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STMPD #117

EXTRA Q.K.D

10 MWe Solar Thermal  
Central Receiver Pilot Plant

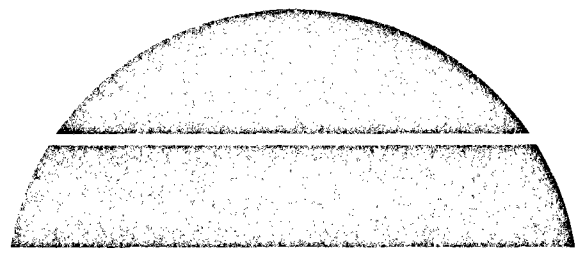
SOLAR FACILITIES DESIGN INTEGRATION

# SITE DEVELOPMENT AND PRELIMINARY EARTHWORK (RADL ITEM 7-27)

July 1979

WORK PERFORMED UNDER CONTRACT  
DE-AC-03-79SF10499

STEARNS-ROGER ENGINEERING CORP  
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P.O. BOX 5888  
DENVER, CO 80217



## U.S. Department of Energy



Solar Energy

117

## PREFACE

This technical construction package is provided by McDonnell Douglas Astronautics Company (MDAC) in accordance with Department of Energy Contract No. DE-AC-03-79SF10499, Reports and Deliverables List (RADL), Item 7-27. The report was prepared by Stearns-Roger Engineering Corporation under MDAC Subcontract No. 78012035.

This technical construction package will become Section 4 of the invitation for bid being prepared by the Department of Energy for the Site Development and Preliminary Earthwork Construction Package No. 1, soon to be released for bid.

RADL 7-27 includes two parts, as follows:

- Technical Specifications for Construction Package No. 1, identified as STMPO Drawing No. 40C7001S (Stearns-Roger Project No. C-21700)
- Supplemental construction drawings as identified in Paragraph 2.1 of the Technical Specification

Questions concerning this report should be directed to R. J. Perkins at (714) 896-3073.

TECHNICAL SPECIFICATIONS

June 13, 1979

NO. 40 C 700 1S

for

**SITE DEVELOPMENT  
AND  
PRELIMINARY EARTHWORK**

**CONSTRUCTION PACKAGE #1**

Prepared by:

**Stearns-Roger**  
ENGINEERING CO.

PROJECT NO. C-21700

CONSTRUCTION PACKAGE NO. 1  
SITE DEVELOPMENT & PRELIMINARY EARTHWORK  
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NOTICE

Wherever the term "Construction Manager" is used, it is intended that it shall mean the Contracting Officer's duly authorized representative which is Townsend and Bottum, Inc.

The Construction Manager will not direct the day-to-day operations of the Contractor, but will provide the inspection and verification of the Contractor's performance in accordance with the design specifications and drawings.

TECHNICAL SPECIFICATIONS FOR CONSTRUCTION PACKAGE NO. 1  
SITE DEVELOPMENT & PRELIMINARY EARTHWORK  
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LIST OF ABBREVIATIONS

The following abbreviations used in this Section 4 are defined as follows:

AASHTO - American Association of State Highway and Transportation Officials.

ASTM - American Society for Testing and Materials.

IFB - Information for Bidders.

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1.0 SCOPE OF WORK

The work of this Contract consists of site development and preliminary earthwork for the 10 MWe Solar Pilot Plant, near Daggett, California.

1.1. Description of Work. The work to be performed hereunder includes, but shall not necessarily be limited to the following:

1.1.1. Eliminating existing man-made obstructions from within the limits of the Project Area.

1.1.2. Removing and disposing of all vegetation and trash from within the limits of the Project Area.

1.1.3. Stripping the topsoil from the earthwork areas and disposing of the stripped material in designated locations.

1.1.4. Performing all cut, fill, excavating, backfilling, borrow, compacting, ditching, trenching, culvert installation, rough grading, finish grading, surveying services for maintaining horizontal and vertical control and accuracy, and other earthwork operations necessary to bring the Project Area to required lines, grades and densities and establish surface drainage.

1.1.5. Excavating and removing existing soils and constructing compacted structural fills in those Plant areas so noted on the Drawings.

1.1.6. Constructing roadways, parking areas and Construction Office Trailer Area, including aggregate base course.

1.1.7. Constructing concrete ditch lining.

1.1.8. Furnishing all labor, supervision, equipment, temporary facilities, materials, supplies and services not furnished by others and which are necessary for satisfactorily accomplishing the work of this Contract.

1.2. Work Not Included. The following items of work related to the work hereunder will be performed by others:

1.2.1. Subsurface investigations.

1.2.2. Initial surveys to establish reference points.

1.2.3. Sampling, testing and inspection of soils and in-place compacted densities.

1.2.4. Constructing Project Area perimeter fencing.

1.2.5. Bituminous paving.

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- 1.2.6. Project permanent structures and supporting facilities.
- 1.2.7. Site access road.
- 1.2.8. Helistop area surfacing.



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2.0. SUPPLEMENTS

The following Supplements are furnished with these Specifications:

2.1. Stearns-Roger Incorporated Drawings. The following Drawings are furnished with, and form a part of, these Specifications:

<u>Drawing No.</u>	<u>S-R Drawing No.</u>	<u>Sheet No.</u>	<u>Rev.</u>	<u>Title</u>
40C1005133900	XL-22934	G1-1	0	General Arrangement Plot Plan (furnished for information only)
40C1005133911	XL-22934	Y1-1	0	Site Plot Plan Layout
40C1005133921	XL-22934	Y2-1	0	Initial Grading Plan
40C1005133922	XL-22934	Y2-2	0	Grading Sections and Details
40C1005133941	XL-22934	Y4-1	0	Storm Drainage Sections and Details
40C1005133951	XL-22934	Y5-1	0	Road Profiles

2.2. Geotechnical Report. The following Geotechnical Report is furnished for information only:

Woodward-Clyde Consultants, "Geotechnical Investigations for the Proposed Solar Pilot Plant, Barstow, California," dated July 27, 1978.

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3.0. EXISTING OBSTRUCTIONS

This Article of these Specifications covers the dispositions to be made by the Contractor regarding existing construction located within or adjacent to the Project Area as shown on Sheet Y2-1.

3.1. General. All work hereunder shall be accomplished in accordance with these Specifications and in a neat, workmanlike manner. The Contractor shall ensure safety of persons, and prevent damage to work not designated for removal. All of the Contractor's methods and operations hereunder will be subject to approval by the Contracting Officer.

3.2. Corral and Shed. The existing corral and shed located in the northern portion of the Project Area shall be removed in its entirety. The shed shall be demolished, fence posts and remaining wire shall be removed, and postholes and depressions shall be backfilled. The Contractor shall remove and dispose of the resulting materials in an established disposal area off the Project as indicated in Article 4.3.2 Open burning at the Project site will not be permitted.

3.3. Well Casing. The existing 12-inch steel well casing located approximately as shown on the Drawings, shall remain in-place, except as follows, and shall be capped. The Contractor shall excavate around the casing to a depth of approximately 6 feet below the existing ground surface, the existing casing shall be cut and the upper portion removed. The remaining lower portion of the casing shall be sealed against entry of dirt by means of a minimum 3/8-inch thick steel plate tack welded over the top of the casing, or by an equivalent capping method acceptable to the Construction Manager. The excavation shall be backfilled to grade with acceptable materials in compacted lifts, in accordance with Article 5.0, EARTHWORK.

3.3.1 Marking. Prior to concealment, the location of the well shall be determined by survey and the coordinates recorded. Following establishing final grades in the vicinity of the well, the well location shall be permanently marked with a driven steel pin not less than 1 inch in diameter, having a permanently attached brass or bronze plate stamped "WELL CASING". The pin shall be encased in a 12" x 12" x 12" concrete collar which projects 2 inches above grade.

3.4. Marking and Protecting Gas Line. The buried natural gas transmission line located adjacent to the western boundary of the Project Area shall be marked and protected from damage throughout the Contractor's operations in the vicinity, especially those operations involving heavy equipment and excavation.

3.4.1. The Contractor shall mark the location of the existing natural gas transmission line along its route by furnishing and installing wooden stakes at not more than 100-foot intervals along the transmission line where the line is within 200 feet of the Contractor's work areas.

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3.4.2. The Contractor-installed stakes shall be of 2x4 lumber, projecting not less than 4 feet above grade after driving, and each shall be topped with a red cloth flag attached to the stake. Each stake shall be driven to sufficient penetration in the soil to prevent overturning due to wind or erosion.

3.4.3. The Contractor shall make known to his workmen and those of his Subcontractors the meaning of the stakes, and shall conduct his operations so as to minimize possibility of damage to the transmission line. Should any damage occur which is attributable to the Contractor's actions or omissions or those of his Subcontractors, the cost of resulting repairs will be charged to the Contractor.

3.4.4. Should any of the Contractor-installed flag stakes be destroyed or uprooted during this Contract, they shall be replaced by and at the expense of the Contractor.

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4.0. CLEARING AND GRUBBING

This Article of these Specifications covers clearing and grubbing necessary for the removal and disposal of vegetation and trash from within the limits specified below.

4.1. General. All existing vegetation shall be removed from within the limits of the Project Area in accordance with the following requirements. The removal of vegetation in each area shall have been completed before commencement of cut, fill, ditching or other earthwork operations in that area.

4.2. Description and Extent

4.2.1. All brush, weeds, accumulated vegetation, trash, sod, subsurface roots larger than 1 inch in diameter, and all matted roots shall be removed from within the earthwork areas of this Contract, as shown on Drawing Y2-1, and for a distance of 5 feet beyond the limits of those areas. Grubbing shall be performed to the depths necessary to accomplish the foregoing. Except in areas where excavation will follow, the depressions created by grubbing shall be backfilled with suitable material.

4.2.2. The area of alfalfa need not be grubbed, but should the height of the alfalfa exceed 8 inches, it shall be mowed and removed prior to that area being stripped in accordance with Article 5.0, EARTHWORK, to prevent mixing an excessive amount of vegetation with the stripped material.

4.3. Disposal. All cleared and grubbed materials including alfalfa hay, if any, and trash shall be removed from the Project Area by the Contractor and shall be transported to and disposed of in the Barstow landfill located approximately 12 miles west of the Project Site on Barstow Road south of Barstow. Open burning will not be permitted.

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5.0. EARTHWORK

This Article of these Specifications is applicable to stripping, excavating, dewatering, borrow, disposal, trenching, ditching, filling, backfilling, hauling, placing, scarifying, wetting or drying, compacting, shaping, grading and other earthwork operations necessary for performance of the work of this Contract. Aggregate surfacing of designated roads, traffic and storage areas is specified in Article 6.0, AGGREGATE SURFACING.

5.1. General Requirements

5.1.1. Lines and Grades. The work of this Contract shall be performed to the lines, grades, sections and densities as shown on the Drawings and as specified herein.

5.1.2. Drainage Control and Dewatering. The Contractor shall maintain drainage in the various work areas to prevent collection of water in excavations, ponding, erosion, and excessively wet or unstable soil conditions. Operations shall include the following:

5.1.2.1. Grading in the vicinity of and for a distance of approximately 25 feet outside each excavation, including slopes, shall be controlled to prevent surface water from entering each excavation where structural fills are required.

5.1.2.2. Any water accumulating in excavations, from whatever source, shall be promptly removed by the Contractor. Dewatering operations shall be continued as necessary for maintaining suitable conditions in the excavations during backfilling operations.

5.1.2.3. Temporary and/or permanent ditches shall be constructed as required for drainage and protection of the work, and shall be maintained unobstructed and free-draining. The area of disposal of drainage water shall be acceptable to the Construction Manager.

5.1.3. Weather Limitations. No earthwork operations involving compaction shall be performed during periods when freezing temperatures, excessive moisture, or similar factors cause doubt that satisfactory results will be obtained, unless the entire procedure is submitted for review by the Construction Manager and upon trial, produces satisfactory results.

5.1.4. Compaction Control

5.1.4.1. Moisture-density relations of soils will be determined in accordance with ASTM D1557, which will be referred to as maximum density hereinafter. Field in-place density tests of compacted fill, backfill and subgrade, will be performed in accordance with ASTM D1556, D2167 or ASTM D2922

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nuclear method. Where in-place densities fall below the required minimums, the Contractor will be required to rework those zones until the required densities are obtained.

5.1.4.2. During placing and/or compacting operations with earth or earth-and-aggregate mixtures, the moisture content of material in the layer being compacted shall be near optimum (optimum +1, -3 percent), shall be uniform throughout the layer, and shall be maintained at near optimum as determined in accordance with ASTM D1557, as specified above. The Contractor shall perform all operations necessary to ensure the proper moisture content, including sprinkling, scarifying, aeration or drainage.

5.1.5. Testing. Testing of materials as necessary to determine moisture-density relations, suitability of materials, and to determine that the required degrees of compaction are being obtained, will be performed, at no cost to the Contractor, by a Testing Agency under separate contract to the Construction Manager. The Contractor shall coordinate his work with the Construction Manager to permit proper inspection as the work progresses.

5.1.6. Equipment. Should any equipment not be maintained in satisfactory working order or prove inadequate for obtaining the prescribed results, such equipment shall be repaired or replaced immediately upon notification to the Contractor that the work performed by the equipment is unacceptable and does not meet the requirements of the plans and specifications.

5.1.7. Sheeting, Shoring and Bracing. It shall be the responsibility of the Contractor to provide and install sheeting, shoring, and bracing as necessary and as required by California and Federal safety regulations, to adequately support banks of excavations for safety of workmen and protection of the work.

5.1.8. Stockpiling. When excess suitable materials result from the excavation work hereunder, or when excessive moisture in excavated material, construction procedure, or other factors make stockpiling of temporarily unusable materials advisable, the materials shall be placed in temporary stockpiles as approved by the Construction Manager. Different classes of materials shall be stockpiled separately. All stockpile areas shall be self-draining. Preparation and maintenance of stockpile areas shall be accomplished by the Contractor without additional compensation.

5.1.9. Wasting. Material which is unsuitable for use in the work, or which is designated to be wasted, shall be wasted in disposal areas designated on the Drawings. Waste material shall be placed in the disposal areas in such manner that the areas will be self-draining. Compaction by at least two passes of a heavy roller will be required throughout disposal areas to prevent wind and rain erosion. Upon completion of wasting operations in each disposal area, the Contractor shall rough grade and dress the area.

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5.1.10. Dust Control. The Contractor shall institute and maintain adequate dust control measures, such as sprinkling, for his work areas.

5.1.11. Borrow Location. Borrow will be available to the Contractor, without charge, from an existing borrow area located near the south boundary of the Project Area, as indicated on the Drawings. For provisions regarding use of this borrow location, see Paragraph 5.5, "Borrow Operations."

5.1.12. Construction Water. Raw water in the quantities required for the Contractor's use in earthwork operations and dust control, will be available without charge at a valved and metered outlet at existing Well "A" as shown on Drawing Y2-1. The Contractor will be responsible for providing all equipment for transporting and utilizing the water to meet his construction needs.

5.2. Materials. Earthwork materials for use in the work shall, to the extent practicable, be obtained from earthwork operations within the Project Area. Where the quantities of suitable materials prove insufficient, they shall be supplemented by suitable materials obtained by the Contractor from the designated borrow area. Production of borrow materials shall be in accordance with Paragraph 5.5 "Borrow Operations."

5.2.1. Suitable Materials. Earthwork materials, to be considered as suitable for use in the work hereunder, shall be free from objectionable materials such as perishable matter, trash, debris, frost or frozen material, stones and hard cemented pieces larger than 3 inches, and shall be compactible, either with or without blending, to the required densities. In addition, all material placed within 18 inches of finished grade shall swell less than 3 percent when tested in accordance with Uniform Building Code Test Method 29-2.

5.2.2. Unsuitable Material

5.2.2.1. All material containing perishable matter such as roots, sod, grass, decayed vegetable matter, debris, frost or frozen material, or materials which cannot be compacted to the specified densities, shall be classified as unsuitable for use in the work.

5.2.2.2. Materials which are temporarily unsuitable due to frost, excessive moisture or improper gradation will not be classified as unsuitable if such material can be satisfactorily reclaimed by screening, aerating, or blending with other materials.

5.2.2.3. Temporarily unsuitable materials shall be stockpiled in accordance with Paragraph 5.1.8. "Stockpiling." Permanently unsuitable materials shall be wasted in accordance with Paragraph 5.1.9, "Wasting."

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5.3. Stripping

5.3.1. Description and Extent. The entire area within which earthwork is performed shall be stripped. Following clearing and grubbing, and before commencing other earthwork operations in that area, it shall be stripped sufficiently to remove all soil containing perishable matter. The average depth of stripping which will be required is anticipated to be 4 inches, except as follows:

5.3.1.1. The formerly cultivated area of alfalfa shall be stripped sufficiently to remove all topsoil and surface vegetation. The average depth of stripping which will be required is anticipated to be 12 inches.

5.3.1.2. The location of the former corral shall be stripped to an anticipated depth of 12 inches.

5.3.2. Disposal. Stripped material shall be transported to and stockpiled in a location designated for the purpose as shown on the Drawings and in accordance with paragraph 5.1.9.

5.4. Excavation

5.4.1. General

5.4.1.1. Excavation shall consist of the satisfactory removal and disposition of all materials, regardless of the nature of the materials encountered, to the lines, grades and dimensions shown on the drawings and specified herein.

5.4.1.2. As nearly as practicable, all excess material excavated and not classified as unsuitable material shall be stockpiled for later use by others. Any materials required for the work which are in excess of the amounts produced from excavation shall be supplied from borrow selected and approved for the particular use. Material shall be borrowed from the designated borrow area. The Contractor's excavation operations shall be conducted in such manner as to yield maximum amounts of suitable materials. Suitable materials shall be wasted only with prior approval from the Construction Manager.

5.4.2. Classification of Excavation

5.4.2.1. Excavation of materials, other than borrow excavation, shall be classified as common excavation. It is not anticipated that hard, cemented materials will be encountered in the work.



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5.4.2.2. Excavation of suitable materials required for completion of the earthwork which are obtained from areas outside the indicated grading and excavation limits, will be classified as borrow.

5.4.3. Overexcavation. Except as specified, overexcavation shall be avoided.

5.4.3.1. If, when the indicated limits of excavation are reached, the exposed material is found to have unsuitable qualities, the Contracting Officer will direct, in writing, the corrective measures to be taken and an equitable adjustment in price will be made for this additional work in accordance with the provisions of the Contract.

5.4.3.2. Unauthorized overexcavation and the corrective measures necessitated thereby will not be considered as a basis for claims for additional payment.

5.4.4. Excavation of Areas to Receive Structural Fill. Those zones of the Plant Area, as indicated on the Drawings, shall be excavated to the elevations and at least the limits indicated, and reconstructed to finish grade in compacted layers of structural fill as specified hereinafter under Paragraph 5.6, "Backfilling."

5.4.4.1. The indicated limits of excavation shall be deemed to be at the bottom of the excavation. The Contractor may, at his option, exceed the horizontal limits shown in order to properly utilize his construction equipment, but shall reconstruct such horizontal overexcavation in the manner and to the specifications of the structural fills, without additional compensation. The banks of the excavations shall be sloped outward as necessary for the safety of workmen and the protection of the work.

5.4.4.2. The excavated materials shall, except for any materials designated by the Construction Manager's Testing Agency as unsuitable, be stockpiled nearby for use in constructing structural fills in the excavated zones. The excavated material shall be piled a sufficient distance from the banks of the excavations to prevent overloading the banks and causing slides.

5.4.5. Excavation of Ditches. Ditches shall be excavated to the slope and section indicated on the Drawings. Overexcavation shall be backfilled to the required grade and slope with suitable material and compacted. All ditches shall be maintained by the Contractor until completion of Contract.

5.4.6. Trenching for Culverts. Trenching for culverts is specified hereinafter under Paragraph 5.8, "Culverts."

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5.5. Borrow Operations

5.5.1. Preparation and excavation of borrow locations, and further processing of the excavated materials if necessary, shall be performed by the Contractor as required to produce material suitable for the intended use. Clearing, grubbing and stripping of borrow areas; disposal of unsuitable materials, and maintenance and dressing of borrow areas shall be performed as operations incidental to borrow.

5.5.2. Borrow locations shall be neatly excavated and adequately drained, and when borrow operations are completed, shall be dressed and left in neat condition.

5.5.3. Production and use of borrow from locations other than that shown on the Drawings shall not be permitted.

5.6. Constructing Structural Fills

5.6.1. General

5.6.1.1. Those areas indicated on the Drawings to receive structural fill, shall be excavated in accordance with Paragraph 5.4.4, "Excavation of Areas to Receive Structural Fills." They shall then be constructed to finish grade in accordance with the following requirements. The zones of structural fill shall, to the extent practicable, be constructed of the stockpiled material removed from the excavation.

5.6.1.2. The material to be placed in the structural fill shall be thoroughly mixed to obtain uniformity of the material and uniform moisture content.

5.6.1.3. During placing and compacting operations, the moisture content of the layer being compacted shall be controlled in accordance with Paragraph 5.1.4.2.

5.6.1.4. Placement of material for structural fill shall not be commenced until all loose material resulting from bank collapse has been removed, the bottom of the excavation has been brought to near optimum moisture content, and the excavation has been approved by the Construction Manager and his Testing Agency as ready for backfilling.

5.6.1.5. The Contractor shall coordinate his placing and compacting operations with the Construction Manager such that proper compaction of each layer can be verified by the Construction Manager's Testing Agency before placement of the succeeding layer.

5.6.2. Compacting Equipment. Compaction shall be accomplished by multiple-wheel pneumatic-tired rollers, vibratory rollers, or other acceptable types of compaction equipment. The compacting equipment shall be of such size, type and condition that it compacts the fill to the required density.

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5.6.3. Placing and Compacting.

5.6.3.1. Material meeting the specified requirements shall be placed in horizontal layers and machine-compacted to not less than 95 percent maximum density.

5.6.3.2. Compacting shall be uniform over the entire layer being compacted, and the equipment shall make sufficient passes to uniformly obtain the desired densities.

5.6.3.3. The first layer shall not exceed 6 inches in uncompacted thickness. Succeeding layers shall not exceed 8 inches in uncompacted thickness. Each layer shall be uniformly compacted to not less than the specified density before placing the succeeding layer.

5.6.3.4. The Construction Manager's Testing Agency will make density tests in accordance with ASTM D1556, ASTM D2167, or ASTM D2922, for each layer of fill. Density tests may be made in the compacted materials below the surface when the surface is disturbed. When these tests indicate that the density or moisture content of any layer of backfill, or portion thereof, does not meet the specified density or moisture content, the deficient zone or zones shall be reworked by and at the expense of the Contractor until the specified density has been obtained.

5.6.3.5. Construction shall continue in accordance with the foregoing until the structural fills have reached the respective finished grades. Should construction of a structural fill zone be suspended due to precipitation or freezing temperatures, the last layer placed before suspension of construction shall be recompact and reinspected before resuming placement.

5.7. Fills

5.7.1. General

5.7.1.1. Fills shall be constructed of suitable material as defined hereinbefore, placed and compacted to the lines, grades and dimensions shown, and to not less than the specified density. The Contractor shall coordinate his placement and compacting operations with the Construction Manager to permit proper inspection as the work progresses.

5.7.1.2. During placing and compacting operations, the moisture content of the layer being compacted shall be controlled in accordance with Paragraph 5.1.4.2.

5.7.2. Preparation of Surfaces to Receive Fill

5.7.2.1. Preparation of surfaces to receive fill shall be accomplished immediately before constructing fill on those surfaces. Areas to receive fill shall have ridges removed, shall be scarified to a depth of approximately 6

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inches, brought to near optimum moisture content, and be compacted to not less than 90 percent maximum density.

5.7.2.2. Construction of fills on these prepared surfaces shall not be commenced prior to their inspection and approval by the Construction Manager's Testing Agency. Any areas showing inadequate compaction or yielding spots shall be reworked, as necessary, until the specified density is obtained.

5.7.3. Placing and Compacting

5.7.3.1 Fill material, at near optimum moisture content as defined above, shall be placed in uniform layers not exceeding 8 inches in uncompacted thickness. Each layer shall be uniformly compacted to the required density before placing the succeeding layer. Except as specified elsewhere, fills shall be compacted to not less than 90 percent maximum density at optimum moisture content. Insufficiently compacted or yielding areas of fill shall be scarified, corrective material added if necessary, and be recompactd to the required density before the following layer is placed.

5.7.3.2. For additional compaction requirements applicable to road and traffic areas, see Paragraph 5.9.1.

5.7.3.3. For additional compaction requirements applicable to the Collector Field, see Paragraph 5.10.

5.7.3.4. For requirements applicable to the construction of structural fills see Paragraph 5.6.1.

5.8. Culverts

5.8.1. General. The Contractor shall furnish and install all pipe and pipe arch culverts shown or required within the various work areas of this Contract. Culvert locations, sections, sizes and gages shall be as shown on the Drawings. Each culvert shall be installed complete with flared end sections, except as otherwise shown on the Drawings.

5.8.2. Materials

5.8.2.1. Culverts shall be galvanized corrugated steel culverts with annular corrugations, conforming to the requirements of AASHTO Specification M36.

5.8.2.2. Coupling bands for culverts shall be the manufacturer's standard galvanized couplings designed to hold culvert ends securely fastened together and in alignment. Flared ends for culverts shall be of a design standard with the manufacturer. All culvert couplings and flared end sections shall conform to AASHTO Specification M36.

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5.8.3. Trenching

5.8.3.1. Excavation for culverts shall be by open cut. The width of trenches at any point below the top of the culvert shall be such as to permit satisfactory makeup of joints and thorough tamping of bedding and backfill under the haunches of the culvert. Trench width below the top of the culvert shall not exceed 12 inches on either side of culvert less than 36 inches, or 18 inches on either side of culvert 36 inches or larger. Above the top of the culvert, trench walls shall be sloped outward in accordance with California and Federal (OSHA) safety regulations.

5.8.3.2. Where culverts are to be underlaid by fill, the fill shall be brought to at least 2 feet above the elevation at which the top of the installed culvert will occur, or to finished grade, whichever is less, with the fill compacted to the specified density for its full depth. The compacted material shall then be trenched for the culvert. Stones 3 inches or larger shall be removed as necessary to prevent point bearing.

5.8.3.3. Bottoms of trenches shall be shaped so that at least the bottom quadrant of the culvert rests on firm soil. Depressions for joints shall be made only after the trench bottom has been graded and shaped.

5.8.3.4. Immediately in advance of culvert laying, the shaped and graded material in the bottom of the trench shall be loosened sufficiently that the corrugations of the bottom quadrant of the culvert are filled with earth when the culvert is laid.

5.8.4. Laying and Makeup

5.8.4.1. Each length of culvert shall be examined carefully before being laid, and damaged culvert or accessories shall not be used.

5.8.4.2. Each culvert shall be laid to the grade and alignment indicated, with the separate sections joined firmly together. Sections shall be laid with the inside laps of circumferential joints pointing in the direction of flow, and with longitudinal laps on the sides.

5.8.4.5. During makeup of joints, the spaces between the bands and the culvert shall be kept free from dirt and grit so the corrugations will fit snugly. While being tightened, each connecting band shall be tapped with a soft-head mallet to take up slack and ensure a tight joint.

5.8.5. Protection Against Corrosion. Before backfilling, all ungalvanized metal, such as bolts, shall be given a heavy brush coat of tar or bituminous paint.

5.8.6. Backfilling

5.8.6.1. Backfilling of culverts shall be with suitable material excavated from the trenches, placed under the haunches and along both sides of the

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culvert in layers not exceeding 6 inches in uncompacted thickness. Stones shall be removed as necessary to prevent point bearing against the culvert.

5.8.6.2. The backfill shall be brought up evenly on both sides of the culvert for its full length, taking care to ensure thorough compaction of the backfill under the haunches of the culvert. Each layer shall be thoroughly compacted to not less than 95 percent of maximum density as determined by ASTM D1557 before placing the succeeding layer. This method of filling and compacting shall be continued until the compacted backfill has reached finished grade or an elevation at least 18 inches above the top of the culvert, whichever is less.

5.8.6.3. Any remaining trench depth shall then be backfilled with fill material placed and compacted in layers as previously specified in Subparagraph 5.7.3. "Placing and Compacting."

5.8.7. Riprap. Where indicated on the drawings, riprap shall be installed to protect slopes at culvert inlets.

5.8.7.1. Riprap shall be hard, durable pieces of stone, angular in shape, of mixed sizes, ranging from 4 to 6 inches in least dimension.

5.8.7.2. Bedding will not be required. The riprap pieces shall be placed and positioned by hand directly on the compacted slopes in a manner which results in a stable single layer of riprap.

5.8.7.3. Placing shall proceed from the bottom of slopes upward, with pieces set in firm contact and voids kept to a minimum. The completed riprap shall be stable and shall show no tendency to slide or roll. Placing riprap by dumping shall not be permitted.

5.9. Preparation of Surfaces to Receive Base Courses

5.9.1. Areas to receive aggregate base course shall, regardless of whether the surfaces are in areas of cut or fill, be brought to finished subgrade elevations and tolerances, and to near optimum moisture content, and the top 12 inches uniformly compacted to not less than 95 percent maximum density. Accomplishing the foregoing in cut areas may require the removal and replacement of material.

5.9.2. After uniformly compacting to the required density, the finished subgrades shall be smooth and shall not vary more than 0.1 foot above or below grade.

5.9.3. Subgrade that does not conform to the above requirements shall be reconstructed to the specific density and finished to the required tolerances without additional compensation.

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5.9.4. Any section or area on the surface of the subgrade showing settlement or sponginess will be rejected, and the Contractor shall correct the conditions as follows:

5.9.4.1. If the rejected section or area of subgrade is underlain by fill, the Contractor shall remove all material placed within the rejected section or area, and satisfactorily rebuild such sections or areas with the materials removed.

5.9.4.2. If the rejected section or area of subgrade is in cut, and tests indicate that the failure was due to inadequate compaction of the subgrade, the Contractor shall remove and rebuild the subgrade. Should the tests indicate that the failure was due to unstable material below subgrade, the Contractor shall remove the unstable material, replace with satisfactory material and reconstruct the subgrade.

5.9.5. Should elapsed time, or a period of precipitation or freezing temperatures occur between completion of an area of subgrade and construction of aggregate base course thereon, the subgrade will be reinspected and, if necessary, reconditioned by the Contractor in accordance with the foregoing requirements.

5.10. Compaction of the Collector Field. The top 24 inches below finish grades throughout the Collector Field, regardless of whether in cut or fill, shall be compacted to not less than 95 percent maximum density. To accomplish the foregoing in areas of cut may require the removal and replacement of existing material.

5.11. Grading. The Contractor shall perform all site grading as shown on the Drawings and as necessary to assure drainage away from the excavations and stockpiled materials, and to prevent ponding of runoff. In addition, the Contractor shall perform finish grading of all embankments and slopes constructed under this Contract. The graded surfaces shall be reasonably smooth, compacted, and free from irregular surface changes. The degree of finish required shall be that ordinarily obtainable from either blade grader or scraper operations. The finished and graded surfaces shall be not more than 0.1 foot above or below the established grade or approved cross-section.

5.12. Maintenance. Work areas of this Contract shall be maintained in satisfactory condition until completion of Contract. Any caving, erosion, rutting, undue settlement, excessive silting of ditches or culverts, and other damage or defects in the work occurring or detectable prior to completion of Contract shall be promptly corrected by the Contractor without additional compensation.

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6.0. AGGREGATE BASE COURSE

This Article of these Specifications covers constructing compacted aggregate base courses for the various on-site areas indicated to be aggregate surfaced, such as roadways, parking areas, and the Construction Office Trailer Area. The extent and finished thickness of such surfacing shall be as shown on the Drawings.

6.1. General. Aggregate surfacing constructed hereunder shall be compacted aggregate base courses conforming to the requirements of Section 26 of the "Standard Specifications of the State of California, Department of Transportation," Class 2 Aggregate Base, 3/4-inch maximum aggregate size, except that the compaction and tolerance requirements specified hereinafter shall govern.

6.1.1. The aggregate base material shall meet the gradation quality and other requirements of Article 26-1.02B of the referenced Standard Specification.

6.1.2. All aggregate base materials required for the work hereunder shall be furnished by the Contractor from off-site sources. The aggregate base material shall not be used in the work until certification by the supplier or the Construction Manager's Testing Agency indicates its compliance with Article 26-1.02B of the Standard Specification.

6.1.3. In-place density of both compacted subgrade and compacted aggregate base course will be determined by the Testing Agency in accordance with ASTM D1556 (Sand-Cone Method) or ASTM D2922 (Nuclear Method).

6.2. Subgrade Requirements. Immediately prior to commencing base course construction thereon, the subgrade surfaces shall be inspected by the Construction Manager's Testing Agency to verify the density and tolerance requirements of Paragraph 5.9. At the time of commencing aggregate base construction, the subgrade of the area to be surfaced shall be near optimum moisture content as determined in accordance with ASTM D1557.

6.3. Construction

6.3.1. Aggregate base material shall be placed only on finished subgrades meeting the specified requirements for section, density, uniformity and smoothness, and which are free from loose or frozen material. Aggregate base material shall not be placed on the prepared subgrades when the moisture content of the top 6 inches of the subgrade exceeds optimum.

6.3.2. The aggregate base material shall be placed in uniform mixtures and shall be spread in layers or windrows without segregation. Segregated materials shall be mixed until uniform.



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6.3.3. The aggregate base material shall be spread, watered, processed, shaped and compacted as specified. Where the required thickness of the completed course is 6 inches or less, the material may be spread and compacted in a single layer. Where the required thickness of the completed aggregate base exceeds 6 inches, the base material shall be spread and compacted in layers of approximately equal thickness, providing the compacted thickness of no layer shall exceed 6 inches.

6.3.4. After the top surface of each course has been spread and shaped, and before compaction is completed, all surface transverse and longitudinal irregularities shall be eliminated.

6.3.5. Each layer of aggregate base material shall be uniformly compacted throughout to a density of not less than 95 percent of maximum density at optimum moisture content as determined in accordance with ASTM D1557.

6.3.6. The finished and compacted surface of the compacted aggregate surfacing shall conform to the grade and typical sections shown on the Drawings, or with authorized modifications thereof. When tested in any direction with a 10 foot straightedge, the finished base course shall not show a deviation in excess of 3/8-inch.

6.3.7. All shoulder construction shall be done in proper sequence with construction of the aggregate base courses. In compacting edges of the subgrade and aggregate base courses, the rolling shall be as specified for the base course. Completed shoulders shall be true to alignment and grade, shaped to drain, and in conformity with the sections shown on the Drawings.

6.4. Maintenance. The Contractor shall maintain all aggregate-surfaced areas and their shoulders in satisfactory condition until completion of the Contract, promptly correcting all erosion, settlement and surface irregularities which may develop. Such maintenance shall be performed by the Contractor as operations incidental to aggregate base course construction, without additional compensation.

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7.0. CONCRETE DITCH LINING

This Article of these Specifications covers constructing ditch linings of reinforced, pneumatically-placed concrete.

7.1. General

7.1.1. Contractor. Only a Contractor experienced in installation of pneumatically-placed concrete shall be utilized in performing the concrete work hereunder. Satisfactory written evidence of such experience shall be furnished to the Construction Manager one week prior to the start of the operation.

7.1.2. Equipment. The Contractor shall furnish and utilize equipment which will apply the concrete by means of pneumatic pressure. The sand and cement shall be thoroughly mixed before being fed to the nozzle. Addition of water to the sand and cement mix shall occur at the discharge nozzle, under the control of the nozzleman. Air and water shall be supplied at the nozzle in sufficient volume and under such pressure as required for proper performance of the work. Pressures at the nozzle shall be steady, without pulsation.

7.1.3. Ditch Preparation. Before placement of reinforcing mesh or concrete, the ditch to be lined shall have been accurately brought to the sections, lines and grades indicated. Compaction and hand shaping shall be performed as required. All soft or yielding areas shall be corrected to at least the density of the adjacent undisturbed earth. All loose material shall be removed. The surfaces to be concreted shall be wet, but not muddy, at the time the concrete is placed.

7.1.4. Timing. The Contractor shall schedule his operations such that the ditch lining is placed before any deterioration of the banks.

7.1.5. Weather Restrictions. Pneumatic placement of concrete shall be performed only when conditions are favorable for obtaining satisfactory results. Concrete shall not be placed during periods when one or more of the following conditions exist at the jobsite:

7.1.5.1 The ambient temperature is above 85 F.

7.1.5.2. Wind velocity exceeds 30 mph.

7.1.5.3. Temperatures below 40 F exist or freezing temperatures are forecast within 24 hours.

7.1.5.4. Precipitation appears imminent.

7.2. Materials

7.2.1. Reinforcing Mesh. Reinforcing mesh shall be 4-inch by 4-inch mesh, W2.9 x W2.9 welded wire fabric conforming to ASTM A185.

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7.2.2. Cement. Cement shall be an approved brand of Portland cement conforming to ASTM C150 Type V. A single brand shall be used throughout the work.

7.2.3. Aggregate. The aggregate shall consist of washed, hard, dense, durable, sharp particles, well graded from fine to coarse, containing no particles which will not pass a 3/8-inch sieve. The aggregate shall be free from organic matter and shall not contain any soil or clay. The aggregate shall, at time of use, contain not less than 3 percent nor more than 5 percent moisture by weight.

7.2.4. Water. Water shall be clean, fresh and free from injurious amounts of impurities. Water available to the Contractor from Well "A" meets these requirements.

7.2.5. Curing Compound. Curing compound shall be membrane-forming type conforming to ASTM C309 Type 1, and shall contain a fugitive dye ingredient to facilitate application and inspection.

7.2.6. Joint Sealer. Joint sealer shall be an approved brand of one component, polymeric rubber caulking conforming to Federal Specification TT-C-598. The joint sealer shall be a grey color.

7.2.7. Premolded Joint Filler. Premolded joint filler shall be an approved brand of cork of the dimensions shown on the drawings and conforming to Federal Specification HH-F-314f Type II, Class B.

7.3 Proportioning. The pneumatically-placed concrete shall be composed of one (1) part cement to 4 parts aggregate by volume, thoroughly dry-mixed before introduction into the application equipment. The water-cement ratio shall be the minimum that will allow efficient operation of the pneumatic application equipment.

7.4. Reinforcement. Reinforcing mesh shall be placed such that the areas to be concreted are covered with mesh, securely fastened at edges and ends, and supported approximately 1 inch off the ground. The sheets of mesh shall, except at expansion joints, be lapped not less than 4 inches at sides and ends, and the lapped sheets securely wire tied together at 18-inch intervals. Reinforcing shall not extend through expansion joints. To prevent displacement during concreting, the reinforcing shall be fastened to the earth slopes by means of bent wire staples located not more than 3 feet apart along the top or free edges of the fabric, and on a 3 by 3 foot grid throughout each slope.

7.5. Expansion Joints. Transverse expansion joints shall be constructed in the ditch liner approximately every 30 feet along its run. Each joint shall be formed by placing the concrete against a premolded joint filler and a removable insert of the dimensions shown on the Drawings. After the concrete has cured, each insert shall be removed and the resulting joint filled with the specified joint sealer.

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7.6. Ground Wires. The Contractor shall install ground wires for the purpose of maintaining better concrete thickness control in his work. The ground wires shall be installed so that they accurately outline the ditch section shown. The ground wires shall be located at intervals sufficient to insure proper finished concrete thickness, and shall be maintained tight. Following completion and approval of each area of concrete work, the ground wires shall be removed.

7.7. Placement

7.7.1. General. Concrete shall be placed only against earth surfaces which are wet but not muddy, and against concrete surfaces which have not cured and have not been sprayed with curing compound. The initial coat shall fill all minor depressions in the surface to be covered. Additional coats shall be applied until a build-up of at least the required overall thickness is achieved.

7.7.2. Workmanship

7.7.2.1. The nozzle shall be held as nearly perpendicular as possible to the surface to which the concrete is applied, and at such distance and narrow range of movement as will produce a spreading effect over a small area. The velocity of discharge from the nozzle, the distance of the nozzle from the surface, and the amount of water used, shall be regulated by the nozzleman in a manner which produces a dense coating and results in a minimum rebound of materials and no sloughing. Rebound material shall not be reused and shall be removed from the work.

7.7.2.2. The maximum thickness of each layer will be limited to the thickness which can be placed without the material sagging. Time between application of layers shall be only sufficient to insure against sagging or sliding. In case a portion of the previous layer has set to such hardness or has become coated in a manner preventing adequate bonding, the surface of that layer shall be thoroughly wetted with water and scrubbed with stiff-bristle brooms before starting the next layer.

7.7.2.3. Construction joints shall be avoided. At the end of the day's work or similar stopping periods, placement shall be stopped at an expansion joint. Where necessary, due to unavoidable work stoppages, the mortar shall be tapered to a thin edge. Before applying the adjacent section, this tapered portion shall be thoroughly cleaned and wetted.

7.7.2.4. The concrete shall be applied in horizontal zones, starting from the base of the slope and progressing up the slope. The concrete shall form a compact, durable covering of not less than 3 inches in total thickness, and shall be free from undue irregularities.

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7.8. Finishing, Curing and Protection

7.8.1. Finish. The pneumatically-placed concrete will not require finishing other than even, true surfaces as obtained by skilled pneumatic placement.

7.8.2. Curing. Immediately following placing the final layer of each area of concrete, the Contractor shall commence curing. Curing shall consist of protecting the concrete from damage and rapid loss of moisture.

7.8.2.1. Curing shall be accomplished using the specified spray-applied membrane-forming curing compound. The compound shall be applied according to the manufacturer's instructions. The manner of application and the rate of application shall result in the formation of a continuous, unbroken film.

7.8.2.2. The curing compound shall be applied to the entire area of the exposed surfaces, and shall be applied in two separate applications, each of which shall be by an even, sweeping motion of the nozzle, with sufficient overlap to ensure uniform and complete coverage. The second application shall follow five to thirty minutes after the first application, and shall be applied to cross and recross the sweep of the first application.

7.8.3. Protection. After final application of the curing compound, the treated surface shall be protected from foot traffic and other sources of damage to the membrane for a minimum of seven (7) days.