

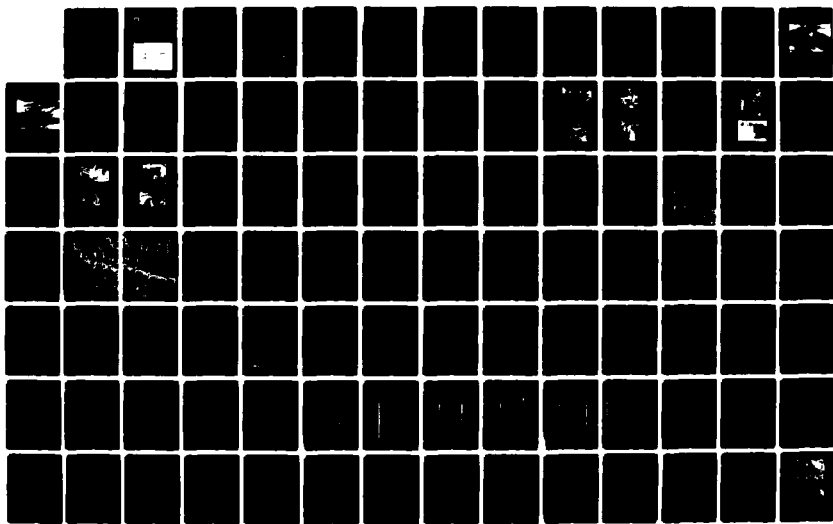
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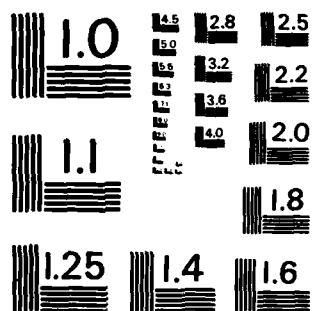
OUTLET WORKS JOE POOL LAKE MOUNTAIN CREEK TEXAS(U) ARMY
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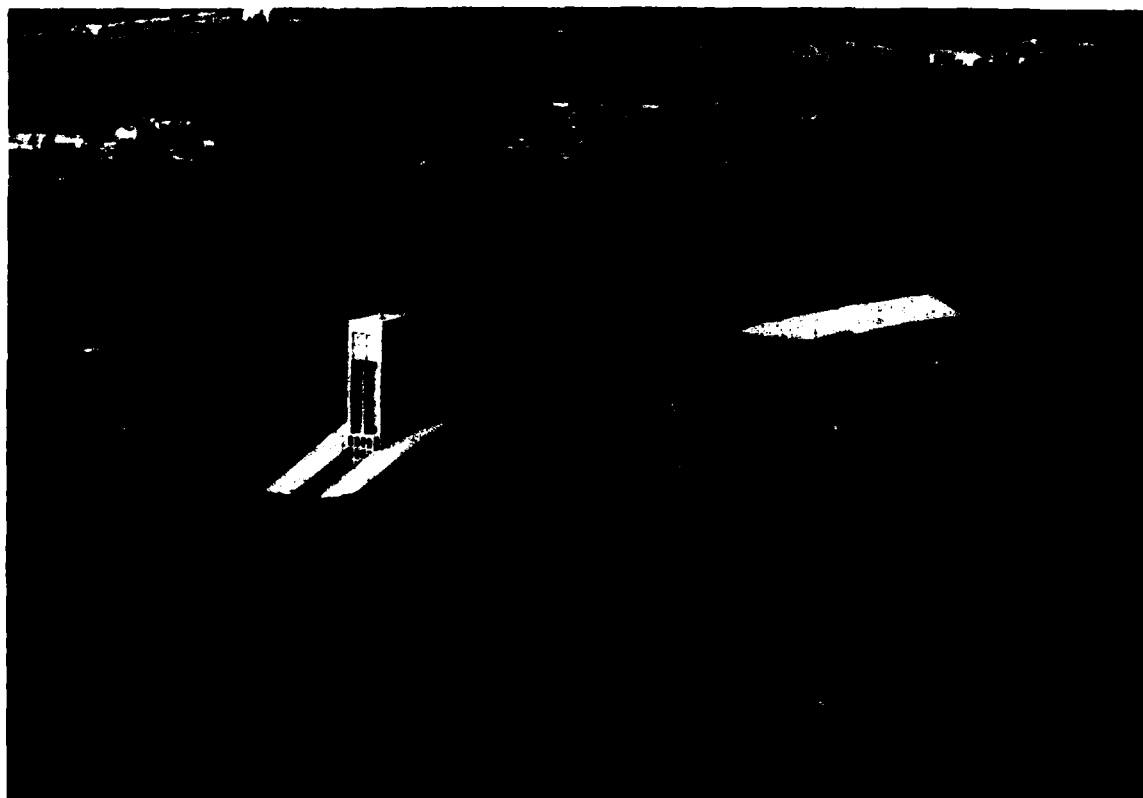
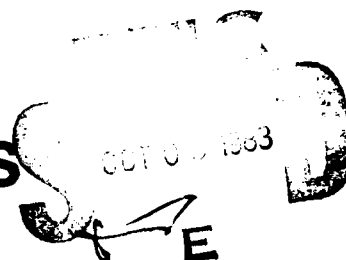


US Army Corps
of Engineers
Fort Worth District

**FINAL
FOUNDATION
REPORT**

**OUTLET WORKS
JOE POOL LAKE
MOUNTAIN CREEK, TEXAS**

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CORPS OF ENGINEERS
FORT WORTH DISTRICT, TEXAS

FINAL
FOUNDATION REPORT

JOE POOL LAKE
OUTLET WORKS

BY

ALAN J. MARR
GEOLOGIST

JUNE 1983



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PREFACE

This report was made by the Geotechnical Branch, Engineering Division, Fort Worth District. The report was prepared by Staff Geologist, Alan J. Marr, under the supervision of the Project Geologist, Robert C. Behm, the Chief of the Geology Section, Melvin G. Green, and the Chief of the Geotechnical Branch, Wayne E. McIntosh.

District Engineer for the Fort Worth District during construction of the Joe Pool Lake Outlet Works was Colonel Donald Palladino. Mr. Shigeru Fujiwara was Chief of the Engineering Division and Messrs. Gary Hames and Mel Sadler served as Resident Engineer during construction.

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I INTRODUCTION

1. Project Location and Description. The Joe Pool Dam and Lake¹ project is located in southwest Dallas County near Grand Prairie, Texas. The dam is located at river mile 11.2 on Mountain Creek, a tributary to the West Fork of the Trinity River. Location of the project is shown on plate 1. The principal features of the Joe Pool Dam and Lake project include: (1) A rolled earth-fill embankment approximately 22,180 feet long with a crest width of 30 feet; (2) a service spillway perched in the left embankment at station 100+00 having a concrete uncontrolled rectangular broadcrested weir 50 feet wide; and (3) a 10.5-foot diameter cut and cover conduit controlled by two 4.75 X 10.5-foot service gates.

2. Construction Authority. Congressional authority for the construction of Joe Pool Dam and Lake is contained in the Public Works - Rivers and Harbor Act approved 27 October 1965 (Public Law 89-298) in accordance with the overall plan of improvement of the Trinity River Basin, Texas as outlined in House Document No. 276 (89th Congress, 1st Session).

3. Purpose of Report. This report has been prepared in accordance with requirements as set forth by the Office, Chief of Engineers, and is the first of two such reports that will record the foundation history of each structural feature of Joe Pool Dam. The subject of this report is the outlet works, to include the approach channel, intake tower approach slab, intake tower, conduit, stilling basin, and discharge channel. A second report will address the embankment, spillway, and service bridge portions of the project.

The purpose of this report is to provide a complete record of foundation conditions encountered during construction. Information contained in this report will be valuable when evaluating (1) necessary remedial action required to prevent or repair any failures resulting from foundation deficiencies, (2) contractor claims related to foundation conditions or alleged change of condition, and (3) planning and design of future comparable construction projects.

A copy of this report should be included in the permanent records maintained at the project office.

4. Project History. Seven damsite locations along Mountain Creek were studied before the proposed site was selected. Subsurface investigations at the proposed site were initiated in April 1969, and continued intermittently over a 10-year period.

The spillway and outlet works were originally sited on the right abutment and were extensively investigated by subsurface exploration.

¹In December 1982 Public Law 97-400 was passed by Congress which officially changed the name of the Project from Lakeview Lake to Joe Pool Lake. All previously published documents, design memorandums, plans, and specifications are entitled Lakeview Lake and will be referred to under the name Lakeview Lake in this report.

These investigations revealed the presence of unsuitable geologic bed-rock conditions in the right abutment. As a result the two structures were resited on the left abutment.

5. Location of the Outlet Works. The outlet works is located on the left abutment at embankment station 76+00. The site plan is shown on plate 2. Aerial views of the site are shown on figures 1 and 2.

6. The Contract. The contractor and pertinent information related to the contract are listed below:

Joe Pool Dam - Outlet Works and Initial Embankment

Contractor: The Lane Construction Corp., Meridian, CT

Contract No.: DACW63-80-C-0009

Bid: \$11,200,632.50

Contract Awarded: 19 November 1979

Notice to Proceed: 30 November 1979

Acknowledged: 6 December 1979

Work Commenced: 7 December 1979

Work Completed: 4 June 1982

NOTE: Construction items included in this contract were the outlet works and two partial embankments. Only the outlet works is discussed in this report. The two partial embankment foundations will be discussed in the Joe Pool Embankment and Spillway Foundation Report.

7. Quality Control. The quality control organization was furnished and compensated by the contractor.

8. Contract Supervision. The outlet works was constructed under the immediate supervision of the District Engineer, U.S. Army Engineer District, Fort Worth, Texas. The contracting officer's representative for administration of the contract was Mr. James D. Leslie, Area Engineer, North Texas Area Office. Messrs. Gary Hames and Mel Sadler each served as Resident Engineers during construction.



Fig 1 Aerial view of Joe Pool Outlet Works excavation



Fig 2 Aerial view of Joe Pool Outlet Works excavation

II FOUNDATION EXPLORATIONS

1. Investigations Prior to Construction. The outlet works was originally sited in the right abutment of the dam. Subsurface investigations in this area, which consisted of 22 core borings, revealed the presence of unsuitable foundation conditions. As a result the outlet works was resited at embankment station 76+00 on the gently sloping left abutment.

Investigations for the left abutment site (the actual construction site) consisted of 33 borings ranging in depth from 25 feet to 125 feet. Locations of the borings are shown on plate 4 and logs of the borings are presented on plates 12 through 25.

2. Investigations During Construction. No unanticipated foundation conditions or problems were encountered during construction. Therefore, no investigations were required during construction.

III GEOLOGY

1. Physiography and Regional Geology. The Joe Pool Dam site is located at the eastern edge of the Eagle Ford Prairie section of the Gulf Coastal Plain physiographic province. Topographically, the damsite is characterized by a moderately steep east abutment, a flat 5000 feet wide floodplain, and a gently sloping west abutment.

The major topographic feature in the area is the White Rock escarpment located one-half mile east of the dam's right abutment. This escarpment trends north-northeast and marks the eastern edge of the Mountain Creek drainage area. Immediately west of the White Rock escarpment are numerous remnants of a small cuesta. The cuesta was formed by a resistant limestone bed of the Eagle Ford Formation which was later eroded into a series of sub-rounded hills rising 30-60 feet above the present Mountain Creek valley. The dam's moderately steep east abutment is formed by one of these hills.

Bedrock strata underlying the embankment and reservoir area consist of Upper Cretaceous units of the Eagle Ford Formation. Regional dip of the Eagle Ford strata is gentle and to the southeast toward the Gulf of Mexico. At the damsite the maximum thickness of the Eagle Ford Formation is 225 feet as indicated by borings along the dam axis which penetrated the Eagle Ford and bottomed in the underlying Woodbine Formation. Lithologically the Eagle Ford Formation consists predominantly of soft to moderately hard clay shale. An areal geology map is shown on plate 3.

2. Geology of the Outlet Works.

a. Description of the Overburden. Overburden within the limits of the outlet works excavation consisted of recent floodplain deposits and older Quaternary terrace deposits. The deposits consisted of sandy clay, clayey sand, and gravel. Overburden slopes in the portion of the outlet works excavation which occurs beneath the embankment were mapped in detail and are presented on plate 6. A typical section of overburden in the outlet works area consisted of an upper zone of dark brown, stiff, silty clay with occasional rootlets near the surface, and occasional calcareous pocket with scattered calcareous nodules to 3/4-inch diameter. Downward the clay becomes more calcareous, sandy to very sandy, stiff to very stiff, and tan to brown with occasional gravels. Sand and/or gravel is usually found at the base of the overburden, and immediately overlying the weathered primary. The composition of this zone varies from almost a pure, non-cemented, orange sand in the excavation slope left of the stilling basin, to a mixture of sand and gravel, to a moderately clean, angular, tan gravel located in the right slope of the excavation near the intake tower. A soft, mushy area was observed in the left (west) slope of the excavation at station 23+00 where the sand gravel zone produced a small amount of seepage.

b. Bedrock Stratigraphy. The outlet works was founded within the Britton member of the Eagle Ford Formation, upper Cretaceous in age. The Britton member is the lowest member of the Eagle Ford Formation and is approximately 160 feet thick at the outlet works site. Based on lithology the Britton member is divided into three units. In ascending order they are: (1) The Lower Britton, Unit I; (2) the Lower Britton, Unit II; and (3) the Upper Britton. The Lower Britton, Unit II, and the Upper Britton comprise the outlet works foundation. The contact between the two members was exposed in the stilling basin chute at station 27+57.6, elevation 447.84. Thus the lower chute section and the stilling basin were founded in the Lower Britton, Unit II member. The remainder of the structure was founded in the Upper Britton member of the Eagle Ford Formation.

c. Bedrock Lithology. The Lower Britton, Unit II, in the chute and stilling basin area is 15 feet thick and consists of moderately hard to hard, occasionally jointed, tannish-gray very calcareous clay shale. The Upper Britton, which supports the remainder of the structure, consists of soft to moderately hard, slightly calcareous, highly jointed and fractured bentonitic clay shale. The following chart details the distinguishing characteristics between the Lower Britton, Unit II, and the Upper Britton in the area near the contact:

<u>Upper Britton</u>	<u>Lower Britton, Unit II</u>
Soft to moderately hard	Moderately hard to hard
Thin-bedded - ripply surface	Thick-bedded
Highly jointed and fractured	Occasional joints and fractures
Dark Gray	Tannish-gray
Scattered fossil shells	Fossiliferous (fine fish scale remains)
Occasional limestone or claystone concretion layers	

d. Bedrock Structure. Regional dip of the strata of the Eagle Ford Formation is to the east-southeast at approximately 50 feet per mile. However, local dip of the strata beneath the outlet works structure showed some variation, ranging from 100 feet per mile to the south to 200 feet per mile to the north, striking generally along an east-west line. Changes in dip often occurred at points where fault planes intersected the outlet works. A total of seven minor faults or fault zones were encountered beneath the structure at the following stations:

20+00	Intake tower
21+02	Conduit
22+19	Conduit
23+76	Conduit
25+60	Conduit
26+67	Conduit
28+78	Stillling basin endsill

There was no distinct pattern as to the orientation of the strike of the faults exposed in the excavation. All of the faults were normal faults. Dip of the fault planes was to the south and displacement across each fault was minor (less than 1.0 foot) in the outlet works structure foundation. However, as much as 2 feet of displacement was observed higher in the section in the IV on 3H clay shale slopes of the outlet works excavation. The fault planes were generally tight with brecciated zones less than 6 inches thick. Minor jointing and fractured zones also occurred in the outlet works foundation. The location of all faults, joints, and fracture areas exposed in the bedrock excavation in the immediate area of the structure are shown on plate 6.

e. Bedrock Weathering. Final excavation grade for the outlet works structure occurred well below the base of bedrock weathering. All foundation bedrock on which concrete was placed was unweathered. Bedrock weathering observed in the slopes of the excavation on each side of the structure can generally be classified into two zones. The upper zone of weathering is described as highly weathered. This zone consists of soft, highly plastic, brown shaly clay. The lower zone is described as slightly weathered and consists of soft, highly jointed-fractured, gray to dark gray clay shale with iron staining on the joint and bedding plane surfaces. This zone grades downward into unweathered clay shale. The combined thickness of the weathered zones in the outlet works area varied from 2.0 to 13.7 feet.

f. Ground Water. No significant flow of ground water was encountered in the outlet works excavation. A very small amount of ground water seeped from the overburden in the left side of the excavation at station 23+00 creating a soft, mushy area on the slope. The areal extent of this seep is shown on plate 6. Excluding this one area, the remainder of the excavation slopes were free of ground water. Faults and joints in the foundation bedrock were tight and produced no ground water.

3. Engineering Characteristics of the Overburden Materials. Overburden in the vicinity of the outlet works consisted primarily of sandy clays (CL and CH) with discontinuous beds of clayey sands and gravel (SC and GC).

Classification and index testing were performed on samples of the various materials comprising the overburden. Results of the tests are presented in Section VIII of the Lakeview Lake Design Memorandum No. 24, Outlet Works. The following shows the range of values and the average values obtained from the tests:

Soil Type		Moisture Content %	Liquid Limit- Plastic Limit	Bar Linear Shrinkage %
CH	Range	9-21		22-24
	Avg	16	60-17	23
CL	Range	6-19		15-20
	Avg	13	42-12	18
SC	Range	6-16		
	Avg	9	37-11	14
GC	Range	6-23		
	Avg	12	-	-
SM/SC	Range	4-7		
	Avg	6	-	-

For design purposes the following strength properties were assigned to overburden materials in the outlet works vicinity:

Type Material	Type Strength	c tsf	Ø degrees
CL&CH	Q	1.0	1.0
CL&CH	R	0.3	13.0
CL&CH	S	0	20.0
SC&GC	Q	-	-
SC&GC	R	-	-
SC&GC	S	0	30

4. Engineering Characteristics of the Primary Materials. Primary materials in the outlet works foundation on which laboratory testing was performed include, in descending order, weathered Upper Britton clay shale, unweathered Upper Britton clay shale, unweathered Lower Britton, Unit II clay shale, and bentonitic clay shale zones in the Lower Britton, Unit II. Results of the tests are presented in Section VIII of the Lakeview Lake Design Memorandum No. 24, Outlet Works. The following shows a range of values and the average values obtained from the tests:

Rock Type		Moisture Content %	Natural Dry Density lb/cu ft	Unconfined Compressive Strength ton/sq ft	Bar Linear Shrinkage %
Upper Britton (wea. clay shale)	Range	21.3-34.7	87-110		18-26
	Avg	27.8	96	5.8	21.8
Upper Britton (unwea. clay shale)	Range	16.3-27.0	104-120	1.9-18.2	13-24
	Avg	19.4	114	12.0	17.3
Lower Britton (Unit II) (unwea. clay shale)	Range	14.3-19.0	103-120	7.2-64.2	13-18
	Avg	17	112	32	15.5
Lower Britton (Unit II) (bentonite)	Range	40.0-42.8	86-107	-	30-32
	Avg	41.4	99		31

For design purposes the following properties were used for the primary materials:

Type Material	Type Strength	c tsf	ϕ degrees
Shale	S	0.5	18
Bentonite	S	0	18

IV EXCAVATION PROCEDURES

1. Excavation Grades. Actual foundation conditions encountered during excavation for the Joe Pool Outlet Works structure were essentially as described in the subsurface data presented in the contract plans and specifications. The designed slopes in the overburden and primary materials were achieved and maintained without difficulty. Some minor variations (overexcavation) from the designed grade lines occurred in the primary material. Final cross sections on the overburden slopes were taken by the Contractor's survey team and checked by a government survey team. The contractor's survey team made all measurements of final excavation grade in the primary material and also assisted the CE geologist in mapping the foundation. Final excavation grades for the approach channel, the outlet works structure, and the discharge channel are shown on plates 5 through 7. Geologic sections are presented on plates 9 through 11.

2. Dewatering Provisions. No serious ground water problems were encountered in the outlet works excavation. With the exception of one small seepage area on the left slope of the excavation at station 23+00, the overburden and primary materials bordering the outlet works excavation were essentially free of ground water. Surface runoff was controlled in three stages. First, a series of diversion ditches located around the periphery of the excavation carried surface runoff away from the excavation. A 10-foot wide berm located about midway up the slopes of the excavation intercepted surface water on the slopes and helped to control erosion. Surface runoff that collected in the stilling basin excavation was removed by 3-inch electrical pumps. These dewatering provisions were effective in maintaining a dry excavation. All concrete and impervious backfill placements were on foundations free of water.

3. Overburden Excavation. Overburden materials in the outlet works excavation included sandy clays, clayey sands and gravels in varying mixtures as previously described. Stripping for the outlet works excavation began on 30 May 1980. Overburden materials were removed using Caterpillar scrapers pushed by Caterpillar D-6 and D-8 bulldozers. The IV on 5H overburden slopes were shaved and finished using motor graders. Suitable overburden materials removed during the outlet works excavation were used as random and semi-compacted fill in the partial embankments being constructed concurrent with the outlet works.

4. Rock Excavation. Primary material removed from the outlet works excavation included weathered and unweathered clay shale of the Eagle Ford Formation. Methods used to excavate the primary material varied according to the material being excavated and the required accuracy of the excavation grade. The following methods were employed:

a. Bulk excavation of weathered clay shale was accomplished similarly to the excavation of overburden materials. This soft, clay-like material was

removed using Caterpillar scrapers pushed by Caterpillar D-6 bulldozers. Slopes in the weathered clay shale were finished to 1V on 5H using motor graders. Most of this material was suitable for use as semi-compacted fill in the partial embankments.

b. Bulk excavation of the soft to moderately hard, unweathered clay shale was accomplished using Caterpillar D-8 bulldozers equipped with ripper teeth. The broken material was then removed using Caterpillar scrapers pushed by D-6 and D-8 bulldozers, and transported to a designated waste disposal area east of the outlet works site. Slopes in the unweathered clay shale were cut and shaved to 1V on 3H using bulldozers and motor graders. This bulk excavation method was used to excavate down to within a minimum of 2 feet above the designed excavation limit in the areas of the excavation which would later be covered with protective concrete or impervious backfill. Final grade in the approach and discharge channels was achieved using this method of excavation.

c. A minimum of 2 feet of undisturbed clay shale was left on all rock foundation surfaces for subsequent removal immediately prior to backfill. Excavation of the remaining 2+ feet of unweathered clay shale in the areas adjacent to the structure limits subsequent to the placement of impervious backfill was accomplished using Caterpillar scrapers pushed by D-6 bulldozers. A Case 350B bulldozer was used to push loose material down the 1V on 3H slopes to be picked up with scrapers and a front-end loader. Final cleaning immediately prior to placement of impervious clay was accomplished with compressed air, and occasional hand-broom cleaning, if required.

Excavation of the final 2+ feet of clay shale cover in the areas beneath the outlet works structure prior to the placement of protective concrete was accomplished with a Warner-Swasey Model G 660 Gradall supported by a Caterpillar front-end loader and a dump truck. Two interchangeable buckets were utilized with the Gradall. A bucket equipped with 6-inch teeth was used to excavate to grade. For final cutting and smoothing the operator switched to a bucket equipped with a blade. In the V-shaped conduit excavation the contractor used three V-shaped wooden template forms to monitor the slopes and elevations of the ditch during excavation. The templates, shown on figure 4, greatly increased the efficiency of the Gradall operations, thereby decreasing the amount of time elapsed between initial cut to final grade and backfill with protective concrete.

The efficiency of the excavations performed by the Gradall machine was highly dependent upon the skill level of the operator. Rapid excavation was required in order to meet the 2-hour maximum time limit between reaching final excavation grade and placing protective concrete. Gradall excavations required constant monitoring to insure final grade was achieved and to minimize overexcavation. In the conduit foundation considerable difficulty was encountered in excavating a V-shaped ditch through moderately hard, horizontally-bedded clay shale. Some over-excavation resulted even with a skilled Gradall operator and nearly constant monitoring.



Fig 3 Conduit foundation with protective concrete in place



Fig 4 Wooden templates used to monitor conduit excavation



Fig 5 Typical collar excavation



Fig 6 Typical preparation for structural concrete placement
in collar excavation

5. Overexcavation. Overexcavation occurred in the following areas:

a. Intake structure/conduit transition area. Preliminary excavation was designed to remove the bulk of the material down to, and not below a minimum of 2 feet above final excavation grade in order to leave 2 feet of undisturbed clay shale as protective cover. However, in the transition area the contractor, as a result of contractor's surveying error, carried preliminary excavation down below final design grade. Several days later, when the contractor was ready to place protective concrete, he was directed to excavate even further below the designed grade so that protective concrete would be placed on fresh, undisturbed clay shale as required by the specifications. As a result the final grade of the transition protective slab is a maximum of 1.6 feet below the designed grade.

b. Along the conduit foundation at locations where the contractor attempted to cut a V-shaped ditch in a soft to moderately hard, horizontally-bedded clay shale. Excavation for the conduit foundation was accomplished using the Gradall, and elevations were monitored using hand levels and wooden templates constructed in the design shape of the ditch. The nearly horizontal clay shale beds, generally less than 1-ft thick, were often separated by slightly softer, bentonitic clay shale seams. This condition made it difficult to attain a smooth, symmetric V-shaped ditch.

c. At select areas in the foundation rock where faulting, jointing, and fracturing were present. These areas are shown on the as-built Excavation Map, Plate 6, and the Structure Foundation Map, Plate 8. During excavation the contractor was required to remove all loose and broken rock material normally associated with faulted and jointed zones, so that protective concrete or impervious backfill would be placed on fresh, competent clay shale. A record of the estimated amount of overexcavation and subsequent concrete overrun in the faulted and jointed areas was maintained by the government inspector.

6. Foundation Preparation. The outlet works foundation consists of unweathered clay shale belonging to the Upper Britton and the Lower Britton, Unit II, members of the Eagle Ford Formation. Preliminary test results indicated the need to minimize the exposure time of the clay shale in order to retard change in moisture content and subsequent deterioration. Figure 7 shows the severity of the deterioration of the foundation clay shale after it remains exposed to air for a period of 3 to 4 weeks. Therefore, a minimum of 2 feet of undisturbed clay shale protective cover was left on all rock foundation surfaces (with the exception of the area described in para 5a) for subsequent removal immediately prior to backfill with protective concrete or impervious clay.

a. Foundations Beneath the Structure. Each day a specific area was designated as the worksite and the final 2+ feet of clay shale protective cover was removed using the Gradall G 660. Upon achieving final design grade, all loose, drummy, or otherwise unsatisfactory rock was removed and the surfaces were cleaned using compressed air. Figures 13 through 63



Fig 7 Typical clay shale deterioration after
3 to 4 weeks exposure

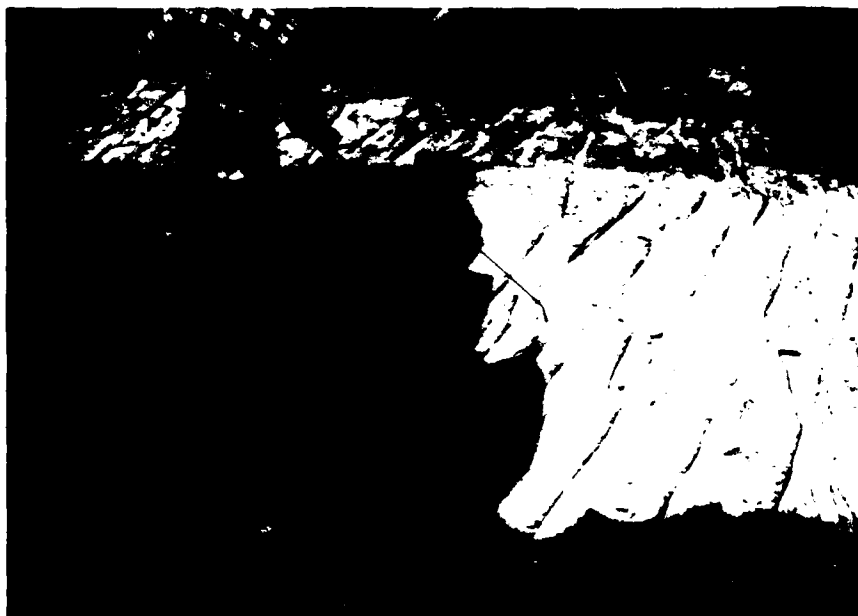


Fig 8 Application of Aerospray 52 moisture sealant

show the condition of each segment of the structure foundation after cleaning and prior to protective concrete backfill. While the surface was being cleaned, the contractor's survey team took final grade cross-sections and assisted the CE geologist in mapping geologic features in the foundation. Immediately after the cleaning and mapping were completed, and the foundation was approved by the inspecting geologist, a 1:1 mixture of water and Aerospray 52, a resin-type sealer manufactured by American Cynamid Company, Wayne, New Jersey, was mechanically sprayed onto the rock surface as shown in figure 8. The foundation surface was then covered with a minimum of 4-inches of protective concrete. A complete record of foundation approval is presented in Section IX of this report.

b. Foundations Adjacent to the Structure. Foundations adjacent to the structure include the unweathered clay shale surface from the edge of the protective concrete to the top of the unweathered clay shale on the excavation slope at approximate elevation 495. The final 2+ feet of clay shale in the foundation adjacent to the structure was excavated using Caterpillar D-6 and D-8 bulldozers equipped with ripper teeth and scrapers. Each day a specific area was designated as the work area and the final 2+ feet of protective clay shale was excavated. Upon achieving final design grade on the foundation floor and slopes, all loose material was removed and the surface was cleaned using compressed air. While the surface was being cleaned the contractor's survey team took final grade cross-sections and assisted the CE geologist in mapping geologic features in the foundation. After the surface was cleaned, mapped, and approved, the rock surface was wetted lightly, and then covered with at least 2 feet of impervious clay backfill before the day's work ended. Figures 64 through 97 show the condition of the foundation adjacent to the structure after cleaning and prior to backfill with impervious clay.

c. Overburden. Overburden materials exposed in the excavation slopes were mapped in detail and are shown on plate 6. Horizontal and vertical limits of the overburden are presented on the cross-sections, plates 9 through 11. No further excavation occurred in the overburden immediately prior to backfill. Materials in the exposed overburden slopes were processed in place and integrated into the impervious clay backfill. Materials were mixed, processed, and benched into the overburden slopes in horizontal layers, and then compacted.

7. Safety. There was no requirement for protection against slides and rock falls in the outlet works excavation. The 1V on 5H overburden slopes and the 1V on 3H primary slopes remained stable throughout construction.

V FOUNDATION ANCHORS

1. General. Permanent foundation anchors were installed in the Joe Pool Dam Outlet Works chute and stilling basin areas. A total of 70 foundation anchors were installed to a minimum depth of 21 feet below the surface of the protective concrete slab.

2. Equipment. The 6-in diameter holes for the foundation anchors were drilled using a Gardner-Denver track-mounted pneumatic drill, shown on figure 9. The anchors consisted of No. 11 rebar equipped with vertical bar spacers wire-fastened to the anchor at 4.75 ft intervals. A one-half inch steel grout pipe designed to extend from the surface to the bottom of the anchor was permanently fixed to each anchor. The grout mixture placed around the anchors consisted of 1.32 gallons of water per 55-pound bag of Masterflow 713 non-shrink grout. The grout was agitated in a one-fourth cu yd electric mortar mixer and pumped into the hole.

3. Procedures. Drilling and installation of the foundation anchors began on 23 March 1981 in the chute section. All of the anchors in the chute section were set at an angle 30° from vertical; anchors in the stilling basin section were set at vertical. Holes for setting the foundation anchors were drilled through the protective concrete slab into unweathered Eagle Ford shale to a total depth of 21 feet. Upon reaching the required depth the holes were blown clean using high velocity air, and tightly plugged until placement of anchor bars and grouting commenced. All holes remained free of water until grout was placed. The normal procedure was to drill a predetermined number of holes, insert the anchor bars, and place grout, all on the same day. After the anchors were set in the hole at the correct elevation, the grout mixture was pumped through the one-half inch grout pipe until grout returned to the surface indicating the hole was filled. As per the grout manufacturer's recommendation, the bars were not vibrated during placement.

4. Pull-Out Tests. Pull-out tests were performed on 19 March on two test anchors installed on 6 March 1981. One test was conducted on an anchor installed in the slope of the chute section at approximate station 27+40; another test was conducted on an anchor installed in the horizontal stilling basin floor at approximate station 27+77. Both anchors were stressed to 50 tons with no failure in the bar or the foundation. Figure No's 11 and 12 show one of the tests in progress. A complete record of test data is on file in the SWF Design Branch, Structural Section.

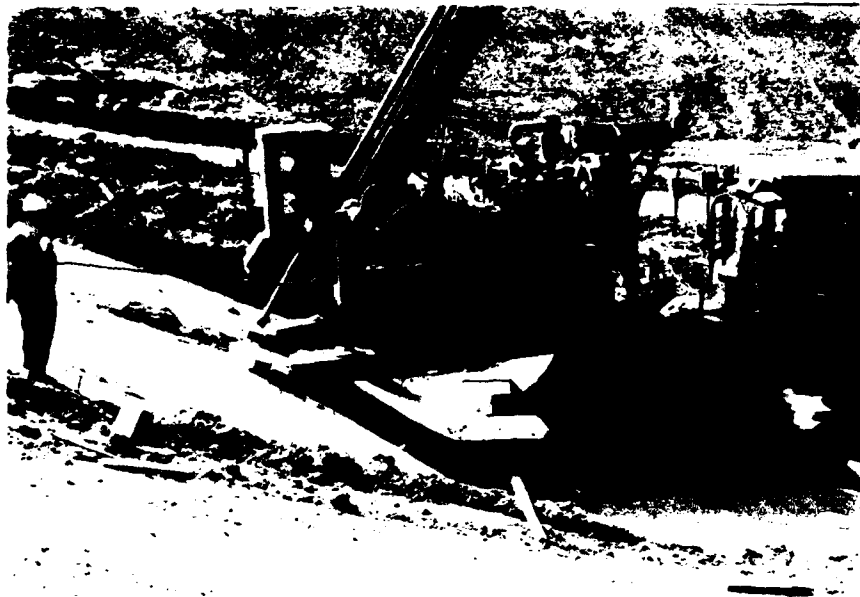


Fig 9 Drilling hole for rock anchor

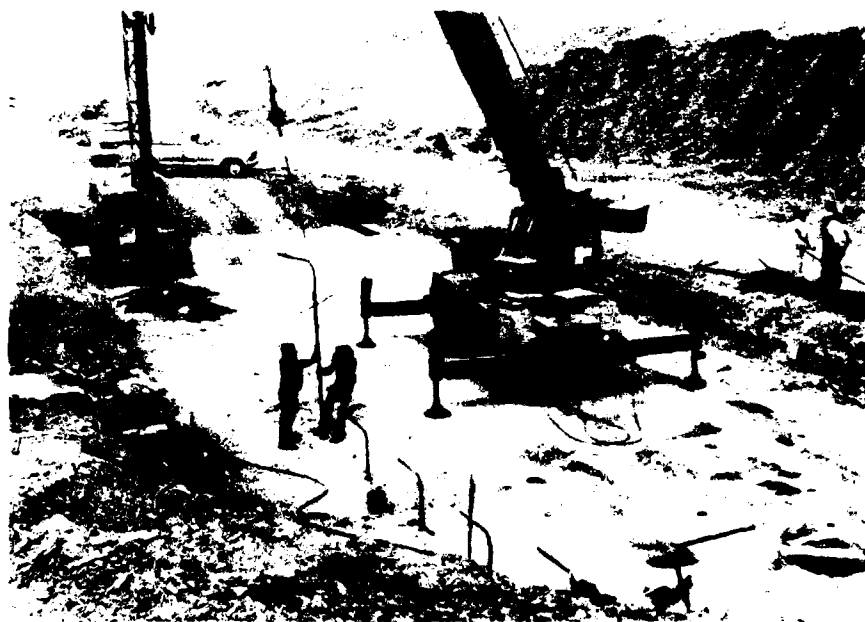


Fig 10 Installing rock anchor

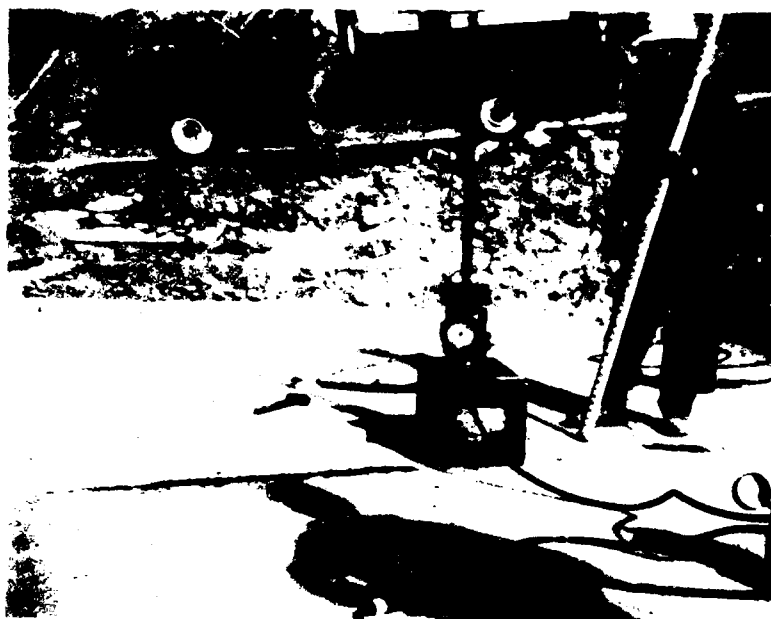


Fig 11 Conducting pull-out test



Fig 12 Conducting pull-out tests

VI CHARACTER OF THE FOUNDATION

1. General. Clay shale belonging to the Lower Britton Unit II and the Upper Britton Members of the Eagle Ford Formation, Cretaceous age, comprise the rock foundations beneath the outlet works structure, adjacent to the structure, and on the slopes of the outlet works excavation up to approximate elevation 500. Overburden consisting of mixtures of clay, sand, and gravel constitute the slopes above elevation 500. A geologic map of the outlet works excavation is presented on plates 5 through 7. Engineering characteristics of the overburden and primary materials comprising the outlet works foundation were presented in Section III of this report. Included is a range of values and the average values of engineering characteristics as derived from pre-construction testing of material samples.

2. Upper Britton Member of the Eagle Ford Formation. The Joe Pool Dam Outlet Works approach slab, intake tower, conduit, and upper portion of the chute section were founded on unweathered clay shale belonging to the Upper Britton Member of the Eagle Ford Formation. The clay shale is soft to moderately hard, gray, medium to thin-bedded, and contains occasional pockets of fossil shells (*Inoceramus Hibiatus*). Thin, soft to moderately hard bentonitic shale seams occur throughout the exposed section. Minor faulting and associated jointing and fracturing noted is shown on plate 6. All encountered faults were normal faults, usually of high angle and low displacement, with less than 1 foot-thick brecciated zones adjacent to fault planes. Joints were tight and tended to dissipate vertically. Within 1 hour after exposure to air and/or sunlight, the clay shale began to show signs of deterioration as predicted by pre-construction test results. Initially the color of the clay shale changed from dark gray to light gray as a result of moisture loss. After a few hours, hair-line cracks appeared along with some minor slaking. After a few days the outer 1 inch of the rock surface would be cracked and deteriorated and could be peeled from the surface by hand. Figure 7 shows the condition of the clay shale after it is left exposed for a period of 3-4 weeks.

3. Lower Britton Unit II Member of the Eagle Ford Formation. Unweathered marly clay shale of the Lower Britton Member of the Eagle Ford Formation supports a portion of the outlet works structure from station 27+58 forward, which includes the lower one-third of the chute section and all of the stilling basin. The Lower Britton Member is slightly harder than the Upper Britton Member, and can be distinguished by a tannish-gray coloring and the presence of pockets of sand-sized fossil fish scale remains. The Lower Britton Member is slightly more thickly-bedded and has less jointing and fracturing than does the Upper Britton Member.

4. Overburden. Overburden materials encountered in the Joe Pool Dam Outlet Works excavation are described in Section III of this report and are shown on plate 6. The overburden consisted of Recent floodplain deposits and older Quaternary terrace deposits. In general the exposed overburden in the slopes of the outlet works excavation consisted of, in descending order, silty, sandy, medium stiff clay overlying fine- to medium-grained, clayey, gravelly sand grading down into moderately sandy to clean, sub-angular to rounded, calcareous gravel. The overburden units varied in their mixtures and thicknesses in different sections of the excavation. The overburden contained no significant amounts of ground water.

VII POSSIBLE FUTURE PROBLEMS

1. Conditions That Could Produce Problems. There were no unanticipated foundation conditions discovered during construction of the Joe Pool Outlet Works which would pose a threat to the stability of the structure. All foundation surfaces were competent and stable, and remained so until covered by impervious backfill or protective concrete.

Minor erosion problems may develop in the exposed 1V on 3H clay shale slopes in the approach and discharge channels prior to the establishment of turf during the Embankment and Spillway contract. As the exposed clay shale deteriorates, it becomes highly erodible.

2. Recommendations. Consideration should be given to flat base excavation for the foundation for cut and cover conduits in lieu of V-shaped excavation. V-shaped excavations in hard rock, or in horizontally-bedded, soft-to-moderately hard clay shale, as in this case, inevitably result in overexcavation (see para IV-5). Even though overexcavation is a responsibility of the contractor, it will be considered in claims, and in future excavation cost estimates.

VIII CONTRACT MODIFICATIONS AFFECTING THE FOUNDATION

One contract modification was approved which affected the outlet works foundation. In accordance with the Value Engineering Incentive Program, the contractor submitted a Value Engineering Change Proposal to delete the placement of pneumatic concrete where shown in the plans, specifically in the collar excavations. Under the change the contractor would excavate the collars to grade, install the steel cage in the excavation, and place structural concrete around the cage. The change amounted to a net cost savings of \$3,517 which, under the Value Engineering Incentive Program, was split 45 percent - 55 percent between the contractor and the government respectively.

The proposal was reviewed and approved by the SWF Design Branch and Geotechnical Branch with the conditions that the time lapse between excavation and placement of concrete be the same as in all other areas of protective concrete (maximum 2 hours), and that Aerospray 52 moisture sealant be applied to the excavation walls immediately after cleaning. The contractor agreed to the conditions and the contract modification was approved on 19 December 1980.

IX RECORD OF FOUNDATION APPROVAL

CONCRETE PLACEMENT						
Station	Location	Date	Start	Stop	AMB Temp	Remarks
27+72-27+96	Stilling Basin	1-29-81	1230	1445	56	to 20' RT
27+96-28+76	" "	1-30-81	1100	1600	32	to 20' RT
27+72-28+00	" "	1-31-81	1300	1500	36	to 20' LT
28+00-28+75	" "	2-02-81	1200	1600	42	to 20' LT
20+00-20+48	Intake Tower	2-04-81	1010	1745	47	Transition
19+65-20+00	" "	2-06-81	1000	1730	42	26' LT to 26' RT
19+15-19+65	" "	2-07-81	0930	1415	45	to 26' RT
19+05-19+65	Appro Slab	2-13-81	1450	1810	52	to 26' LT
18+85-19+15	" "	2-14-81	1135	1230	60	to 26' RT
18+85-19+05	" "	2-14-81	1250	1320	60	to 26' LT
20+49.5-20+66.5	Conduit	2-16-81	1300	1700	71	Monolith 1
20+66.5-20+69.5	"	2-18-81	1515	1545	70	Collar 1-2
20+69.5-20+86.5	"	2-18-81	1615	1750	70	Monolith 2
20+89.5-21+06.5	"	2-19-81	1130	1245	60	Monolith 3
21+09.5-21+26.5	"	2-19-81	1300	1415	60	Monolith 4
21+29.5-21+46.5	"	2-19-81	1615	1845	60	Monolith 5
21+49.5-21+66.5	"	2-20-81	1215	1325	75	Monolith 6
21+69.5-21+86.5	"	2-20-81	1415	1550	75	Monolith 7
27+34-27+50	Chute	2-24-81	1440	1630	75	±15' LT to ±15' RT
27+50-27+72	"	2-25-81	1345	1945	69	±18' LT to ±18' RT
20+86.5-20+89.5	Conduit	2-26-81	1400	1445	74	Collar 2-3
21+06.5-21+09.5	"	2-26-81	1600	1635	74	Collar 3-4
21+26.5-21+29.5	"	2-26-81	1810	1900	74	Collar 4-5

RECORD OF FOUNDATION APPROVAL (cont'd)

CONCRETE PLACEMENT						
Station	Location	Date	Start	Stop	AMB Temp	Remarks
21+46.5-21+49.5	Conduit	2-27-81	1700	1800	68	Collar 5-6
21+66.5-21+69.5	"	2-28-81	1100	1140	63	Collar 6-7
		3-05-81	1600	1645	60	
21+89.5-22+06.5	"	3-10-81	1300	1415	65	Monolith 8
22+09.5-22+26.5	"	3-11-81	1315	1500	64	Monolith 9
22+29.5-22+46.5	"	3-11-81	1545	1710	64	Monolith 10
27+10-27+34	Chute	3-12-81	1235	1500	64	±12' LT to ±12' RT
22+49.5-22+66.5	Conduit	3-13-81	1245	1430	70	Monolith 11
22+69.5-22+86.5	"	3-13-81	1500	1630	70	Monolith 12
21+86.5-21+89.5	"	3-14-81	0900	0930	60	Collar 7-8
22+89.5-23+06.5	"	3-16-81	1240	1340	65	Monolith 13
23+09.5-23+26.5	"	3-16-81	1430	1545	65	Monolith 14
28+76-28+85	Stilling Basin	3-17-81	1640	1730	49	Key
22+06.5-22+09.5	Conduit	3-18-81	1500	1730	59	Collar 8-9
23+29.5-23+46.5	"	3-19-81	1120	1240	65	Monolith 15
23+49.5-23+66.5	"	3-23-81	1230	1350	60	Monolith 16
23+69.5-23+86.5	"	3-24-81	1310	1445	62	Monolith 17
23+89.5-24+06.5	"	3-24-81	1530	1620	62	Monolith 18
23+06.5-23+09.5	"	3-25-81	1200	1310	65	Collar 13-14
23+26.5-23+29.5	"	3-25-81	1350	1500	65	Collar 14-15
22+46.5-22+49.5	"	3-26-81	1720	1800	73	Collar 10-11
22+26.5-22+29.5	"	3-27-81	1015	1100	60	Collar 9-10
22+66.5-22+69.5	"	3-27-81	1210	1245	60	Collar 11-12

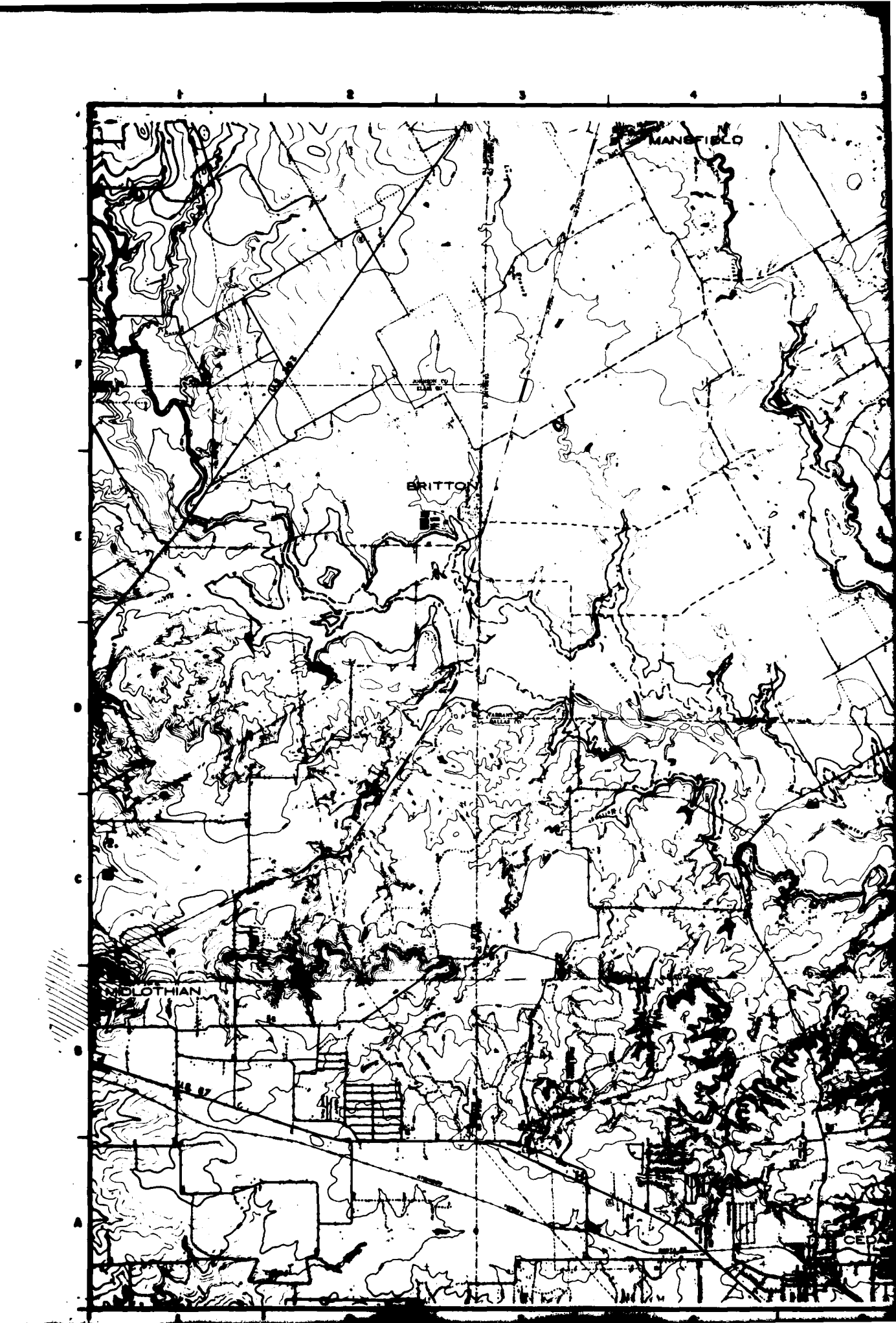
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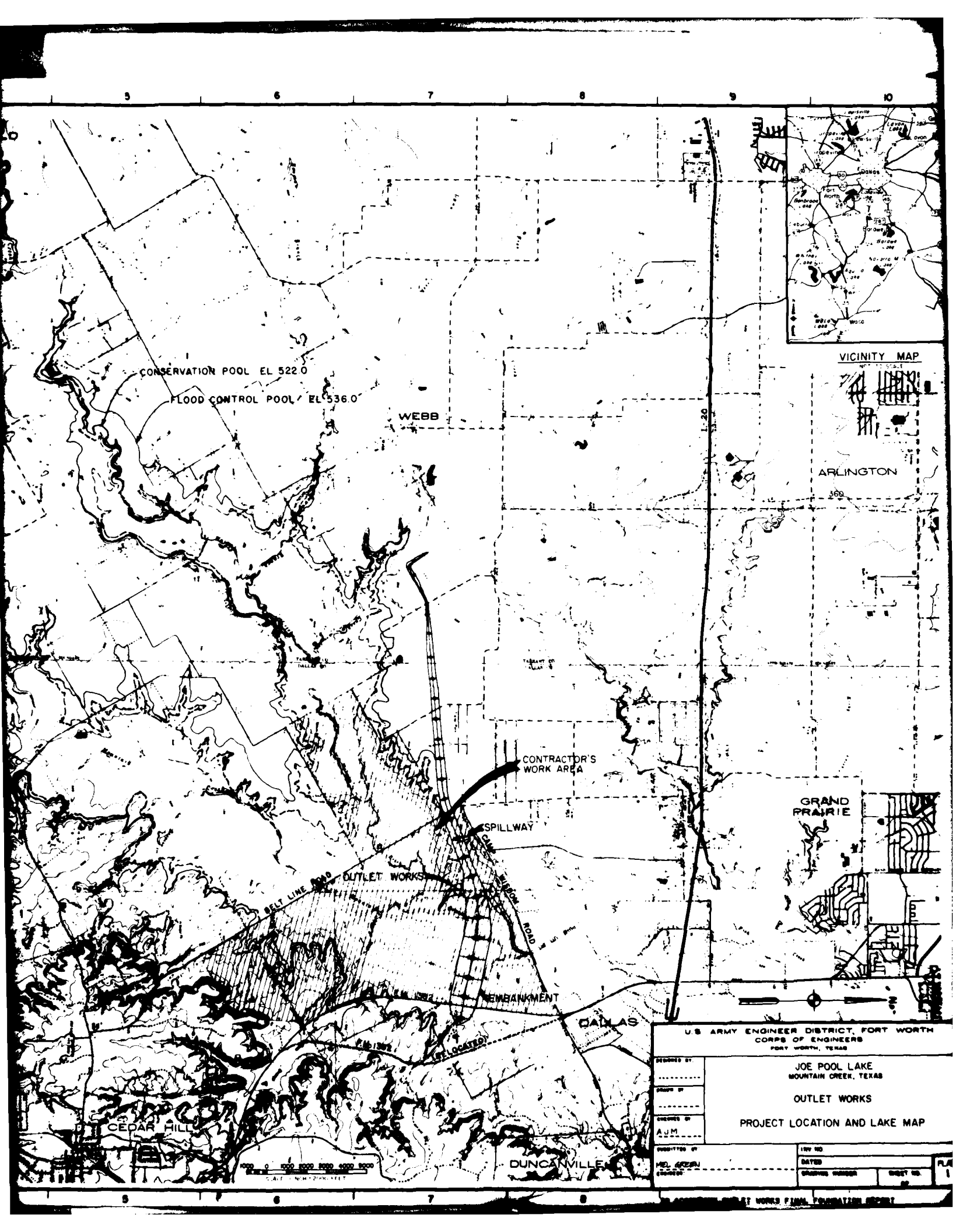
Station	Location	Date	CONCRETE PLACEMENT		AMB	Remarks
			Start	Stop	Temp	
22+86.5-22+89.5	Conduit	3-27-81	1430	1515	60	Collar 12-13
24+09.5-24+26.5	"	4-01-81	1600	1710	84	Monolith 19
24+29.5-24+46.5	"	4-02-81	1335	1450	72	Monolith 20
24+49.5-24+66.5	"	4-03-81	1200	1250	71	Monolith 21
24+69.5-24+86.5	"	4-0-81	1255	1405	67	Monolith 22
24+89.5-25+06.5	"	4-06-81	1550	1710	67	Monolith 23
25+09.5-25+26.5	"	4-07-81	1445	1645	74	Monolith 24
25+29.5-25+46.5	"	4-08-81	1100	1230	70	Monolith 25
25+49.5-25+66.5	"	4-08-81	1330	1500	70	Monolith 26
23+66.5-23+68.5	"	4-08-81	1415	1500	71	Collar 16-17
23+86.5-23+89.5	"	4-09-81	1215	1240	79	Collar 17-18
24+26.5-24+29.5	"	4-09-81	1310	1340	79	Collar 18-19
25+89.5-26+06.5	"	4-10-81	1125	1240	77	Monolith 27
26+09.5-26+26.5	"	4-10-81	1350	1440	77	Monolith 28
26+29.5-26+46.5	"	4-10-81	1655	1810	77	Monolith 29
24+26.5-24+29.5	"	4-11-81	1300	1330	76	Collar 19-20
26+49.5-26+66.5	"	4-13-81	1130	1345	78	Monolith 30
26+69.5-26+86.5	"	4-13-81	1430	1645	78	Monolith 31
26+66.5-26+69.5	"	4-14-81	1030	1130	68	Collar 30-31
24+46.5-24+49.5	"	4-15-81	0925	1000	60	Collar 20-21
24+66.5-24+69.5	"	4-15-81	1040	1110	60	Collar 21-22
24+86.5-24+89.5	"	4-15-81	1130	1230	60	Collar 22-23
25+06.5-25+09.5	"	4-15-81	1350	1435	60	Collar 23-24

RECORD OF FOUNDATION APPROVAL (cont'd)

Station	Location	Date	CONCRETE PLACEMENT		AMB	Remarks
			Start	Stop	Temp	
25+26.5-25+29.5	Conduit	4-15-81	1500	1600	60	Collar 24-25
25+46.5-25+49.5	"	4-15-81	1645	1720	60	Collar 25-26
25+66.5-25+69.5	"	4-15-81	1750	1835	60	Collar 26-27
26+89.5-27+06.5	"	4-16-81	1420	1600	87	Monolith 32
27+09.5-27+26.5	"	4-16-81	1645	1855	87	Monolith 33
26+06.5-26+09.5	"	4-17-81	1000	1025	80	Collar 27-28
26+26.5-26+29.5	"	4-17-81	1110	1215	80	Collar 28-29
26+46.5-26+49.5	"	4-17-81	1300	1325	80	Collar 29-30
26+66.5-26+69.5	"	4-17-81	1350	1430	80	Collar 30-31
26+86.5-26+89.5	"	4-17-81	1445	1530	80	Collar 31-32
27+06.5-27+09.5	"	4-17-81	1550	1630	80	Collar 32-33

NOTE: The contract specified that the clay shale surface be sealed with a resin-type sealer (Aerospray 52) within 15 minutes after reaching final grade and covered with protective concrete within 2 hours after reaching final grade. The contractor made a sincere effort, and in most instances, met the time limitations required by the contract. Mapping of the foundation was accomplished during the time span between excavation and encasement, usually immediately following surface cleaning. Approval of the foundation surface occurred immediately before placement of protective concrete.





CONSERVATION POOL EL 522.0

FLOOD CONTROL POOL EL 536.0

WEBB

VICINITY MAP

ARLINGTON

CONTRACTOR'S
WORK AREA

SPILLWAY

OUTLET WORKS

EMBANKMENT

DALLAS

CEGAR HILL

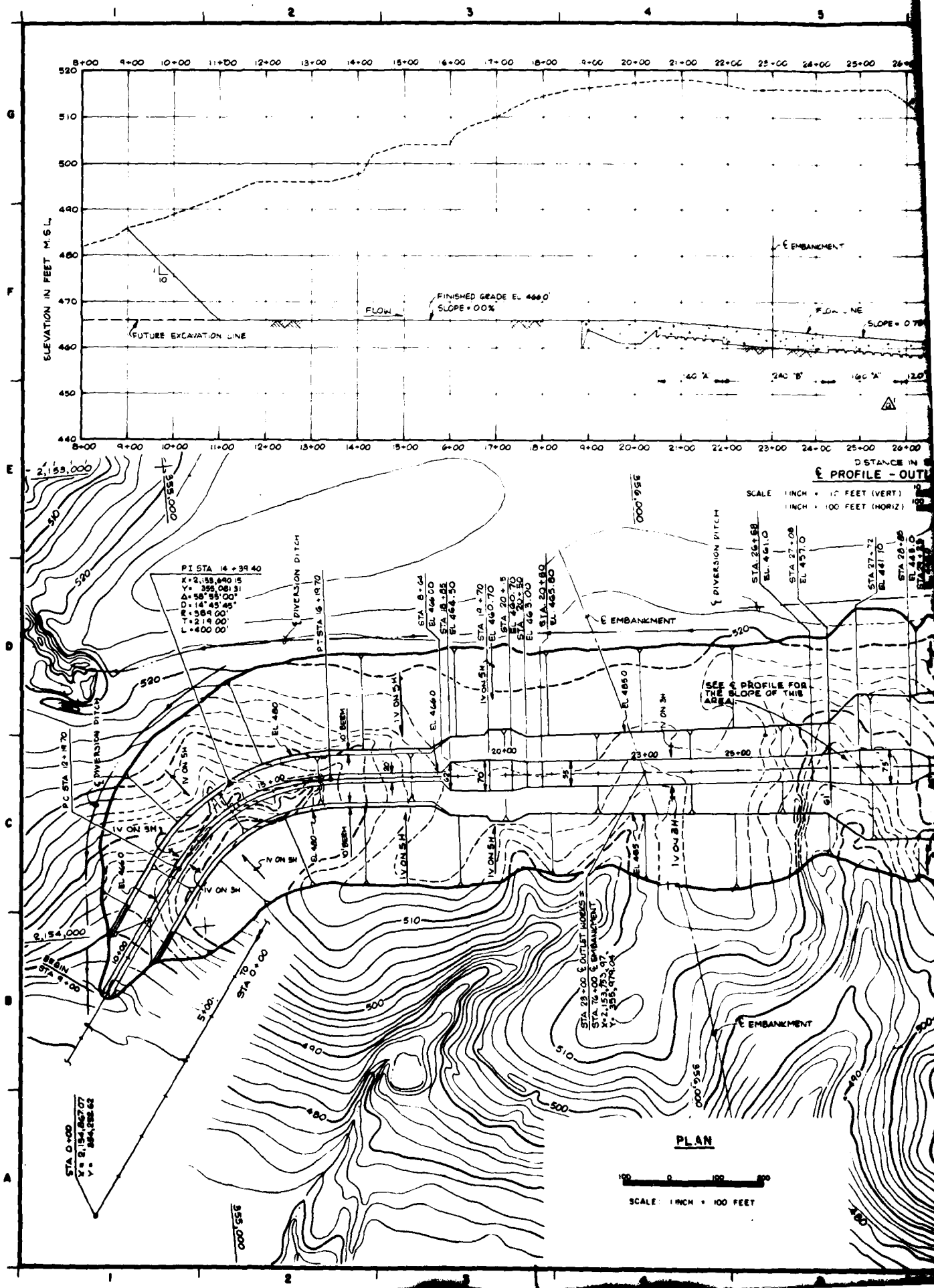
DUNCANVILLE

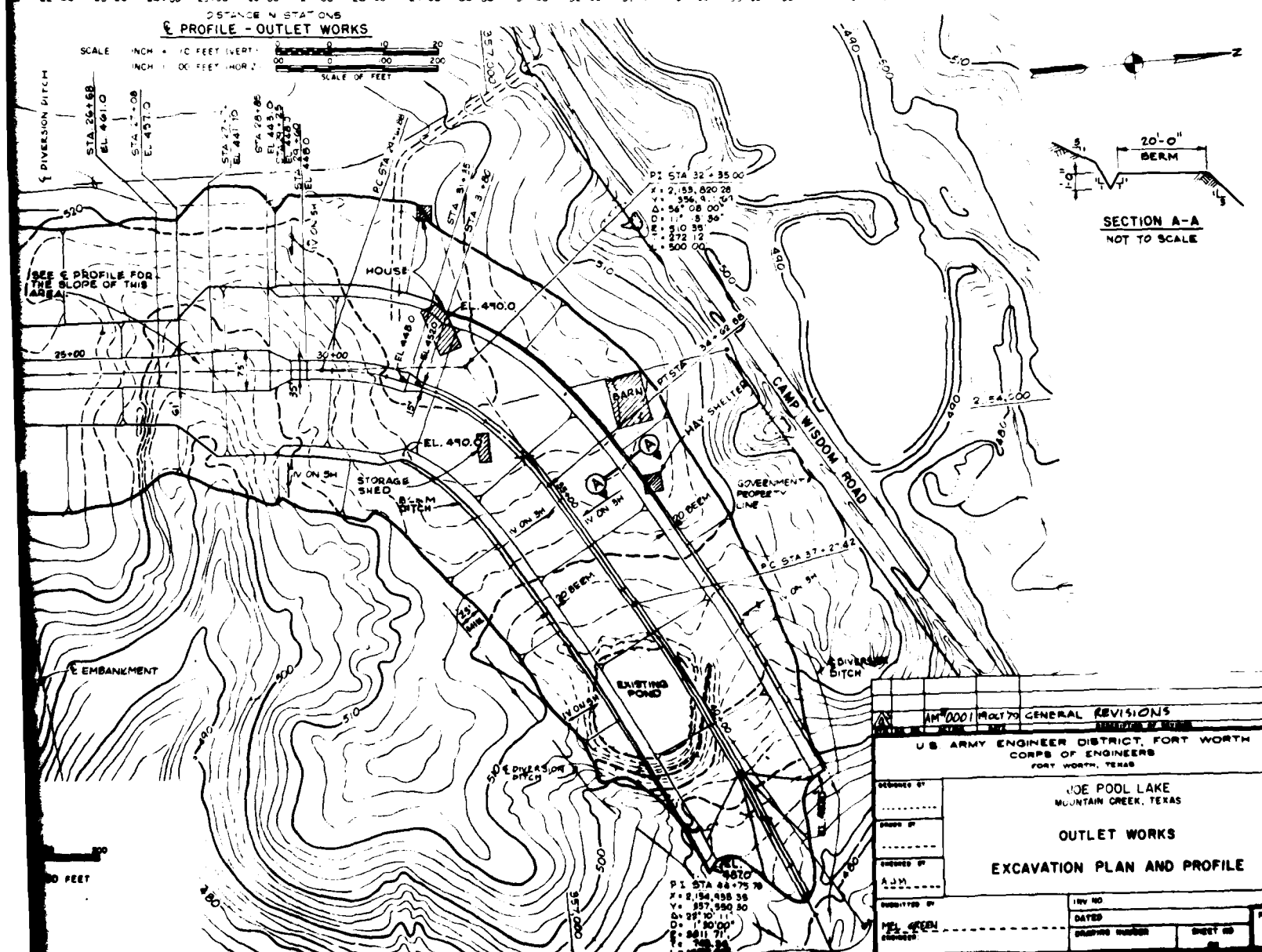
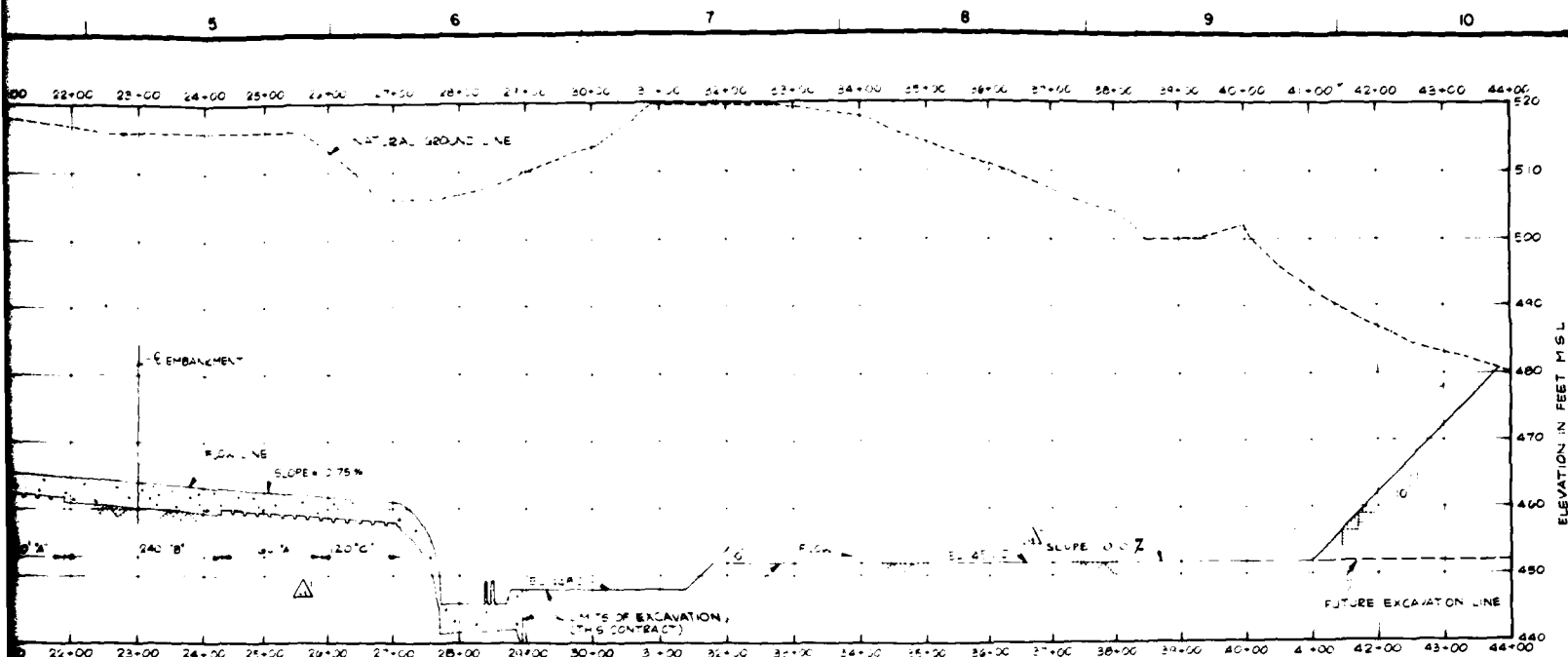
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: JOE POOL LAKE
MOUNTAIN CREEK, TEXAS
PROJECT LOCATION AND LAKE MAP

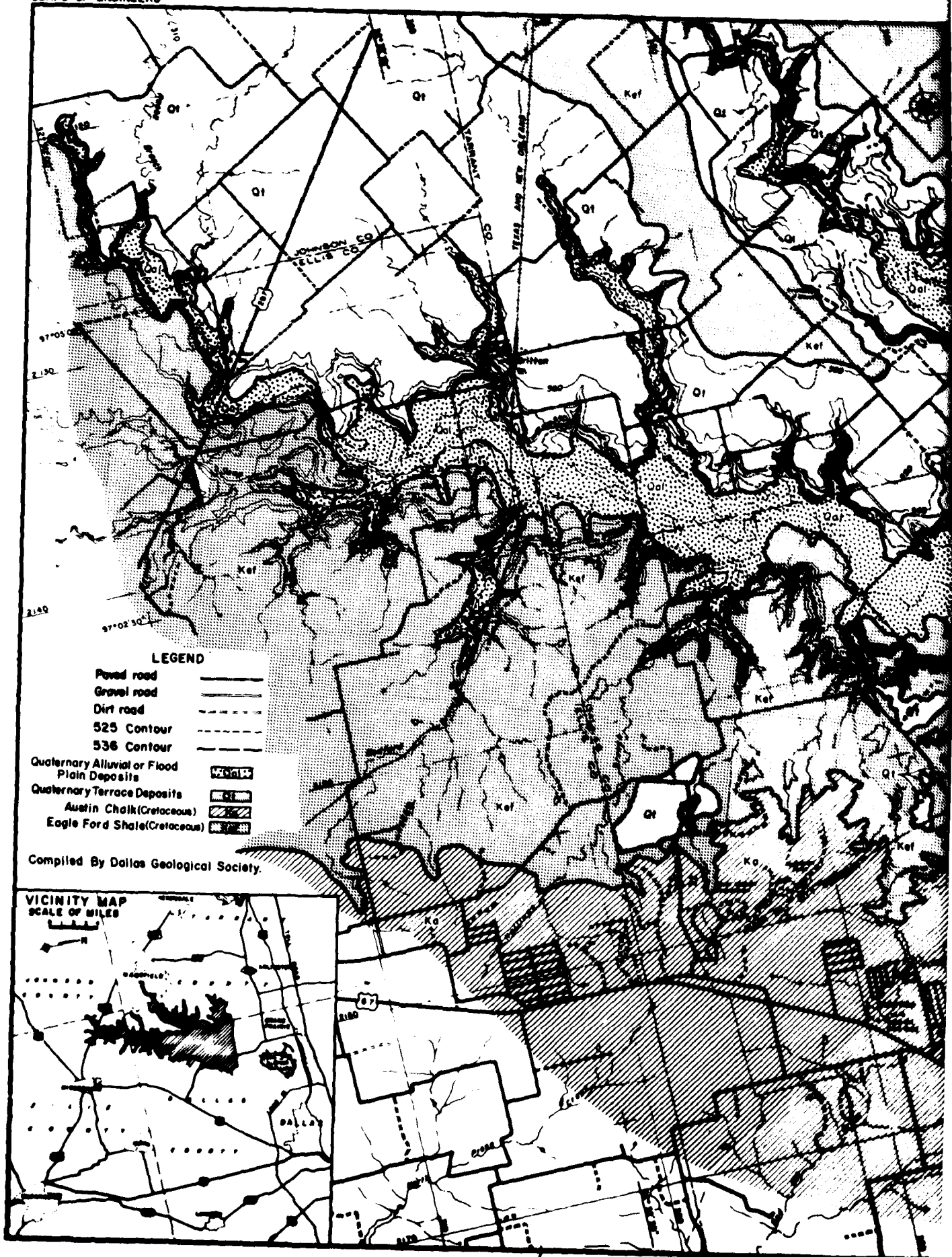
DRAWN BY: AUM
CHECKED BY: MEL. GREEN
DATE: 1964
SHEET NO. 1
TOTAL SHEETS: 1

JOE POOL LAKE MOUNTAIN CREEK, TEXAS





CORPS OF ENGINEERS





U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

JOE POOL LAKE
MOUNTAIN CREEK, TEXAS

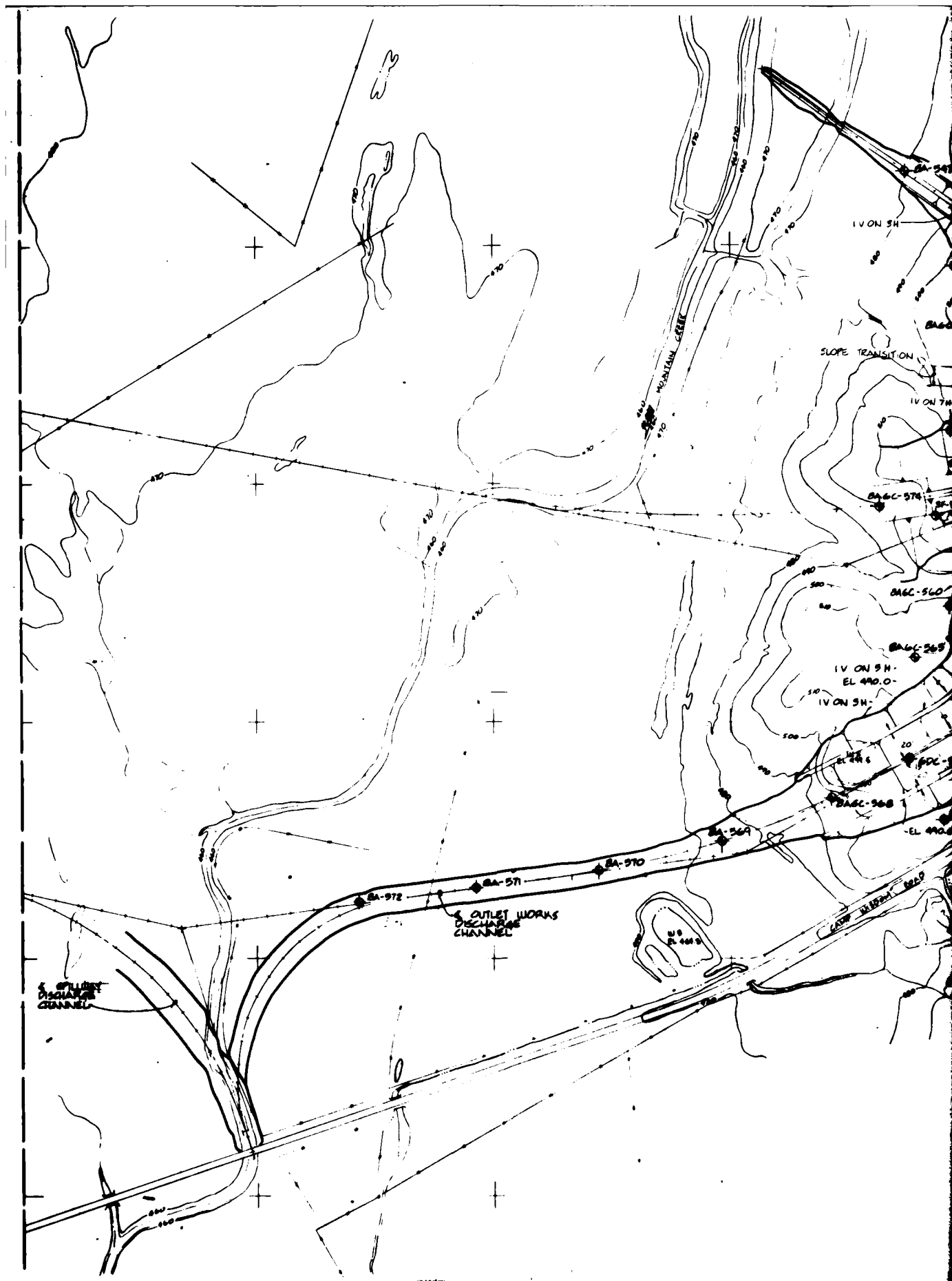
OUTLET WORKS
AREAL GEOLOGY MAP

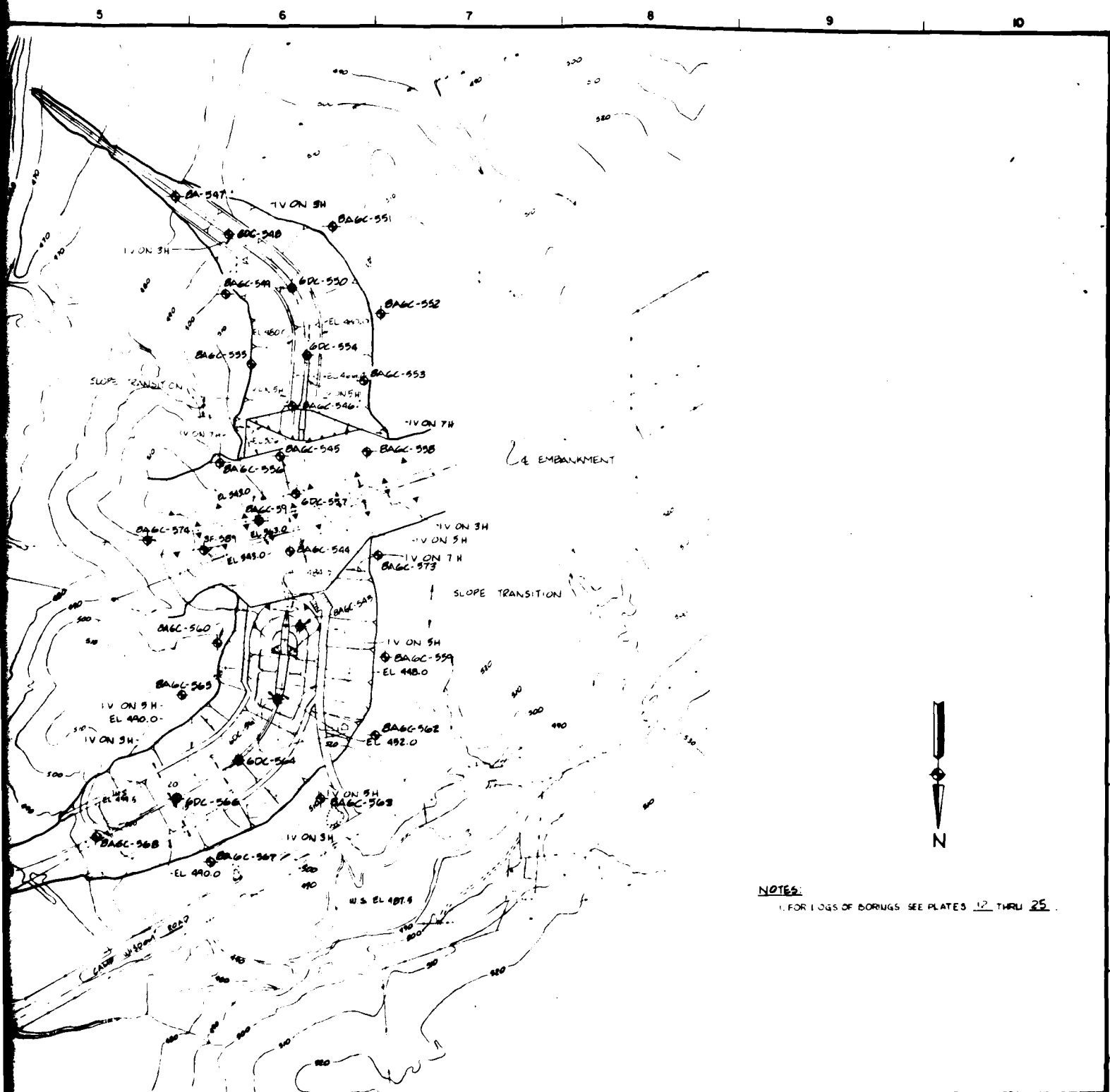
DESIGNED BY: K. BEHM
CHECKED BY: M. GREEN
DRAWN BY: MEL GREEN
DATE: _____

CONTRACT NO. _____
DRAWING NUMBER _____
SHEET NO. _____

PLATE 3

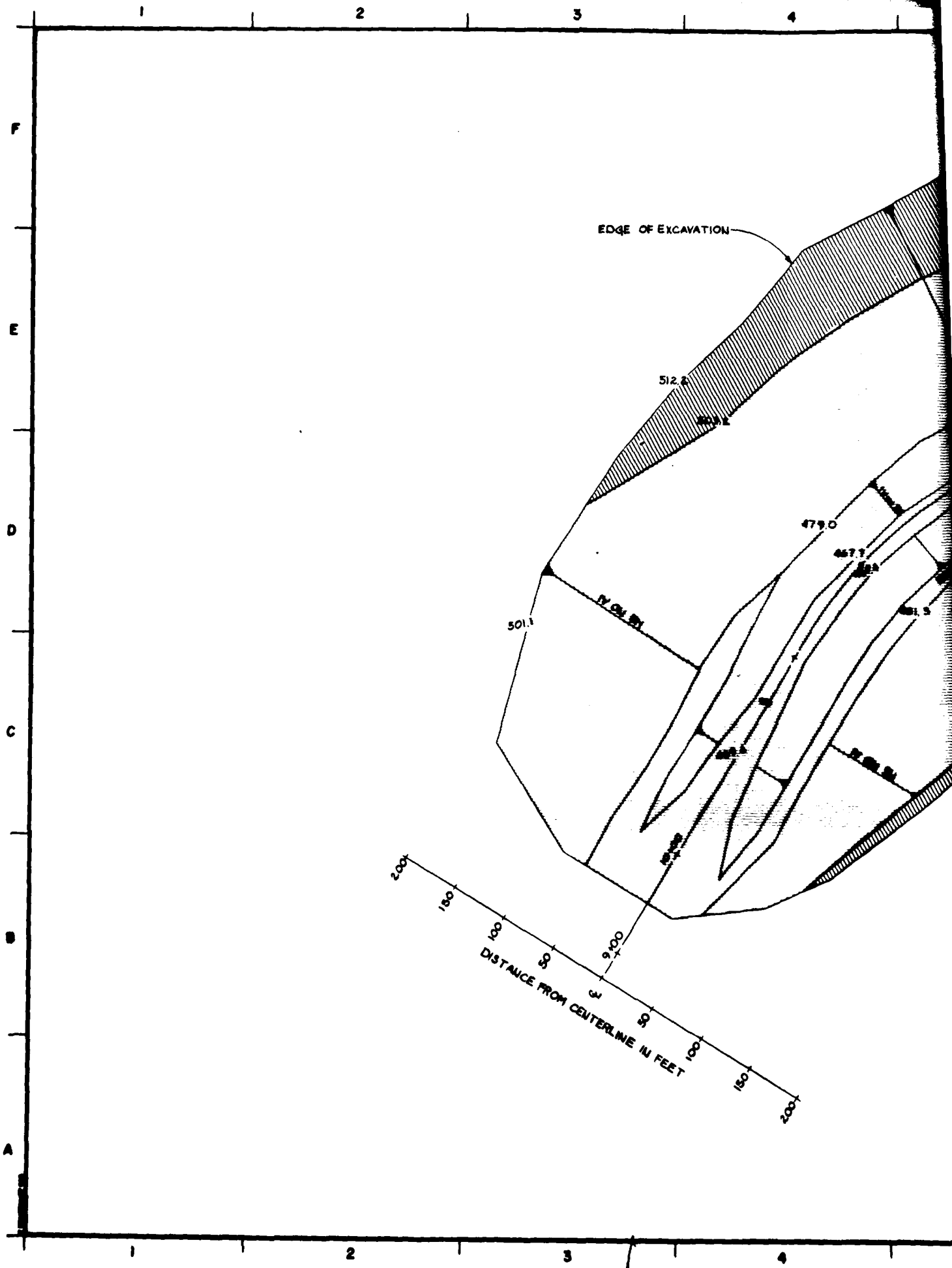
TO ACCOMPANY OUTLET WORKS FINAL FOUNDATION REPORT

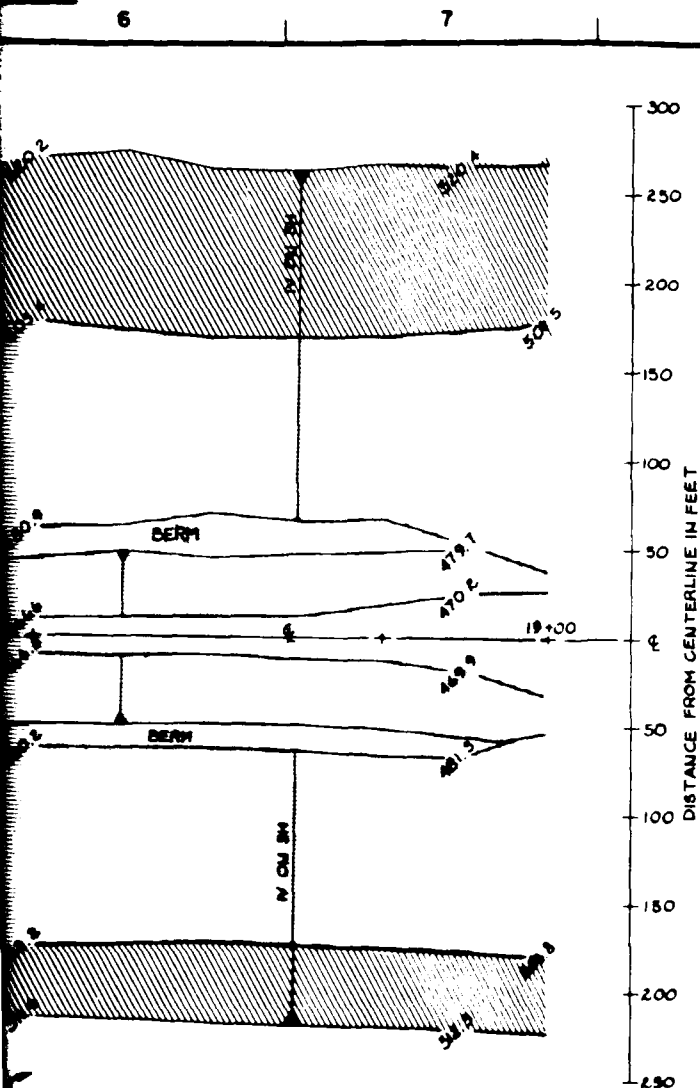




NOTES:
1. FOR LOGS OF BORINGS SEE PLATES 12 THRU 25.

DESIGNED BY		JOHN R. DUNN	
DRAWN BY		R. DUNN	
CHECKED BY		M. GREEN	
SUBMITTED BY		MEL GREEN	
ENGINEER		ENGINEER	
DATE		JAN 1964	
SHEET NO.		4	
DRAWING NUMBER		OUTLET WORKS	
PROJECT		JOE POOL LAKE	
LOCATION		MOUNTAIN CREEK, TEXAS	
SHEET NO.		4	
DRAWING NUMBER		OUTLET WORKS	
PROJECT		JOE POOL LAKE	
LOCATION		MOUNTAIN CREEK, TEXAS	
SHEET NO.		4	





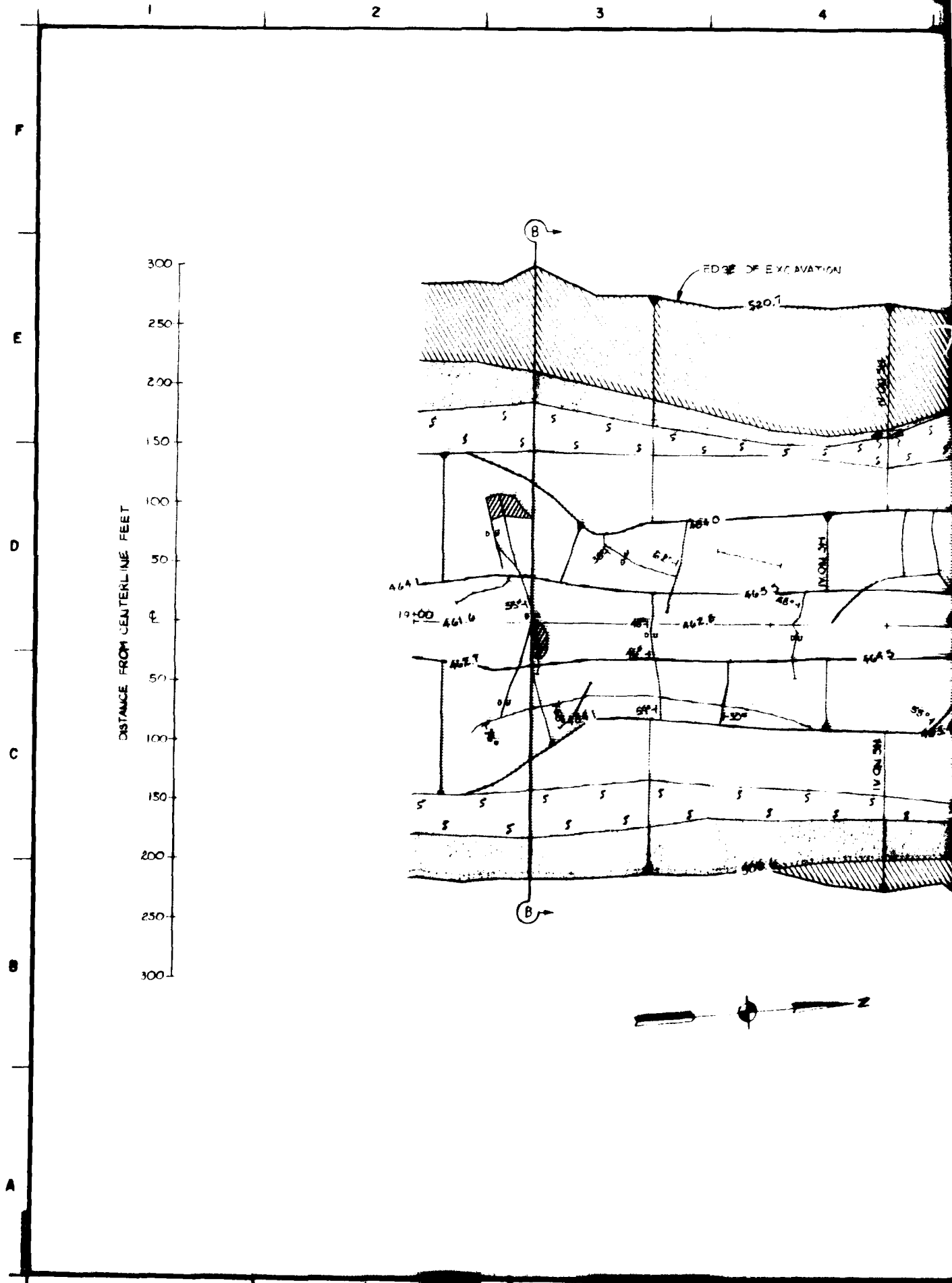
NOTE: FOR SECTION A-A SEE PLATE 9.

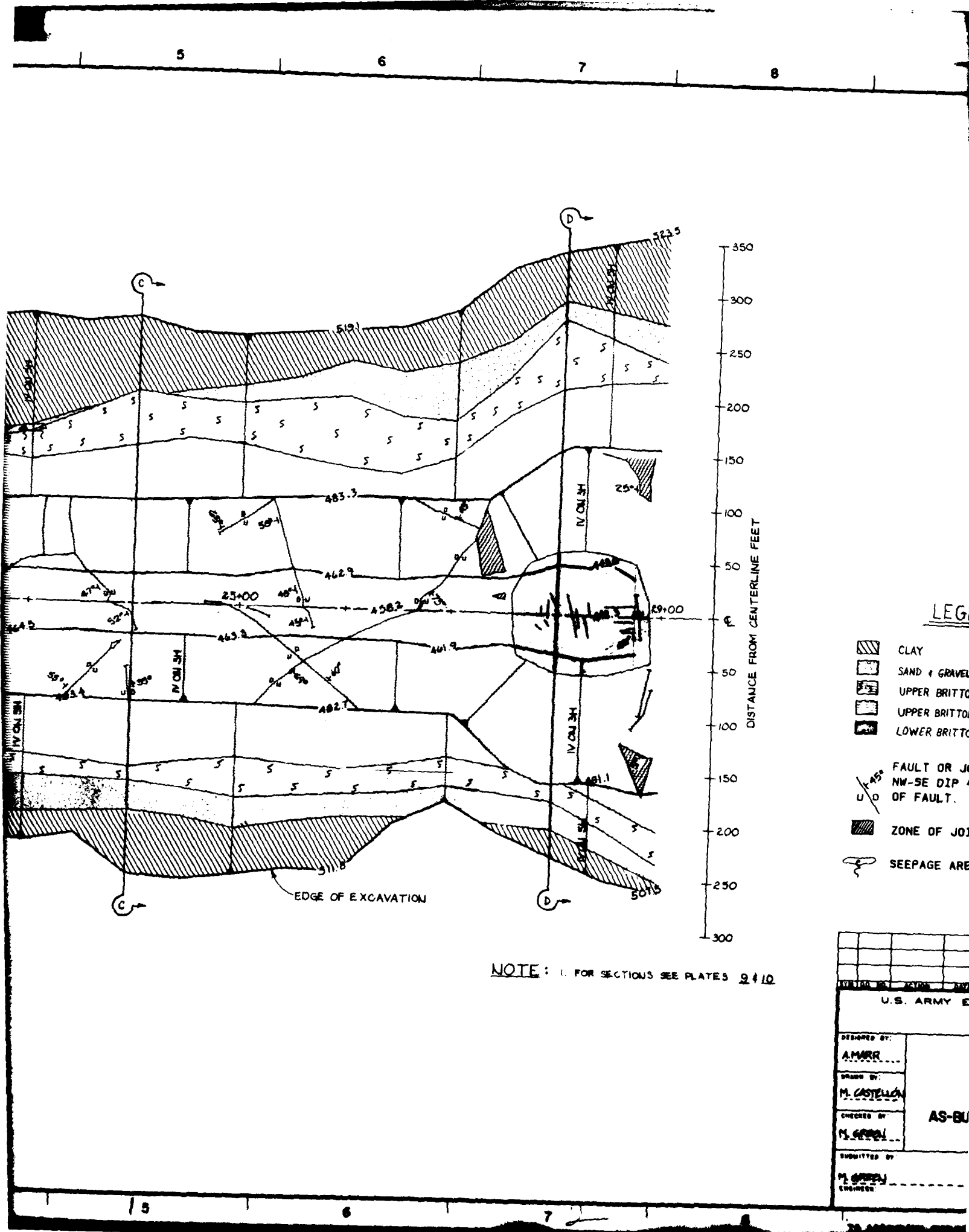
LEGEND

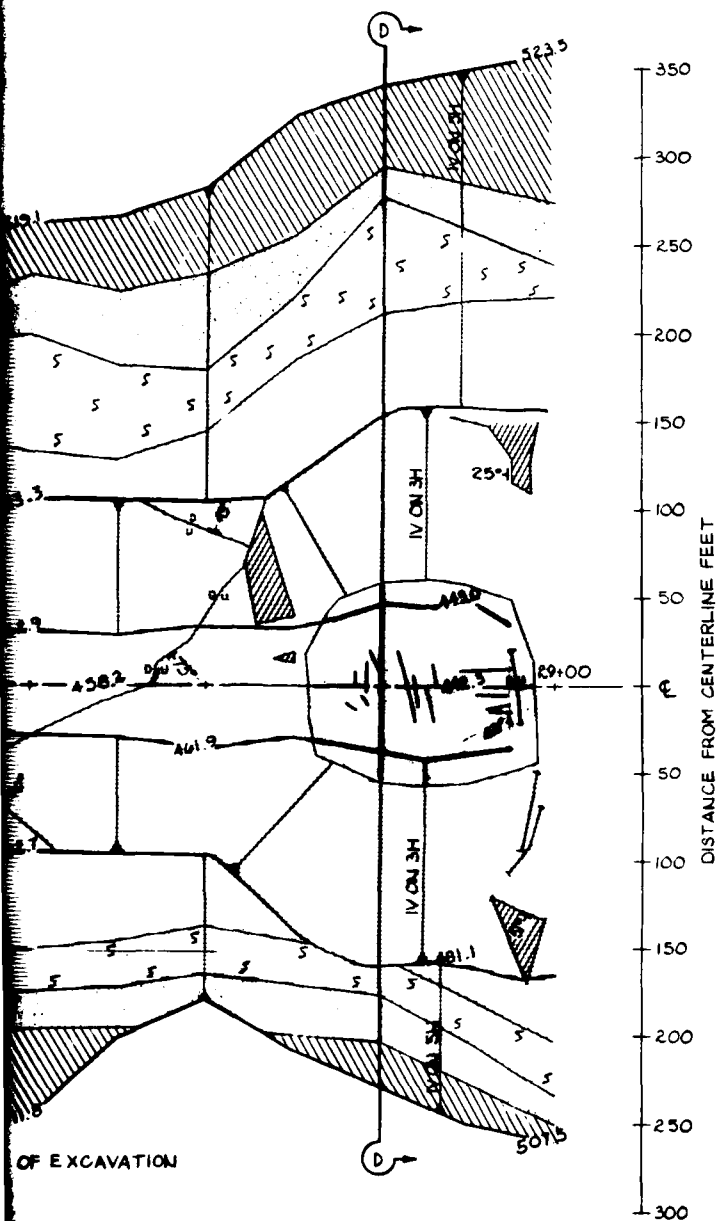
-  OVERBURDEN
-  UPPER BRITTON FM

U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS			
DESIGNED BY: A. HARR	JOE POOL LAKE MOUNTAIN CREEK, TEXAS		
DRAWN BY: M. CASTELLAN	OUTLET WORKS		
CHECKED BY: M. GREEN	AS-BUILT EXCAVATION PLAN		
STATION 9+00 THRU STATION 19+00			
SUBMITTED BY: MEL GREEN ENGINEER	INV NO.	DATED:	
CONTR NO.	DRAWING NUMBER	SHEET NO.	PLATE 5

TO ACCOMPANY OUTLET WORKS FINAL FOUNDATION REPORT







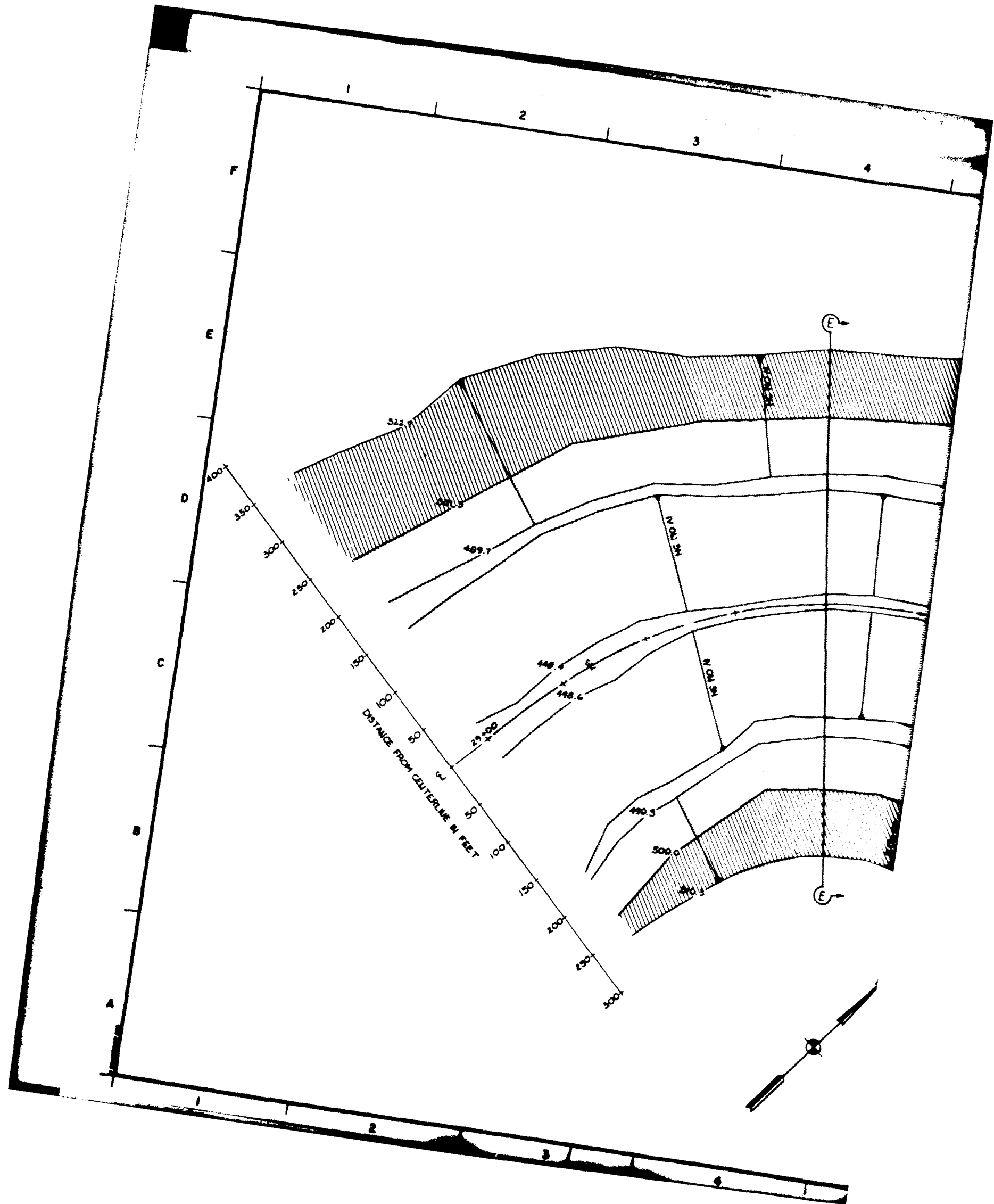
NOTE: 1. FOR SECTIONS SEE PLATES 9 & 10.

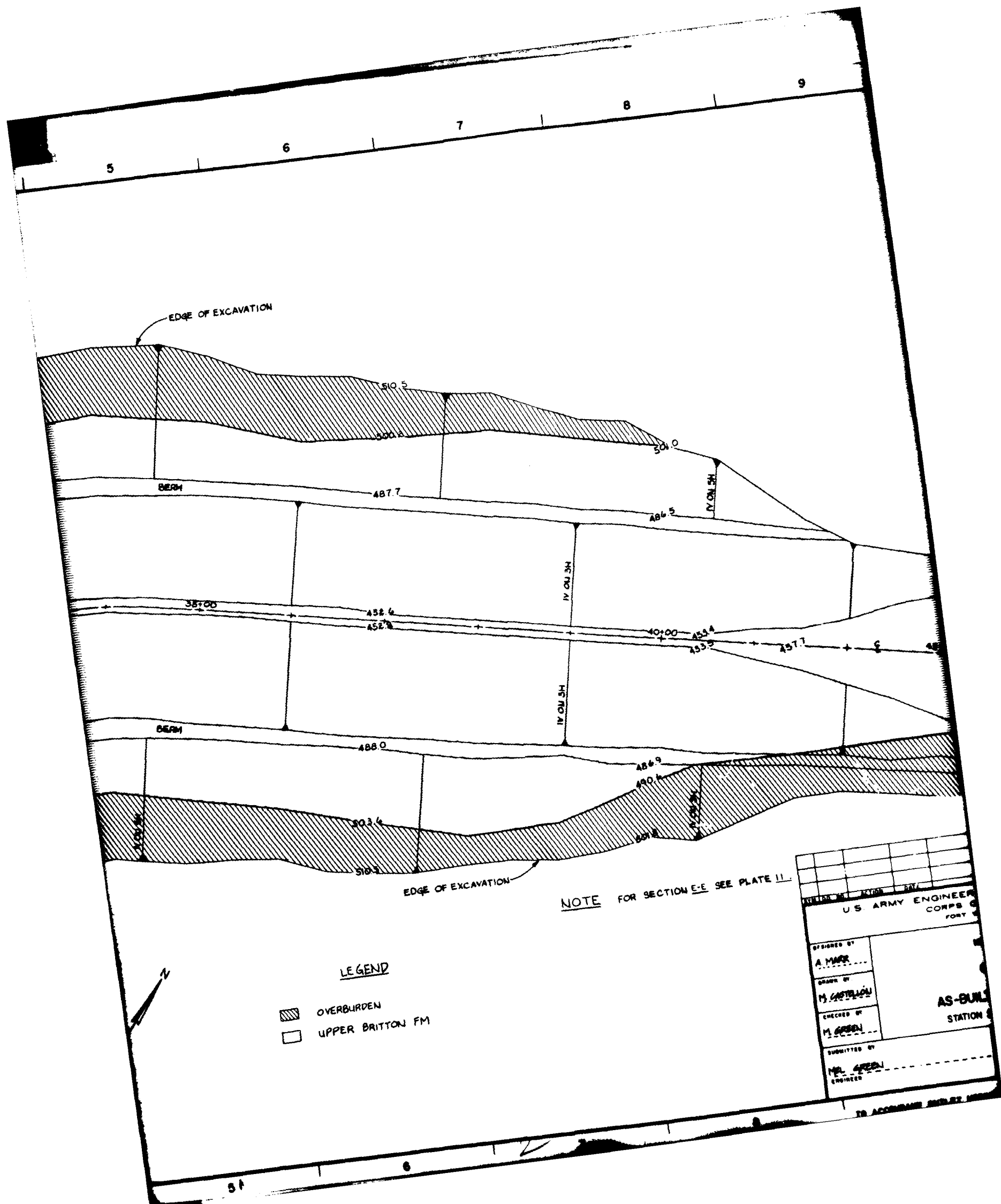
LEGEND

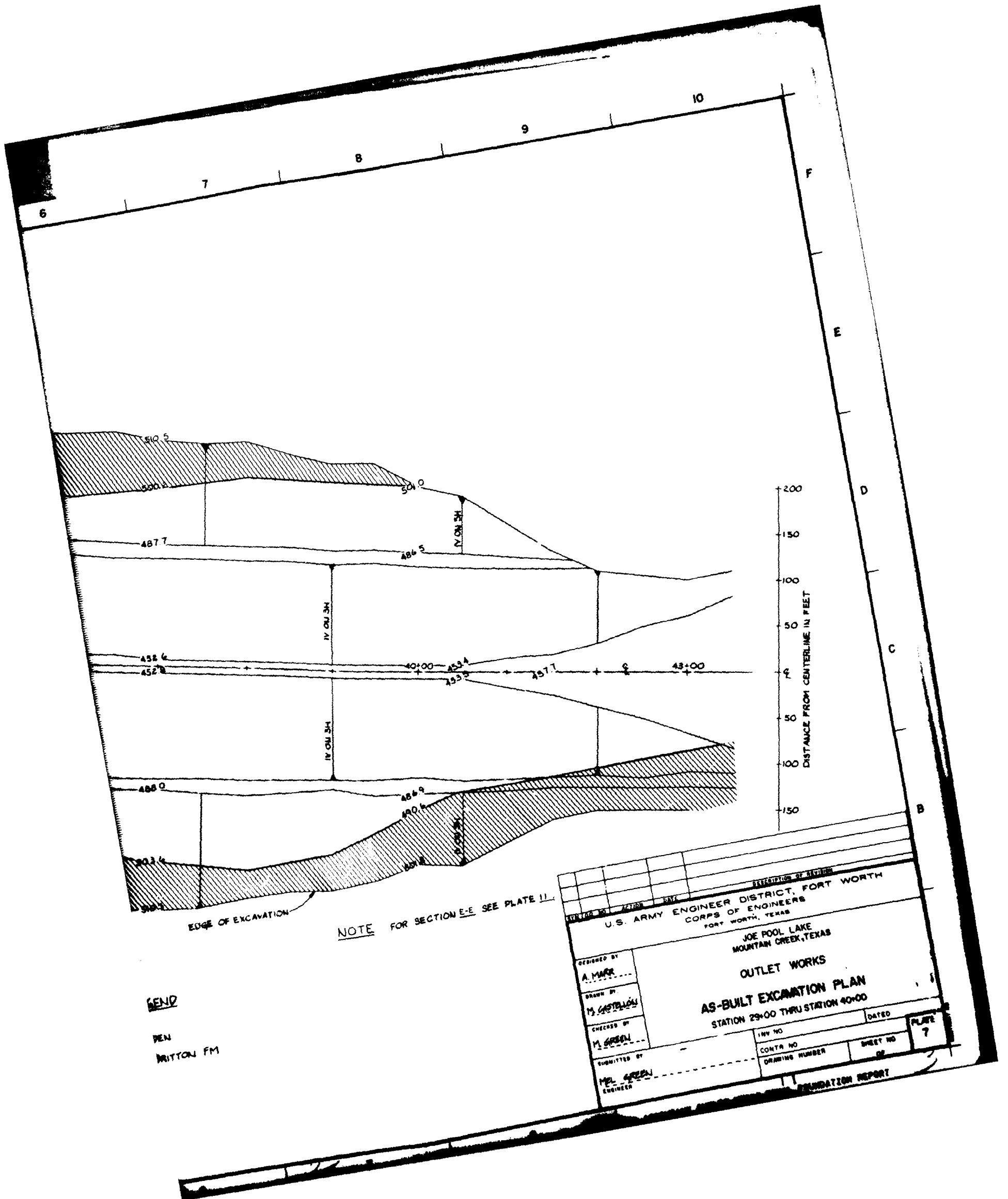
- CLAY
- SAND & GRAVEL
- UPPER BRITTON FM, WEATHERED
- UPPER BRITTON FM, UNWEATHERED
- LOWER BRITTON FM
- FAULT OR JOINT EXPOSED ON SURFACE. STRIKE NW-SE DIP 45° NE DOWNTOWN SIDE ON NE SIDE OF FAULT.
- ZONE OF JOINTED OR BROKEN PRIMARY
- SEEPAGE AREA

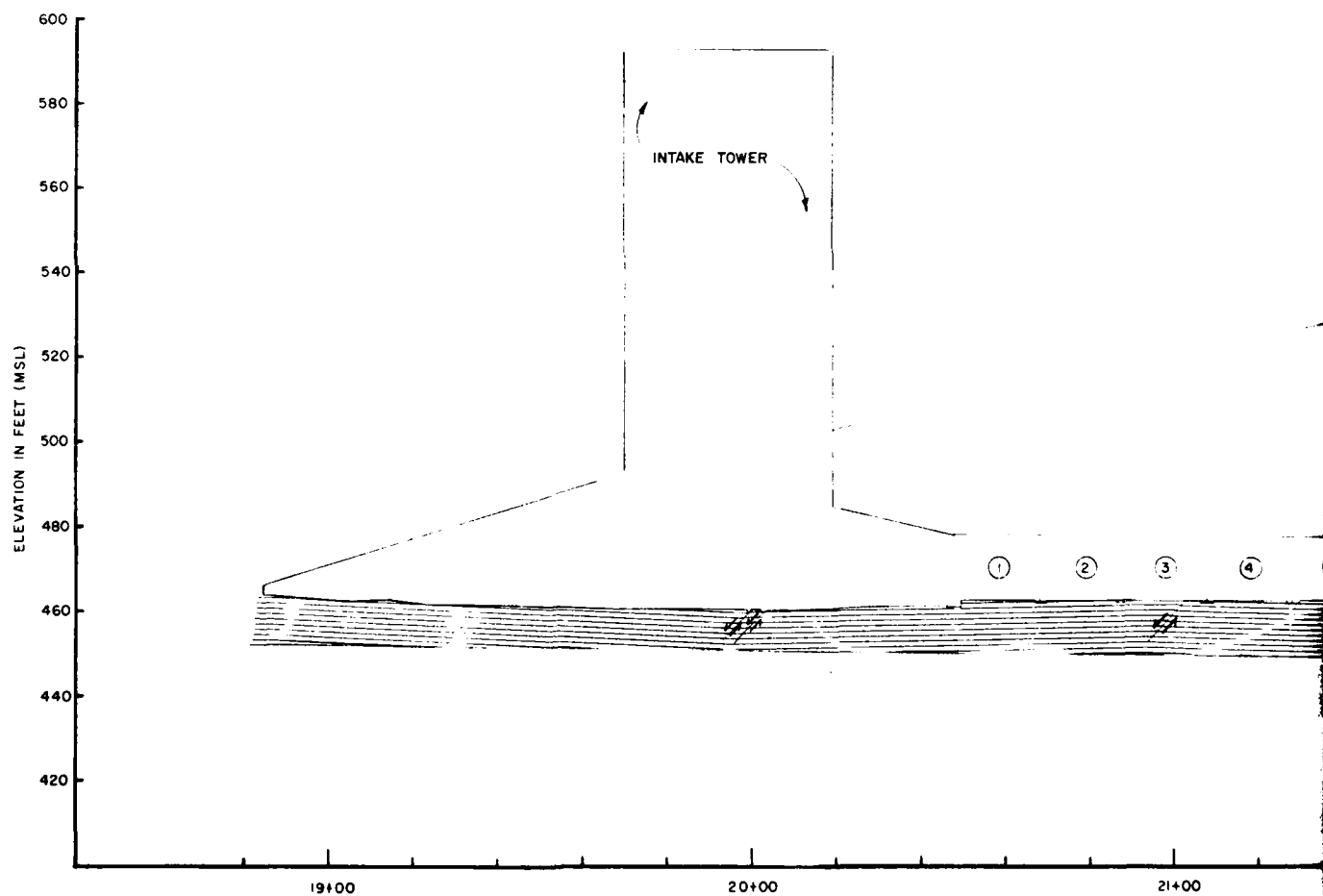
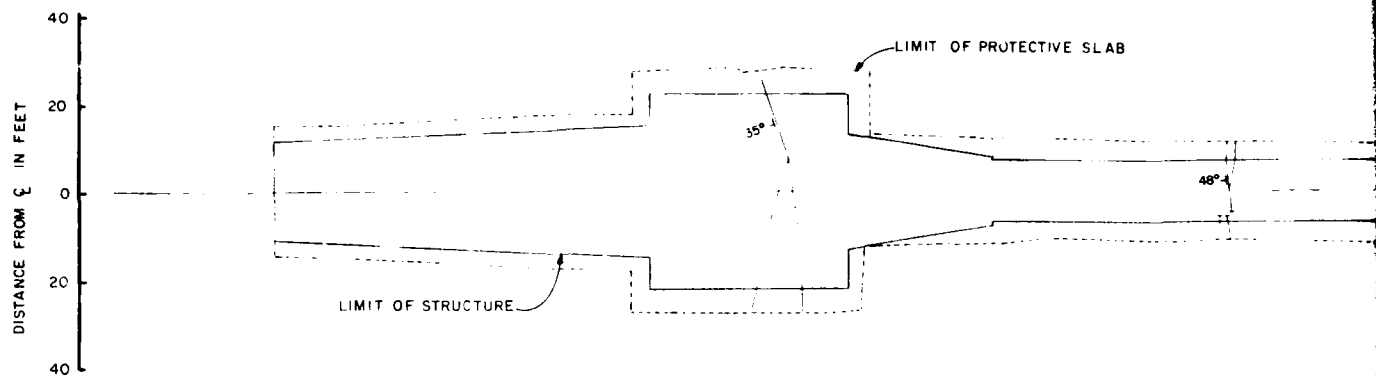
SYMBOL NO.				ACTION				DATE				DESCRIPTION OF REVISION			
U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS															
DESIGNED BY: A. MARR				JOE POOL LAKE MOUNTAIN CREEK, TEXAS											
DRAWN BY: M. CASTELLON				OUTLET WORKS											
CHECKED BY: M. GREEN				AS-BUILT FOUNDATION EXCAVATION PLAN STATION 19+00 THRU STATION 29+00											
SUBMITTED BY: M. GREEN ENGINEER								INV NO.				DATED.			
								CONTR NO.				SHEET NO.			
								DRAWING NUMBER				OF			
												PLATE 6			

TO ACCOMPANY OUTLET WORKS FINAL FOUNDATION REPORT

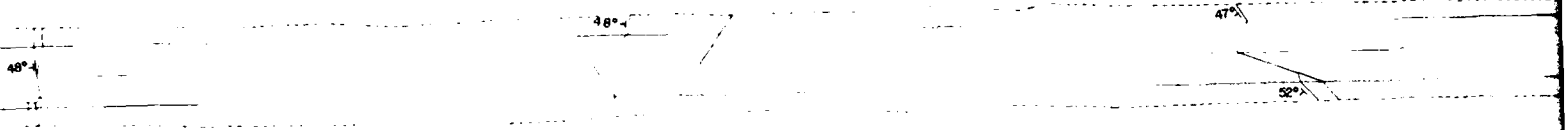




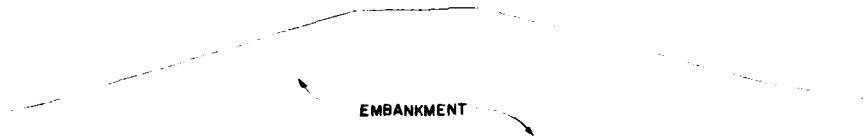




PLAN VIEW

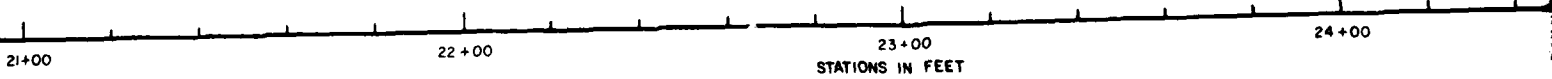


EMBANKMENT CENTERLINE



3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

CENTERLINE PROFILE



LEGEND

- ☐ UPPER BRITTON FM
- ☐ LOWER BRITTON FM
- ☒ 45° FAULT OR JOINT EXPOSED ON SURFACE
DIP 45° NE, DOWNTHROWN SIDE ON

LIMIT OF PROTECTIVE SLAB

10°

LIMIT OF STRUCTURE

19 20 (21) 22 23 24 (25) (26) (27) (28) (29) (30) (31) (32) (33)

00

25+00

26+00

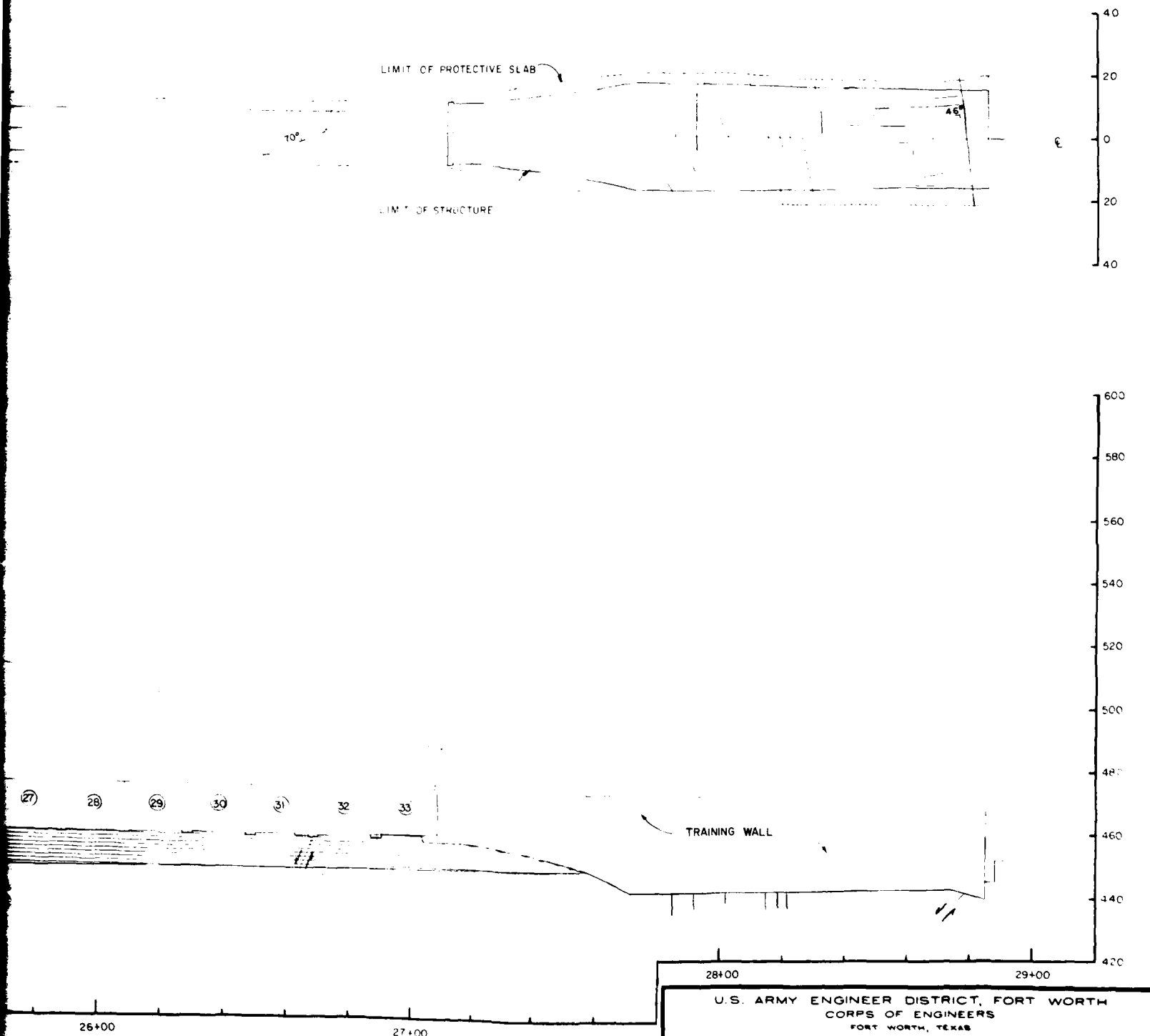
27+00

N FM

N FM

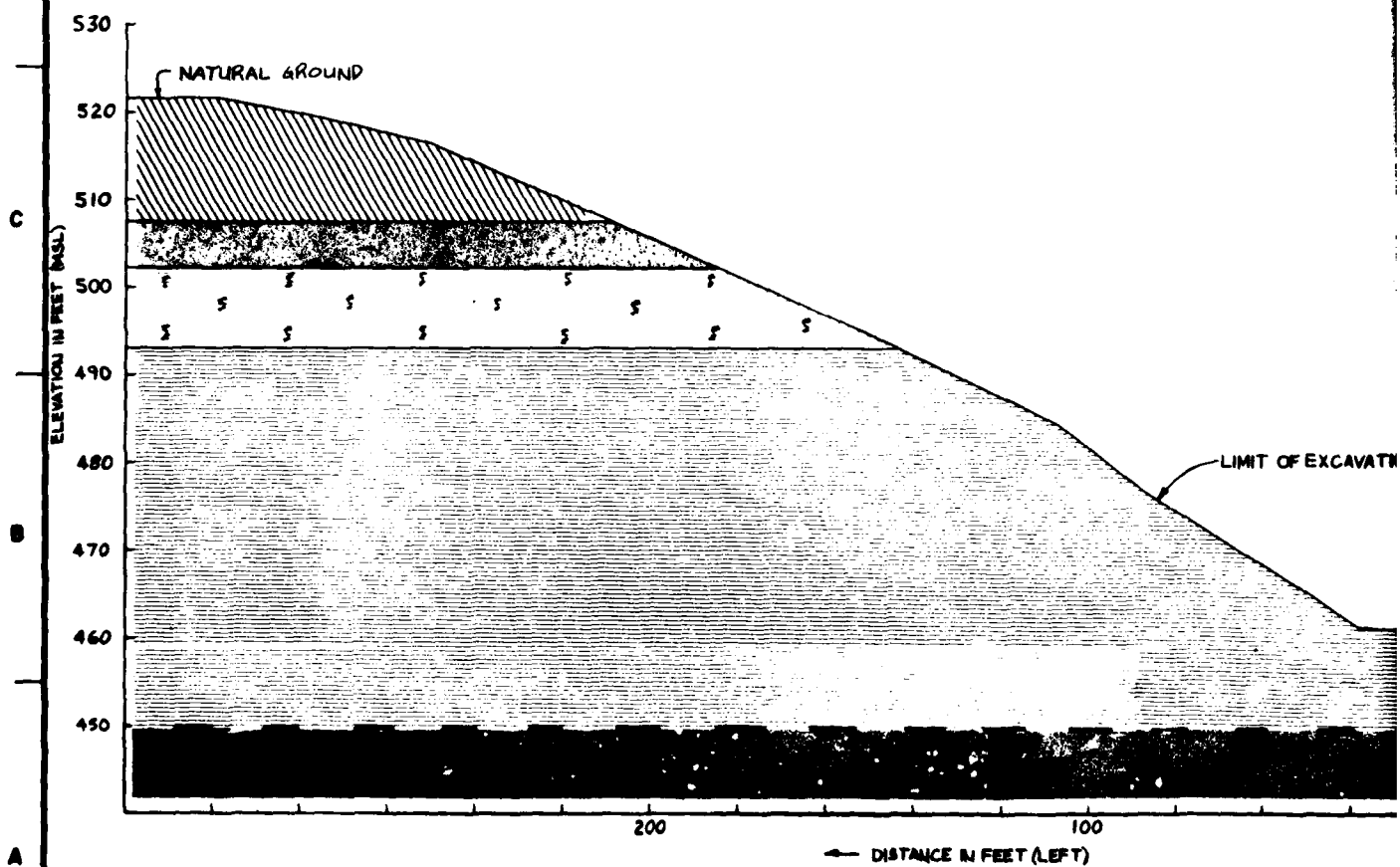
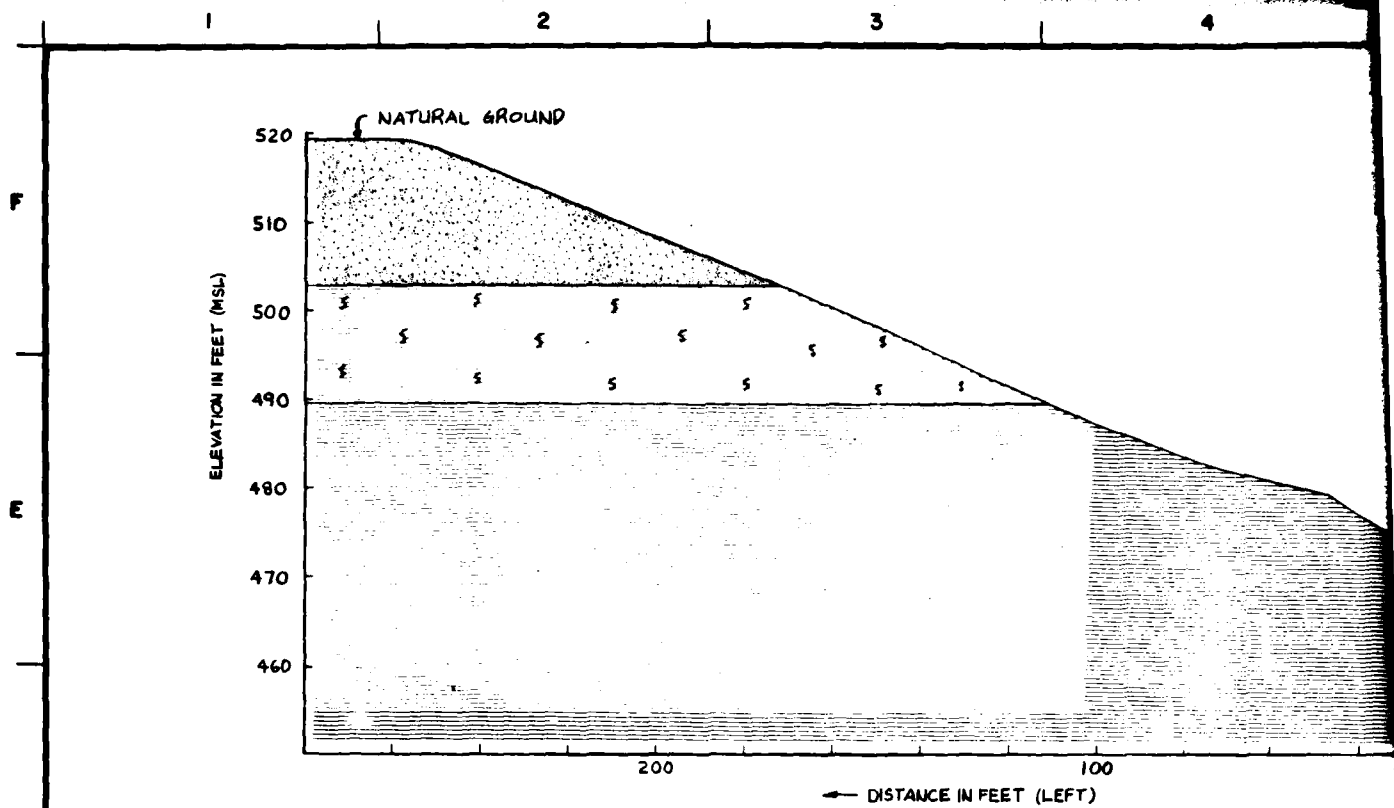
EXPOSED ON SURFACE STRIKE NW-SE
UNTHROWN SIDE ON NE SIDE OF FAULT

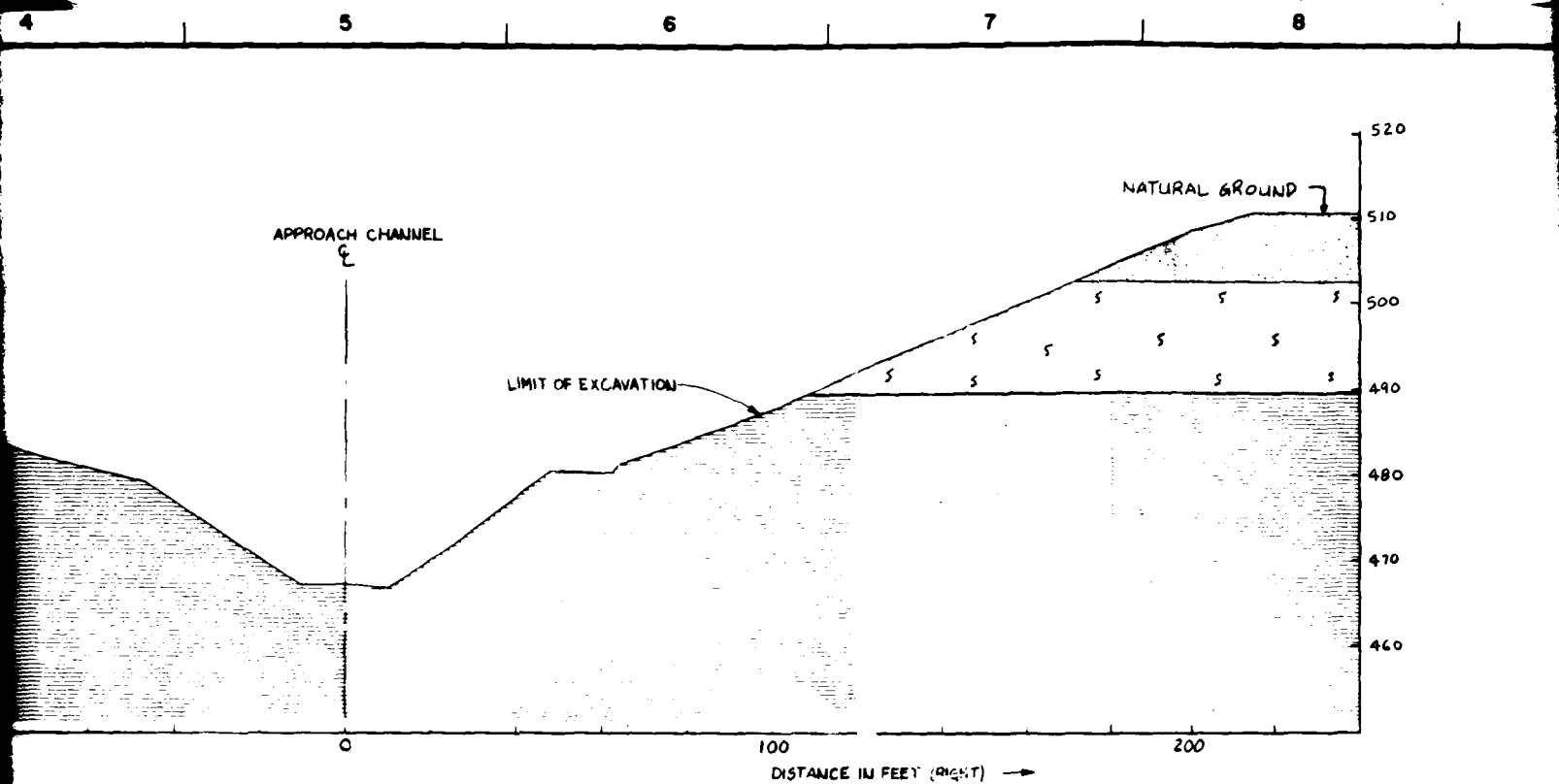
20' 0 20' 40'
SCALE OF FEET



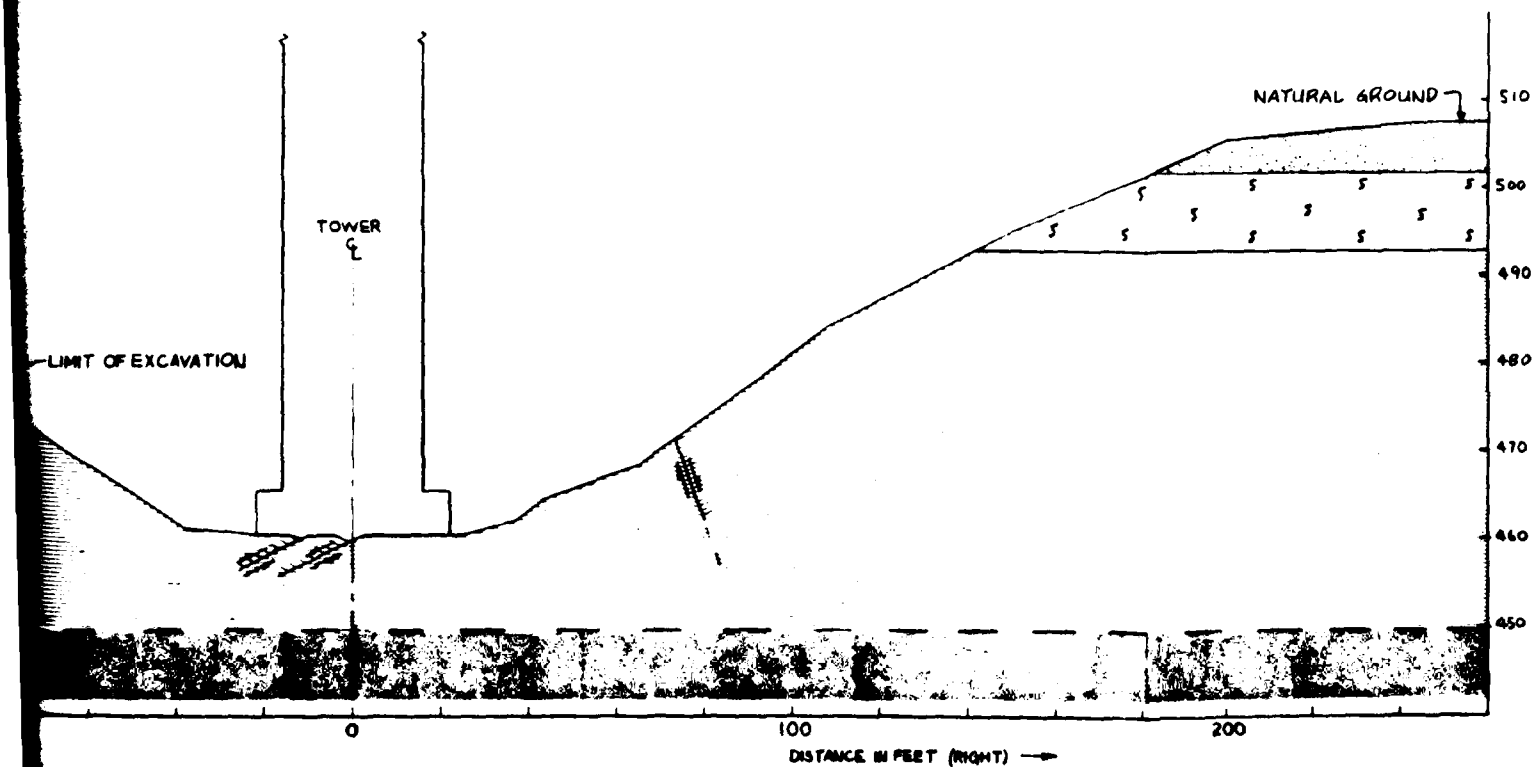
U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS			
DESIGNED BY A. MARR		JOE POOL LAKE MOUNTAIN CREEK, TEXAS	
DRAWN BY B. SMITH		OUTLET WORKS	
CHECKED BY M. GREEN		STRUCTURE FOUNDATION AS-BUILT PLAN & PROFILE	
SUBMITTED BY MEL GREEN ENGINEER		INV NO	DATE
		CONTR NO	SHEET NO OF
		DRAWING NUMBER	PLATE 8

1 TO ACCOMPANY OUTLET WORKS FINAL FOUNDATION REPORT

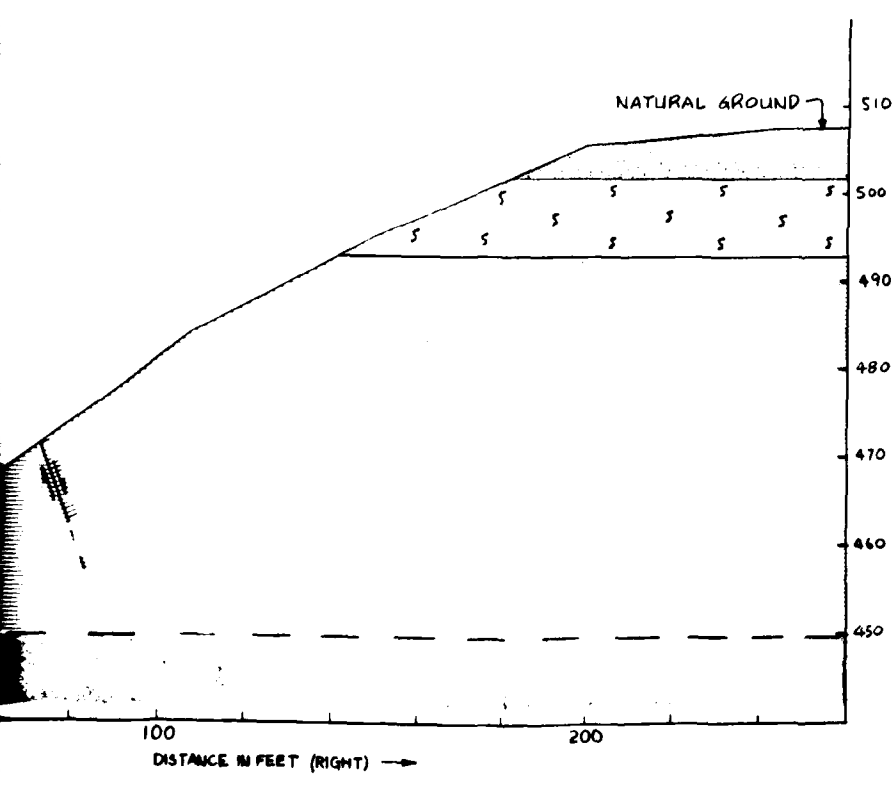
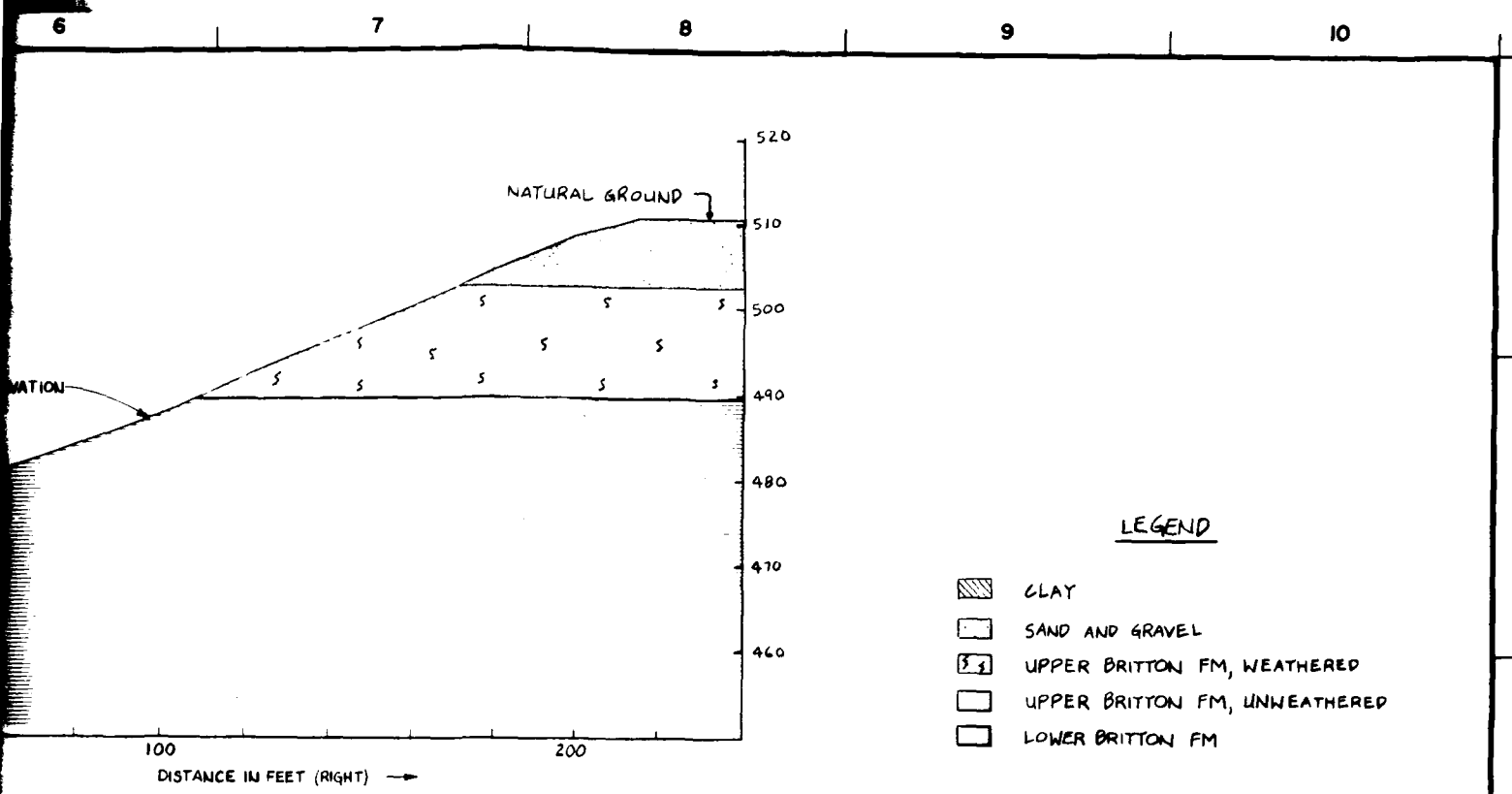




SECTION A-A

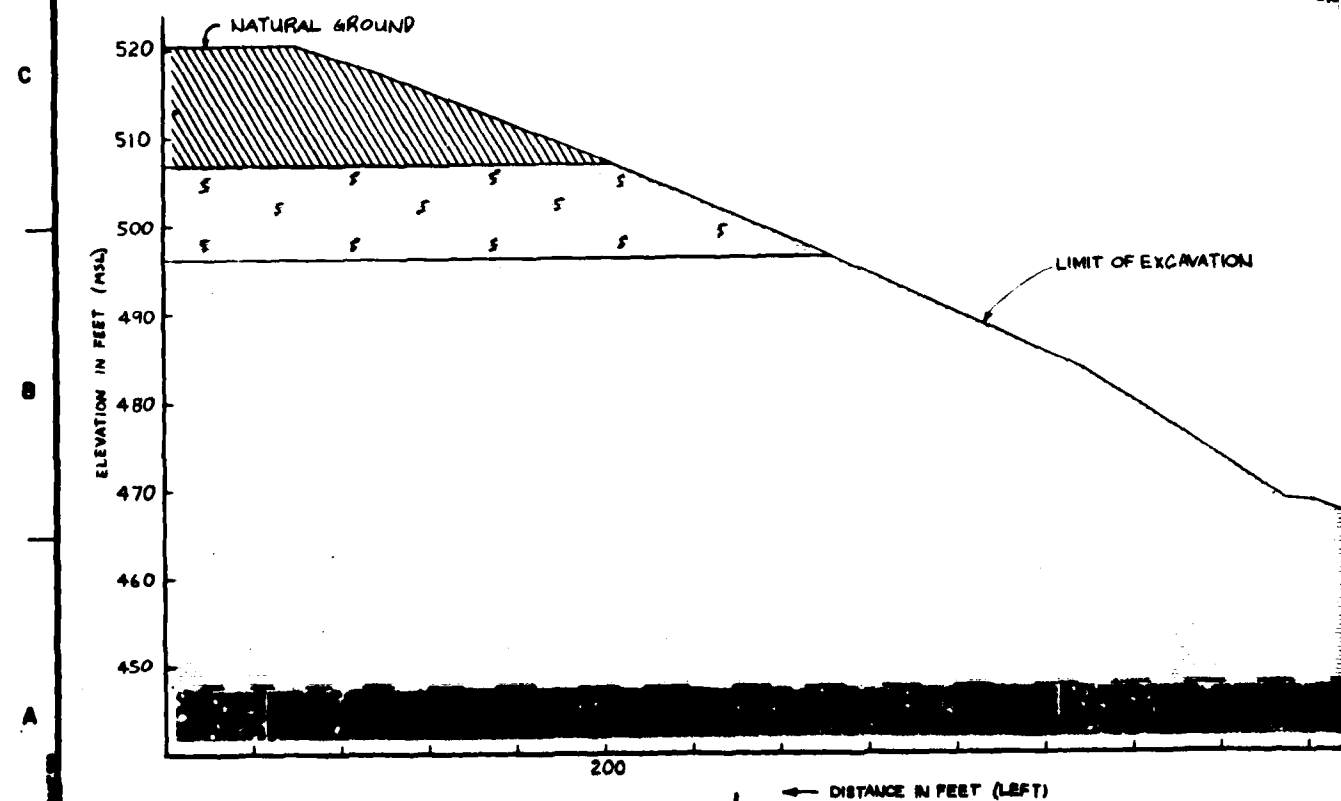
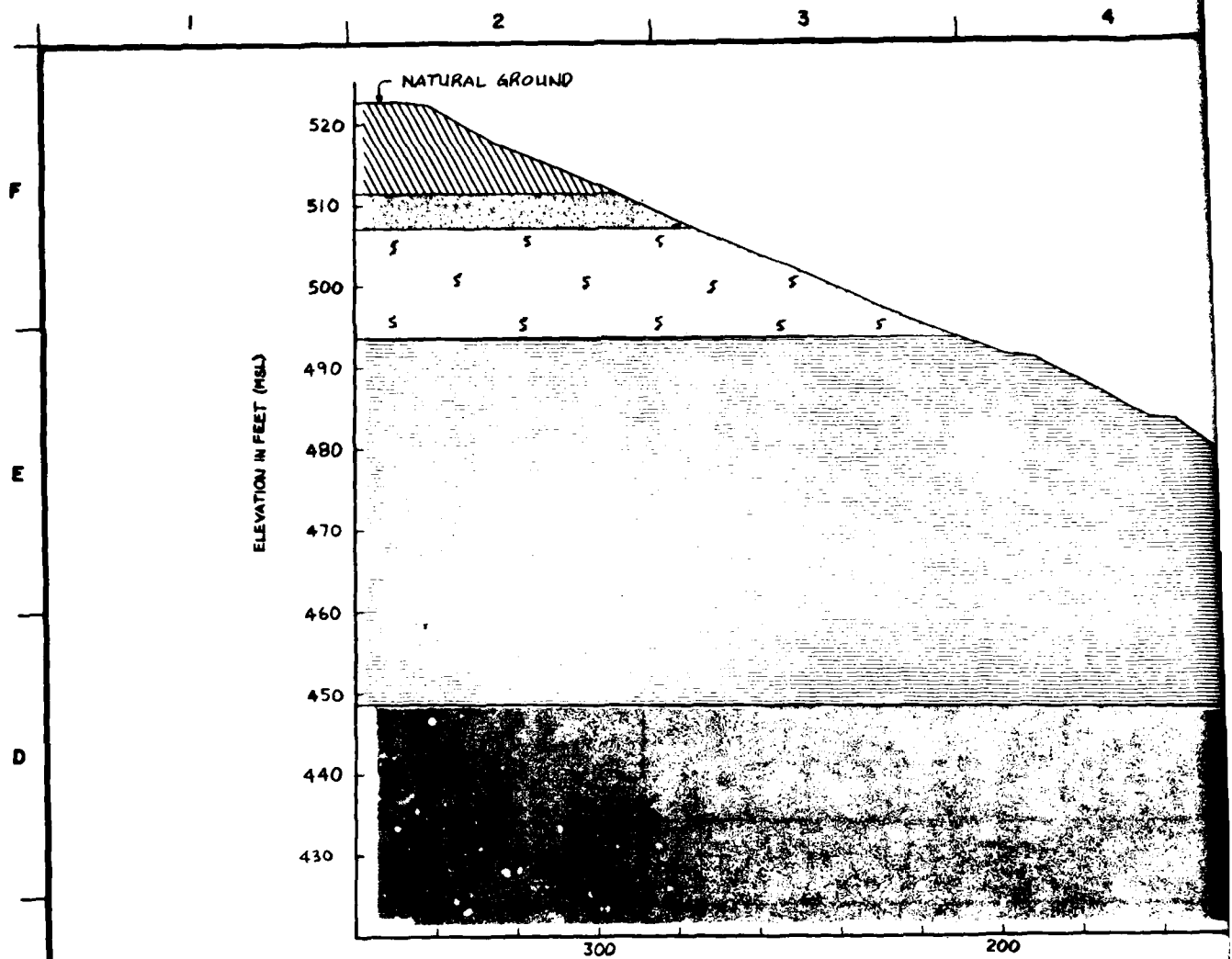


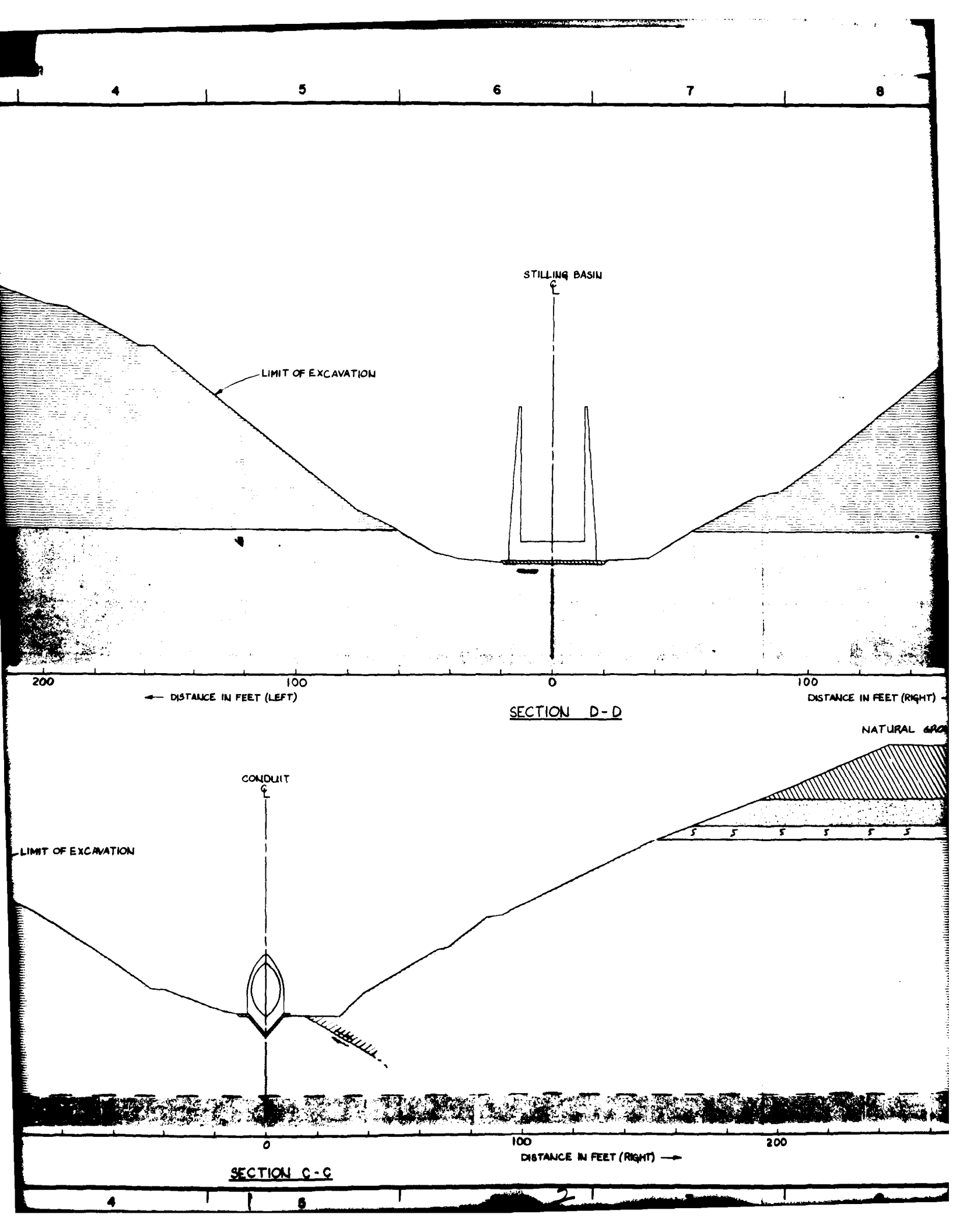
SECTION B-B



- NOTES**
1. FOR LOCATIONS OF CROSS-SECTIONS SEE PLATES 5 & 6.
 2. BOTH SECTIONS LOOKING DOWNSTREAM
 3. GEOLOGIC CONTACTS DASHED WHERE ESTIMATED

U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS	
DESIGNED BY: A. MAIR CHECKED BY: M. GREEN SUBMITTED BY: M. GREEN	JOE POOL LAKE MOUNTAIN CREEK, TEXAS OUTLET WORKS GEOLOGIC SECTIONS A-A AND B-B
SUBMITTED BY: MEL GREEN ENGINEER	INVITATION NO. _____ DATE: _____ CONTRACT NO. _____ DRAWING NUMBER _____ SHEET NO. 9





6

7

8

9

10

STILLING BASIN

NATURAL GROUND

500

490

480

470

460

450

440

430

0

100

200

DISTANCE IN FEET (RIGHT) →

SECTION D-D

NATURAL GROUND

510

500

490

480

470

460

450

100

200

DISTANCE IN FEET (RIGHT) →

NOTES

1. FOR LOCATIONS OF SECTIONS SEE PLATE 4
2. BOTH SECTIONS LOOKING DOWNSTREAM
3. GEOLOGIC CONTACT DASHED WHERE ESTIMATED

LEGEND

-  CLAY
-  SAND AND GRAVEL
-  UPPER BRITTON FM, WEATHERED
-  UPPER BRITTON FM, UNWEATHERED
-  LOWER BRITTON FM

DATE		DRAWN BY		CHECKED BY		APPROVED BY	
U.S. ARMY ENGINEER DISTRICT, FORT WORTH		CORPS OF ENGINEERS		FORT WORTH, TEXAS		JOE POOL LAKE MOUNTAIN CREEK, TEXAS	
DESIGNED BY A. HARR		CHECKED BY M. GREEN		APPROVED BY M. GREEN		OUTLET WORKS GEOLOGIC SECTIONS C-C AND D-D	
SUBMITTED BY MEL GREEN		CONTRACT NO.		DRAWING NO.		SHEET NO. 10	

TO ACCOMPANY AND SET NOTES FINAL FOUNDATION REPORT

F

E

D

C

B

A

ELEVATION IN FEET (MSL)

510

500

490

480

470

460

450

440

200

100

← DISTANCE IN FEET (LEFT)

	SAND AND
	UPPER DR
	UPPER DR
	LOWER DR

4

5

6

7

8

DISCHARGE CHANNEL

LIMIT OF EXCAVATION

← 100
DISTANCE IN FEET (LEFT)

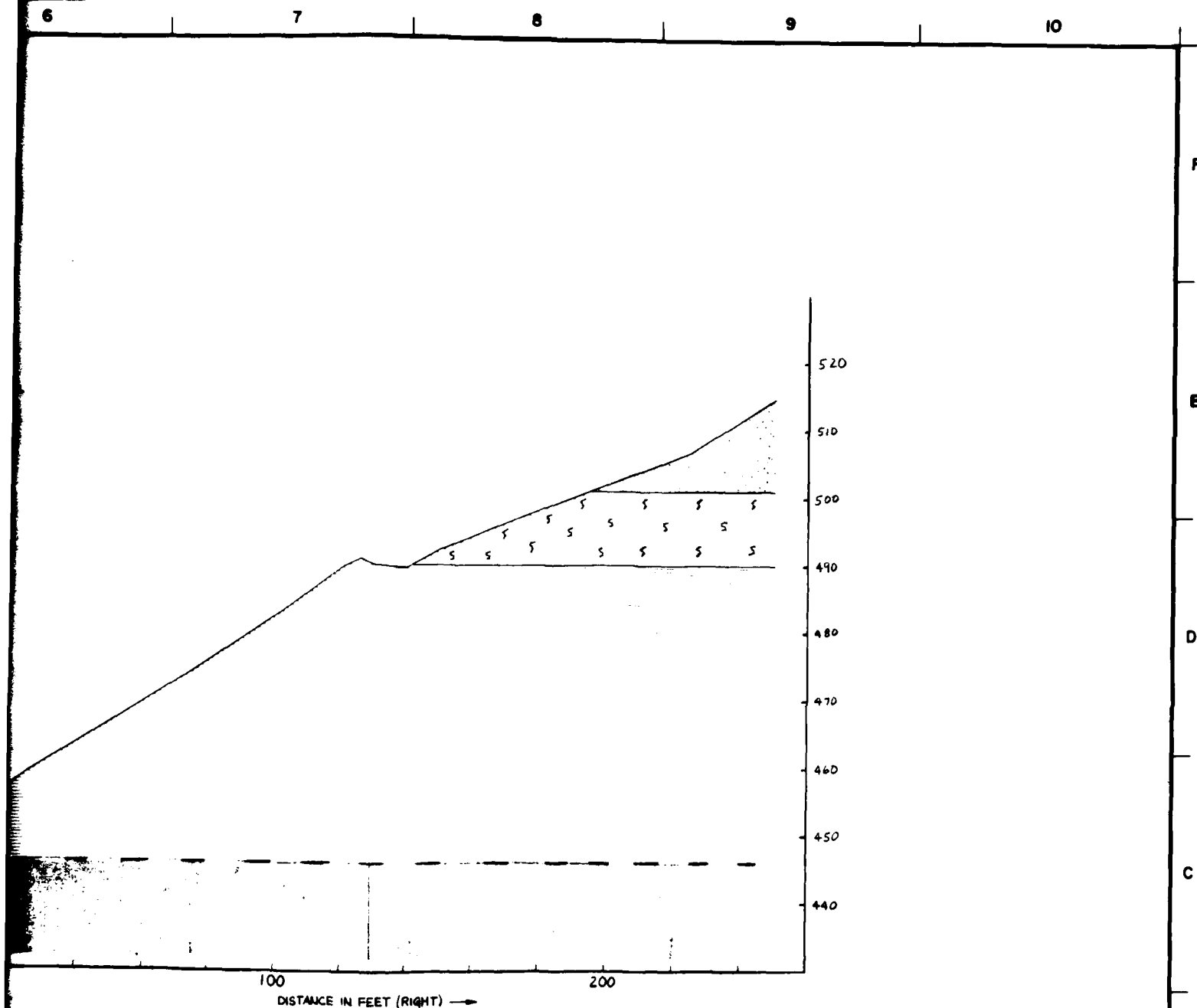
SECTION E-E

100 →
DISTANCE IN FEET (RIGHT)NOTES:

1. FOR LOCATION OF SECTION SEE PLATE I.
2. CROSS SECTION LOOKING DOWNSTREAM
3. GEOLOGIC CONTACT DASHED WHERE ESTIMATED

LEGEND

-  SAND AND GRAVEL
-  UPPER BRITTON FM, WEATHERED
-  UPPER BRITTON FM, UNWEATHERED
-  LOWER BRITTON FM



NOTES :

1. FOR LOCATION OF SECTION SEE PLATE 7.
2. CROSS SECTION LOOKING DOWNSTREAM
3. GEOLOGIC CONTACT DASHED WHERE ESTIMATED

[illegible]

DEPTH	DESCRIPTION	UNIT	REMARKS
100	CLAY, TO 20 INCHES TO 24 TO 200 20, CALC, 24, 25, 200 TO 24 200, 24 200, 24 24 24 24 24 24 24	L	
40	CLAY, CLAY, SANDY, 24 24, 24, 24, 24, 24, 24, 24 24, 24 24, 24 24, 24 24 - 24 24	24 24 24 24	
50	CLAY, 24 24 24 24, 24, 24 24, 24, 24, 24, 24 24 - 24 24	24 24 24	
60	CLAY, 24 24, 24, 24, 24, 24, 24, 24, 24 24 - 24 24	24 24 24	

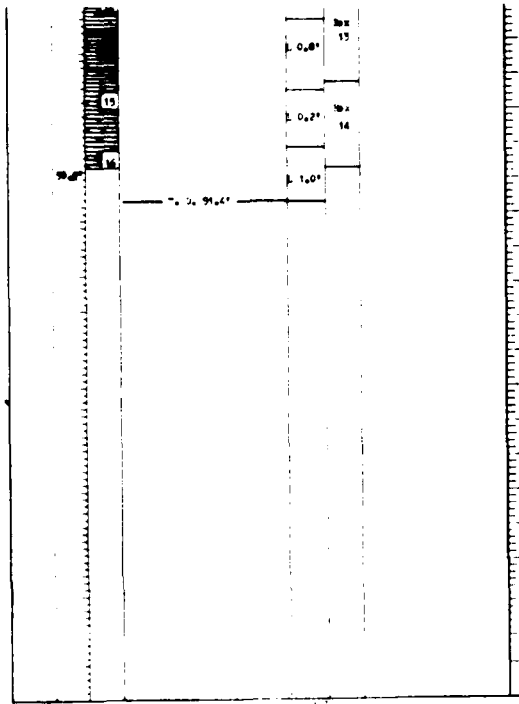
TO ACCOMPANY OUTLET WORKS FOUNDATION REPORT PLATE 13

[illegible][illegible]

[illegible]

[illegible]

PROJECT LOG		DATE		TIME		LOCATION		DRILLER		REMARKS	
0.00 to 0.25		1		1.00		1.00		1.00		1.00	
0.25 to 0.50		2		1.00		1.00		1.00		1.00	
0.50 to 0.75		3		1.00		1.00		1.00		1.00	
0.75 to 1.00		4		1.00		1.00		1.00		1.00	
1.00 to 1.25		5		1.00		1.00		1.00		1.00	
1.25 to 1.50		6		1.00		1.00		1.00		1.00	
1.50 to 1.75		7		1.00		1.00		1.00		1.00	
1.75 to 2.00		8		1.00		1.00		1.00		1.00	
2.00 to 2.25		9		1.00		1.00		1.00		1.00	
2.25 to 2.50		10		1.00		1.00		1.00		1.00	
2.50 to 2.75		11		1.00		1.00		1.00		1.00	
2.75 to 3.00		12		1.00		1.00		1.00		1.00	
3.00 to 3.25		13		1.00		1.00		1.00		1.00	
3.25 to 3.50		14		1.00		1.00		1.00		1.00	
3.50 to 3.75		15		1.00		1.00		1.00		1.00	
3.75 to 4.00		16		1.00		1.00		1.00		1.00	
4.00 to 4.25		17		1.00		1.00		1.00		1.00	
4.25 to 4.50		18		1.00		1.00		1.00		1.00	
4.50 to 4.75		19		1.00		1.00		1.00		1.00	
4.75 to 5.00		20		1.00		1.00		1.00		1.00	
5.00 to 5.25		21		1.00		1.00		1.00		1.00	
5.25 to 5.50		22		1.00		1.00		1.00		1.00	
5.50 to 5.75		23		1.00		1.00		1.00		1.00	
5.75 to 6.00		24		1.00		1.00		1.00		1.00	
6.00 to 6.25		25		1.00		1.00		1.00		1.00	
6.25 to 6.50		26		1.00		1.00		1.00		1.00	
6.50 to 6.75		27		1.00		1.00		1.00		1.00	
6.75 to 7.00		28		1.00		1.00		1.00		1.00	
7.00 to 7.25		29		1.00		1.00		1.00		1.00	
7.25 to 7.50		30		1.00		1.00		1.00		1.00	
7.50 to 7.75		31		1.00		1.00		1.00		1.00	
7.75 to 8.00		32		1.00		1.00		1.00		1.00	
8.00 to 8.25		33		1.00		1.00		1.00		1.00	
8.25 to 8.50		34		1.00		1.00		1.00		1.00	
8.50 to 8.75		35		1.00		1.00		1.00		1.00	
8.75 to 9.00		36		1.00		1.00		1.00		1.00	
9.00 to 9.25		37		1.00		1.00		1.00		1.00	
9.25 to 9.50		38		1.00		1.00		1.00		1.00	
9.50 to 9.75		39		1.00		1.00		1.00		1.00	
9.75 to 10.00		40		1.00		1.00		1.00		1.00	



U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS			
DESIGNED BY		JOE POOL LAKE MOUNTAIN CREEK, TEXAS	
CHECKED BY		OUTLET WORKS AND INITIAL EMBANKMENTS	
SUBMITTED BY		LOGS OF BORINGS SASC-89 AND SASC-843	
DRAWING NUMBER		SHEET NO.	
DATE		REVISION NO.	

Drilling Log

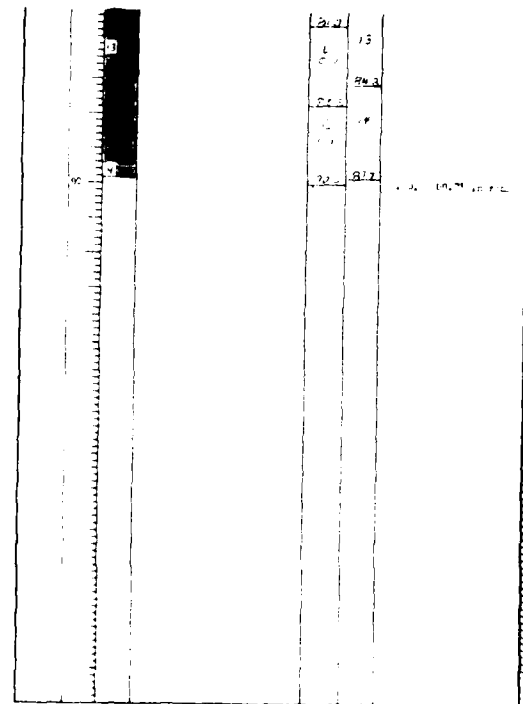
1. Date: 12/15/54
2. Location: Mountain Creek, Texas
3. Driller: [Signature]
4. Recorder: [Signature]
5. Project: Outlet Works and Initial Embankments

Depth (ft)	Soil Description	Remarks
0.0	Surface	
1.0	Topsoil	
2.0	Clay	
3.0	Clay	
4.0	Clay	
5.0	Clay	
6.0	Clay	
7.0	Clay	
8.0	Clay	
9.0	Clay	
10.0	Clay	
11.0	Clay	
12.0	Clay	
13.0	Clay	
14.0	Clay	
15.0	Clay	
16.0	Clay	
17.0	Clay	
18.0	Clay	
19.0	Clay	
20.0	Clay	
21.0	Clay	
22.0	Clay	
23.0	Clay	
24.0	Clay	
25.0	Clay	
26.0	Clay	
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28.0	Clay	
29.0	Clay	
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34.0	Clay	
35.0	Clay	
36.0	Clay	
37.0	Clay	
38.0	Clay	
39.0	Clay	
40.0	Clay	
41.0	Clay	
42.0	Clay	
43.0	Clay	
44.0	Clay	
45.0	Clay	
46.0	Clay	
47.0	Clay	
48.0	Clay	
49.0	Clay	
50.0	Clay	

Drilling Log

1. Date: 12/15/54
2. Location: Mountain Creek, Texas
3. Driller: [Signature]
4. Recorder: [Signature]
5. Project: Outlet Works and Initial Embankments

Depth (ft)	Soil Description	Remarks
0.0	Surface	
1.0	Topsoil	
2.0	Clay	
3.0	Clay	
4.0	Clay	
5.0	Clay	
6.0	Clay	
7.0	Clay	
8.0	Clay	
9.0	Clay	
10.0	Clay	
11.0	Clay	
12.0	Clay	
13.0	Clay	
14.0	Clay	
15.0	Clay	
16.0	Clay	
17.0	Clay	
18.0	Clay	
19.0	Clay	
20.0	Clay	
21.0	Clay	
22.0	Clay	
23.0	Clay	
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35.0	Clay	
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38.0	Clay	
39.0	Clay	
40.0	Clay	
41.0	Clay	
42.0	Clay	
43.0	Clay	
44.0	Clay	
45.0	Clay	
46.0	Clay	
47.0	Clay	
48.0	Clay	
49.0	Clay	
50.0	Clay	



**U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS**

REPORTED BY: **JOE POOL LAKE**
MOUNTAIN CREEK, TEXAS

DESIGNED BY: **OUTLET WORKS AND INITIAL EMBANKMENTS**

CHECKED BY: **LOGS OF BORINGS**
SASC-544, 545, 546

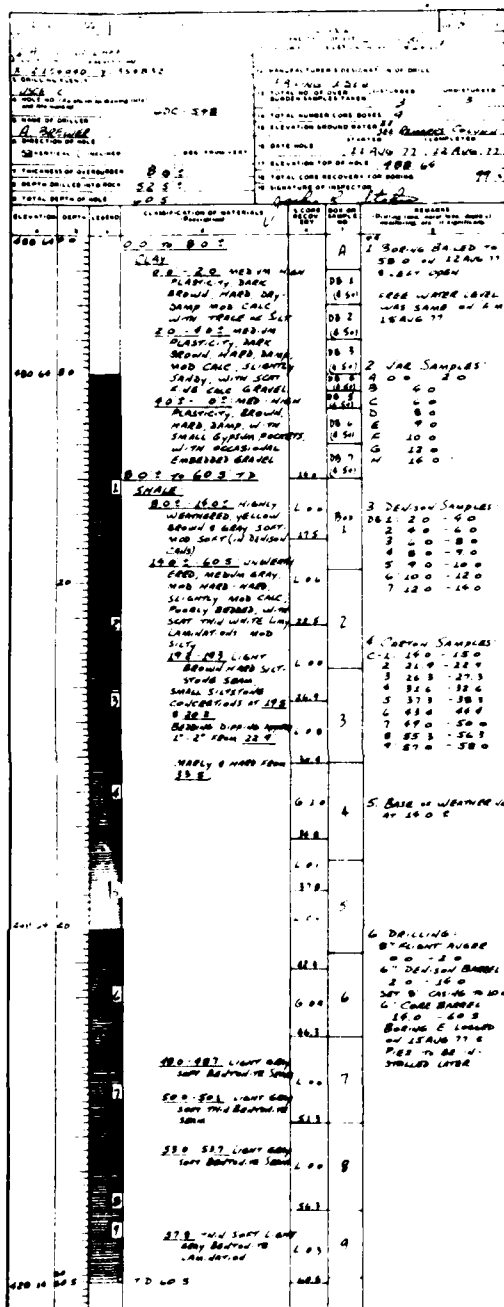
DATE: _____

PROJECT: _____

DRIVING NUMBER: _____

SHEET NO: _____

GENERAL INFORMATION		LOCATION OF MATERIAL		TEST DATA	
1. NAME OF PROJECT	2. LOCATION OF PROJECT	3. NAME OF MATERIAL	4. LOCATION OF MATERIAL	5. TEST DATA	6. TEST DATA
7. NAME OF MATERIAL	8. LOCATION OF MATERIAL	9. NAME OF MATERIAL	10. LOCATION OF MATERIAL	11. TEST DATA	12. TEST DATA
13. NAME OF MATERIAL	14. LOCATION OF MATERIAL	15. NAME OF MATERIAL	16. LOCATION OF MATERIAL	17. TEST DATA	18. TEST DATA
19. NAME OF MATERIAL	20. LOCATION OF MATERIAL	21. NAME OF MATERIAL	22. LOCATION OF MATERIAL	23. TEST DATA	24. TEST DATA
25. NAME OF MATERIAL	26. LOCATION OF MATERIAL	27. NAME OF MATERIAL	28. LOCATION OF MATERIAL	29. TEST DATA	30. TEST DATA
31. NAME OF MATERIAL	32. LOCATION OF MATERIAL	33. NAME OF MATERIAL	34. LOCATION OF MATERIAL	35. TEST DATA	36. TEST DATA
37. NAME OF MATERIAL	38. LOCATION OF MATERIAL	39. NAME OF MATERIAL	40. LOCATION OF MATERIAL	41. TEST DATA	42. TEST DATA
43. NAME OF MATERIAL	44. LOCATION OF MATERIAL	45. NAME OF MATERIAL	46. LOCATION OF MATERIAL	47. TEST DATA	48. TEST DATA
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79. NAME OF MATERIAL	80. LOCATION OF MATERIAL	81. NAME OF MATERIAL	82. LOCATION OF MATERIAL	83. TEST DATA	84. TEST DATA
85. NAME OF MATERIAL	86. LOCATION OF MATERIAL	87. NAME OF MATERIAL	88. LOCATION OF MATERIAL	89. TEST DATA	90. TEST DATA
91. NAME OF MATERIAL	92. LOCATION OF MATERIAL	93. NAME OF MATERIAL	94. LOCATION OF MATERIAL	95. TEST DATA	96. TEST DATA
97. NAME OF MATERIAL	98. LOCATION OF MATERIAL	99. NAME OF MATERIAL	100. LOCATION OF MATERIAL	101. TEST DATA	102. TEST DATA
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133. NAME OF MATERIAL	134. LOCATION OF MATERIAL	135. NAME OF MATERIAL	136. LOCATION OF MATERIAL	137. TEST DATA	138. TEST DATA
139. NAME OF MATERIAL	140. LOCATION OF MATERIAL	141. NAME OF MATERIAL	142. LOCATION OF MATERIAL	143. TEST DATA	144. TEST DATA
145. NAME OF MATERIAL	146. LOCATION OF MATERIAL	147. NAME OF MATERIAL	148. LOCATION OF MATERIAL	149. TEST DATA	150. TEST DATA
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157. NAME OF MATERIAL	158. LOCATION OF MATERIAL	159. NAME OF MATERIAL	160. LOCATION OF MATERIAL	161. TEST DATA	162. TEST DATA
163. NAME OF MATERIAL	164. LOCATION OF MATERIAL	165. NAME OF MATERIAL	166. LOCATION OF MATERIAL	167. TEST DATA	168. TEST DATA
169. NAME OF MATERIAL	170. LOCATION OF MATERIAL	171. NAME OF MATERIAL	172. LOCATION OF MATERIAL	173. TEST DATA	174. TEST DATA
175. NAME OF MATERIAL	176. LOCATION OF MATERIAL	177. NAME OF MATERIAL	178. LOCATION OF MATERIAL	179. TEST DATA	180. TEST DATA
181. NAME OF MATERIAL	182. LOCATION OF MATERIAL	183. NAME OF MATERIAL	184. LOCATION OF MATERIAL	185. TEST DATA	186. TEST DATA
187. NAME OF MATERIAL	188. LOCATION OF MATERIAL	189. NAME OF MATERIAL	190. LOCATION OF MATERIAL	191. TEST DATA	192. TEST DATA
193. NAME OF MATERIAL	194. LOCATION OF MATERIAL	195. NAME OF MATERIAL	196. LOCATION OF MATERIAL	197. TEST DATA	198. TEST DATA
199. NAME OF MATERIAL	200. LOCATION OF MATERIAL	201. NAME OF MATERIAL	202. LOCATION OF MATERIAL	203. TEST DATA	204. TEST DATA
205. NAME OF MATERIAL	206. LOCATION OF MATERIAL	207. NAME OF MATERIAL	208. LOCATION OF MATERIAL	209. TEST DATA	210. TEST DATA
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217. NAME OF MATERIAL	218. LOCATION OF MATERIAL	219. NAME OF MATERIAL	220. LOCATION OF MATERIAL	221. TEST DATA	222. TEST DATA
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229. NAME OF MATERIAL	230. LOCATION OF MATERIAL	231. NAME OF MATERIAL	232. LOCATION OF MATERIAL	233. TEST DATA	234. TEST DATA
235. NAME OF MATERIAL	236. LOCATION OF MATERIAL	237. NAME OF MATERIAL	238. LOCATION OF MATERIAL	239. TEST DATA	240. TEST DATA
241. NAME OF MATERIAL	242. LOCATION OF MATERIAL	243. NAME OF MATERIAL	244. LOCATION OF MATERIAL	245. TEST DATA	246. TEST DATA
247. NAME OF MATERIAL	248. LOCATION OF MATERIAL	249. NAME OF MATERIAL	250. LOCATION OF MATERIAL	251. TEST DATA	252. TEST DATA
253. NAME OF MATERIAL	254. LOCATION OF MATERIAL	255. NAME OF MATERIAL	256. LOCATION OF MATERIAL	257. TEST DATA	258. TEST DATA
259. NAME OF MATERIAL	260. LOCATION OF MATERIAL	261. NAME OF MATERIAL	262. LOCATION OF MATERIAL	263. TEST DATA	264. TEST DATA
265. NAME OF MATERIAL	266. LOCATION OF MATERIAL	267. NAME OF MATERIAL	268. LOCATION OF MATERIAL	269. TEST DATA	270. TEST DATA
271. NAME OF MATERIAL	272. LOCATION OF MATERIAL	273. NAME OF MATERIAL	274. LOCATION OF MATERIAL	275. TEST DATA	276. TEST DATA
277. NAME OF MATERIAL	278. LOCATION OF MATERIAL	279. NAME OF MATERIAL	280. LOCATION OF MATERIAL	281. TEST DATA	282. TEST DATA
283. NAME OF MATERIAL	284. LOCATION OF MATERIAL	285. NAME OF MATERIAL	286. LOCATION OF MATERIAL	287. TEST DATA	288. TEST DATA
289. NAME OF MATERIAL	290. LOCATION OF MATERIAL	291. NAME OF MATERIAL	292. LOCATION OF MATERIAL	293. TEST DATA	294. TEST DATA
295. NAME OF MATERIAL	296. LOCATION OF MATERIAL	297. NAME OF MATERIAL	298. LOCATION OF MATERIAL	299. TEST DATA	300. TEST DATA
301. NAME OF MATERIAL	302. LOCATION OF MATERIAL	303. NAME OF MATERIAL	304. LOCATION OF MATERIAL	305. TEST DATA	306. TEST DATA
307. NAME OF MATERIAL	308. LOCATION OF MATERIAL	309. NAME OF MATERIAL	310. LOCATION OF MATERIAL	311. TEST DATA	312. TEST DATA
313. NAME OF MATERIAL	314. LOCATION OF MATERIAL	315. NAME OF MATERIAL	316. LOCATION OF MATERIAL	317. TEST DATA	318. TEST DATA
319. NAME OF MATERIAL	320. LOCATION OF MATERIAL	321. NAME OF MATERIAL	322. LOCATION OF MATERIAL	323. TEST DATA	



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TIME:	10 00 AM
LOCATION:	100 000 00 000 000
REMARKS:	

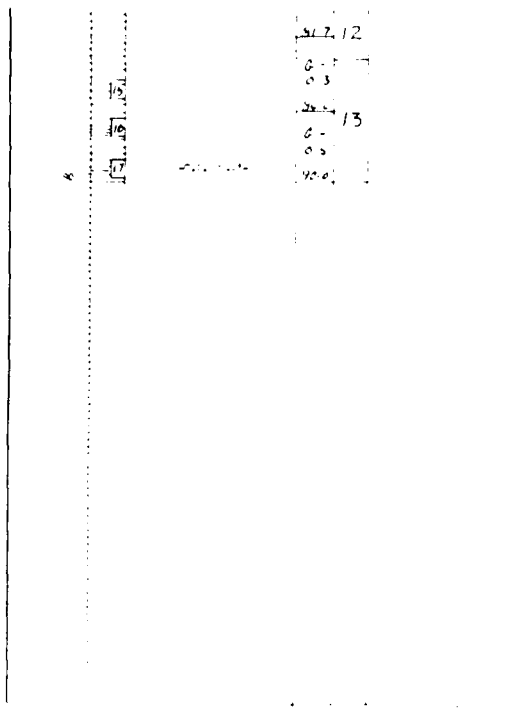
Borehole Log		Date		Sheet	
Project		Location		Scale	
1. Project Name		2. Date		3. Sheet	
4. Project Number		5. Date		6. Sheet	
7. Project Name		8. Date		9. Sheet	
10. Project Number		11. Date		12. Sheet	
13. Project Name		14. Date		15. Sheet	
16. Project Number		17. Date		18. Sheet	
19. Project Name		20. Date		21. Sheet	
22. Project Number		23. Date		24. Sheet	
25. Project Name		26. Date		27. Sheet	
28. Project Number		29. Date		30. Sheet	
31. Project Name		32. Date		33. Sheet	
34. Project Number		35. Date		36. Sheet	
37. Project Name		38. Date		39. Sheet	
40. Project Number		41. Date		42. Sheet	
43. Project Name		44. Date		45. Sheet	
46. Project Number		47. Date		48. Sheet	
49. Project Name		50. Date		51. Sheet	
52. Project Number		53. Date		54. Sheet	
55. Project Name		56. Date		57. Sheet	
58. Project Number		59. Date		60. Sheet	
61. Project Name		62. Date		63. Sheet	
64. Project Number		65. Date		66. Sheet	
67. Project Name		68. Date		69. Sheet	
70. Project Number		71. Date		72. Sheet	
73. Project Name		74. Date		75. Sheet	
76. Project Number		77. Date		78. Sheet	
79. Project Name		80. Date		81. Sheet	
82. Project Number		83. Date		84. Sheet	
85. Project Name		86. Date		87. Sheet	
88. Project Number		89. Date		90. Sheet	
91. Project Name		92. Date		93. Sheet	
94. Project Number		95. Date		96. Sheet	
97. Project Name		98. Date		99. Sheet	
100. Project Number		101. Date		102. Sheet	

Borehole Log		Date		Sheet	
Project		Location		Scale	
1. Project Name		2. Date		3. Sheet	
4. Project Number		5. Date		6. Sheet	
7. Project Name		8. Date		9. Sheet	
10. Project Number		11. Date		12. Sheet	
13. Project Name		14. Date		15. Sheet	
16. Project Number		17. Date		18. Sheet	
19. Project Name		20. Date		21. Sheet	
22. Project Number		23. Date		24. Sheet	
25. Project Name		26. Date		27. Sheet	
28. Project Number		29. Date		30. Sheet	
31. Project Name		32. Date		33. Sheet	
34. Project Number		35. Date		36. Sheet	
37. Project Name		38. Date		39. Sheet	
40. Project Number		41. Date		42. Sheet	
43. Project Name		44. Date		45. Sheet	
46. Project Number		47. Date		48. Sheet	
49. Project Name		50. Date		51. Sheet	
52. Project Number		53. Date		54. Sheet	
55. Project Name		56. Date		57. Sheet	
58. Project Number		59. Date		60. Sheet	
61. Project Name		62. Date		63. Sheet	
64. Project Number		65. Date		66. Sheet	
67. Project Name		68. Date		69. Sheet	
70. Project Number		71. Date		72. Sheet	
73. Project Name		74. Date		75. Sheet	
76. Project Number		77. Date		78. Sheet	
79. Project Name		80. Date		81. Sheet	
82. Project Number		83. Date		84. Sheet	
85. Project Name		86. Date		87. Sheet	
88. Project Number		89. Date		90. Sheet	
91. Project Name		92. Date		93. Sheet	
94. Project Number		95. Date		96. Sheet	
97. Project Name		98. Date		99. Sheet	
100. Project Number		101. Date		102. Sheet	

[illegible]

O. C. NAME <u>W. L. RAY</u>		TITLE <u>ENGINEER</u>	
U. S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS			
DESIGNED BY 		JOE POOL LAKE MOUNTAIN CREEK, TEXAS	
OUTLET WORKS AND INITIAL EMBANKMENTS			
LOGS OF BORINGS 8ABC-553 AND 6DC-554			
DRAWN BY 	IN CHARGE DATED 	SHEET NO. OF	REVISION NO.
ENGINEER	DRAWING NUMBER	SHEET NO. OF	REVISION NO.

NO.	DATE	TIME	WIND	TEMP	WAVE	SEA	SKY	MOON	STAR	PLANET	COMET	OTHER
1	10/1/58	10:00	10	10	10	10	10	10	10	10	10	10
2	10/2/58	10:00	10	10	10	10	10	10	10	10	10	10
3	10/3/58	10:00	10	10	10	10	10	10	10	10	10	10
4	10/4/58	10:00	10	10	10	10	10	10	10	10	10	10
5	10/5/58	10:00	10	10	10	10	10	10	10	10	10	10
6	10/6/58	10:00	10	10	10	10	10	10	10	10	10	10
7	10/7/58	10:00	10	10	10	10	10	10	10	10	10	10
8	10/8/58	10:00	10	10	10	10	10	10	10	10	10	10
9	10/9/58	10:00	10	10	10	10	10	10	10	10	10	10
10	10/10/58	10:00	10	10	10	10	10	10	10	10	10	10
11	10/11/58	10:00	10	10	10	10	10	10	10	10	10	10



Boring Log		Boring Log	
Station	Depth	Station	Depth
866-558	0.0	866-559	0.0
866-558	0.3	866-559	0.3
866-558	1.0	866-559	1.0
866-558	1.3	866-559	1.3
866-558	1.5	866-559	1.5
866-558	1.8	866-559	1.8
866-558	2.0	866-559	2.0
866-558	2.3	866-559	2.3
866-558	2.5	866-559	2.5
866-558	2.8	866-559	2.8
866-558	3.0	866-559	3.0
866-558	3.3	866-559	3.3
866-558	3.5	866-559	3.5
866-558	3.8	866-559	3.8
866-558	4.0	866-559	4.0
866-558	4.3	866-559	4.3
866-558	4.5	866-559	4.5
866-558	4.8	866-559	4.8
866-558	5.0	866-559	5.0
866-558	5.3	866-559	5.3
866-558	5.5	866-559	5.5
866-558	5.8	866-559	5.8
866-558	6.0	866-559	6.0
866-558	6.3	866-559	6.3
866-558	6.5	866-559	6.5
866-558	6.8	866-559	6.8
866-558	7.0	866-559	7.0
866-558	7.3	866-559	7.3
866-558	7.5	866-559	7.5
866-558	7.8	866-559	7.8
866-558	8.0	866-559	8.0
866-558	8.3	866-559	8.3
866-558	8.5	866-559	8.5
866-558	8.8	866-559	8.8
866-558	9.0	866-559	9.0
866-558	9.3	866-559	9.3
866-558	9.5	866-559	9.5
866-558	9.8	866-559	9.8
866-558	10.0	866-559	10.0

U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS			
DESIGNED BY	JOE POOL LAKE MOUNTAIN CREEK, TEXAS		
DRAWN BY			
CHECKED BY			
SUBMITTED BY			
ENGINEER			
LOGS OF BORINGS 866-558, 559 AND 560		DATE	
DRAWING NUMBER		SHEET NO.	
		OF	

TO ACCOMPANY OUTLET WORKS FINAL FOUNDATION REPORT PLATE 22

[illegible]

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

BELLING LOG		LOG NO. 565	
1. 10' to 1.0'		2. 10' to 1.0'	
3. 10' to 1.0'		4. 10' to 1.0'	
5. 10' to 1.0'		6. 10' to 1.0'	
7. 10' to 1.0'		8. 10' to 1.0'	
9. 10' to 1.0'		10. 10' to 1.0'	
11. 10' to 1.0'		12. 10' to 1.0'	
13. 10' to 1.0'		14. 10' to 1.0'	
15. 10' to 1.0'		16. 10' to 1.0'	
17. 10' to 1.0'		18. 10' to 1.0'	
19. 10' to 1.0'		20. 10' to 1.0'	
21. 10' to 1.0'		22. 10' to 1.0'	
23. 10' to 1.0'		24. 10' to 1.0'	
25. 10' to 1.0'		26. 10' to 1.0'	
27. 10' to 1.0'		28. 10' to 1.0'	
29. 10' to 1.0'		30. 10' to 1.0'	
31. 10' to 1.0'		32. 10' to 1.0'	
33. 10' to 1.0'		34. 10' to 1.0'	
35. 10' to 1.0'		36. 10' to 1.0'	
37. 10' to 1.0'		38. 10' to 1.0'	
39. 10' to 1.0'		40. 10' to 1.0'	
41. 10' to 1.0'		42. 10' to 1.0'	
43. 10' to 1.0'		44. 10' to 1.0'	
45. 10' to 1.0'		46. 10' to 1.0'	
47. 10' to 1.0'		48. 10' to 1.0'	
49. 10' to 1.0'		50. 10' to 1.0'	
51. 10' to 1.0'		52. 10' to 1.0'	
53. 10' to 1.0'		54. 10' to 1.0'	
55. 10' to 1.0'		56. 10' to 1.0'	
57. 10' to 1.0'		58. 10' to 1.0'	
59. 10' to 1.0'		60. 10' to 1.0'	
61. 10' to 1.0'		62. 10' to 1.0'	
63. 10' to 1.0'		64. 10' to 1.0'	
65. 10' to 1.0'		66. 10' to 1.0'	
67. 10' to 1.0'		68. 10' to 1.0'	
69. 10' to 1.0'		70. 10' to 1.0'	
71. 10' to 1.0'		72. 10' to 1.0'	
73. 10' to 1.0'		74. 10' to 1.0'	
75. 10' to 1.0'		76. 10' to 1.0'	
77. 10' to 1.0'		78. 10' to 1.0'	
79. 10' to 1.0'		80. 10' to 1.0'	
81. 10' to 1.0'		82. 10' to 1.0'	
83. 10' to 1.0'		84. 10' to 1.0'	
85. 10' to 1.0'		86. 10' to 1.0'	
87. 10' to 1.0'		88. 10' to 1.0'	
89. 10' to 1.0'		90. 10' to 1.0'	
91. 10' to 1.0'		92. 10' to 1.0'	
93. 10' to 1.0'		94. 10' to 1.0'	
95. 10' to 1.0'		96. 10' to 1.0'	
97. 10' to 1.0'		98. 10' to 1.0'	
99. 10' to 1.0'		100. 10' to 1.0'	

BELLING LOG		LOG NO. 566	
1. 10' to 1.0'		2. 10' to 1.0'	
3. 10' to 1.0'		4. 10' to 1.0'	
5. 10' to 1.0'		6. 10' to 1.0'	
7. 10' to 1.0'		8. 10' to 1.0'	
9. 10' to 1.0'		10. 10' to 1.0'	
11. 10' to 1.0'		12. 10' to 1.0'	
13. 10' to 1.0'		14. 10' to 1.0'	
15. 10' to 1.0'		16. 10' to 1.0'	
17. 10' to 1.0'		18. 10' to 1.0'	
19. 10' to 1.0'		20. 10' to 1.0'	
21. 10' to 1.0'		22. 10' to 1.0'	
23. 10' to 1.0'		24. 10' to 1.0'	
25. 10' to 1.0'		26. 10' to 1.0'	
27. 10' to 1.0'		28. 10' to 1.0'	
29. 10' to 1.0'		30. 10' to 1.0'	
31. 10' to 1.0'		32. 10' to 1.0'	
33. 10' to 1.0'		34. 10' to 1.0'	
35. 10' to 1.0'		36. 10' to 1.0'	
37. 10' to 1.0'		38. 10' to 1.0'	
39. 10' to 1.0'		40. 10' to 1.0'	
41. 10' to 1.0'		42. 10' to 1.0'	
43. 10' to 1.0'		44. 10' to 1.0'	
45. 10' to 1.0'		46. 10' to 1.0'	
47. 10' to 1.0'		48. 10' to 1.0'	
49. 10' to 1.0'		50. 10' to 1.0'	
51. 10' to 1.0'		52. 10' to 1.0'	
53. 10' to 1.0'		54. 10' to 1.0'	
55. 10' to 1.0'		56. 10' to 1.0'	
57. 10' to 1.0'		58. 10' to 1.0'	
59. 10' to 1.0'		60. 10' to 1.0'	
61. 10' to 1.0'		62. 10' to 1.0'	
63. 10' to 1.0'		64. 10' to 1.0'	
65. 10' to 1.0'		66. 10' to 1.0'	
67. 10' to 1.0'		68. 10' to 1.0'	
69. 10' to 1.0'		70. 10' to 1.0'	
71. 10' to 1.0'		72. 10' to 1.0'	
73. 10' to 1.0'		74. 10' to 1.0'	
75. 10' to 1.0'		76. 10' to 1.0'	
77. 10' to 1.0'		78. 10' to 1.0'	
79. 10' to 1.0'		80. 10' to 1.0'	
81. 10' to 1.0'		82. 10' to 1.0'	
83. 10' to 1.0'		84. 10' to 1.0'	
85. 10' to 1.0'		86. 10' to 1.0'	
87. 10' to 1.0'		88. 10' to 1.0'	
89. 10' to 1.0'		90. 10' to 1.0'	
91. 10' to 1.0'		92. 10' to 1.0'	
93. 10' to 1.0'		94. 10' to 1.0'	
95. 10' to 1.0'		96. 10' to 1.0'	
97. 10' to 1.0'		98. 10' to 1.0'	
99. 10' to 1.0'		100. 10' to 1.0'	

U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS	
DESIGNED BY	JOE POOL LAKE MOUNTAIN CREEK, TEXAS
DRAWN BY	
CHECKED BY	
OUTLET WORKS AND INITIAL EMBANKMENTS	
LOGS OF BORINGS 8A8C-563, 8A8C-564, 8A8C-565 AND 8A8C-566	
INVESTIGATED BY	INV NO.
ENGINEER	DATED
DRAWING NUMBER	SHEET NO.
TO ACCOMPANY OUTLET WORKS FINAL FOUNDATION REPORT PLATE 23	

1. NAME OF VESSEL
2. DATE OF DEPARTURE
3. NAME OF CAPTAIN
4. NAME OF COMMANDER
5. NAME OF SURVEYOR
6. NAME OF ASSISTANT SURVEYOR
7. NAME OF BOATSWAIN
8. NAME OF ENGINEER
9. NAME OF DECK HAND
10. NAME OF COOK
11. NAME OF STOWAGE
12. NAME OF SAILOR
13. NAME OF SAILOR
14. NAME OF SAILOR
15. NAME OF SAILOR
16. NAME OF SAILOR
17. NAME OF SAILOR
18. NAME OF SAILOR
19. NAME OF SAILOR
20. NAME OF SAILOR
21. NAME OF SAILOR
22. NAME OF SAILOR
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SUBMITTED BY			
ENGINEER			
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TO ACCOMPANY OUTLET WORKS FINAL FOUNDATION REPORT PLATE 20



Fig 13 Intake tower foundation. Station 18+70. 14 Feb 81



Fig 14 Intake tower foundation. Station 18+85. 14 Feb 81

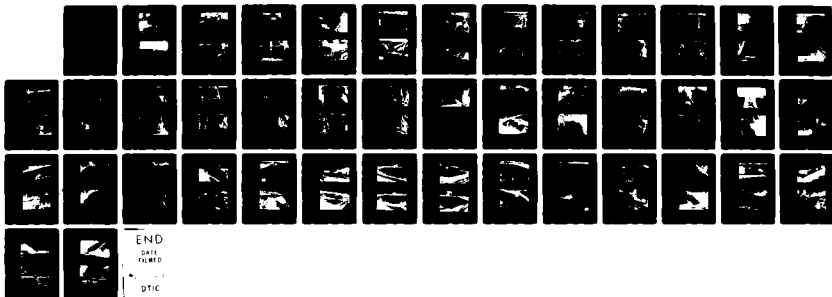
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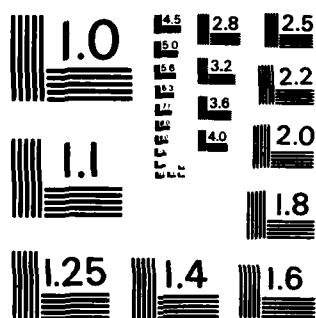
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Fig 15 Intake tower foundation. Station 19+10. 7 Feb 81



Fig 16 Intake tower foundation. Station 19+75. 7 Feb 81



Fig 17 Intake tower foundation. Station 19+75. 6 Feb 81



Fig 18 Fault crossing intake tower foundation. Station 19+90
6 Feb 81



Fig 19 Intake tower foundation. Station 20+50. 4 Feb 81

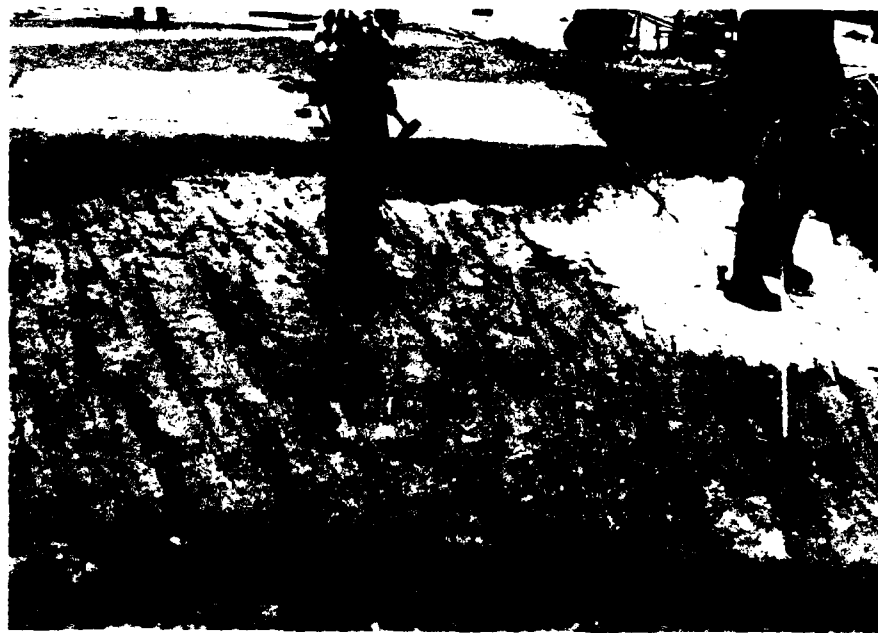


Fig 20 Intake tower foundation. Station 19+80. 6 Feb 81



Fig 21 Conduit foundation. Station 20+48 - 20+68 - 16 Feb 81



Fig 22 Conduit foundation. Station 20+48 - 20+68 - 16 Feb 81



Fig 23 Conduit foundation. Station 20+68 - 20+88 - 18 Feb 81



Fig 24 Conduit foundation. Station 20+88 - 21+08 - 19 Feb 81

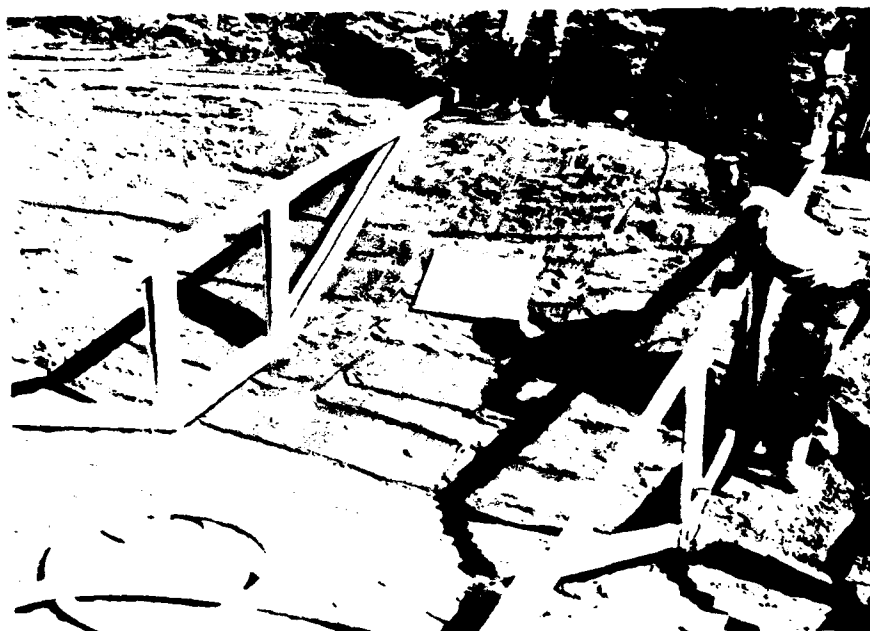


Fig 25 Conduit foundation. Station 21+08 - 21+28 - 19 Feb 81

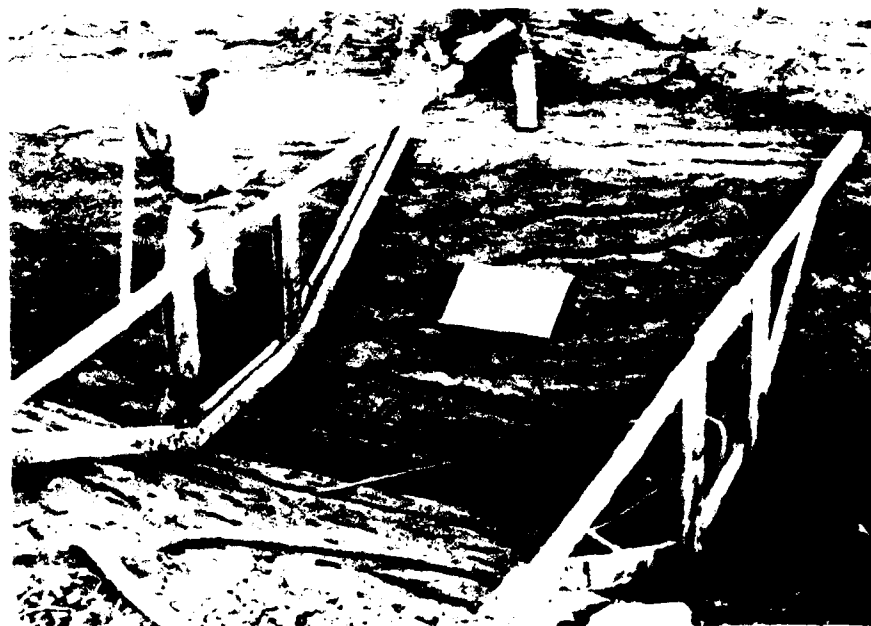


Fig 26 Conduit foundation. Station 21+28 - 21+48 - 19 Feb 81



Fig 27 Conduit foundation. Station 21+48 - 21+68 - 20 Feb 81



Fig 28 Conduit foundation. Station 21+68 - 21+88 - 20 Feb 81

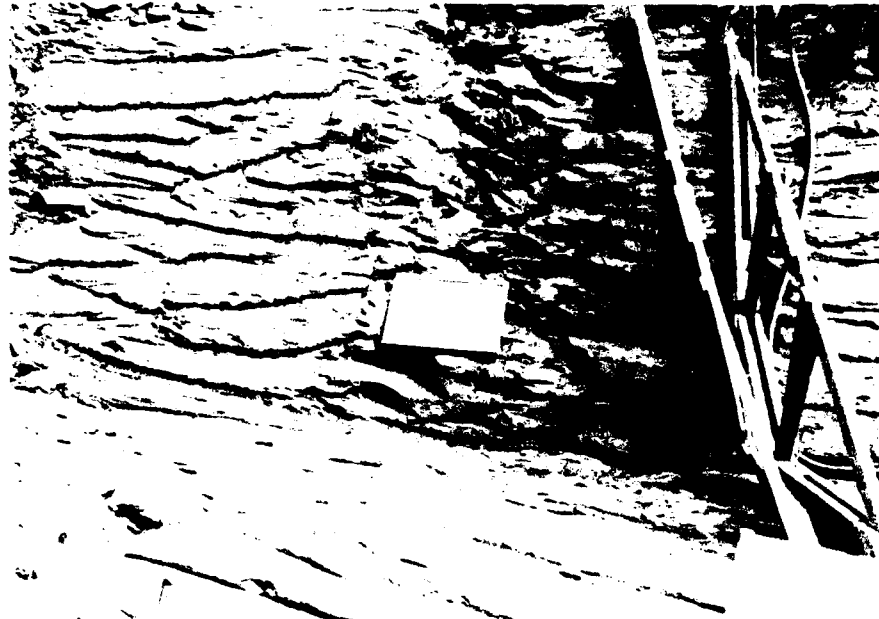


Fig 29 Conduit foundation. Station 22+08 - 22+28 11 Mar 81



Fig 30 Conduit foundation. Station 22+28 - 22+48 11 Mar 81

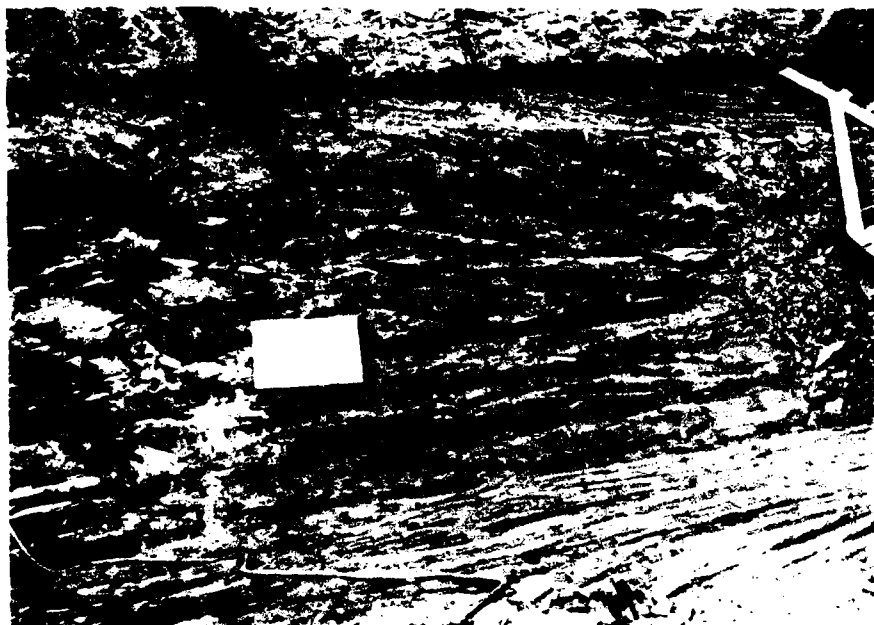


Fig 31 Conduit foundation. Station 22+48 - 22+68 13 Mar 81



Fig 32 Conduit foundation. Station 22+68 - 22+88 13 Mar 81



Fig 33 Conduit foundation. Station 22+88 - 23+08 16 Mar 81

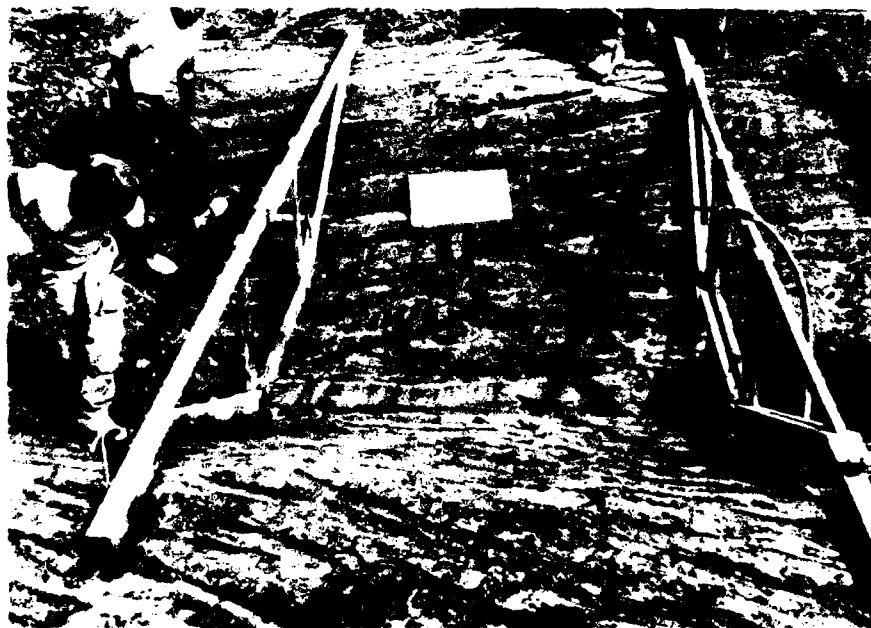


Fig 34 Conduit foundation. Station 23+08 - 23+28 16 Mar 81

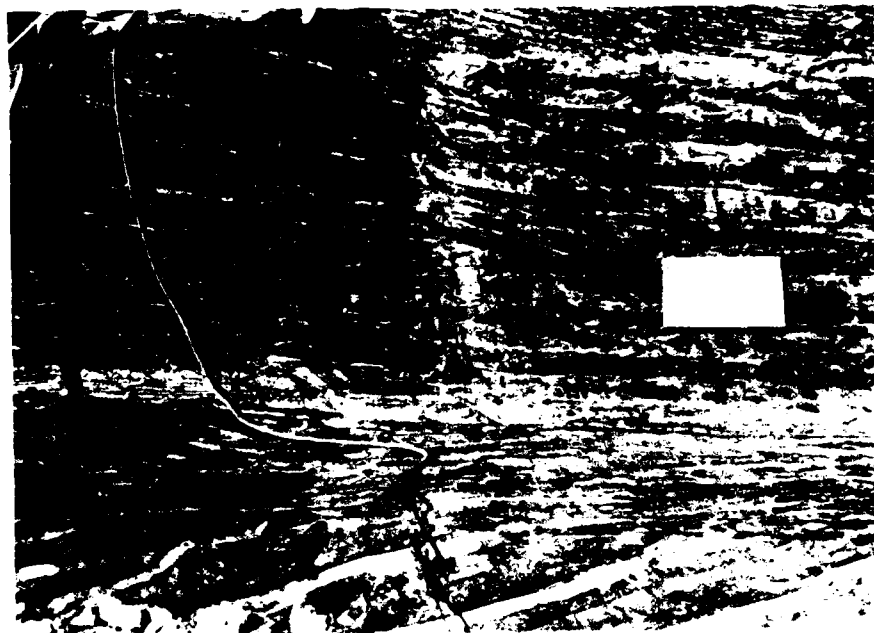


Fig 35 Conduit foundation. Station 23+28 - 23+48 19 Mar 81



Fig 36 Conduit foundation. Station 23+48 - 23+68 23 Mar 81

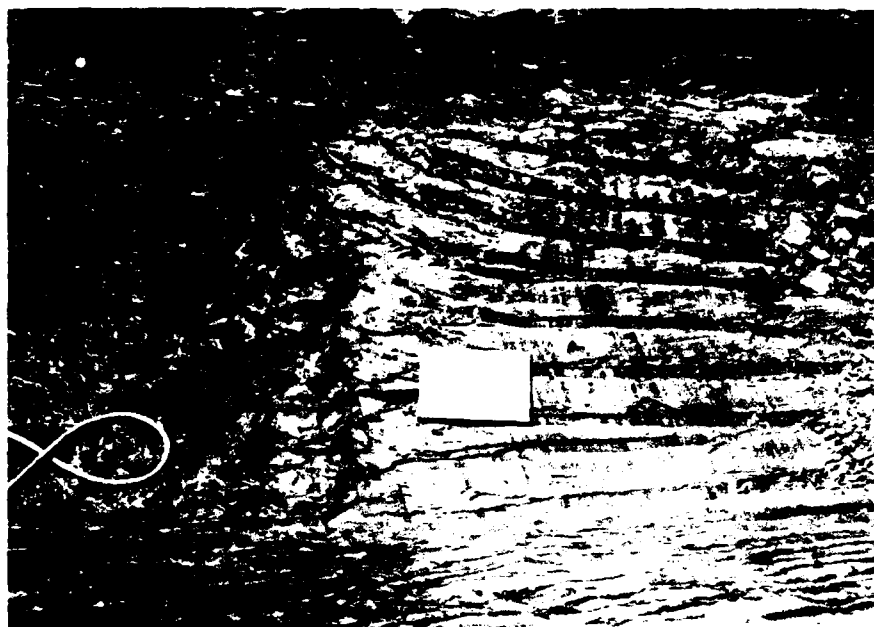


Fig 37 Conduit foundation. Station 23+68 - 23+88 24 Mar 81



Fig 38 Conduit foundation. Station 23+88 - 24+08 24 Mar 81



Fig 39 Conduit foundation. Station 24+08 - 24+28 1 Apr 81

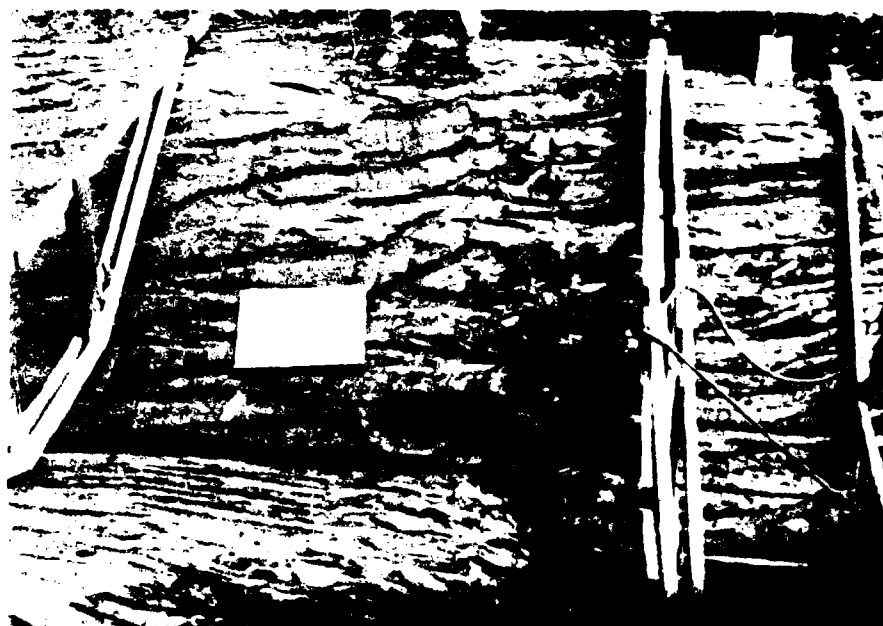


Fig 40 Conduit foundation. Station 24+28 - 24+48 2 Apr 81



Fig 41 Conduit foundation. Station 24+48 - 24+68 3 Apr 81



Fig 42 Conduit foundation. Station 24+68 - 24+88 6 Apr 81



Fig 43 Conduit foundation. Station 24+88 - 25+08 6 Apr 81



Fig 44 Conduit foundation. Station 25+08 - 25+28 7 Apr 81

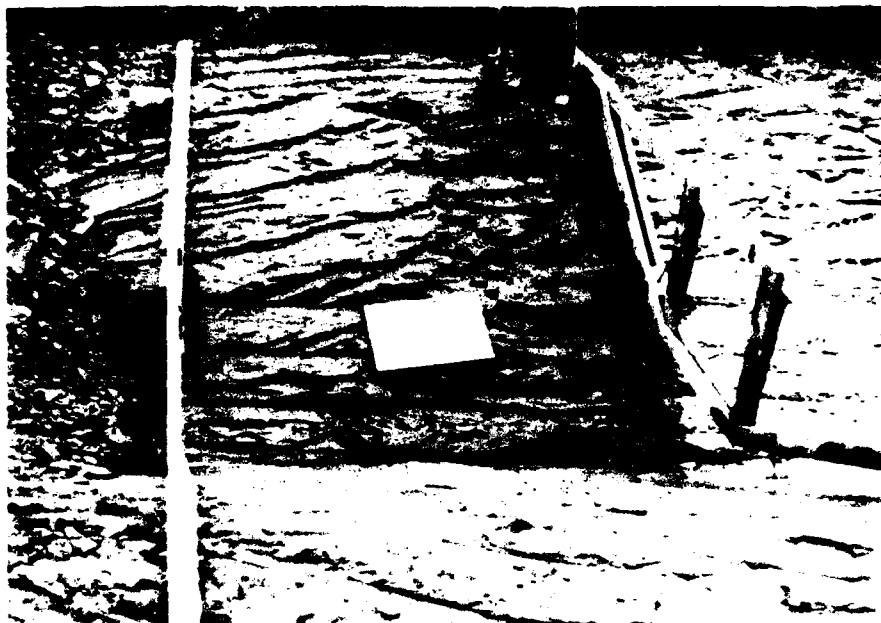


Fig 45 Conduit foundation. Station 25+28 - 25+48 8 Apr 81

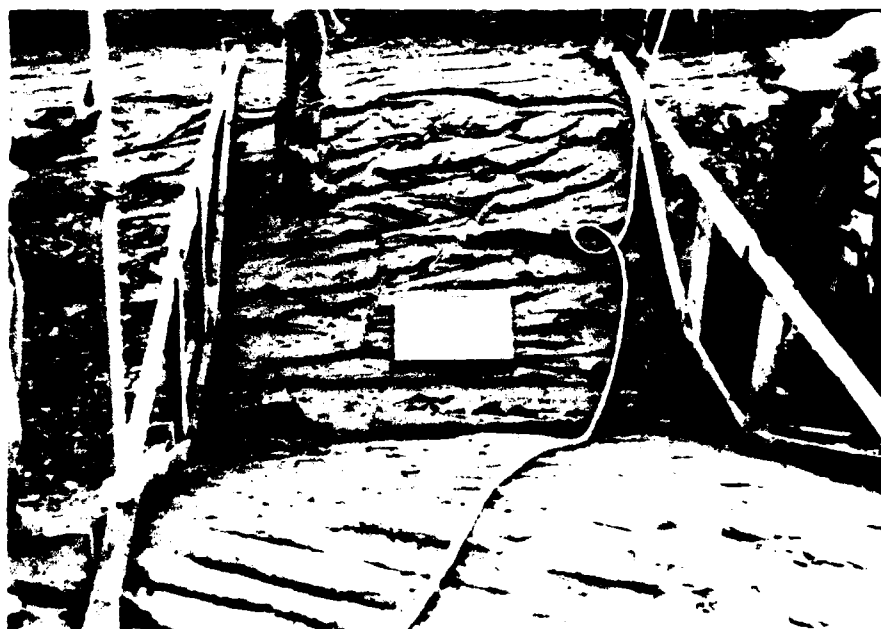


Fig 46 Conduit foundation. Station 25+48 - 25+68 8 Apr 81

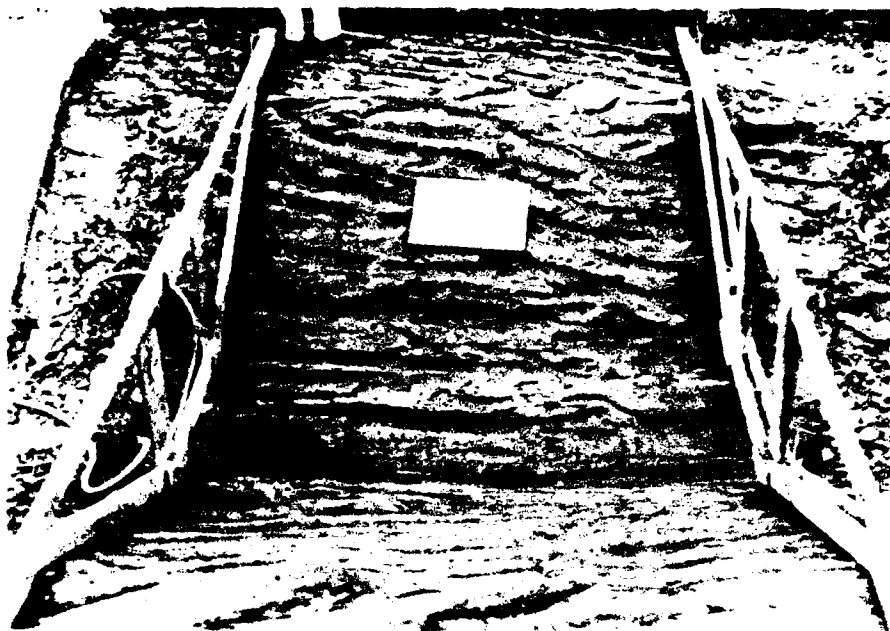


Fig 47 Conduit foundation. Station 25+68 - 25+88 10 Apr 81



Fig 48 Conduit foundation. Station 25+88 - 26+08 10 Apr 81

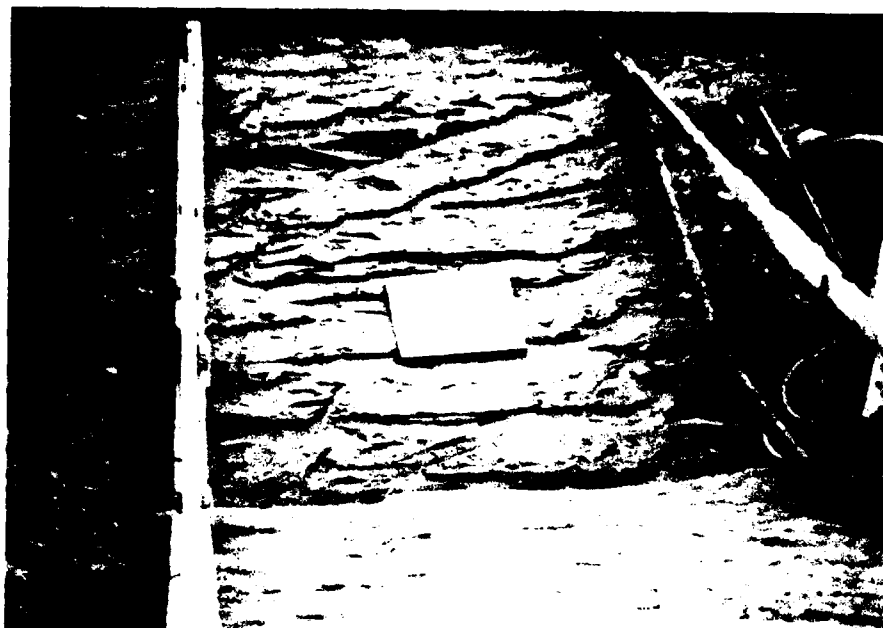


Fig 49 Conduit foundation. Station 26+08 - 26+28 10 Apr 81

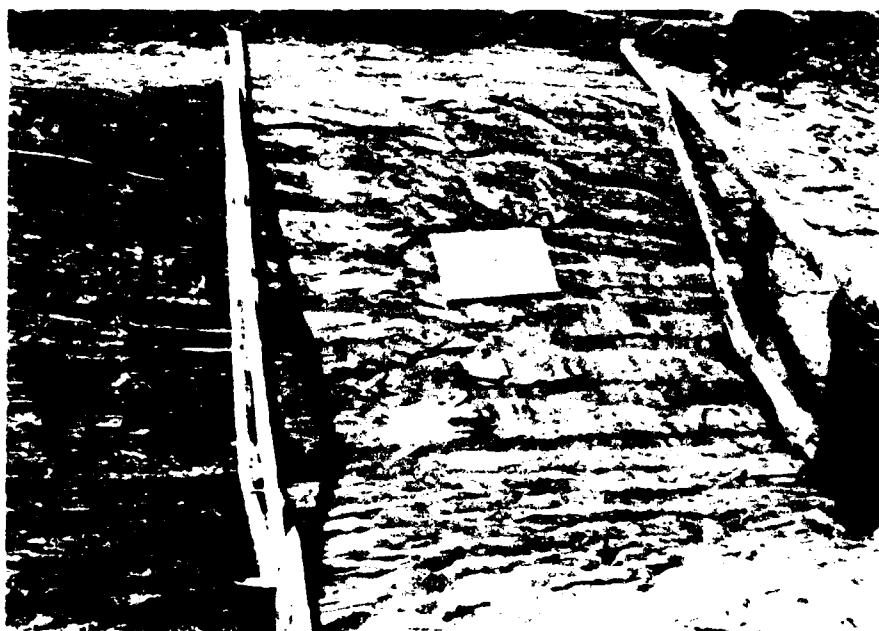


Fig 50 Conduit foundation. Station 26+28 - 26+48 13 Apr 81

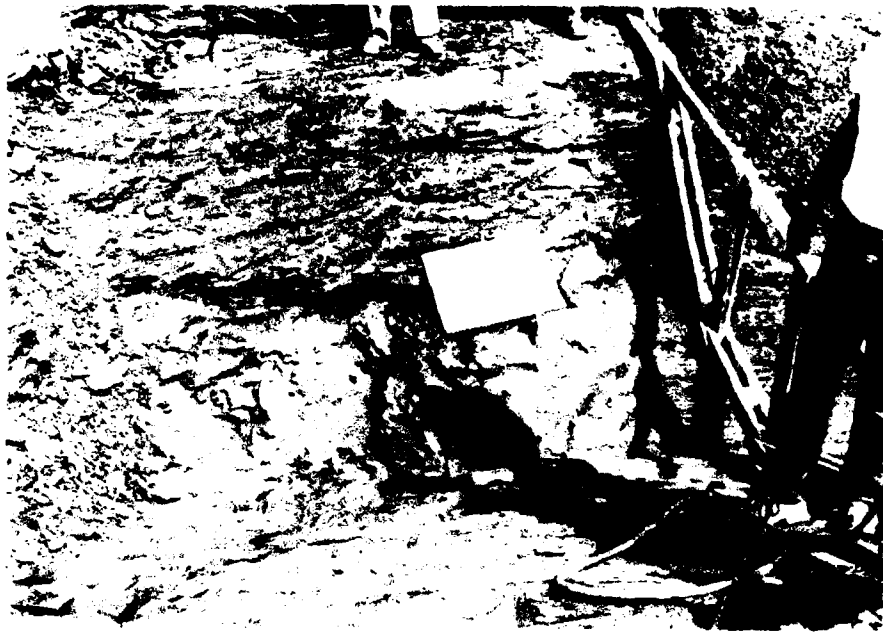


Fig 51 Conduit foundation. Station 26+48 - 26+68 13 Apr 81



Fig 52 Conduit foundation. Station 26+68 - 26+88 16 Apr 81

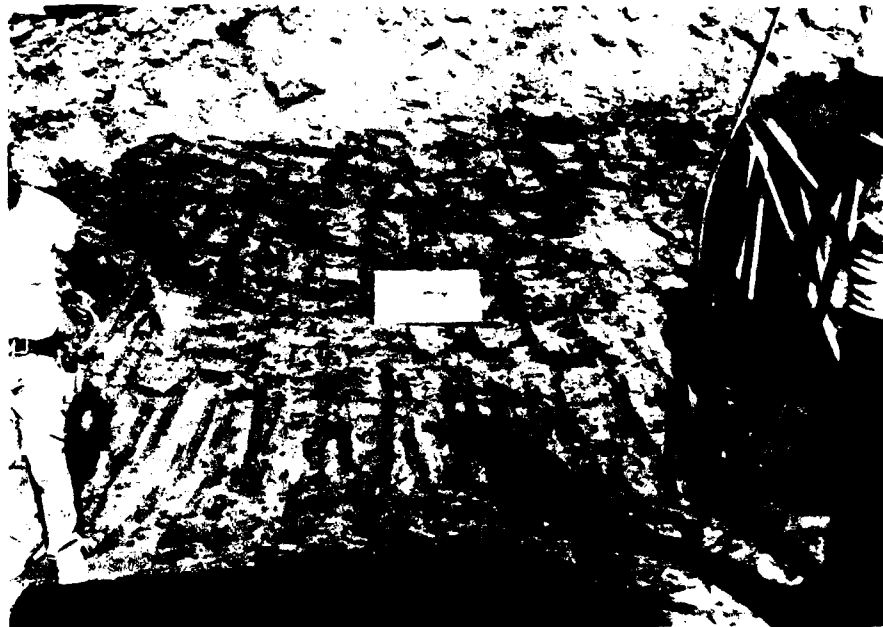


Fig 53 Conduit foundation. Station 26+88 - 27+08 16 Apr 81



Fig 54 Stilling basin chute foundation. Contact between Upper Britton and Lower Britton members in center of photo at station 27+58 25 Feb 81



Fig 55 Stilling basin chute foundation. Station 27+65 25 Feb 81



Fig 56 Stilling basin foundation. Station 27+65 29 Jan 81



Fig 57 Stilling basin foundation. Station 27+80 29 Jan 81



Fig 58 Stilling basin foundation. Station 28+78 31 Jan 81



Fig 59 Stilling basin foundation. Station 27+95 2 Feb 81



Fig 60 Stilling basin foundation. Station 27+90 30 Jan 81



Fig 61 Joint in stilling basin foundation. Station 28+60
30 Jan 81



Fig 62 Stilling basin end key foundation. Station 28+80
Right side 17 Mar 81



Fig 63 Stilling basin end key foundation. Station 28+80
Left side 18 Mar 81

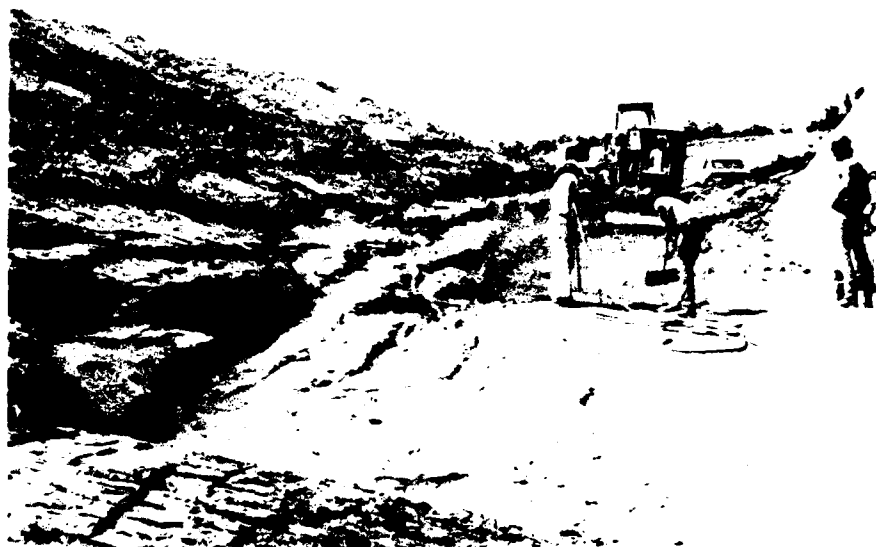


Fig 64 Foundation right of intake tower. Station 18+85 -
19+70 24 Jun 81



Fig 65 Foundation right of intake tower. Station 18+85 -
19+70 24 Jun 81



Fig 66 Foundation right of conduit. Station 20+75 - 21+75
29 Jun 81



Fig 67 Foundation right of conduit. Station 20+75 - 21+75
29 Jun 81



Fig 68 Foundation left of conduit. Station 20+50 - 21+50
13 Jul 81



Fig 69 Foundation left of conduit. Station 21+50 - 22+50
15 Jul 81



Fig 70 Foundation left of conduit. Station 22+50 - 23+50
17 Jul 81



Fig 71 Foundation right of conduit. Station 23+50 - 24+10
24 Jul 81



Fig 72 Foundation at base of slope - right of conduit.
Station 20+50 - 22+00 28 Jul 81



Fig 73 Foundation at base of slope - right of conduit.
Station 22+00 - 24+00 29 Jul 81



Fig 74 Excavation slope right of conduit. Station 20+50 -
21+70 5 Aug 81



Fig 75 Excavation slope left of intake tower. Station 18+90 -
20+50 6 Aug 81



Fig 76 Excavation slope right of intake tower. Station 18+90 -
20+50 10 Aug 81



Fig 77 Excavation slope left of conduit. Station 20+50 -
21+50 20 Aug 81



Fig 78 Excavation slope left of conduit. Station 21+60 -
22+50 21 Aug 81



Fig 79 Excavation slope left of conduit. Station 22+50 -
24+00 22 Aug 81



Fig 80 Excavation slope right of conduit. Station 21+80 -
23+10 24 Aug 81



Fig 81 Excavation slope right of conduit. Station 23+10 -
24+00 25 Aug 81



Fig 82 Excavation slope right of conduit. Station 24+00 - 25+20 26 Aug 81

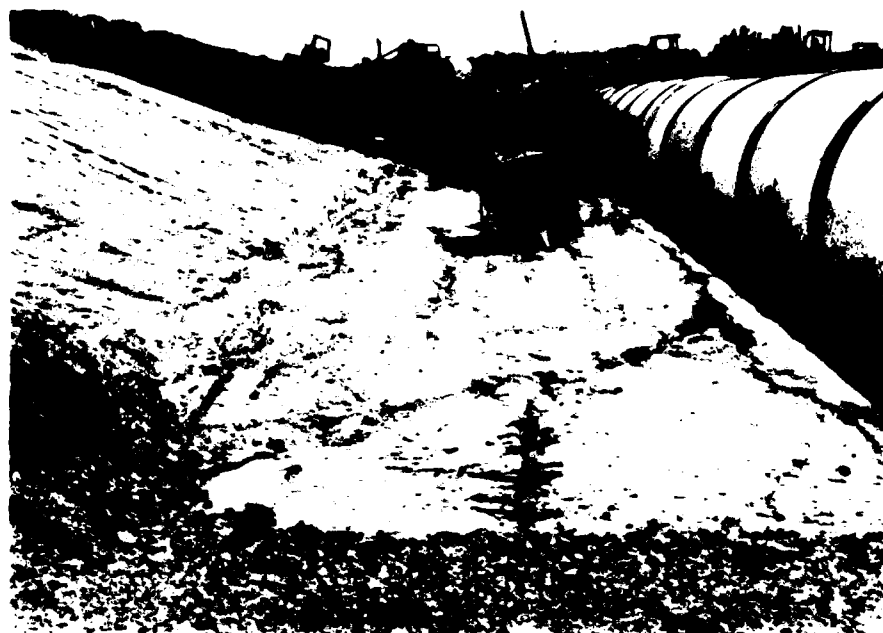


Fig 83 Foundation right of conduit. Station 24+00 - 25+20 26 Aug 81



Fig 84 Excavation slope right of conduit. Station 26+40 - 27+20 10 Sep 81



Fig 85 Foundation right of conduit. Station 26+40 - 27+20 10 Sep 81



Fig 86 Excavation slope right of stilling basin. Station 27+30 - 28+00 11 Sep 81



Fig 87 Foundation right of stilling basin. Station 27+30 - 28+00 11 Sep 81



Fig 88 Excavation slope right of stilling basin. Station 28+00 - 28+50 15 Sep 81



Fig 89 Excavation slope right of stilling basin. Station 28+50 - 29+00 16 Sep 81

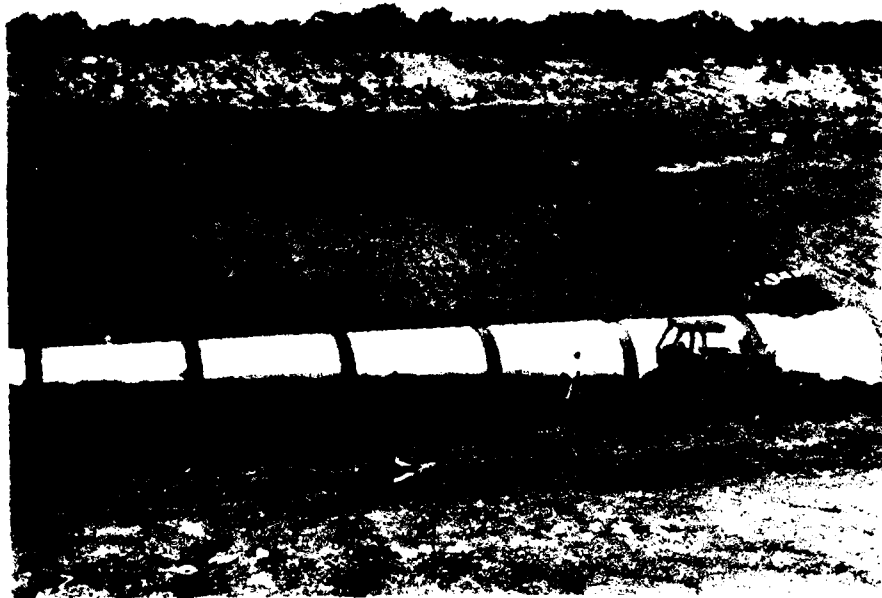


Fig 90 Excavation slope left of conduit. Station 26+30 - 27+20 17 Sep 81



Fig 91 Foundation left of conduit. Station 26+30 - 27+20 17 Sep 81



Fig 92 Excavation slope left of stilling basin. Station
27+20 - 27+80 18 Sep 81



Fig 93 Foundation left of stilling basin chute. Station
27+20 - 27+80 18 Sep 81

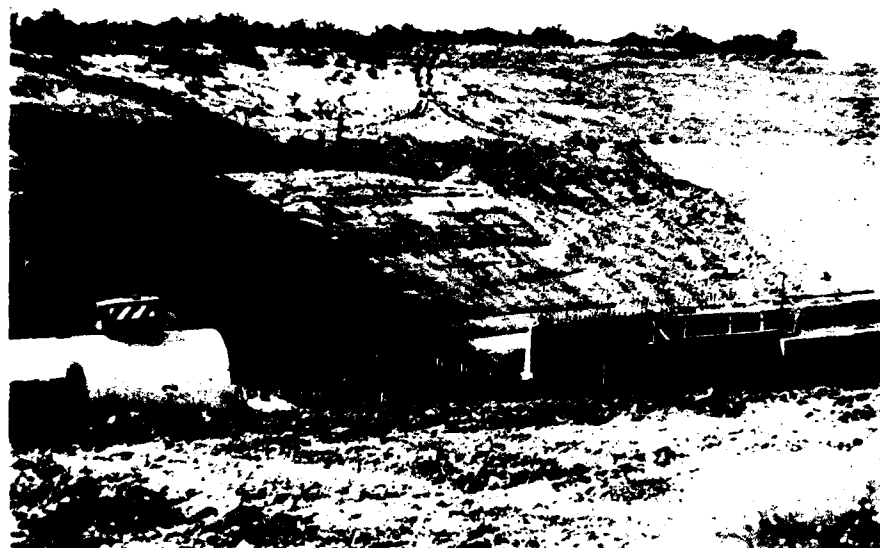


Fig 94 Excavation slope left of stilling basin. Station
27+80 - 28+30



Fig 95 Excavation slope left of stilling basin. Station
27+80 - 28+30 21 Sep 81



Fig 96 Excavation slope left of stilling basin. Station
28+50 - 28+90 22 Sep 81



Fig 97 Excavation slope left of stilling basin. Station
28+50 - 28+90 22 Sep 81