TECHNICAL SPECIFICATIONS
FOR
FARMERS BRANCH CREEK
CHANNEL IMPROVEMENTS

Prepared for:

The Hudson Group, Inc.
3050 Post Oak Boulevard, Suite 110
Houston, Texas 77056

Prepared by:

Turner Collie & Braden Inc.
5710 LBJ Freeway, Suite 370
Dallas, Texas 75240

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ITEM NO. A2004 - EMBANKMENT

PART 1 - GENERAL

1.01 Scope of Work

Place and compact approved materials to required lines, grades, and cross-sections as shown on PLANS.

PART 2 - PRODUCTS

2.01 General

As called for in other items of TECHNICAL SPECIFICATIONS or as shown on PLANS.

PART 3 - EXECUTION

3.01 Construction Methods

Place embankment on properly cleared and prepared areas. Use suitable materials from excavation, borrow, or other designated or approved sources. Use material free from vegetation, roots, and debris. Scarify or roughen existing sloped areas receiving new embankment. Construct embankments or fills in successive horizontal layers, extending across entire fill area. Fill material to be placed in horizontal layers of depths compatible to material being placed and type of equipment to be used. No layer spread for compaction to exceed 8 inches of compacted thickness. Each layer of fill to be uniform as to material, moisture, and density before compaction. Compact to required density by blading, rolling, and sprinkling with approved equipment. Use mechanical tamps to obtain required density in inaccessible areas. Unless otherwise specified, place embankment at or near optimum moisture and compact to at least 95 percent AASHTO Standard Methods T-99-74 density. Make at least one density test per 500 cubic yards of embankment.

3.02 Measurement and Payment

Unless otherwise indicated, no separate payment for work performed under this Item, including testing. Include cost of same in Contract price bid for items of which this work is a component. When indicated in PROPOSAL as pay item, measure "Embankment" by cubic yard volume based on average end

areas and actual lengths placed. Measurement to be made from prepared ground elevation to finished top and side slopes. Embankment to be paid for at Contract unit price. Price paid for embankment to be full compensation for all items of work described herein, including testing.

END OF ITEM

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ITEM NO. A2008 - CLEARING AND GRUBBING (CHANNEL)

PART 1 - GENERAL

1.01 Scope of Work

Furnish labor, supervision, materials, equipment, and supplies necessary for clearing, grubbing, and stripping operations.

PART 2 - PRODUCTS

2.01 General

Not required for this Item.

PART 3 - EXECUTION

3.01 Construction Methods

A. Clear, grub, and dispose of trees, stumps, brush, logs, vegetation, rubbish, and other objectionable matter from the entire easement area.

B. Protect from damage any trees designated to remain.

C. In areas to be cleared that are not within the limits of the proposed channel, clear out stump holes of all refuse and loose earth, backfill and compact to approximate density of surrounding ground. Do not allow water to accumulate in stump holes before backfilling.

D. Burn or dispose of offsite all refuse from clearing operations in approved manner. Obtain required permits from various governmental agencies involved. Bury no refuse on Owner's property.

3.02 Measurement and Payment

Measure "Channel Clearing" by the acre or lump sum as indicated in PROPOSAL. Payment for work under this Item will be made at Contract unit price for "Channel Clearing."

END OF ITEM

Std. 5/13/80

ITEM NO. A2009 - CHANNEL EXCAVATION

PART 1 - GENERAL

1.01 Description

A. Extent of Work: Work under this Item consists of required excavation for completed channel or ditch section, disposal of excavated materials in designated areas, and all related work as shown on PLANS and as specified hereinafter.

B. Work Specified Elsewhere - Erosion Control: Per Item "Seeding," "Spot Sodding Grass," or "Concrete Slope Protection."

PART 2 - PRODUCTS

Not required for this Item.

PART 3 - EXECUTION

3.01 Construction Methods

A. Excavation: Contractor to excavate to required lines, grades, and cross-sections shown on PLANS or as modified by Engineer. Material to be removed in channel excavation of whatever character or physical conditions will be unclassified and paid for as herein provided. A tolerance of 0.3 foot plus or minus from typical dimensions for channel excavation will be allowed, provided that no abrupt changes in grading of side slopes or alignment occurs. Where special structures, inlets, and concrete lining are provided for, construction to conform to grades and dimensions indicated. Dimensions for embankment and shallow ditches at top of channel slopes are minimum. Grade interceptor ditches to slope uniformly to nearest inlet.

B. Pipeline Crossings: Contractor to suspend machine excavation within 5 feet of any pipeline right-of-way until a company representative is present to identify pipe location and to direct further excavation operations. Notification of pipeline company of Contractor's operations and request for attendance of a representative to be Contractor's responsibility. Contractor to resume suspended operations only under supervision of pipeline company representative and employ only such excavation methods, means, equipment, and safety measures as approved by representative. Contractor not to accomplish work on pipeline as part of this Contract, such as lowering, cribbing up, construction of bents, repairs to coating, cutting, welding, making repairs,

or other essential work, all of which will be done by pipeline company and at its own expense. Contractor to be solely responsible to pipeline company for any damages to its line and any related construction as a result of Contractor's operations, irrespective of any order, directive, or approval by Company representative or of his presence at the site. Contractor not to be reimbursed directly for any extra work or expenditure as a result of intersecting any pipeline installation. Any contingent costs therefor to be anticipated in preparation of the bid and included as distributed items of cost in the price for unclassified channel excavation.

C. Disposal of Excavated Material: Dispose of all excess spoil as shown on PLANS or called for by Special Provision to this Item. When excess spoil is to be stockpiled, spoil piles to be shaped to permit drainage without excessive erosion and openings to be left in the spoil piles at least every 200 feet to permit drainage of adjacent lands.

D. Final Slope Treatment: Prior to final inspection, Contractor to remove all silt and slides from the channel and to drag slopes to an even surface. When indicated, seed and fertilize or pave channel side slopes and maintenance area in accordance with PLANS.

3.02 Measurement and Payment

"Channel Excavation" will be measured in its original position by method of average end areas. Payment will be based upon the unit price per cubic yard for "Channel Excavation." Such payment to be full compensation for furnishing all labor, supervision, supplies, materials, and equipment, etc., required to complete the work.

END OF ITEM

ITEM NO. A2273 - RIPRAP

PART 1 - GENERAL

1.01 Scope

A. This section specifies riprap rock (limestone) for special applications in drainage channels as specified on PLANS or other TECHNICAL SPECIFICATIONS or as directed by Engineer.

B. Work under this item consists of furnishing all labor, materials, equipment and supervision necessary to install the riprap, filter fabric, and bedding materials in accordance with the plans and specifications.

1.02 Related Work

Related work as called for on PLANS and specified elsewhere in this or other SPECIFICATIONS.

1.03 Riprap Delivery, Storage and Handling

A. Store riprap on-site in areas approved by the Engineer. Keep the storage area clean, firm, smooth and well drained in order that the riprap can be completely recovered free from dirt and other foreign matter.

B. Stockpile and handle material so as to not cause undue segregation of materials either in the stockpile, or while loading or hauling.

PART 2 - PRODUCTS

2.01 Riprap

A. The riprap shall consist of blocks of broken limestone. Use of concrete blocks is prohibited. Each block shall have a minimum diameter and weight as follows:

Stone Size Range (ft)	Stone Weight Range (Lbs)	Percent of Gradation Smaller Than
1.40 to 1.50	180 to 300	100
1.10 to 1.30	120 to 165	85
0.90 to 1.00	60 to 90	50
0.40 to 0.50	6 to 12	15

B. Dimensions of Blocks - No more than 25% of the blocks may have a length greater than 2-1/2 times the width or thickness. No length of block shall exceed 3 times the width or thickness.

2.02 Geotextile

Provide a geotextile filter fabric material as specified in Item A2274 - Filter Fabric.

2.03 Bedding Material

A. Provide gravel, crushed rock, crushed concrete, or stone consisting of tough, durable particles.

B. The bedding material shall contain less than 2% by weight of thin, flat and elongated prices.

C. The bedding material shall contain less than 5% by volume of organic matter, fines, or soft, friable gradation.

D. The minimum thickness of bedding material shall be 6 inches.

E. Gradation - The bedding material shall be well graded and shall conform to the following gradation.

Sieve Size (Square Mesh)	**Percent Passing (By Weight)**
2-inch	100
1-inch	55-85
No. 4	15-55
No. 40	0-15
No. 80	0-10
No. 200	0-5

PART 3 - EXECUTION

3.01 Channel Preparation

A. Accurately trim and dress the channel side slopes and bottom to proper lines and grade prior to placing riprap.

B. Bring fill areas to as shown on PLANS. Fill materials and execution of fill shall be in accordance with Item A2009 - Channel Excavation.

C. The prepared section shall be inspected prior to placing the filter fabric and bedding material.

3.02 Filter Fabric

A. Provide geotextile filter fabric for riprap where indicated on the plans.

B. Installation of filter fabric shall be as specified in Item A2274 - Filter Fabric.

3.03 Bedding Material

A. Provide bedding material for the riprap where indicated on the PLANS or as directed by Engineer per field condition.

B. Place bedding material uniformly on the filter fabric to thickness, grade, line, and slope. Place material by any method which will not cause segregation of particle sizes. Provide a surface that is even and free from mounds, windows, or depressions.

C. No compaction of the bedding material is required.

D. Placement of bedding material underwater will be permitted by any method that will ensure compliance with the above requirements.

3.04 Riprap Placement

A. Place the riprap to the slopes, lines, and grades as shown on the plans, to provide a well-graded mass of riprap without voids.

B. Thickness of the riprap layer shall be as shown on the plans.

C. Place the riprap in one course (lift) across the channel bottoms and up the channel side slopes. Place the riprap carefully on the prepared surface, bedding material or geotextile in such a manner to avoid displacement or damage to the subgrade.

D. The riprap stones are to be in close contact, be well-graded and to be free from pockets of small stones or clusters of large stones.

E. Do not drop riprap from such a height to cause breakage.

F. Prevent mixture or incorporation of dirt or other materials with the riprap during placing operation.

G. Placing riprap underwater will be permitted using equipment and procedures capable of placing riprap to specified requirements.

H. Obtain specified distribution of the various sizes of blocks throughout the mass by selective loading of the material, by controlled placement of successive loads, or by other methods which will obtain specified results. Rearrange individual blocks by mechanical means or by hand as necessary to obtain a well-graded mass.

I. Place the riprap blocks in position and such a manner to ensure the completed riprap is stable, without a tendency to slide or roll down the side slope.

J. Fill spaces between larger riprap blocks with spalls and smaller blocks of the largest feasible size to form a compact mass. Do not place spalls and small blocks in nests in place of larger sized block. Inclusion of spalls, chips and small broken blocks shall not exceed 5% of the riprap mass.

K. In placing riprap, release blocks as near to their final position as practical.

PART 4 - MEASUREMENT AND PAYMENT

A. Measurement for riprap shall be per square yard of the type of riprap placed in specified layer of thickness(es) at locations as shown on PLANS. Payment for riprap shall be based on the Contract price bid per square yard for each specified type and thickness(es) of riprap, and shall be full compensation for all labor, materials, and equipment required to place riprap.

B. Measurement for bedding material shall be per square yard of bedding material placed in specified layer of thickness under riprap. Payment for bedding material shall be based on the contract price bid per square yard of each specified thickness of bedding material for riprap, and shall be full compensation for all labor, materials, and equipment required to place bedding material.

C. Measurement and payment for filter fabric shall be as specified in Item A2274 - Filter Fabric.

END OF ITEM

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ITEM NO. A2274 - FILTER FABRIC

PART 1 - GENERAL

1.01 Description

This section addresses the supply and installation of a filter fabric which shall be placed under all riprap installation or where specified on PLANS or other items in this TECHNICAL SPECIFICATION or as directed by Engineer.

1.02 Submittals

A. Submit the standard manufacturer's catalogue sheets and other pertinent information for filter fabric.

B. Certified test results showing actual test values conformed to the required properties of fabric listed in this section.

C. Manufacturer's installation recommendation.

PART 2 - PRODUCT

2.01 Materials

A. Provide an engineered fabric commonly used in geotechnical applications.

B. The fabric shall provide a permeable layer or media while retaining in situ soil without clogging.

C. The fabric shall be a fabric woven from monofilaments of stabilized polypropylene, polyvinylidine chloride, nylon, polyolefins or polyester, with sealed edges to eliminate ravelling. The fabric shall be inert to commonly encountered chemicals and hydrocarbons, shall be mildew and rot resistant, and shall be resistant to ultra-violet light exposure, insects, and rodents. The fabric shall be nonbiodegradable and inert over a Ph range of 3 to 12.

D. Properties of Fabric:

PROPERTY	VALUE	TEST METHOD	UNIT
Grab Strength (Min)	260	ASTM D-1682	Lb
Grab Elongation	15-40	ASTM D-1682	%
Mullen Burst (Min)	515	ASTM D-3786	psi
Trapezoid Tear (Min)	100	ASTM D-2263	Lb
Puncture Strength (Min)	140	ASTM D-4833 (Modified)	Lb
Modulus (Load @ 10% Elongation) (Min)	125	ASTM D-1682	Lb
Abrasion Resistance (1000 cycles, 1kg) (Min)	120	ASTM D-1175 & D-1682	Lb
E.O.S. (Ref.COE CW02215)	50-80	CFMC-FFET-1	Sieve No.
Open Area (Ref. COE 1310, 5/73)	1-3	-	%
Permeability Coefficient (k)	.01	CFMC-FFET-2	cm/sec
Air Permeability	30	ASTM D-737	cfm/ft
Water Permeability (h=20-10 cm) (Min)	25	CFMC-FFET-1	gpm/ft2
Gradient Ratio (Ref. COE CW02215) (Max)	3	-	-
Ultraviolet Stability (Min)	85	ASTM D-1682	%

E. The fabric shall be wrapped in a protective covering to guard against moisture and extended ultraviolet exposure prior to placement.

F. Anchors and all other miscellaneous hardware shall be galvanized.

G. Filter fabric under riprap and over gabions: Contech C70/06 or approved equal.

PART 3 - EXECUTION

3.01 Installation

A. Prepare channel bottom and slope to lines and grades as shown on PLANS before placing filter fabric.

B. Remove any objectional materials that might puncture filter fabric.

C. Filter fabric shall be placed directly on the ground surface. Longitudinal and transverse joints shall be overlapped at least one foot (1) or as recommended by manufacturer, if requirement is more than 1 foot. Avoid vehicular traffic on fabric once it is placed.

D. Anchor filter fabric under riprap toe, as shown on PLANS or specified elsewhere in these TECHNICAL SPECIFICATIONS.

E. Filter fabric shall be kept in its protective wrapping until ready for use. Any fabric that has been out of its protective cover for over 72 hours without being covered shall be considered unsatisfactory and shall be removed and replaced with satisfactory fabric at the Contractor's expense.

F. Torn, punctured or separated sections of fabric shall be repaired by placing a fabric patch over the hole or separation seams. The patch shall be large enough to overlap a minimum of three feet (3') in all directions .

G. Anchor trenches and side trenches shall be backfilled in accordance with Item A2009 - Channel Excavation.

PART 4 - MEASUREMENT AND PAYMENT

A. Measurement for filter fabric under riprap shall be per square yard of filter fabric placed at locations as shown on PLANS. Payment for filter fabric under riprap shall be based on the Contract price bid per square yard of filter fabric, and shall be full compensation for all labor, materials, and equipment required to place filter fabric.

END OF ITEM

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ITEM NO. A3006 - CONCRETE SLOPE PROTECTION

PART 1 - GENERAL

1.01 Description

Furnish and place concrete slope paving composed of portland cement concrete, constructed as herein specified on an approved subgrade, in conformity with the lines, grades, dimensions, and details shown on PLANS.

1.02 Work Specified Elsewhere

Other related work as called for on PLANS or specified elsewhere in this or other TECHNICAL SPECIFICATIONS.

1.03 Quality Assurance

A. Submittals: Submit mix designs for strength.

B. Tests: Make test specimens to maintain check on concrete strength throughout job.

PART 2 - PRODUCTS

2.01 Materials

A. Concrete: As specified on PLANS and in accordance with Item "Concrete."

B. Reinforcing Steel: In accordance with Item "Reinforcing Steel."

C. Expansion Joint Material: As specified on PLANS and per ASTM D1752-67. Furnish test results in compliance with ASTM D545-77, if requested.

D. Curing Materials: Per Item "Concrete."

PART 3 - EXECUTION

3.01 Construction Methods

A. Prior to placing material, prepare subgrade to proper section for width and depth of slope paving.

B. Dispose of excess excavation, if any, from site, at no cost to Owner.

C. Locate construction joints as shown on PLANS or otherwise indicated.

D. Place 1-inch expansion joint material at joints where slope paving is placed against walls or around columns or piling and at maximum intervals of 80 feet throughout length of slope paving. Nail 1-inch by 1-inch redwood board to top of joint material and, after slope paving has set and cured, remove redwood board and fill area with joint sealant.

E. Unless otherwise indicated on PLANS, use minimum No. 3 reinforcing bars at maximum spacing of 18 inches in each direction. Distance from first parallel bar to edge of concrete not to exceed 6 inches.

F. Wire reinforcing equivalent in sectional area to reinforcing bars may be used. Use minimum of 6-inch lap at all splices, with not less than 1 inch nor more than 3 inches clearance from fabric to edge of concrete and no wires projecting beyond last member parallel to edge of concrete.

G. Support reinforcing steel throughout placement of slope paving to maintain its position approximately equidistant from top and bottom surface of concrete.

H. After concrete has been placed, compacted, and shaped to conform to dimensions shown on PLANS, and after it has set sufficiently to avoid slumping, finish the surface with wooden float to secure a reasonably smooth surface.

I. Cure concrete slope protection in accordance with Item "Concrete Structures," immediately following finishing operation.

3.02 Measurement and Payment

A. Measure "Concrete Slope Protection" by the square yard of surface area complete in place and accepted.

B. "Concrete Slope Protection" to be paid for at the Contract unit price bid, measured as provided above. Price to be full compensation for furnishing and placing all materials, including expansion joint material, joint sealant, and reinforcing steel; surface finishing and curing; and all manipulations, labor, tools, equipment, and incidentals necessary to complete the work.

END OF ITEM

ITEM NO. B1001 - CONCRETE

PART 1 - GENERAL

1.01 Description

A. Scope
   1. This Item governs for materials used for storing, and handling of materials, and for proportioning and mixing of concrete for reinforced concrete pavement and all reinforced concrete precast and cast-in-place structures.
   2. Contractor assumes responsibility for cost and design of proper concrete mixture.

B. Other related work as called for on PLANS or specified elsewhere in this or other TECHNICAL SPECIFICATIONS.

1.02 Quality Assurance

A. Furnish laboratory reports showing proportions and materials selected will produce laboratory-mixed concrete of specified quality and having strengths 20 percent higher than 28-day strength specified, at maximum slump and maximum air content specified.

B. Owner to select testing laboratory, conforming to ASTM E329, to make tests throughout concrete operations. When requested by Owner, Engineer or his representative will monitor tests and review results.

1.03 Submittals

A. Samples
   1. Furnish material samples to approved testing laboratory for review and testing.
   2. Provide sufficient quantities for testing and determining mixes to produce concrete classes specified.

B. Mix Designs
   1. Submit mix designs for each different concrete strength and for each different aggregate.
   2. Secure confirmation of laboratory tests on proposed mix designs prior to submittal.
   3. Use only approved mix designs.
   4. Make required tests of mix as called for elsewhere in this specification under "Tests."

C. Reports: Provide certified mill reports on cement and sieve analysis on aggregate.

D. Tests
1. Make moisture tests of aggregate to ensure proper batching and proportioning.
2. Provide and maintain curing facilities conforming to ASTM C31.
3. For Structural Concrete
   a. Perform sufficient number of tests to maintain check on quality.
   b. Conduct tests as per test procedures (ASTM C31 and C39 for Compression Test).
   c. When portland cement concrete (other than high-early-strength concrete) is used, test minimum of two standard 6-inch by 12-inch cylinders at 7 days and minimum of two 6-inch by 12-inch cylinders at 28 days for each 50 yards of concrete placed or each structure, whichever is less.
   d. When high-early-strength concrete is used, test minimum of two standard 6-inch by 12-inch cylinders at 3 days and minimum of two 6-inch by 12-inch cylinders at 7 days for each 50 cubic yards of concrete placed or for each structure, whichever is less. Minimum strengths normally required at 7 and 28 days will be required at 3 and 7 days, respectively.
4. For paving concrete, test pavement work as required by PLANS and/or as follows:
   a. Make one beam for each 1,000 square yards of pavement, or part thereof, for each day's pour and/or one beam on each street.
   b. Size of beams as required by ASTM C31.
   c. Core sampling in accordance with requirements of Special Provision. If requirements not established by Special Provision, make one core for each 1,000 square yards of pavement or at least one core for each street, whichever is least in area.
   d. Fill core hole with nonshrinking grout at no additional cost to Owner.
   e. Test core for compressive strength and for thickness.
   f. Test for flexural strength in accordance with ASTM C-293, "Flexural Strength of Concrete (using simple beam with center-point loading)."
5. For air entrainment, make two tests, in accordance with ASTM C138 or C173, for each day's placing.
6. Make slump tests periodically in accordance with ASTM C143.

E. Specimen Handling
1. Mark test specimens clearly in a definite sequence.
2. Transport and store specimens to prevent damage.
3. Provide insulated shed for storage of cylinders and beams.
4. Provide records identifying each cylinder with locations from which specimens were taken.

5. Cure specimens under laboratory conditions, except that for a possibility of surrounding air temperature falling below 40°F; additional specimens to be cured under job conditions may be required.

F. Failure to Meet Specifications
1. Concrete failing to meet specifications will be rejected.
2. Should a 3-day (high-early cement) or 7-day (normal cement) test fail to meet established strength requirements, extended curing or resumed curing may be required.
3. Contractor to strengthen structures, or replace portions thereof, which fail to meet established strength requirements, at Contractor's expense.
4. Test cores, when required, to be in accordance with procedures of ASTM C42, at no additional cost to Owner.

1.04 Product Delivery, Storage, and Handling

A. Cement
1. Store in weathertight enclosures and protect against dampness, contamination, and warehouse set.
2. Store off ground in well-ventilated building.

B. Aggregates
1. Stockpile to prevent excessive segregation or contamination with other materials or other sizes of aggregates.
2. Use only one supply source for each aggregate stockpile.

C. Admixtures
1. Store to prevent contamination, evaporation, or damage.
2. Protect liquid admixtures from freezing or harmful temperature ranges.
3. Agitate emulsions prior to use.

PART 2 - PRODUCTS

2.01 Materials

A. Concrete: Ready-mixed concrete conforming to ASTM C94 or site-mixed concrete (dry weight 145-150 pounds per cubic foot).
1. Cement
a. ASTM C150, Type I.
b. ASTM specifications for weight variations and length of storage.
c. Use no caked cement.
d. Deliver in bags for site-mixed concrete.
e. Use only one brand of cement in any one structure.
f. Cement for Class "P" concrete may be delivered in bulk if method of handling is approved.

2. Admixtures
   a. Air-entraining admixtures in accordance with ASTM C260.
   b. Water-reducing and retarding admixtures in accordance with ASTM C494, Type A or Type D admixture, modified as follows:
      1) Bleeding water no greater than bleeding water of ASTM C494 reference concrete when tested as per ASTM C232.
      2) Increase durability, decrease permeability, and increase resistance to surface scaling, when compared to ASTM C494 reference concrete.
      3) No chlorides or alkalies added during manufacture of admixture.
   c. High-range water-reducing admixture (superplasticizer) in accordance with ASTM C494, Type F or Type G, modified as follows:
      1) Superplasticized concrete to be nonsegregating, have little bleeding, and have physical properties similar to low water-cement ratio concrete.
      2) Admixture composed of a synthesized sulfonated polymer to be added to the concrete mixer with gauge water at the central batch plant.
      3) Use only one liquid admixture to achieve the superplasticized concrete, except where air entrainment is desired, in which case, air entraining admixture to be compatible with superplasticizer admixture.
      4) Treated concrete must be capable of maintaining superplastic state in excess of 2 hours.
      5) Dosage as recommended by the manufacturer.
   d. Additional Requirements
      1) Manufacturer to provide proof of successful field use of water-reducing and retarding admixture from recognized laboratories and other authorities.
      2) Manufacturer to provide local representative and warehouse facilities, when requested by Owner.
      3) Provide qualified concrete technician to assist in concrete mix design, if required.
      4) If required, Contractor to acquire approved commercial laboratory testing, at no cost to Owner, to furnish certification of compliance with this specification.
      5) Water-reducing and retarding admixtures used in Class A and Class K concrete only, unless otherwise specified.
      6) Use manufacturer's published recommended dosage for optimum results as minimum requirements. Dosage may be varied by Engineer after analysis of results of local commercial laboratory tests using materials from sources assigned by Contractor.

7) Dispensing and mixing equipment and procedures at batch plant are subject to approval.

3. Coarse Aggregate
   a. Durable particles of gravel, crushed gravel, crushed blast furnace slag, crushed stone, or combination thereof, conforming to ASTM C33.
   b. Use clean, durable particles, free from frozen materials, clay, salt, alkali, vegetable matter, or other coating which would adversely affect strength of concrete or bonding of aggregate to cement paste.
      1) Nonprestressed concrete aggregate size from No. 4 to 1-1/2 inches.
      2) Prestressed concrete aggregate size from No. 4 to 1 inch.
   c. The maximum size coarse aggregate to be as indicated above or no greater than three-fourths of the minimum clear spacing between parallel reinforcing bars or prestressing tendons, whichever is smaller.
4. Fine Aggregate
   a. Natural sand as per ASTM C33.
   b. Fineness modulus between 2.4 and 2.9.
5. Water
   a. Free from oils, acids, alkalis, organic matter, or other deleterious substances and not containing more than 1,000 parts per million of sulphates.
   b. Testing not required from municipal supplies approved by Texas Department of Health, but from other sources water will be sampled and tested, at no additional cost to Owner, before use.
6. Slump
   a. Test method as per ASTM C143.
   b. As indicated in Classification Table.
7. Mix Proportioning
   a. As per Classification Table, based on maximum water-cement ratio and minimum strength requirements, with limits set on minimum cement content.
   b. Increase cement content above minimum or use approved admixtures, without additional cost to Owner, if type, gradation, or sizes of aggregate being supplied gives concrete mixture not meeting strength and workability requirements.
8. Coring Materials: Per Item "Concrete Structures."

B. Nonshrink Grout: Grout to have moderate fluidity and to conform to Corps of Engineers Specification CRD-C 621-82B.

CLASSIFICATION TABLE

Class - Type		Min. Comp. Strength (psi) 7-day	28-day	Max. Water Content[1] Pounds of Water/Lb. Cement	Gallons of Water/Bag Cement	Min. Cement Per C.Y.[2] Lbs.	Bags	Slump Range (in.)*	Total Air Content (%)
A	- Structural	2000	3000	0.55	6.25	494	5.25	2-1/2 to 4-1/2	2-1/2 to 4-1/2
A_{sp}	- Structural[3]	2000	3000	0.50	5.65	423	4.50	7 to 10[4]	3 to 5
B	- Slope Protection	1200	2000	0.75	8.50	400	4.25	2-1/2 to 4	2-1/2
C	- Pipe Blocking	-	1500	0.97	11.00	282	3.00	3 to 5	3 to 6
D	- Seal Slab	-	-	-	-	376	4.00	6 to 8	as needed
E	- Monolithic Sewer	2000	3000	0.55	6.25	564	6.00	4 to 6	3 to 5
F	- Prestressed[5]	-	5000	0.51	5.75	635	6.75	2 to 3	as needed
G	- Prestressed[5]	-	6000	0.49	5.50	658	7.00	2 to 3	as needed
K	- Structural[6]	2800	4000	0.45	5.65	564	6.00	3-1/2 to 5	2-1/2 to 4-1/2
K_{sp}	- Structural[3]	2800	4000	0.45	5.00	517	5.50	7 to 10[4]	3 to 5
P	- Paving 6-Inch[8]	2000	3000 500[7]	0.66	7.50	470	5.00	3 to 5	2-1/2 to 4-1/2
P	- Paving 7-Inch[8]	2000	3000 500[7]	0.66	7.50	470	5.00	3 to 5	2-1/2 to 4-1/2
P	- Paving 8-Inch[8]	2100	3000 550[7]	0.66	7.50	517	5.50	3 to 5	2-1/2 to 4-1/2

* All Slump Ranges + 1/2-Inch Tolerance

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[1] Include in maximum water, free water in aggregate minus absorption of aggregate based on a 30-minute absorption period.

[2] For concrete placed under water, minimum cement per cubic yard shall be 6100 pounds (6.5 bags).

[3] A_{sp} and K_{sp} to contain approved High Range Water Reducing (HRWR) Admixture.

[4] Maximum 2-inch slump before additon of HRWR Admixture.

[5] For prestressed concrete, water reducing admixture may be used as needed.

[6] Use approved water-reducing and retarding admixture.

[7] Minimum flexural strength at 7 days.

[8] Slump range 1-3 inch when slip form method of construction used.

PART 3 - EXECUTION

3.01 Mixing Concrete

General

1. Ready-mixed and in accordance with requirements of current ACI building codes.
2. Postpone or delay work during adverse weather conditions.
3. Protect dry batch material so that it reaches mixer in a dry condition.
4. Use batch mixer having approved and positive water control and measuring device for all materials.
5. Continue mixing to ensure uniform distribution of materials, but not less than 1-1/2 minutes after all materials have been introduced into mixer drum.
6. Rotate drum at peripheral speed recommended by mixer manufacturer.
7. Mix and deliver as per ASTM C94.
   a. Add mixing water at plant.
   b. Mix concrete in quantities required for immediate use, and discharge at jobsite within 1 hour after introduction of cement to aggregate. If Contractor can prove that concrete consistency measured by slump will not be reduced by more than 2 inches when superplasticized concrete is used, time interval between mixing and placing may be extended to a maximum of 90 minutes or to a period in which slump loss will not exceed 2 inches.
   c. Begin mixing operation within 30 minutes after cement and aggregates intermingled.
   d. Ready-mixed concrete producer to furnish delivery tickets indicating
      1) Delivery date and time dispatched.
      2) Name and location of project.
      3) Name of Contractor.
      4) Name of ready-mixed concrete producer.
      5) Truck number.
      6) Number of cubic yards of concrete in load.
      7) Class of concrete.
      8) Cement content in bags per cubic yard of concrete.
      9) Amount of admixture in concrete, if any.
      10) Number of gallons of water in mixture.
      11) Air content.
8. Job mix concrete in approved type mixer and do not load beyond manufacturer's rated capacity.
   a. Normal Weight Concrete
      1) Mix batches of 1 cubic yard or less for minimum of 1-1/2 minutes after materials are placed in mixer.
      2) Increase mixing time 15 seconds for each half yard increase over one cubic yard batch.

b. Maintain positive batch control equipment to within 1 percent accuracy.
c. Clean, maintain, and operate equipment so as to thoroughly mix material as required.
d. Hand-mixing permitted for small placements only or in emergencies, as authorized.
e. Hand-mixed batches not to exceed a two-bag batch in volume.

9. Do not mix when air temperature is at or below 40°F (taken in the shade away from artificial heat) and falling, or if likely to fall below 40°F in next 24 hours.
10. To produce concrete with minimum temperature of 50°F, heat aggregate and/or water uniformly as follows:
    a. Water temperature not to exceed 180°F and/or aggregate temperature not to exceed 150°F.
    b. Heat mass of aggregate uniformly.
    c. Temperature of aggregates and water to be between 50°F and 85°F before introduction of cement.

3.02 Installation

In accordance with other applicable TECHNICAL SPECIFICATIONS.

3.03 Measurement and Payment

A. No separate measurement and payment for work performed under this Item except as indicated below. Include cost of same in Contract price bid for work of which this is a component part.

B. Measure "Extra Concrete," when approved by Engineer, by cubic yard of concrete of class ordered, complete in place. Pay for "Extra Concrete" at Contract unit price bid per cubic yard for classes of "Extra Concrete" used.

END OF ITEM

ITEM NO. B2001 - CONCRETE STRUCTURES

PART 1 - GENERAL

1.01 Description

A. Scope: Construction procedures for all concrete structures, including methods for forming, placing, and curing.

B. Other related work as called for on PLANS or specified elsewhere in this or other TECHNICAL SPECIFICATIONS.

1.02 Submittals

A. Submit samples, mix designs, tests, and reports, per Item "Concrete."

B. Prior to start of work, submit following information when requested by Special Provision.
   1. Methods of construction.
   2. Plans for forms and falsework.
   3. Amount and type of equipment.
   4. Concrete placing schedule with facilities for handling concrete shrinkage.
   5. Tabulation of concrete surfaces indicating types of finish on each surface.

PART 2 - PRODUCTS

2.01 Materials

A. Concrete: Per applicable concrete Item.

B. Expansion Joint Material: Per ASTM D1752-67. Furnish test results as to compliance with ASTM D545-77.

C. Waterstop: Manufactured from virgin polyvinyl chloride plastic compound conforming to U.S. Corps of Engineers' Specification No. CW-03150-80 and containing no scrap or reclaimed material. Unless otherwise indicated, furnish WIRESTOP waterstops as manufactured by Paul Murphy Plastics, Roseville, Michigan of the following types.
   1. Expansion Joints: Type 05-151-CHR-6380.
   2. Construction Joints: Type 05-151-FHR-6380, or Type 05-151-FDR-4316 as applicable.

D. Curing Materials: Unless otherwise indicated, use the following on all concrete surfaces, including those to be painted, waterproofed, and grouted. Protecrete, as manufactured by P. A. Thornburg, Inc., Houston, Texas.

E. Forms and Falsework
   1. Timber
      a. Seasoned, good quality timber free from loose or unsound knots, knot holes, twists, shakes, decay, and other imperfections which would affect its strength or impair finished surface of concrete.
      b. Wedges, when required, to be hardwood.
   2. Metal
      a. Thickness of metal forms as required to maintain true shape without warping or bulging.
      b. Keep metal forms free from rust, grease, or other foreign materials, and use only those which present a smooth surface and line up properly.
      c. Aluminum not permitted.

F. Grout
   1. Nonshrinking Grout: Premixed grout which is nonmetallic, noncorrosive, and nonstaining; containing specially selected silicon sands, cement, shrinkage compensating agents, plasticizing and water reducing agents.
      a. Conform to requirements of Corps of Engineers CRD-C588 Test Method CRD-C589.
      b. Minimum 28-day compressive strength of 8,000 psi.
      c. Maintain grout temperature during placement between 50°F and 90°F.
      d. Prepare and place grout according to grout manufacturer's specifications.
   2. Nonshrink Epoxy Grout: Five Star epoxy grout as manufactured by U.S. Grout Corporation or equal.

G. Permanent Moisture Barrier: Polyethylene film minimum thickness of .006 inch (6 mils) with high-impact strength rating.

H. Concrete Bonding Agent: Acceptable manufacturers:
   1. "Daraweld-C" as manufactured by W. R. Grace and Company, Houston, Texas.
   2. "Bond Crete-S" as manufactured by Burke Concrete Accessories, Inc., Houston, Texas.

I. Waterproofing: Self-adhering polyethylene with a rubberized asphalt mastic material.
   1. Minimum 4 mil thickness polyethylene coated on one side with a layer of adhesive rubberized asphalt with protective membrane.

2. Designed for tensile strength of 250 psi when tested in accordance with ASTM D412-80.
3. Thickness to be 60 mils excluding the protective release membrane.
4. Furnish in rolls 36 inches minimum width and 50 feet minimum length.

J. Expansion Bolts: ASTM Type 304 stainless steel with pullout and shear strengths equal to or greater than those provided by Hilti Kwik-Bolts, for all sizes and embedments required on the project. Submit test results as per ASTM E488-76 "Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements."

K. Coal-Tar Epoxy Coating
1. Modified coal-tar epoxy compound consisting of 100 percent sprayable solids not requiring solvent material for application or curing. Finished product to be flexible and free of chalking, checking, and hairline shrinkage cracks. Manufacturers: Madewell 1103 Coal Tar Epoxy Coating or equal.
2. Coal-Tar Epoxy Primer: Madewell 927 or equal.

PART 3 - EXECUTION

3.01 General Requirements

Time Sequence of Construction Operations
1. Do not place superstructure members, forms, falsework, or erection equipment on substructure before concrete has cured for 4 days.
2. Erect forms on footings supported by piling or drilled shafts after concrete has cured for 4 days. Such work may begin on spread footings after concrete has aged at least 2 curing days.
3. Support of tie beam and/or cap forms by falsework placed on previously placed tie beams is permissible, provided curing requirements are completed and tie beams are properly supported to eliminate stresses not provided for in design.
4. For bridges and direct traffic culverts, construction traffic and traveling public permitted in accordance with the following.
   a. Authorization for light construction traffic not to exceed a three-quarter ton truck may be given after last slab of concrete has been in place at least 14 days.
   b. Authorization for normal construction traffic, when necessary, and to traveling public may be given after last slab of concrete has been in place 30 days.
5. Forms, or screed supports for bridges, may be attached to I-beams or girders by welding.

3.02 Construction Methods

A. Forming
   1. General Requirements: Design and construct to carry maximum anticipated loads and provide rigidity to prevent settlement or deformation.
   2. Design Loads: Use 150 pounds per cubic foot for concrete and live load of 50 pounds per square foot of horizontal surface of form work with 125 percent of allowable stresses used for design of structures.
   3. Falsework
      a. Make timber sills and grillages large enough to support superimposed load without settlement.
      b. Place falsework which cannot be founded on a satisfactory spread footing on piling or drilled shafts.
      c. Cap each falsework bent transversely by a member of proper size, and fasten caps securely to each pile or column in bent and set at proper elevation, allowing for a construction camber.
      d. Use wedges, if required, in pairs and arrange so as to ensure uniform bearing.
      e. Use of wedges to compensate for incorrectly cut bearing surfaces not permitted.
   4. Forms
      a. General
         1) Provide mortar-tight forms sufficient in strength to prevent bulging or sagging.
         2) Maintain to proper line and grade, and prevent warping and shrinkage.
         3) Clean areas of extraneous material before concrete placement.
         4) If bulging or sagging occurs, remove concrete causing such condition and reset forms.
         5) Construct forms to permit their removal without damage to concrete.
         6) Use metal form ties of a type that permits their easy removal and which will not require removal of excessive concrete.
         7) Remove metal alignment appliances from forms to a depth of at least 1/2 inch from concrete surface without undue chipping or spalling, leaving a smooth opening in the concrete surface.
         8) Burning off of rods, bolts, or ties not permitted.
         9) Cut wire ties back at least 1/2 inch from face of concrete.
         10) Metal tie-holding devices to develop strength of ties and to be adjustable for alignment.
         11) Remove spreaders, which are separate from the forms, as concrete is placed.
         12) Provide clean-out openings for walls and other locations where access to bottom of forms is not readily attainable.

13) Prior to erection, treat facing of forms with oil or other bond-breaking coating which will not discolor or otherwise injuriously affect concrete surface.
14) Wet surface of forms to be in contact with concrete immediately before placing concrete.
15) Before concrete placement, align edges and faces of form panels and tape or fill joints with patching plaster or cold-water putty to prevent leakage; sand lightly with No. 0 sandpaper to make joints smooth.
16) Forms of any kind are not permitted under permanent structures.

b. Timber
1) Timber for facing or sheathing surfaced on at least one side and two edges.
2) Use nominal 2-inch lumber minimum thickness for forms for bottoms of beams.
3) Use lumber of nominal 1-inch minimum thickness elsewhere, generally, and back by sufficient number of studs and wales.
4) Provide form linings free of irregularities for concrete surfaces to be given rubbed finish.
5) Lining not required with plywood forms.
6) Plywood form lining made with waterproof adhesive to be 1/4-inch minimum thickness, oiled at mill, and re-oiled or lacquered on job before using.
7) Use tempered Masonite Concrete Form Board, 3/16-inch minimum thickness, as alternate form lining.
   a) Keep moist at least 12 hours before applying to sheathing by moistening screen side of board and stacking boards screen side to screen side.
   b) Use smooth, hard face as concrete contact surface of form.
8) Plywood forms to be minimum 3/4-inch thickness and made with waterproof adhesive backed by adequate studs and wales, with form lining not required.
9) Molding for chamfer strips, or other uses.
   a) Redwood, cypress, or pine.
   b) Use quality which will not split when nailed and will hold true lines.
   c) Mill cut, dressed on all faces.
   d) Fillet sharp corners and edges with triangular chamfer strips, 3/4 inch on sides.

c. Metal
1) Lining not required.
2) Countersink bolt and rivet heads on facing sides of metal forms.

3) Design clamps, pins, or other connecting devices to hold forms rigidly together and to allow removal without injury to concrete.
4) Straight metal panel forms may be used for all structures with straight walls and for those structures with curved walls only below ground level.
5) Curved metal panels may be used for all structures with curved walls.

B. Joints
1. Expansion Joints
a. Remove form from formed joints as soon as possible to permit free expansion of concrete.
b. Anchor expansion joint fillers to concrete on side of joint by means of copper wire not lighter than No. 12 B&S gage or copper nails of approved size.
c. Ensure complete separation of concrete sections by joint material.
2. Construction Joints
a. Other than those indicated, joints not permitted without written authorization.
b. Roughen previously placed concrete surface so as to expose aggregate particles.
c. Remove loose materials, and wash and scrub surface clean with stiff brooms.
d. Keep concrete surface moist for 12 hours prior to placing adjacent concrete.
e. Immediately prior to placing concrete thereon, wet surface of joint with clean water.

C. Placing Reinforcement: Per Item "Reinforcing Steel."

D. Placing Concrete
1. Seal Slabs
a. Use in all excavations for structures requiring reinforcing steel in base slab. For retaining wall footings and bridge footings, use seal slab only if shown on PLANS.
b. Excavate 2 inches minimum below bottom of structural slab and pour seal slab concrete to structural slab bottom elevation.
c. Provide rough float finish.
d. No direct payment made for seal slab concrete.
2. General Requirements
a. Give advance notice before placing concrete.
b. Place concrete only after forms and reinforcing placement have been checked.

c. Discontinue pile driving and other causes of vibration until concrete has attained an age of at least 18 hours.
d. Mix, place, and finish concrete in daylight hours. If necessary to continue after daylight hours, light entire working area.
e. Do not place concrete when impending weather conditions, such as rain, sleet, or snow, threaten to impair quality of finished work.
f. If rainfall occurs during concrete placement, provide covering to protect work.
g. Place concrete in forms or excavations with no apparent moisture therein.
h. Standing water not permitted in forms or excavations during concrete placement.

3. Handling and Transporting
   a. Use method and equipment to maintain rate of placement as required to prevent cold joints.
   b. Place concrete by buckets, chutes, buggies, pipes, or troughs, which prevent separation of concrete ingredients.
   c. With prior written approval, use belt conveyors or pumps, and test samples at discharge end.
   d. Protect concrete transported by conveyors from sun and wind to prevent loss of slump and workability.
   e. Pipes used to pump concrete to be shaded and/or wrapped with wet burlap to prevent loss of slump and workability.
   f. Do not transport concrete through aluminum pipes, tubes, or other aluminum equipment.
   g. Use of chutes in excess of 35 feet total length prohibited.
4. Depositing: Contractor to provide thermometer to measure temperature of concrete.
   a. Equip chutes with baffles for depositing concrete on steep slopes, or make chutes in short lengths that reverse lateral direction of movement.
   b. Provide downpipe at end of chute.
   c. Use no slope steeper than one vertical to two horizontal.
   d. Discharge concrete from chutes and troughs either vertically down inside of forms or into pockets outside of forms from which it may flow through holes left in forms.
   e. Keep chutes, troughs, and pipes clean and free from coatings of hardened concrete.
   f. Deposit concrete in continuous horizontal layers maximum 12 inches thick.
   g. Depositing large quantities at one point and running or working it along forms not permitted.
   h. Limit free-fall of concrete to 4 feet, except in walls 10 inches or less in thickness, if segregation can be prevented.
   i. Use tremies for placing concrete in walls over 10 inches thick.

j. Remove hardened concrete spatter ahead of plastic concrete.
k. Do not jar forms after concrete has taken initial set or place any strain on projecting reinforcement.
l. Make tremies in sections, or provide in several lengths, so outlet may be adjusted to proper heights during placing operations.
m. Place each layer while preceding layer is still plastic, but do not allow more than one hour to elapse between placement of successive layers.
n. Apply vibrators to concrete immediately after depositing and move throughout mass, through layer of concrete just placed, and several inches into plastic layer below.
o. Consolidate concrete and flush mortar to form surfaces by continuous working with immersion-type vibrators.
p. Do not attach vibrators to forms or reinforcement.
q. Provide one standby vibrator for emergency use.
r. If excessive bleeding causes water to form on surface of concrete in tall forms, use stiffer mix.
s. In walls and deep beams, place concrete to a point approximately 1 foot below finished elevation of bottom of slab or beam to be poured monolithically with wall, and allow to settle; but to avoid a cold joint, resume placement of concrete before initial set occurs.
t. Overfill forms and screed off excess concrete after partial stiffening.
u. Placing Concrete in Cold Weather: Minimum temperature of all concrete at time of placement to be not less than 50°F.
    1) Maintain slab temperatures at 50°F or above for period of 72 hours from time of placement and above 40°F for additional 72 hours.
    2) Maintain temperature of all other structural elements at 40°F or above for period of 72 hours from time of placement.
    3) Maintain temperature of concrete placed on or in the ground above 40°F for period of 72 hours from time of placement.
    4) Protect concrete against freezing during curing period in accordance with Portland Cement Association "Design and Control of Concrete Mixtures."
    5) Protect concrete from temperatures below 40°F until it has cured for a minimum of 3 days at 70°F or 5 days at 50°F. Remove and replace, at Contractor's expense, all concrete deemed unsatisfactory by Engineer.
    6) Protection may consist of additional covering, insulated forms, artificial heatings, or other means approved by Engineer.
v. Placing Concrete in Hot Weather: When air temperature is above 90°F use approved retarding agent in all exposed concrete and in all cased drilled shafts regardless of temperature.

1) Reinforcing steel, steel beam flanges, and other surfaces in contact with concrete to be cooled to below 90°F by means of water spray or other approved methods.
2) Concrete temperature prior to placement not to exceed 85°F, plus a maximum tolerance of 5°F. Concrete above this maximum will be rejected.
3) Reduce concrete temperature at time of placement to satisfy maximum allowable temperature by one or more of the following:
   a) Addition of cold water with a subsequent addition of cement to maintain proper water-cement ratio. Tanks or trucks used for storing or transporting water to be insulated or painted white. Mechanical refrigeration may be used to reduce water temperatures.
   b) Addition of crushed, shaved, or chipped ice directly into the mixer with a subsequent addition of cement to maintain proper water-cement ratio. Continue mixing until ice is completely melted.
   c) Other approved methods.

w. Placing Concrete in Water
1) Only when authorized, use concrete mix with minimum 6.5 sacks cement per cubic yard of concrete.
2) Forms, cofferdams, or caissons to be sufficiently tight to prevent water current passing through space in which concrete is being deposited.
3) Pumping water not permitted during placing, nor until concrete has set for at least 36 hours.
4) Place concrete with tremie, closed bottom-dump bucket, or other approved method to avoid free-fall through water.
5) Do not disturb concrete after depositing, and maintain horizontal layers at all times.
6) Use watertight tube 10 inches or less in diameter for tremie and constructed so that bottom can be sealed and opened after it is in place and fully charged with concrete.
7) Support tremie to allow easy movement horizontally to cover work area and vertically to control concrete flow.
8) Stop flow by lowering tremie.
9) Capacity of bottom-dump buckets not less than 1/2 cubic yard.
10) Lower bucket or tremie gradually and carefully to rest upon concrete already placed and raise very slowly during upward travel, intent being to maintain still water at point of discharge and to avoid agitating mixture.
11) Pour concrete continuously until work is completed.

x. Placing Concrete on Ground or Seal Slabs
   1) Place concrete in footings after depth and character of foundation is observed.
   2) Place footing concrete upon seal slabs after caissons, cofferdams, excavations, forms, etc. are free from water and seal surface cleaned.
   3) Locate pumps or bailing equipment in sump outside of forms.
   4) Immediately before placing concrete, moisten subgrade to decrease absorption of moisture, if seal slab or waterproofing not required.
   5) With prior authorization, side forms in dry excavation may be omitted.
   6) Place column concrete monolithically unless otherwise provided.

E. Curing Concrete
   1. Keep forms tight against concrete, or remove and start curing operations.
   2. Length of Curing
      a. Cure concrete for 6 consecutive curing days.
      b. Cure high-early-strength concrete for 3 consecutive curing days.
      c. Cure bridge slabs and top slabs of direct traffic culverts for 10 consecutive curing days.
   3. Definition of Curing Day
      a. "Curing Day" is any calendar day during which the temperature, taken in the shade away from artificial heat, is above 50°F for at least 19 hours (on colder days, if satisfactory provisions are made, maintain the temperature at all surfaces of the concrete above 40°F for the entire 24-hour day).
      b. Required curing period begins when all concrete therein has attained initial set.
   4. Curing Methods
      a. Flat Concrete: Apply curing material as specified at the rate of 200 square feet per gallon using a pump type spray. Apply after concrete is set sufficient to bear full weight of applicator. Immediately after application of curing material, re-wet concrete using potable water and spray or fog nozzle. Do not allow to puddle.
      b. Formed Concrete: Apply curing material as specified as soon as practical after removing forms, at a rate of 200 square feet per gallon.
      c. Formed concrete that is to be rub-finished, apply curing material as specified as soon as rubbing is finished.
      d. Formed or flat concrete that is to be painted or waterproofed should be treated with curing material as specified as soon as possible after finishing and prior to application of paint or waterproofing material.

e. Grout and Grouted Areas: Apply curing material as specified to areas to receive grout prior to grout application and also apply a coat of curing material as specified to the grout after application.

F. Removal of Forms and Falsework
1. Remove forms from surface to receive rubbed finish when concrete has attained adequate strength to prevent damage, and remove only as rapidly as rubbing operation progresses.
2. Re-wet wood forms or form lining left in place longer than 24 hours as required to keep them moist.
3. Remove forms and falsework from portions of structures that do not require rubbed finish, after the following number of curing days.
   a. Forms for falsework under slabs, beams, or girders - 7 days.
   b. Forms for walls, columns and piers - 2 days.
4. If cold weather continues below 40°F, form and falsework may be removed at the end of a period of calendar days equal to twice the number of curing days specified.

G. Defective Work: Any defective work discovered after form removal to be repaired or replaced immediately at Contractor's expense.

H. Concrete Surface Finish: For concrete having no special finish indicated, remove ties, fill holes, and remove fins and rough edges. Exposed concrete surfaces, other than floors, to have a rubbed finish except where noted on PLANS.
1. Monolithic Finish
   a. Finish slabs, platforms, and steps monolithically between joints.
   b. Set screeds prior to concrete placement, and make sufficiently rigid to withstand impact of concrete being placed.
   c. Tamp concrete thoroughly to force coarse aggregate away from surface of slab, then float to secure hard surface.
   d. Provide wood float finish, except use steel-trowel finish for building and pump station floor slabs, and elsewhere as indicated on PLANS, unless otherwise directed.
   e. "Dusting" floor surfaces with dry material not permitted.
   f. Round edges at all expansion joints with suitable jointing or edging tools.

I. Exposed Aggregate Panels
1. Forms for raised panels to be sandblasted may be removed on the day following concrete placement (about 18 hours). Continue curing after sandblasting.
2. Immediately after form removal, sandblast to a depth of from 3/8 inch to 5/8 inch.

3. Protect smooth surfaces adjacent to sandblasted panels during sandblasting.
4. Coarse aggregate for raised panels range from Standard No. 4 to 1-1/2-inch gradation.
5. Exposed aggregate sandblasted surfaces are to receive a coat of curing material as specified. Preparatory work, application, and precautions in strict compliance with manufacturer's recommendations.

J. Rub-Finished Surfaces
1. General: Rub-finish exposed vertical and battered surfaces from 6 inches below ground surface or from 6 inches below normal water level to top, except for small plinths and similar structures which extend less than 12 inches above finished grade.
2. Procedure
   a. Start rubbing operations when concrete has attained adequate strength for form removal (about 18 hours after concrete placement). Continue curing afterwards.
   b. Do necessary pointing as forms are removed.
   c. Remove forms only as rubbing progresses in order to prevent rapid hardening of surface to be rubbed.
   d. After pointing has set, wet surface with brush and give first surface rubbing with No. 16 carborundum stone or equal.
   e. Rub sufficiently to bring surface to paste and to produce smooth dense surface without irregularities.
   f. Add no cement to form surface paste.
   g. Spread or brush material, which has been ground to paste, uniformly over surfaces and allow to take reset.
   h. Do not rub chamfered corners in first rubbing.
   i. Complete first rubbing within 36 hours after completion of concrete placement.
   j. For final acceptance, clean surfaces of structure and give final finish rubbing with No. 30 carborundum stone or equal.
   k. After rubbing, strip surfaces with brush and allow mortar on surface to take reset; then wash surface with clean water.
   l. Leave structure with clean, neat, and uniform appearing finish.
   m. Apply a coat of curing material as specified. Preparatory work, application, and precautions in strict compliance with manufacturer's recommendations.

K. Patching and Filling Holes
1. Tie and Bolt Holes
   a. Fill holes with cement mortar to which has been added white cement so that patches will not appear darker than adjacent concrete surface.
   b. Use mortar as dry as possible and pack into holes.

c. Fill holes, entirely through concrete, with nonshrinking grout from inside structure with a pressure gun or other device that will force mortar through to outside face.
d. Strike off excess mortar flush and finish surface to make filled holes as inconspicuous as possible.

2. Honeycomb and Minor Defects
   a. Patch slight honeycomb and minor defects in concrete with cement mortar mixed one part cement to two parts fine aggregate. Match color of adjacent concrete.
   b. Repair area by cutting out unsatisfactory material by chipping or other approved methods and replace with new concrete, securely keyed and bonded to old concrete, and finish so as to make joints as inconspicuous as possible. Use stiff mixture and thoroughly tamp into place.
   c. Use nonshrinking grout for large honeycomb and for hydraulic structures with honeycomb sufficient to cause leakage through concrete.

L. Waterstops and Waterproofing
1. Waterstops
   a. Secure each edge of waterstop by tying with clean steel wire to reinforcing steel at intervals not to exceed one foot.
   b. Make waterstops continuous by heat sealing at splices as recommended by manufacturer. Minimum requirements are as follows.
      1) Only splicing of straight runs allowed in forms. Butt weld straight splices.
      2) Fabricate all other waterstop joints at central location on jobsite or by waterstop manufacturer.
      3) Miter and weld splices in expansion joint waterstops at directional changes bulb to bulb.
   c. Puncturing waterstops not allowed.
2. Waterproofing
   a. Apply approved primer, as recommended by manufacturer of membrane, to clean, dry surface at rate of not more than 250 square feet per gallon, and allow to dry to tack-free condition before applying membrane.
   b. Apply membrane within 12 hours of priming, or re-prime surface.
   c. Apply membrane vertically or horizontally, wrinkle free, with a minimum of 2-1/2-inch overlaps and staggered. For horizontal application, upper course to lap over lower course.
   d. Repair accidental damage to membrane by spot application of material to damaged areas with minimum of 6-inch overlap in all directions.

e. Exercise special care to ensure protection of waterproofing membrane from damage during backfill operations.

M. Grouting
1. Clarifier Slabs
a. Prepare slab to receive grout using concrete bonding agent in accordance with manufacturer's recommendation.
b. Use grout mixture of one part portland cement and three parts sand by weight, with maximum 6-inch slump.
c. Slab receiving bonding agent to have a broom finish and be free of dirt, grease, and other foreign substances before placement of bonding agent.
d. Placing Grout
1) Do not deposit large quantities at one point.
2) Use clarifier mechanism operated by hand only for final screeding.
3) Do not allow grout to build up in front of mechanism greater than 3 inches.
2. For Setting New Equipment
a. Use nonshrink epoxy grout as specified in 2.01 F.
b. Grouting Procedure
1) Clean surface to receive grout of laitance, grease, oil, organic matter, and loose particles.
2) Blow out bolt holes.
3) Chip concrete to obtain firm bond.
4) Set grout forms true, level, tight, and well braced.
5) Assemble equipment to be grouted before grouting.
6) Clean baseplates and all items to be embedded and set in final position.
7) Shim equipment bases for easy removal of shims.
8) Moisten area to receive grout.
9) Do not mix more grout than can be placed in 20 minutes.
10) Place grout from one end or side only to avoid excessive air entrapment and to ensure good compaction.
11) Work and rod grout continuously while it is being placed.
12) After grout has attained full strength, remove shims.
13) Replace grout damaged by shim removal with like material.
14) Steel trowel exposed grout, and protect exposed area from drying out rapidly.
15) Do not stress items embedded in grout, and do not operate equipment for 36 hours after grout is placed.
3. Other Grouting
a. For general purposes, use mixture of one part portland cement and two parts sand by weight.

b. If space to be grouted is 1 inch or less in thickness and cannot be tamp grouted, use a mixture of one part portland cement and one part sand by weight.
c. If space to be grouted is large, use original concrete mixture.
d. For grout to be tamped, use stiff mixture produced by prolonged mixing.
e. To obtain stiff grout, mix mortar using amount of water required to thoroughly mix ingredients, then continue mixing without additional water until grout is stiff enough to be compacted by tamping when placed.
f. For grouting blockouts for embedded pipes and similar items, use nonshrinking grout as per 2.01 F. of this Item.

N. Coal-Tar Epoxy Coating
1. When specified elsewhere, apply coal-tar epoxy coating.
2. Repair all form tie holes, honeycomb, and other surface defects prior to application of waterproofing.
3. Concrete surfaces to be clean, free of scale, grease, oil curing compounds, and all other foreign material. Etch with muriatic acid if necessary for proper cleaning. Flush muriatic acid with fresh water spray before the etched surface drips to remove all salts.
4. Apply two coats of coal-tar epoxy primer to 5 mils (dry) per coat.
5. Apply coal-tar epoxy with roller or airless sprayer without thinning.
6. Mix in quantities that can be applied within 1 hour from the time of mixing.
7. Apply two coats of coal-tar epoxy to 25 mils (dry) per coat.
8. Storage and handling as per manufacturer's recommendations.
9. Protect treated surfaces from temperatures below 50°F until completely cured (48 hours minimum).

O. Cleanup: Clean up area and remove excess material, dismantled forms and falsework, and debris during construction, and clean area completely and thoroughly after completion of the work herein described.

3.03 Measurement and Payment

No separate payment for work performed under this Item. Include cost of same in Contract price bid for work of which this is a component part.

END OF ITEM

ITEM No. B3001 - REINFORCING STEEL

PART 1 - GENERAL

1.01 Description

A. Scope: Furnish and place reinforcing steel, deformed and smooth, chairs, ties, splicing devices, and other reinforcing accessories required to complete work.

B. Other related work as called for on PLANS or specified elsewhere in this or other TECHNICAL SPECIFICATIONS.

1.02 Quality Assurance

Conform with approved shop drawings and with ACI Manual of Practice for Detailing Reinforced Concrete Structures.

1.03 Submittals

A. Submit the following in accordance with Contract Documents.
   1. Product data for all materials used.
   2. Shop drawings indicating location, placement, sizes, and bending.
   3. When welding is required, furnish report of chemical analysis, showing percentages of carbon, manganese, phosphorus, and sulphur.

B. Certificate of Compliance: Submit certified copy of mill certificates of compliance with requirements herein specified.

C. Special Equipment: Submit information on mechanical splicing devices, couplers, and all other reinforcing accessories.

1.04 Product Delivery, Storage, and Handling

A. Deliver to jobsite free from dirt, loose scale and rust, paint, oil, or other foreign material.

B. Store above surface of ground upon platforms, skids, or other supports, and protect from mechanical injury and surface deterioration caused by exposure to conditions producing rust or other damage.

C. Handle so as not to sustain crimping, bending, or warping before and during placement.

PART 2 - PRODUCTS

2.01 Materials

A. General Requirements
   1. Nominal size, area, and theoretical weight in accordance with Table 1, ASTM A615 supplementary requirement.
   2. Bending
      a. Bend in shop, cold, true to shapes indicated on PLANS.
      b. Irregularities in bending are cause for rejection.
      c. Detail bars in accordance with ACI 315.
      d. Inside diameter of bar bends, in terms of nominal bar diameter (d) of bar which is bent, in accordance with ACI 315.
   3. Fabrication tolerances in accordance with ACI 315 except as necessary to satisfy clearance requirements of paragraph 3.01 A.2. of this Item.
   4. Splices
      a. Except where shown, not permitted without prior written approval.
      b. Not permitted in main reinforcement at points of maximum stress, unless shown otherwise on PLANS.
      c. When not indicated on PLANS, but permitted with prior written approval, subject to the following:
         1) Not larger than #8 bars.
         2) Not permitted in bars 30 feet or less in length, except vertical.
         3) Splices center to center not less than 30 feet, and no individual bar length less than 10 feet.
         4) Maintain specified concrete cover and tie bars together securely.
         5) Stagger main bar splices in adjacent bars a minimum of two splice lengths.
      d. Lap Splices
         1) Lap bars in accordance with table shown on "Concrete Standards" sheet or as indicated or noted on drawings.
         2) Lap bars so that both bars will be in the same plane parallel with the nearest concrete surface.
         3) All splices to be full contact lap splices and securely tied together.
      e. Welded Splices
         1) Procedures and electrodes as specified in AWS D1.4.
         2) For bars No. 6 and smaller, use lap weld splices with fillet weld equal to one-half bar diameter on each side for 4 inches in length.
         3) For bars No. 7 and larger, use butt weld splices in accordance with AWS D1.4.
         4) Prepare ends for butt welding in the field, and deliver bars of sufficient length to permit this practice.
      f. All splices, whether lap weld, mechanical, or coupler, to develop full strength of bar.

B. Reinforcing Steel
   1. Deformed, conforming to ASTM A615 Grade 40 and Grade 60, as specified.
   2. Welded wire fabric conforming to ASTM A185.
   3. Cold drawn steel wire conforming to ASTM A82.
   4. Spiral reinforcement to be deformed bars conforming to ASTM A615, or smooth bars or wire conforming to ASTM A82.
   5. Smooth dowels for expansion joints, conforming to ASTM A615 Grade 60.

C. Epoxy: Unless otherwise specified or shown, the epoxy for grouting reinforcement into existing concrete to conform to Servicised Epoxtite Binder as manufactured by W. R. Grace & Co., Houston, Texas.

PART 3 - EXECUTION

3.01 Installation

A. Place reinforcing steel in positions indicated on PLANS and approved shop drawings.
   1. Dimensions shown are to centers of bars, unless otherwise noted.
   2. Hold bars securely in place with tie wires and other approved means during placement of concrete.
      a. In plane of steel parallel to nearest surface of concrete, bars not to vary from PLAN placement by more than one-twelfth of spacing between bars.
      b. In plane of steel perpendicular to nearest surface of concrete, bars not to vary from PLAN placement by more than 1/4-inch.
   3. Looped wire bar ties ("pig tails") will be permitted for concrete pavement only. Do not use looped wire bar ties ("pig tails") for structural concrete.
   4. Do not tack weld reinforcing.
   5. Space steel required distance from forms or earth by approved galvanized metal spacers, metal spacers with plastic coated tips, stainless steel spacers, plastic spacers, or approved precast mortar or concrete blocks.
      a. For approval of plastic spacers, provide samples of plastic which show no indications of deterioration after immersion in a 5 percent solution of sodium hydroxide for 120 hours.
      b. Cast precast block, maximum 2-1/2 inches square, to thickness required for proper reinforcement clearance from forms, or seal slabs.
   6. Use galvanized metal chairs to support all reinforcing steel. For pavement use plastic chairs as manufactured by Sheplers (or approved equal) or metal chairs to support all reinforcing steel. Metal chairs need not be galvanized. Spacing for plastic or metal chairs to be 24-inch, center to center each way to support reinforcing in concrete pavement. Metal chairs to be secured with wire to the reinforcing steel.

7. Use heavy bolster to support bottom layer of reinforcing in abutment caps, bent caps, and other beams.
8. In bridge deck slab, use two rows of supports for bottom layer of reinforcing parallel to beams for each bay between beams. Use high chairs to support top layer.
9. Clean all mortar, mud, dirt, etc. from reinforcement before placing concrete.
10. Protect exposed steel from corrosion or other damage.
11. Correct placement of steel to be verified by Contractor before concrete is placed.
12. Provide adequate support for reinforcement extending out of formwork to ensure proper alignment.
13. Tie reinforcing steel for all structural slabs at all intersections, except where spacing is less than one foot in each direction, alternate intersections only need to be tied. Tie reinforcing steel in concrete pavement at a minimum of alternate intersections.
14. For reinforcing steel cages for other structural members, tie steel at enough intersections to provide a rigid cage of steel.

B. Grout reinforcing steel into existing concrete when indicated on PLANS.
1. Holes to receive reinforcement may be wet or dry drilled using rotating machines only.
2. Drill holes within 1/4 inch of the location shown on PLANS.
3. Flush wet drilled holes with clean water to remove residue and blow out using oil-free compressed air.
4. Blow out dry drilled holes with oil-free compressed air.
5. Clean oil-contaminated hole using appropriate solvents and bottle brush. Solvents to be flushed and hole blown out with oil-free compressed air.
6. Backfill over-drilled holes with epoxy grout.
7. Reinforcement grouted in place to be free of contaminants. Use the appropriate solvents and wire brushing to remove contaminants.
8. Provide adequate support for reinforcement to ensure alignment and maintain reinforcement in the center of the drilled hole.

3.02 Measurement and Payment

A. No separate measurement and payment for work performed under this Item, except as indicated below. Include cost of same in Contract price bid for work of which this is a component part.

B. Measure "Extra Reinforcing Steel," when approved by Engineer, by pound of calculated weight of steel actually placed. Pay for "Extra Reinforcing Steel" at Contract unit price bid per pound of "Extra Reinforcing Steel" placed.

END OF ITEM

APPENDIX

GEOTECHNICAL INVESTIGATION

TERRA-MAR

Consulting Engineers • Geotechnical • Environmental • Construction Materials Testing

DALLAS • FORT WORTH • HOUSTON

September 23, 1993
Report No. DE93-043

Turner, Collie & Braden, Inc.
5710 LBJ Freeway, Suite 370
Dallas, Texas 75240

ATTN: Mr. Laird Ellis, P.E.
Project Manager

GEOTECHNICAL INVESTIGATION
FARMERS BRANCH CREEK CHANNEL IMPROVEMENTS
FARMERS BRANCH, TEXAS

Gentlemen:

Submitted herewith are the results of the geotechnical investigation performed at the above referenced site. The investigation was performed in accordance with our letter dated September 9, 1993. This investigation was authorized by Mr. Laird Ellis on September 10, 1993. This report describes the material, both soil and rock, forming the creek bed along the proposed section of Farmers Branch Creek.

Project Description

The project consists of the lining of an approximate 500 foot length of Farmers Branch Creek with reinforced concrete. It is our understanding that the existing creek section will be trimmed/ reshaped to a trapezoidal section with a bottom width of about 20 feet and sloped sides about 4 to 8 feet in height. Shallow excavations up to two (2) feet below the existing creek bed are anticipated to maintain a mild downstream gradient. This investigation was performed to determine the type of soils and rock to be encountered in the shallow excavations performed below the existing creek bed.

Investigation and Results

The purpose of this investigation was to divide the proposed section of the creek into subsections based on the material exposed along the creek bed. In areas where alluvial soils were exposed along the creek bed, a probe was used to determine the depth to rock if present within a three foot depth. Swiss Hammer tests were also performed to evaluate the approximate compressive strength of the rock encountered.

An overview of the existing creek along the proposed section is presented in Figure 1. It is understood that elevations along the creek bed decrease from about El 543.15 at Station 8+50 to about El 542.77 at Station 3+50 as shown on the plan of the proposed section of Farmers Branch Creek provided by Turner, Collie and Braden. The plan shows creek bed elevations of El 545.68 at Station 5+68. Bottom width of the existing

creek channel gradually narrows from about forty five (45) feet at Station 8+50 to about fifteen (15) feet at Station 3+50 with larger widths measured on the upstream side. The depth of water in the creek ranged from a few inches to about thirty (30) inches at the time of this investigation.

The proposed section of the creek may be divided into two general subsections based on a visual examination and scattered probings of materials exposed along the creek bed, as shown in Figure 2. The creek consists of water bearing alluvial soils exposed along the creek bed from approximately Station 3+50 to Station 6+80. The alluvial soils on the creek bed generally consist of sandy gravel and cobble with varying amounts of silt and clay. Soft gray sandy clay layers were encountered in probings near the left creek bank. Numerous shale and limestone cobbles (between 3 and 8-inch size) and boulders (greater than 8-inch size) were also noted on the creek bed along the proposed section. Hard limestone boulders larger than 3 foot square and 2 foot thick were observed. Swiss Hammer tests performed on limestone boulders exposed above the water surface indicated compressive strengths of about 4,000 to 6,000 pounds per square inch. It should be recognized that the water bearing alluvial soils are very pervious and will require dewatering prior to beginning excavation. The groundwater level should be maintained at least one to two feet below the excavation base in areas underlain by the water bearing alluvial soils.

Soil probings were performed below the creek bed to determine the depth to refusal in hard unpenetrable material if present within a three (3) foot probing depth. The approximate locations of soil probings performed along the proposed section of the creek are shown in Figure 1. The results of the probings, summarized on Table One, indicate that hard unpenetrable material (shale formation or a large hard shale/ limestone boulder) is present at the probing locations at depths ranging from 0.5 to 1.7 feet below the existing creek bed between Stations 3+50 to 6+80.

The dark gray Eagle Ford Shale Formation is exposed along the creek bed from approximately Station 6+80 to Station 8+50. The exposed shale formation is moderately hard. At the time of this investigation, the shale bedrock was at least 12 inches below the water surface. Swiss Hammer tests can not be performed under submerged conditions. However, a three (3) inch thick shale sample was obtained from the creek bottom. Swiss Hammer tests performed on this sample indicated a compressive strength of less than 1,500 pounds per square inch. Shale and limestone boulders are also present along the creek bed within this channel section.

Conclusions

The variation in the shale depth along the channel section is due to previous creek erosion and subsequent deposition of the alluvial deposits. Erosion effects are typically most severe along a meandering section of a creek (near a bend) where creek flow velocities are the largest. As indicated on Figure 2, the alluvial deposits begin at Station 6+80 where the creek begins to bend.

Limitations

This study was conducted for the exclusive use of Turner, Collie and Braden, Inc. The reproduction of this report or any part thereof, in plans or other documents supplied to persons other than the owner, should bear language indicating that the information contained therein is for general design purposes only. All contractors referring to this geotechnical report should draw their own conclusions for bidding purposes. We appreciate the opportunity to assist on this project. Please do not hesitate to call if you have any questions or if we can be of further assistance.

Sincerely,

TERRA-MAR, INC.

Nasir H. Syed, E.I.T.
Staff Engineer

Mark J. Farrow, P.E.
Vice President

Copies Submitted: (3) Turner, Collie & Braden, Inc.
Mr. Laird Ellis, P.E.

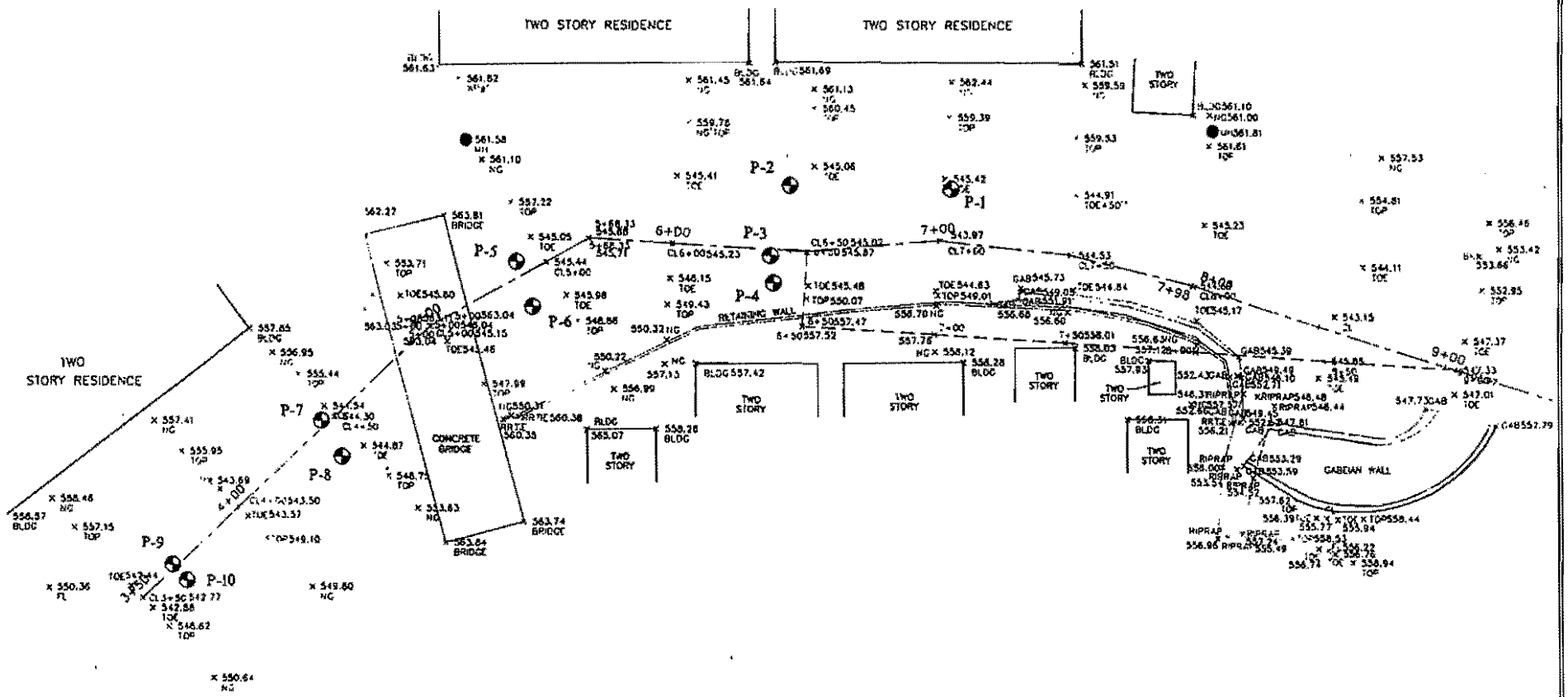
TABLE ONE

PROBING SUMMARY

Probing Location**	Depth to Refusal in Hard Unpenetrable Material (ft)*
P-1	1.7
P-2	0.5
P-3	1.5
P-4	Below 3.0
P-5	1.0
P-6	Below 3.0
P-7	0.7
P-8	Below 3.0
P-9	1.0
P-10	Below 3.0

* Depth measured from existing creek bed. Hard unpenetrable material encountered in probings could either be the shale formation or a large hard shale/ limestone boulder. The material encountered in the probings consisted of sandy gravel, cobble, silt and clay. Large boulders are also present along the creek bed.

** Probings between Stations 3+50 and 6+80. Moderately hard dark gray shale exposed in creek bed between Stations 6+80 and 8+50.



0 30 60 120

FEET

NOTE: See Table One for probing refusal depth in unpenetrable material.

LEGEND

Location of Probings

NORTH

Proposed Section of Farmers Branch Creek
Farmers Branch, Texas

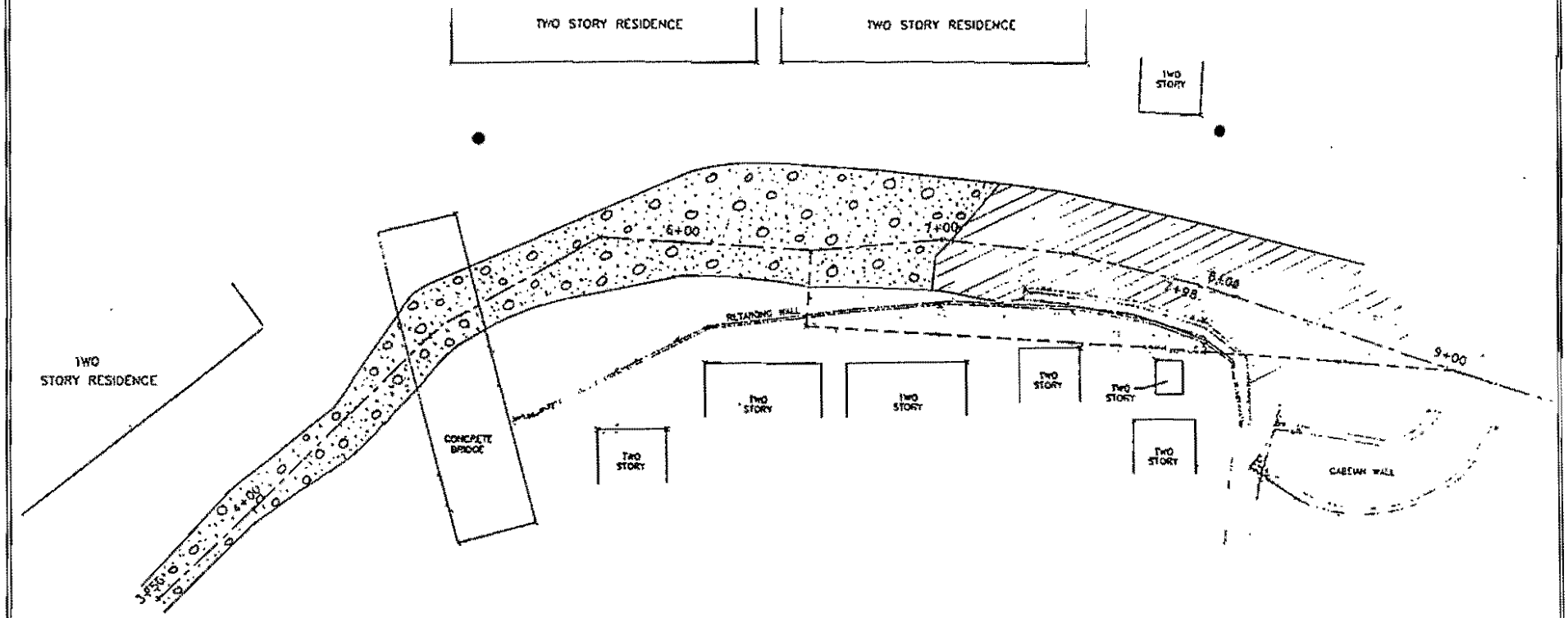
OVERVIEW

TERRA-MAR, INC.

DE93-043

FIGURE 1

FIGURE 1



LEGEND

SHALE Formation exposed along creek bed

Water bearing sandy GRAVEL, cobble, shale & limestone fragments & boulders observed along creek bed. See Table One for probing refusal depths.

NORTH

0 30 60 120

FEET

Proposed Section of Farmers Branch Creek
Farmers Branch, Texas

EXPOSED MATERIALS

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FIGURE 2

FIGURE 2