.2 Corrugated Metal Pipe and Pipe Arch

Laying shall be with the separate sections joined firmly together, with the outside laps of circumferential joints pointing upstream, and with longitudinal laps on the sides. Part paved pipe shall be installed so that the centerline of bituminous pavement in the pipe, indicated by suitable markings on the top at each end of the pipe sections, coincides with the specified alignment of pipe. Fully paved steel pipe or pipe arch shall have a painted or otherwise applied label inside the pipe or pipe arch indicating sheet thickness of pipe or pipe arch. Any unprotected metal in the joints shall be coated with bituminous material as specified in AASHTO M 190 or AASHTO M 243. Interior coating shall be protected against damage from insertion or removal of struts or tie wires. Lifting lugs shall be used to facilitate moving pipe without damage to exterior or interior coatings. During transportation and installation, pipe or pipe arch and coupling bands shall be handled with care to preclude damage to the coating, paving or lining. Damaged coatings, pavings and linings shall be repaired in accordance with the manufacturer's recommendations prior to placing backfill. Pipe on which coating, paving or lining has been damaged to such an extent that satisfactory field repairs cannot be made shall be removed and replaced. Vertical elongation, where indicated, shall be accomplished by factory elongation. Suitable markings or properly placed lifting lugs shall be provided to ensure placement of factory elongated pipe in a vertical plane.

3.3.3 Multiple Culverts

Where multiple lines of pipe are installed, adjacent sides of pipe shall be at least half the nominal pipe diameter or 3 feet apart, whichever is less.

3.3.4 Jacking Pipe Through Fills

Methods of operation and installation for jacking pipe through fills shall conform to requirements specified in Volume 1, Chapter 1, Part 4 of AREMA Eng Man.

3.4 JOINTING

3.4.1 Concrete and Clay Pipe

3.4.1.1 Cement-Mortar Bell-and-Spigot Joint

The first pipe shall be bedded to the established grade line, with the bell end placed upstream. The interior surface of the bell shall be thoroughly cleaned with a wet brush and the lower portion of the bell filled with mortar as required to bring inner surfaces of abutting pipes flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into a bell so that sections are closely fitted. After each section is laid, the remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with sufficient additional mortar. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped or bandaged with cheesecloth to hold mortar in place.

3.4.1.2 Cement-Mortar Oakum Joint for Bell-and-Spigot Pipe

A closely twisted gasket shall be made of jute or oakum of the diameter required to support the spigot end of the pipe at the proper grade and to make the joint concentric. Joint packing shall be in one piece of sufficient length to pass around the pipe and lap at top. This gasket shall be thoroughly saturated with neat cement grout. The bell of the pipe shall be thoroughly cleaned with a wet brush, and the gasket shall be laid in the bell for the lower third of the circumference and covered with mortar. The spigot of the pipe shall be thoroughly cleaned with a wet brush, inserted in the bell, and carefully driven home. A small amount of mortar shall be inserted in the annular space for the upper two-thirds of the circumference. The gasket shall be lapped at the top of the pipe and driven home in the annular space with a caulking tool. The remainder of the annular space shall be filled completely with mortar and beveled at an angle of approximately 45 degrees with the outside of the bell. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint thus made shall be wrapped with cheesecloth. Placing of this type of joint shall be kept at least five joints behind laying operations.

3.4.1.3 Cement-Mortar Diaper Joint for Bell-and-Spigot Pipe

The pipe shall be centered so that the annular space is uniform. The annular space shall be caulked with jute or oakum. Before caulking, the inside of the bell and the outside of the spigot shall be cleaned.

a. Diaper Bands: Diaper bands shall consist of heavy cloth fabric to hold grout in place at joints and shall be cut in lengths that extend one-eighth of the circumference of pipe above the spring line on one side of the pipe and up to the spring line on the other side of the pipe. Longitudinal edges of fabric bands shall be rolled and stitched around two pieces of wire. Width of fabric bands shall be such that after fabric has been securely stitched around both edges on wires, the wires will be uniformly spaced not less than 8 inches apart. Wires shall be cut into lengths to pass around pipe with sufficient extra length for the ends to be twisted at top of pipe to hold the band securely in place; bands shall be accurately centered around lower portion of joint.

b. Grout: Grout shall be poured between band and pipe from the high side of band only, until grout rises to the top of band at the spring line of pipe, or as nearly so as possible, on the opposite side of pipe, to ensure a thorough sealing of joint around the portion of pipe covered by the band. Silt, slush, water, or polluted mortar grout forced up on the lower side shall be forced out by pouring, and removed.

c. Remainder of Joint: The remaining unfilled upper portion of the joint shall be filled with mortar and a bead formed around the outside of this upper portion of the joint with a sufficient amount of additional mortar. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind actual laying of pipe. No backfilling around joints shall be done until joints have been fully inspected and approved.

3.4.1.4 Cement-Mortar Tongue-and-Groove Joint

The first pipe shall be bedded carefully to the established grade line with the groove upstream. A shallow excavation shall be made underneath the pipe at the joint and filled with mortar to provide a bed for the pipe. The grooved end of the first pipe shall be thoroughly cleaned with a wet brush, and a layer of soft mortar applied to the lower half of the groove. The tongue of the second pipe shall be cleaned with a wet brush; while in horizontal position, a layer of soft mortar shall be applied to the upper half of the tongue. The tongue end of the second pipe shall be inserted in the grooved end of the first pipe until mortar is squeezed out on interior and exterior surfaces. Sufficient mortar shall be used to fill the joint completely and to form a bead on the outside.

3.4.1.5 Cement-Mortar Diaper Joint for Tongue-and-Groove Pipe

The joint shall be of the type described for cement-mortar tongue-and-groove joint in this paragraph, except that the shallow excavation directly beneath the joint shall not be filled with mortar until after a gauze or cheesecloth band dipped in cement mortar has been wrapped around the outside of the joint. The cement-mortar bead at the joint shall be at least 1/2 inch, thick and the width of the diaper band shall be at least 8 inches. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind the actual laying of the pipe. Backfilling around the joints shall not be done until the joints have been fully inspected and approved.

3.4.1.6 Plastic Sealing Compound Joints for Tongue-and-Grooved Pipe

Sealing compounds shall follow the recommendation of the particular manufacturer in regard to special installation requirements. Surfaces to receive lubricants, primers, or adhesives shall be dry and clean. Sealing compounds shall be affixed to the pipe not more than 3 hours prior to installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Sealing compounds shall be inspected before installation of the pipe, and any loose or improperly affixed sealing compound shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while making the joint with mastic-type sealant, a slight protrusion of the material is not visible along the entire inner and outer circumference of the joint when the joint is pulled up, the pipe shall be removed and the joint remade. After the joint is made, all inner protrusions shall be cut off flush with the inner surface of the pipe. If non-mastic-type sealant material is used, the "Squeeze-Out" requirement above will be waived.

3.4.1.7 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed

home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.4.1.8 External Sealing Band Joint for Noncircular Pipe

Surfaces to receive sealing bands shall be dry and clean. Bands shall be installed in accordance with manufacturer's recommendations.

3.5 BACKFILLING

3.5.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded and initial backfilled, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed 12" max layers Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached finish grade or subgrade of road structural section. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.5.2 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.5.3 Compaction

3.5.3.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.5.3.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

a. Under airfield and heliport pavements, paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.5.4 Determination of Density

Testing is the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D2167 or ASTM D6938. When ASTM D6938 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D6938 results in a wet unit weight of soil and ASTM D6938 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D6938. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.6 PIPELINE TESTING

3.6.1 Post-Installation Inspection

One hundred percent of all reinforced concrete pipe installations shall be checked for joint separations, soil migration through the joint, cracks greater than 0.01 inches, settlement and alignment.

a. Replace pipes having cracks greater than 0.1 inches in width or deflection greater than 5 percent deflection. An engineer shall evaluate all pipes with cracks greater than 0.01 inches but less than 0.10 inches to determine if any remediation or repair is required. RCP with crack width less than 0.10 inches and located in a non-corrosive environment (pH 5.5) are generally acceptable. Repair or replace any pipe with crack exhibiting displacement across the crack, exhibiting bulges, creases, tears, spalls, or delamination.

b. Reports: The deflection results and finial post installation inspection report shall include: a copy of all video taken, pipe location identification, equipment used for inspection, inspector name, deviation from design, grade, deviation from line, inspector notes, condition of joints, condition of pipe wall (e.g. distress, cracking, wall damage dents, bulges, creases, tears, holes, etc.).

-- End of Section --

SECTION TABLE OF CONTENTS

SECTION 35 31 19

STONE PROTECTION
08/14

-- End of Section Table of Contents --

SECTION 35 31 19

STONE PROTECTION
01/08

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 within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 33/33M	(2007) Standard Test Method for Concrete Aggregates
ASTM E 548	General Criteria Used for Evaluating Laboratory Competence
ASTM C 127	(2007) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 295	(2008) Petrographic Examination of Aggregates for Concrete
ASTM C 535	(2003e1) Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 88	(1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM D 5519	(2007) Particle Size Analysis of Natural and Man-Made Riprap Materials
ASTM D 5313	(2013) Standard Test Method for Evaluation of Durability of Rock for Erosion Control Under Wetting and Drying Conditions
ASTM D 1141	(2013) Standard Practice for the Preparation of Substitute Ocean Water
ASTM C 131	(2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM D 5313	(2013) Standard Test Method for Evaluation of Durability of Rock for Erosion Control Under Wetting and Drying Conditions

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Stone Sources; G

Name and location of quarry and service history of stone from the quarry as applicable to paragraph: Source Authorization Criteria.

SD-05 Design Data

Method of placement; G

SD-0 The following test reports shall be submitted in accordance with SECTION: 01330 SUBMITTAL PROCEDURES.

Stone Quality Testing; G
Gradation Sampling and Testing; G

Quality compliance and gradation test results performed in accordance with paragraph: Stone Quality 2.1.4 and paragraph: Gradation 2.1.5.

SD-07 Certificates

Waybills and Delivery Tickets

Copies of waybills and delivery tickets shall be submitted as stated in paragraph: Waybills and Delivery Tickets.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Definitions

2.1.1.1 Rounded Stone

Stone which is obtained from alluvial deposits and is nearly spherical and well rounded. Stone of this type is typically processed from river beds and/or alluvial river derived material.

2.1.1.2 Angular Stone

Stone which is obtained from bedrock deposits and is angular in shape. Stone of this type is typically quarried from bedrock deposits.

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 Stone Sources

2.1.3.1 Stone from Project Excavation

Stone conforming to these specifications for riprap will not all be available from the required excavation(s). The required riprap will need to be obtained from off-site sources. Non weathered cobbles or boulders occasionally encountered from required excavations may be used on this project, provided that it is angular and conforms to all requirements of this Stone Protection Specification, to include Stone Quality and Source Authorization Criteria herein of this specification. If Project Excavation Stone is used, the Contractor shall perform a minimum of two tests for stone quality on the Project Excavation Stone.

2.1.3.2 Salvaged Stone

Salvaged Stone resulting from removal operations and excavations may be used on this project, but must conform to all requirements of this Stone Protection specification, to include Stone Quality and Source Authorization Criteria as specified herein and provided that it is angular. If salvage stone is used, the Contractor shall perform a minimum of two tests for stone quality on the Salvaged Stone.

2.1.3.3 Stone Source Authorization

Before any stone is produced from any source for completion of the work under this contract, the source of stone must be submitted for approval and authorized by the Contracting Officer's Representative. The Contractor shall designate in writing the stone source from which he proposes to furnish stone. A stone source may be one or a combination of the following types of sources of stone: a. Off-site stone source listed within the specifications herein. b. Off-site stone source proposed by the Contractor and not listed within the specifications herein. c. Salvaged Stone source. d. Stone source from the project excavation. 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, intervals, or strata will be rejected, when such materials do not comply with the specifications. Before a proposed source or sources of stone will be considered for evaluation and approval, the Contractor must demonstrate that the source is capable of providing the quality, quantities and gradation needed and at the rate needed to maintain the scheduled progress of the work. 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.

2.1.3.4 Source Authorization Criteria

Authorization of a proposed stone source will be based on test results, a quarry or stone source inspection, and/or service records. A minimum of two stone quality test results per source will be required, as outlined in paragraph: Quality Compliance Sampling and Testing, below. The Contracting Officer's Representative will use past Corps of Engineers test results as the primary criteria to authorize the source when based on test results. The Contracting Officer's Representative will use test results from other agencies or private laboratories, and or service records as the secondary criteria to authorize a source. 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 and in a similar weathering environment as the one to be constructed under these specifications. The Contracting Officer's Representative will make the final decision on the source of stone authorization, based primarily on the quarry/stone source inspection, Corps of Engineers test results and the Corps of Engineer's Geologist's inspection.

2.1.3.5 Quarry Inspection

The proposed quarry source shall be inspected prior to source authorization. The quarry inspection shall be performed by the Contracing Officer's Representative, a representative of the Contractor, a representative of the quarry, and a geologist from the Geotechnical Branch of the Los Angeles District.

2.1.3.6 Potential Off-site Stone Sources

On the basis of information and data available to the Government, the following off-site sources located near the project have in the past produced stone meeting the quality requirements of these specifications:

Quarry Name	Nearest City
3M	Corona
Black Mountain	Victorville
Oro Grande/ Sparkhule Hill	Victorville

Listing of a stone source is not to be construed as to 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 listed off-site source or any source for the matter, must meet all the requirements 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 or size of stone required for the project. Stone may be furnished from other sources designated by the Contractor and authorized by the Contracting Officer's Representative, subject to the conditions stated herein.

2.1.4 Stone Quality

2.1.4.1 Quality Compliance Sampling and Testing

The Contractor shall have a minimum of two stone quality evaluation tests performed on stone samples collected from each of the proposed sources. These tests shall be run as two separate full suites of quality tests as specified herein. Samples of stone from a proposed source shall be taken at the quarry and selected by the Corps of Engineers Geologist. The Contracting Officer's Representative, the Superintendent of the quarry and

the Contractor must be present during the sample collection. The two stone samples shall consist of at least 300 pounds each of representative stone from the proposed stone source. The quarry/stone source faces and the stockpiles to be used shall be examined and sampled. The inspection shall occur and samples shall be taken, a minimum of 90 days in advance of the time, when the stone will be required in the work. The Contractor will then ship the samples at the Contractor's expense to a laboratory which is a Corps of Engineers validated laboratory or one that has been approved by the Contracting Officer's Representative. The tests to which the stone shall be subjected and the required results are discussed below. The results of the Stone Quality Tests shall be submitted for review to the Contracting Officer's Representative a minimum of 90 days in advance of the time when the stone will be required in the work.

2.1.4.2 Stone Quality Testing Requirements

Stone shall be subjected to such tests as are necessary to demonstrate to the satisfaction of the Contracting Officer's Representative that the materials are acceptable for use in the work. At a minimum, the stone shall meet the following full suite of test requirements:

Test	Test Method	Requirement
Petrographic Analysis	ASTM C 295 (4 and 5)	Good quality and acceptable for use as stone protection
Wetting and Drying	ASTM D 5313(1 and 5)	No fracturing (2)
Specific Gravity (Bulk SSD)	ASTM C 127 (5)	2.65 minimum
Absorption	ASTM C 127 (5)	2.0% maximum
Magnesum Sulfate Soundness	ASTM C 88 (2 and 5)	10% max loss (3)
Abrasion Loss	ASTM C 535 (5)	20% max loss after 500 revolutions

All stone samples ran for Specfic Gravity, Absorption, Magnesium Sulfate Soundness and Abrasion shall be collected as a composite sample with a size range graded from approximately 3 to 4 inches diameter and shall have a combined total weight of approximately 150 pounds, in lieu of the size gradation and weights given in the ASTMS C 535, C 88 and C 127. In addition to the above tests, the stone shall be subjected to a petrographic and X-ray diffraction analysis, in accordance with ASTM C 295 (5). The stone must not contain any expansive clays. Stone for grouted stone shall not contain excessive amounts of deleterious minerals, associated with alkali-silica or alkali-carbonate reactions, as described in ASTM C 33/33M.

NOTE: (1): Test procedure for wetting and drying test. The Contractor shall perform this test using all procedures according to ASTM D 5313, but the following specific procedures for wetting and drying testing must be performed: The entire sample is carefully examined and four representative test specimen slabs are selected and produced. The specimen slabs should be large enough to produce three separate cut slabs, each a minimum of 2-1/4 inches thick, with a minimum total surface area of 25 square inches on the slab side. In no case will the slab be less than 5 inches length per side. The test specimens are color photographed, to show all surface features, before the slabs are produced.

Right after the slabs are produced and prior to running the first cycle,

the slabs are again photographed to show all surface features and then they are carefully examined under a low-power microscope of at least 20X magnification, and all visible surface features are noted and recorded. *A length scale is included and shown in all color photographs of slabs.* The slabs are then subjected to a maximum of **thirty cycles** of wetting and drying. Two of the four slabs are each soaked in fresh tap water with 0.5 percent ethyl alcohol added by mass; the other two out of four slabs are soaked in salt water, prepared in accordance with ASTM D 1141. After every four cycles, the specimens are again color photographed, then examined with the low-power microscope, to check for openings or movement of fractures, disintegration, spalling, splitting, 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 or worsens is recorded. After **thirty** cycles (end of the test), 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 broken-off during the test, are oven-dried, weighed, and photographed. **The test may be terminated prior to the completion of thirty cycles, if the mass of the largest remaining fragment of the slab amounts to less than half of the mass of the original slab specimen.**

NOTE: (2): 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: (3): 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 as defined in paragraph: Source Authorization Criteria.

NOTE: (4): The test procedure for Petrographic and X-ray Diffraction is performed according to ASTM C 295, except for the following:

(a) A color, microscopic photograph shall be made of each stone type, and the individual minerals within the stone shall be identified by labels and arrows, upon the photograph.

(b) A very detailed macroscopic and microscopic description shall be made of the stone, to include all the mineral constituents, individual sizes, their approximate percentages, and mineralogical histories. A description of stone hardness, texture, weathering, and durability factors shall also be discussed.

(c) A written summary of the suitability of stone for use as stone protection, based on the Petrographic and X-ray tests and the results of ASTM C 535, shall be presented in the final laboratory report on stone quality.

NOTE: (5): A minimum of a set of two color photographs shall be taken for every stone quality test. One of the two photos shall be taken prior to commencement of any of the tests and the other shall be taken after the completion of any of the tests. A suitable *length scale* shall be included in each color photograph taken. The photos shall also be labeled "prior to testing" and "after testing" and shall show the name of the test and the name of the sample.

2.1.4.3 Stone Acceptance Criteria

Prior to placement, all stone shall be subject to acceptance, by the

Contracting Officer's Representative. 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, hard, and free of laminations, weak cleavages, undesirable weathering, or blasting or handling-induced fractures which subtend more than 1/3 of the total circumference of the stone along the plane of fracturing and which would tend to increase its deterioration from natural causes;

c. of such character that the stone will not disintegrate from the action of air, water, or the conditions of handling and placing;

d. clean and free from earth, clay, refuse, or adherent coatings.

e. Ungrouted Stone: Ungrouted stone shall be angular quarried material, 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. Stone for Grouted Stone: Stone for grouted stone protection may be either rounded stone or angular quarried material, with a shape which assures reasonable adhesion with cement grout, yet allows flow of grout throughout the layer, to ensure adequate bonding. The greatest dimension of each piece shall be not greater than 3 times the least dimension.

g. Bedding Material or Gravel Blanket: Bedding material or gravel blanket obtained from an authorized source shall meet all the requirements specified herein, but shall have a percentage of wear not to exceed 45 percent, when tested in accordance with ASTM C 131.

2.1.5 Gradation

2.1.5.1 General

Quality-Control gradation tests shall be conducted by the Contractor and all stone shall be within the specified gradations below. If the stone is delivered by the truckload, each truckload shall be representative of the gradation requirements. All points on individual grading curves shall be between the boundary limits, as defined by smooth curves, drawn through specified grading limits and 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. One gradation test for each stone size from each designated stone source is required for initial acceptance of the stone source. Subsequent gradation tests will be performed on a frequency determined according to the total estimated quantity of stone. If test results show that stone does
not meet the required grading, the hauling and placement operations will be stopped immediately and will not resume, until processing procedures are adjusted, and a passing gradation test is completed, showing that gradation requirements are met. All gradation tests shall be at the expense of the

Contractor.

a. Riprap for Ungrouted Stone and Grouted Stone: Stone for ungrouted and grouted stone shall be quarried, non weathered angular stone, reasonably well-graded, within the limits specified below, when tested in accordance with ASTM D 5519, Test Method A.

36 Inch Stone Gradation

Size of Individual Pieces	Percent Smaller (by weight)
36 inch	100
30 inch	50-90
24 inch	30-50
19 inch	0-15
15 inch	0-5

24 Inch Riprap Gradation

Size of Individual Pieces	Percent Smaller (by weight)
24 inch	100
15 inch	50-90
12 inch	0-40
9 inch	0

18 Inch Riprap Gradation

Size of Individual Pieces	Percent Smaller (by weight)
18 inch	100
15 inch	60-90
12 inch	15-45
9 inch	0-15
9 inch	0-5

12 Inch Riprap Gradation

Size of Individual Pieces	Percent Smaller (by weight)
12 inch	100
9 inch	60-90
5 inch	0-15
3/4 inch	0-5

b. Bedding Stone: Bedding material shall be reasonably well-graded within the limits specified below, when tested in accordance with ASTM C 136.

6 inch minus bedding stone

Sieve Size	Smaller (by weight)
6 inch	100
3 inch	45-90
1-1/2 inch	0-20

3 inch minus bedding stone (for 12” and smaller riprap)

Sieve Size	Smaller (by weight)
3 inch	100
1-1/2 inch	35-75
3/8 inch	0-15

2.1.5.2 Gradation Sampling and Testing

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Tests shall be performed by an approved testing laboratory, on samples selected in the presence of the Contracting Officer's Representative. Testing may be performed by the Contractor, subject to approval by the Contracting Officer's Representative. Testing shall be supervised by a registered Civil Engineer, experienced in rock gradation testing. 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 for each stone size 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 stone class placed as follows: one each for every 5,000 tons of 36 inch stone; one each for every 10,000 tons of 18 inch riprap; one each for every 4,000 tons of 24 inch riprap; one each for every 5,000 tons of 12 inch riprap; and one for every 2,500 tons of bedding stone placed. Each sample shall be selected at random from the production run for the first test. Each sample shall be selected from stone placed on grade or stockpiled on-site for all additional tests. All sampling and gradation tests performed by the Contractor shall be in the presence of the Contracting Officer's Representative. The minimum sample sizes for each test shall be as follows:

Stone Class	Minimum Sample Weight
36 inch stone protection	30 tons
24 inch stone protection	25 tons
18 inch stone protection	20 tons
12 inch stone protection	15 tons
Bedding stone protection	2,000 pounds

2.1.6 Rejected Stone

Stone of unsuitable quality and/or size distribution, as required by these specifications, shall be rejected. Any rejected stone 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.

PART 3 EXECUTION

3.1 FOUNDATION PREPARATION

3.1.1 General

Subgrade preparation for material placement shall conform to the provisions of SECTION EARTHWORK. 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 1 inch 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. Immediately prior to placing the stone, the prepared base shall be inspected by the Contracting Officer's Representative, and no material shall be placed thereon, until that area has been approved.

3.2 PLACEMENT

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 overbuilding. Templates shall be placed at adequate intervals, as determined by the Contracting Officer's Representative, to accurately delineate the surface of the work being placed. For all stonework, the Contractor shall submit the method of placement to the Contracting Officer's Representative for approval, before placement begins.

3.2.2 Bedding Material

Bedding material shall be spread uniformly on the prepared base, in a satisfactory manner, to the neat lines indicated or directed. Placing of material by methods which will tend to segregate particle sizes will not be permitted. Material shall not be dropped from a height of more than 18 inches. Any damage to the prepared surface of the base, during placement of the material shall be repaired, before proceeding with the work. Compaction of the material will not be required, but it shall be finished, to present a reasonably even surface, free from mounds or windrows. A tolerance of plus or minus 1 inch from the slope-lines and grades, when measured with a 10-foot straight edge, will be allowed in each finished course, except that either extreme of such tolerance shall not be continuous over an area greater than 200 square feet.

3.2.3 Grouted and Ungrouted Stone Protection

Grouted and ungrouted stone protection 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, from the bottom of the slope or lowest portion requiring placement, to the top of the slope and in a manner to avoid displacing the underlying material. Material shall not be dropped from a height of more than 18 inches. Method of placement shall be submitted to the Contracting Officer's Representative, for approval, prior to commencement of placement operations. The Contractor shall maintain the stone protection until accepted, and any material displaced by any cause, shall be replaced, at Contractor's expense, to the lines and grades shown on the drawings. Self-propelled equipment shall not be used over placed stone except in areas where compacted materials are required over grouted stone. In areas requiring compacted

fill over grouted stone, a minimum of 24 inches of material shall be placed and compacted with small equipment before self-propelled equipment is utilized. 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 permitted. A tolerance of minus 2 to plus 2 inches from the indicated slope-lines and grades will be allowed in the finished surface, except that either extreme of such tolerance shall not be continuous over an area greater than 200 square feet.

3.2.4 Grouted Stone

Stone for grouted stone shall be placed in such a manner to produce a reasonably well-graded mass and to ensure that all individual stones can be satisfactorily embedded in grout. Method of Placement shall be submitted to the Contracting Officer's Representative, for approval, 7 days prior to commencement of placement operations. 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 18 inches. The Contractor shall maintain the stone until accepted by the Contracting Officer's Representative, and any material displaced by any cause shall be replaced at the Contractor's expense, to the lines and grades indicated. Self-propelled equipment shall not be used over placed stone. 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 minus 2 to plus 2 inches, from the indicated slope-lines and grades will be allowed in the finished surface, except that either extreme of such tolerance shall not be continuous over an area greater than 200 square feet. Use of thin, flat stones will not be permitted.

3.3 DEMONSTRATION SECTION

3.3.1 General

Prior to placement of stone protection the Contractor shall construct sections, to demonstrate his proposed operations for production placement. The sections shall demonstrate procedure and capability of

grading and placing stone protection within the tolerances specified. Each demonstration section shall be 50 feet wide and a minimum of 30 feet high and extend to the full height of the slope, and shall conform to all applicable specifications.

3.3.1.1 Methods and Equipment

Methods and equipment employed for placement shall demonstrate the adequacy for use in placement of stone protection 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's Representative, for comparison with the computed quantities.

3.3.2 Demonstration Section Evaluation

The Contractor shall not proceed in placing stonework, prior to the approval of the demonstration section. Within a period of 7 days after completion of the section, the Contracting Officer's Representative shall determine the adequacy of the section to function as part of the permanent construction. The Contractor shall be notified as to the acceptability of the section and may be directed to modify methods of construction, and remove the section, if necessary.

3.3.3 Removal of Demonstration Section

If removal of the demonstration section is required, it shall be conducted in such a manner as to maintain the integrity of the underlying subgrade. The Contractor shall make his own arrangements for disposal in areas not located on the site.

3.4 DELIVERY

All stone delivered by truck shall be weighed, and the scale tickets shall be certified, by authorized weighers. All trucks used for delivering stone shall be plainly numbered.

3.4.1 Scales

Scales used for measurement shall, at the option of the Contractor, be either public scales or approved scales, provided by the Contractor. Weighing shall be at the point nearest the work at which the public scale is available or at which it is practicable for the Contractor to provide a scale. Scales shall be standard truck scales of the beam type. The scales shall be of sufficient size and capacity to accommodate all trucks used in hauling the material. Scales shall be tested, approved, and sealed by an inspector of the State Inspection Bureau, charged with scales inspection, within the state in which the project is located. Scales shall be calibrated and resealed as often as necessary, to insure continuous accuracy. The necessary number of standard weights for testing the scales shall be on hand at all times, and, if an official inspection bureau of the state is not available, the scales will be tested by the Contracting Officer's Representative.

3.4.2 Waybills and Delivery Tickets

Copies of waybills or delivery tickets shall be submitted to the Contracting Officer's Representative, during the progress of the work. The Contractor shall furnish the Contracting Officer's Representative scale

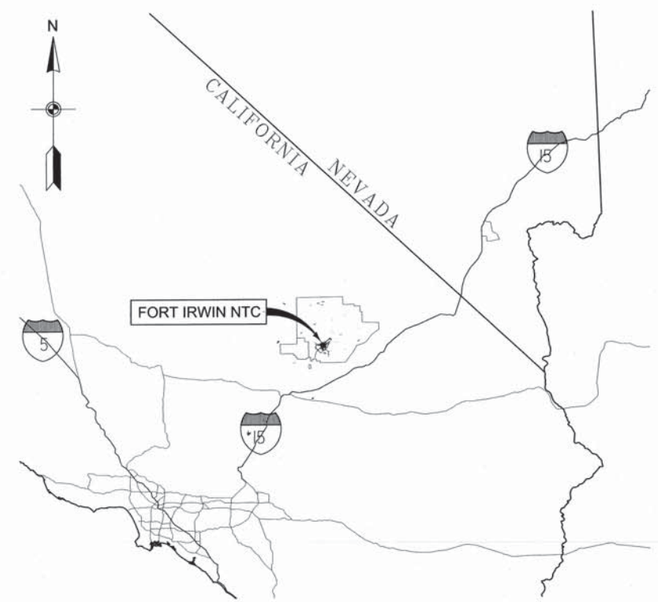
tickets for each load of material weighed; these tickets shall include tare weight, identification mark of each vehicle weighed, plus date, time, and location of the loading. Tickets shall be furnished at the point and time individual loads arrive at the work site. A master log of all vehicle loading shall be furnished for each day of loading operation. The Contractor shall file with the Contracting Officer's Representative the master log of loadings, certified waybills and/or certified tickets, within 24 hours of material delivery. Prior to the final payment, the Contractor shall furnish written certification that the material recorded on the submitted waybills and/or certified tickets was actually used in the construction covered by the contract.

-- End of Section --

POCA NO. W912PL-14-R-0089
SECTION 3, CIVIL REPAIR
FORT IRWIN NTC
SAN BERNARDINO COUNTY, CALIFORNIA

PROJECT LOCATION
SCALE: 1 IN. = 1200 FT.

1200 600 0 1200 2400
SCALE: 1" = 1200'



VICINITY MAP
SCALE: 1 IN. = 40 MI.

40 20 0 40 80
SCALE: 1 IN. = 40 MI.

SCHEDULE OF DRAWINGS

SHEET NO.	DESCRIPTION
T-1	COVER SHEET
T-2	GENERAL NOTES
C-1	AREA 14 - BRIDGE 9 & CHANNELS PLANS
C-2	AREA 14 - BRIDGE 9 & CHANNELS SECTIONS
C-3	AREA 41 - INNERLOOP CHANNEL PLAN & SECTIONS
C-4	AREA 45 - PLAN & SECTIONS
C-5	AREA 63 - ENERGY DISSIPATOR DETAILS
M-1	MISCELLANEOUS DETAILS - METAL BEAM GUARDRAIL LAYOUT
M-2	MISCELLANEOUS DETAILS - GUARDRAIL & DELINEATOR DETAILS
M-3	MISCELLANEOUS DETAILS - GUARDRAIL DETAILS
M-4	MISCELLANEOUS DETAILS - FENCING & TRENCHING DETAILS
SP-1	DESIGNATED STOCKPILE LOCATION

THIS PROJECT WAS DESIGNED BY THE LOS ANGELES DISTRICT OF THE U.S. ARMY CORPS OF ENGINEERS. THE INITIALS OR SIGNATURES AND REGISTRATION DESIGNATIONS OF INDIVIDUALS APPEAR ON THESE PROJECT DOCUMENTS WITHIN THE SCOPE OF THEIR EMPLOYMENT AS REQUIRED BY E.R. 1110-1-8152. SIGNATURES AFFIXED HEREON INDICATE OFFICIAL RECOMMENDATION AND APPROVAL OF ALL THE DRAWINGS IN THIS SET.

REVISIONS			
SYMBOL	DESCRIPTIONS	DATE	APPROVAL

FORT IRWIN NATIONAL TRAINING CENTER
STORM DAMAGE REPAIR
SAN BERNARDINO COUNTY, CALIFORNIA
SECTION 3, CIVIL REPAIR

COVER SHEET

PREPARED UNDER THE DIRECTION OF:
COL. KIMBERLY M. COLLOTON
DISTRICT ENGINEER

SUBMITTED BY:
CHIEF, DESIGN BRANCH

DESIGNED BY: XXX
DRAWN BY: XXX
CHECKED BY: XXX

APPROVED BY:
CHIEF, ENGINEERING DIVISION

DATE: 9/15/2014

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DISTRICT FILE NO.

POCA NO. W912PL-14-R-0089

FILE NAME: T-IPOCA3.DGN

Scales: AS SHOWN

SHEET
T-1

Plot Date: $date$

GENERAL NOTES:

1. All work shall conform to the following documents and standards

   a. FY14 Master POCA Specificaiton
   b. County of San Bernardino Transportation Department Standards and Specifications
   c. Fort Irwin Department of Public Works requirements and standards

2. The existing contours of elevation indicated on the drawings may not be accurate and may not represent the existing ground surface. The Contractor shall make his own evaluation of the existing ground surface and how it relates to the features to be constructed. Differences thereto will not be the basis for any contract modification or additional payments to the Contractor.

3. The location of existing utilities indicated on the drawings may not be accurate. The Contractor shall make his own evaluation as to the disposition of existing utilities. The Contractor shall notify the local underground service alert and the Fort Irwin Department of Public Works, and obtain existing utility location data prior to any demolition or excavation. The following potholing note applies to all work under this contract and appears throughout the drawings:

   "THE CONTRACTOR SHALL LOCATE AND POTHOLE ALL EXISTING UTILITIES (SEWER, WATER, ELECTRICAL, COMMUNICATIONS, GAS, ETC., WHETHER OR NOT INDICATED ON THE PLANS) IN THE VICINITY OF THE PROPOSED CONSTRUCTION AND PRIOR TO ANY DEMOLITION OR EXCAVATION WORK. THE CONTRACTOR SHALL RECORD THE HORIZONTAL AND VERTICAL LOCATION, SIZE, AND MATERIAL OF CONSTRUCTION OF THE POTHOLED UTILITIES. THIS INFORMATION, ALONG WITH ANY CONFLICTS WITH PROPOSED CONSTRUCTION, SHALL BE SUBMITTED IN WRITING TO THE CONTRACTING OFFICER, PRIOR TO ANY DEMOLITION OR EXCAVATION WORK."

4. All existing monumentation disturbed or destroyed by the Contractor or his operation, shall be replaced by the Contractor, at no additional cost to the Government.

5. Bench Marks and Basis of Bearings. The Contractor may contact the Contracting Officer to obtain horizontal and vertical control, when not indicated on the drawings.

6. The Contractor shall provide traffic control and detours as required by the Contracting Officer for all work under this contract. Refer to the POCA specifications and the Fort Irwin Department of Public Works for submittal and approvals of the Contractor's traffic control plan.

7. Contractor Facilities. The Contractor shall obtain written approval from the Contracting Officer for the use of any temporary facilities, including work or storage areas.

8. Disposal of Materials. Demolished materials, including but not limited to, concrete, AC pavement, plastic, metal items, and vegetation shall be disposed offsite from Government property, in an approved disposal facility. Excess materials from the cleanout of drainage courses and structures (excavated materials not reused in the work), may be disposed in the designated stockpile site shown on Sheet SP-1 or as space permits in the Ft. Irwin Inert Disposal Site, provided the material does not contain vegetation, trash, or rubble. The Inert Disposal Site is located off post on Fort Irwin Rd., approximately 4 miles from the controlled access. There will be no charge for disposal of materials at these locations; refer to Sheet SP-1 for conditions on stockpiling for that designated stockpile location. Other demolished or removed items not reused in the work or directed for Government salvage, shall become the property of the Contractor and shall be removed from Government property.

9. Earthwork. The source for fill materials will be:

   a. Satisfactory excavated materials resulting from the work under this contract.
   b. Satisfactory excavated materials resulting from the work of other contractors working on post.
   c. The existing stockpiles of material immediately north of the new Army Weed Hospital site. There will be no charge to the USACE Contractor for this material.
   d. Import from sources off post.

10. All temporary slopes shall meet OSHA Standards and shall not exceed a gradient of 1.5H:1V; otherwise the Contractor shall provide shoring of excavations where required or directed.

11. All overexcavation indicated, overexcavation required to remove unsuitable material, and the subsequent filling and compacting shall be performed in the presence of a representative of the USACE Los Angeles District, Geotechnical Branch.

12. Goldstone. As indicated or directed, provide a 3 inch layer of goldstone over graded areas to match existing, adjacent goldstone. Goldstone shall be imported, 1 1/8 inch minus crushed gravel, color: California Gold.

13. Concrete Removals. When removing concrete flatwork, the Contractor shall make removals to the nearest control joint in each direction. Sawcutting between joints will not be permitted unless otherwise directed. When removing concrete curb and gutter, the Contractor may sawcut in between control joints, as directed.

14. Guardrails. Timber components of guardrails shall be pressure treated and suitable for use when in direct contact with earth.

15. Pavement Striping and Markings. The Contractor shall provide new pavement striping and markings to match existing, whether over new work or to repair markings damaged by his operations. Contact the Fort Irwin Department of Public Works for requirements.

16. Overexcavation Requirements Beneath Riprap or Grouted stone. The Contractor shall test the subgrade for relative compaction prior to placing geofabric, bedding or stone. The Contractor shall submit to the Contracting Officer a Geotechnical Report, prepared by an independent laboratory licensed to practice in the State of California, that identifies relative compaction of the subgrade material. If the relative compaction is less than 90% of the maximum dry density (MDD) per ASTM D1557, then overexcavation to competent material, as determined by the Contracting Officer, shall be performed by the Contractor. The Contractor shall recompact material in the area of overexcavation to 90% MDD per ASTM D1557.

LEGEND

- (1) REMOVE AND DISPOSE
- (2) PROTECT IN PLACE
- ~~(3) REMAIN (DELETED)~~
- (4) REMOVE AND REINSTALL
- (5) TO BE RELOCATED BY OTHERS

HP = HIGH POINT
FS = FINISH SURFACE
FG = FINISH GRADE
TC = TOP OF CURB
CF = CURB FACE
FL = FLOWLINE
BW = BACK OF SIDEWALK
INV = INVERT
TG = TOP OF GRATE
EP = EDGE OF PAVEMENT
POB = POINT OF BEGINNING
POE = POINT OF ENDING
BCR = BEGIN OF CURB RETURN
ECR = END OF CURB RETURN
AC = ASPHALTIC CONCRETE
CSP = CORRUGATED STEEL PIPE
MH = MANHOLE
TBM = TEMPORARY BENCHMARK
WWF = WELDED WIRE FABRIC
MGBR = METAL BEAM GUARDRAIL
CMP = CORRUGATED METAL PIPE
RCB = REINFORCED CONCRETE BOX
CMU = CONCRETE MASONRY UNIT
HDPE = HIGH DENSITY POLYETHYLENE
PP = POWER POLE
MDD = MAXIMUM DRY DENSITY

- EXISTING UTILITY POLE
- EXISTING UTILITY POLE LINE
- EXISTING TREE WITH DIAMETER INDICATED (16")
- EXISTING LIGHT POLE
- EXISTING IRRIGATION BOX
- EXISTING VALVE WELL
- EXISTING 16" SQUARE, 12" DEEP PRECAST DROP INLET WITH CAST IRON GRATE. 4" DIA SCH 40 PVC EXIT PIPE LOCATIONS UNKNOWN.
- EXISTING POWER POLE
- EXISTING OR NEW CONCRETE PAVEMENT
- EXISTING AC PAVEMENT
- EXISTING TRENCH DRAIN. EXIT PIPE LOCATION UNKNOWN.
- METAL BEAM GUARD RAIL
- REFLECTIVE DELINEATOR
- SWALE
- GROUTED STONE
- RIPRAP

CONSTRUCTION NOTES:

[X] BOXED CONSTRUCTION NOTES ARE SPECIFIC TO EACH AREA AND CHANGE FROM AREA TO AREA WITHIN THE SET OF PLANS.

SYMBOL	DESCRIPTIONS REVISIONS	DATE	APPROVAL

FORT IRWIN NATIONAL TRAINING CENTER
STORM DAMAGE REPAIR
SAN BERNARDINO COUNTY, CALIFORNIA
SECTION 3, CIVIL REPAIR

GENERAL NOTES

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: XXX
DRAWN BY: XXX
CHECKED BY: XXX
FILE NAME: T-2POCA3.DGN

SUBMITTED BY:
ARTHUR Y. JUNG, PE
CHIEF, DESIGN BRANCH

DISTRICT FILE NO.
POCA NO. W912PL-14-R-0089

Scale: AS SHOWN
SHEET
T-2

Plot Date: $date$

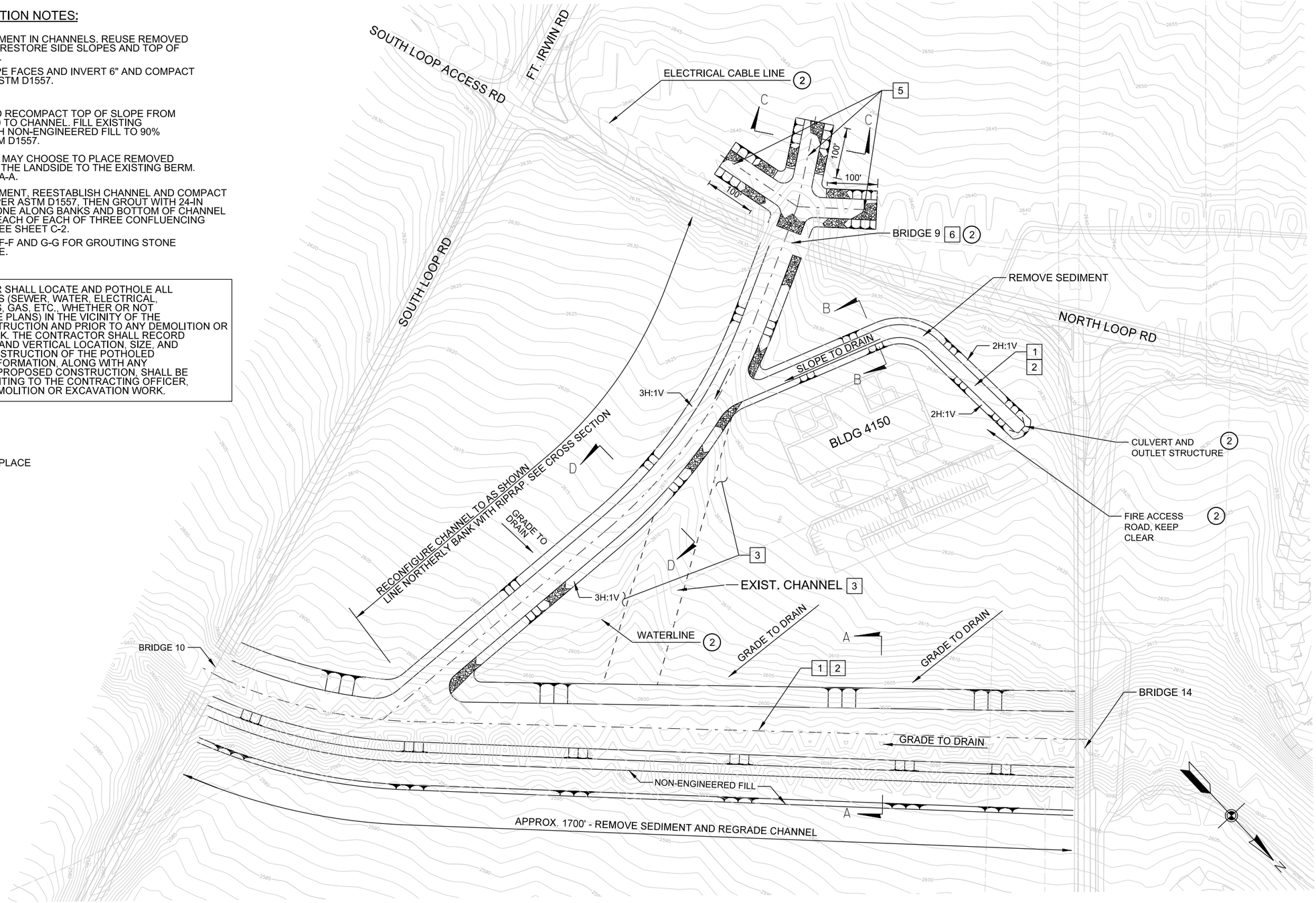
CONSTRUCTION NOTES:

1. REMOVE SEDIMENT IN CHANNELS. REUSE REMOVED SEDIMENT TO RESTORE SIDE SLOPES AND TOP OF EMBANKMENT.
2. SCARIFY SLOPE FACES AND INVERT 6" AND COMPACT TO 95% PER ASTM D1557.
3. REGRADE AND RECOMPACT TOP OF SLOPE FROM BUILDING 4150 TO CHANNEL. FILL EXISTING CHANNEL WITH NON-ENGINEERED FILL TO 90% MDD PER ASTM D1557.
4. CONTRACTOR MAY CHOOSE TO PLACE REMOVED SEDIMENT ON THE LANDSIDE TO THE EXISTING BERM. SEE SECTION A-A.
5. REMOVE SEDIMENT, REESTABLISH CHANNEL AND COMPACT TO 95% MDD PER ASTM D1557, THEN GROUT WITH 24-IN GROUTED STONE ALONG BANKS AND BOTTOM OF CHANNEL ALONG 100' REACH OF EACH OF THREE CONFLUENCING CHANNELS. SEE SHEET C-2.
6. SEE SECTION F-F AND G-G FOR GROUTING STONE UNDER BRIDGE.

THE CONTRACTOR SHALL LOCATE AND POTHOLE ALL EXISTING UTILITIES (SEWER, WATER, ELECTRICAL, COMMUNICATIONS, GAS, ETC., WHETHER OR NOT INDICATED ON THE PLANS) IN THE VICINITY OF THE PROPOSED CONSTRUCTION AND PRIOR TO ANY DEMOLITION OR EXCAVATION WORK. THE CONTRACTOR SHALL RECORD THE HORIZONTAL AND VERTICAL LOCATION, SIZE, AND MATERIAL OF CONSTRUCTION OF THE POTHOLED UTILITIES. THIS INFORMATION, ALONG WITH ANY CONFLICTS WITH PROPOSED CONSTRUCTION, SHALL BE SUBMITTED IN WRITING TO THE CONTRACTING OFFICER, PRIOR TO ANY DEMOLITION OR EXCAVATION WORK.

LEGEND

(2) PROTECT IN PLACE



PLAN
SCALE: 1 IN. = 100FT.

100 50 0 100 200
SCALE: 1" = 100'

SYMBOL	DESCRIPTIONS REVISIONS	DATE	APPROVAL

FORT IRWIN NATIONAL TRAINING CENTER
STORM DAMAGE REPAIR
SAN BERNARDINO COUNTY, CALIFORNIA
SECTION 3, CIVIL REPAIR

AREA 14
BRIDGE 9 & CHANNELS PLAN

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

SUBMITTED BY: ARTHUR Y. JUNG, PE, CHIEF, DESIGN BRANCH

DESIGNED BY: CW
DRAWN BY: LHD
CHECKED BY: MDN
FILE NAME: C-IAREAI4.DGN
POCA NO. W912PL-14-R-0089
DISTRICT FILE NO.

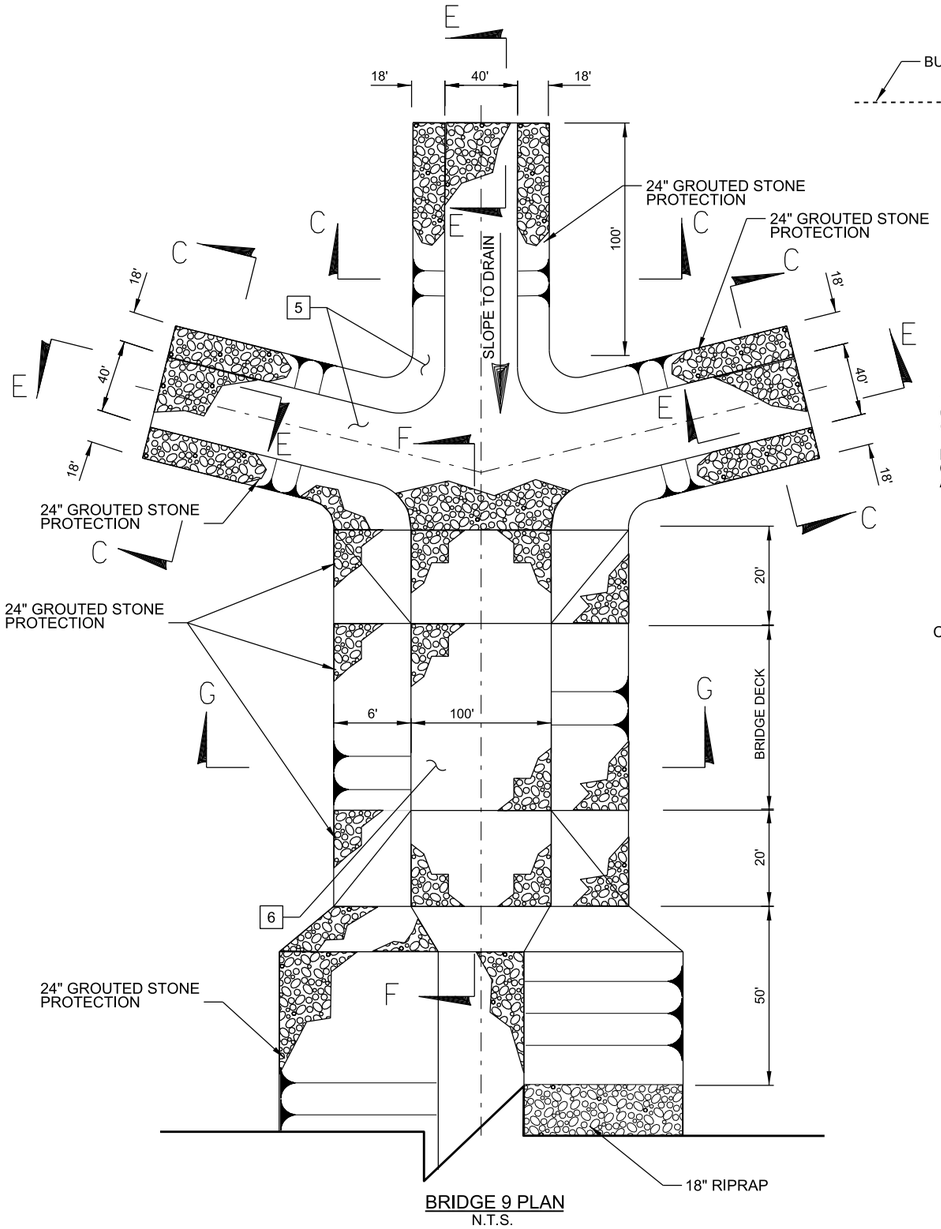
Scale: AS SHOWN
SHEET
C-1

Plot Date: $date$

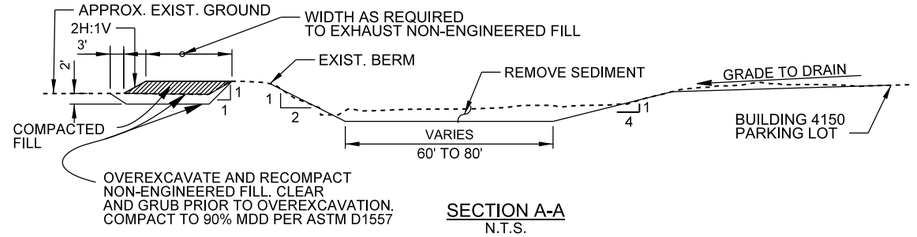
CONSTRUCTION NOTES:

5 REMOVE SEDIMENT, REESTABLISH CHANNEL AND COMPACT TO 95% MDD PER ASTM D1557. THEN GROUT WITH 24-IN GROUTED STONE ALONG BANKS AND BOTTOM OF CHANNEL ALONG 100' REACH OF EACH OF THREE CONFLUENCING CHANNELS.

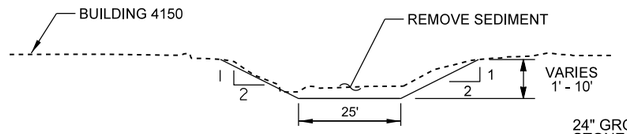
6 SEE SECTION F-F AND G-G FOR GROUTING STONE UNDER BRIDGE.



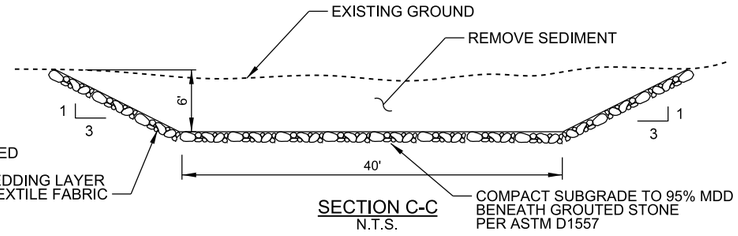
BRIDGE 9 PLAN
N.T.S.



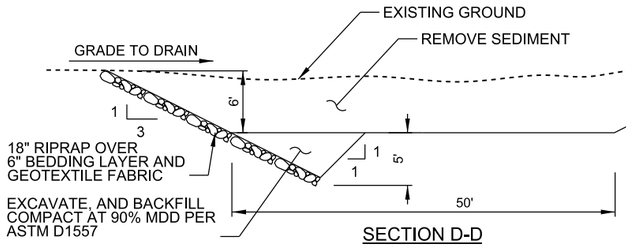
SECTION A-A
N.T.S.



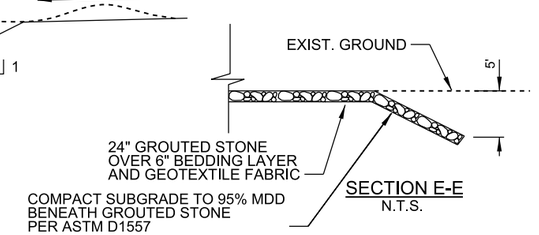
SECTION B-B
N.T.S.



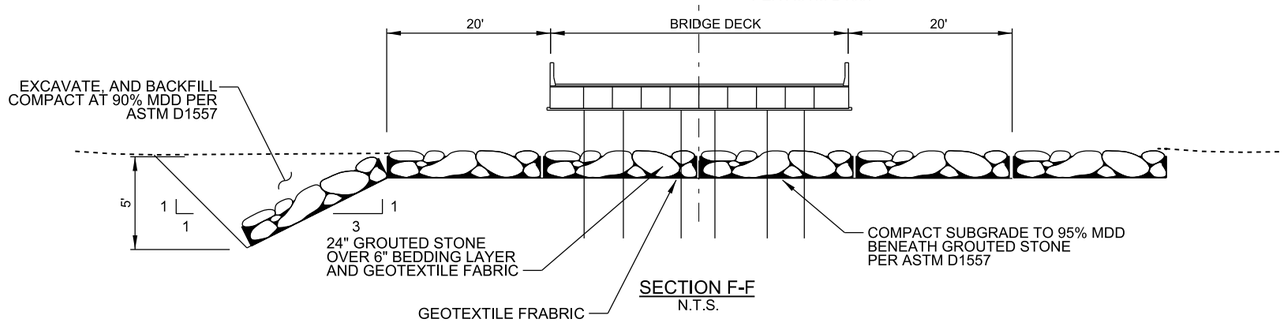
SECTION C-C
N.T.S.



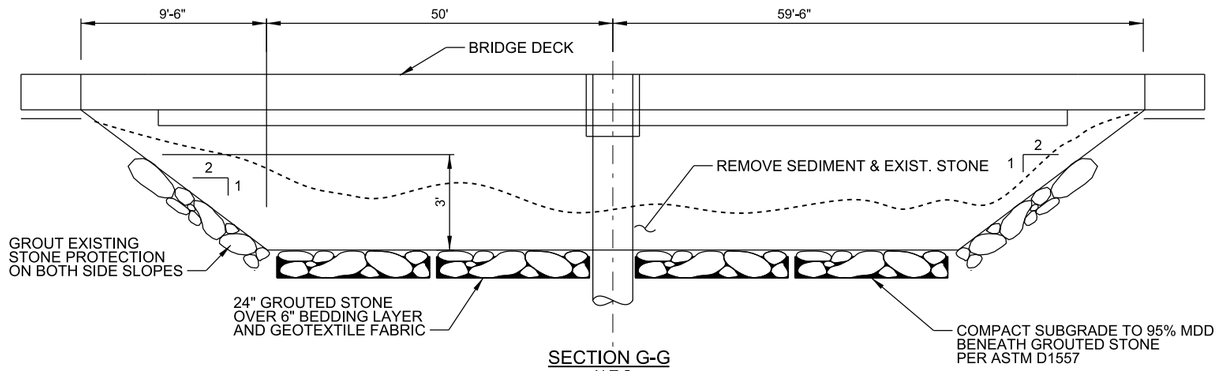
SECTION D-D
N.T.S.



SECTION E-E
N.T.S.



SECTION F-F
N.T.S.



SECTION G-G
N.T.S.

FORT IRWIN NATIONAL TRAINING CENTER
STORM DAMAGE REPAIR
SAN BERNARDINO COUNTY, CALIFORNIA
SECTION 3, CIVIL REPAIR

AREA 14
BRIDGE 9 & CHANNELS SECTIONS

SYMBOL	DESCRIPTIONS REVISIONS	DATE	APPROVAL

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

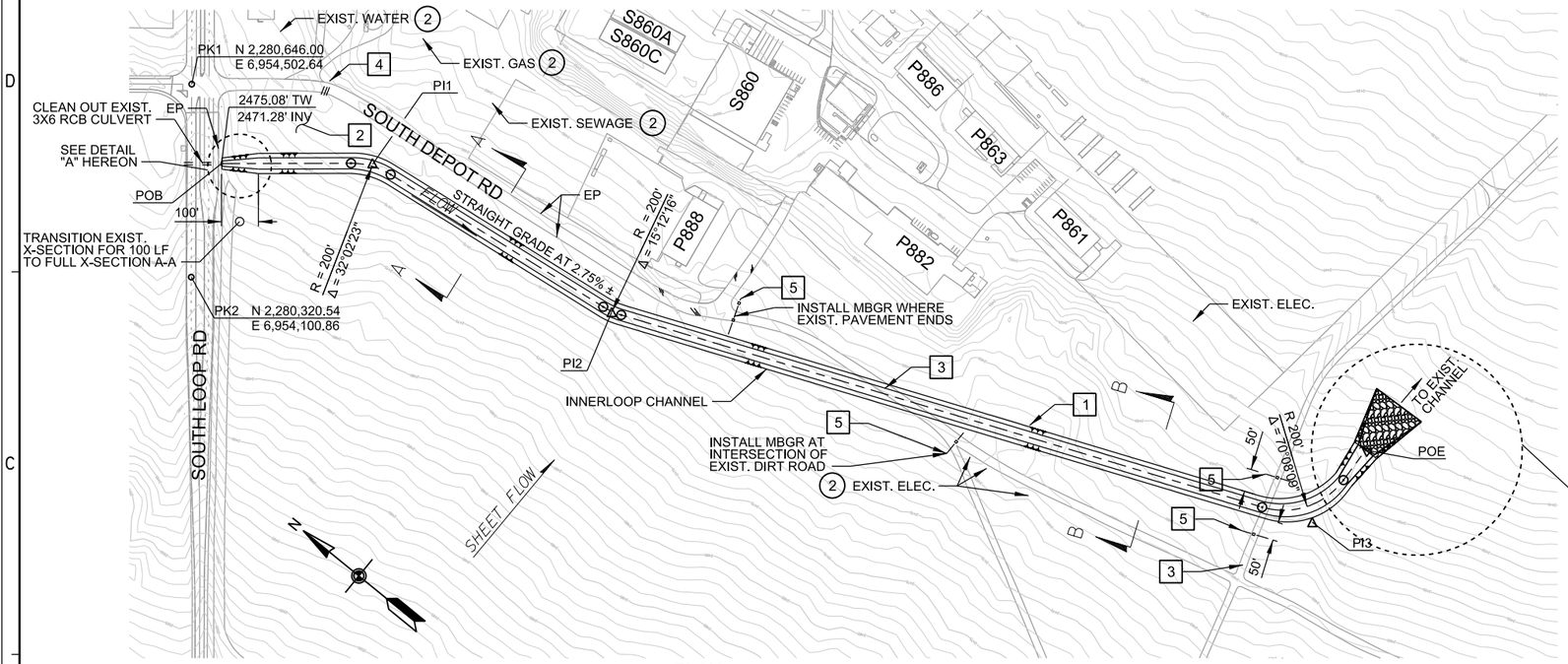
SUBMITTED BY: ARTHUR Y. JUNG, PE, CHIEF, DESIGN BRANCH

DESIGNED BY: C.W
DRAWN BY: L.H.D
CHECKED BY: M.D.N

FILE NAME: C-2AREA14.DGN
POCA NO. W912PL-14-R-0089
DISTRICT FILE NO.

Scale: AS SHOWN
SHEET
C-2

Plot Date: $date$



PLAN
SCALE: 1 IN. = 200 FT.

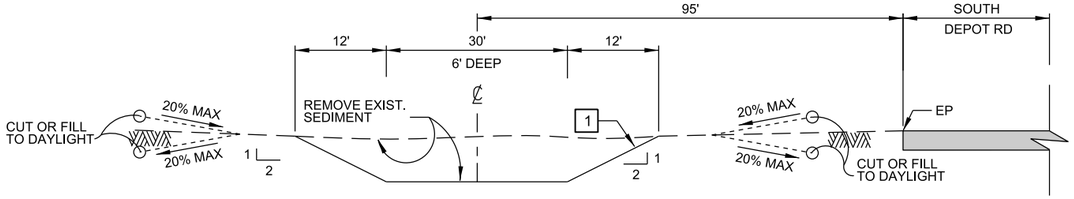
400 200 0 200 400
SCALE: 1" = 200'

THE CONTRACTOR SHALL LOCATE AND POTHOLE ALL EXISTING UTILITIES (SEWER, WATER, ELECTRICAL, COMMUNICATIONS, GAS, ETC., WHETHER OR NOT INDICATED ON THE PLANS) IN THE VICINITY OF THE PROPOSED CONSTRUCTION AND PRIOR TO ANY DEMOLITION OR EXCAVATION WORK. THE CONTRACTOR SHALL RECORD THE HORIZONTAL AND VERTICAL LOCATION, SIZE, AND MATERIAL OF CONSTRUCTION OF THE POTHOLE UTILITIES. THIS INFORMATION, ALONG WITH ANY CONFLICTS WITH PROPOSED CONSTRUCTION, SHALL BE SUBMITTED IN WRITING TO THE CONTRACTING OFFICER, PRIOR TO ANY DEMOLITION OR EXCAVATION WORK.

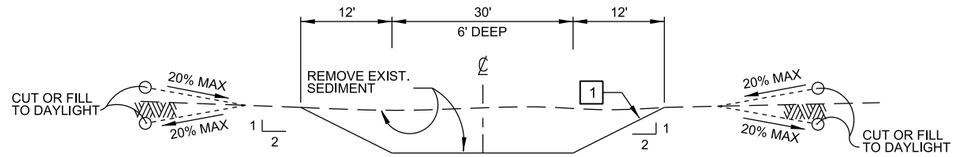
VERT DATUM = NAVD 88
HORI DATUM = NAD 1983
PROJECTION = CA ZONE V

BASIS OF BEARING		
	BEARING	LENGTH
PK1 TO PK2	S50°55'25"W	517'

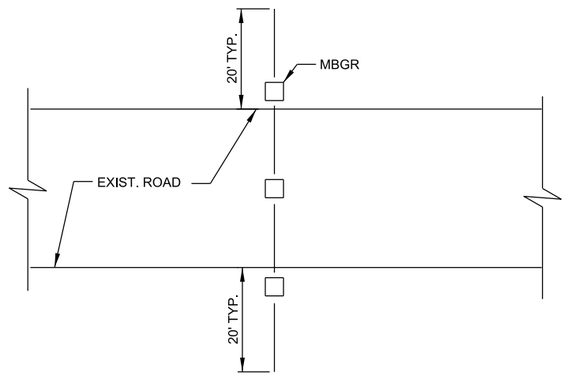
	INNERLOOP CHANNEL ℄ DATA	
	BEARING	DISTANCE
POB	S39°18' 34"E	404.84'
PI1		
PI2	S7°16' 12"E	755.21'
PI2	S22°28' 28"E	1960.54'
PI3		
POE	N87°23' 23"E	240.40'



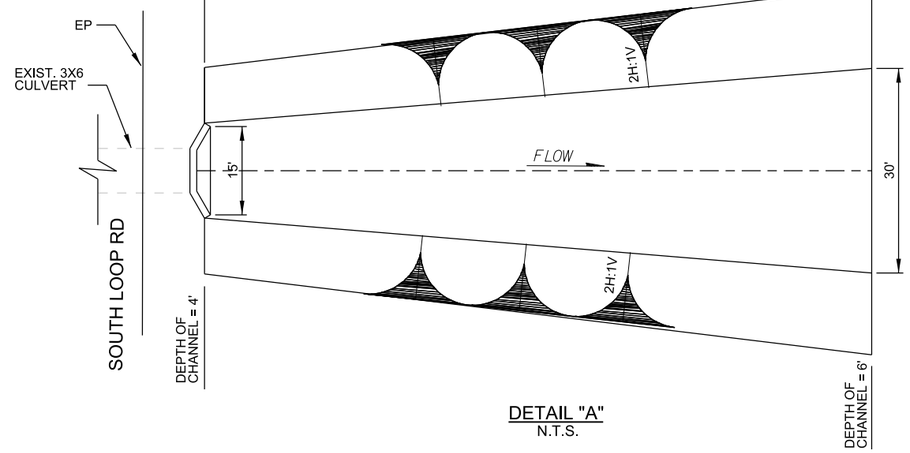
SECTION A-A
N.T.S. (LOOKING U/S)



SECTION B-B
N.T.S. (LOOKING U/S)



5 GUARDRAIL PLAN
N.T.S.



DETAIL "A"
N.T.S.

LEGEND

(2) PROTECT IN PLACE

CONSTRUCTION NOTES:

1. CONSTRUCT CHANNEL. SEE DETAILS ABOVE.
2. FILL EXIST. CHANNELS TO EXIST. ADJACENT GRADE WITH NON-ENGINEERED FILL AND SLOPE TO DRAIN TOWARDS NEW CHANNEL. COMPACT TO 90% MDD PER ASTM D 1557.
3. DIRT ROAD ACCESS TO BE ABANDONED AND REROUTED BY OTHERS.
4. ABANDON 3 EXIST. 30" CMP ON BOTH ENDS. PLUG SOLID WITH 2000 PSI CONCRETE.
5. INSTALL METAL BEAM GUARDRAIL PER MISCELLANEOUS DETAILS SHEETS. METAL BEAM GUARDRAILS SHALL BE INSTALLED AT MIN 20 LF FROM EDGE OF EACH SIDE OF EXIST. ROAD. SEE MBGR PLAN HEREON.

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

FORT IRWIN NATIONAL TRAINING CENTER
STORM DAMAGE REPAIR
SAN BERNARDINO COUNTY, CALIFORNIA
SECTION 3, CIVIL REPAIR

AREA 41
INNERLOOP CHANNEL PLAN & SECTIONS

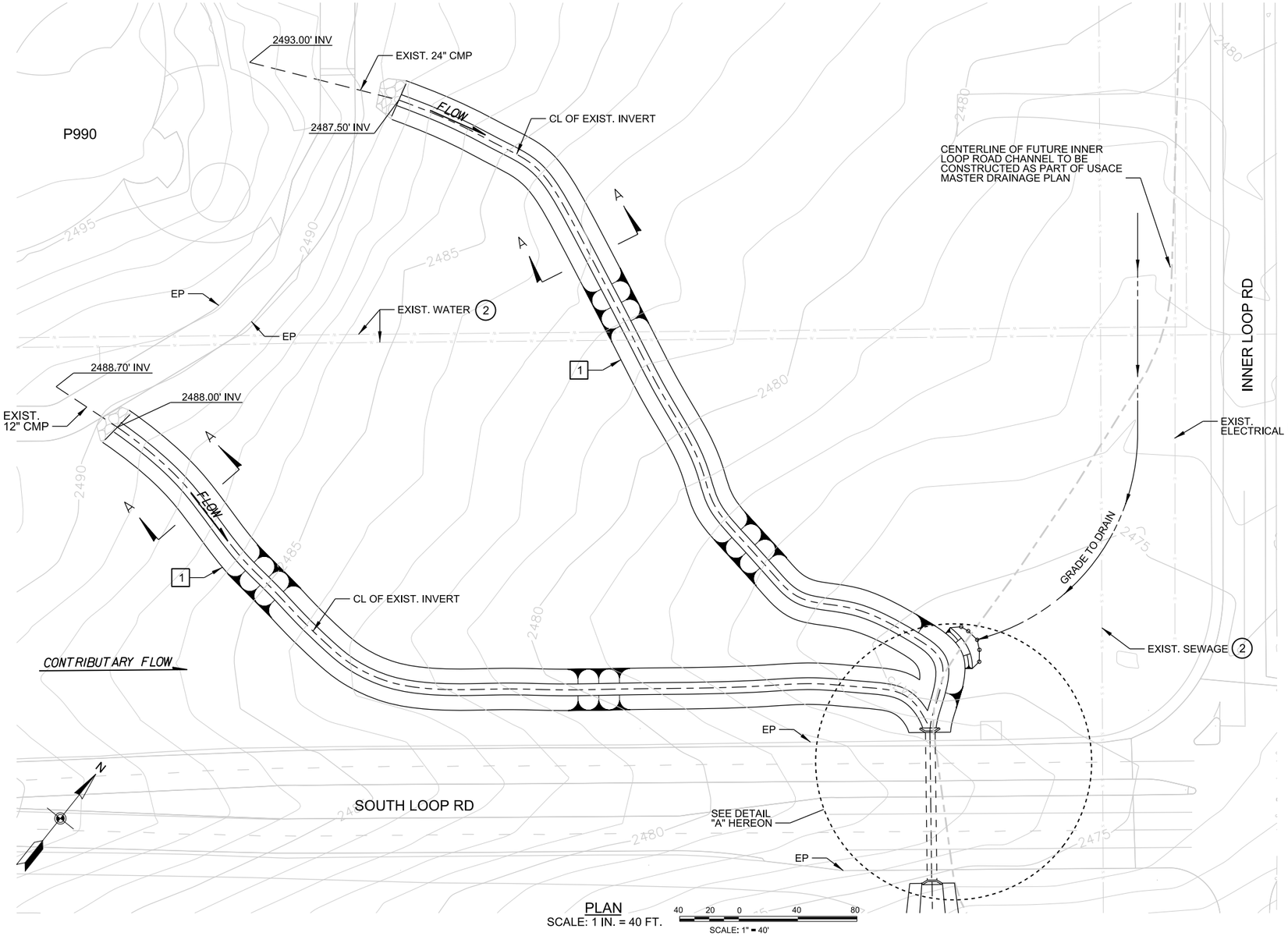
DESIGNED BY:	MM
DRAWN BY:	MM
CHECKED BY:	MDN
FILE NAME:	C-3AREA41.DGN
POCA NO.	W912PL-14-R-0089
DISTRICT FILE NO.	

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

SUBMITTED BY:
ARTHUR Y. JUNG, PE
CHIEF, DESIGN BRANCH

Scale: AS SHOWN
SHEET
C-3

Plot Date: $date$



PLAN
SCALE: 1 IN. = 40 FT.

40 20 0 40 80
SCALE: 1" = 40'

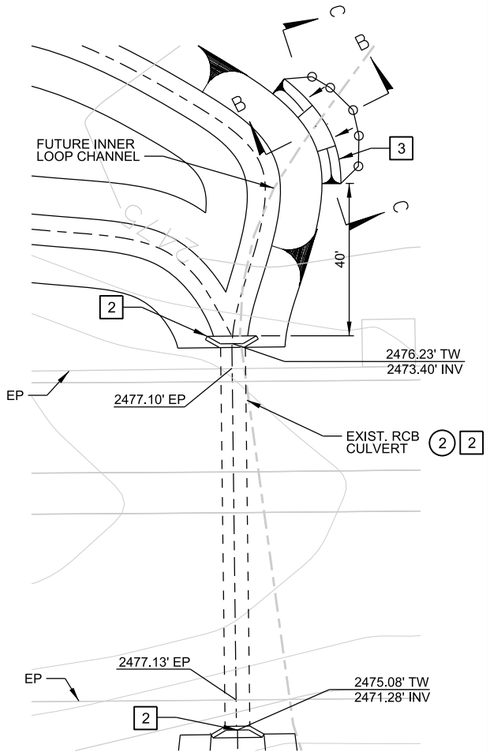
THE CONTRACTOR SHALL LOCATE AND POTHOLE ALL EXISTING UTILITIES (SEWER, WATER, ELECTRICAL, COMMUNICATIONS, GAS, ETC., WHETHER OR NOT INDICATED ON THE PLANS) IN THE VICINITY OF THE PROPOSED CONSTRUCTION AND PRIOR TO ANY DEMOLITION OR EXCAVATION WORK. THE CONTRACTOR SHALL RECORD THE HORIZONTAL AND VERTICAL LOCATION, SIZE, AND MATERIAL OF CONSTRUCTION OF THE POTHOLE UTILITIES. THIS INFORMATION, ALONG WITH ANY CONFLICTS WITH PROPOSED CONSTRUCTION, SHALL BE SUBMITTED IN WRITING TO THE CONTRACTING OFFICER, PRIOR TO ANY DEMOLITION OR EXCAVATION WORK.

CONSTRUCTION NOTES:

1. REPAIR EXIST. CHANNEL. UNCOMPACTED EXCAVATED MATERIAL SHALL BE SPREAD AT 6" MAX LAYER ON TOP OF BANK. SEE DETAILS BELOW.
2. CLEAN OUT EXIST. RCB CULVERT.
3. CONSTRUCT EARTHEN SPILLWAY. SEE DETAILS BELOW.

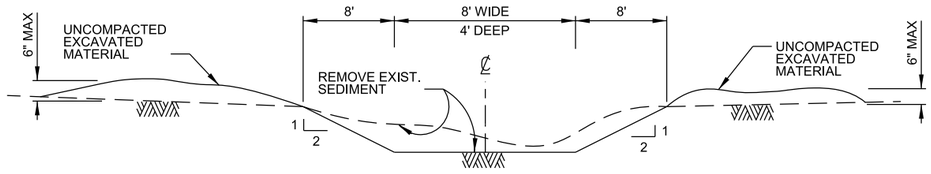
LEGEND

(2) PROTECT IN PLACE

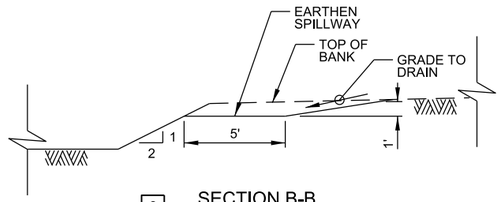


DETAIL "A"
SCALE: 1 IN. = 20 FT.

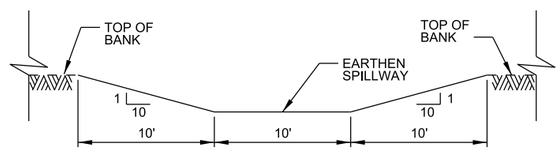
20 10 0 20 40
SCALE: 1" = 20'



1 SECTION A-A
N.T.S. (LOOKING U/S)



3 SECTION B-B
N.T.S.



3 SECTION C-C
N.T.S.

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

FORT IRWIN NATIONAL TRAINING CENTER
STORM DAMAGE REPAIR
SAN BERNARDINO COUNTY, CALIFORNIA
SECTION 3, CIVIL REPAIR

AREA 45
PLAN & SECTIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

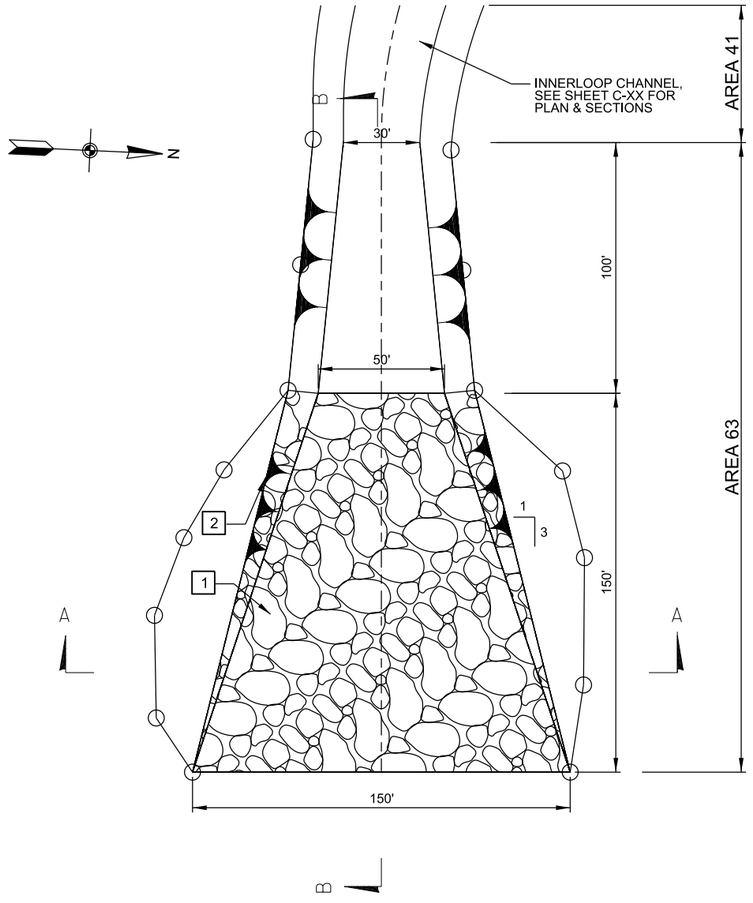
SUBMITTED BY: ARTHUR Y. JUNG, PE
CHIEF, DESIGN BRANCH

DESIGNED BY: MM
DRAWN BY: MM
CHECKED BY: MDN

DISTRICT FILE NO. POCA NO. W912PL-14-R-0089
FILE NAME: C-4AREA45

Scale: AS SHOWN
SHEET C-4

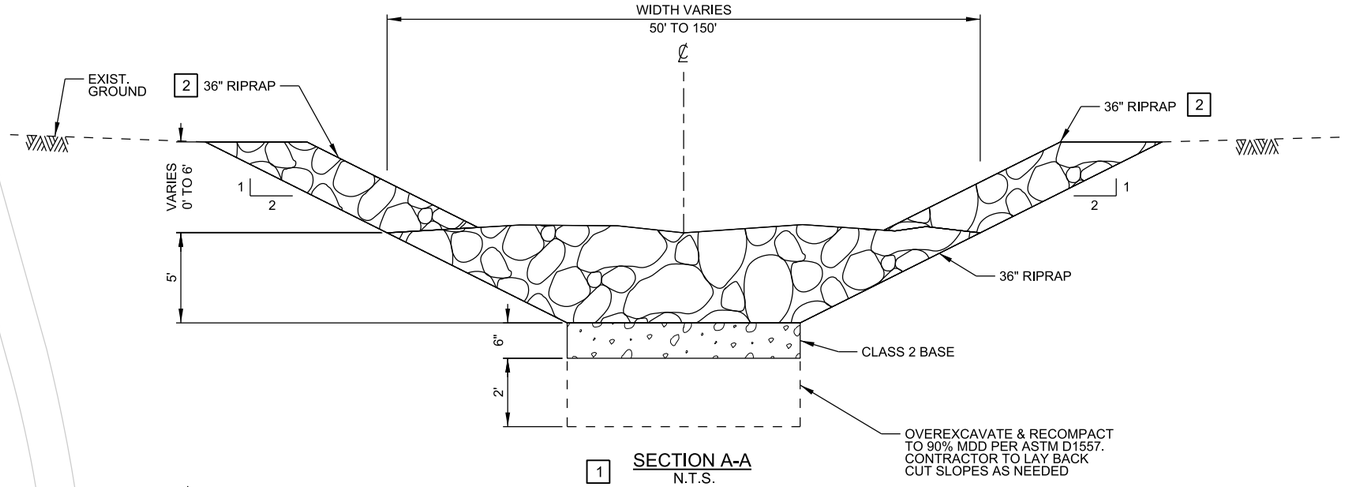
Plot Date: $date$



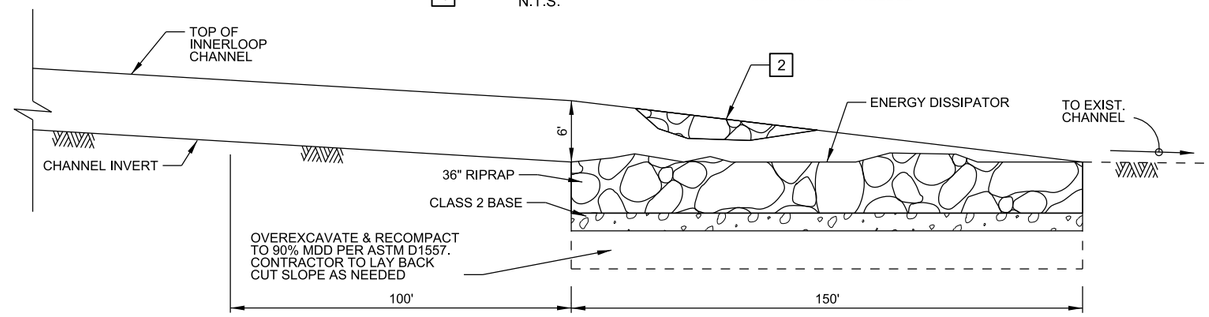
PLAN
SCALE: 1 IN. = 30 FT.

30 15 0 30 60
SCALE: 1" = 30'

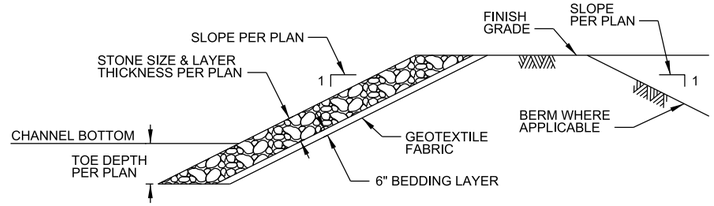
EXIST. DIRT ROAD



1 SECTION A-A
N.T.S.



1 SECTION B-B
N.T.S.



2 TYP. RIPRAP SECTION
N.T.S.

CONSTRUCTION NOTES:

1. CONSTRUCT ENERGY DISSIPATOR WITH 36" RIPRAP. SEE DETAILS ABOVE.
2. PLACE 1 LAYER OF 36" RIPRAP ON SLOPE. SEE DETAILS ABOVE.

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

FORT IRWIN NATIONAL TRAINING CENTER
STORM DAMAGE REPAIR
SAN BERNARDINO COUNTY, CALIFORNIA
SECTION 3, CIVIL REPAIR

AREA 63
ENERGY DISSIPATOR DETAILS

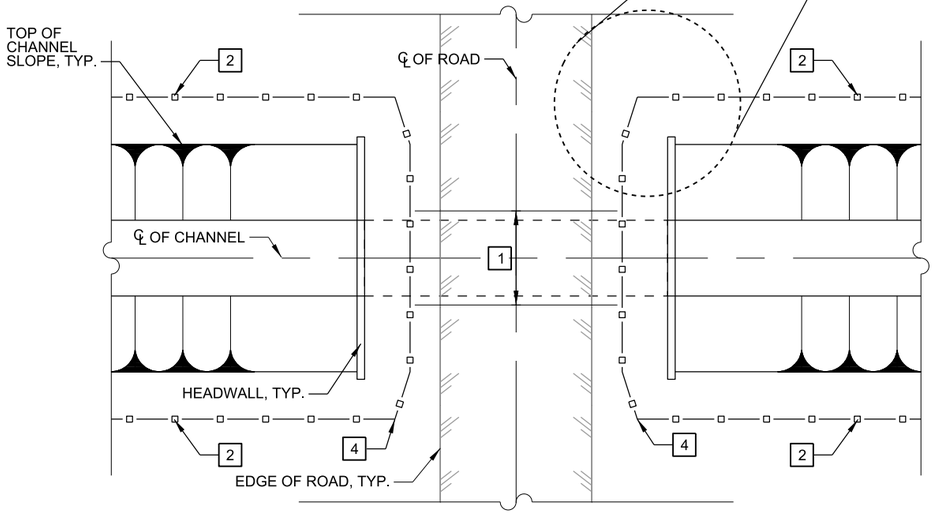
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

SUBMITTED BY: ARTHUR Y. JUNG, PE, CHIEF, DESIGN BRANCH

DESIGNED BY: MM
DRAWN BY: MM
CHECKED BY: MDN
FILE NAME: C-5AREA63.DGN
POCA NO. W92PL-14-R-0089
DISTRICT FILE NO.

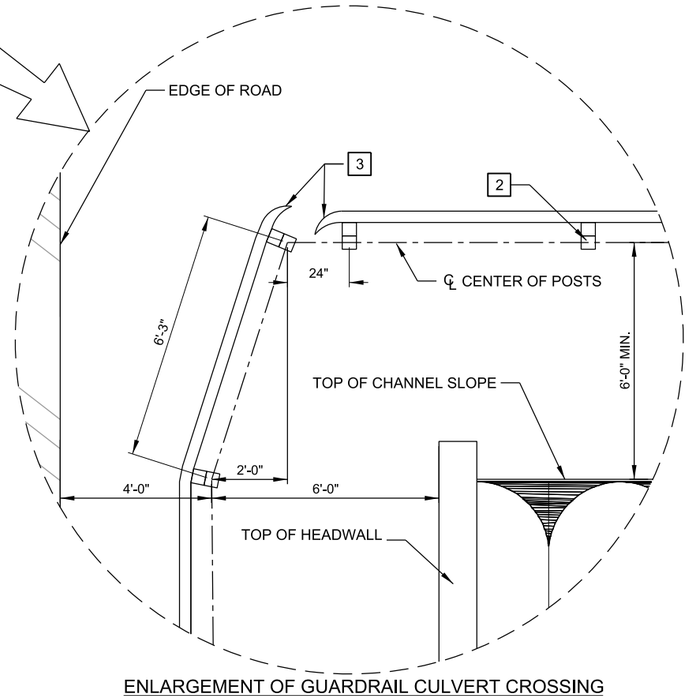
Scale: AS SHOWN
SHEET C-5

Plot Date: $date$



10 5 0 10 20
SCALE: 1" = 10'

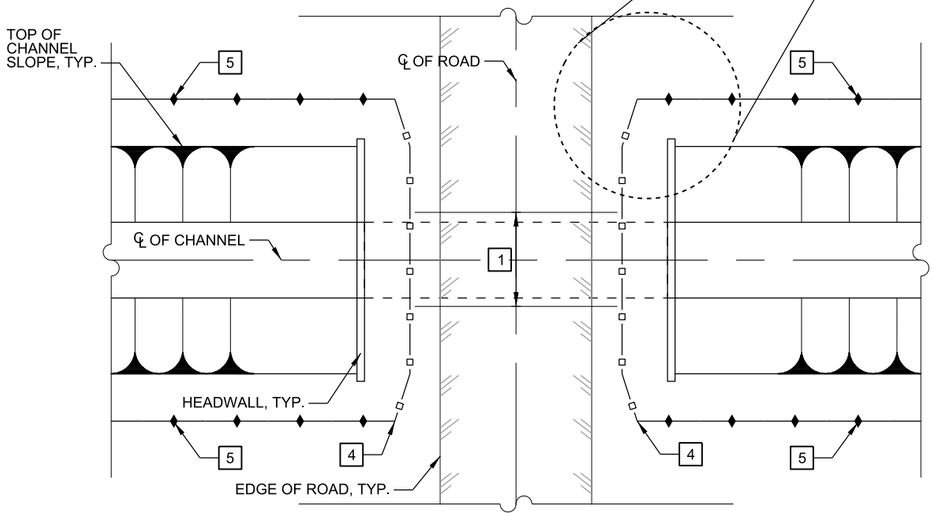
TYPICAL GUARDRAIL CULVERT CROSSING PLAN
WITH GUARDRAIL PARALLEL TO CHANNEL
SCALE: 1 IN. = 10 FT.



ENLARGEMENT OF GUARDRAIL CULVERT CROSSING
WITH MBGR PARALLEL TO CHANNEL
N.T.S.

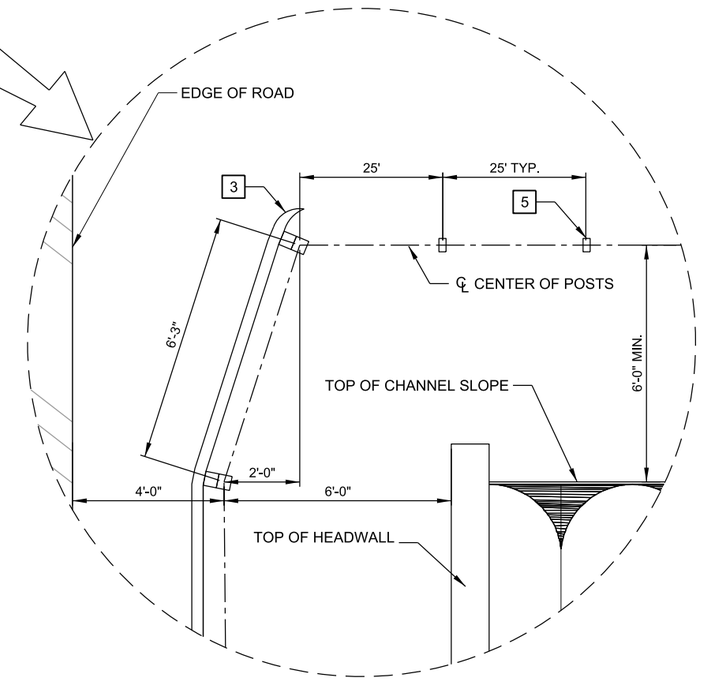
CONSTRUCTION NOTES:

1. SEE TYPICAL MBGR INSTALLATION ABOVE CULVERT DETAIL.
2. SEE TYPICAL MBGR ROADWAY INSTALLATION DETAIL FOR ALL MBGR POSTS NOT OVER A CULVERT.
3. SEE TERMINAL SECTION DETAIL.
4. SEE MBGR POST DELINEATOR DETAIL.
5. SEE METAL POST DELINEATOR DETAIL FOR ALL DELINEATORS RUNNING PARALLEL TO CHANNEL.



10 5 0 10 20
SCALE: 1" = 10'

TYPICAL GUARDRAIL CULVERT CROSSING PLAN
WITH DELINEATORS PARALLEL TO CHANNEL
SCALE: 1 IN. = 10 FT.



ENLARGEMENT OF GUARDRAIL CULVERT CROSSING
WITH DELINEATORS PARALLEL TO CHANNEL
N.T.S.

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

FORT IRWIN NATIONAL TRAINING CENTER
STORM DAMAGE REPAIR
SAN BERNARDINO COUNTY, CALIFORNIA
SECTION 3, CIVIL REPAIR

MISCELLANEOUS DETAILS
METAL BEAM GUARDRAIL LAYOUT

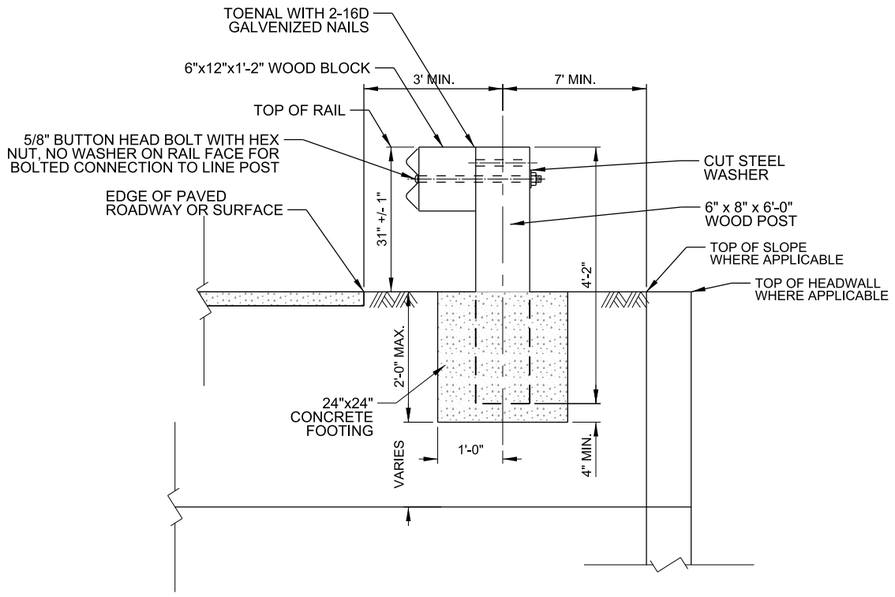
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

SUBMITTED BY: ARTHUR Y. JUNG, PE
CHIEF, DESIGN BRANCH

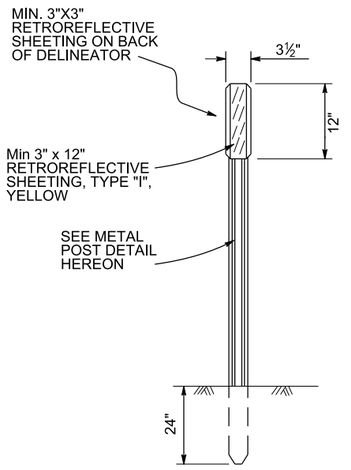
DESIGNED BY: DW
DRAWN BY: DW
CHECKED BY: MDN
FILE NAME: M-1.DGN
POCA NO. W912PL-14-R-0089
DISTRICT FILE NO.

Scale: AS SHOWN
SHEET
M-1

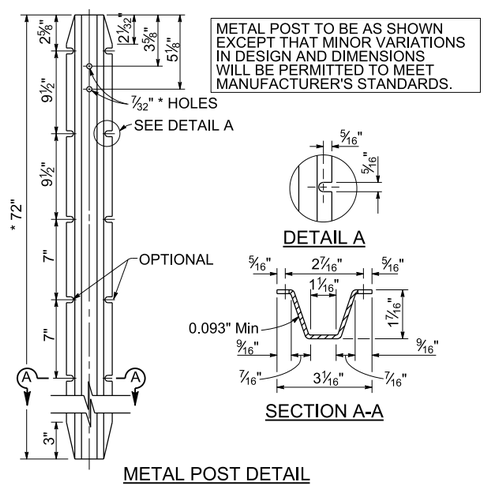
Plot Date: $date$



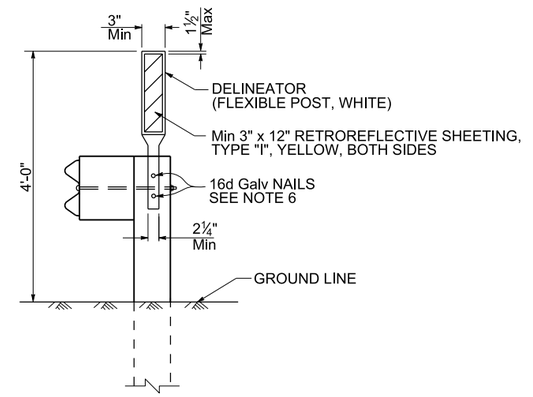
2 TYPICAL GUARDRAIL ROADWAY INSTALLATION
N.T.S.



5 METAL POST DELINEATOR
N.T.S.



METAL POST DETAIL
N.T.S.



4 GUARDRAIL POST DELINEATOR
N.T.S.

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

FORT IRWIN NATIONAL TRAINING CENTER
STORM DAMAGE REPAIR
SAN BERNARDINO COUNTY, CALIFORNIA
SECTION 3, CIVIL REPAIR

MISCELLANEOUS DETAILS
GUARDRAIL & DELINEATOR DETAILS

DESIGNED BY:	DW
DRAWN BY:	DW
CHECKED BY:	MDN
FILE NAME: M-2.DGN	
POCA NO. W912PL-14-R-0089	

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

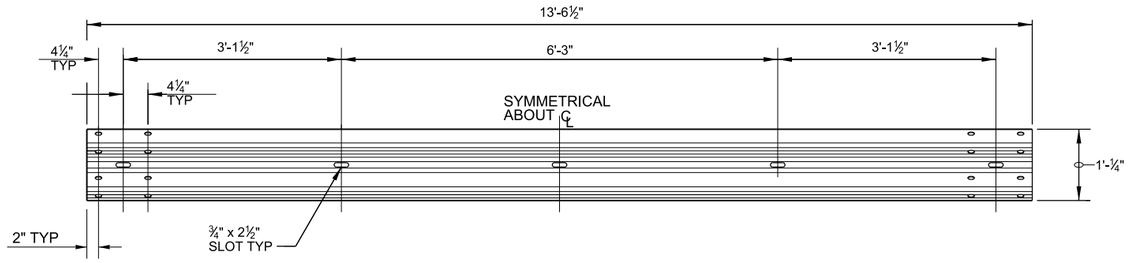
SUBMITTED BY: ARTHUR Y. JUNG, PE
CHIEF, DESIGN BRANCH

DISTRICT FILE NO.

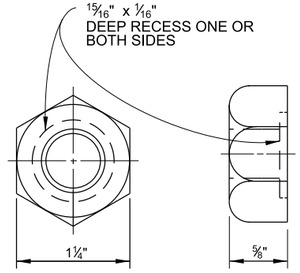
Scale: AS SHOWN

SHEET
M-2

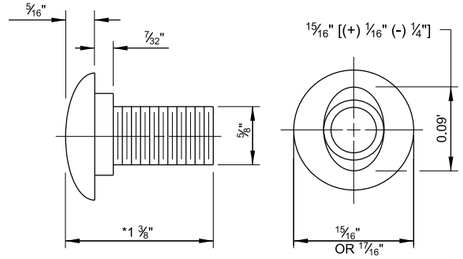
Plot Date: $date$



TYPICAL RAIL ELEMENT
N.T.S.

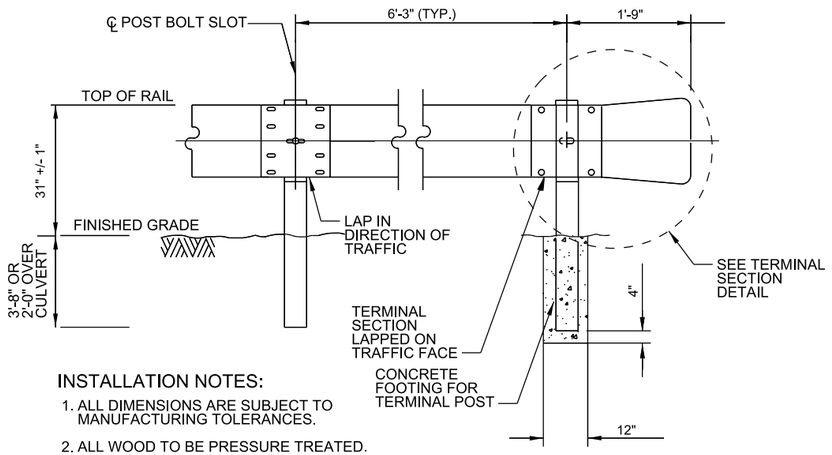


5/8" RECESS NUT
N.T.S.



*POST BOLT: SIMILAR EXCEPT LENGTH

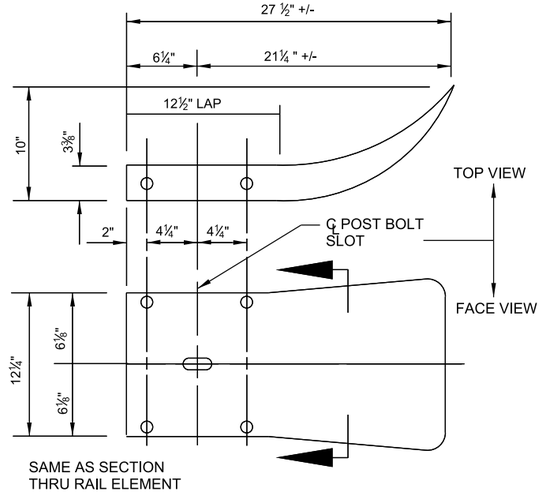
5/8" BUTTON HEAD BOLT
N.T.S.



INSTALLATION NOTES:

1. ALL DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES.
2. ALL WOOD TO BE PRESSURE TREATED.

METAL BEAM GUARDRAIL SYSTEM WITH WOOD POST AND BLOCKS
N.T.S.



3 TERMINAL SECTION
N.T.S.

SECTION THRU RAIL ELEMENT
N.T.S.

SYMBOL	DESCRIPTIONS	DATE APPROVAL
	REVISIONS	

FORT IRWIN NATIONAL TRAINING CENTER
STORM DAMAGE REPAIR
SAN BERNARDINO COUNTY, CALIFORNIA
SECTION 3, CIVIL REPAIR

MISCELLANEOUS DETAILS
GUARDRAIL DETAILS

DESIGNED BY: DW
DRAWN BY: DW
CHECKED BY: MDN
FILE NAME: M-3.DGN

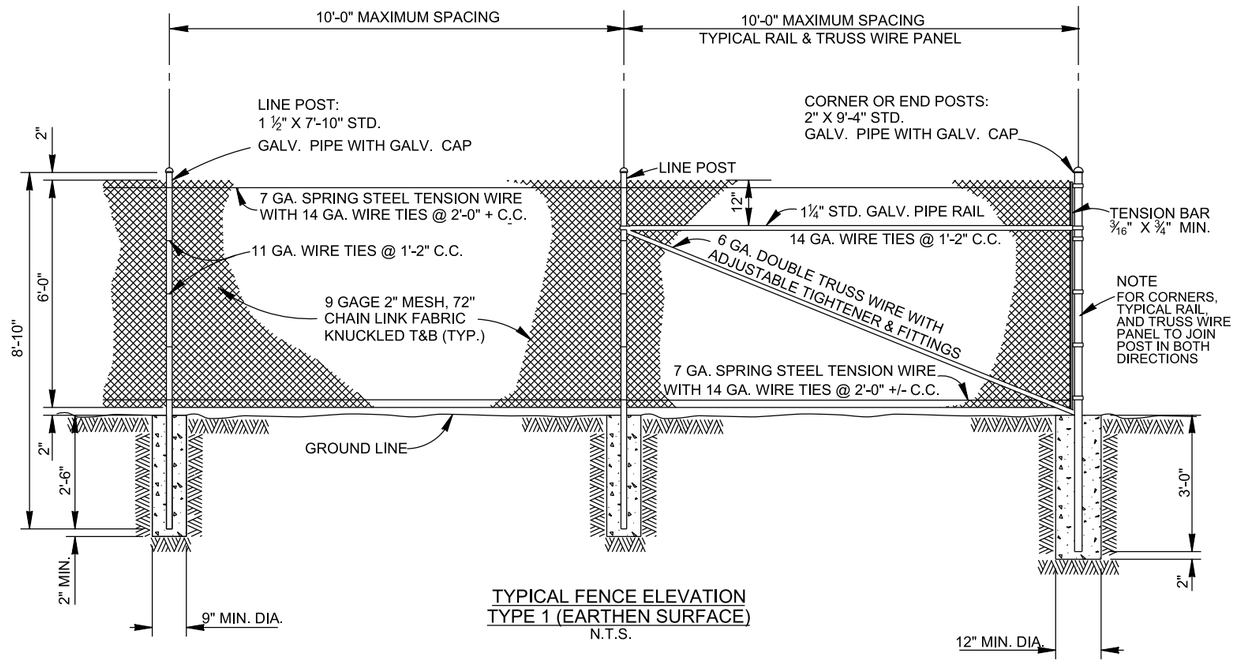
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

SUBMITTED BY:
ARTHUR Y. JUNG, PE
CHIEF, DESIGN BRANCH

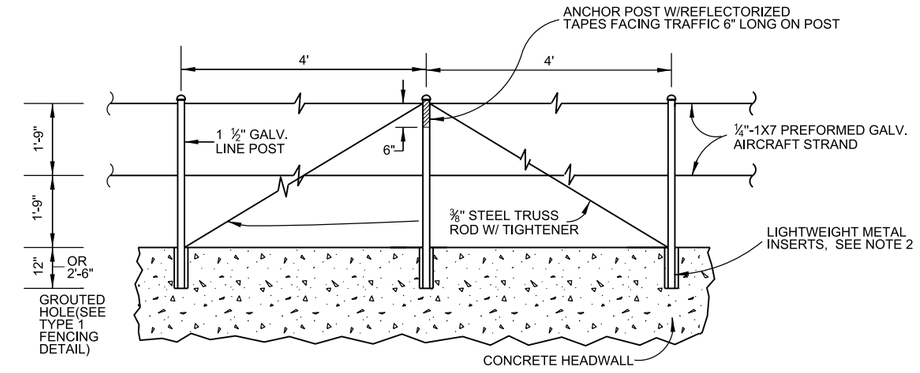
POCA NO. W912PL-14-R-0089
DISTRICT FILE NO.

Scale: AS SHOWN
SHEET
M-3

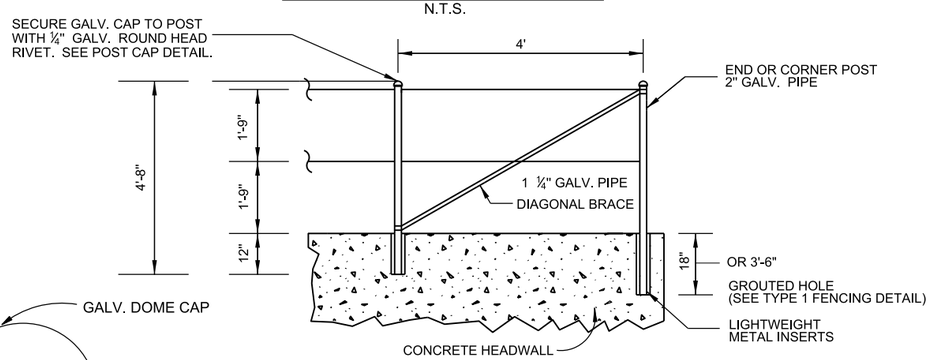
Plot Date: $date$



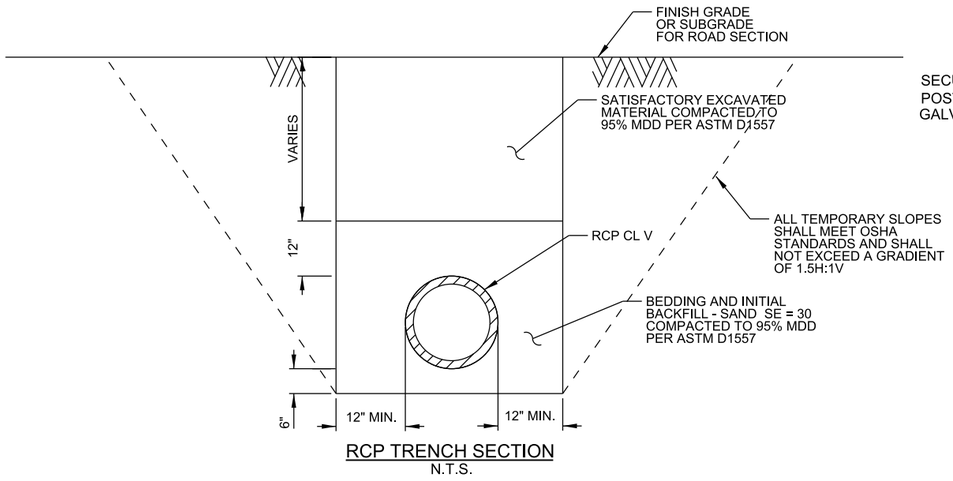
TYPICAL FENCE ELEVATION
TYPE 1 (EARTHEN SURFACE)
N.T.S.



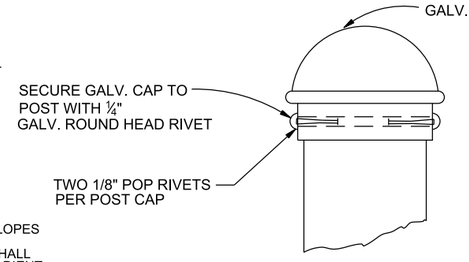
TYPICAL TYPE 2 FENCE ELEVATION
N.T.S.



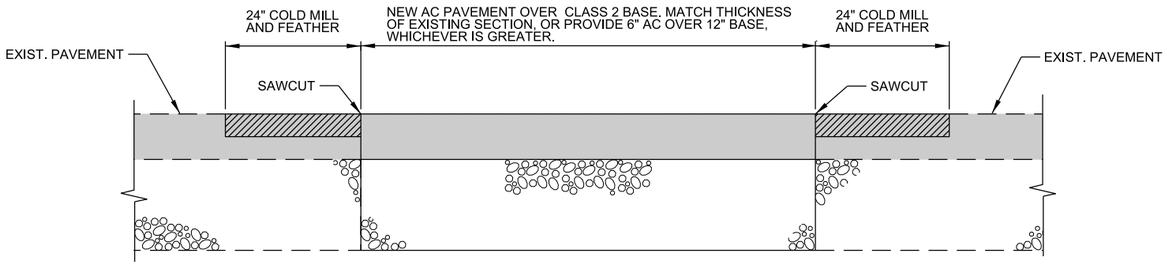
TYPICAL TYPE 2 END POST DETAIL
N.T.S.



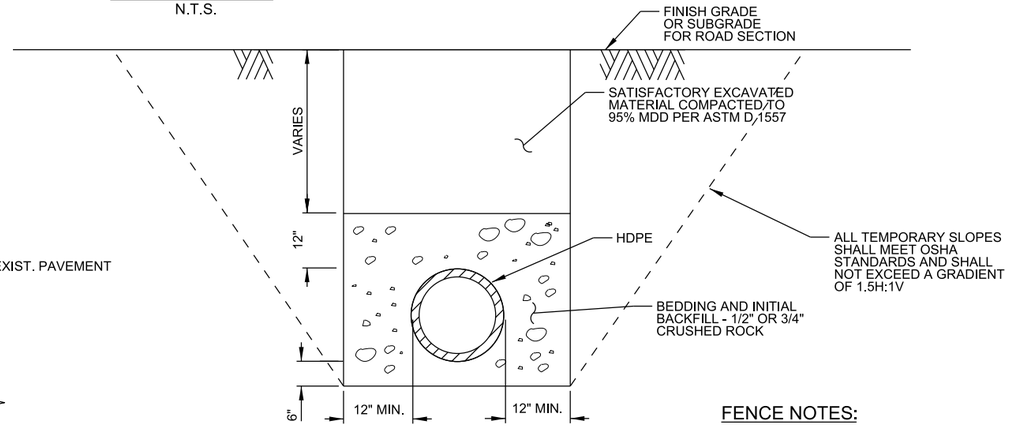
RCP TRENCH SECTION
N.T.S.



POST CAP DETAIL
N.T.S.



AC PAVEMENT REPAIR SECTION
N.T.S.



HDPE TRENCH SECTION
N.T.S.

FENCE NOTES:

1. ADJUSTABLE TIGHTENERS SHALL BE TURNBUCKLE OR EQUIVALENT, HAVING 6 INCH MIN. TAKE UP.
2. LIGHTWEIGHT METAL INSERTS SHALL BE METAL TUBES WITH I.D. 2" GREATER THAN O.D. OF PIPE USED. POSTS ARE TO BE GROUTED INTO INSERTS.

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

FORT IRWIN NATIONAL TRAINING CENTER
STORM DAMAGE REPAIR
SAN BERNARDINO COUNTY, CALIFORNIA
SECTION 3, CIVIL REPAIR

MISCELLANEOUS DETAILS
FENCING & TRENCHING DETAILS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

SUBMITTED BY: ARTHUR Y. JUNG, PE
CHIEF, DESIGN BRANCH

DESIGNED BY: DW
DRAWN BY: DW
CHECKED BY: MDN
FILE NAME: M-4.DGN
POCA NO. W912PL-14-R-0089
DISTRICT FILE NO.

Scale: AS SHOWN
SHEET
M-4

Plot Date: $date$

VALUE ENGINEERING PAYS

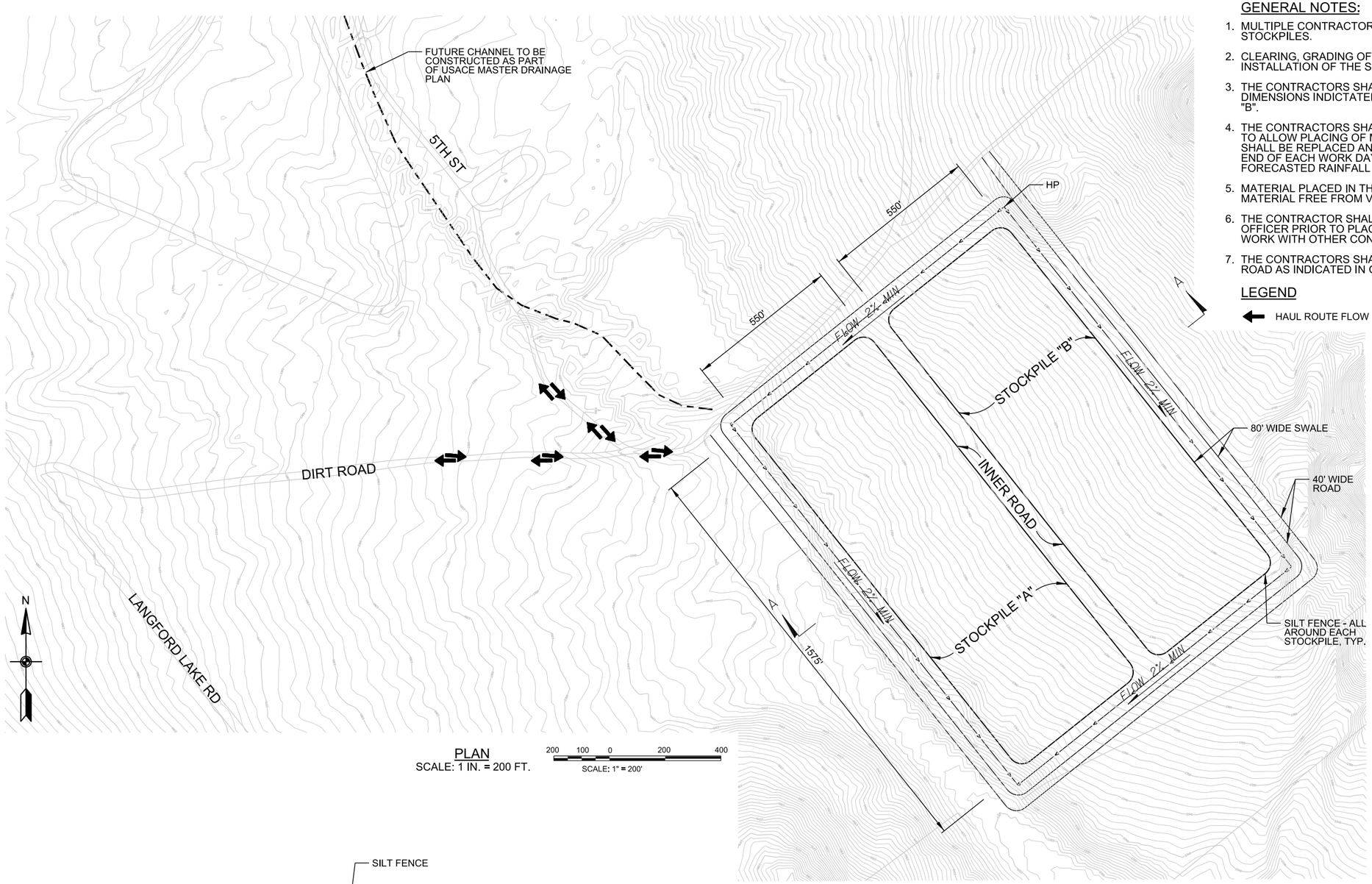
SAFETY PAYS

GENERAL NOTES:

1. MULTIPLE CONTRACTORS WILL BE DEPOSITING MATERIAL IN THESE STOCKPILES.
2. CLEARING, GRADING OF THE PERIMETER ROADS & SWALE AND INSTALLATION OF THE SILT FENCE, WILL BE DONE BY OTHERS.
3. THE CONTRACTORS SHALL FILL STOCKPILE "A" TO 10' HIGH AND THE DIMENSIONS INDICTATED PRIOR TO PLACING MATERIAL IN STOCKPILE "B".
4. THE CONTRACTORS SHALL REMOVE AND REPLACE THE SILT FENCING TO ALLOW PLACING OF MATERIAL IN THE STOCKPILES. SILT FENCE SHALL BE REPLACED AND INTACT AROUND BOTH STOCKPILES AT THE END OF EACH WORK DAY, AND IMMEDIATELY PRIOR TO ANY FORECASTED RAINFALL EVENT.
5. MATERIAL PLACED IN THE STOCKPILES SHALL BE CLEAN, EXCAVATED MATERIAL FREE FROM VEGETATION, TRASH, OR RUBBLE.
6. THE CONTRACTOR SHALL COORDINATE WITH THE CONTRACTING OFFICER PRIOR TO PLACEMENT OF MATERIAL IN THE STOCKPILE AND WORK WITH OTHER CONTRACTORS TO AVOID CONFLICTS.
7. THE CONTRACTORS SHALL MAINTAIN SWALE, SILT FENCE, GRADED ROAD AS INDICATED IN GOOD WORKING ORDER.

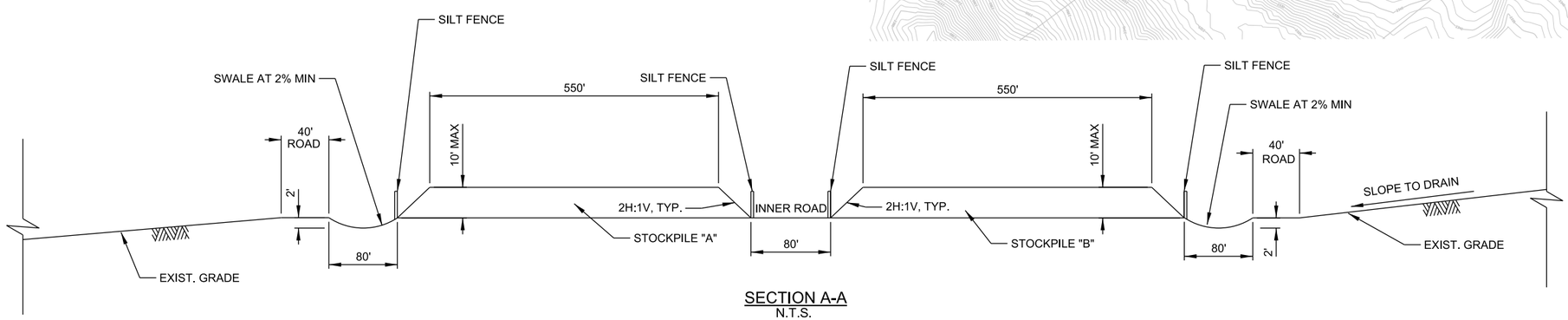
LEGEND

HAUL ROUTE FLOW OF TRAFFIC



PLAN
SCALE: 1 IN. = 200 FT.

200 100 0 200 400
SCALE: 1" = 200'



SECTION A-A
N.T.S.

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

FORT IRWIN NATIONAL TRAINING CENTER
STORM DAMAGE REPAIR
SAN BERNARDINO COUNTY, CALIFORNIA
SECTION 3, CIVIL REPAIR

DESIGNATED STOCKPILE LOCATION

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

SUBMITTED BY: ARTHUR Y. JUNG, PE
CHIEF, DESIGN BRANCH

DESIGNED BY: CW
DRAWN BY: CW
CHECKED BY: MDN

POCA NO. W912PL-14-R-0089
FILE NAME: SP-1.DGN

DISTRICT FILE NO.

Scale: AS SHOWN

SHEET
SP-1

Plot Date: $date$