



**US Army Corps  
of Engineers**  
Tulsa District

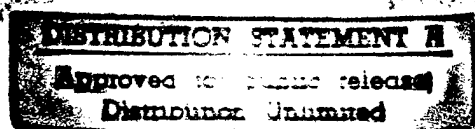
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# LAKE WICHITA

HOLLIDAY CREEK, TEXAS

**HOLLIDAY CREEK, WICHITA FALLS, TEXAS  
LOCAL FLOOD PROTECTION**

## **SPILLWAY FOUNDATION REPORT**



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DECEMBER 1997

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Holliday Creek, Wichita Falls, Texas  
Local Flood Protection Spillway Foundation Report

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LAKE WICHITA  
HOLLIDAY CREEK, WICHITA FALLS, TEXAS  
LOCAL FLOOD PROTECTION

SPILLWAY FOUNDATION REPORT

U.S. ARMY ENGINEER DISTRICT, TULSA  
CORPS OF ENGINEERS  
TULSA, OKLAHOMA

LAKE WICHITA  
HOLLIDAY CREEK, TEXAS

SPILLWAY FOUNDATION REPORT

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LAKE WICHITA  
HOLLIDAY CREEK, TEXAS

SPILLWAY FOUNDATION REPORT

I - INTRODUCTION

**1-01. Purpose and Scope.** This report presents pertinent information gathered and conditions encountered during the foundation excavation for the primary spillway at Lake Wichita dam. Included in the report is a description of the geology, excavation procedures, character of the foundation, foundation preparation, special treatments, logs, plates, and photographs.

**1-02. Project Authorization.** Public Law 99-662 authorized the Lake Wichita, Holliday Creek, local protection project in November, 1986. The city of Wichita Falls has signed a Local Cooperation Agreement, which contains specific costsharing guidelines conforming to PL 99-662. This project includes the rehabilitation of the Lake Wichita dam.

**1-03. Location and Description.** Lake Wichita is located on Holliday Creek about six miles southwest of the center of the business district of Wichita Falls, Texas. Holliday Creek, rises in Archer County and flows northeasterly to its confluence with the Big Wichita River in the city of Wichita Falls. At normal pool, Lake Wichita covers about 2 square miles, with a volume of about 5,570 acre-feet. The Holliday Creek watershed is about 32 miles long, has a maximum width of 9 miles, and a drainage area of about 154 square miles. About 128 square miles of this drainage is located above the Lake Wichita damsite. Prior to the reconstruction, Lake Wichita dam consisted of a low earthfill structure 6,250 feet long with a maximum height of approximately 28 feet. The embankment, with a top elevation varying between 983 and 990, had a 20-foot-wide crest, with a timber retaining wall, 1,950 feet long, which was used to protect part of the upstream slope from erosion. The initial embankment was built in 1901 and later modified in the 1970's. A 400-foot-wide uncontrolled concrete ogee weir spillway with crest elevation at 980.44 was located in the right abutment, 290 feet downstream of the box culvert bridge on Old Lake Road (FM 2380). The outlet works consisted of two 36-inch-diameter cast iron pipes through the embankment that connected into a concrete vault located on the downstream side of the dam in the Holliday Creek valley. The vault housed the control valves for the outlet works. West of the outlet works, an irrigation and surface drainage ditch ran along the downstream toe of the dam for approximately 1900 feet.

**1-04. Description of Work Done Under this Contract.** This contract modifies the existing dam to include a main embankment, a series of dikes, two spillways, and an outlet works. The main embankment and the series of dikes are rolled earthfills having crest widths of 16 feet at elevation 993.0 NGVD. The embankment incorporated the existing dam by plating the downstream or upstream face and raising the top of the dam. The outlet works is a concrete sluice structure located at station 71+82.05 of the main embankment. It consists of an intake structure with manually operated gates, and a stilling basin with outfall invert elevation at 966.0. The primary spillway consists of a 200-foot-wide concrete uncontrolled rectangular broadcrested weir with a crest elevation of 976.0 (see photos 1 and 2). The centerline of the primary spillway is at embankment station 64+52.25. A 200-foot-wide rectangular concrete chute on 1V to 3H slope connects the weir to a concrete stilling basin. The auxiliary spillway consists of a 400-foot-wide concrete uncontrolled trapezoidal broadcrested weir with a crest elevation of 982.0. The auxiliary spillway is located between the auxiliary dike and dike No. 2, and 270 feet upstream of the box culvert bridge on FM 2380.

**1-05. Contractor and Corps of Engineers Supervision.** The project was designed by Fort Worth District, constructed by Min-Kota of Brooklyn Park, Minnesota, and administered by the Tulsa District.

Contractor Supervision and Quality Control

Contractor:	Min-Kota
Address:	3401 85th Avenue North Brooklyn Park, MN 55443
Project Superintendent:	Dale Moser
Project Engineer:	Kym Burgstrom
Project Quality Control:	Mike Henly
Project Surveyor:	Subcontractor: Biggs & Mathews

Corps of Engineers Supervision

Resident Engineer:	Dennis Frazier
Office Engineer:	Gerald Grosz
Geologist:	David Struck
Chief, Laboratory:	Doug Booth

## II - GEOLOGY

2-01. **Physiography.** The project is in the Red River rolling plains of North Central Texas. The region is generally characterized as a rolling plain with some broken terrain and low hills. Local relief is measured in tens of feet. Soil cover is generally thin, and supports a growth of mesquite brush and native grasses. Local rock outcrops consist primarily of shales and sandstones, with some limestones.

2-02. **Regional Geology.** The Lake Wichita region is in the Osage Plains subsection of the Central Lowlands physiographic province. Stratigraphically, the region is underlain by geologic strata belonging to, in ascending order, the Putnam Formation, the Admiral Formation, and the Belle Plains Formation. These formations are generally considered part of the upper Wichita Group of mid-Permian (Leonard) age. In this part of north-central Texas, the upper Wichita Group consists of shales with interbedded sandstone. These beds transition laterally southward into the limestone and shale deposits of Central Texas. The limestones have a marine origin, but change northward to rock from shallow water continental deposits, typically represented by the 20-foot-thick sandstone encountered at Lake Wichita. This sandstone has not been named, but it occurs approximately 50 feet lower in the section than the Elm Creek Limestone member of the Admiral Formation. Structurally, major sedimentary basins to the southwest account for the lateral change to marine limestone in Central Texas. The Anadarko Basin in Oklahoma and the Llano Uplift to the southeast, with influence by local structures (such as the Red River Uplift and the Fort Worth Basin), control the attitude of Wichita strata in this region. The regional dip is less than one degree to the west-northwest and is reflected in the local strata.

2-03. **Geology of the Dam Site.** The project is located in the Wichita group, Wolfcamp Series, Permian System of the Paleozoic Era. In Design Memorandum No. 2, prior to 1987, the surface formation was called the Admiral Formation. However, there exists a facies change in the formation at this site and the rock encountered is not the same as what is represented in the geological description for the type locality assumed for this region. Therefore, in the revised Texas Geological Atlas, a decision was made to change the nomenclature, redividing some formations. North of the Brazos River (approximate boundary) the formation is called the Nocona Formation. The Nocona Formation is equivalent to the Admiral Formation and the upper Coleman Junction Formation. The Nocona Formation is composed of mudstone, sandstone, siltstone and conglomerate, reddish-brown mudstone predominates. The following two excerpts from the new Geologic Atlas describe the formations in the damsite area. The atlas indicates that the Petrolia Formation is the surface formation at the damsite (see exhibit 1, Geologic Atlas of Texas, Wichita Falls-Lawton Sheet (in part), revised 1987).

Petrolia Formation. The Petrolia corresponds with two formations, Jagger Bend and Valera Formation, undivided (Pjv) and Elm Creek (Pec). The Petrolia Formation (new), Pp, with sandstones, ss10, ss9, ss8, ss7, ss6, ss5, ss4, ss3, ss1, separately mapped. Stratigraphic cutoff of Pjv and Pec is at Brazos River. Mudstone, shale, sandstone, conglomerate, and limestone; mostly reddish-brown mudstone, unstratified and crudely stratified calcareous nodules common, laminated and cross bedded sandstones in lentils and small channel-fill bodies throughout containing plant fossils and rare vertebrate footprints, gray and variegated planar and Plano convex lenses of claystone and shale like those of the Waggoner Ranch Formation common in Baylor and Archer Counties; lenticular, calcareous-nodule conglomerates throughout, poorly indurated, locally contain abundant vertebrate fossils; limestone (northward extension of basal beds of Elm Creek Formation), light-gray, very argillaceous, locally desiccation-cracked, thin-bedded, discontinuous, locally very sandy, northern termination of basal Elm Creek Limestone bed near Lake Kickapoo. Sandstones, brown and reddish-brown, fine to medium-grained, thick-bedded to massive, crossbedded, commonly soft-sediment-deformed, locally conglomeratic with clasts of mudstone and calcareous nodules, sandstone bodies discontinuous, restricted to northern portions of outcrop belt, generally deeply weathered and poorly exposed across gently rolling terrain, locally folded northeast of Wichita Falls; thickness of sandstone members 3 to 25 feet. Thickness of Petrolia (new) 360 to 400 feet.

Nocona Formation. The Nocona corresponds with Admiral Formation (Pad) and the Coleman Junction Formation (Pcj). The Nocona Formation (new), PN, with sandstones, ss11, ss10, ss9, ss8, ss7, ss6, ss5, ss4, abd ss1, separately mapped. Stratigraphic cutoff of Pad is in southwestern Archer County. Mudstone, sandstone, siltstone, and conglomerate; reddish-brown mudstone predominates, locally gray and variegated in thin beds and planoconvex lenses in part containing vertebrate and abundant plant fossils, crudely stratified and unstratified calcareous nodules common, laminated and cross-laminated sandstones and siltstone in thin sheets and lentils 1 to 3 feet thick throughout, lenticular calcareous-nodule conglomerate common. Sandstones, ss11, ss10, ss9, ss8, ss7, ss6, ss5, ss4, abd ss1, tan to dark-brown, fine-grained to very coarse grained, locally conglomeratic (chert clasts) in easternmost part of outcrop belts, in part massive, thin- to thick-bedded, soft-sediment deformation typical in thicker beds, large-scale crossbeds common, sandstone beds generally thinner and increasingly less numerous southwestward; in Clay County, individual members locally exhibit multistory configuration of sandstone beds; thickness of sandstone members 5 to 40 feet. Thickness of Nocona Formation (new) 280 to 350 feet; Pn thickens northeastward.

a. Observations at the Site. In places, the sandstone appears to be crossbedded while in other locations the bedding is more horizontal and contains poorly preserved plant fossils. Joints within the crossbedded area are filled with a yellow leather-like substance. An extensive survey was not made of the base of the sandstone to determine

general dip, however some point measurements were taken. Nodules which appear to be iron concretions are scattered throughout the excavation site, with the largest concentration located about two-thirds the way up on the right bank. Some of the more weathered nodules display greens and blues indicating the presence of copper. The green is also disseminated in the clay shale on the left side of the spillway.

Slickensiding (not due to equipment) was observed in the shale. The clay shale also exhibited jointing with no discernible bed displacement, possibly being ancient desiccation cracks. There appears to be a displacement in the base of the sandstone on the right side of the spillway excavation at station 413+30 and also on the left side of the excavation at station 415+56. There were wet spots near each of these displacements. The upstream wet spot is located on the left side of the spillway (northwest), approximate station 415+46, 130 feet left of the spillway centerline. The spot is about 5 feet above the floor excavation and is moist around several cracks and appeared to flow where they coalesced (see photos 3 through 5). This was a minor problem during construction as the weather was dry. The upstream wet spot is about 200-250 feet from the lake and below the lake level. The downstream wet spot was located on the right side of the spillway, approximate station 413+30, 100 feet right of centerline, and had a pump in it most of the time. This wet spot seems to be where the sandstone butts up against a dark shale. The sandstone may be a stream channel deposit and the wet spot may be from a pond just uphill and off the property, (see photos 6 through 8).

b. Seismicity. Lake Wichita Dam is located within Zone 1 on the Uniform Building Code (UBC) Seismic Risk Map of the United States, indicating that minor damage to structures could occur in the event of earthquake activity. The following parameters were used for the design of an earthquake event:

Frequency of occurrence . . . . .	2,000 years
Magnitude (M) . . . . .	4.6
Horizontal Acceleration . . . . .	0.032 g
Horizontal Velocity . . . . .	1.0 cm/sec

### III - FOUNDATION EXPLORATION

3-01. Investigations Prior to Construction. Site investigations were conducted at Lake Wichita Dam by both Tulsa and Fort Worth Districts, U.S. Army Corps of Engineers. Results of site investigations conducted by Tulsa District were presented in General Design Memorandum No. 1, published in June 1985. Additional investigations were

conducted by Fort Worth District in 1988. Locations of borings are shown on plate 9. Geologic logs of borings are shown on plates 12 through 18.

a. Investigations by Tulsa District. Investigations by Tulsa District included a total of 20 borings, 4 of which had been drilled in 1959 for the Site Survey Report. Overburden was sampled with continuous 6-inch Denison barrels, and 4-inch core samples were taken of the underlying rock. Bail tests and/or pressure tests were used to establish field permeability values.

b. Investigations by Fort Worth District. Additional investigations were performed by the Fort Worth District in preparation of the Feature Design Memorandum which included 14 additional borings. Six borings were drilled to investigate conditions at the embankment and spillway sites, and eight borings were drilled along the proposed realignment of the Holiday Creek channel. Overburden was sampled with a 6-inch Denison sampler, 12-inch flight auger, and a 4-inch hand auger. Six-inch cores were taken in bedrock material. Field permeability was evaluated in selected borings using bail/recovery and pressure tests.

**3-02. Investigations During Construction.** Daily inspections by field personnel were performed to assure quality control. Every ten square feet or lesser area of the spillway foundation was mapped (see plate 5) and photographed (see example photos 10-13) at the time of foundation approval. The full inventory of photographs is currently retained at the field project office.

#### IV - EXCAVATION

**4-01. Spillway Overburden Excavation.** Overburden was excavated using dozers with rippers, and tracked backhoe or tractor-mounted backhoe loading into scrapers.

**4-02. Spillway Rock Excavation.** Rock was excavated using dozers with rippers and tracked backhoe or tractor-mounted backhoe loading into scrapers. Blasting was not required for removal of the materials. Due to the exposed shales being subject to possible slaking as a result of moisture loss, removal of the in-place material was halted a minimum of two feet above final grade. The final excavation was then made using a trackhoe to remove the bulk of the material, followed by hand cleanup and application of a sealer in designated areas to prevent moisture loss.

**4-03. Spillway Foundation Preparation.** Excavation to final grade proceeded in patchwork fashion, generally 10-foot by 10-foot areas. The area was cleaned, mapped, and photographed. Exposed rock under or within 5 feet of the planned concrete

portions of the spillway structure received a protective resin sealer within 60 minutes of being exposed. Within 24 hours, these areas were then covered with 3½ inches of protective concrete, 12 inches of filter sand covered with 3½ inches of protective concrete, or compacted fill, depending on which of the three coverings the plans indicated. Areas outside the sealed footprint received compacted fill.

## V - CHARACTER OF FOUNDATION

5-01. General. The foundation of the spillway from approximate station 413+00 to station 415+74 is mudstone (clay shale) moderately soft, blocky and slickensided, mostly dark gray, but with some red shale, approximately 24.5 feet thick (see photo 10). The foundation from station 415+74 to station 415+88 along the centerline and up the incline is sandstone, vertical distance 4.667 feet. The foundation from station 415+88 to station 416+03 is primarily siltstone. The balance of material along the centerline is interbedded sandstones and shale. See photos 10 through 13.

5-02. Foundation Anchors. There are 84 #9 rebar foundation anchors in the spillway. There are 36 anchors, grouped 12 across in 3 rows, located in the stilling basin, one row of 12 anchors about midway in the incline chute, and 3 rows of 12 anchors at the bottom portion of the incline. The anchors are 8 feet apart, center-to-center, transverse to the centerline, and 9 feet apart parallel to the centerline within the appropriate groupings. Six-inch-diameter holes were drilled 15 feet into the foundation at approximate right (90°) angles to the protective concrete covering. Only the 36 anchors in the stilling basin are vertical. The anchors were grouted using a nonshrink Portland cement grout. Two anchor pull-out tests were performed in accordance with the specifications and the results met all requirements. See photos 14 through 18.

5-03. Protective Concrete. A 3½-inch layer of protective concrete covered the area under the concrete spillway, spillway wall foundation, and the area five feet outside of the spillway wall foundation. The protective concrete covers the sealed foundation, shale or sandstone, or 12 inches of filter sand as indicated in the plans.

5-04. Filter Sand. Twelve inches of filter sand provide drainage under the concrete apron portion of the spillway. The water is collected by drain pipes that connect to the drainage system along the walls of the spillway. A modification to the filter gradation was granted during construction to allow the percentage of material passing the No. 100 sieve size to change from the maximum specified 3 percent to 5 percent because the selected source was unable to produce the gradation. The filter gradation conformed to the following specified limits.

## FILTER MATERIAL GRADATION

<u>Seive Size (square mesh)</u>	<u>Percent Passing (by weight)</u>
3/8-inch	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	20-60
No. 50	10-30
No. 100	0-5*

\* Modified during construction from 0-3 to 0-5 percent.

5-05. **Dewatering.** The only dewatering done was with sump pumps which were used to control the ponded water from the low areas in the spillway excavation.

5-06. **Foundation Grouting.** Pressure testing conducted indicated through seepage would be negligible, consequently no foundation grouting was done.

## VI - CONCLUSIONS

### 6-01. **Conclusions.**

a. The sandstone and shales comprising the foundation of the spillway are considered adequate.

b. The foundation is considered to be tight, however, the origin of the groundwater producing the two wet spots was not determined.

c. Instrumentation in the spillway was not considered necessary.

e. The UBC seismic area is zone 1.

## VII - REFERENCES

The following listed references were used in preparation of this report.

1. Geologic Atlas of Texas, Wichita Falls-Lawton Sheet, revised 1987
2. Design Memorandum No. 2, Embankment, Spillway and Outlet Works, March 1989
3. Project Plans and Specifications
4. Geology of Texas, vol. 1, Stratigraphy 1932, ninth printing 1990

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GEOLOGIC ATLAS OF TEXAS  
WICHITA FALLS - LAWTON SHEET  
(IN PART)

EXHIBIT 1



NE

Holocene and/or Pleistocene  
 Pleistocene  
 Lower Cretaceous  
 Guadalupe Series  
 Leonard Series  
 Lower Permian  
 Permian  
 Wolfcamp Series

Alluvial terrace  
 Trinity Group  
 Clear Fork Group

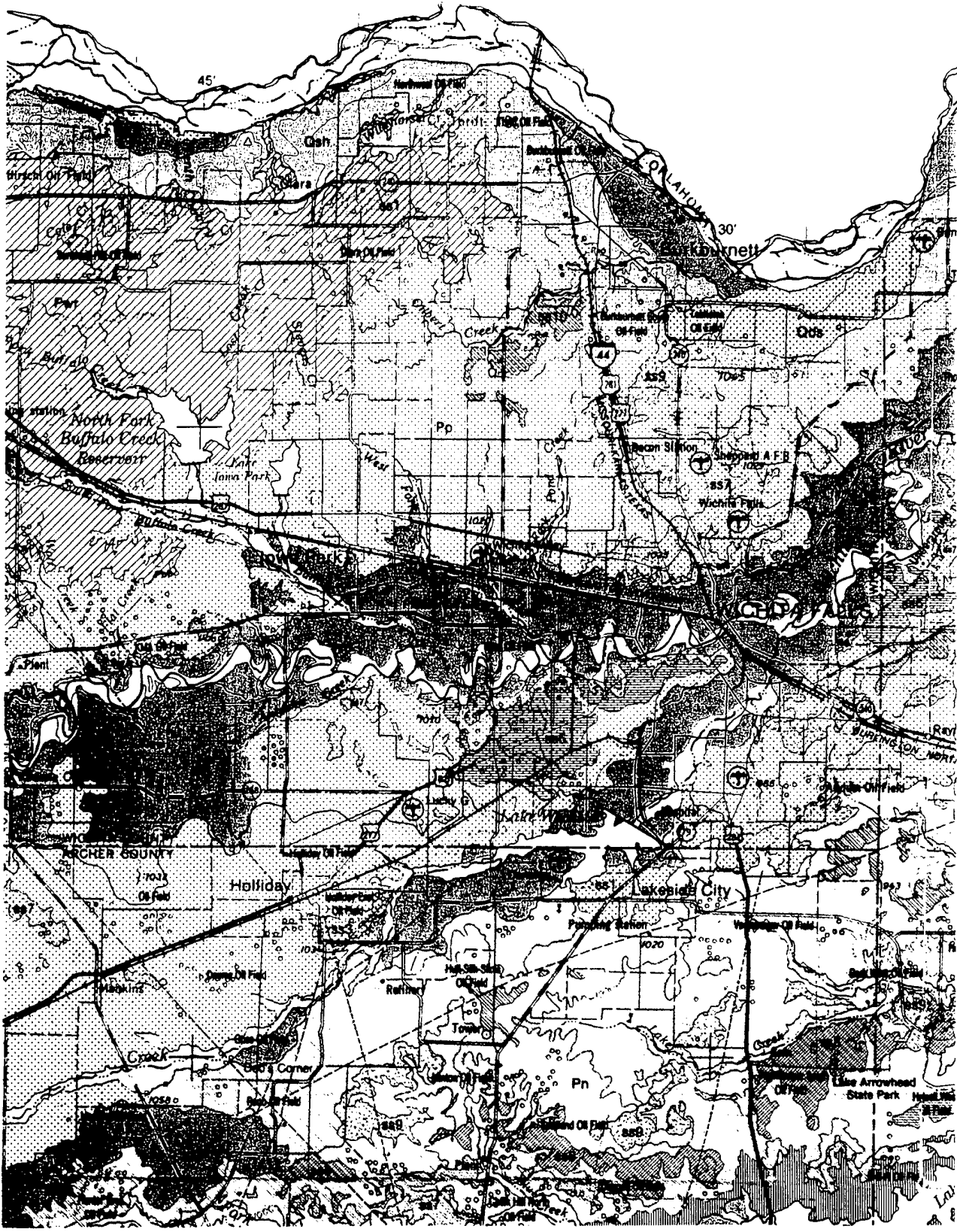
Lower Permian  
 Formations

Albany Group (revised)

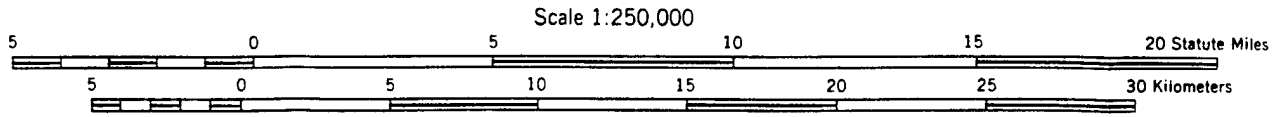
Jagger I  
 Formation

Admiral  
 (revised)

Santa Ana  
 Formation



WICHITA GROUP (REVISED)



Scale 1:250,000  
 CONTOUR INTERVAL 100 FEET  
 TRANSVERSE MERCATOR PROJECTION

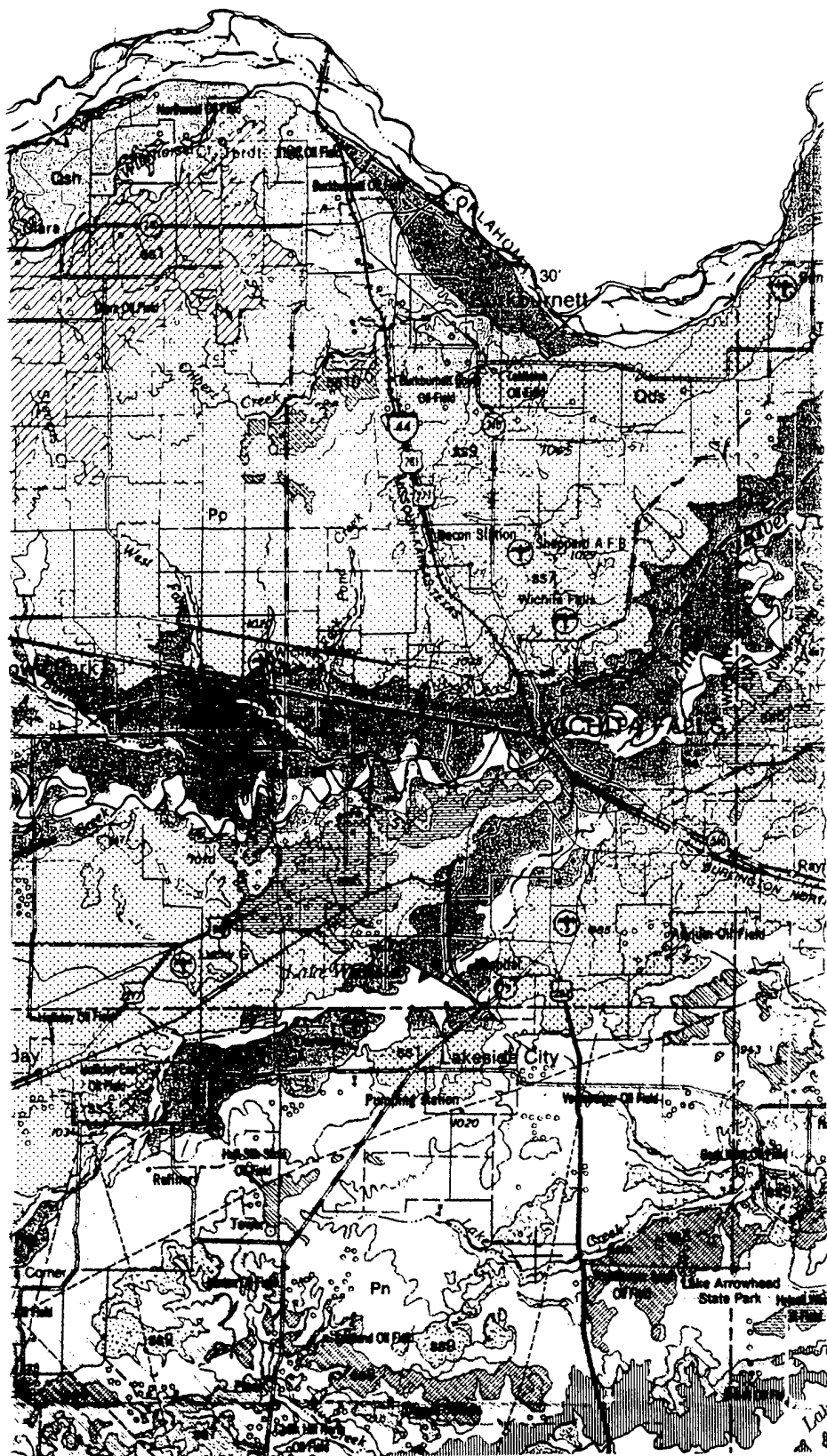
1957 MAGNETIC DECLINATION FOR THE CENTER OF THIS SHEET IS 7°27'. MEAN ANNUAL CHANGE IS 8.6 WESTERLY.

**GEOLOGIC ATLAS OF TEXAS, WICHITA FALLS-LAWTON (PARTIAL)**

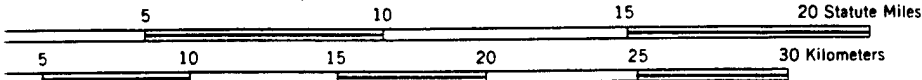
ALFRED SHERWOOD ROMER MEMORIAL EDITION

1987

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Scale 1:250,000



CONTOUR INTERVAL 100 FEET  
TRANSVERSE MERCATOR PROJECTION

NET MAGNETIC DECLINATION FOR THE CENTER OF THIS SHEET IS 7°W. YEAR ANNUAL CHANGE IS 0.5' WESTWARD.

STATES OF TEXAS, WICHITA FALLS-LAWTON (PARTIAL)

ALFRED SHERWOOD ROMER MEMORIAL EDITION

1987

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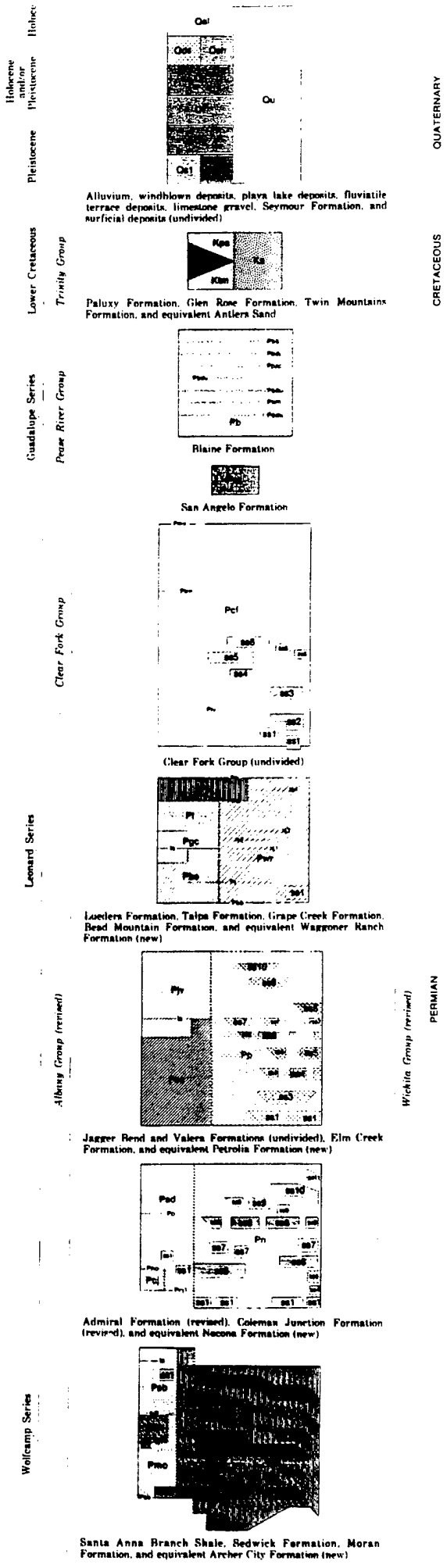


EXHIBIT 1

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PHOTOGRAPHS

EXHIBIT 2

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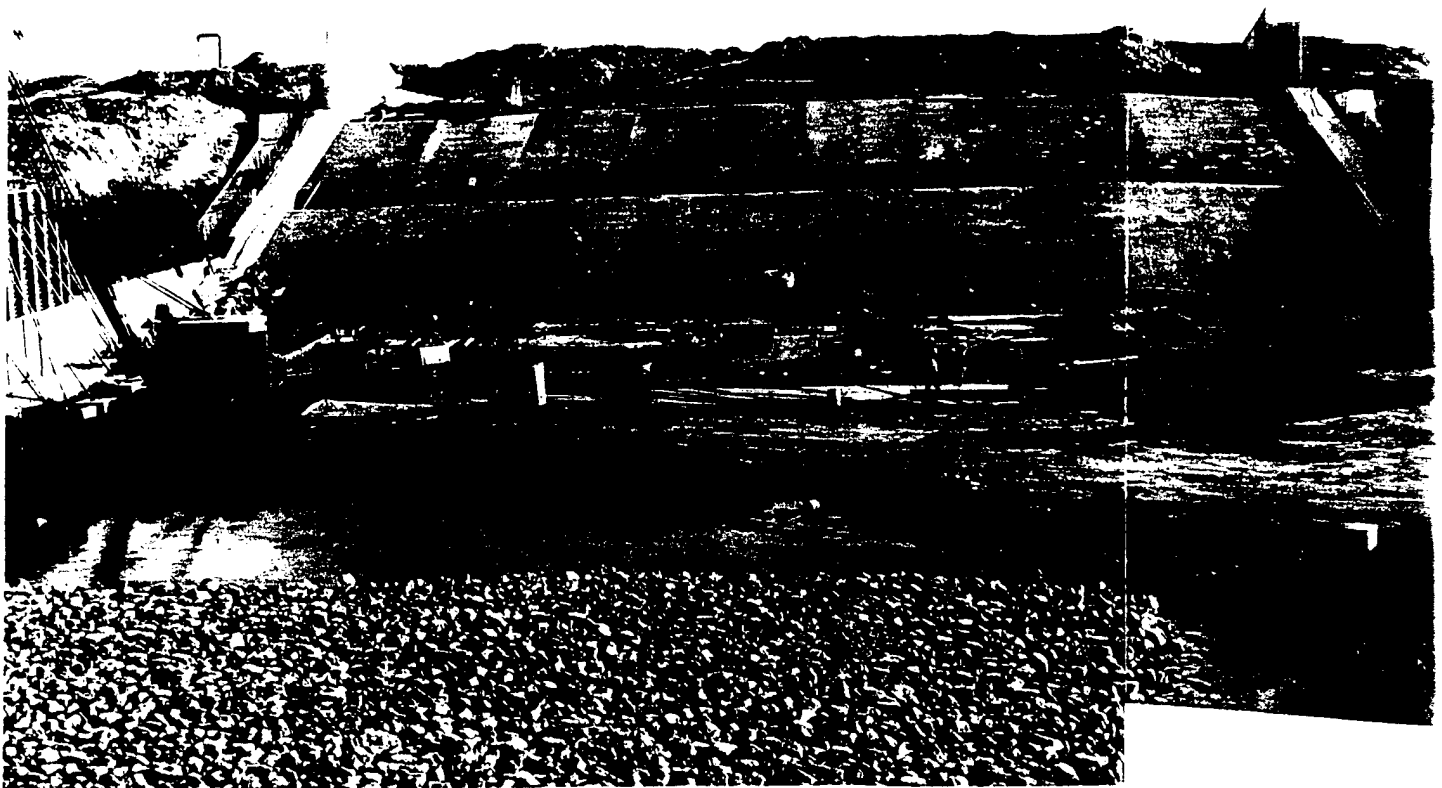
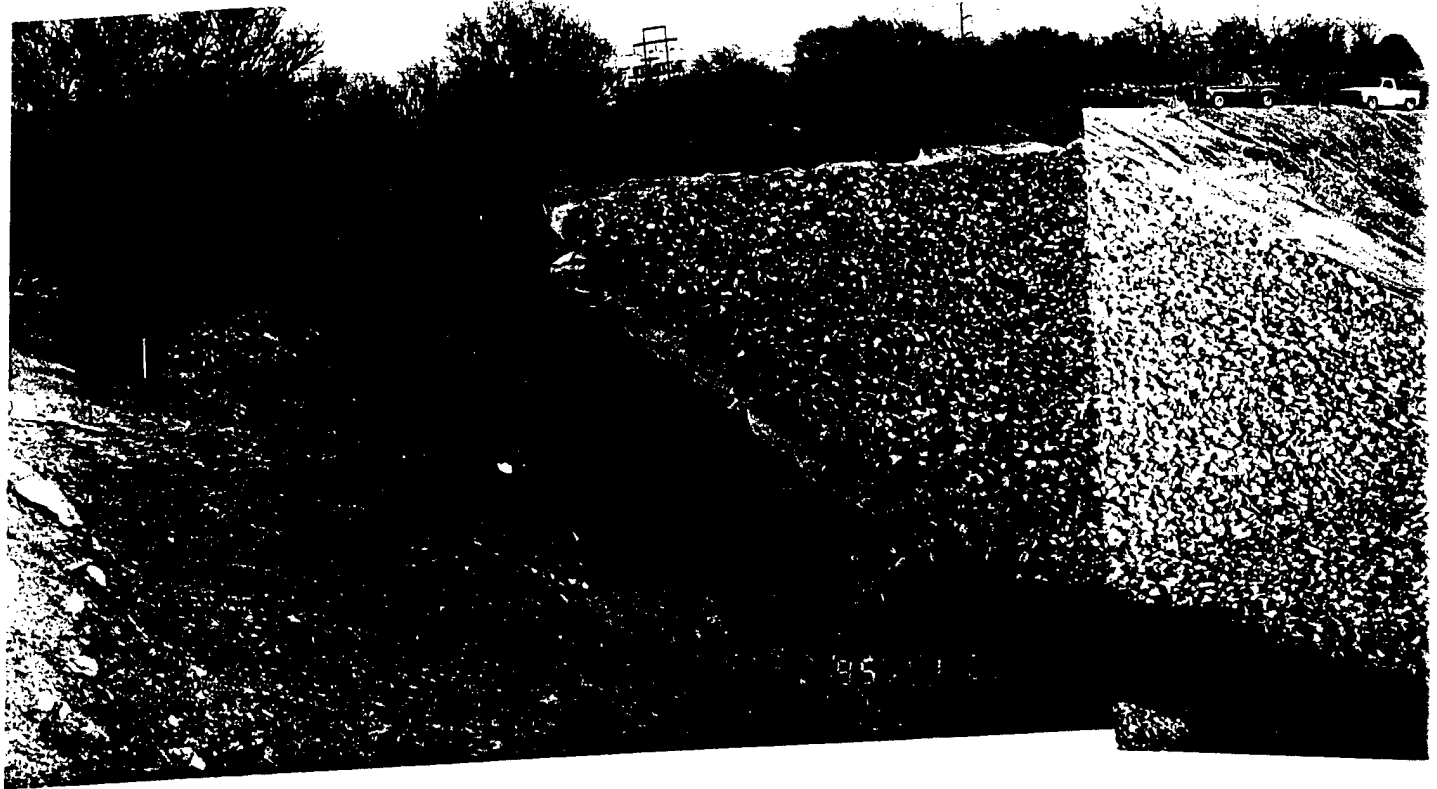
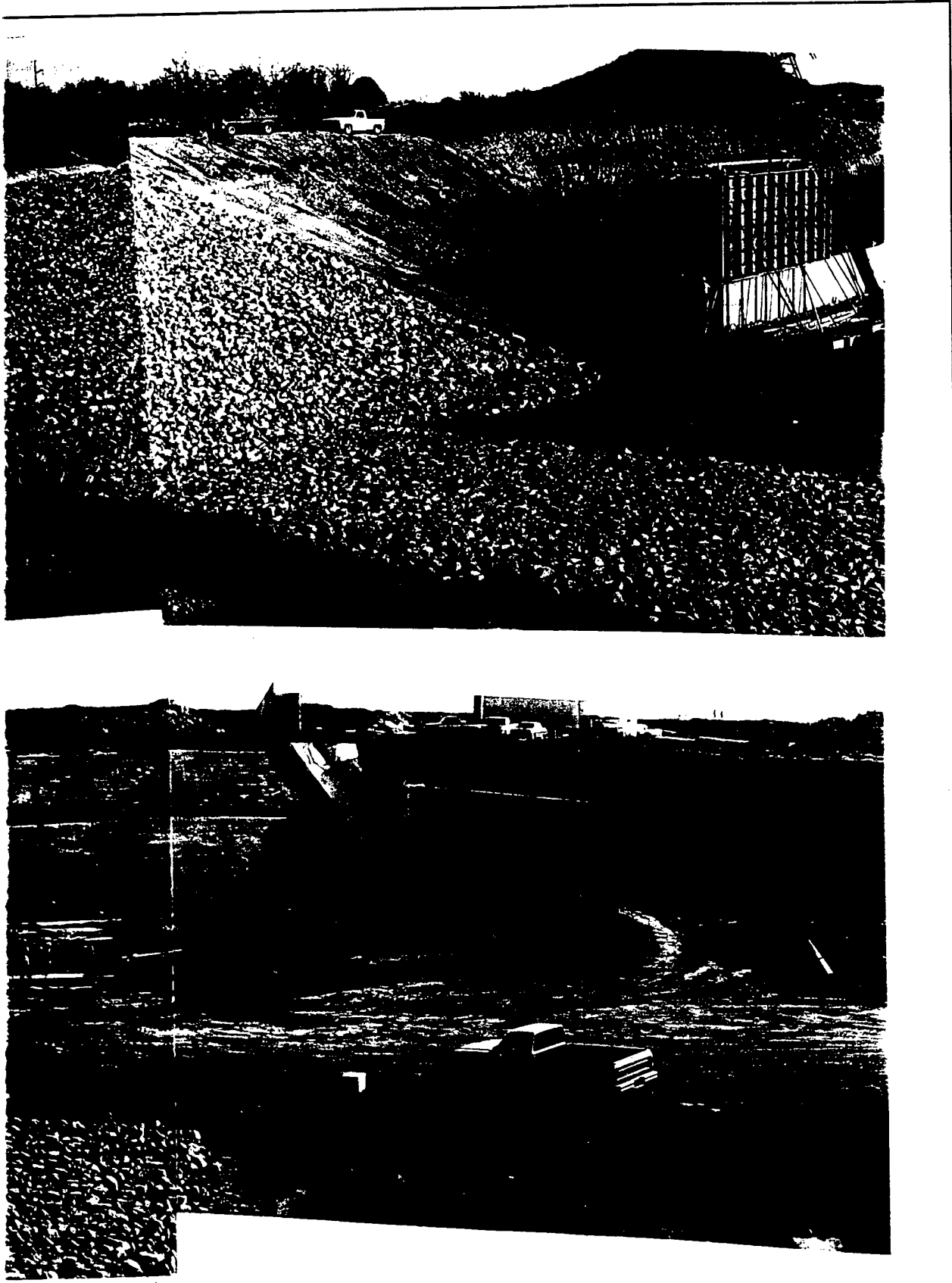


Photo 1. Composite view of the downstream portion of the main spillway  
25 JANUARY 1995

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the downstream portion of the main spillway channel.  
5 JANUARY 1995

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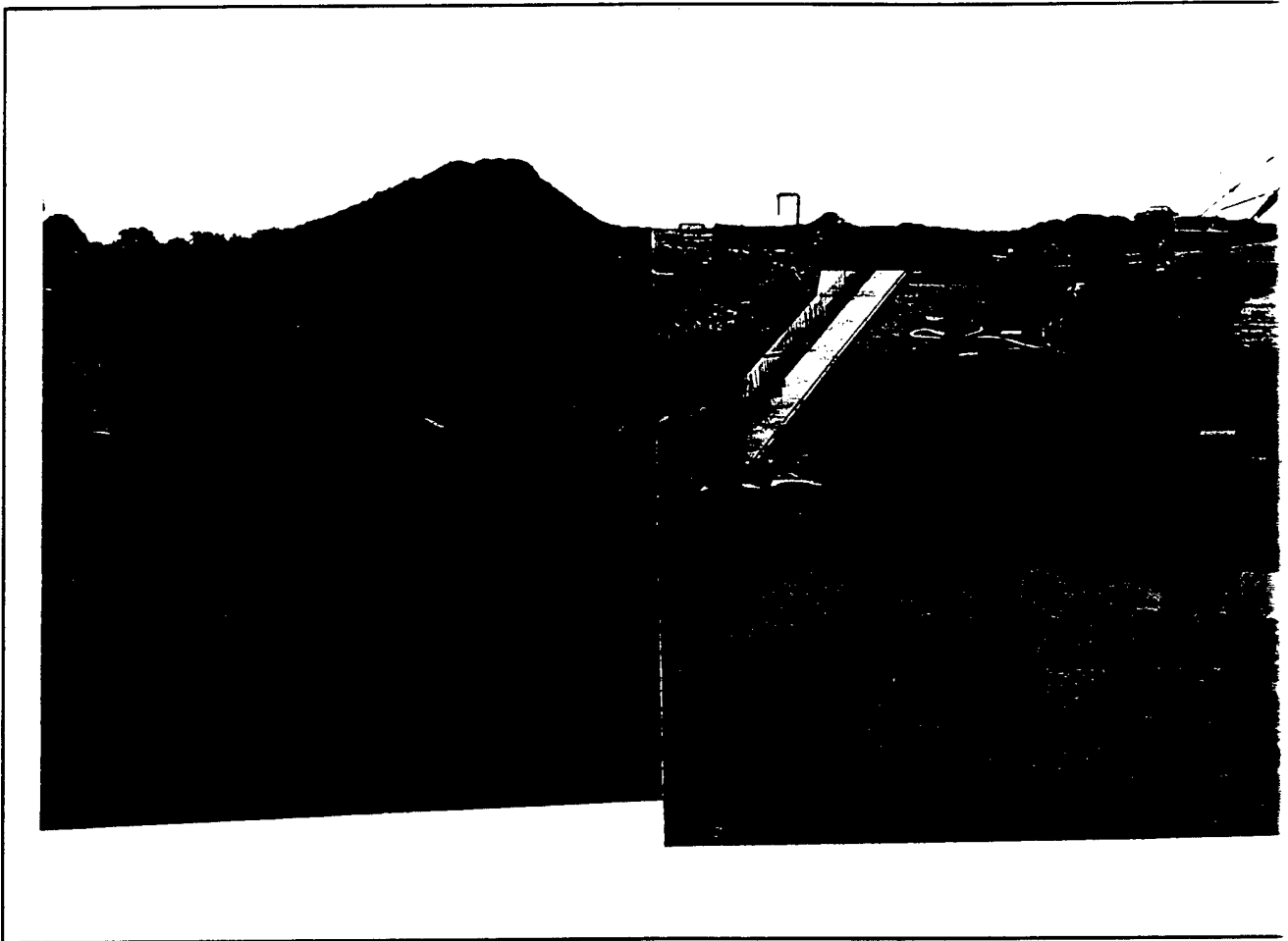
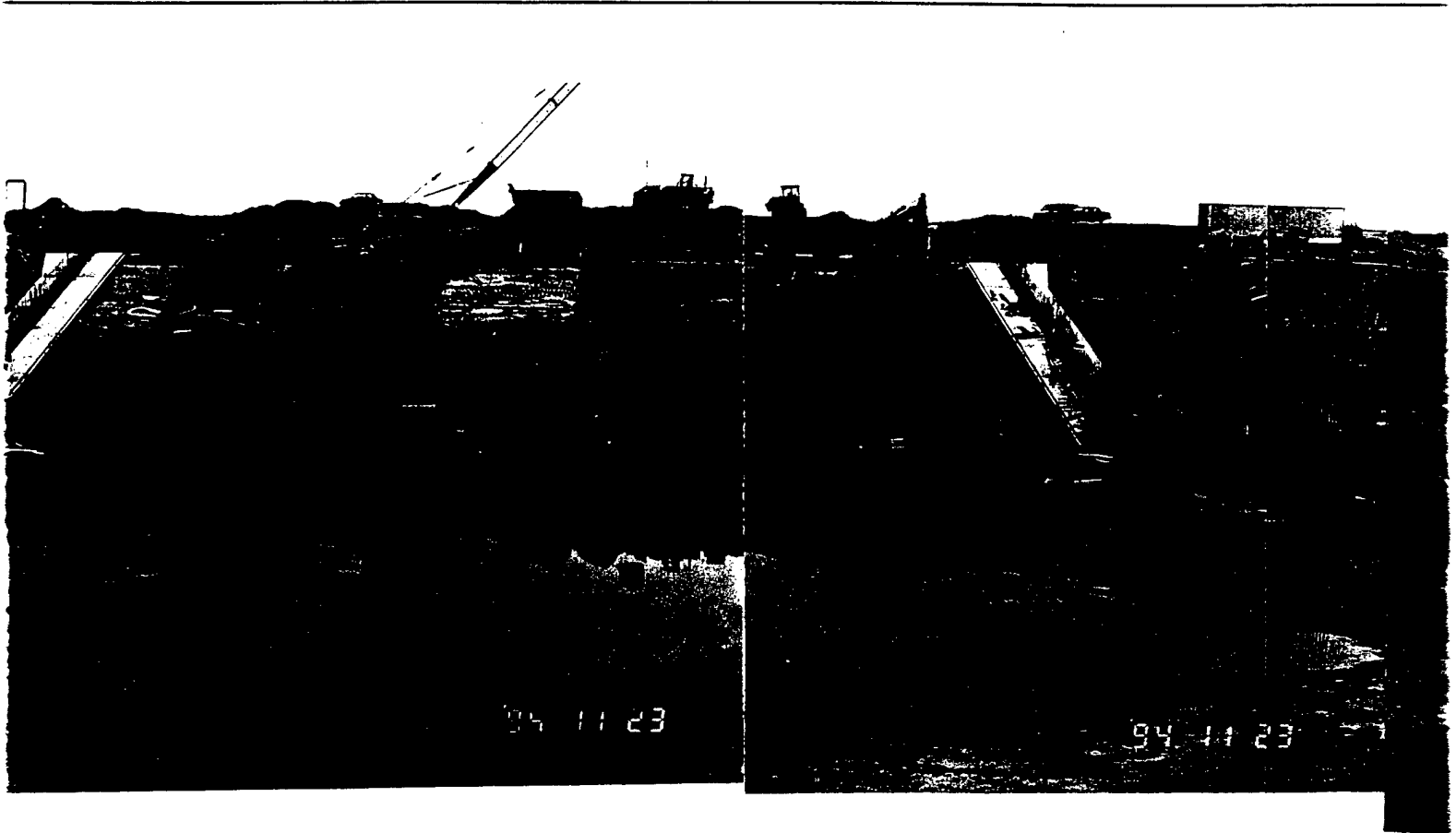


Photo 2. Composite view of the

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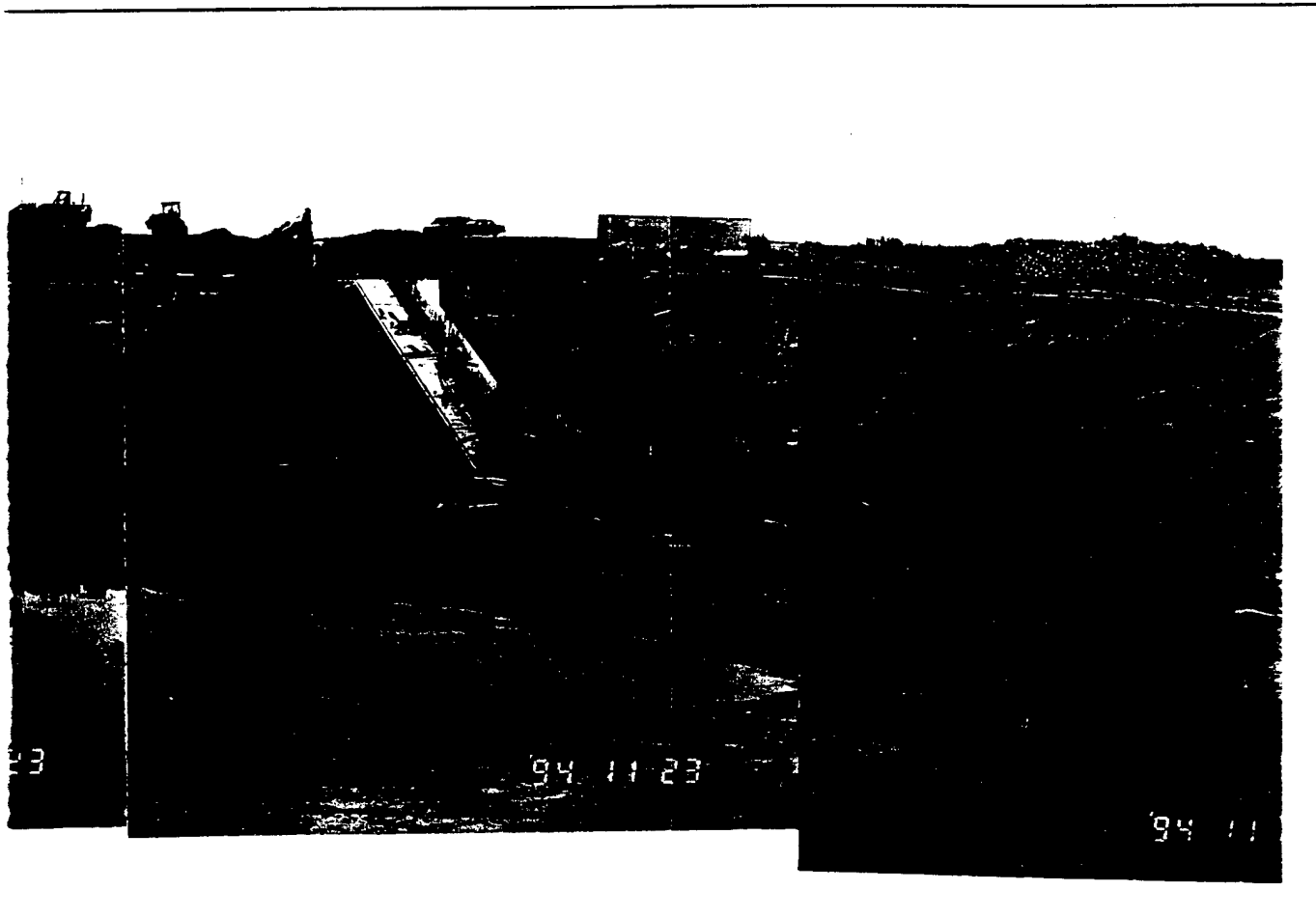
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**Photo 2.** Composite view of the downstream portion of the main spillway channel.

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portion of the main spillway channel.

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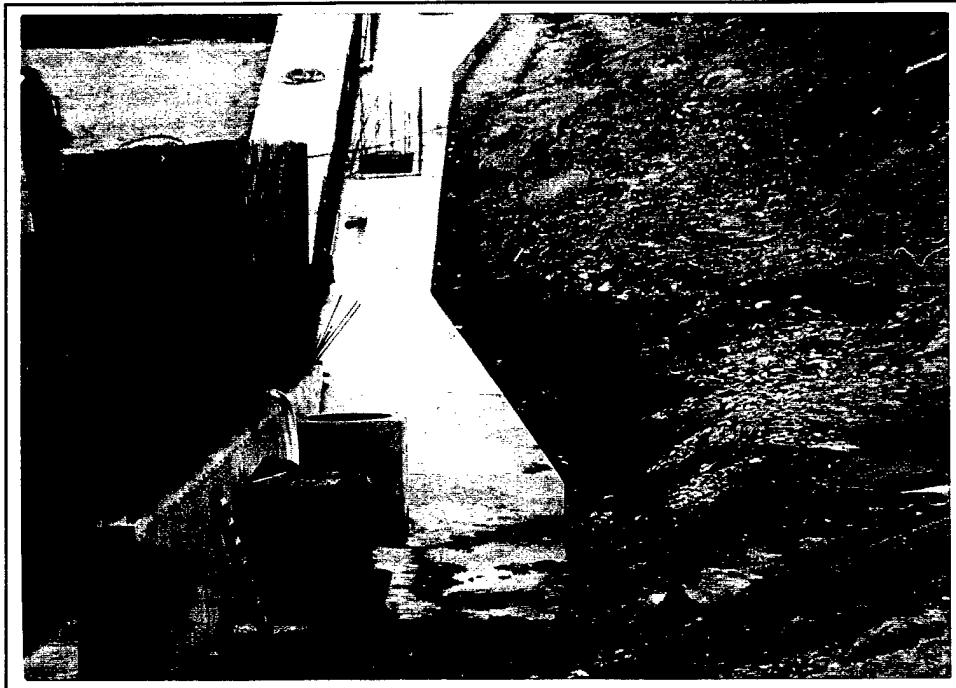


Photo 3. Wet spot on the left side of the spillway at base of the sandstone.

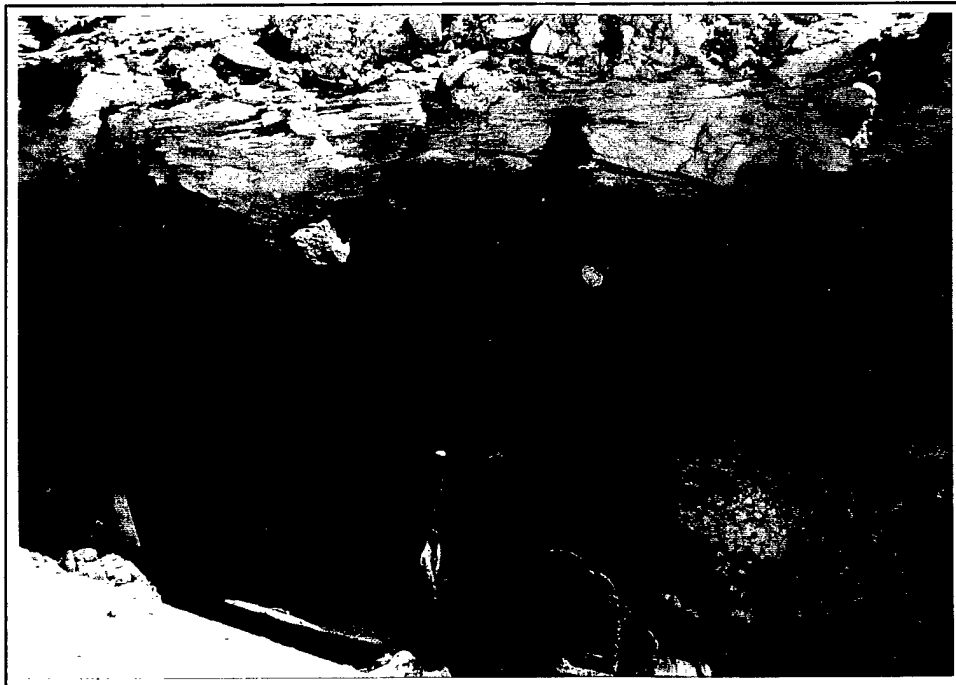
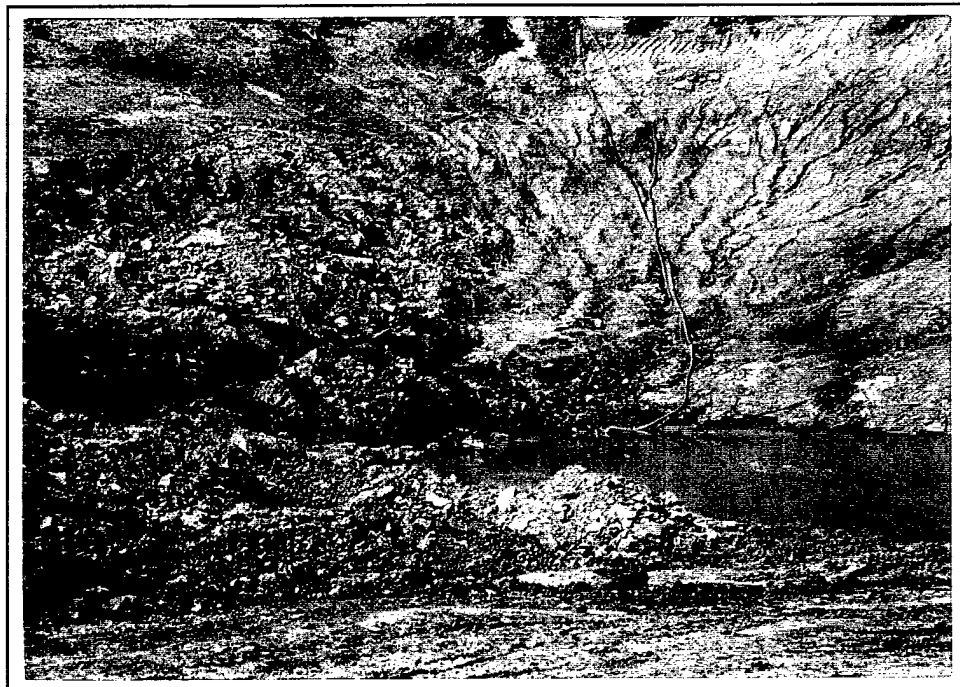


Photo 4. Close-up of wet spot shown in photo 3.

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**Photo 5.** Wet spot on the left side of the spillway at fracture in the sandstone.



**Photo 6.** Wet spot on the right side of the spillway below the stockpond. Note wet area within the loose material on the left side of photo.

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**Photo 7.** Area above wet spot on the right side of the spillway after some detritus removed. Note wet sections in sandstone on left and center of photo.



**Photo 8.** Close-up of area near the center of photo 7.

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HOLLIDAY CREEK, WICHITA FALLS, TEXAS  
SPILLWAY FOUNDATION REPORT

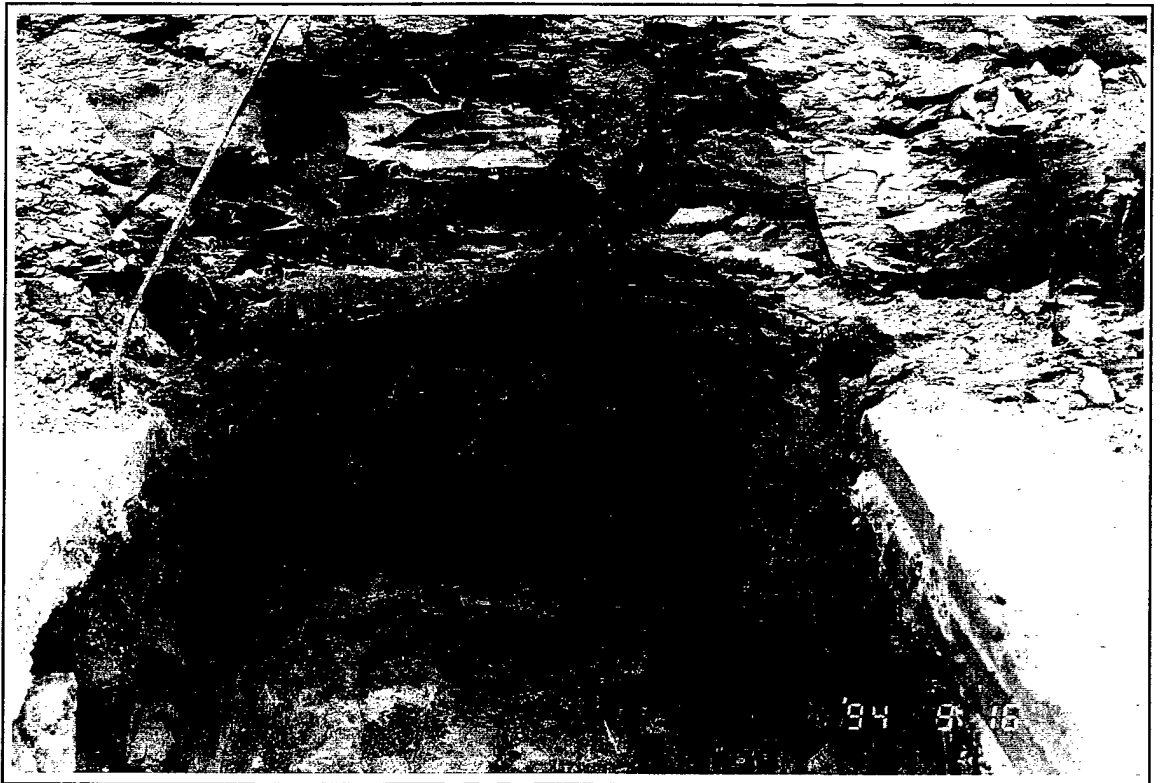


**Photo 9.** Station 415+88 to 415+90, 40 to 50 feet right of centerline showing the blocky, non-fissionable structure of the claystone.

LAKE WICHITA  
HOLLIDAY CREEK, WICHITA FALLS, TEXAS  
SPILLWAY FOUNDATION REPORT

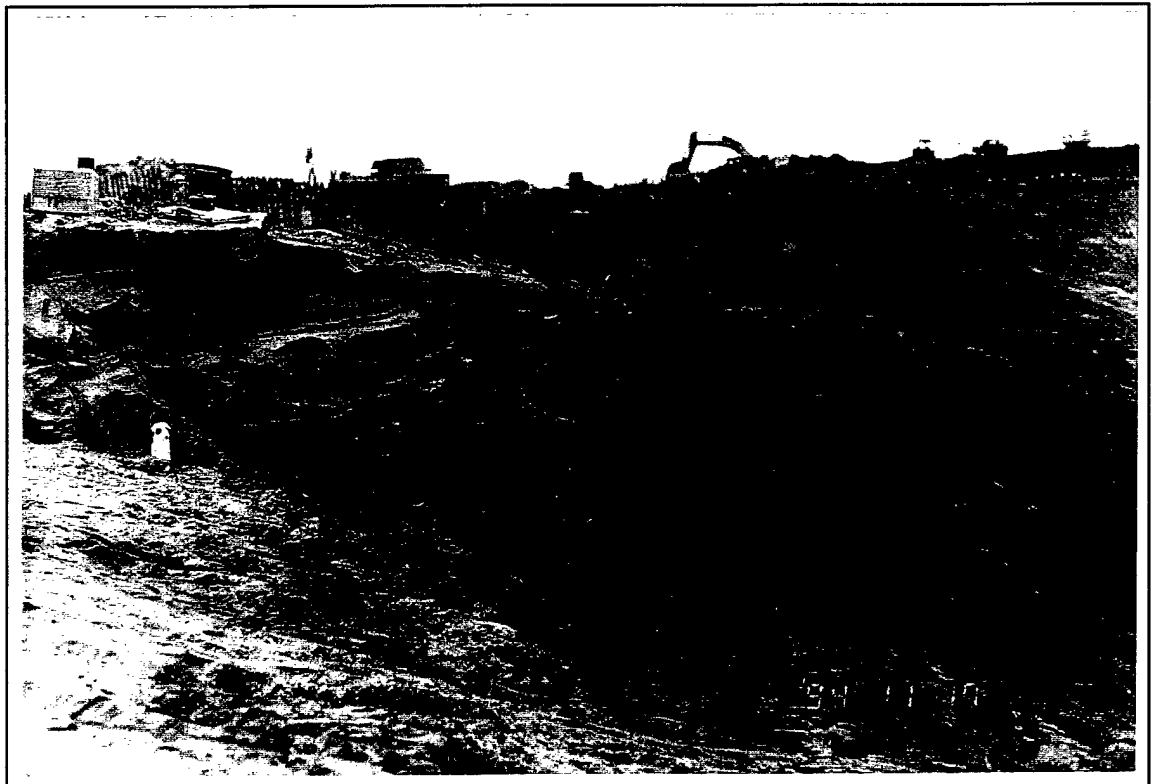


**Photo 10.** Record photo of foundation at Station 415+57 to 415+61, 94 to 99 feet left of centerline. Note slickensides in the claystone above the number "6".

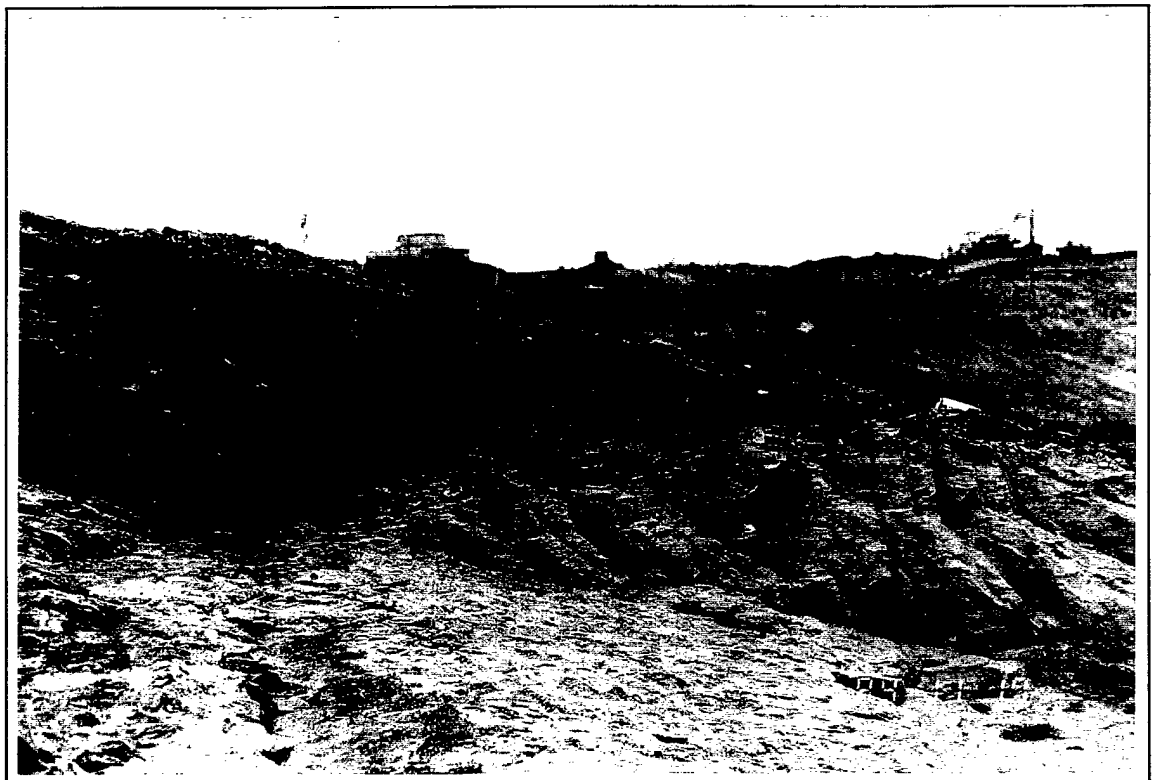


**Photo 11.** Record photo of foundation at Station 416+50 to 416+54, 117 feet left of centerline to the end of the trench. Note variegated claystone.

LAKE WICHITA  
HOLLIDAY CREEK, WICHITA FALLS, TEXAS  
SPILLWAY FOUNDATION REPORT



**Photo 12.** Vertical cut in spillway excavation 44 feet left of centerline, Station 415+90 to 416+00. Note the relationship of the different rock strata within the cut.



**Photo 13.** Vertical cut 43 feet left of centerline Station 415+80 to 415+90. Note the same relationships as in photo 12. Red claystone is common in both areas.

LAKE WICHITA  
HOLLIDAY CREEK, WICHITA FALLS, TEXAS  
SPILLWAY FOUNDATION REPORT



Photo 14. Drilling anchor holes.

LAKE WICHITA  
HOLLIDAY CREEK, WICHITA FALLS, TEXAS  
SPILLWAY FOUNDATION REPORT



Photo 15. Setup for the anchor pullout test.



Photo 16. Anchor pullout test.

LAKE WICHITA  
HOLLIDAY CREEK, WICHITA FALLS, TEXAS  
SPILLWAY FOUNDATION REPORT

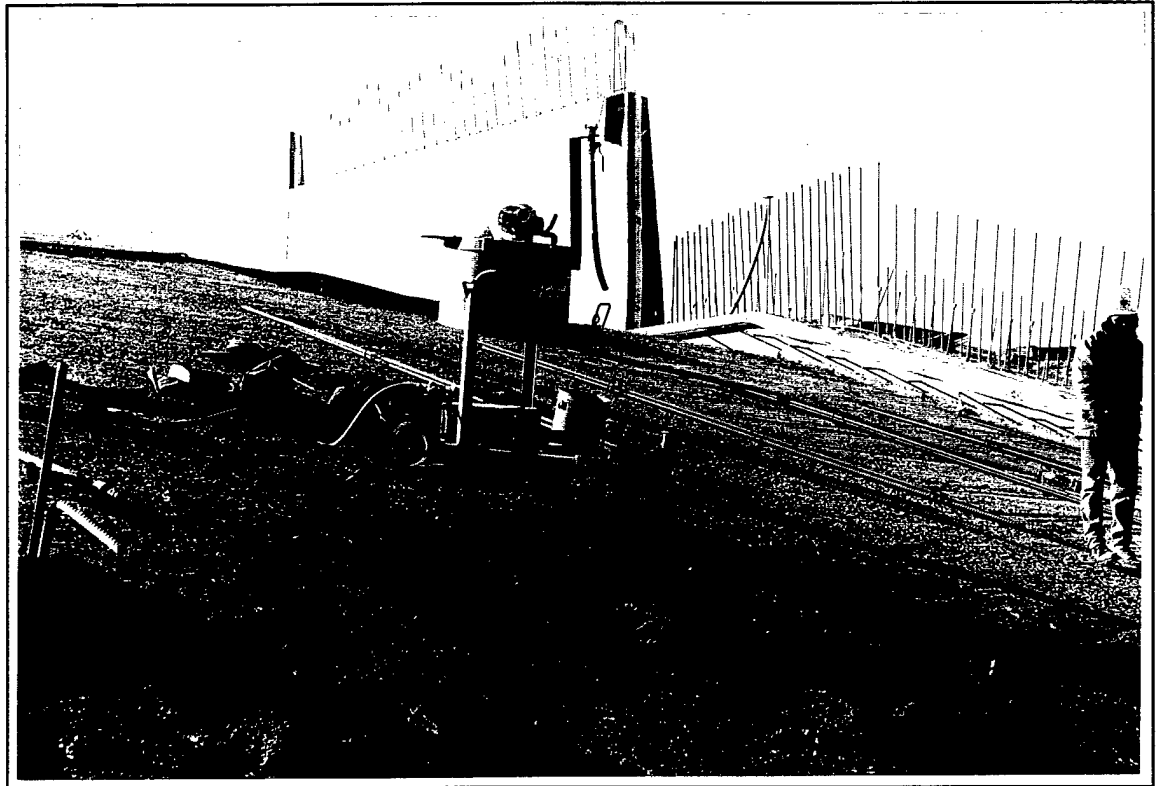


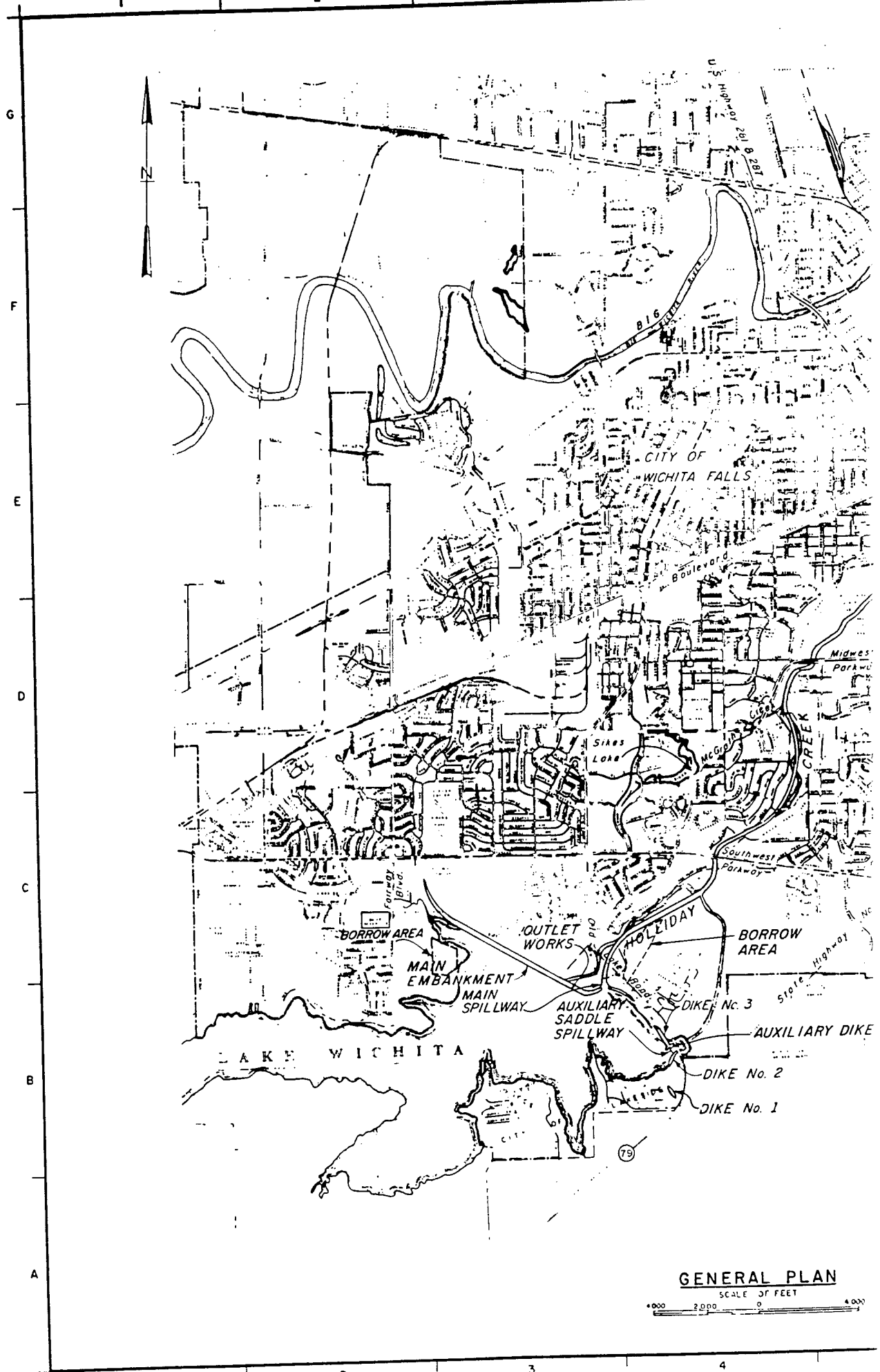
Photo 17. Setup for grouting the anchors.



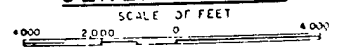
Photo 18. Inplace anchors.

LAKE WICHITA  
HOLLIDAY CREEK, WICHITA FALLS, TEXAS  
SPILLWAY FOUNDATION REPORT

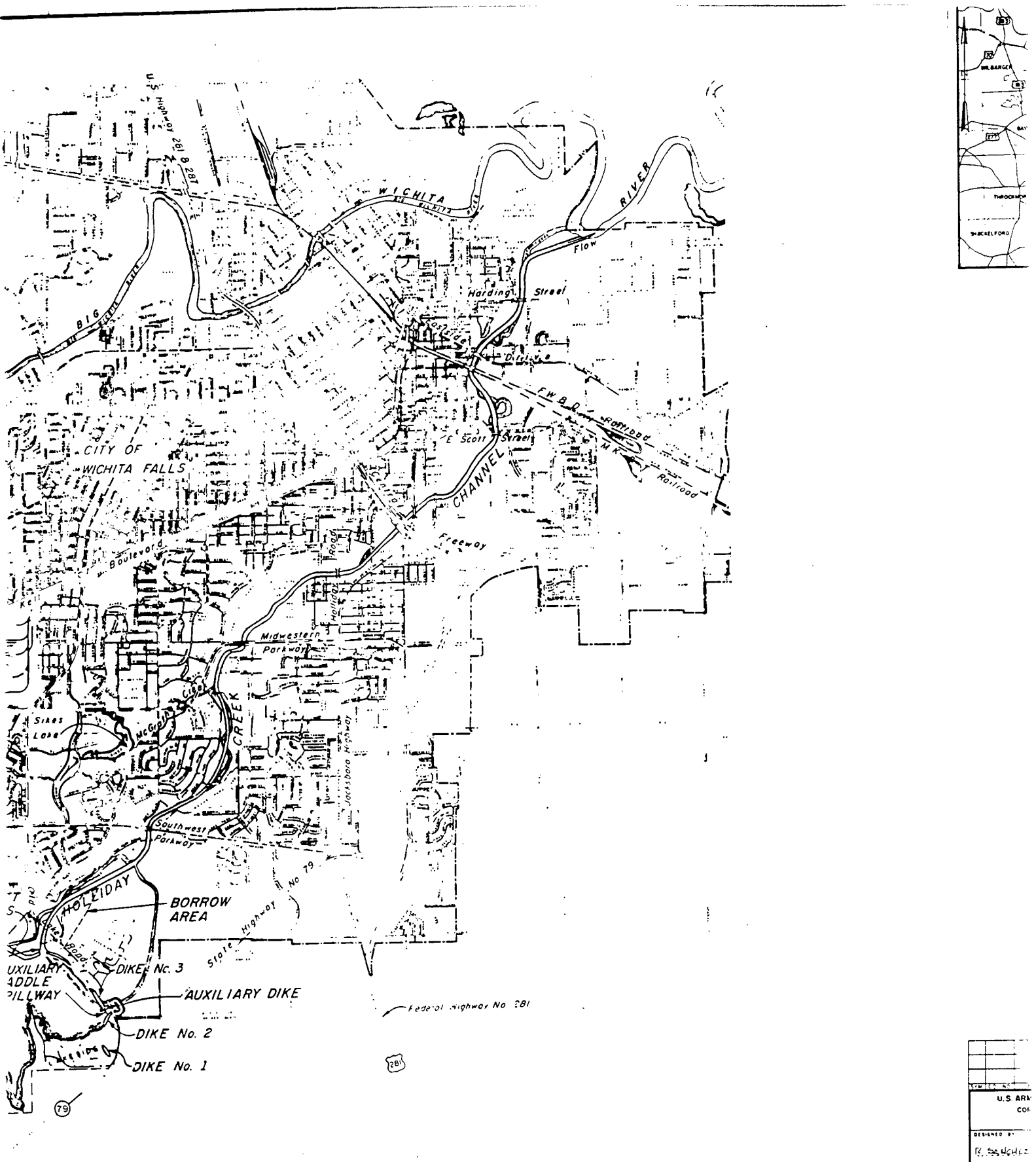
PLATES



**GENERAL PLAN**



①

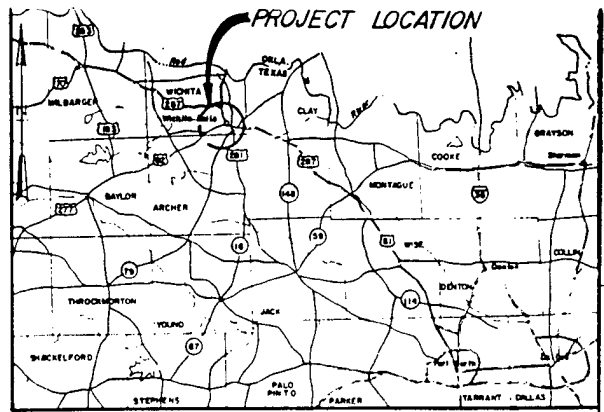
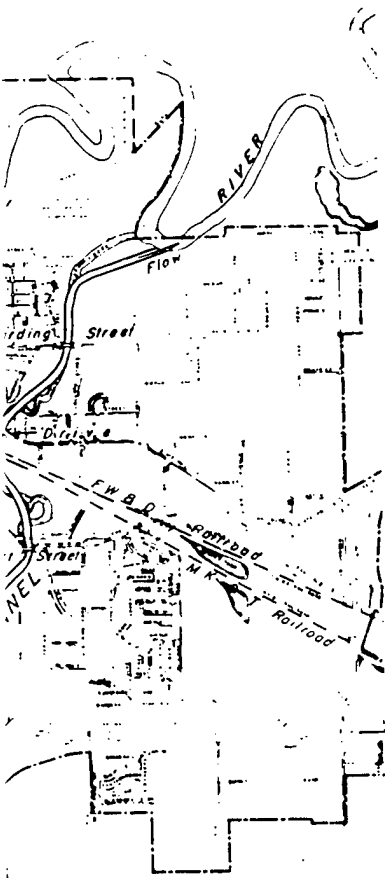


**GENERAL PLAN**

SCALE OF FEET  
 0 2,000 4,000

THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

DESIGNED BY	R. S. WOOD
DRAWN BY	B. S. J. J.
CHECKED BY	S. A. J. J.
SUBMITTED BY	
DATE	



VICINITY MAP

1 No 781

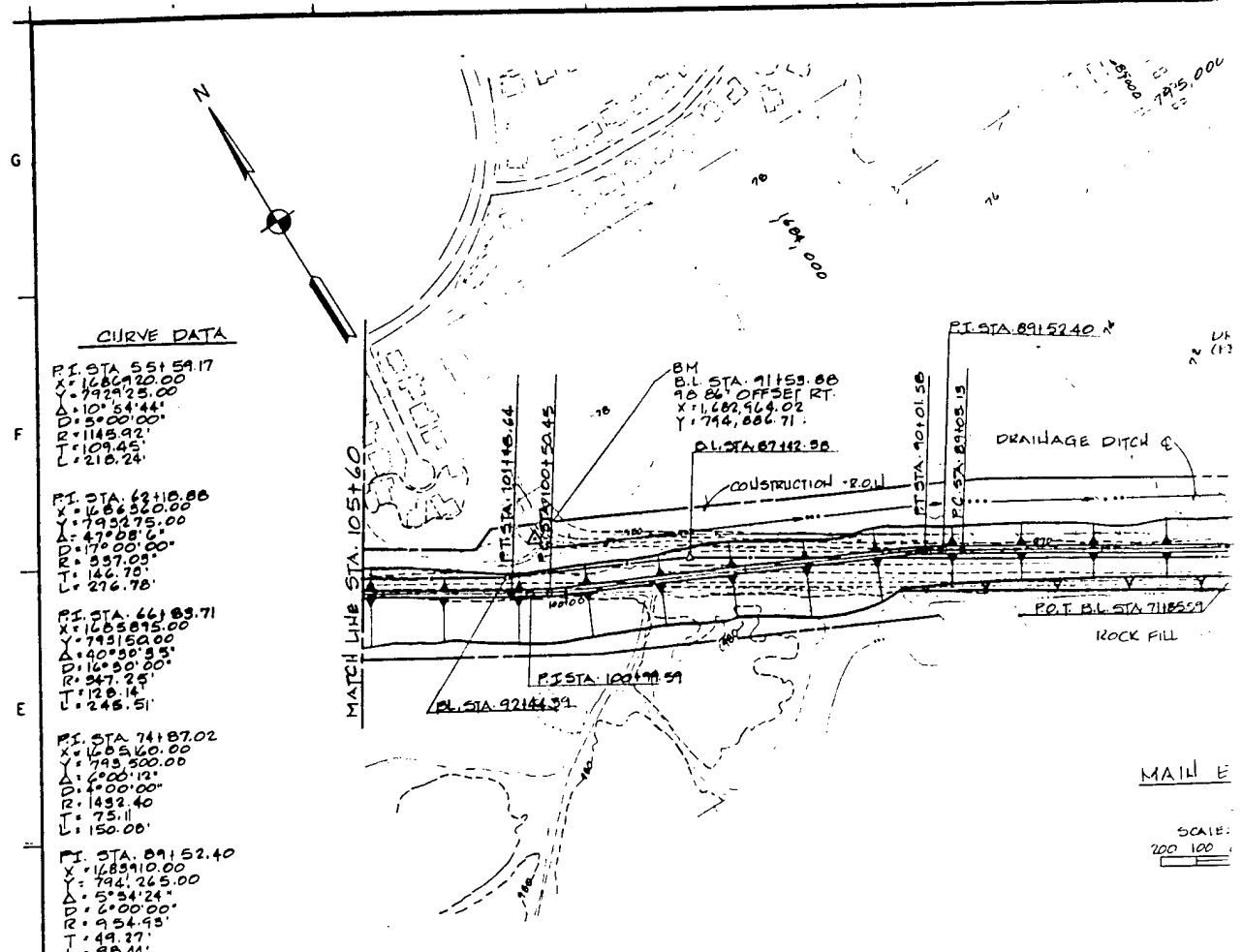
THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

SECTION NO.		ACTION		DATE		DESCRIPTION OF REVISION	
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA				U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS			
DESIGNED BY R. SANCHEZ		RED RIVER WATERSHED LAKE WICHITA HOLLIDAY CREEK, WICHITA FALLS, TEX.					
DRAWN BY B. SMITH		LOCAL FLOOD PROTECTION PHASE III					
CHECKED BY C. ARMSTRONG		GENERAL PLAN AND VICINITY MAP					
SUBMITTED BY		NO. 47, DACW56-92-B-0032		DATED			
CONTR. NO.		DRAWING NUMBER		SHEET NO.		SEQUENCE	
		BE360-C3-1.1.1					

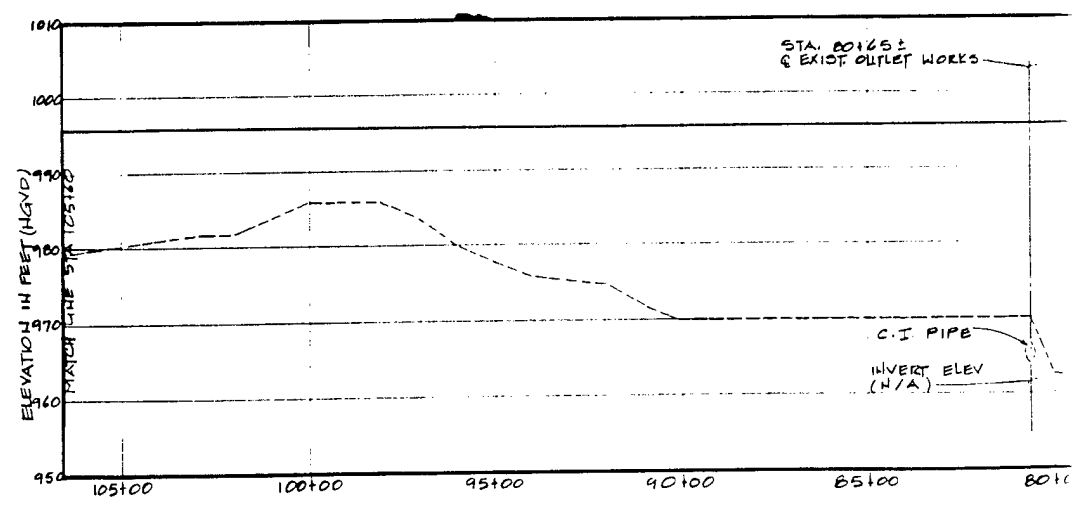
6 7 8

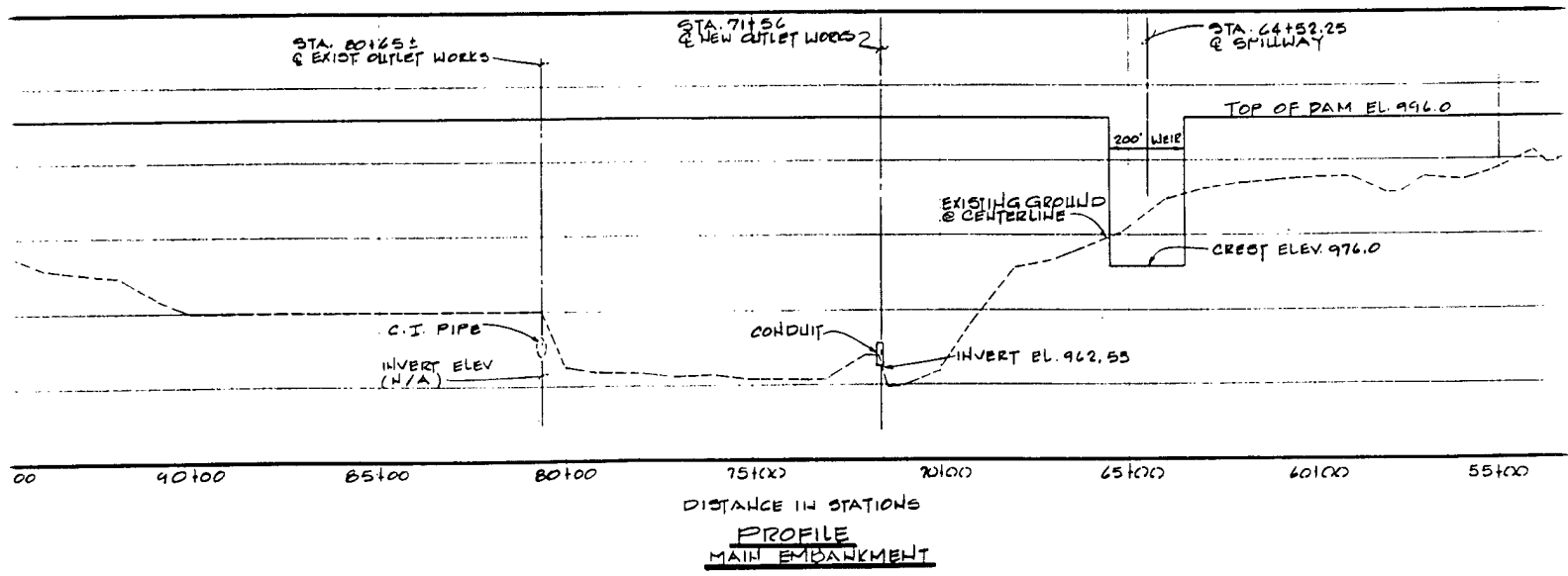
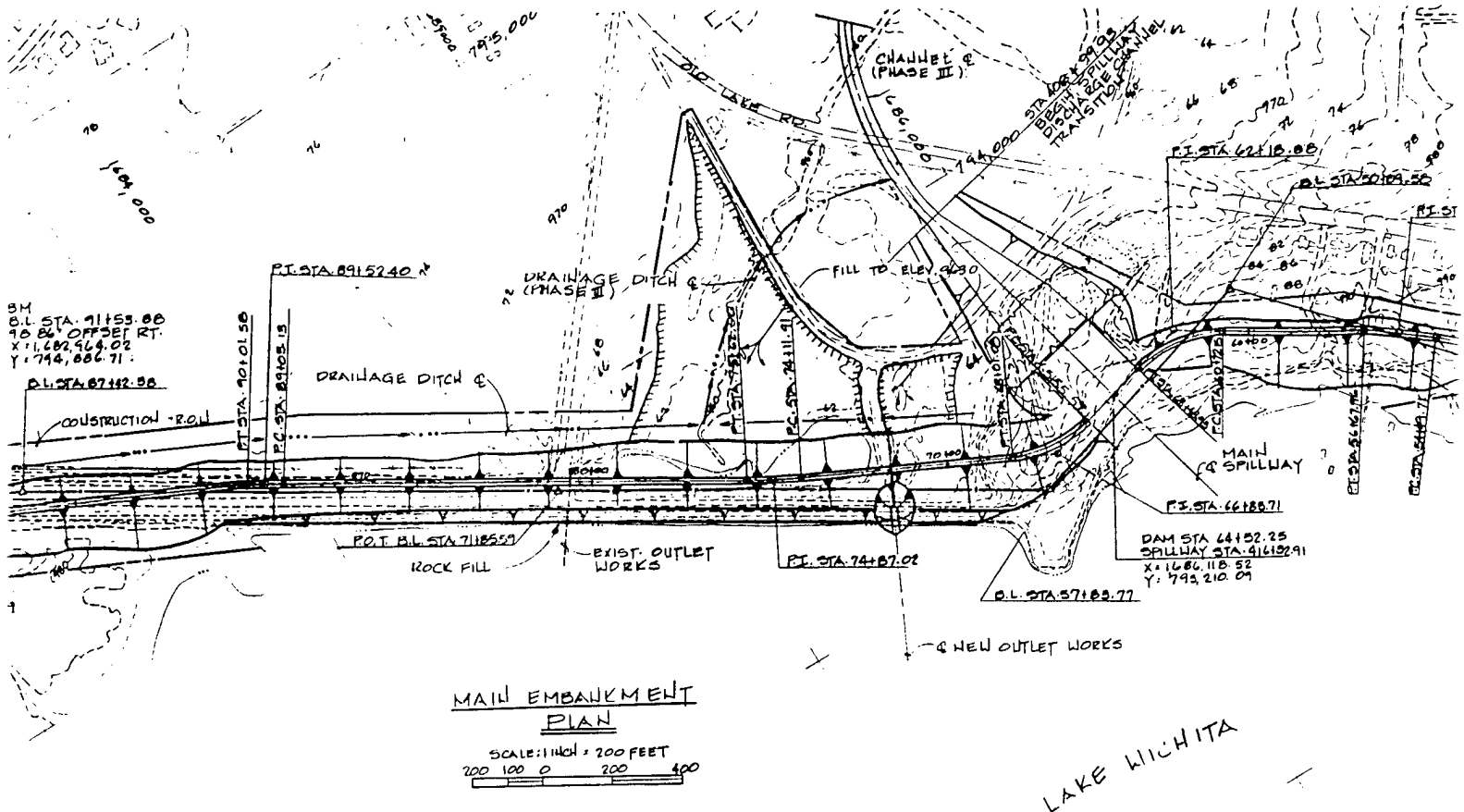
3

PLATE 1

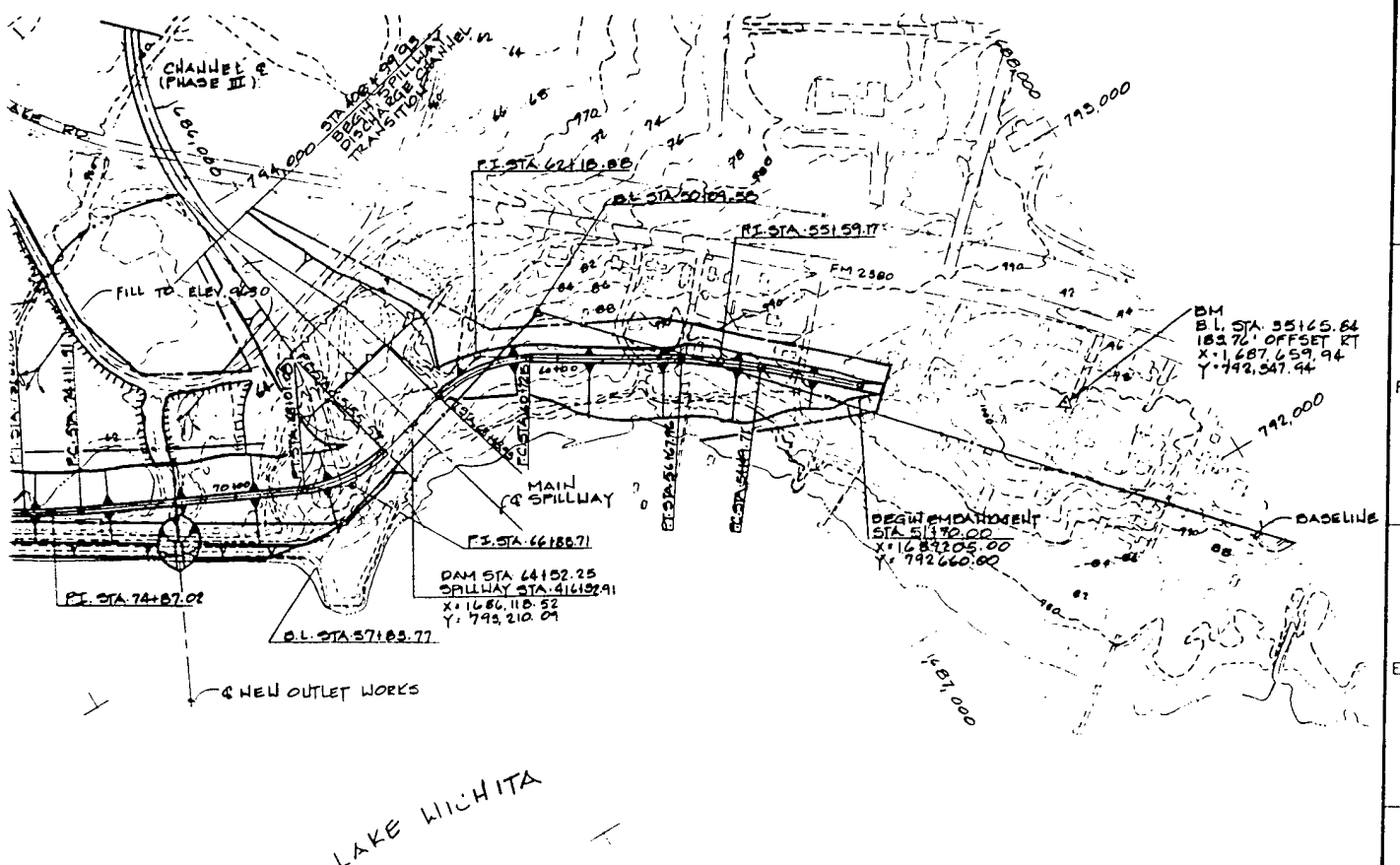


MAIL E  
 SCALE:  
 200 100

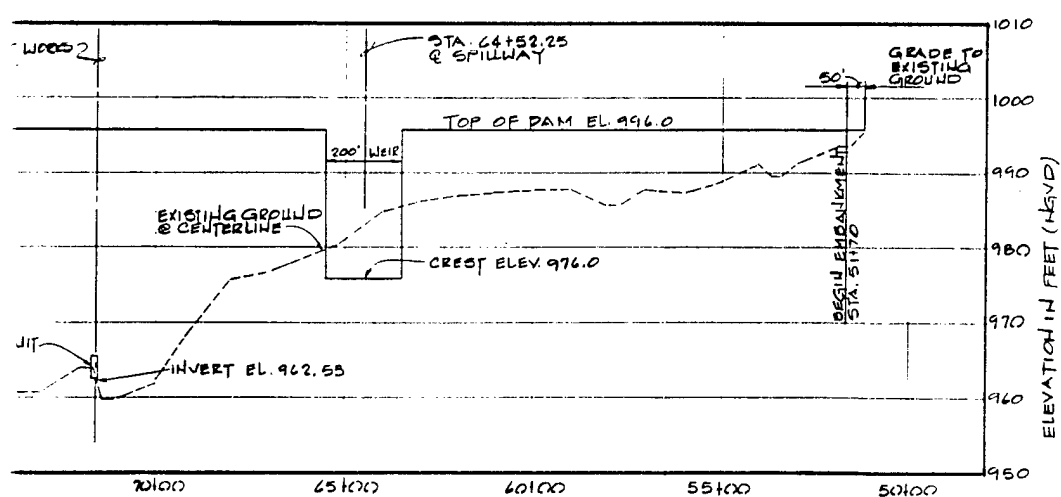




THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT REPORT AND WAS REPRODUCED FOR USE IN THIS REPORT



LAKE WICHITA



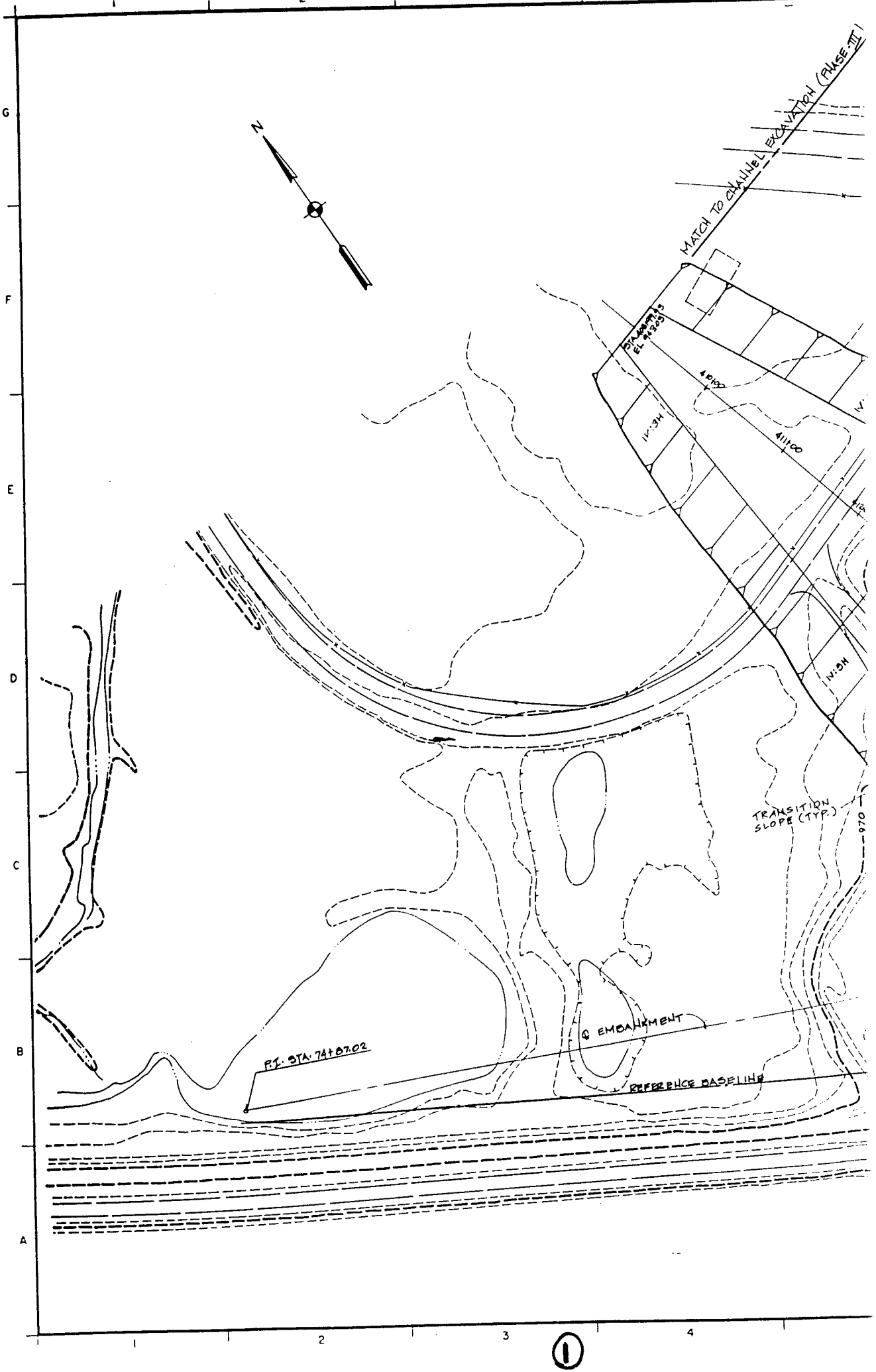
4 STATIONS  
FILE  
BANKMENT

THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

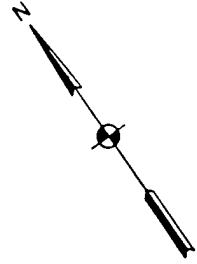
DESIGNED BY: P. ELDER		DRAWN BY: B. SMITH		REVIEWED BY: R. RANCHO		SUBMITTED BY: JACK V. JENSEN	
U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS				RED RIVER WATERSHED LAKE WICHITA HOLLIDAY CREEK, WICHITA FALLS, TEXAS LOCAL FLOOD PROTECTION PHASE III EMBANKMENT PLAN AND PROFILE (STA. 51+70 TO STA. 105+00)			
SOL. NO.		DATED:		CONTR. NO.		SEQUENCE NO.	
DRAWING NUMBER		SHEET NO.		OF			

3

PLATE 2



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D  
C  
B  
A



MATCH TO CHANNEL EXCAVATION (RISE III)

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EL. 250.00

14.34

411.00

14.34

97.0

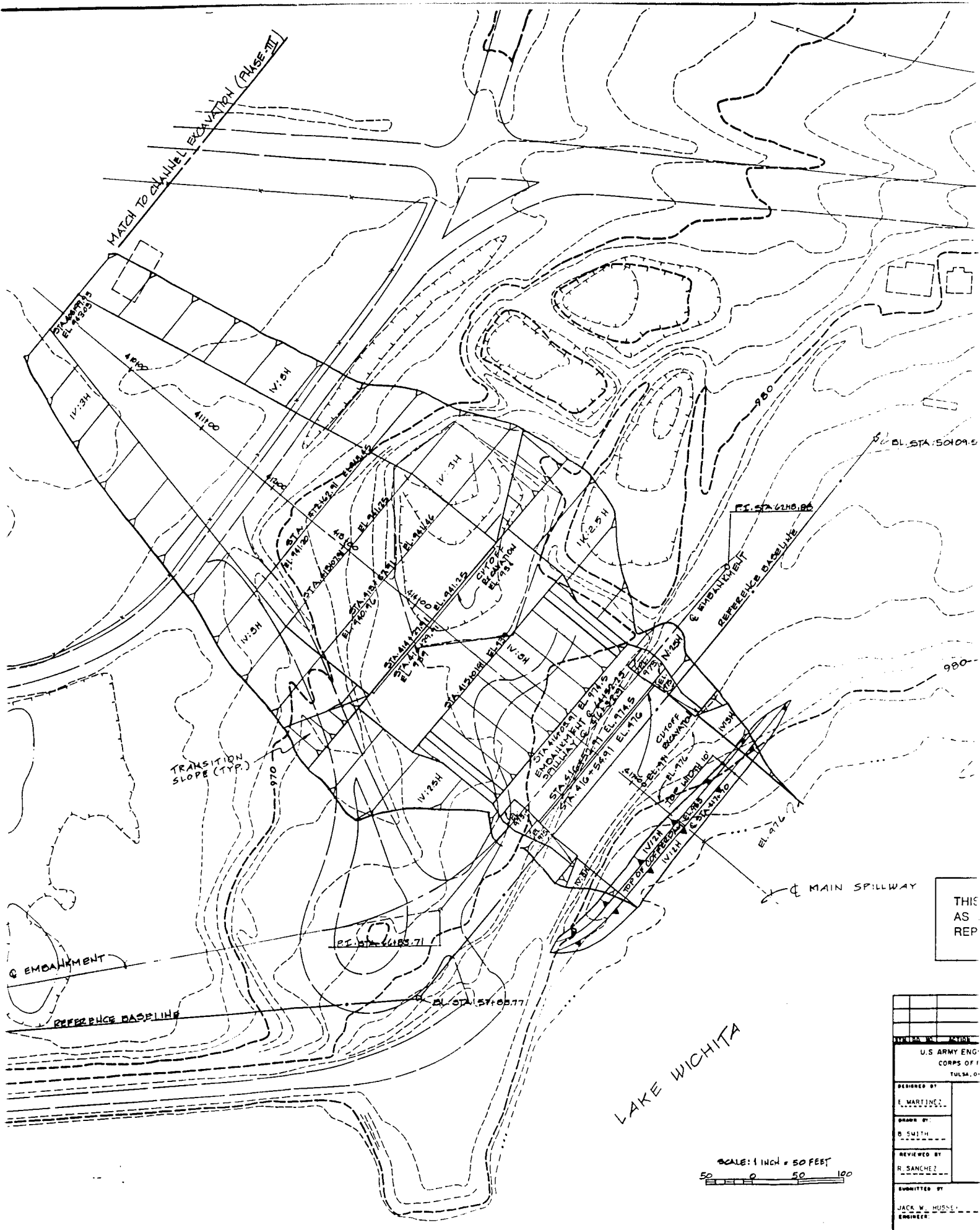
TRANSITION  
SLOPE (TYP.)

P.L. STA. 74+07.02

EMPALEMENT

REFERENCE BASELINE

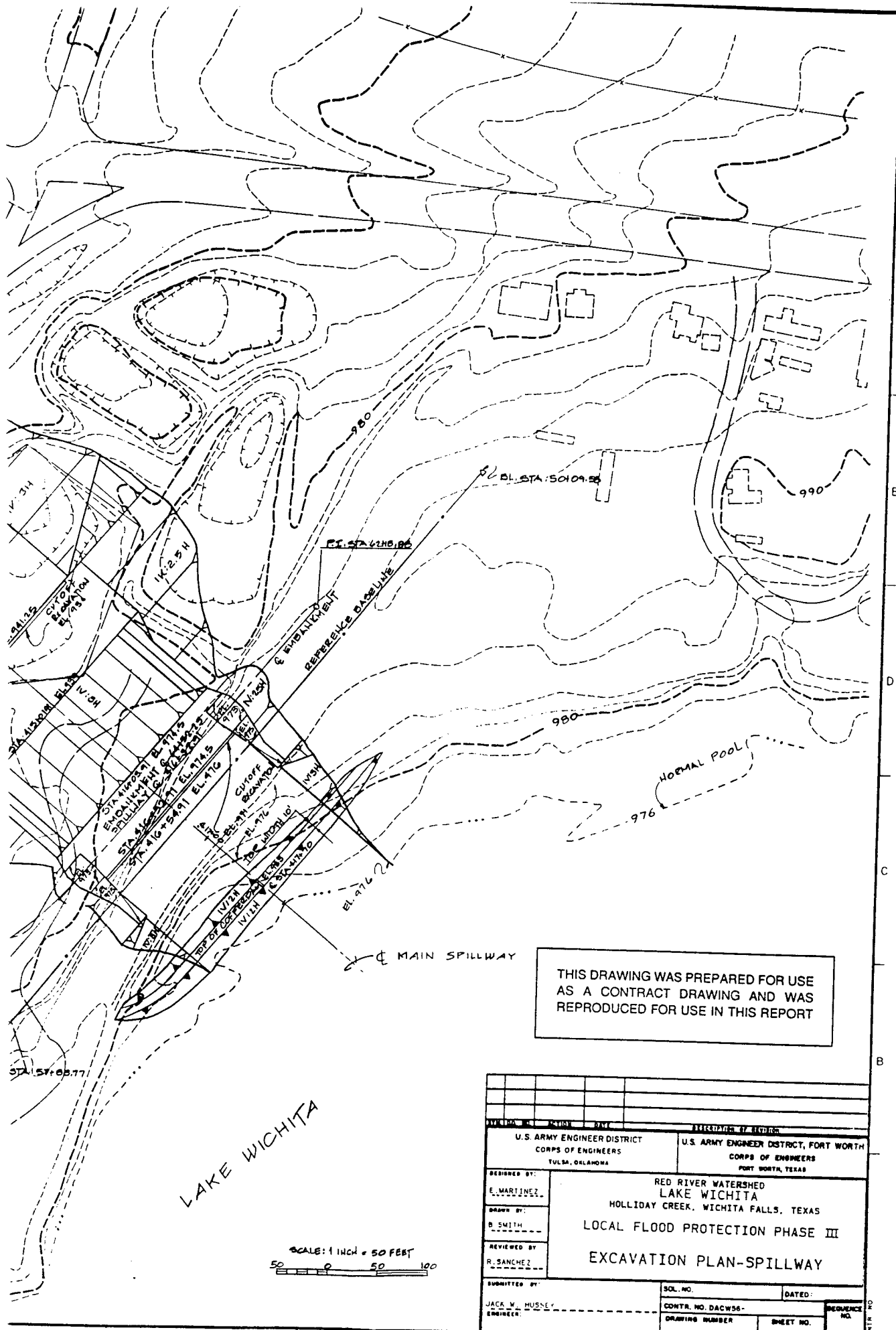
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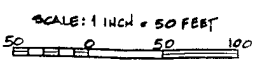
DESIGNED BY	E. MARTINEZ
DRAWN BY	B. SMITH
REVIEWED BY	R. SANCHEZ
SUBMITTED BY	JACK W. HUSSEY ENGINEER

2

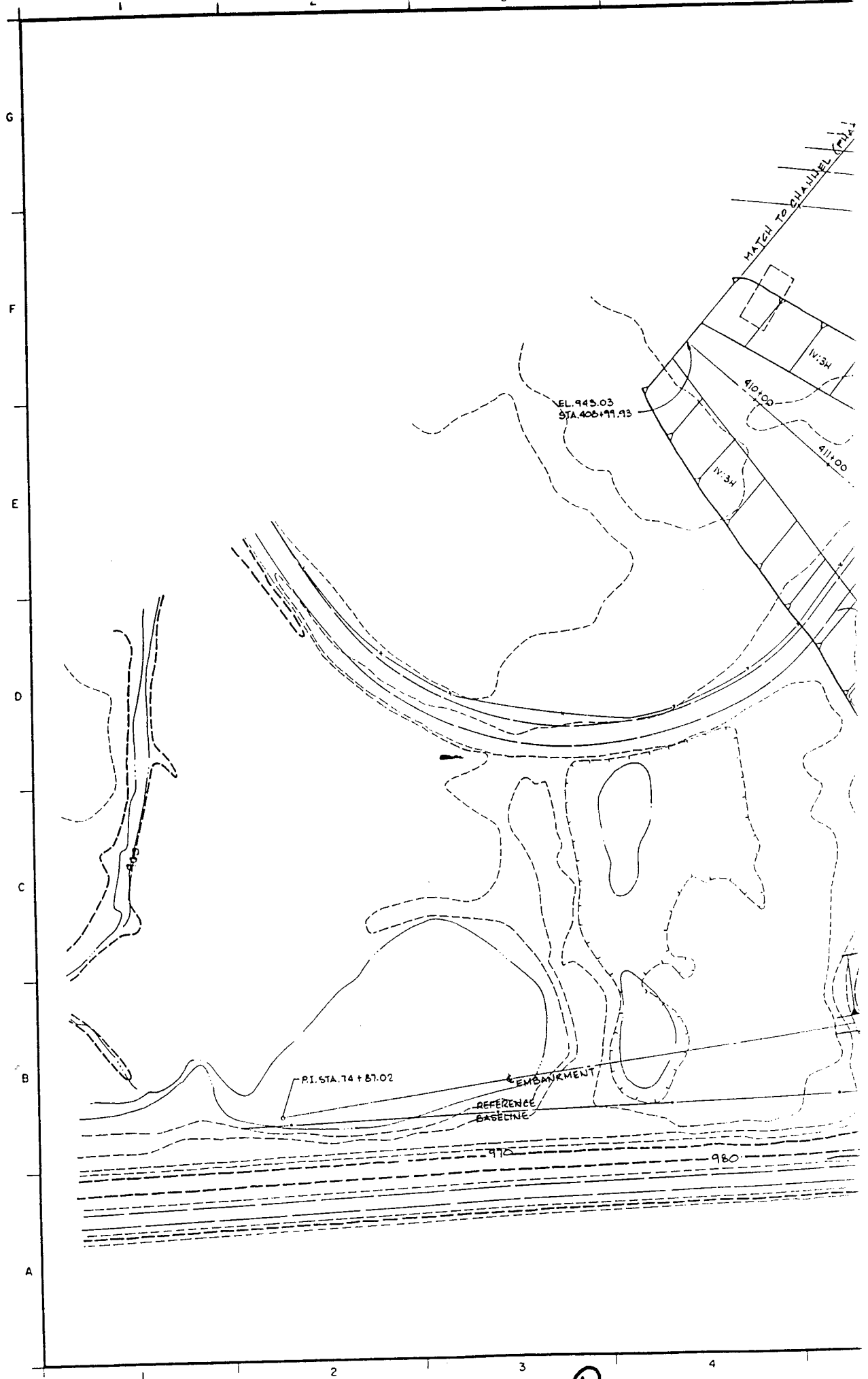


THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

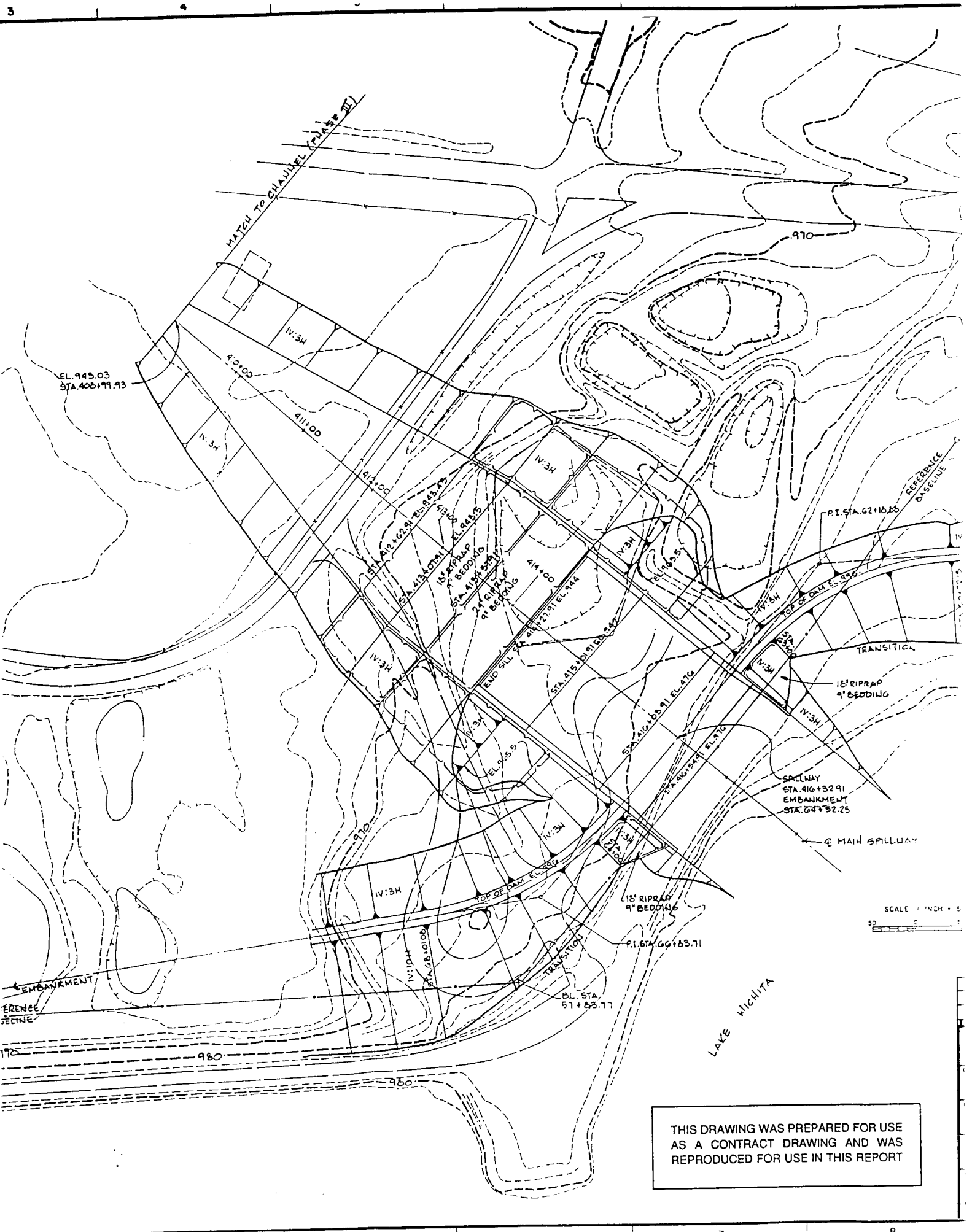
LAKE WICHITA



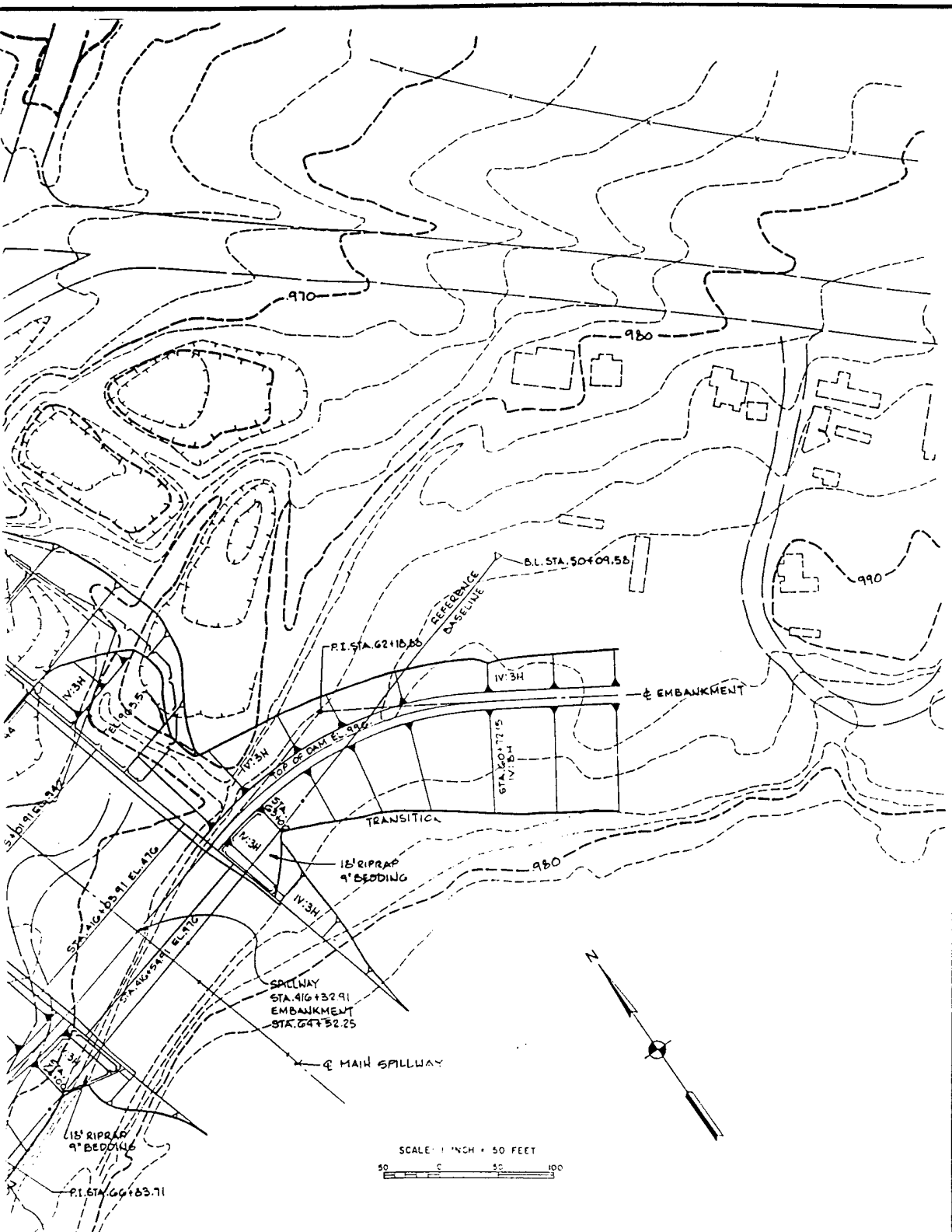
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA		U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS	
DESIGNED BY: E. MARTINEZ	RED RIVER WATERSHED LAKE WICHITA HOLLIDAY CREEK, WICHITA FALLS, TEXAS		
DRAWN BY: B. SMITH	LOCAL FLOOD PROTECTION PHASE III EXCAVATION PLAN-SPILLWAY		
REVIEWED BY: R. SANCHEZ	SUBMITTED BY: JACK W. MUSLEY ENGINEER	SOL. NO. CONTR. NO. DACW56- DRAWING NUMBER	DATED: SHEET NO. OF



①



THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT



THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA		U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS	
DESIGNED BY: E. MARTINEZ		RED RIVER WATERSHED LAKE WICHITA HOLLIDAY CREEK, WICHITA FALLS, TEXAS LOCAL FLOOD PROTECTION PHASE III GRADING PLAN - SPILLWAY	
DRAWN BY: M. BLANTON			
REVIEWED BY: S. ARMSTRONG			
SUBMITTED BY: JACK W. HUSSEY		SOL. NO.	DATED:
ENGINEER:		CONTR. NO. DACW36-	SEQUENCE NO.
		DRAWING NUMBER	SHEET NO. OF

414+00

415+00

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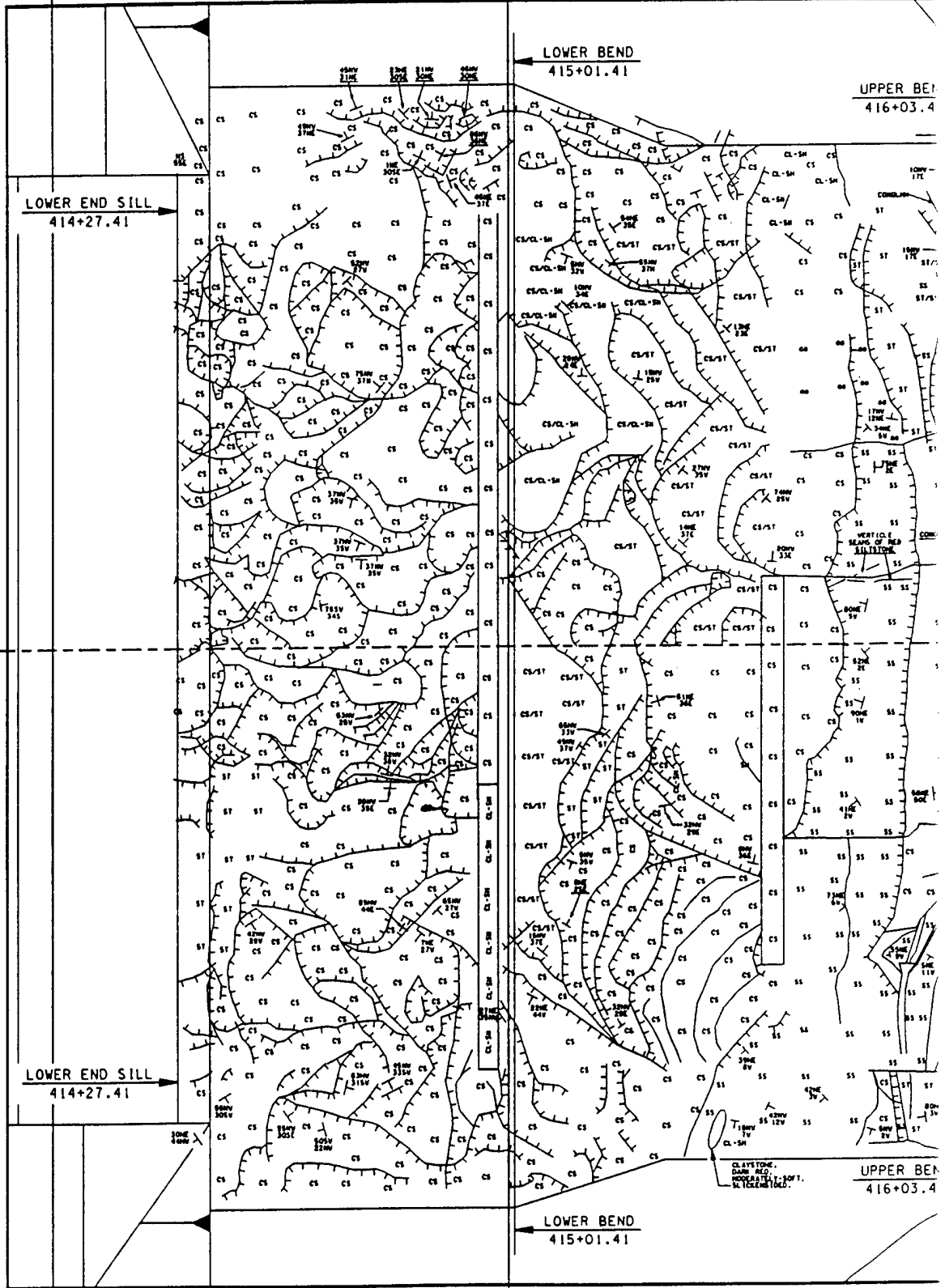
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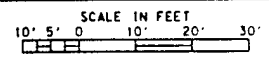


414+00

415+00

4

ENLARGED PLAN VIEW



1

416+00

417+00

CENTERLINE OF NEW EMBANKMENT 416+32.91

UPPER BEND 416+03.41

UPPER END SILL 416+53.41

UPPER END SILL 416+53.41

UPPER BEND 416+03.41

CENTERLINE OF NEW EMBANKMENT 416+32.91

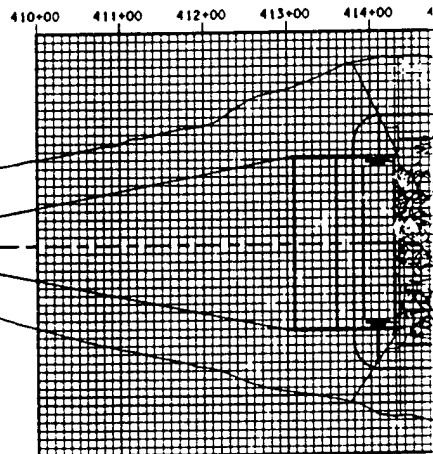
416+00

417+00

### LEGEND

- STRIKE & DIP SYMBOL  
STRIKE & DIP DIRECT
  - FRACTURE.
  - FRACTURE SHOWING DI
  - CS SANDSTONE.
  - SS SANDSTONE.
  - ST SILTSTONE.
  - CL-SH CLAY-SHALE.
- NOTE: SANDSTONE EXHIBITS CLAYSTONE IS CLAY-FISSILITY.

SEE ENLA (TH)

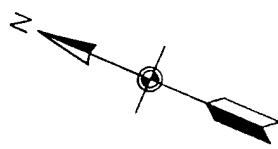


### OVERALL PLAN

SCALE IN FEET  
80' 40' 0'

### ENLARGED PLAN VIEW

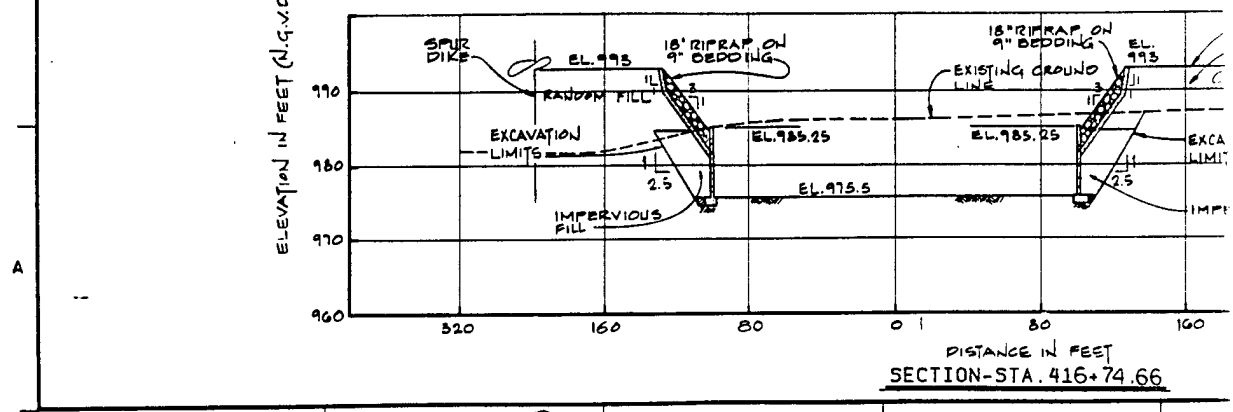
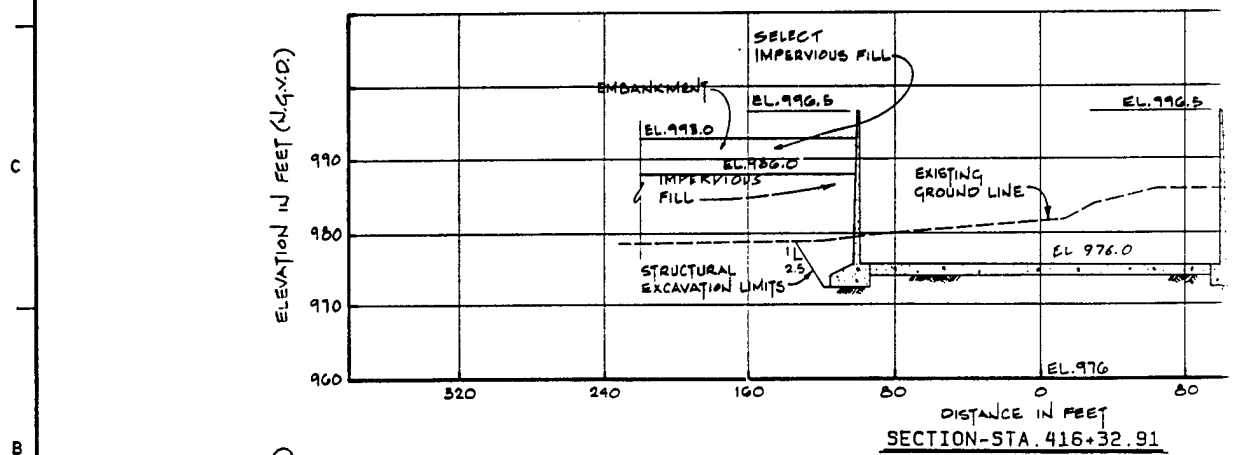
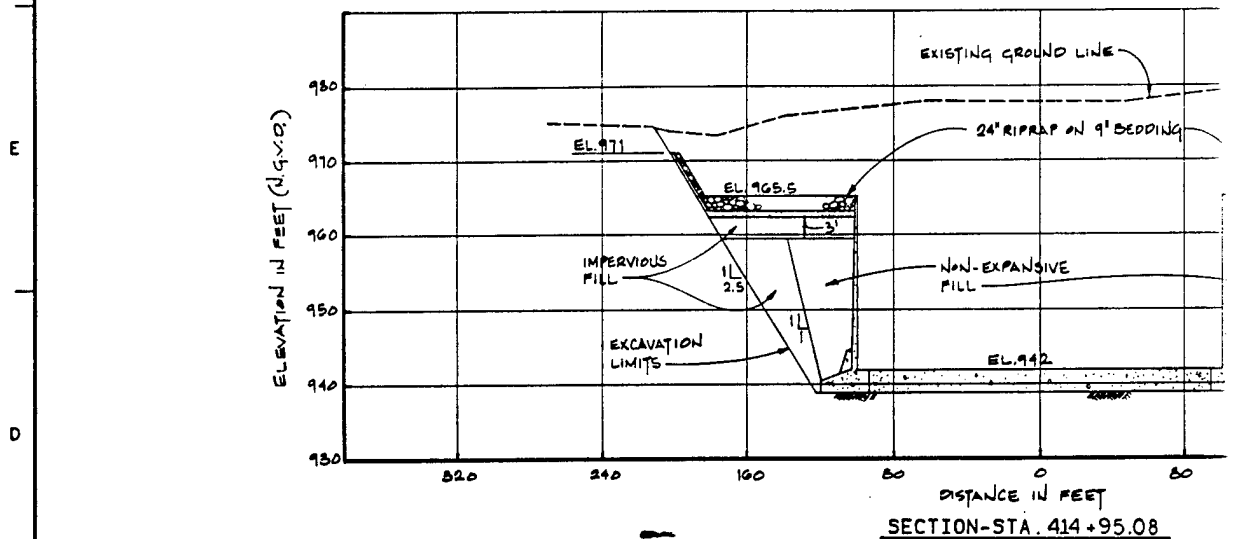
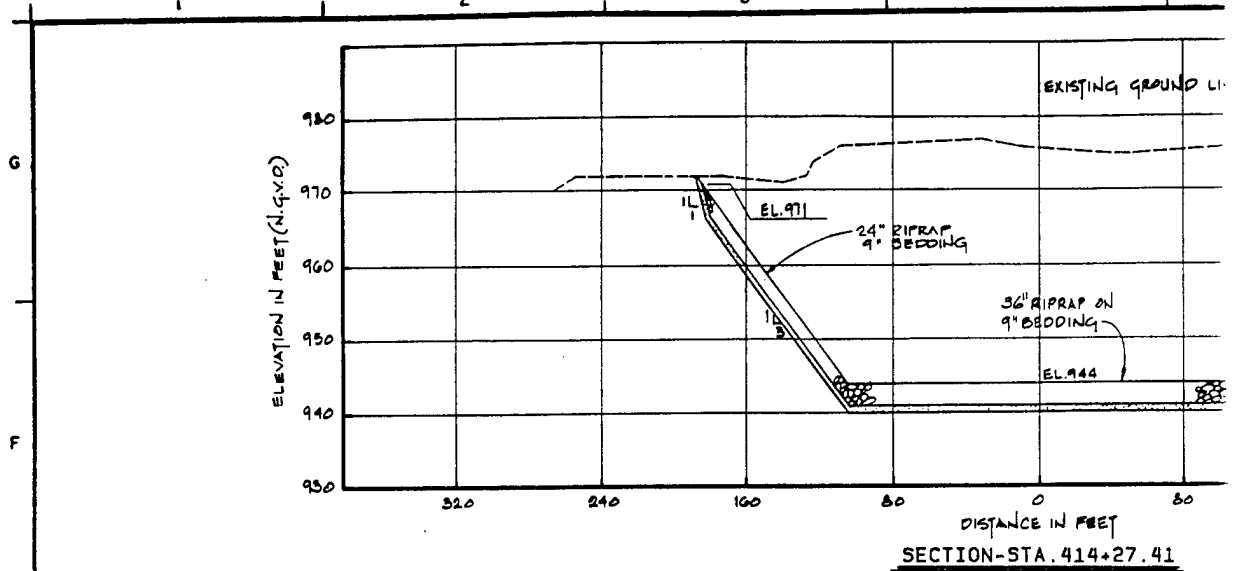
SCALE IN FEET  
10' 5' 0' 10' 20' 30'

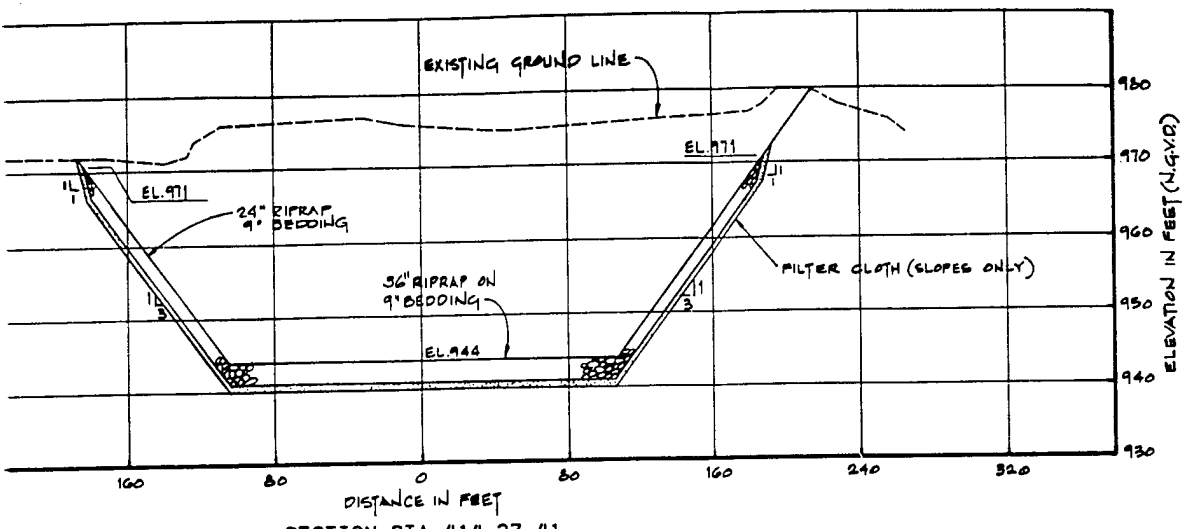


THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

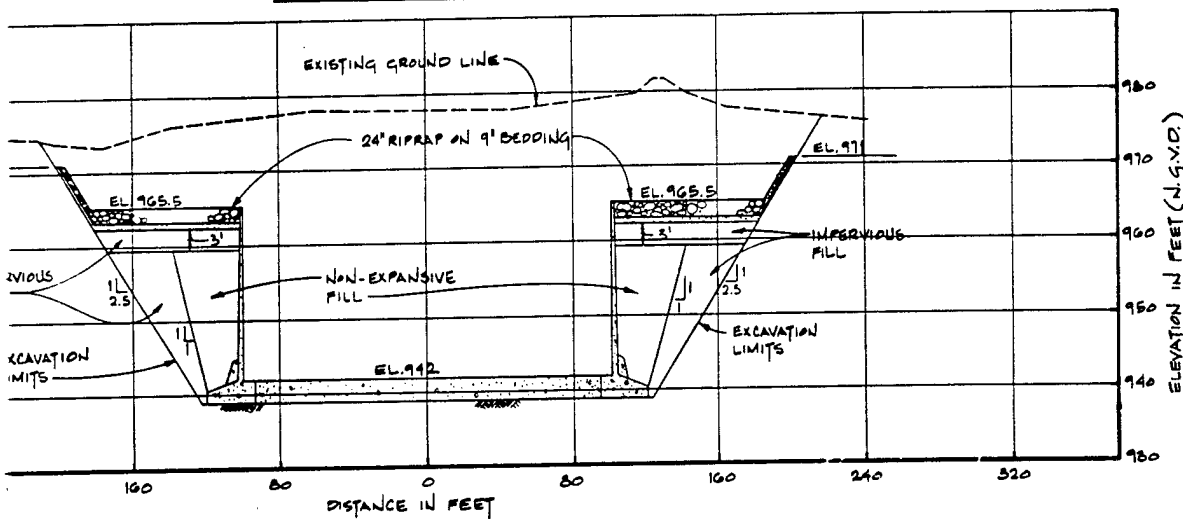
SYMBOL
<b>7</b>
DESIGNED BY FRANK OLER
DRAWN BY LORI BRUCE R. B. PETER
REVIEWED BY RON BARKER
SUBMITTED BY
CHIEF, GEOTECHNICAL PLOT SCALE AS SHOWN
DESIGN FILE DAMCRACK.DGN
PLOT DATE SEPTEMBER 15



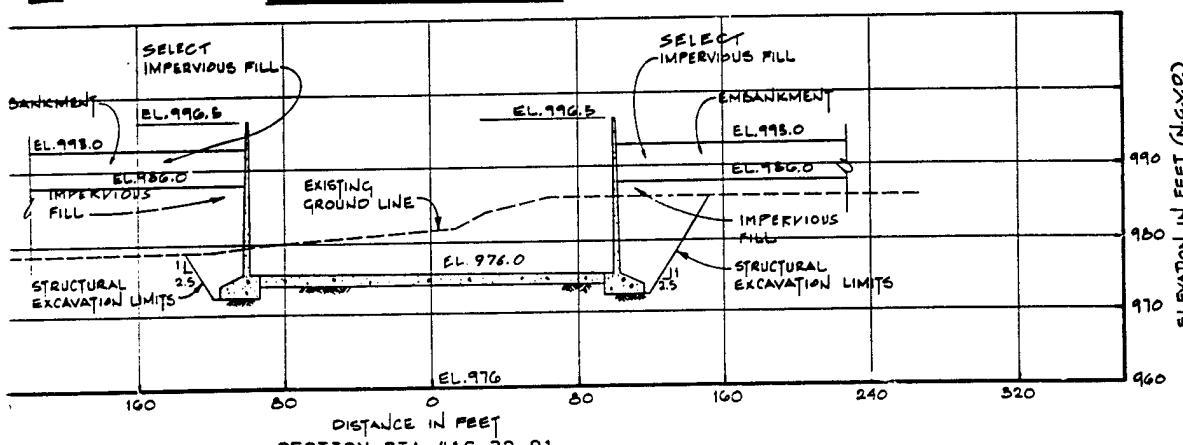




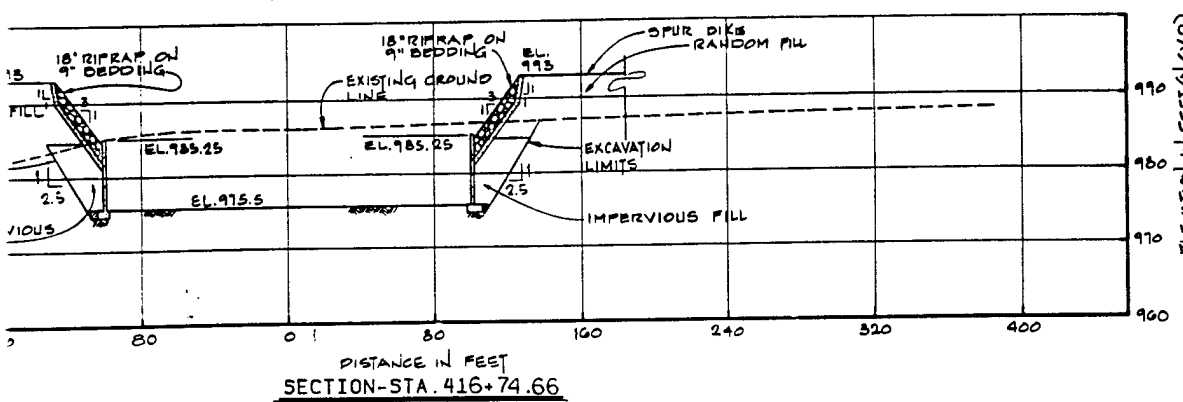
**SECTION-STA. 414+27.41**



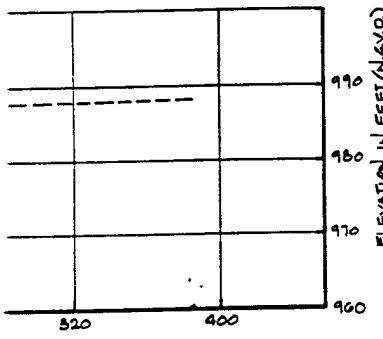
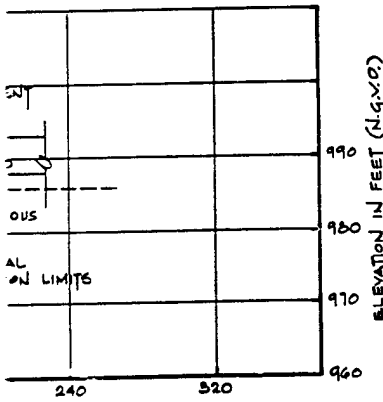
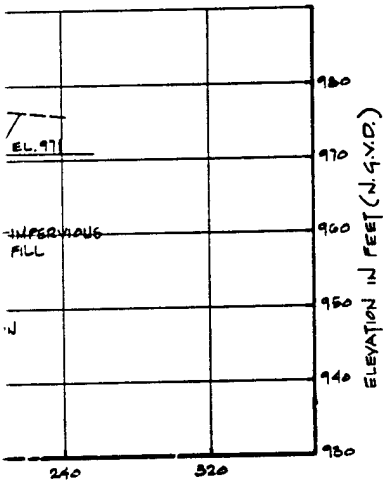
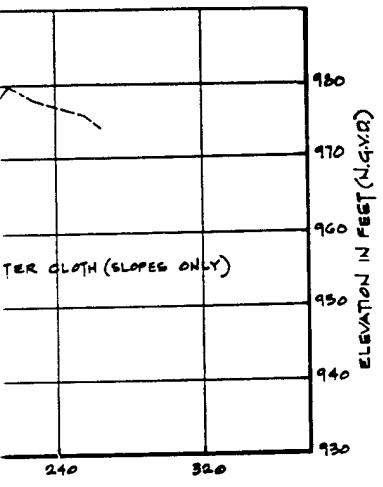
**SECTION-STA. 414+95.08**



**SECTION-STA. 416+32.91**



**SECTION-STA. 416+74.66**

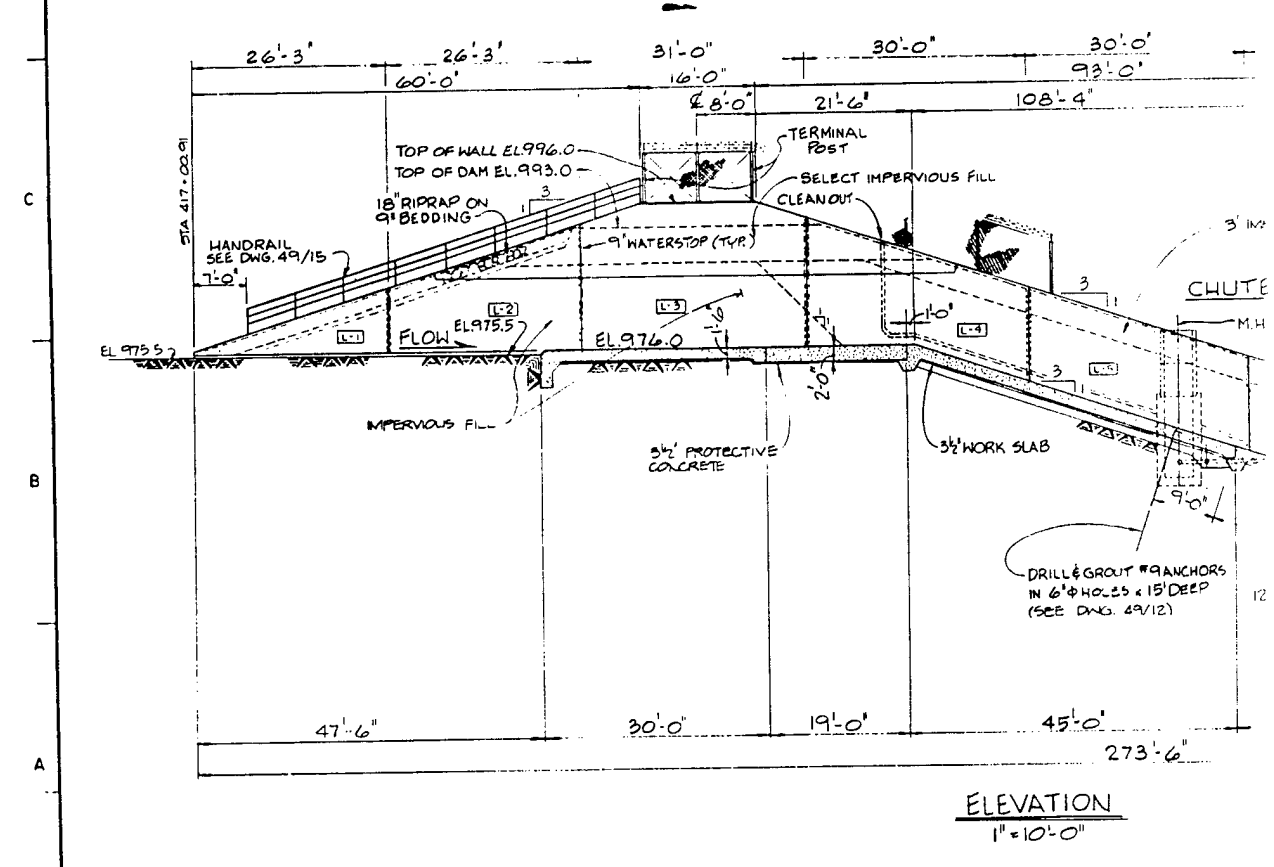
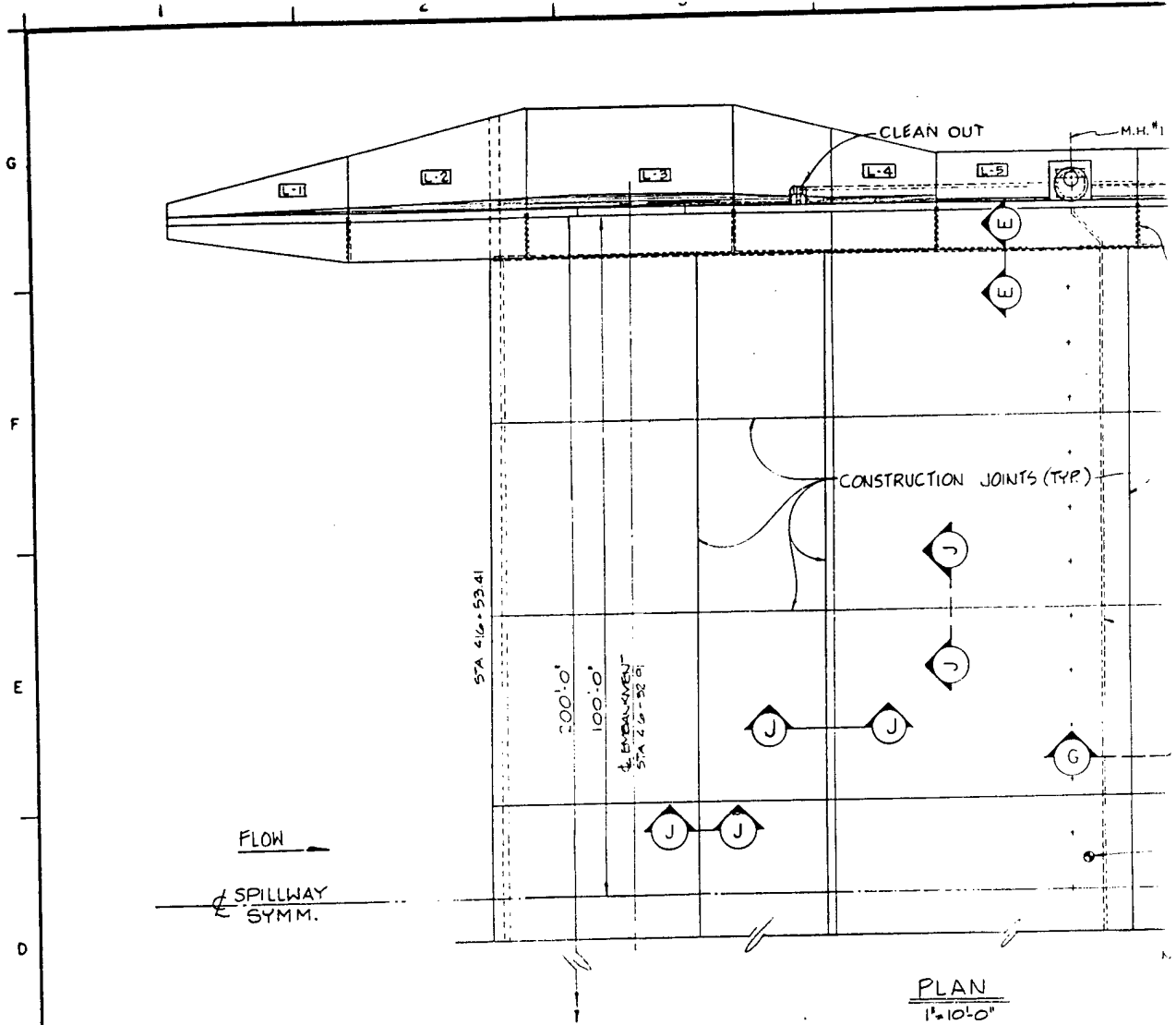


**MAIN SPILLWAY**

- NOTES:**
1. PLACE NON EXPANSIVE FILL BEHIND THE WALLS EXCEPT WHERE THE SPILLWAY PASSES THROUGH THE EMBANKMENT IMPERVIOUS CORE.

THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA		U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS	
DESIGNED BY: E. MARTINEZ	RED RIVER WATERSHED LAKE WICHITA HOLLIDAY CREEK, WICHITA FALLS, TEXAS LOCAL FLOOD PROTECTION PHASE III  <b>SPILLWAY SECTIONS</b>		
DRAWN BY: M. BLANTON			
REVIEWED BY: R. SANCHEZ			
SUBMITTED BY: JACK W. MUSSEY ENGINEER	SOL. NO. CONTR. NO. DACW56-	DATED:	SEQUENCE NO. SHEET NO. OF

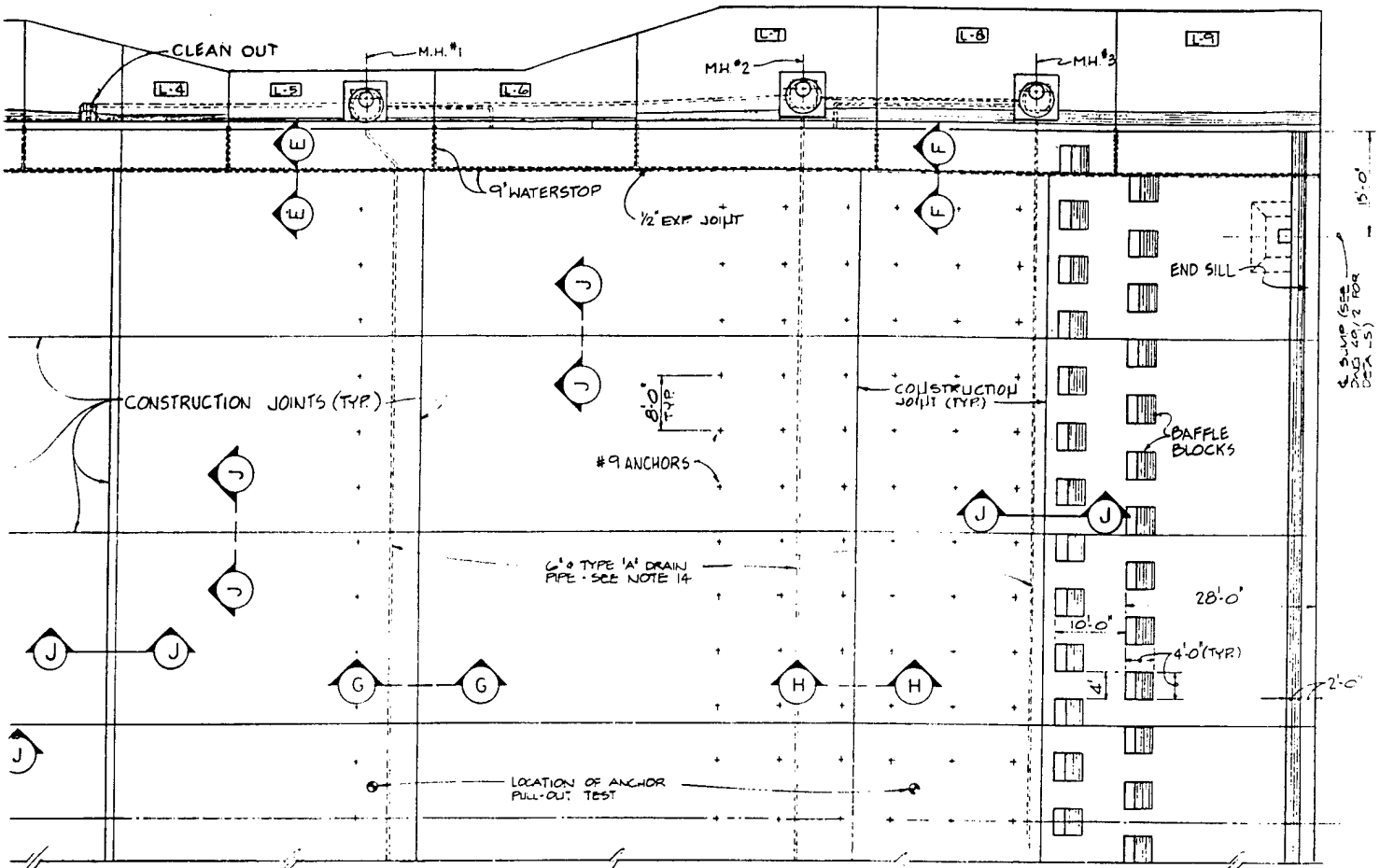


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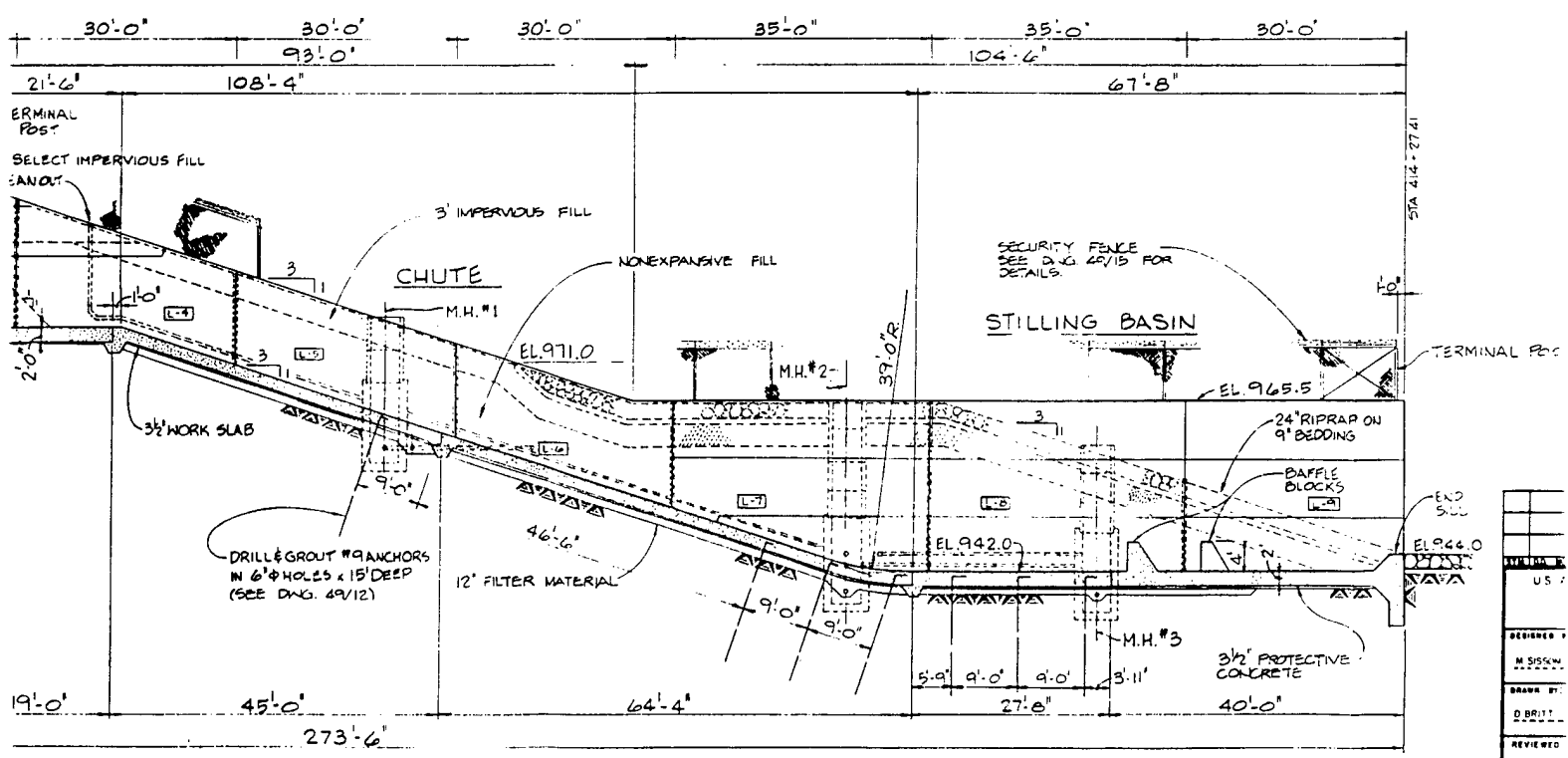
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**PLAN**  
1"=10'-0"

NOTE: SEE DNG. 49/12 FOR SECTIONS E-E, F-F, G-G, H-H, J-J AND DETAILS.

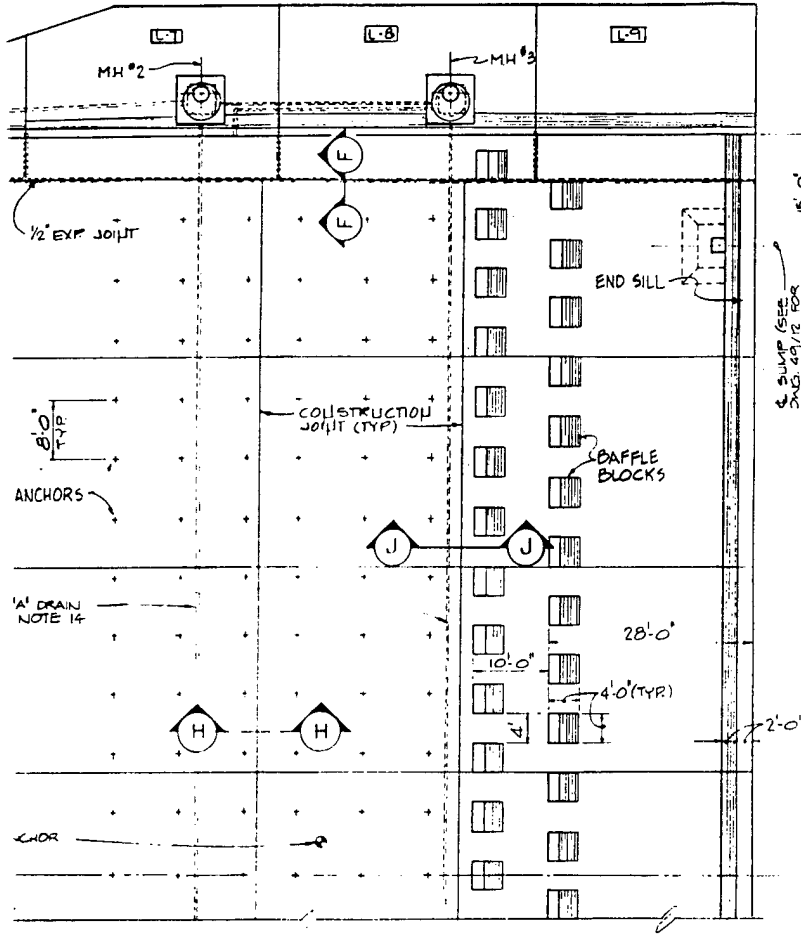


**ELEVATION**  
1"=10'-0"

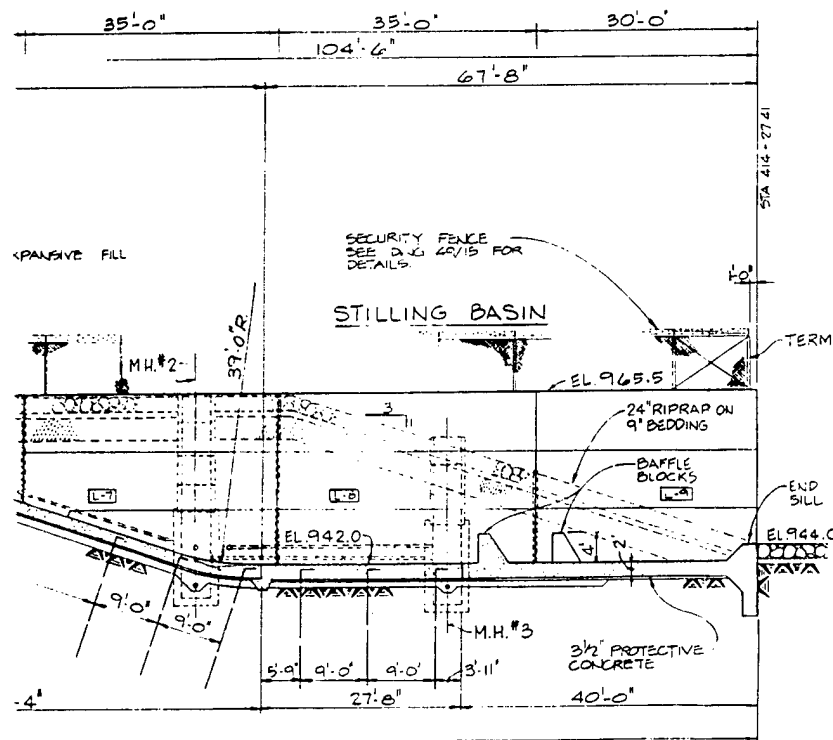
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**GENERAL NOTES**

- CONCRETE SHALL HAVE THE FOLLOWING MINIMUM COMPRESSIVE STRENGTHS (28):  
 PROTECTIVE CONCRETE/WORK SLAB.  $f_c = 3500$  psi  
 LEAN CONCRETE CONCRETE FOR BAFFLES, END-SILLS.  $f_c = 4000$  psi  
 OUTLET WORKS STRUCTURES  $f_c = 4000$  psi  
 ALL OTHER CONCRETE  $f_c = 3000$  psi
- UNLESS OTHERWISE NOTED, CONCRETE COVER OVER STEEL REINF. SHALL BE A MINIMUM OF 3.0 INCHES.
- ALL EXPOSED CONCRETE EDGES SHALL BE CHAMFERED 3/4 INCHES, EXCEPT AS NOTED.
- ALL CONCRETE SURFACES SHALL BE FINISHED IN ACCORDANCE WITH THE CONTRACT SPECIFICATIONS. ALL EXPOSED SURFACES SHALL HAVE A CLASS "B" FINISH, EXCEPT AS NOTED, AND CLASS "B" FINISH SHALL EXTEND ONE FOOT BELOW BACKFILL OR RIPRAP. CONCRETE SURFACES ONE FOOT BELOW BACKFILL OR RIPRAP AND FORMED CONSTRUCTION JOINTS SHALL HAVE A CLASS "D" FINISH.
- ALL CONSTRUCTION AND CONSTRUCTION (LIFT) JOINTS IN EXPOSED FORMED SURFACES SHALL BE CHAMFERED 3/4 INCHES UNLESS NOTED OR SHOWN OTHERWISE.
- CONSTRUCTION JOINTS (MONOLITH JOINTS) SHALL PREVENT BOND OF CONCRETE ACROSS THE JOINT. BOND BREAKING MATERIAL SHALL BE MEMBRANE CURING COMPOUND OR BITUMINOUS PAINT. WATERSTOPS SHALL BE PROTECTED FROM THE BOND BREAKING MATERIAL.
- ALL JOINTS IN THE SPILLWAY SLAB SHALL HAVE TOOLED EDGES WITH RADIUS AS SHOWN ON THE DRAWINGS. SEE DMC. 49/12.
- REINFORCING STEEL SHALL CONFORM TO THE REQUIREMENTS OF ASTM-A-615, A-616 OR A-617, GRADE 60.
- ADDITIONAL LAP SPLICES FOR THE CONVENIENCE OF THE CONTRACTOR ARE PERMISSIBLE WITHIN ANY ONE LAP LENGTH. ALL ADDITIONAL SPLICES ARE AT THE CONTRACTOR'S EXPENSE.
- ALL REINFORCING STEEL LAP AND SREBMENT LENGTHS, STANDARD HOOK DIMENSIONS AND SPLICE DETAILS SHALL BE IN ACCORDANCE WITH ACI 318-83, UNLESS OTHERWISE SHOWN OR NOTED. (SEE TABLE ON DMC. 49/15.)
- DROP STRUCTURE WINGWALLS SHALL BE BACKFILLED UNIFORMLY ON BOTH SIDES SO THAT THE MAXIMUM DIFFERENTIAL FILL HEIGHT DOES NOT EXCEED FIVE (5) FEET.
- FOR GRADATION OF RIPRAP, SEE SPECIFICATIONS.
- WATERSTOPS TO BE AS MANUFACTURED BY GREENSTREAK, INC., ST. LOUIS, MO. 63177; STYLE 756 AND 757, OR APPROVED EQUAL.
- TYPE "A" DRAIN PIPE IS CORRUGATED POLYETHYLENE PIPE WITH SLOTTED PERFORATIONS AND A FILTER FABRIC COVERING, SUCH AS "SOCK" DRAIN MANUFACTURED BY ADVANCED DRAINAGE SYSTEMS, INC. OF COLUMBUS, OHIO; OR HANCAR, INC. OF YORKUN, TEXAS.
- TO SECURE A VERTICAL OR NEAR VERTICAL CUT IN THE FOUNDATION MATERIALS, THE CONTRACTOR MAY USE ANY METHOD OF EXCAVATION APPROVED BY THE CONTRACTING OFFICER. NO PAYMENT WILL BE MADE FOR OVERBREAKAGE BEYOND THE LIMITS OF EXCAVATION SHOWN ON THE DRAWINGS. WHERE CONCRETE IS PLACED AGAINST THE FACE OF THE EXCAVATION, THE CONTRACTOR WILL BE REQUIRED TO REPLACE ANY OVERBREAKAGE WITH CONCRETE, AT HIS EXPENSE.
- THE SECTIONS OF THE SPILLWAY SLAB, AS DIVIDED BY THE INDICATED CONSTRUCTION JOINTS, SHALL BE PLACED IN AN ALTERNATING FASHION FORMING A CHECKERBOARD PATTERN. THERE SHALL BE A MINIMUM OF 72 HOURS BETWEEN PLACING ADJACENT SECTIONS. CLOSURE SECTIONS MEET TO THE RETAINING WALLS SHALL BE PLACED IN ALTERNATE FASHION AFTER COMPLETION OF THE WALL FOOTINGS.
- THE CONTRACTOR MAY, AT HIS OPTION, USE CONTINUOUS LAKE PAVING FOR THE CHUTE AND STILLING BASIN SLABS. THERE IS NO RESTRICTION ON THE WIDTH OF LAKE USED. IF THIS OPTION IS SELECTED, THE LANES SHALL BE PLACED IN ALTERNATING FASHION WITH A MINIMUM TIME OF 72 HOURS BETWEEN PLACING ADJACENT LANES. CONSTRUCTION JOINTS ARE REQUIRED BETWEEN LANES AND WHETHER CONCRETE PLACEMENT IS INTERRUPTED FOR A TIME SUFFICIENT TO CAUSE A COLD JOINT.

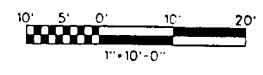


1. FOR SECTIONS E-E, F-F, AND DETAILS.

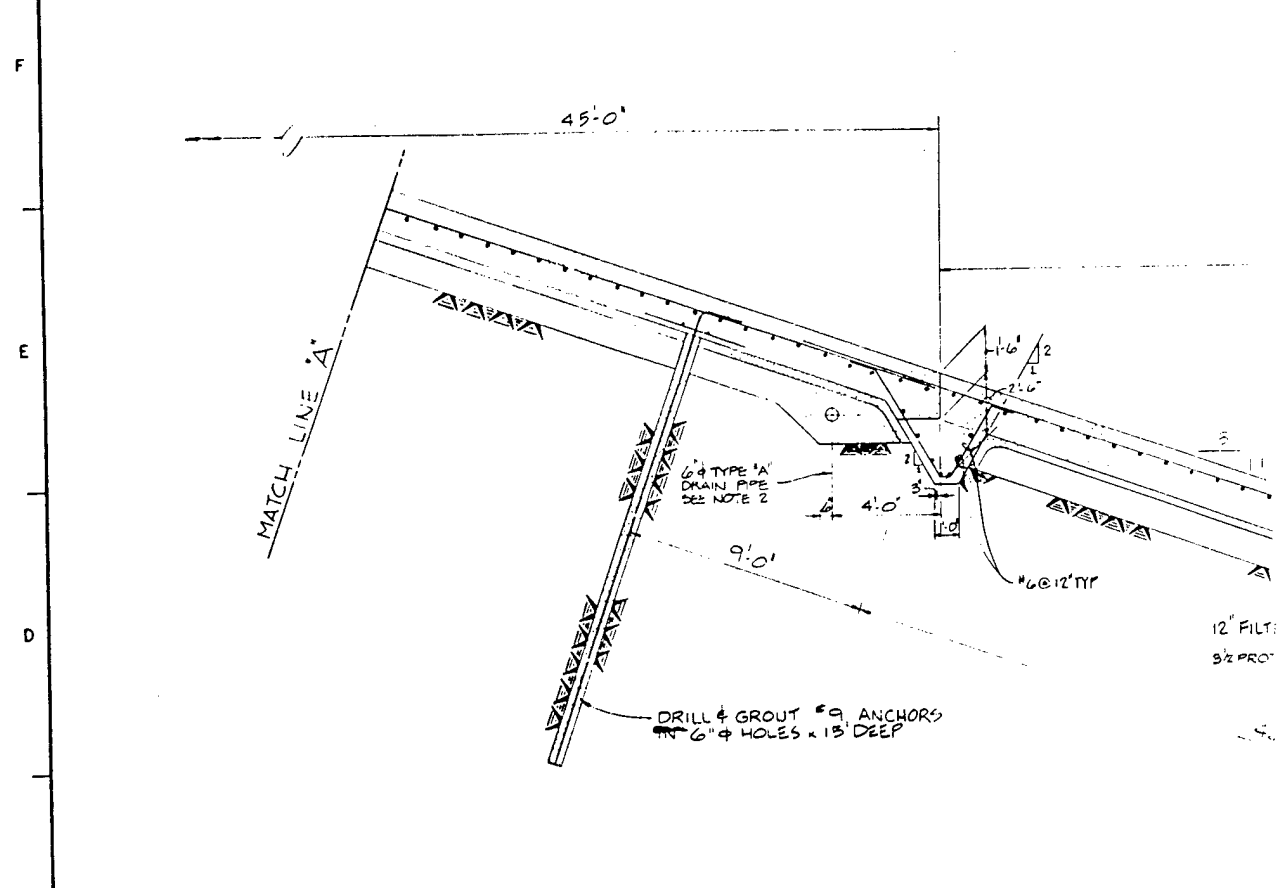
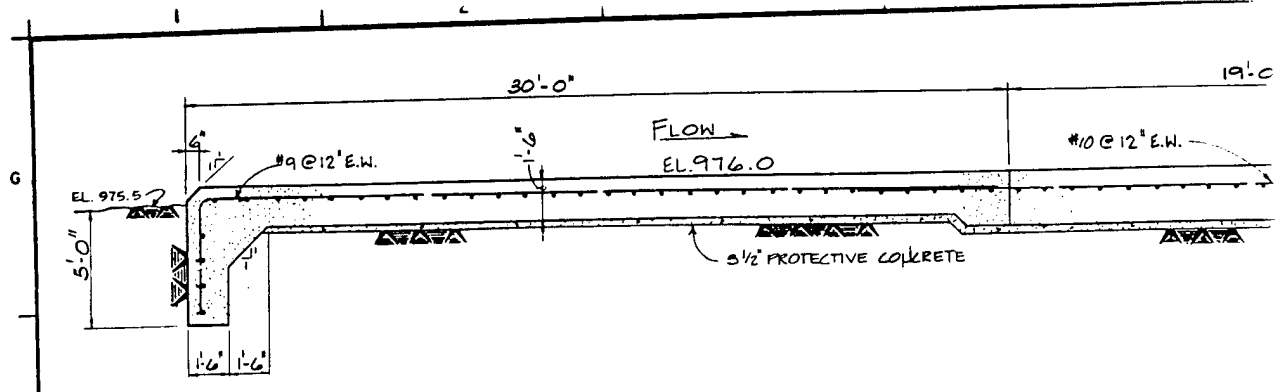


C.J. = CONSTRUCTION JOINT, M.H. = MAN-HOLE, DS. = DOWNSTREAM, U.S. = UPSTREAM, E.W. = EACH WAY, 2 F. = EACH FACE, T.F. = TOP FACE, B.F. = BOTTOM FACE, N.F. = NEAR FACE, F.F. = FAR FACE, T.F.S. = TOP & BOTTOM, C.I. = CAST IRON.

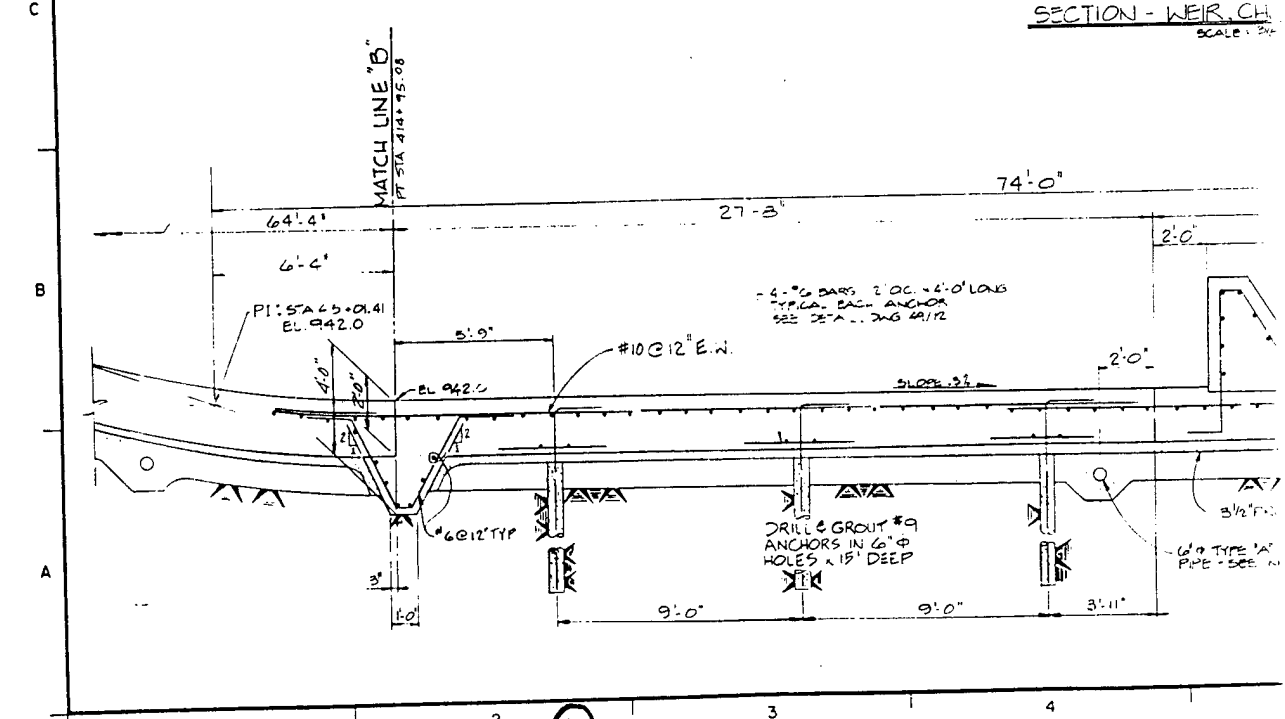
THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT



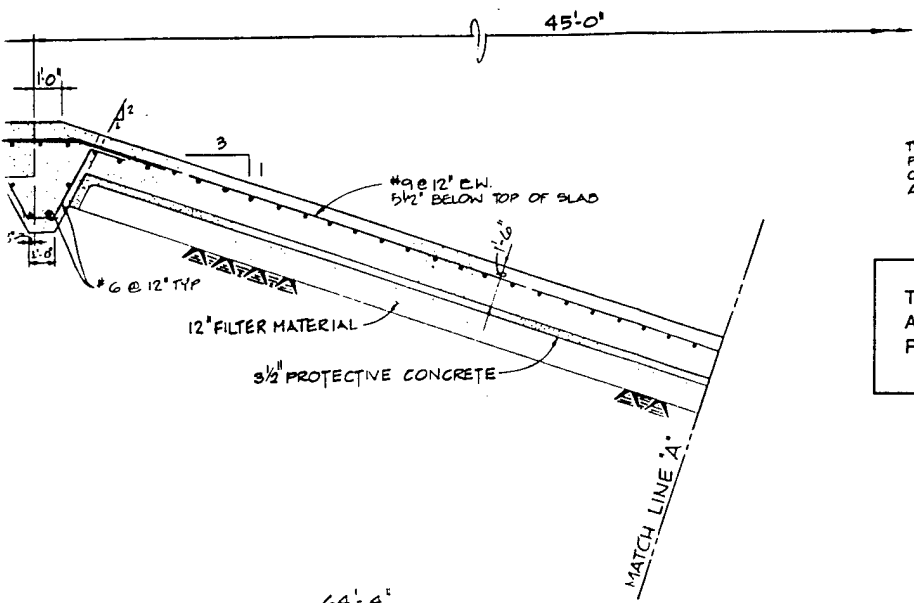
DESIGNER BY: M. SISSON		U.S. ARMY ENGINEER DISTRICT, TULSA CORPS OF ENGINEERS TULSA, OKLAHOMA		U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS	
DRAWN BY: D. BRITT		RED RIVER WATERSHED LAKE WICHITA HOLLIDAY CREEK, WICHITA FALLS, TEXAS LOCAL FLOOD PROTECTION, PHASE III MAIN SPILLWAY PLAN, PROFILE AND GENERAL NOTES			
REVIEWED BY: W. SHAWVER					
SUBMITTED BY: G.E. YOUNG ENGINEER		SOL. NO. DACW56-92-B-0032 CONTA. NO. DACW56-		DATED:	
		DRAWING NUMBER 6E360-C3-49/1		SHEET NO. OF	



SECTION - WEIR CH.  
SCALE: 3/4"

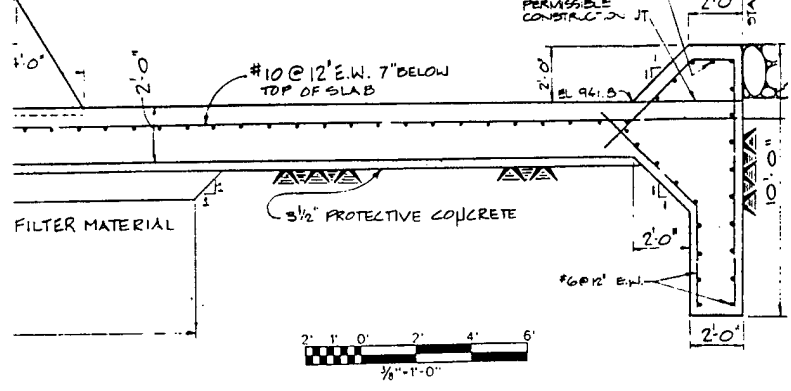
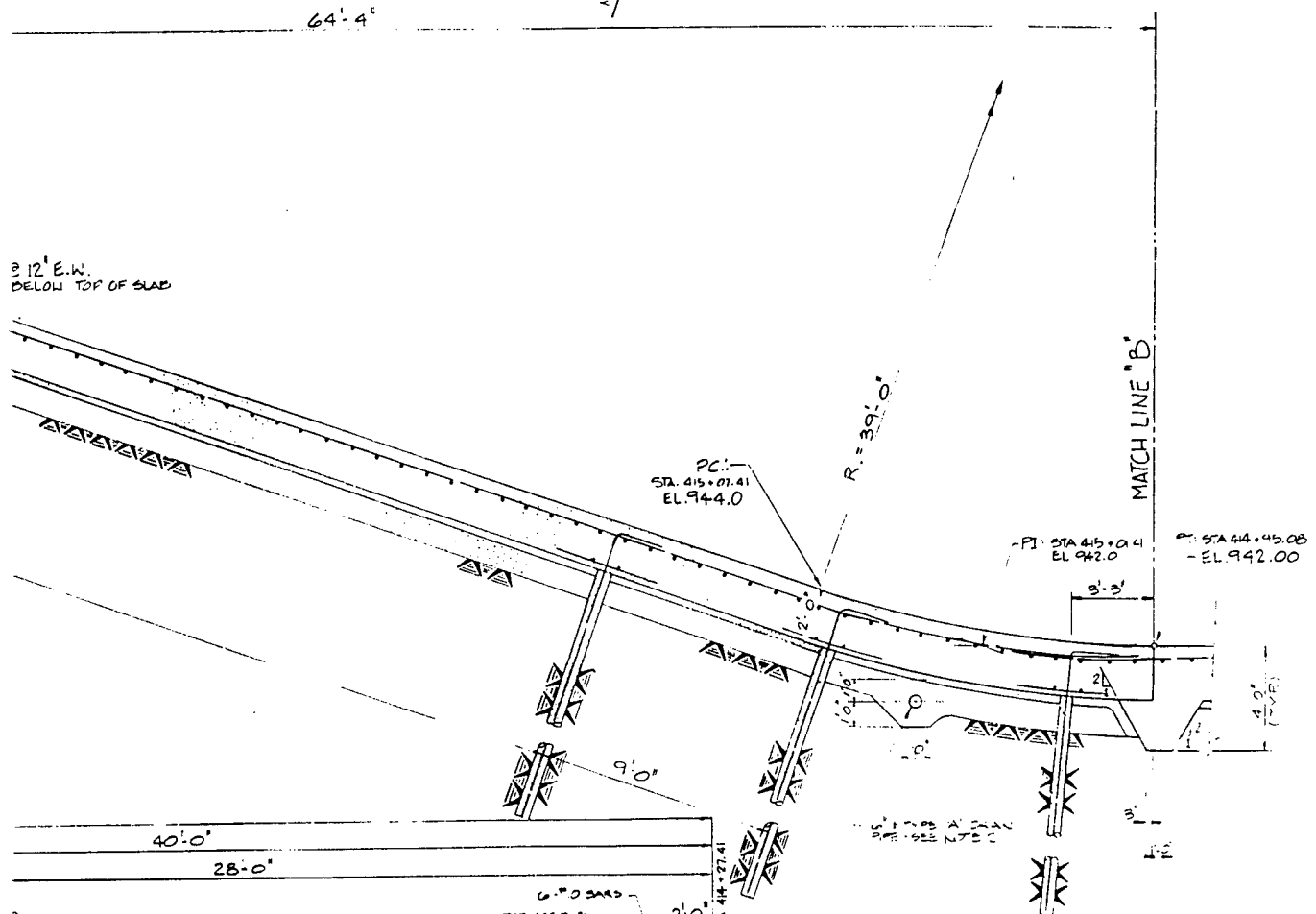






TYPE 'A' DRAIN PIPE IS CORRUGATED POLYETHYLENE PIPE WITH SLOTTED PERFORATIONS AND FILTER FABRIC COVERING SUCH AS 'SOCK' DRAIN MFG. BY ADVANCED DRAINAGE SYSTEMS OF COVINGTON, OHIO

THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

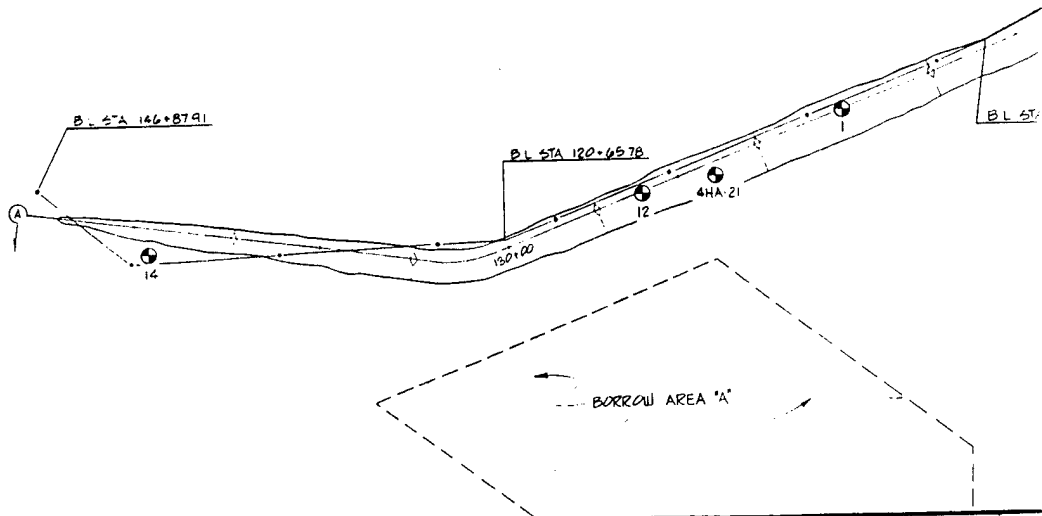


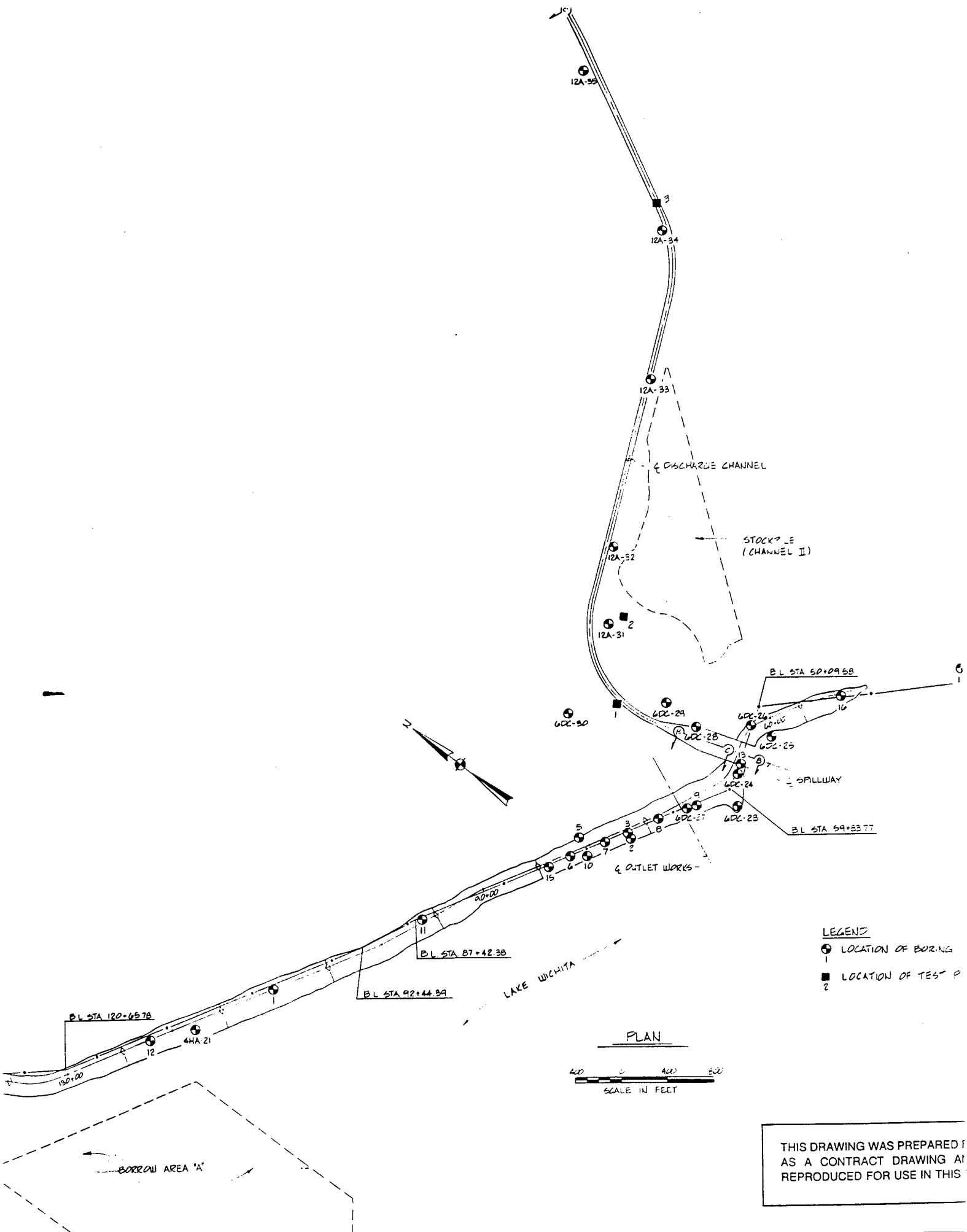
U.S. ARMY ENGINEER DISTRICT, TULSA CORPS OF ENGINEERS TULSA, OKLAHOMA		U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS	
DESIGNED BY: M. SISSON	RED RIVER WATERSHED LAKE WICHITA HOLLIDAY CREEK, WICHITA FALLS, TEXAS LOCAL FLOOD PROTECTION PHASE III		
DRAWN BY: D. BRITT	MAIN SPILLWAY WEIR AND SLAB DETAILS I		
REVIEWED BY: W. SHAWER	SUBMITTED BY: G. E. YOUNG ENGINEER		
SOL. NO. DACW56-92-B-0032 DATED:		SEQUENCE NO.	
CONTR. NO. DACW56-		SHEET NO.	
DRAWING NUMBER BE 360-C3-49/11		OF	

3

PLATE 8

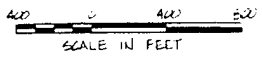
G  
F  
E  
D  
C  
B  
A



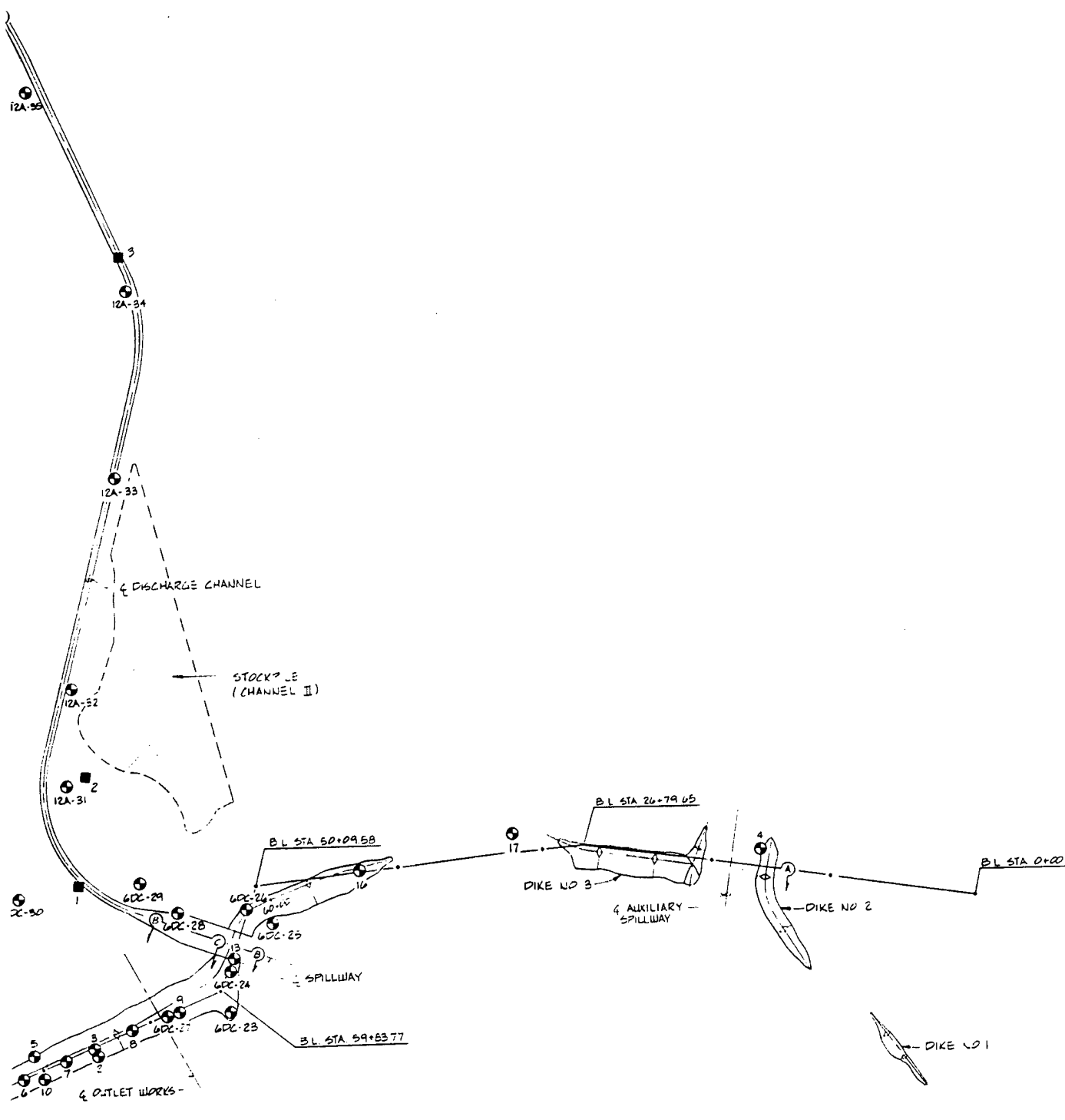


**LEGEND**  
 ⊕ LOCATION OF BORING  
 ■ LOCATION OF TEST

**PLAN**



THIS DRAWING WAS PREPARED AS A CONTRACT DRAWING AND REPRODUCED FOR USE IN THIS



**LEGEND**

- ⊕ LOCATION OF BORING
- LOCATION OF TEST PIT

**PLAN**

40 100 200 300  
SCALE IN FEET

THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

DESIGNED BY: A MARR M. KARRS		REVISIONS OF RECORD	
DRAWN BY: K. MILLER		U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS	
REVIEWED BY: R. BEHM ENGINEER		RED RIVER WATERSHED LAKE WICHITA HOLLIDAY CREEK WICHITA FALLS, TEXAS	
SUBMITTED BY: R. BEHM ENGINEER		LOCAL FLOOD PROTECTION PHASE III	
CONTR. NO.		DATED:	
DRAWING NUMBER		SEQUENCE NO.	
SHEET NO.		OF	

G

F

E

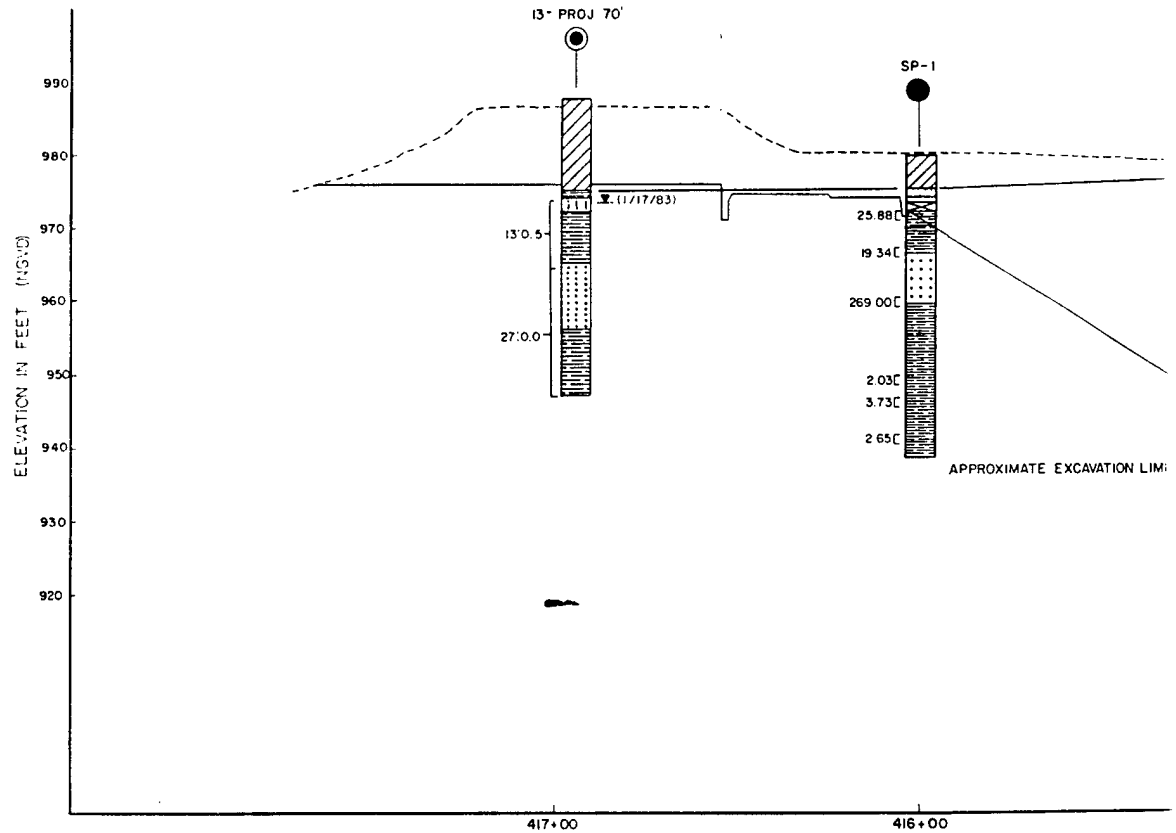
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C

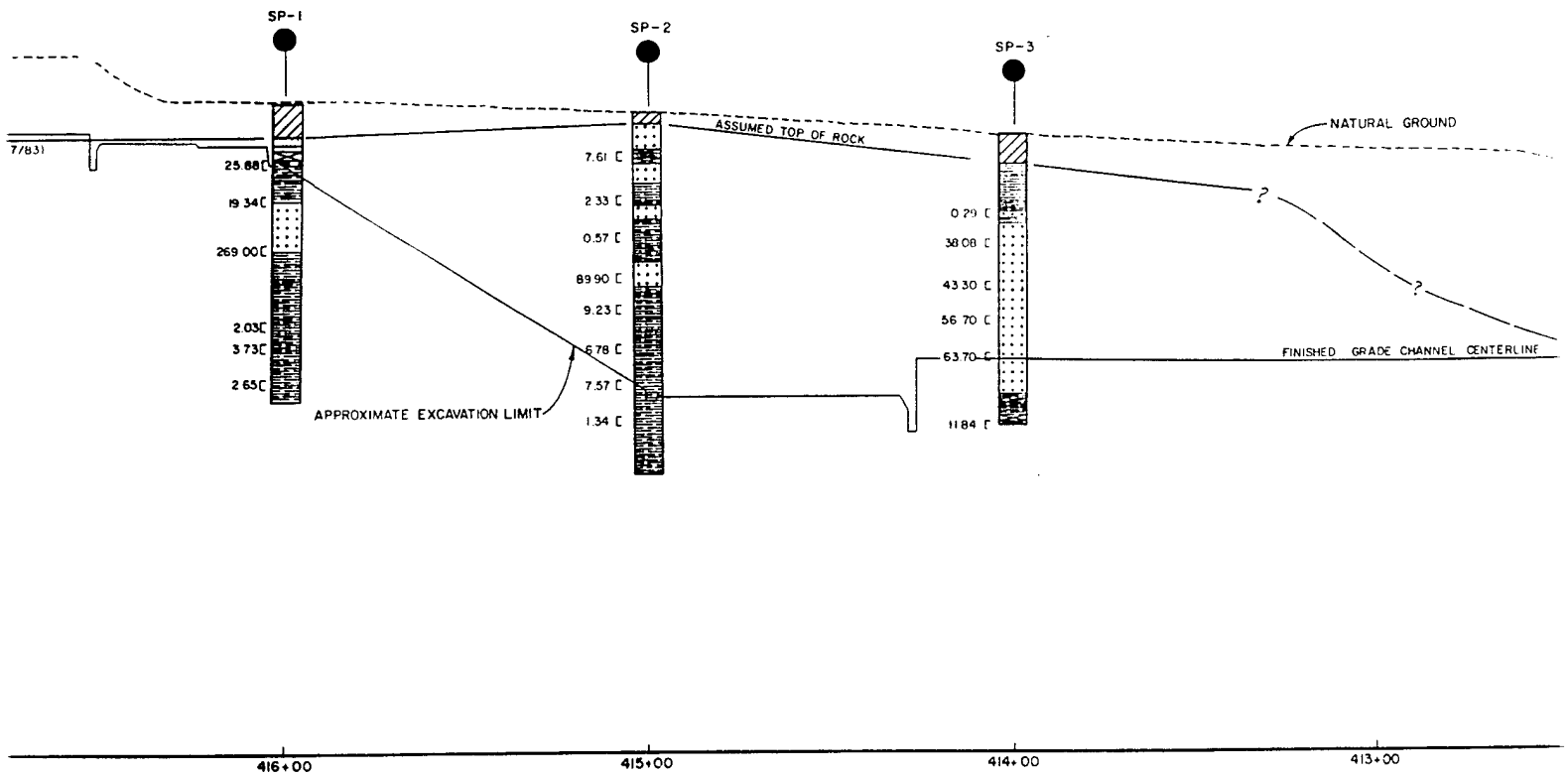
B

A

NEW EMBANKMENT



NEW EMBANKMENT

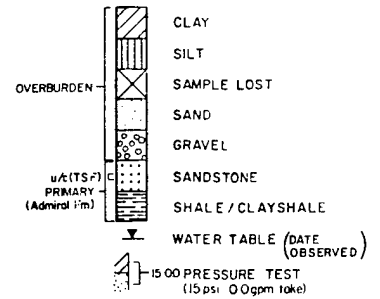


SPILLWAY STATIONS IN FEET

SPILLWAY PROFILE  
SECTION B-B

LEGEND

- AUGER HOLE
- CORE HOLE
- ⊙ CORE AND DENISON BARREL HOLE
- ⊕ DENISON BARREL HOLE



BY: [ ]

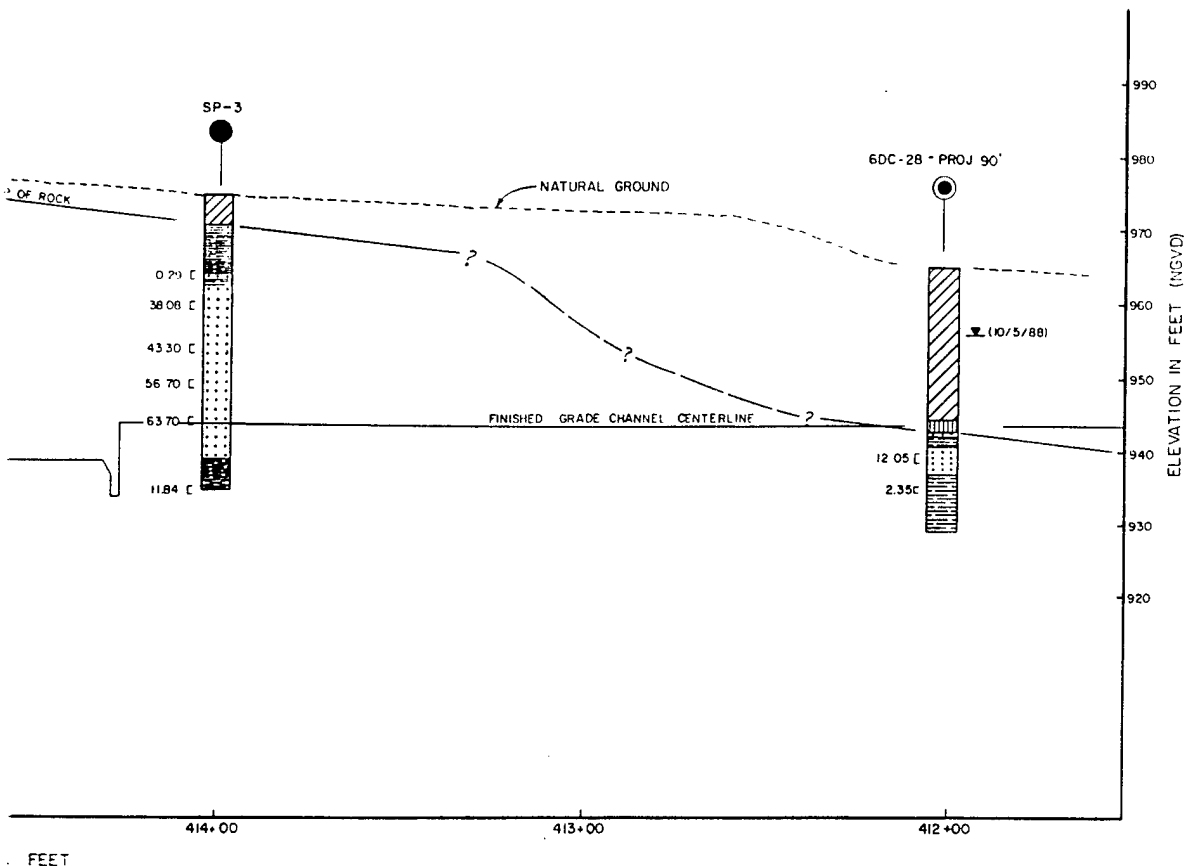
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R: [ ]

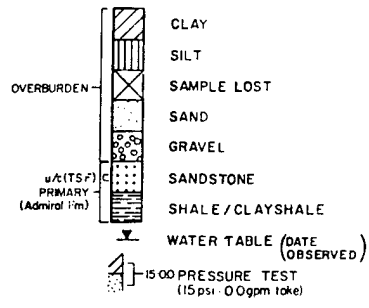
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F



**LEGEND**

- AUGER HOLE
- CORE HOLE
- CORE AND DENISON BARREL HOLE
- DENISON BARREL HOLE



THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

DESIGNED BY: A. MARR		DRAWN BY: C. KIRBY		REVIEWED BY: R. BEHM		SUBMITTED BY: ROBERT C. BEHM	
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA		U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS		RED RIVER WATERSHED LAKE WICHITA HOLLIDAY CREEK, WICHITA FALLS, TEXAS LOCAL FLOOD PROTECTION PHASE III SPILLWAY CENTERLINE PROFILE			
CONTR. NO. DACW56-		DRAWING NUMBER BE 360-C3-9R/3		SHEET NO. OF		SEQUENCE NO.	

3

PLATE 10