

AD-A142 769

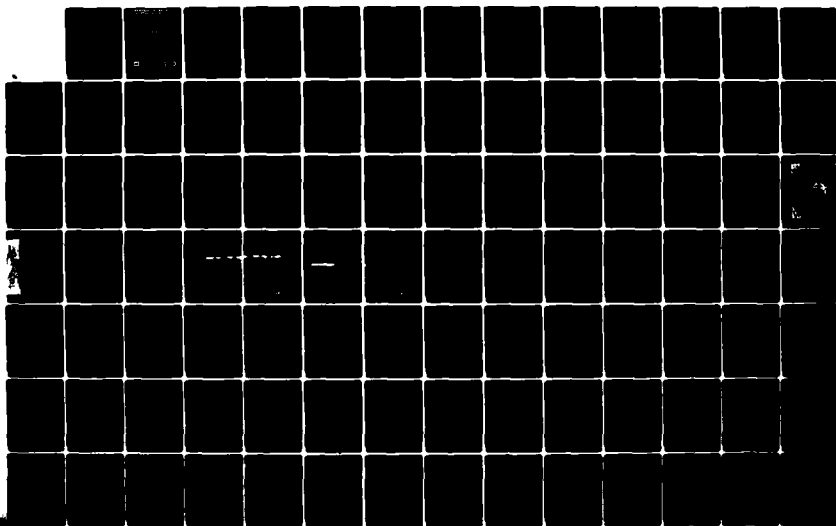
EMBANKMENT CRITERIA AND PERFORMANCE REPORT SALT CREEK
AND TRIBUTARIES NEBRASKA SITE 18 BRANCHED OAK DAM AND
LAKE(U) CORPS OF ENGINEERS OMAHA NE MAY 84

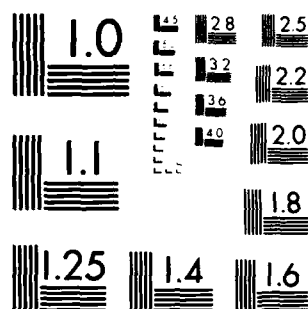
1/2

UNCLASSIFIED

F/G 13/13

NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

②

MAY 1984

AD A1 42769

SALT CREEK AND TRIBUTARIES, NEBRASKA

SITE 18

BRANCHED OAK DAM AND LAKE

AD A1 42769

DTIC FILE COPY



US Army Corps
of Engineers
Omaha District

DTIC
ELECTE
JUL 10 1984
S E D

84 07 05 112

DISK 39-C
PROJECT C6657

SALT CREEK AND TRIBUTARIES

BRANCHED OAK DAM AND LAKE

SITE 18

RAYMOND, NEBRASKA

EMBANKMENT CRITERIA AND PERFORMANCE REPORT



Accession For	
NTIS GRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	<i>form 50 per</i>
By _____	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
<i>A-1</i>	

PREPARED BY: UNITED STATES ARMY
CORPS OF ENGINEERS
OMAHA DISTRICT

**SALT CREEK AND TRIBUTARIES
BRANCHED OAK DAM AND LAKE
SITE 18
RAYMOND, NEBRASKA**

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

TABLE OF CONTENTS

<u>Paragraph</u>	<u>Title</u>	<u>Page No.</u>
PERTINENT DATA		PD 1-2
1.	INTRODUCTION	1
1.1.	Purpose of Report	1
1.2.	Authorization and Purpose of Project	1
1.3.	Location and Description of Project	1
1.4.	Project Maintenance	2
1.5.	History of Project Design	2
1.5.1.	Survey Report	2
1.5.2.	General Design	2
1.5.3.	Final Design	2
1.6.	History of Project Construction	3
2.	GEOLOGY	3
3.	FOUNDATION INVESTIGATION	4
3.1.	Subsurface Exploration	4
3.2.	Foundation Conditions	5
4.	FOUNDATION PREPARATION	5
5.	EMBANKMENT	6
5.1.	Embankment Section	6
5.2.	Embankment Materials	6
5.2.1.	Earthfill	6
5.2.2.	Embankment Drain Filter Material	7
5.2.3.	Slope Protection	7
5.2.3.1.	Riprap	7
5.2.3.2.	Spalls	8
5.2.3.3.	Bedding	8
5.2.3.4.	Gravel Surfacing	8
5.3.	Embankment Placement	9
5.3.1.	General	9
5.3.2.	Compacted Embankment Fill	9
5.3.3.	Embankment Bern Fill	10
5.3.4.	Embankment Drain Filter Material	10
5.3.5.	Slope Protection Placement	11

TABLE OF CONTENTS CONT'D

<u>Paragraph</u>	<u>Title</u>	<u>Page No.</u>
	5.3.5.1. Riprap	11
	5.3.5.2. Spalls	11
	5.3.5.3. Bedding	11
	5.3.5.4. Gravel Surfacing	11
5.4.	Embankment Settlement	12
5.5.	Laboratory Testing	12
	5.5.1. Triaxial Compression Tests	12
	5.5.1.1. Undisturbed Alluvium Foundation	12
	5.5.1.2. Remolded Embankment Material	13
	5.5.2. Direct Shear Tests	13
	5.5.3. Adopted Design Values	14
5.6.	Embankment Stability	14
	5.6.1. Method of Analyses	14
	5.6.2. Design Cases	14
	5.6.2.1. End of Construction	15
	5.6.2.2. Steady Seepage Case	15
	5.6.2.3. Partial Pool	15
	5.6.2.4. Sudden Drawdown	15
	5.6.3. Summary	15
5.7.	Seepage Control	16
	5.7.1. Embankment	16
	5.7.2. Foundation	16
	5.7.3. Abutment	17
5.8.	Diversion and Closure	17
6.	EMERGENCY SPILLWAY	17
7.	OUTLET WORKS	18
	7.1. Intake Structure	18
	7.2. Conduit	18
	7.3. Stilling Basin and Outlet Channel	19
8.	INSTRUMENTATION AND RESPONSE	19
	8.1. General	19
	8.2. Pore Pressure Piezometers	19
	8.3. Open Tube Type Piezometers	20
	8.4. Foundation Settlement Gauges	20
	8.5. Crest Movement Markers	20
	8.6. Intake Structure Movement	21
	8.7. Conduit Movement	21
	8.8. Reservoir Stage Recorder	21
9.	CONSTRUCTION MODIFICATIONS	21
	9.1. General	21
	9.2. Contract Modifications	22

TABLE OF CONTENTS CONT'D

<u>Paragraph</u>	<u>Title</u>	<u>Page No.</u>
10.	OPERATIONAL HISTORY AND PERFORMANCE	23
10.1.	General	23
10.2.	Inspections	23
10.3.	Reservoir Levels	24
10.4.	Significant Operational Events	24
	10.4.1. Crest Road	24
	10.4.2. Seepage	24
	10.4.2.1. Relief Well	25
	10.4.2.2. Seepage Drains	25
	10.4.3. Service Road	26
	10.4.4. Water Rights Gate	26
10.5.	Performance	26

APPENDIX A - DRAWINGS

<u>Plate No.</u>	<u>Title</u>
A1	Project Location Map
A2	Excavation and Embankment Plan - Sheet 1
A3	Excavation and Embankment Plan - Sheet 2
A4	Boring Location - General Plan
A5	General Soil and Geologic Profile Along Embankment Centerline
A6	Boring Legend and Record of Borings - Left Abutment Area
A7	Record of Borings - Embankment Area: Sections A-A and B-B
A8	Record of Borings - Left Abutment Area: Section G-G and H-H
A9	Record of Borings - Right Abutment Area: Sections I-I, J-J, and K-K
A10	Record of Borings - Right Abutment Area
A11	Record of Borings - Right Abutment Area: Sections E-E and F-F
A12	Record of Borings - Left Abutment Area: Sections C-C and D-D
A13	Record of Borings - Left Abutment Area: Sections L-L and M-M
A14	Record of Borings - Upstream Borrow Areas
A15	Record of Borings - Spillway Area
A16	Typical Sections - Embankment, Embankment Drain, and Outlet Channel
A17	Embankment - Sections and Details
A18	Laboratory Test Data - Remolded Embankment Material: Compaction Tests, Triaxial, and Direct Shear Test Summaries
A19	Laboratory Test Data - Consolidation Tests: Flood Plain Alluvium
A20	Laboratory Test Data - Consolidation Tests: Abutment and Outlet Works Area
A21	Laboratory Test Data - Unconsolidated - Undrained "Q" Test: Stratum "A"
A22	Laboratory Test Data - Unconsolidated - Undrained "Q" Tests: Stratum "B"
A23	Laboratory Test Data - Consolidated - Undrained "R" Tests
A24	Laboratory Test Data - Remolded Embankment Material: Triaxial "Q" and "R" and Direct Shear "S" Tests
A25	Laboratory Test Data - Direct Shear "S" Tests
A26	Stability Analyses - Circular Arc Method: Construction and Seepage Cases
A27	Stability Analyses - Circular Arc Method: Sudden Drawdown and Partial Pool Cases
A28	Stability Analyses - Wedge Method: End of Construction Case

APPENDIX A - DRAWINGS (CON'T)

<u>Plate No.</u>	<u>Title</u>
A29	Diversion and Closure - Plan and Section
A30	Spillway - Grading Plan and Section
A31	Outlet Works - Excavation Plan: Sheet 1
A32	Outlet Works - Excavation Plan: Sheet 2
A33	Outlet Works - Embankment Plan and Section: Sheet 1
A34	Outlet Works - Embankment Plan: Sheet 2
A35	Outlet Works - Sections
A36	Intake Structure - Miscellaneous Details
A37	Water Rights Gate - Details
A38	Outlet Works - Conduit: Concrete and Reinforcement Details
A39	Stilling Basin Details
A40	Embankment Berm - Plan and Section

NOTE: Many of the Plates used are the original Construction Plates and contain notes referring to the construction of the dam.

APPENDIX B - PHOTOGRAPHS

<u>Plate No.</u>	<u>Photo No.</u>	<u>Description</u>
B1	1	Aerial view of project. High Pool Condition.
	2	Aerial view of project. High Pool Condition.
B2	3	Aerial view of project. High Pool Condition.
	4	Aerial view of project during ponding of the reservoir.
B3	5	View of upstream embankment slope.
	6	View of upstream embankment slope, crushed rock surfaced service road, and upstream slope riprap protection.
B4	7	Overview of dam crest, downstream slope, and right abutment
	8	View of downstream slope of the dam.
B5	9	View of upstream embankment slope, crushed rock surfaced service road, riprap slope protection, and outlet works intake tower.
	10	View of riprap slope protection on the IV on 3H upstream embankment slope.
B6	11	View of riprap slope protection on right abutment shoreline area.
	12	View of upstream end of emergency spillway.
B7	13	View of emergency spillway channel.
	14	View of outlet works intake structure.
B8	15	View of outlet works intake structure.
	16	View of stilling basin structure and conduit portal.
B9	17	View of hydraulic jump created in stilling basin.
	18	View of stilling basin and discharge channel.
B10	19	View of outlet channel from crest of dam.
	20	View of crushed rock surfaced service road during construction.
B11	21	View of crushed rock surfaced service road during construction.
	22	View of outlet end of downstream valley relief well and parallel drain pipe.
B12	23	View of stilling basin and locations of seepage drains.
	24	View of 2-inch seepage drain just upstream of the stilling basin structure.
B13	25	View of 4-inch seepage drain installed along the left crest slope of the stilling basin.
	26	View of dam crest and paved highway which runs along the crest of the dam.
B14	27	View of dam crest and paved highway which runs along the crest of the dam.

APPENDIX C - INSTRUMENTATION PLATES

<u>Plate No.</u>	<u>Title</u>
C1	Instrumentation Location Plan
C2	Pore Pressure Piezometers - Line A: Station 14+00
C3	Pore Pressure Piezometers - Line B: Station 24+00
C4	Pore Pressure Piezometers - Line C: Station 28+00
C5	Pore Pressure Piezometers - Line D: Station 37+00
C6	Piezometer Observations - Line 1
C7	Piezometer Observations - Line 2
C8	Piezometer Observations - Line 3
C9	Piezometer Observations - Line 4
C10	Downstream Toe Piezometer Observations
C11	Foundation Settlement Data - Vertical Movement
C12	Crest Movement - Longitudinal, Transverse, and Vertical Movement
C13	Crest Movement Markers - Horizontal Movement
C14	Intake Structure - Vertical Movement
C15	Conduit Settlement - Profile
C16	Outlet Works - Conduit Vertical Movement Histories

**PERTINENT DATA
SITE 18**

1. Reservoir Data

Drainage Area	88.7 square miles
Permanent Pool Area	1,800 acres at El.1284.0 (Conservation Pool)
Sediment Storage	13,250 acre-feet
Flood Control Capacity Below Spillway Crest	14.9 inches of runoff

2. Embankment

Type	Homogeneous rolled fill
Crest Elevation	1320.0 feet m.s.l.
Maximum Height above Streambed	80 feet
Height above Valley Floor	68 feet
Crest Width	32 feet
Crest Length	Approximately 5,200 feet
Slope Protection	Grass
Wave Erosion Protection	Riprap
Seepage Control	Pervious vertical drain with intermittent outlets
Compacted Fill Quantities	Approximately 2,524,400 cubic yards
Berm Fill Quantities	Approximately 297,400 cubic yards

3. Emergency Spillway

Type	Uncontrolled, grassed, earth channel
Side Slopes	1V on 3H
Crest Elevation	1311.0 feet m.s.l.
Crest Length	300 feet
Width (Bottom)	200 feet
Length	Approximately 1,900 feet
Excavation	Approximately 607,000 cubic yards

4. Borrow

Quantity	Approximately 2,147,000 cubic yards
----------	-------------------------------------

5. Outlet Works

Type Inlet	Concrete Drop
Service Gate	4'x6' Vertical Lift, Hand Operated, Bottom Elevation 1274.0 feet m.s.l.
Conservation Pool Outlet	2 - 3.5'x12', 1284.0 feet m.s.l.

5. Outlet Works Cont'd

Water Rights Gate	10" Diameter Vertical Lift, Hand Operated, Bottom Elevation 1276.3 feet m.s.l.
Conduit Type, Size, and Length	1 - 72" Ø RCP x 408' long
Seepage Control	Five Seepage Diaphragms
Stilling Basin	Saint Anthony Falls Type
Outlet Channel	
Length	1,100 feet
Excavation Quantity	91,000 cubic yards
Discharge Capacity	
@ Pool El. 1311.0 feet m.s.l.	1,320 c.f.s.

6. Downstream Discharges. Assuming the service outlet is 50 percent operative, the maximum discharge downstream from the reservoir would be 660 c.f.s. for the Reservoir Design Flood, which is well within the bankfull capacity of 2,700 c.f.s. In the event of a probable maximum flood occurrence, the maximum outflow would be 4,800 c.f.s. and would exceed the downstream capacity for a period of several days.

7. Pertinent Storage Levels.

<u>Feature</u>	<u>Elevation Ft. MSL</u>	<u>Area Acres</u>	<u>Storage A.F.</u>
Top of Dam	1320.0	4,460	133,966
Embankment Design Flood	1317.3	4,207	122,283
Spillway Crest	1311.0	3,640	97,556
Reservoir Design Flood	1295.1	2,466	49,491
Conservation Pool	1284.0	1,780	25,994
Sediment Pool	1275.7	1,272	13,250
Gated Outlet	1274.0	1,160	11,224

The 100-year sediment allowance is 13,250 acre-feet. This is an average depth of 2.8 inches over the basin.

8. References. For additional information and description on the construction background, operational data, or procedures regarding this dam and lake, reference is made to the "Branched Oak Dam and Reservoir, Operation and Maintenance Manual," dated July 1981; "Design Memorandum No. MSC 20, Branched Oak Dam and Reservoir," dated June 1965; "Periodic Inspection Reports," dated July 1968, September 1969, November 1970, July 1972, October 1974 and October 1979; and "Plans and Specifications for Branched Oak Dam and Reservoir," March 1966.

**SALT CREEK AND TRIBUTARIES
BRANCHED OAK DAM AND LAKE
SITE 18
RAYMOND, NEBRASKA**

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

1. INTRODUCTION.

1.1. **Purpose of Report.** This report provides a summary record of significant design, construction, and operational data on Branched Oak Dam for use by engineers to familiarize themselves with the project, reevaluate the embankment when unsatisfactory performance occurs, and provide guidance for designing comparable future projects. It was prepared in accordance with MRD-R 1110-1-8, subject: "Construction Foundation Reports and Embankment Criteria and Performance Reports," dated 27 February 1978 and ER 1110-2-1901, subject: "Embankment Criteria and Performance Reports," dated 31 December 1981.

1.2. **Authorization and Purpose of Project.** Project authorization was provided by Public Law 85-500, 85th Congress, commonly referred to as the "Flood Control Act of 1958." Authority was granted to construct a flood control project on Salt Creek and Tributaries, Nebraska, essentially in accordance with the report of the Chief of Engineers contained in House Document 396, 84th Congress, 2nd Session. Branched Oak Dam is one of the features of the authorized project. The dam was designed and constructed by the Corps of Engineers as part of a system of 10 dams and reservoirs on the tributaries of Salt Creek above the City of Lincoln, Nebraska, for flood control, fish and wildlife conservation, and recreation. The permanent pool is maintained and operated for fish and wildlife conservation and recreation by the State of Nebraska Game and Parks Commission for public use.

1.3. **Location and Description of Project.** Branched Oak Dam is located in the southeastern part of Nebraska in Lancaster County, approximately 4 miles west of Raymond, Nebraska. See the Project Location Map, Plate A1,

Appendix A. The main features of the dam consist of an earth embankment, grassed emergency spillway, and concrete outlet works structure. These are located as shown on Plates A2, A3, and A4. Aerial views of the completed project are shown on Plates B1 and B2, Appendix B.

1.4. Project Maintenance. Major repairs of the embankment, spillway, outlet works and discharge channel are the responsibility of the Corps of Engineers. The Nebraska State Game and Parks Commission is responsible for routine maintenance, such as repair of minor slope erosion, control of burrowing animals, and maintenance of grass cover. The State is also responsible for maintaining the conservation pool for fish and wildlife conservation and for recreational purposes.

1.5. History of Project Design.

1.5.1. Survey Report. The initial recommendations for construction of a system of dams on tributaries of the Salt Creek were made in the "Survey Report on Flood Control for Salt Creek and its Tributaries, Nebraska and its Supplements" dated January 1953. This report formed the basis for Congressional authorization.

1.5.2. General Design. In December 1960, the "General Design Memorandum," No. MSC-1, was submitted to higher authority. The report updated the survey report in terms of economic feasibility and provided an overall general design of the multi-dam Salt Creek Project.

1.5.3. Final Design. Final design of Branched Oak Dam (Site 18) is covered in Design Memorandums MSC-20, Branched Oak Dam and Reservoir, and MSC-20, Supplement A, Revised Section V - Earthwork. These reports present detailed designs of the earth embankment, emergency (earthen) spillway, outlet works, and the necessary bridge, road, and utility alterations.

1.6. History of Project Construction. Branched Oak Dam was constructed by contract, under the supervision of the Corps of Engineers, Omaha District. Contract No. DA25-066-CIVENG-66-0127, Branched Oak Dam and Reservoir, was advertised on 1 March 1966 and bids were opened 7 April 1966. Brandt Construction Incorporated and John H. Brandt (in a joint venture) were awarded the contract. The contract bid was \$1,447,604, which was \$231,194 below the Government Estimate. Final payment though, amounted to \$1,459,017 due to modifications to the contract and payment of actual quantities.

Work on the project was ordered to proceed by 10 May 1966, and was completed in two construction seasons, with a final completion date of 31 December 1967. In the first construction season (August 1966 to November 1966), the contractor was required to complete the outlet works intake structure to elevation 1280.0, and the right and left abutment sections of the dam embankment to a minimum elevation of 1272.0. Also, from a point 200 feet right to 200 feet left of centerline of the outlet works, (Sta. 39+20 to 43+20), the crest was to be constructed to elevation 1320.0. The purpose of this was to obtain practically all of the foundation settlement under the conduit pipe and the intake structure prior to the start of the second construction season (April 1967 to November 1967). Closure, seeding, completion of the embankment, and remaining work was completed during the second construction season.

Additional improvements to the dam, since its original construction, are discussed in section 10.4. in this report.

2. GEOLOGY. The Salt Creek drainage basin is located primarily in Lancaster County in eastern Nebraska and lies entirely within the Dissected Till Plains Section of the Central Lowlands Physiographic Province. Pleistocene and Pliocene deposits of glacial, interglacial and eolian origin overlie bedrock, which is at a maximum depth of over 200 feet, although in some localized areas, the bedrock occurs at relatively shallow depths.

Bedrock under the greater portion of the basin is the Dakota Group sandstone and shales of Cretaceous age, with some Permian limestone and shales in the southeastern portion of the basin and Pennsylvanian limestone and shales in the northeastern portion of Lancaster County. In the damsite area, a typical section of the deposits in descending order are as follows: Peorian Loess Formation, Loveland (loess-clay) Formation, Kansan Glacial Drift, Aftonian (interglacial) Formation, the Grand Island Formation, the Seward Formation, and the Nebraskan Glacial Drift. In general, the Salt Creek basin is an eroded and dissected till plain which was covered by two eolian deposits, the Loveland (loess-clay) Formation and the Peorian Loess Formation. Post-Loveland erosion removed most of the Loveland and the remaining Loveland was subsequently covered by the younger Peorian Loess. In many places, especially in the western half of the basin, all the loess, both the Loveland and Peorian, was removed by erosion exposing the underlying glacial drift. In a few local areas, notably in the eastern part of Seward County, southcentral and northeastern part of Lancaster County, and southeast part of Saunders County, all of the Pleistocene deposits have been removed by erosion exposing the underlying bedrock.

3. FOUNDATION INVESTIGATION.

3.1. Subsurface Exploration. A total of 79 borings, 20 to 100 feet deep, were drilled to determine soil characteristics for general and specific design studies of this site. These consisted of 19 borings within the floodplain alluvium foundation area, 29 borings within spillway and abutment areas, 16 borings within possible borrow areas, and 15 borings within possible recreation development areas. The locations and identifying numbers of these borings are shown on Plate A4. Disturbed moisture and classification samples were taken from each boring at every change in material and at intervals not greater than 5 feet in depth. Disturbed sack samples were taken of representative spillway and borrow area materials, and undisturbed Shelby samples were taken of representative embankment foundation materials. Standard

penetration tests were also taken at those borings which were within the embankment flood plain foundation and outlet works areas. Logs of the borings are shown on Plates A6 through A15.

3.2. Foundation Conditions. The valley foundation soils at this site consisted primarily of clay alluvium derived from Kansan and Nebraskan glacial drift clay, and from Aftonian formation silts and sands, and clay silt loess. The alluvium underlain by the Grand Island and Seward Formations, was primarily classified as lean, sandy, and fat clay (CL and CH). In the left abutment and spillway area, in descending order, the soils were composed of a loess mantle, Kansan drift, and Nebraskan drift. The loess was classified as lean and sandy clay and silt (CL, CH, and ML). It was described as stiff and medium dense, moist and brown, and about 20 feet thick. The Kansan drift was classified primarily as lean and sandy clay (CL and CH) with some sand and was about 30-40 feet thick. It was described as medium stiff to stiff, moist, red-brown and brown. The Nebraskan drift was classified as fat and sandy clay and silt (CH, CL, and ML). It was described as very stiff to hard, moist to wet and gray in color. In the right abutment the loess mantle was absent and the Aftonian formation was present between the Kansan and Nebraskan drift. It was described as stiff, medium dense, moist, light gray, and was classified as silt (ML). The general soil and geologic profile is shown on Plate A5. Specific soil characteristics and laboratory classification within definite areas are shown on the subsequent plates of boring logs Nos. A6 through A15.

4. FOUNDATION PREPARATION. Before work began, all vegetation, such as brush, heavy sod, heavy growth of grass, and all decayed vegetable matter, rubbish, road surfacing, and other unsuitable material within the area upon which fill was to be placed was required to be removed. After completion of the clearing and stripping, all depressions were filled and steep slopes flattened. After filling the depressions, and immediately prior to the placement of embankment fill, the foundation was required to be loosened thoroughly by

scarifying, plowing, or harrowing to a depth of 4 inches. After the removal of roots or other debris turned up in the loosening process, the foundation was compacted in preparation for placement of fill material.

5. EMBANKMENT. A discussion of the design and construction of the embankment is presented in the following sections. It includes a description of the embankment section and materials, the design shear strengths, stability analyses, seepage control, and general construction of the embankment.

5.1. Embankment Section. The embankment is a rolled, homogeneous, impervious earthfill with a pervious embankment drain consisting of a continuous vertical drain with intermittent horizontal outlets. It has a crest length of 5,200 feet and a crest width of 32 feet. It is 68 feet high and has a crest elevation of 1320.0 feet m.s.l.

The slopes of the embankment are as follows:

Upstream

1 on 3, 1 on 5, 1 on 3	1300-1320
1 on 3	1280-1300
1 on 10	1265-1280
1 on 3	ground-1265

Downstream

1 on 3	1288-1320
1 on 5	ground-1288

See Plates A16 and A17 for typical embankment sections and details, and Plates B3 and B4 for views of the embankment slopes and crest.

5.2. Embankment Materials.

5.2.1. Earthfill. The embankment was constructed primarily of loess and glacial drift material from spillway excavation, abutment area

borrow, and alluvium from upstream borrow. This material provided a relatively impervious embankment section consisting of 2,524,400 cubic yards of homogeneous rolled earth fill and an additional 297,400 cubic yards of fill in the upstream berm.

5.2.2. Embankment Drain Filter Material. The embankment drain filter material consisted of washed sand, gravel, or crushed stone well graded between the following limits:

<u>Sieve Size</u>	<u>Percent by Weight Passing</u>
3/4 inch	100
No. 4	75-95
No. 16	45-70
No. 200	0-5

5.2.3. Slope Protection. Wave action on the upstream face of the embankment, in the range of the permanent pool, is dissipated on 20 inches of riprap, placed on 6 inches of spalls, which is placed over 6 inches of bedding. Other embankment and excavation slopes are protected by a grass cover, except for the LV on 10H slope of the upstream berm, between elevation 1270 and 1280 which is protected by a 12-inch layer of gravel. See Plate A17 and Plates B5 and B6 for sections, details, and views of the slope protection.

5.2.3.1. Riprap. Riprap wave protection on the embankment and around the intake structure is a quarried limestone, and specifications required it to be free of thin slabby pieces and be reasonably well-graded between the following limits:

<u>Weight per Stone</u>		<u>Percent of Total Weight</u>
<u>Type A</u>	<u>Type B</u>	<u>Lighter than or Passing</u>
800 lbs.	50 lbs.	100
200 lbs.	20 lbs.	35-55
20 lbs.	5 lbs.	0-10

Quality testing of the riprap material consisted of Bulk Specific Gravity, Soundness in Magnesium Sulfate, and Soundness in Freezing and Thawing.

Type A riprap was used between elevations 1280.0 and 1300.0 and was underlined by 6 inches of spalls placed on 6 inches of bedding material. Type B riprap was used for the outlet works and was underlined by 6 inches of bedding material.

5.2.3.2. Spalls. The spalls were to be at least equal in quality of the stone used for riprap and reasonably well-graded within the following limits:

<u>Sieve Size</u>	<u>Percent by Weight Passing</u>
4 inch	100
1-1/2 inch	55-85
3/4 inch	30-65
No. 4	0-10

5.2.3.3. Bedding. The 6-inch bedding layer used beneath the riprap and spalls consisted of sand and gravel and was required to be reasonably well-graded between the following limits:

<u>Sieve Size</u>	<u>Percent by Weight Passing</u>
3/4 inch	100
No. 4	80-95
No. 16	55-80
No. 200	0-10

5.2.3.4. Gravel Surfacing. The 1V on 10H upstream slope is protected by a 12-inch layer of gravel. The material consisted of sand and gravel and was required to be reasonably well-graded within the following limits:

Sieve Size

Percent by Weight Passing

3/4 inch	100
No. 4	80-95
No. 16	55-80
No. 200	0-20

5.3. Embankment Placement.

5.3.1. General. Specifications required the gradation and distribution of materials throughout the earthfill section of the dam be such that the embankment would be free from lenses, pockets, streaks, and layers of material differing substantially in texture or gradation from surrounding material.

5.3.2. Compacted Embankment Fill. The more impervious fill materials were placed toward the upstream section of the embankment, and the more pervious of the fill materials were placed toward the downstream section of the embankment, so that a transition in permeability was affected from the upstream to the downstream portions of the embankment.

After dumping, the material was spread in approximate horizontal layers over fill areas. The layers were 6 inches thick or less after compaction and had moisture contents ranging from 2 percent above optimum to 4 percent below. Before compaction, each layer of fill was harrowed, if needed, to break up and blend materials and to obtain uniform moisture content. If one pass of the harrow did not break up or blend the materials sufficiently, additional passes were performed, but no more than three passes were required. Each 6-inch layer of material was compacted to at least 95 percent of the maximum density as determined by the Standard AASHO method, T99, Method D. Portions of the fill which could not be compacted with rollers because of space restrictions, were placed in 4-inch loose lift layers and compacted with power tampers to the same degree of compaction as that obtained on other portions of the fill.

During construction, over 1,100 field compaction control tests were taken during the periods of August 1966 to November 1966 (1st Construction season), and April 1967 to November 1967 (2nd Construction season). A summary of the tests is given in the following table.

- SUMMARY OF FIELD COMPACTION CONTROL TESTS -

TYPE TEST	RANGE	MOST PREDOMINANT
MAXIMUM DRY DENSITY (PCF)	95.2 - 120.0	100.1 - 104.7
PERCENT COMPACTION	94.2 - 111.0	97.0 - 102.4
OPTIMUM WATER CONTENT (%)	12.2 - 24.5	17.0 - 22.3
LIQUID LIMIT	14 - 63	40 - 50
PLASTIC INDEX	7 - 46	22 - 29

5.3.3. Embankment Berm Fill. The embankment berm was constructed of borrow area materials in 12 inch thick layers. Compaction was accomplished by the controlled movement of the construction equipment over the fill in such a manner as to obtain the maximum amount of evenly distributed compaction possible. Moisture control was not required except that the upper limit of the moisture content was that which permitted the movement of construction equipment.

5.3.4. Embankment Drain Filter Material. The filter material was placed in 8 inch thick layers and each layer was thoroughly compacted by vibratory plate compactors. The material was placed by methods which eliminated the mixing of earth and the filter material. Filter material

found to be dirty or otherwise contaminated was removed and replaced at no cost to the government.

5.3.5. Slope Protection Placement.

5.3.5.1. Riprap. The riprap was placed on the spall and bedding layers so as to produce a reasonably well-graded mass of rock with a minimum percentage of voids. A tolerance of plus or minus 4 inches from the required slope lines and grades was allowed, except that either extremes of such tolerance was not to be continuous over an area greater than 200 square feet. The riprap was placed to its full course thickness in one operation and in such a manner as to avoid displacing the spall layer and to minimize segregation of the riprap. The desired distribution of the various sizes of stones throughout the mass was obtained by selective loading of the material at the quarry site and by controlled dumping. All stone was required to be placed by means of a clam, orange peel, or skip box. Dumping of stone at the top of the slopes and rolling or pushing them into place was not permitted.

5.3.5.2. Spalls. Specifications required that the spalls be placed on the bedding layer by methods which would obtain the best possible graded mass of uniform thickness. A tolerance of plus or minus 1 inch was permitted in areas not exceeding 200 square feet.

5.3.5.3. Bedding. The bedding material was spread uniformly on the prepared base by methods which did not cause segregation of particle sizes within the bedding. Compaction of the bedding layer was not required, but it was finished to present a reasonably even surface. The average thickness was required to be within plus or minus 1 inch from the required thickness within areas not exceeding 100 square feet.

5.3.5.4. Gravel Surfacing. Specifications required placing of the gravel in a manner which would prevent segregation of particle sizes. The material was placed in one layer and compacted by one complete pass of a crawler type tractor weighing not less than 20,000 pounds.

5.4. Embankment Settlement. A total foundation settlement of approximately 3.52 feet was estimated to occur at the maximum embankment section. In computing the settlement, a maximum embankment section of 68 feet high was considered to bear on 42 feet of compressible valley alluvium. This compressible material was divided into a 6-foot top stratum of medium stiff to stiff, primarily lean clay, above a 36-foot thick soft to medium stiff stratum of lean, sandy, and fat clay.

Time settlement studies indicated that approximately 70 percent of consolidation would occur during construction and the remaining 30 percent would occur at a diminishing rate over an indefinite period. The embankment was provided with a 1-foot overbuild to compensate for the continuing settlement. Total foundation settlement to date has been 3.85 feet, of which 3.40 feet occurred during construction. The 1-foot overbuild was therefore sufficient, since only 0.45 feet of settlement has occurred since construction. Foundation settlement gauges indicate that the rate of settlement has leveled off and is now negligible.

5.5. Laboratory Testing. Laboratory tests were performed on representative disturbed and undisturbed samples. These tests consisted of the following: (1) mechanical analyses, Atterberg limits, and moisture determinations, (2) compaction tests, (3) consolidation tests, (4) triaxial compression tests, "Q" and "R," and (5) direct shear "S" tests. Laboratory results for the above tests are given on Plates A18 through A25, and a discussion of the triaxial compression and direct shear tests is given below.

5.5.1. Triaxial Compression Tests. Twenty-three series of triaxial compression tests, "Q" and "R," were performed on undisturbed samples of alluvium foundation and remolded embankment material, and are discussed below.

5.5.1.1. Undisturbed Alluvium Foundation. Eleven series of "Q" tests on alluvial material, along with a study of drill log data,

resulted in the division of the alluvium into strata A and B for "Q" strengths. Stratum A is the top 8-foot thickness. It is stiff, dry to moist, primarily lean clay. Stratum B consisted of 31 feet of alluvium that ranged from soft to stiff, moist to saturated, silty, sandy, and lean clay, and medium to stiff fat clay. The range in strengths were as follows:

<u>Stratum</u>	<u>Depth-Ft.</u>	<u>Tan ϕ</u>	<u>Coh - T/SF</u>
A	0-8	0.13 to 0.40	0.55 to 1.60
B	8-39	0.0 to 0.03	0.32 to 1.45

Seven series of "R" tests were performed on the alluvium. The alluvium was not divided into strata for "R" strengths. The range in strengths were as follows:

<u>Tan ϕ</u>	<u>Coh - T/SF</u>
0.19 to 0.25	0.15 to 0.60

5.5.1.2. Remolded Embankment Material. Three series of "Q" tests and two series of "R" tests were performed on representative embankment materials remolded at 95 percent of maximum density and 2 percent above optimum moisture. The resulting strengths were as follows:

<u>Test</u>	<u>Sample</u>	<u>Tan ϕ</u>	<u>Coh-T/SF</u>
Q	C-1, Loess	0.11	0.90
Q	C-2, Drift	0.0	1.32
Q	C-3, Alluvium	0.0	1.30
R	C-2, Drift	0.21	0.31
R	C-3, Alluvium	0.23	0.30

5.5.2. Direct Shear Tests. Seven series of direct shear "S" tests were performed on undisturbed alluvium and remolded embankment materials. The strength results were as follows:

<u>Sample Type</u>	<u>Tan ϕ</u>	<u>Coh-T/SF</u>
Undisturbed	0.52	0.20
Undisturbed	0.65	0.0
Undisturbed	0.35	0.38
Undisturbed	0.57	0.10
Remolded (C-1)	0.44	0.40
Remolded (C-2)	0.43	0.40
Remolded (C-3)	0.41	0.0

5.5.3. Adopted Design Values. After evaluating all the test results the following strengths were used in design:

ADOPTED DESIGN VALUES

<u>Material</u>	<u>Unit Weight</u>		<u>"Q" Case</u>		<u>"R" Case</u>		<u>"S" Case</u>	
	<u>T/CF</u>		<u>Coh</u>	<u>Tanϕ</u>	<u>Coh</u>	<u>Tanϕ</u>	<u>Coh</u>	<u>Tanϕ</u>
	<u>Bouyant</u>	<u>Saturated</u>						
Embankment	0.0288	0.06	1.0	-	0.30	0.22	-	0.45
Foundation								
Stratum "A"	0.0288	0.06	1.0	-	0.25	0.21	-	0.50
Stratum "B"	0.0268	0.058	0.45	-	0.25	0.21	-	0.50

5.6. Embankment Stability. Stability analyses were performed on both the downstream and the upstream slopes at the maximum embankment section positioned over the greatest depth of relatively soft foundation.

5.6.1. Method of Analyses. The wedge and circular arc methods of analyses were used. These are patterned after the finite slice method outlined in EM 1110-2-1902, Appendix III, dated 27 December 1960. The analyses were run using the Omaha District RCA 301 Computer. The most critical failure surface was found by trial and each critical case was then checked manually. The computer and manual results were in close agreement.

5.6.2. Design Cases. Embankment stability analyses were performed for the end of construction, steady seepage, partial pool, and sudden drawdown cases. Stability sections and their respective factors of safety for the design cases are shown on Plates A26, A27, and A28.

5.6.2.1. End of Construction. This case was run using both the circular arc and the wedge method of analyses. Instantaneous placement of the embankment was assumed and the computed factors of safety were 1.24 and 1.26 respectively. These factors are slightly lower than the 1.3 specified in EM 1110-2-1902. However, from experience of previous Salt Creek Dams, it was known that during the 2-year construction period the consolidation of the foundation due to the embankment load would result in an increase in strength to the extent that it was felt that the factor of safety would be above 1.5. Therefore, for this case, the values were considered adequate.

5.6.2.2. Steady Seepage Case. The downstream slope was analyzed by the circular arc method assuming the pool at the spillway level and the pervious drain operative. The "R" and "S" shear strengths were used in separate computations to determine a range of stability values. The respective minimum factors of safety were 1.32 and 1.78.

5.6.2.3. Partial Pool. The upstream slope was studied for the critical pool elevation of 1274.0 (low level gated outlet elevation). The saturation line was assumed horizontal at each pool level. The "R" shear strengths were used in the computations and the minimum factor of safety was 1.54.

5.6.2.4. Sudden Drawdown. The upstream slope stability was analyzed assuming instantaneous drawdown from the pool at spillway level, elevation 1311.0, to the permanent pool at elevation 1284.0. The "R" shear strengths were used and the minimum factor of safety was 1.44.

5.6.3. Summary. As can be seen in the following table, all factors of safety considered critical were either very close to or exceeded those required in the stability manual. Those which were less than that required and still considered adequate were the result of engineering judgment and experience with similar situations.

STABILITY ANALYSES

Case	Shear Strength	Minimum Required Factor of Safety	Computed Factor of Safety
End of Construction	Q	1.3	1.24*
Steady Seepage	R	1.4	1.32**
Steady Seepage	S	1.4	1.78
Partial Pool	R	1.5	1.54
Sudden Drawdown	R	1.2	1.44

*See discussion in section 5.6.2.1.

**The 1.32 factor of safety for the "R" strength was considered adequate when bracketed with the higher "S" case factor of safety of 1.78.

5.7. Seepage Control.

5.7.1. Embankment. Seepage through the embankment was considered negligible due to the relatively low permanent pool, the infrequent interval and short duration of higher pools, and because of the impervious nature of the embankment. An embankment seepage control internal drain consisting of 32,583 cubic yards of compacted pervious material, with outlets, prevents eventual saturation of the downstream embankment slope under all normal long term seepage conditions. The drain is 3-feet wide with a top elevation of 1311.0 (Spillway Crest Elevation). It is located 10 feet downstream from the embankment centerline and has outlets at 50-foot intervals throughout the embankment section. See Plate A16 for typical sections of the embankment drain.

5.7.2. Foundation. An analysis of foundation seepage was made using a method developed by Mr. P. T. Bennett and published in the proceedings of ASCE Vol. III, 1946, entitled, "The Effect of Blankets on Seepage Through Pervious Foundations." The analysis was performed at the maximum embankment section with a pool elevation of 1311.0 (Spillway Crest

Elevation). The depth of the semi-impervious blanket was assumed to be 40 feet and extend infinitely both upstream and downstream. The depth of the pervious sand was considered as 20 feet. In determining the effective length of semi-impervious blanket, ratios of coefficients of permeability of blanket to that of underlying sands (K_f/K_b) were assumed as 1,000 upstream and 800 downstream. A gradient factor of safety of 1.63 was obtained at the downstream toe of the embankment. The minimum allowable gradient factor of safety was 1.5, therefore, underseepage control (such as relief wells) was not required.

5.7.3. Abutment. Seepage was not considered a problem because of the adequate impervious cover which exists over the sands in the abutments.

5.8. Diversion and Closure. A system of temporary dikes and channels as shown on Plate A29, were used to divert the stream flows into a temporary channel constructed through the embankment area. Specifications required the embankment closure section to be constructed to elevation 1274.0 within 6 days after the start of closure operations and to elevation 1288.0 within 10 days. The embankment at elevation 1288.0 then provided sufficient pool volume to contain the runoff from a 100-year flood occurrence probability with about 5 feet of freeboard.

6. EMERGENCY SPILLWAY. The emergency spillway is a grass-lined, uncontrolled, earth cut channel. It is located in the left abutment, approximately 2100 feet from the embankment. It has a slightly-curved alignment, is 200-feet wide, and 1900-feet long. The spillway has a 300-foot long flat crest at elevation 1311.0 at its upstream entrance, and a 0.2 percent downstream bed slope. Side slopes are 1V on 3H. Total spillway excavation was approximately 607,000 cubic yards. The spillway plan and section are shown on Plate A30, and views of the spillway are shown on Plates B6 and B7.

As stated in General Design Memorandum, MSC-1, "Salt Creek and its Tributaries," the spillway channel must be wide enough to pass the Standard

Project Flood routed 5 days after a Reservoir Design Flood (5 inches of runoff), with outlets assumed to be 50 percent operative and spillway velocities not to exceed 8 feet per second. The 8 feet per second limiting velocity was established as the velocity below which serious erosion would not occur. This criteria was far exceeded since the Standard Project Flood routed in the above manner would fail to reach the spillway crest by more than 10 feet.

7. OUTLET WORKS. The outlet works consist of an intake structure, conduit, stilling basin, and outlet channel. Sections and details of the outlet works are shown on Plates A31 through A39 and views of these structures are shown on Plates B7 through B10.

7.1. Intake Structure. The intake structure is a reinforced concrete box shaft with 6-foot by 12-foot inside dimensions and is commonly referred to as a drop inlet structure. The structure has a 4-foot by 6-foot manually operated gated opening located in the upstream side with a crest elevation of 1274.0. The purpose of the gated opening is to lower the level of the conservation pool in order to inspect the conduit, make shoreline repairs, and control fish population. A water rights gate was recently constructed into the intake structure and is used to release water for downstream needs. See section 10.4.4. in this report for more information concerning the water rights gate. There are also two ungated openings in the intake structure, each 3.5 feet by 12.0 feet with crest elevations of 1284.0 (Normal Operating Pool Elevation).

7.2. Conduit. The conduit consists of a monolithic reinforced concrete pipe 72 inches in diameter and 408-feet long. Experience has shown that piping due to seepage is more likely to occur along the conduit than in any other location in or under the embankment. Therefore, in order to eliminate the possibility of piping, five seepage diaphragms were attached to the conduit. They are located near the axis of the dam with spacing between diaphragms of approximately 40 feet.

7.3. Stilling Basin and Outlet Channel. The stilling basin is a Saint Anthony Falls parabolic drop inlet type structure constructed of reinforced concrete. An outlet channel extends downstream from the stilling basin approximately 1,200 feet to the original creek channel. The first 80 feet of the channel downstream of the stilling basin is protected with riprap. The first 70 feet having 15 inches of riprap placed on 6 inches of bedding and the remaining 10 feet having 30 inches of riprap placed on 6 inches of bedding. The remainder of the channel is protected by a grass cover. Excavation of the channel was approximately 91,000 cubic yards.

8. INSTRUMENTATION AND RESPONSE.

8.1. General. Instrumentation for Branched Oak Dam and Reservoir consists of 28 pore pressure piezometers, 32 open tube type (downstream) piezometers, 4 foundation settlement gauges, 7 crest movement markers, 8 vertical movement inserts, and a reservoir stage recorder. Details of the instrumentation are given in the following sections.

8.2. Pore Pressure Piezometers. Twenty-eight pore pressure piezometers were installed at Branched Oak Dam in cross sections A, B, C, and D through the embankment as shown on Plate C1. The purpose of these piezometers is to monitor pore pressure response, migration, and dissipation during and after embankment construction. Twenty-four of these piezometers reach into the alluvium foundation. Four piezometers, one in each cross section, were installed near the embankment centerline with their tips set in fill near the base of the embankment. These four have always been dry with the exception of some seepage water draining down along the outside of the pipes from the manholes to the piezometers. This condition was eliminated when drains were installed in all four of the crest manholes in 1977. Of the original 28 piezometers 21 are currently operable and their water levels are read approximately every three months. The other seven piezometers were installed on the upstream slope of the dam below the normal pool level and have been under water since early 1969. Plots of all the piezometer readings

are shown on Plates C2 through C5. The readings indicate generally good response and in the expected range for these piezometers.

8.3. Open Tube Type Piezometers. There are 32 open tube type piezometers scattered throughout the downstream area of the dam. Plots of the water level readings, depths and locations of the piezometers are shown on Plates C6 through C10. Pressure tests of the piezometers in 1977 indicate that all the piezometers are functional and respond well. Readings indicate that the water levels are within the expected range for these piezometers.

8.4. Foundation Settlement Gauges. There are four foundation settlement gauges located along the centerline of the dam on piezometer lines A, B, C, and D as shown on Plate C11. The maximum settlement has been at gauge C-10U and is about 3.85 feet with approximately 3.4 feet of the settlement occurring during construction. All points appear to have a similar rate of settlement, and recent readings indicate that the rate of movement has leveled off.

8.5. Crest Movement Markers. Seven crest movement markers were placed at 600-foot intervals along the downstream edge of the crest as shown on Plate C12.

Because of the erratic plots of transverse movement shown on Plate C12, the accuracy of the line of sight method of surveys normally used was questionable, and therefore, was replaced by a coordinate method of surveys. Initial surveys in 1977 and surveys in 1980, using the coordinate method, indicate slight downstream movement as can be seen on Plate C13.

The maximum settlement occurs at point MI-2 which is over the valley alluvium near the right abutment, and is approximately 0.69 feet. The maximum differential settlement between points occurs between MI-1 and MI-2 and is approximately 0.73 feet. Overall, the movement plots of these points, given on Plate C12, indicate a very uniform settlement along the embankment except at point MI-2.

8.6. Intake Structure Movement. Four movement insert markers are located in the top of the intake structure as shown on Plate C14. Vertical movement surveys have been taken six times since the original readings were taken in January 1968. Plots of these surveys, shown on Plate C14, indicate a small and uniform settlement of the structure, having less than 0.10 feet total settlement. This stability is credited to its firm foundation of stiff to very stiff sandy and lean clay glacial drift.

8.7. Conduit Movement. Surveys of conduit movement are shown on Plates C15 and C16. With the exception of initial settlement during construction, little conduit movement has taken place. Surveys since March 1967 have shown less than 1 inch of differential movement and have shown no overall trend for the conduit to move either up or down. This stability is credited to the firmer foundation of Nebraskan Drift material under the conduit as opposed to the alluvial clay under the embankment in the valley. A plot of the change in length and a history plot of four vertical movement points along the conduit are shown on Plate C16.

8.8 Reservoir Stage Recorder. The reservoir stage recorder is housed in a 5-foot 4-inch, by 5-foot 4-inch, by 8-foot high concrete block structure located at the crest of the embankment near the outlet works. The instrument records reservoir levels in digital format on paper tape at 15-minute intervals. It is a bubbler type installation whereby the stage is determined by the hydrostatic pressure required to force nitrogen gas out of a submerged orifice. An auxiliary staff gauge with the same datum as the recorder is located near the intake of the outlet structure and extends from elevation 1271.0 feet m.s.l. to elevation 1287.0 feet m.s.l. The gauges are operated and maintained by Corps of Engineers personnel.

9. CONSTRUCTION MODIFICATIONS.

9.1. General. Six contract modifications occurred during the construction of this project. The changes were determined necessary and in the best

interest of the Government. Details of the modifications are given in the following section.

9.2. Contract Modifications.

(Mod. #1) October 1966. Modification No. 1 was a change in the specifications of the contract. Change was necessary to revise construction contract commitments to conform to real estate acquisition commitments. The contract price and time remained unchanged.

(Mod. #2) August 1967. Due to flooding in June 1967, debris consisting of logs and brush were deposited in the reservoir below the elevation of the permanent pool. The Contractor had previously completed the clearing and grubbing required by the contract, and did not by any act or failure to act contribute to the deposit of the debris. Therefore, since the debris was unacceptable in the permanent reservoir, a contract modification was made to allow for payment for removal of the debris. This resulted in an increase of \$800 in the contract price. The contract time remained unchanged.

(Mod. #3) September 1967. Due to abnormally bad weather between May and June, it was determined necessary to modify the contract time for performance of all work included in Items 3 and 4 of the Completion Schedule 22 calendar days. Items 3 and 4 consisted of the following: Item 3, complete outlet works and complete right and left abutment embankment; Item 4, complete all remaining work, except seeding. The contract price and completion time for all other work remained unchanged.

(Mod. #4) December 1967. This modification extended the completion date of Item 5 (Seeding) in the Completion Schedule 10 calendar days. The extension was necessary due to Mod. #3 which extended the time for performance of Items 3 and 4. (See Mod. #3). Since Item 4 was prerequisite to Item 5, the time extension was deemed necessary. The contract price remained unchanged.

(Mod. #5) July 1968. This modification gave the contractor an additional 45 calendar days to complete Item 1 (Complete Right and Left Abutment Embankment) of the contract. Misinterpretation of the Plans and Specifications caused an increased haul distance and delayed the completion of the embankment, thus requiring the additional time.

(Mod. #6.) July 1968. This modification provided for reimbursement to the contractor for loss of indirect costs as a result of underrun in quantity of contract Items 10, "Spalls," and 12, "Riprap-Type B." Contract price was increased by the lump-sum amount of \$2,841.56. The time for performance was unchanged.

10. OPERATIONAL HISTORY AND PERFORMANCE.

10.1. General. The Secretary of the Army granted a license to the State of Nebraskan and Parks Commission to use and occupy the land and water areas of the Branched Oak Dam and Reservoir for Public Park and Recreational purposes. For consideration of the privileges granted, the State was required to maintain the project in a manner acceptable to the District Engineer. In general, this requires routine maintenance. Any major repairs, either to the embankment, outlet works, or spillway, are accomplished by the Corps of Engineers.

10.2. Inspections. In-depth inspections of Branched Oak Dam and Reservoir are conducted in accordance with ER 1110-2-100, "Periodic Inspections and Continuing Evaluation of Completed Civil Works Projects." The inspections are reported in Periodic Inspection Reports Nos. 1 through 6, dated July 1968, September 1969, November 1970, July 1972, October 1974, and October 1979, respectively. The next periodic inspection of Branched Oak Dam is scheduled for 1984. These periodic inspections are made jointly by representatives of the Operations and Engineering Divisions of the Omaha District Corps of Engineers and by representatives of the Missouri River Division Office. The reports include the evaluation of the embankment, structural performance, and instrumentation observations.

In addition to the periodic inspections, annual inspections are made by the Operations Division of the Omaha Corps of Engineers, and monthly inspections have been performed by Fort Crook Area Forces since 1980. These reports include a comprehensive inspection of all features of the dam.

10.3. Reservoir Levels. Reservoir water surface elevation readings have been recorded daily since the ponding of reservoir water began. Of these readings, one middle of the month observation from each month has been plotted for record and is shown on Plate C6. These daily water surface elevation readings are taken either from the intake structure mounted staff gauge or from the water stage recorder located in the gauge house near the crest of the dam. The highest pool elevation reading ever recorded at this dam was 1286.6 (2.6 feet above normal operating pool) which occurred in October 1973.

10.4. Significant Operational Events.

10.4.1. Crest Road. In 1970, the upstream side of the crest was extended 12 feet by the State of Nebraska for the purpose of building a two-lane paved road across the crest of the dam. All costs and necessary work for completion of the project was the responsibility of the State of Nebraska with approval of the plans, specifications, etc., by the Corps of Engineers. A sectional view of the road is shown on Plate A17, and Plates B13 and B14 show views of the completed road.

10.4.2. Seepage. Branched Oak Dam and Reservoir has a history of seepage along the downstream toe of the embankment. The main areas of concern have been, (1) at the base of the right abutment approximately between sta. 10+00 and sta. 15+00, (2) near the center of the flood plain valley, (3) along the left cut slope downstream of the stilling basin, and (4) from the internal embankment sand drain outlet at sta. 41+00 located back and upstream of the stilling basin structure. Methods used to alleviate the problem in these areas are discussed in the following sections.

10.4.2.1. Relief Well. In 1975, a 6-inch diameter relief well was installed in the downstream embankment toe near the old creek channel at sta. 28+00. The well was used in an attempt to lower the ground water level in that area. It was thought that if it would relieve the hydrostatic pressure in the deeper sand stratum, that the drainage of overlying alluvium would improve, thus lowering the ground water level and minimizing local ponding. Recent inspections indicate that the relief well has been functioning as expected and the ground water level has subsided. Periodic flow measurements of the relief well are shown on Plate C6, and the discharge end of the well is shown on Plate B11. Details of design and a cost summary of the relief well and perforated pipe (discussed in next paragraph) are presented in Design Memorandum No. MSC-23.

Besides the relief well, a 6-inch perforated drain pipe was placed in the same trench parallel to and at the same elevation as the relief well out-flow pipe. This drain has flowed steady at approximately 5 gpm and indicates that shallow drains such as this are effective in lowering local high ground-water problems. However, since the relief well is also in the area the actual effect of the shallow drain cannot be determined.

10.4.2.2. Seepage Drains. In 1977-1978, two seepage drains were installed in the vicinity of the stilling basin. A 2-inch pipe was installed into the embankment drain at the toe of the embankment approximately along a line with the centerline of the stilling basin to provide a controlled outlet for any seepage through the drain. The second drain is a 4-inch perforated pipe installed along the left side of the stilling basin cut slope at elevation 1252.0. The purpose of the drain is to provide a controlled outlet for seepage that drains from the left abutment area. According to the 1979 Periodic Inspection Report, these drains were functioning well and keeping the area dry. See Plate C6 for a plot of the flow readings, Plate A39 for drain details, and Plates B12 and B13 for views of the drains.

The drains were installed as part of the Salt Creek - Outlet Works Rehabilitation (Phase I), which included channel cleanout and conduit grouting performed at various other Salt Creek Dams. The work was performed by Technical Inspections Corp. of Lincoln, Nebraska, under contract No. DACW45-77-B-0086. Total contract cost was \$114,708.50 with approximately \$18,800 allotted for the seepage drains at Branched Oak.

10.4.3. Service Road. In 1976, a crushed rock surfaced service road was constructed along the upstream embankment slope. It was constructed by Theisen Bros. Inc., of Norfolk, Nebraska under Contract No. DACW45-76-B-0100 at a cost of \$33,280. The road was built by cutting into the slope along the top side of the upstream slope riprap protection. It was constructed primarily for inspection and more efficient maintenance of the upstream slope. Before the road was constructed, a barge or a temporary construction road cut into the upstream slope was necessary each time riprap repair was required. Details of the design of the road are presented in Design Memorandum No. MSC-25. Plan and sections of the service road are shown on Plate A40. Plates B3, B10, and B11 show views of the service road during and after construction.

10.4.4. Water Rights Gate. In October 1981, a 10-inch diameter gate was constructed into the intake structure as shown on Plate A37. The gate is used to release water for downstream needs. Its small size enables it to be used more efficiently than the structure's 4-foot by 6-foot gate which was originally used.

The gate was constructed by contract (No. DACW 45-81-C-0229) at a cost of approximately \$7,000. The contractor was Pro Dive Incorporated of Ottawa, Illinois.

10.5. Performance. The Branched Oak Dam and appurtenant structures are in good condition. Since 1967, when the project was completed, periodic annual, and monthly inspections and evaluations of the instrumentation data

has revealed no significant problems concerning the safety of the dam. The maximum reservoir level attained at Branched Oak Dam since its completion occurred in October 1973 and was 1286.6 feet m.s.l. This was 2.6 feet above the normal operating pool and 24.4 feet below the spillway crest. The project is well maintained, and because of its relative close proximity to the Omaha District Offices, it can readily be inspected if potential problems develop. Maintenance problems which do develop are generally rectified before they turn into major problems which may subsequently affect the integrity of the dam.

APPENDIX A
DRAWINGS



18,000 A.C.

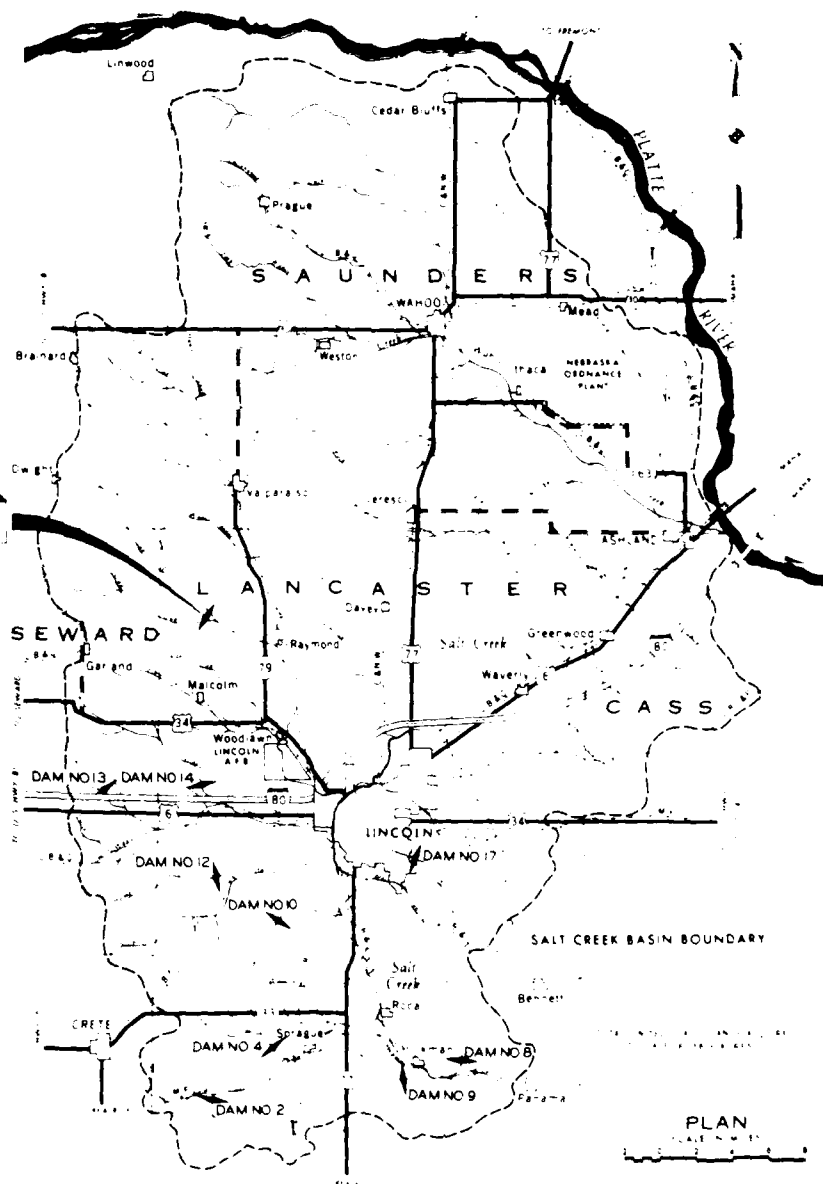
10-31-77

12

BRANCHED OAK LAKE

SALT CREEK, NEBRASKA
BRANCHED OAK DAM
SITE 18
AERIAL PHOTOGRAPH

BRANCHED OAK DAM
SITE NO 18

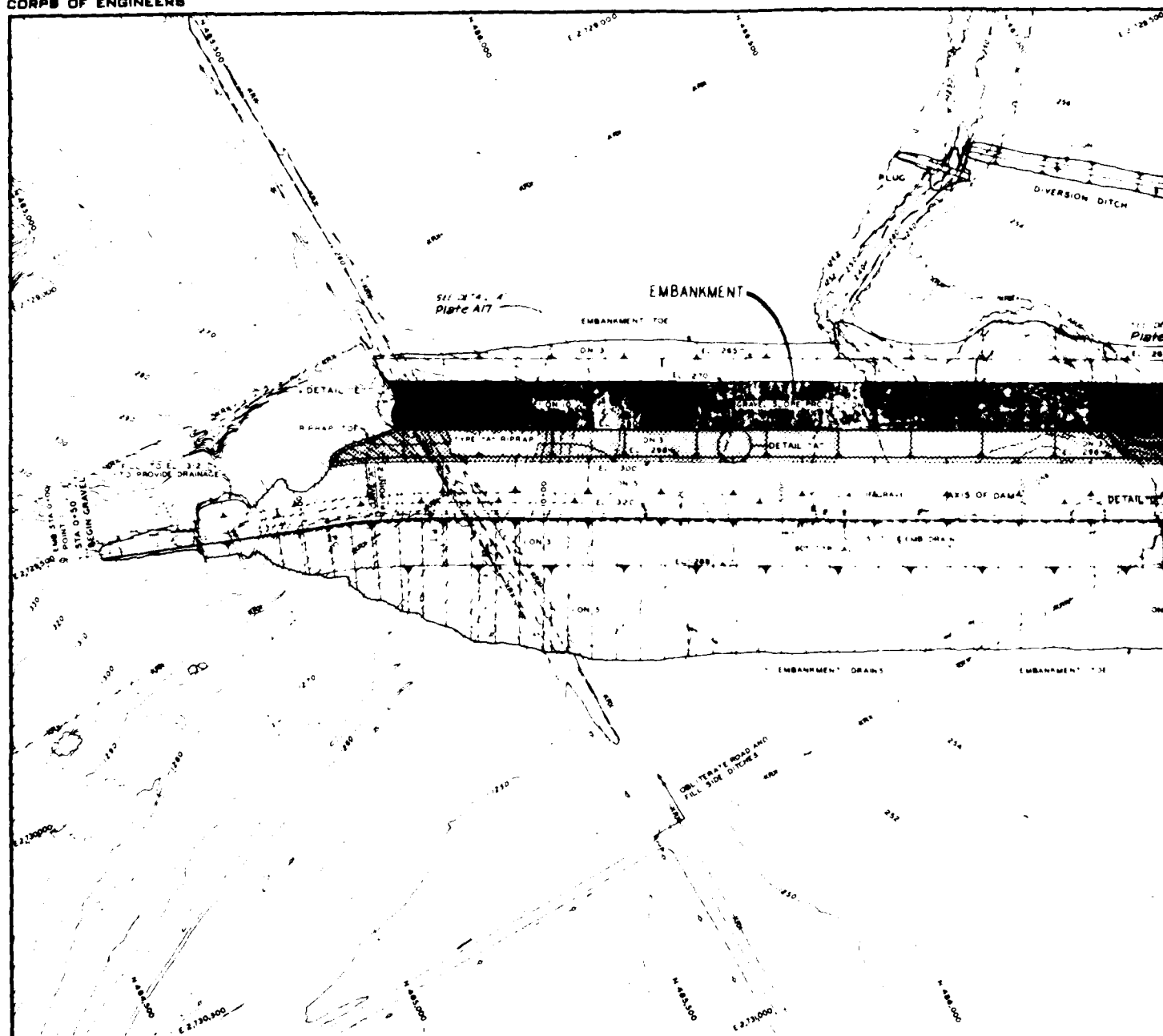




DATE		MONTH		DAY		YEAR	
		19		08		1968	
U. S. ARMY ENGINEER DISTRICT OMAHA CORPS OF ENGINEERS OMAHA, NEBRASKA							
REQUESTED BY DESIGNED BY CHECKED BY AUTHORIZED BY DATED DISSEMINATED APPROVED		BRANCHED OAK DAM AND LAKE SITE NC 18 PROJECT LOCATION MAP 10-1 10-2 10-3 10-4 10-5 10-6 10-7 10-8 10-9 10-10 10-11 10-12 10-13 10-14 10-15 10-16 10-17 10-18 10-19 10-20 10-21 10-22 10-23 10-24 10-25 10-26 10-27 10-28 10-29 10-30 10-31 10-32 10-33 10-34 10-35 10-36 10-37 10-38 10-39 10-40 10-41 10-42 10-43 10-44 10-45 10-46 10-47 10-48 10-49 10-50 10-51 10-52 10-53 10-54 10-55 10-56 10-57 10-58 10-59 10-60 10-61 10-62 10-63 10-64 10-65 10-66 10-67 10-68 10-69 10-70 10-71 10-72 10-73 10-74 10-75 10-76 10-77 10-78 10-79 10-80 10-81 10-82 10-83 10-84 10-85 10-86 10-87 10-88 10-89 10-90 10-91 10-92 10-93 10-94 10-95 10-96 10-97 10-98 10-99 10-100					
10-1 10-2 10-3 10-4 10-5 10-6 10-7 10-8 10-9 10-10 10-11 10-12 10-13 10-14 10-15 10-16 10-17 10-18 10-19 10-20 10-21 10-22 10-23 10-24 10-25 10-26 10-27 10-28 10-29 10-30 10-31 10-32 10-33 10-34 10-35 10-36 10-37 10-38 10-39 10-40 10-41 10-42 10-43 10-44 10-45 10-46 10-47 10-48 10-49 10-50 10-51 10-52 10-53 10-54 10-55 10-56 10-57 10-58 10-59 10-60 10-61 10-62 10-63 10-64 10-65 10-66 10-67 10-68 10-69 10-70 10-71 10-72 10-73 10-74 10-75 10-76 10-77 10-78 10-79 10-80 10-81 10-82 10-83 10-84 10-85 10-86 10-87 10-88 10-89 10-90 10-91 10-92 10-93 10-94 10-95 10-96 10-97 10-98 10-99 10-100		10-1 10-2 10-3 10-4 10-5 10-6 10-7 10-8 10-9 10-10 10-11 10-12 10-13 10-14 10-15 10-16 10-17 10-18 10-19 10-20 10-21 10-22 10-23 10-24 10-25 10-26 10-27 10-28 10-29 10-30 10-31 10-32 10-33 10-34 10-35 10-36 10-37 10-38 10-39 10-40 10-41 10-42 10-43 10-44 10-45 10-46 10-47 10-48 10-49 10-50 10-51 10-52 10-53 10-54 10-55 10-56 10-57 10-58 10-59 10-60 10-61 10-62 10-63 10-64 10-65 10-66 10-67 10-68 10-69 10-70 10-71 10-72 10-73 10-74 10-75 10-76 10-77 10-78 10-79 10-80 10-81 10-82 10-83 10-84 10-85 10-86 10-87 10-88 10-89 10-90 10-91 10-92 10-93 10-94 10-95 10-96 10-97 10-98 10-99 10-100					

THIS PLAN ACCOMPANIES CONTRACT NO
08CA45 MODIFICATION NO

CORPS OF ENGINEERS





CURVE "A" EMB.

Δ 8° 30' 02" R
D 4' 00'
T 106.45'
L 212.51'
R 1432.395'
PC 5+55.12
PT 7+67.63

CURVE "B" EMB.

Δ 22° 44' 47" L
D 6' 00'
T 192.08'
L 379.11'
R 954.93'
PC 44+49.10
PT 48+28.21

CURVE "C" OUTLET WORKS

Δ 62° 00" R
D 20' 00'
T 172.13'
L 310.00'
R 286.47'
PC 427.87 Rt.
PT 737.87 Rt. on O.R.L.

CURVE "D" SPILLWAY

Δ 35° 10' 11"
D 4' 00'
T 453.97'
L 879.24'
R 1432.41'
PC 9+10.85
PT 17+90.00

LEGEND:

- 250— EXISTING GROUND CONTOURS
- 280— NEW GROUND CONTOURS
- X— EXISTING FENCE
- VRX— EXISTING FENCE TO BE REMOVED
- BRUSH AND TREES
- EXISTING UTILITY LINES
- EXISTING BUILDINGS
- U.S. GOV'T. BOUNDARY
- EARTH WORK THIS CONTRACT
- STONE PROTECTION THIS CONTRACT
- GRAVEL SLOPE PROTECTION THIS CONTRACT

GENERAL NOTE:

1. For applicable General Notes, see PLATE A3.

THIS DRAWING HAS BEEN REDUCED TO
THREE-FIFTHS THE ORIGINAL SCALE

LOCATION OF POINTS

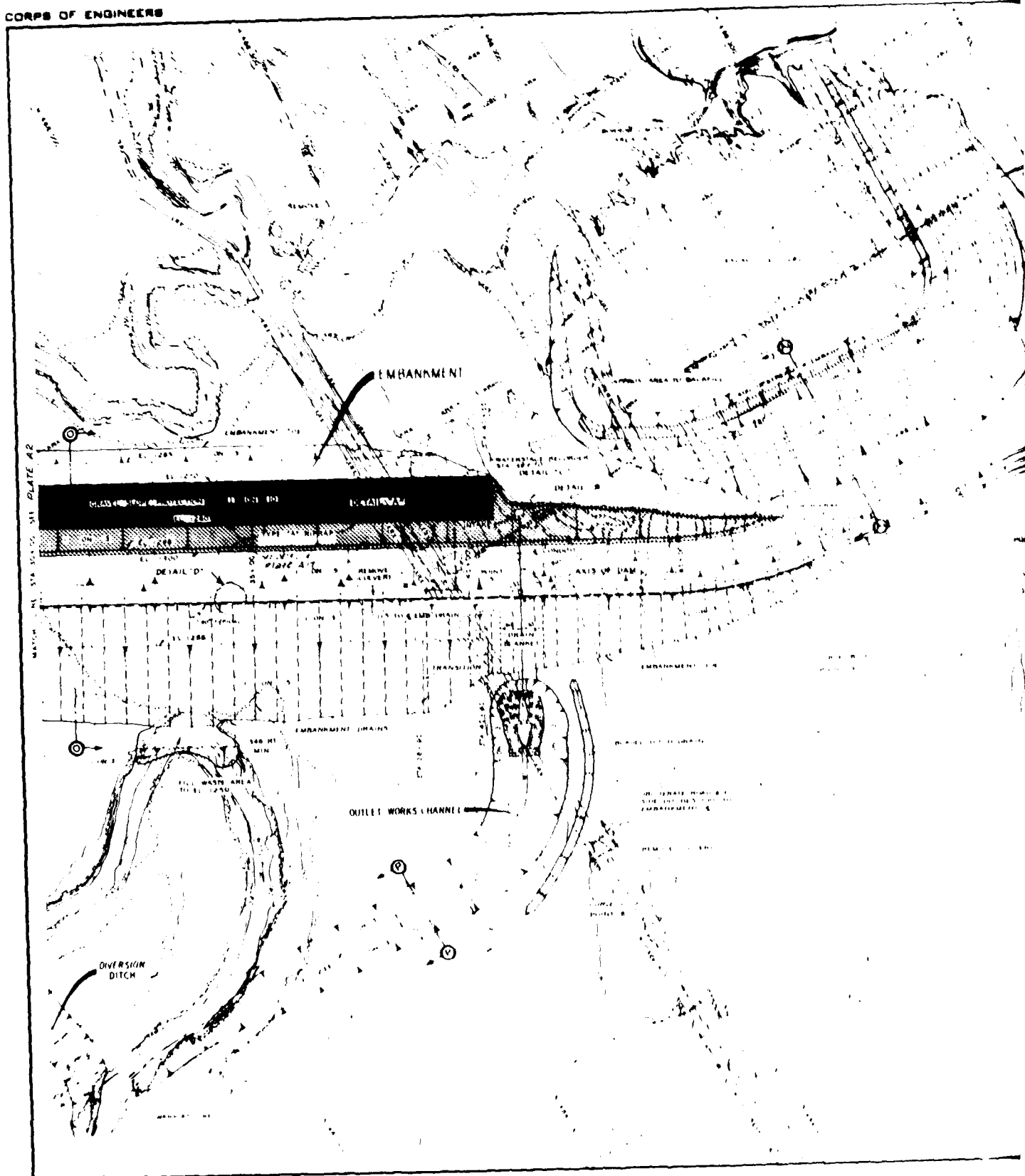
POINT NO.	STATION	COORDINATES		BEARING
		NORTH	EAST	
1	Emb. 0+00	484,760.00	2,729,500.00	N17° 48' 27" E
2	Emb. P.I. 6+61.57	485,389.87	2,729,702.32	N26° 18' 29" E
3	Emb. P.I. 48+41.18	488,957.37	2,731,466.24	N 3° 33' 42" E
4	Emb. 51+79.58	489,500.00	2,731,500.00	
5	Emb. 41+20	488,490.43	2,731,235.25	S63° 41' 31" E
6	On P.I. 600' Rt.	488,224.51	2,731,773.10	
7	SW Sta. 0+00	492,135.00	2,731,000	N57° 24' 58" E
8	SW P.I.	492,870.00	2,732,150	S67° 24' 51" E
9	SW Sta. 28+87.08	492,800	2,733,700	

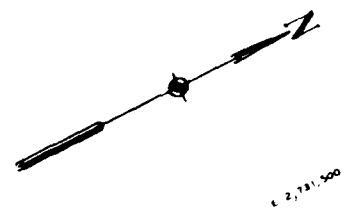
SCALE 1 INCH = 100 FEET
100 0 100

THIS PLAN ACCOMPANIES CONTRACT NO. 1001541-1-0000
MODIFICATION NO.



U. S. ARMY ENGINEER DISTRICT, OMAHA GROUP OF ENGINEERS OMAHA, NEBRASKA	
BALT CREEK AND ITS TRIBUTARIES, NEBRASKA BRANCHED OAK DAM AND LAKE SITE NO. 18	
EXCAVATION AND EMBANKMENT PLAN SHEET 1	
DESIGNED BY: C.E.C.	DATE: JULY 1968
CHECKED BY: C.W.O.	
APPROVED BY: L.S.S.	
BY: <i>Charles L. Hopp</i>	
DATE: JULY 1968	
SCALE: AS SHOWN	





1 2 3 32 0000

THIS DOCUMENT HAS BEEN REPRODUCED IN
WHOLE OR PART BY THE NATIONAL ARCHIVES

1. The exact alignment grade, width and side slopes of the diversion ditches and plugs will be selected by the contractor, subject to approval. The ditches are optional if other means are used to provide drainage in and upstream of the embankment areas.
2. Waste material shall be placed in the channel fill at the downstream toe of the embankment. The material shall be placed in 2' lifts and traffic compacted as directed. The material may be placed alongside of the channel until after closure.
3. Natural terraces shall be maintained against the embankment so as to prevent drainage along the embankment toe.
4. The alignment and grade of all bladed drain ditches shall be established in the field.
5. All elevations shown refer to feet above M.S.L., 1954 General Adjustment.
6. For sections, details and profiles, see PLATES A5 and A17.
7. For control points, see PLATE A2.
8. For legend, see PLATE A2.
9. Borrow area grading shall be accomplished to the approximate new contours shown.

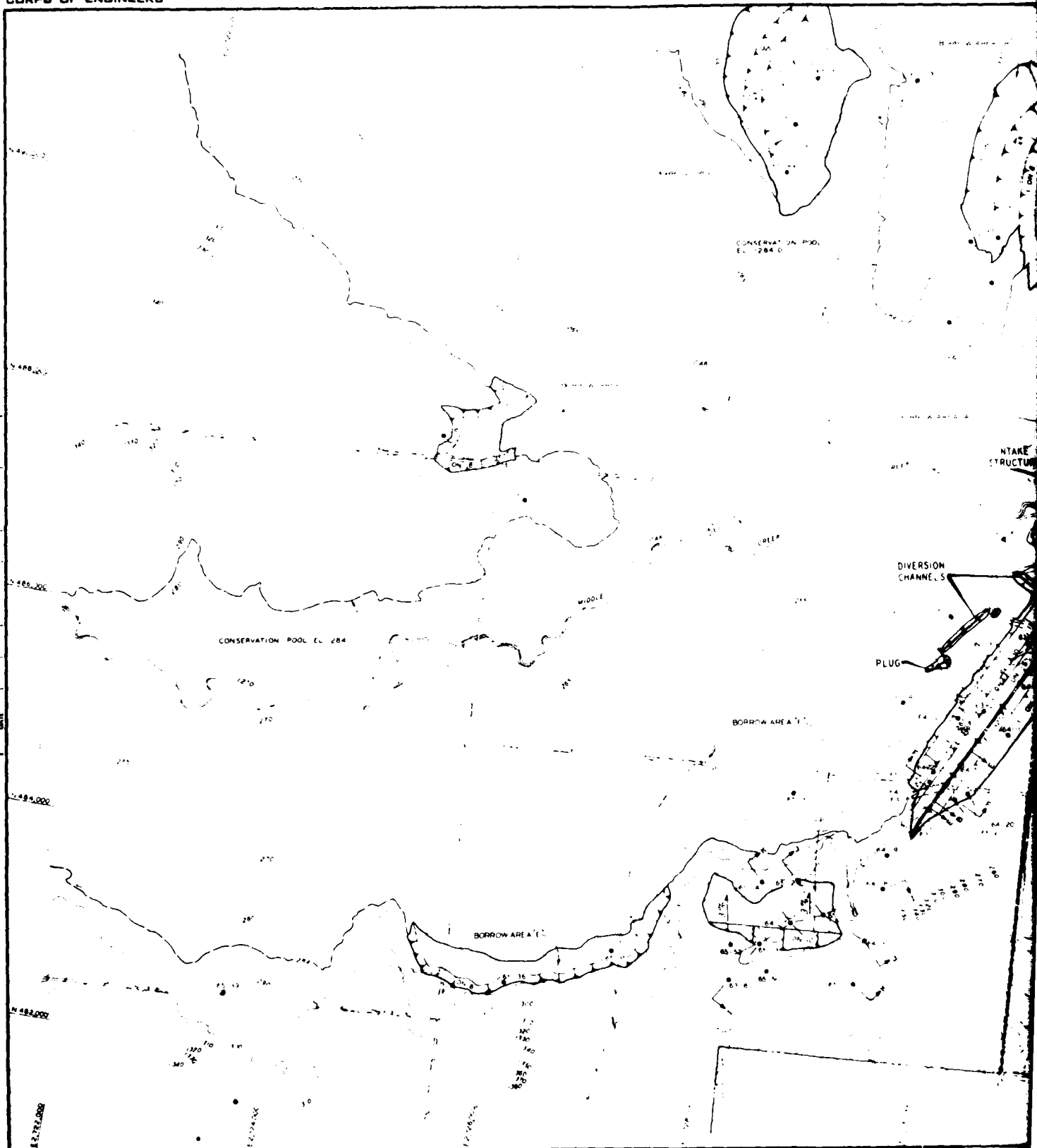
[illegible]

SCALE 1 INCH = 100 FEET

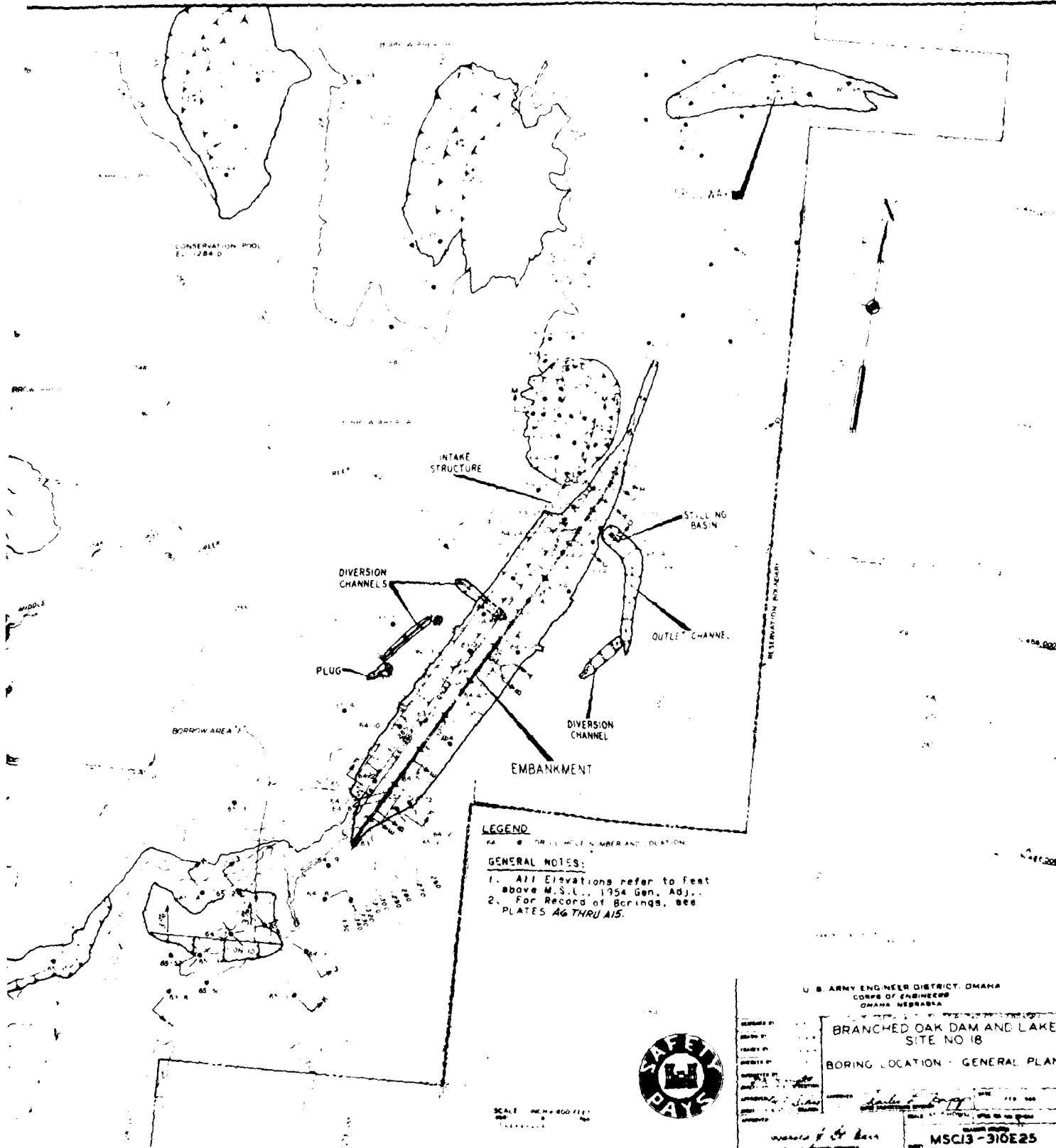
THIS PLAN ACCOMPANIES CONTRACT NO. _____
REGISTRATION NO. _____

ASSIGNMENT	
DATE	
MODIFICATION	
PAGE	

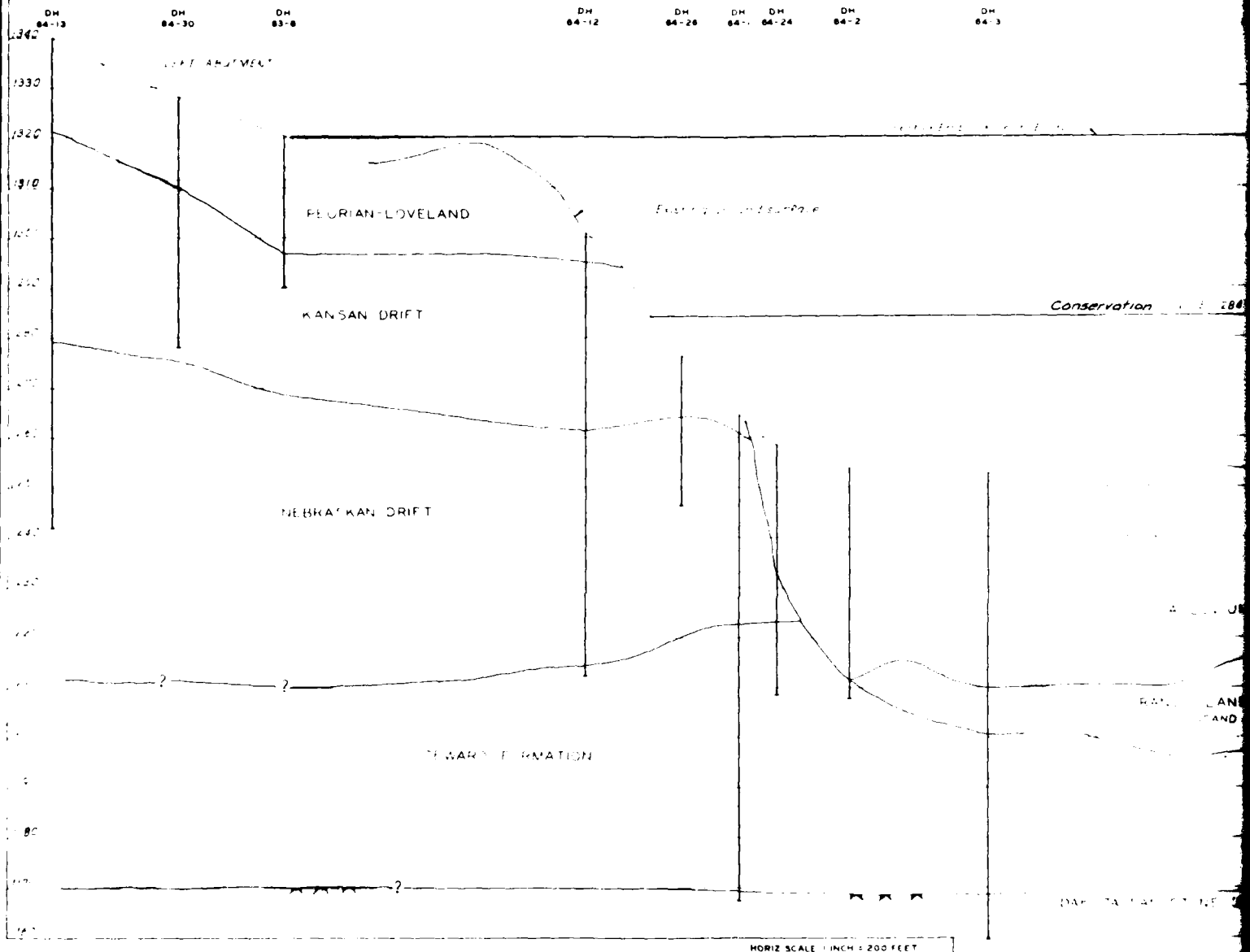
A 105 Micro-master Film or a Paper Reproducible Record Copy Must Be Made Before Every Amendment and for Modification



EN



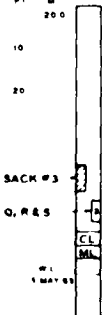
CORPS OF ENGINEERS



AGE	FORMATION	DESCRIPTIVE NOTES
QUATERNARY	PEURIAN (LOESS) FORMATION AND LOWLAND (LOESS CLAY) FORMATION UNDIFFERENTIATED.	BOLIAN (WIND-BLOWN) DEPOSITS, ALTHOUGH THE LOWER MORE CLAYEY LOWLAND IS PARTIALLY AQUICLUS.
	KANSAN GLACIAL DRIFT	ALL SEDIMENTS DEPOSITED DURING KANSAN GLACIAL STAGE, PRIMARILY A PEBBLY-CLAY (TILL) AT THIS SITE.
	GRAND ISLAND FORMATION	SANDS AND GRAVELS DEPOSITED IN PRE-KANSAN VALLEYS BY EASTWARD FLOWING STREAMS FROM WEST OF THE TILL BORDER DURING KANSAN GLACIAL STAGE.
	AFTONIAN FORMATION	AN INTERGLACIAL DEPOSIT OF SILT, SAND AND CLAY DERIVED FROM THE OLDER NEBRASKAN DRIFT BY EROSION.
	NEBRASKAN GLACIAL DRIFT	TILL, PRIMARILY A PEBBLY CLAY DEPOSITED ON THE TERTIARY PLAINS DURING THE NEBRASKAN GLACIAL STAGE. SILTS AND SANDS, GLACIALLY MIXED AND PARTIALLY GRADED. SOURCES PUSHED AHEAD OF THE ADVANCING GLACIER AND DEPOSITED IN THE TERTIARY LOWLANDS.
TERTIARY	SEWARD FORMATION	SILTS AND CLAYS, USUALLY CALCAREOUS, DEPOSITED PRIMARILY IN THE LOWLANDS OF THE NORTH CRETACEOUS TOPOGRAPHY.
CRETACEOUS	DAKOTA FORMATION	PRIMARILY SANDSTONES AND SHALES. ONLY SANDSTONE ENCOUNTERED AT THE SITE.

LEGEND

DH 83-7
13270
MAY 1963



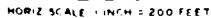
Drill Hole Number
Elevation at Top of Ground
Date of Boring
(M) Percent of moisture at time of drilling as determined by Laboratory Test.
(P.I.) Plasticity Index
(L.L.) Liquid Limit
Atterberg Limits based on visual comparison with similar sample actually tested.
(S.P.) Standard Penetration in blows per foot required to drive a 2" O.D. sampler by dropping a 140 lb. hammer 30 inches
Location and identifying number of each sample taken.
Location and identifying number of undisturbed sample taken and the type of test performed.
Soil Classification based on Atterberg Limits, Mechanical Analysis and Visual Comparison.
Static water level and date recorded.
Inspector's field description of soil encountered.

CLASSIFICATION OF SOILS:

- CB FINE AND SANDY FINE CLAY
- CL LOAM, SANDY, SILTY AND
- ML SILT, SANDY AND CLAYEY
- OL SILTY LOAM AND SILTY CLAY
- CH CLAYEY SAND
- SH SAND OF GRAVELLY SAND
- SW SAND OF GRAVELLY SAND
- GS SILTY SANDY GRAVEL

GENERAL NOTES:

- 1. All Elevations shown are U.S.L., 1929 General Adm.
- 2. For location of borings



D H 63 /
 13270
 MAY 1963

(M) Percent of moisture at time of drilling
as determined by Laboratory Test.

(P.I.) Plasticity Index

(L.L.) Liquid Limit

S.P.) Standard Penetration in blows per foot required to drive a 2" O.D. sampler by dropping a 140 lb. hammer 30 inches

Location and identifying number of each sample taken.

Location and identifying number of undisturbed sample taken and the type of test performed.

Soil Classification based on Atterberg Limits,
Mechanical Analysis and Visual Comparison.

Static water level and date recorded.

inspector's field description of soil encountered.

CE	FAT AND SANDY FAT CLAY
CL	LEAN, SANDY, SILTY AND GRAVELLY CLAY
ML	SILT, SANDY AND CLAYEY SILT
SM	SILTY SAND & SILTY GRAVELLY SAND
SC	CLAYEY SAND
SP	SAND OR GRAVELLY SAND, POORLY GRAINED
SN	SAND OR GRAVELLY SAND, WELL GRAINED
GW	SILTY SANDY GRAVEL

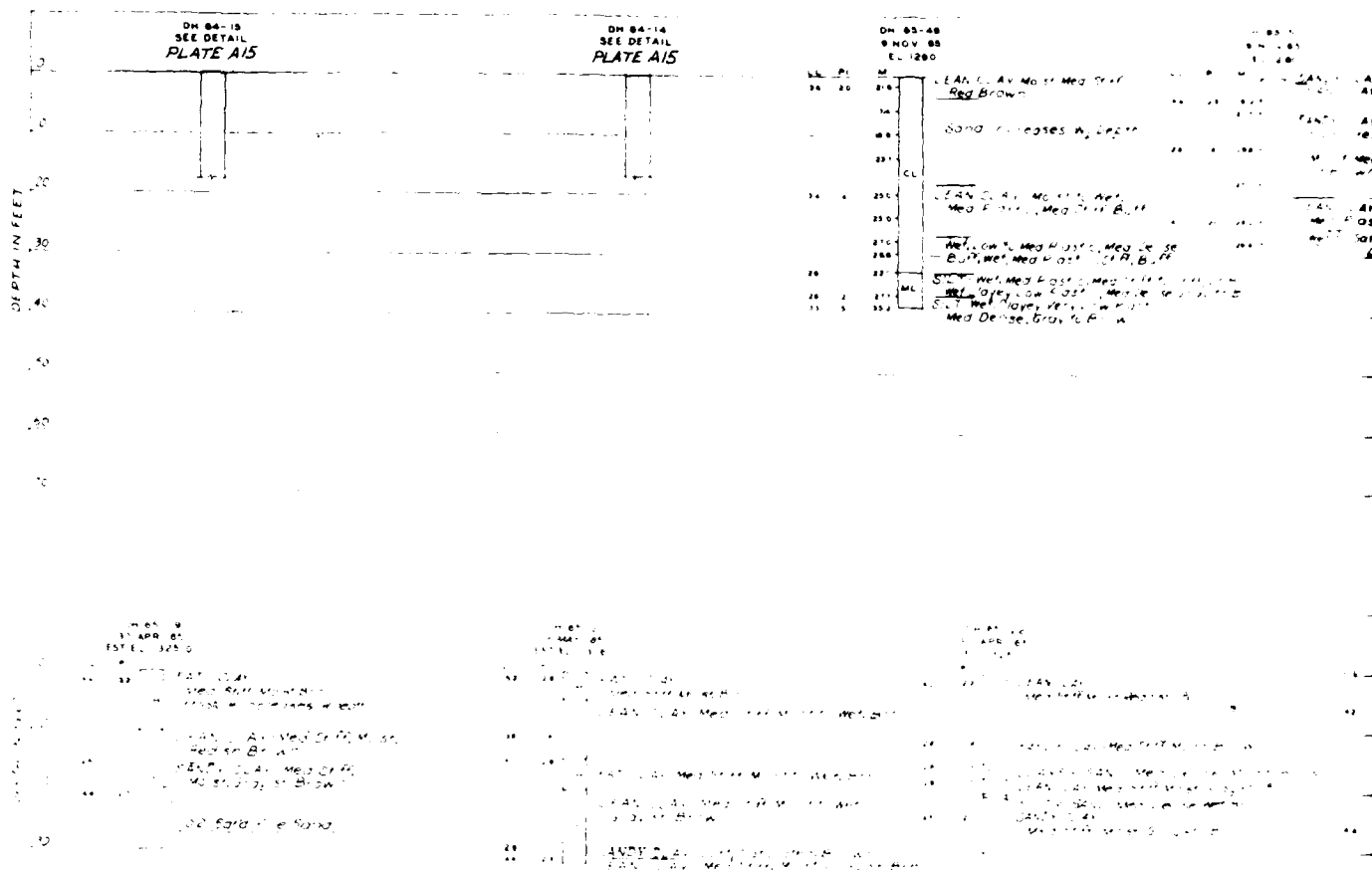
1. All Elevations shown refer to foot above U.S.L., 1924 General Adjustment.
2. For location of Springs, see plate A4.



THIS PLAN ACCOMPANIES CONTRACT NO.
 DA-38-066-42 MODIFICATION NO. _____

DATE	DESCRIPTION	MADE	APPROVED
	AS B ONE		
U. S. ARMY ENGINEER DISTRICT, OMAHA CORPS OF ENGINEERS OMAHA, NEBRASKA			
FORWARDED BY	SALT CRACK AND ITS TRIBUTARIES, NEBRASKA		
RETURN BY	BRANCHED OAK DAM & RESERVOIR		
ANALYZED BY	GENERAL SOIL & GEOLOGIC PROFILE		
DESIGNED BY	ALONG EMBANKMENT CENTERLINE		
REMARKS BY			
APPROVED	APPROVED	DATE	
<i>W. H. L. L. L.</i>	<i>W. H. L. L. L.</i>		
APPROVED	APPROVED	DATE	
<i>W. H. L. L. L.</i>	<i>W. H. L. L. L.</i>		

COPIES	AMENDMENT	MODIFICATION
	DATE	DATE
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		

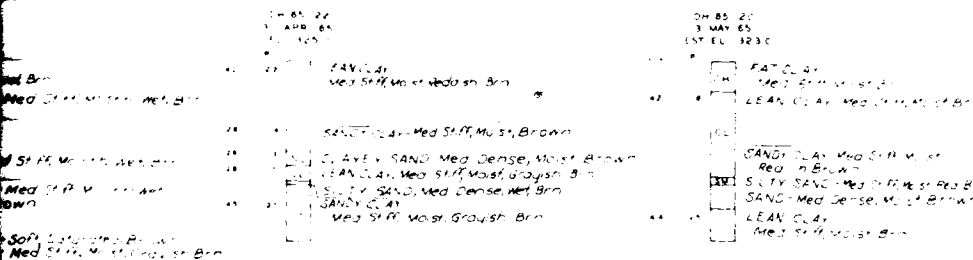
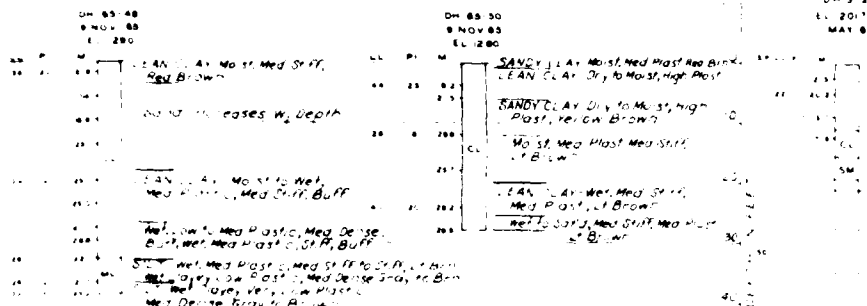


1. The data shown graphically and by symbol for each respective boring represents the actual geologic features observed and logged at the location given on the drawings. While the borings are representative of subsurface conditions at their respective locations and for their respective vertical reaches, local variations characteristic of the subsurface materials of this region are anticipated and, if encountered, such variations will not be considered as differing "materially" within the purview of Article IV of the contract.
2. Descriptions of material, based on visual inspection in the field, are shown to the right of the graphic log.
3. Absence of water readings in the Graphic Log of any boring is not necessarily to be construed that ground water will not be encountered in excavation at that location.
4. Information on material has been condensed in the Graphic Logs. Additional information is shown on field logs which may be inspected at the Omaha District Office.
5. Undisturbed sampling was accomplished with a Shelby drill using a Shelby tube sampler. Disturbed samples were obtained with a percussion type drill using an open end drive barrel.

Brown	Bwn.	Med
Calcareous	Calc.	Occ
Carbonaceous	Carb.	Pis
Dark	Ok.	Sat
Gray	Gry.	Sea
Light	Lt.	Var
Material	Mat'l.	Wit

SW	SAND OR GRAVELLY SAND
SP	SAND OR GRAVELLY SAND
SM	SILTY SAND OR SILTY
SC	CLAYEY SAND OR CLAYEY
ML	SILTS, SANDY SILTS, OR CLAYEY SILTS
CL	LEAN CLAYS, SANDY CL OR GRAVELLY CLAYS
CH	FAT CLAYS

Proposed excavation limits this contract
(S.P.) Standard Penetration in blows per
foot required to drive a 2" O.D. sampler
by dropping a 140 lb. hammer 30 inches



1. All elevations shown refer to feet above M.S.L., 1954 General Adjustment.
2. For location of Bearings, see PLAN A4.

Brown	Brn.	Medium	Med.
Calcareous	Calc.	Occasional	Occ.
Carbonaceous	Carb.	Plasticity	Piast.
Dark	Dk.	Saturated	Sat.
Gray	Gry.	Scattered	Scat.
Light	Lt.	Very	V
Material	Mat'l.	With	W

SW	SAND OR GRAVELLY SAND, WELL GRADED
SP	SAND OR GRAVELLY SAND, POORLY GRADED
SM	SILTY SAND OR SILTY GRAVELLY SAND
SC	CLAYEY SAND OR CLAYEY GRAVELLY SAND
ML	SILTS, SANDY SILTS, GRAVELLY SILTS OR CLAYEY SILTS
CL	LEAN CLAYS, SANDY CLAYS, SILTY CLAYS OR GRAVELLY CLAYS
CH	FAT CLAYS

graphically and by symbol for boring represents the actual as observed and logged at the on the drawings, while the representative of subsurface con- for respective locations and for vertical reaches, local var- characteristic of the subsurface mat- region are anticipated and, if such variations will not be con- sidering "materially" within the Article IV of the contract.

of material, based on visual
the field, are shown to the right
100.

water readings in the Graphic Log is not necessarily to be construed as indicating that ground water will not be encountered at that location.

on material has been condensed
logs. Additional information
old logs, which may be inspected
District Office.

Sampling was accomplished with
using a Shelby tube sampler.
files were obtained with a per-
drill using an open end drive



U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

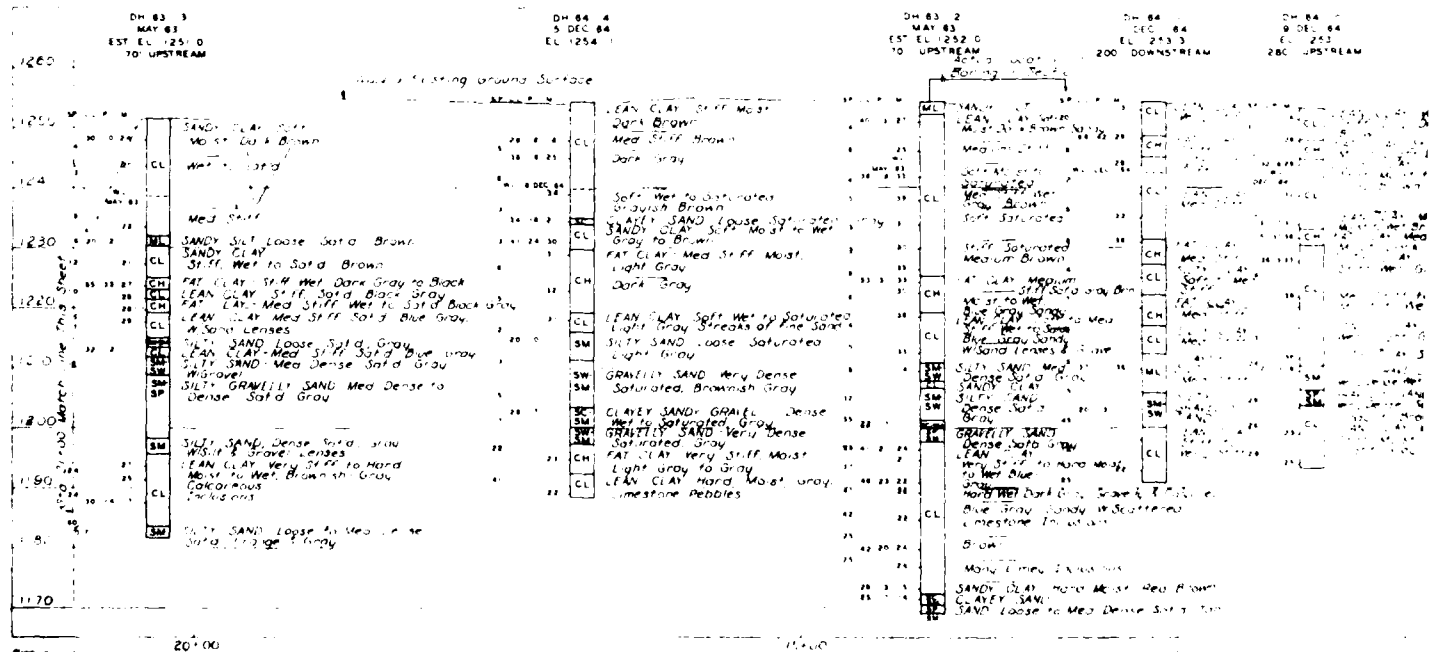
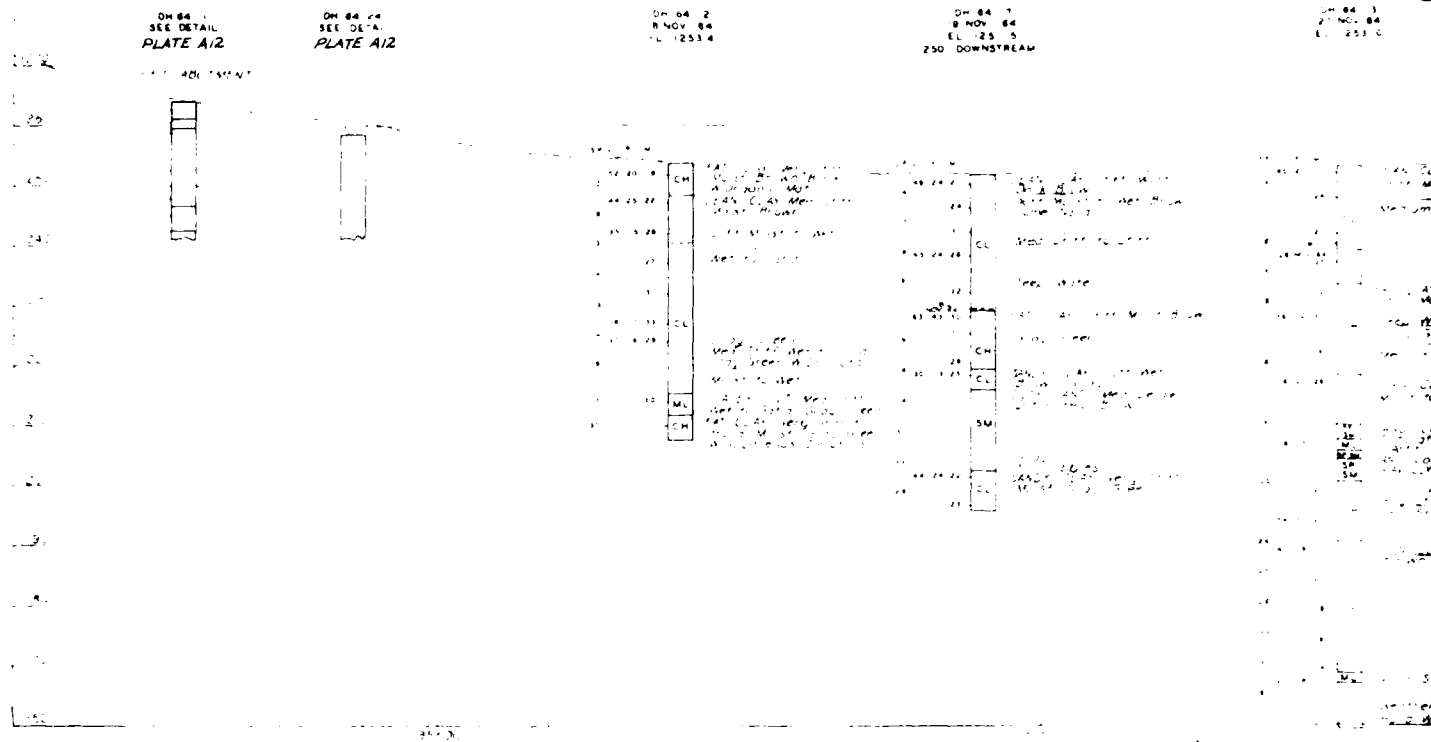
RECORDED BY
INDEXED BY
FILED BY
SERIALIZED BY
EXTENSION BY
DATE
TIME
OFFICE

BRANCHED OAK DAM AND LAKE
SITE NO 10
BURNING BRN AND
RECORD OF BORINGS
LEFT ABUTMENT AREA

APPROVED
DATE
TIME
OFFICE

MS-C-310E26

CORPS OF ENGINEERS

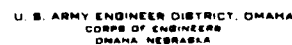


GENERAL NOTES:

1. All elevations shown refer to feet above
M.S.L., 1954 Gen. Adj.
2. For Boring Legend, Classification of Soils
and Descriptive Notes, see PLATE A6.
3. For Location of Borings, see PLATE A4.

RIGHT VALLEY ALONG EMBANKMENT & SECTION 8

SCALE VERT 1 INCH = 10 FEET
HORIZ. 1 INCH = 50 FEET



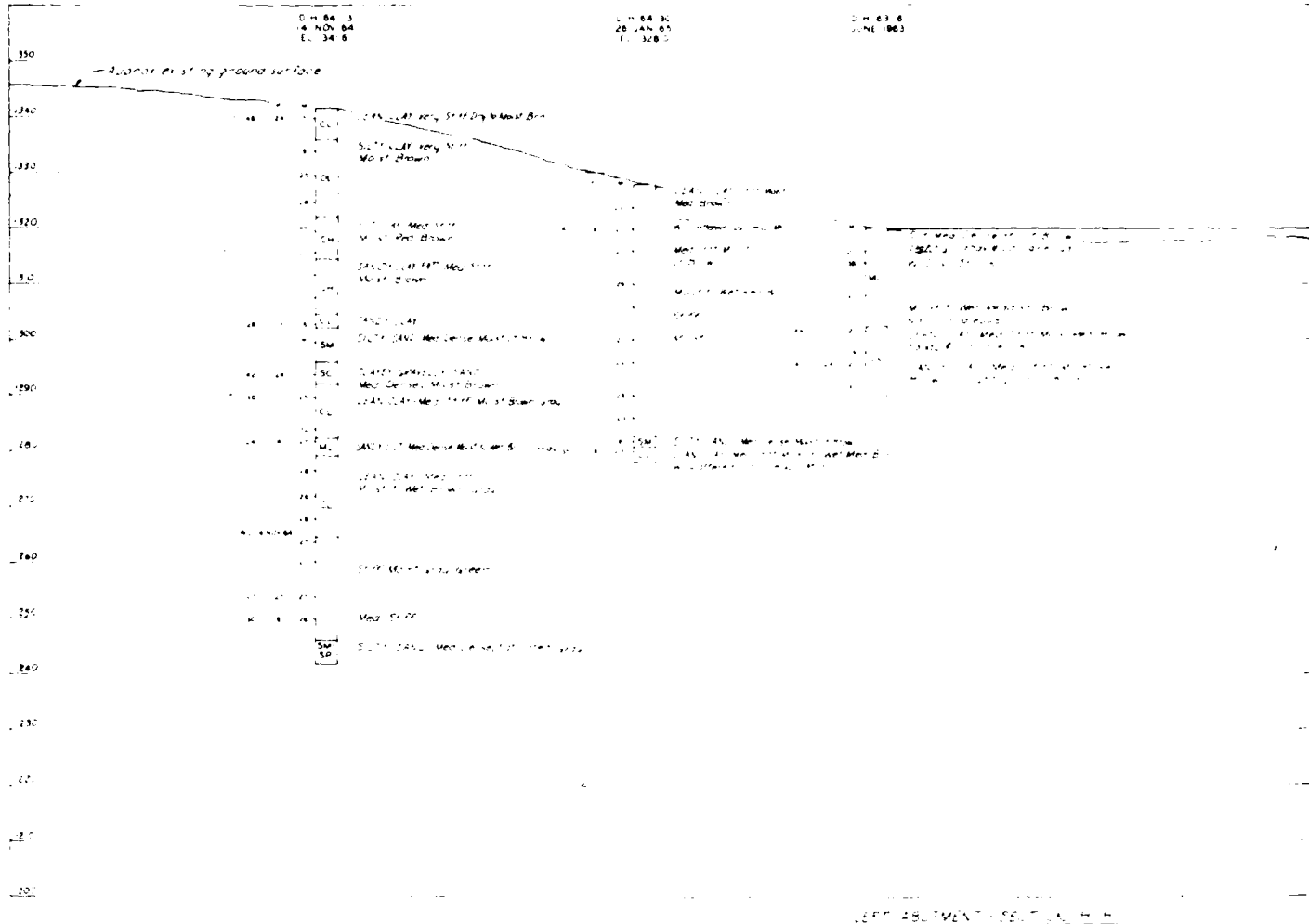
BRANCHED OAK DAM AND LAKE
SITE NO 18
RECORD OF BORINGS
EMBANKMENT AREA
SECTIONS A-A AND B-B

RIGHT VALLEY ALONG EMBANKMENT & SECTION B B

SCALE VERT 1 INCH = 10 FEET
HORIZ 1 INCH = 50 FEET

DESIGNED BY	BRANCHED OAK DAM AND LAKE SITE NO 18		
DRAWN BY	RECORD OF BORINGS EMBANKMENT AREA		
CHECKED BY	SECTIONS A-A AND B-B		
APPROVED BY	<i>[Signature]</i>	DATE	FEB 68
APPROVED BY	<i>[Signature]</i>	DATE	MAY 1968 AND 02-68
APPROVED BY	<i>[Signature]</i>	DATE	MSC13 - 310E27

CORPS OF ENGINEERS

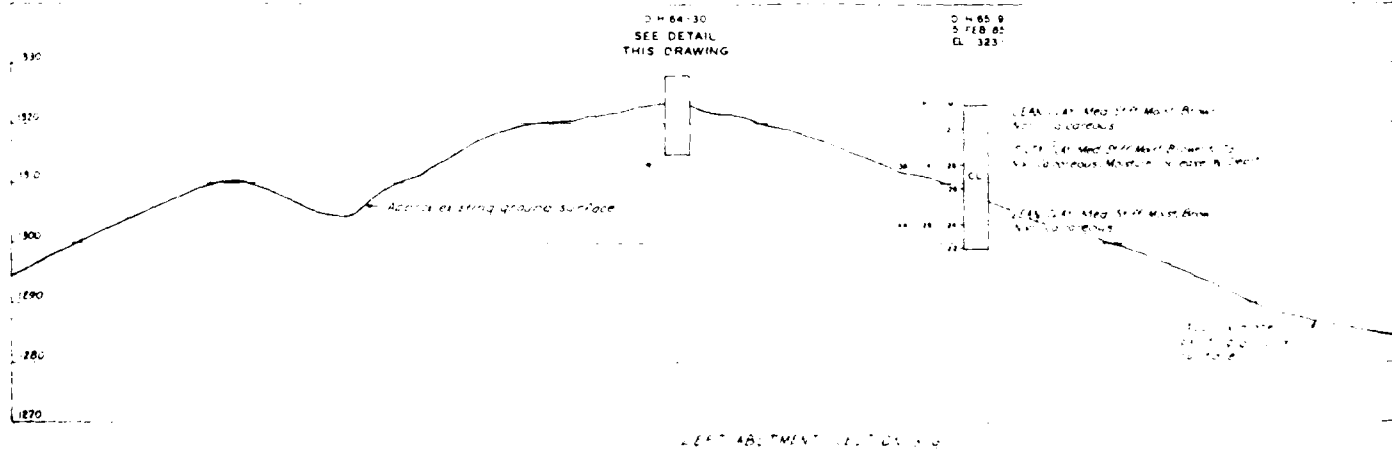


A 105 Micro-master Film or a Paper Reproducible Record
copy Must Be Made Before Every Amendment and/or Modification

INTRODUCTION

DATE _____

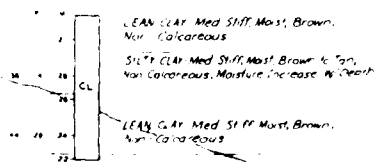
WOLFE



1. 2. 3.



D 44 85-9
5 FEB 85
EL 13231



Approximate
test ground
surface

LABUTMENT SECT. 6 G G

[illegible]

1. All elevations shown refer to feet above
mean low water, 1984 Jan. Adj.

... for burning Legend, Cla
... descriptive Notes, se
... fication of Soils
... A-1 A6.

5. Location of Borings, see PLATE A4.



U S ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

BRANCHED OAK DAM AND LAKE
SITE NO. 8
RECEIVED 10/10/64
101 ARMYMENT AREA
SE THONG 101 ARMYMENT AREA

MSC13-310E 20

4 FEB 65
1 10 2

11 04
 4 44 24
 1 12 0

...the ...

[illegible]

SCALE VERT INCH = 2 FEET
HORIZ INCH = 40 FEET

3-85 2
5 FEB 65
F 122 2

2- 65
2- 68 65
E. 343

24 64 8
 30 0E 64
 1 33 3

A 105 Micro-master Film or a Paper Reproducible Record Copy Must be Made Before Every Amendment and/or Modification

CL 100' Medium dense
thin yellowish grey

CL 90' Dense
greyish blue sand lenses
with thin silty clay
lenses

CL 80' Silty clay
medium dense

ML 70' Medium dense to dense
slaty grey

[illegible][illegible]

OW 64-18
19 JAN 64
EL 13300

DM 65 11
EL 1343 1

DM 64 17
SEE DETAIL
THIS DRAWING

OH 85 12
3 FEB 65
EL 1334

[illegible]

A hand-drawn stratigraphic column with the following layers from top to bottom:

- SANDY CLAY
- CLAY CLAY
- SANDY CLAY
- CLAY SANDY
- SANDY CLAY

Labels on the left side of the column:

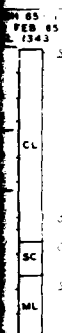
- CL (next to the second layer)
- SC (next to the fourth layer)
- ML (next to the bottom layer)

[illegible]

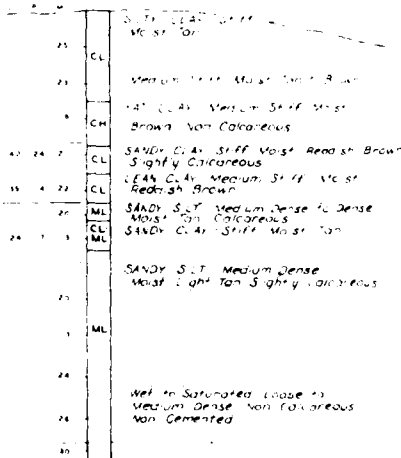
SCALE VERT 1 INCH = 10 FEET
HORIZ 1 INCH = 100 FEET



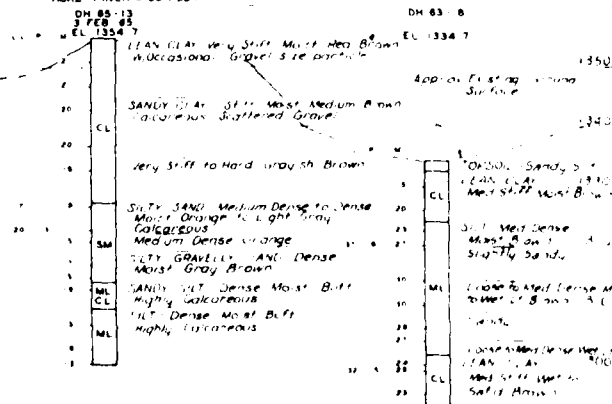
TEST IN K
 SCALE VERT 1 INCH = 10 FEET
 SCALE HORIZ 1 INCH = 50 FEET



DH 84 16
 30 DEC 84
 EL 1331.3



SECTION J J
 SCALE VERT 1 INCH = 10 FEET
 SCALE HORIZ 1 INCH = 50 FEET



GENERAL NOTES:

1. All elevations shown refer to feet above M.S.L., 1954 Gen. Adj.
2. For Boring Legend, Classification of Soils and Descriptive Notes, see PLATE AG.
3. For Location of Borings, see PLATE A4.

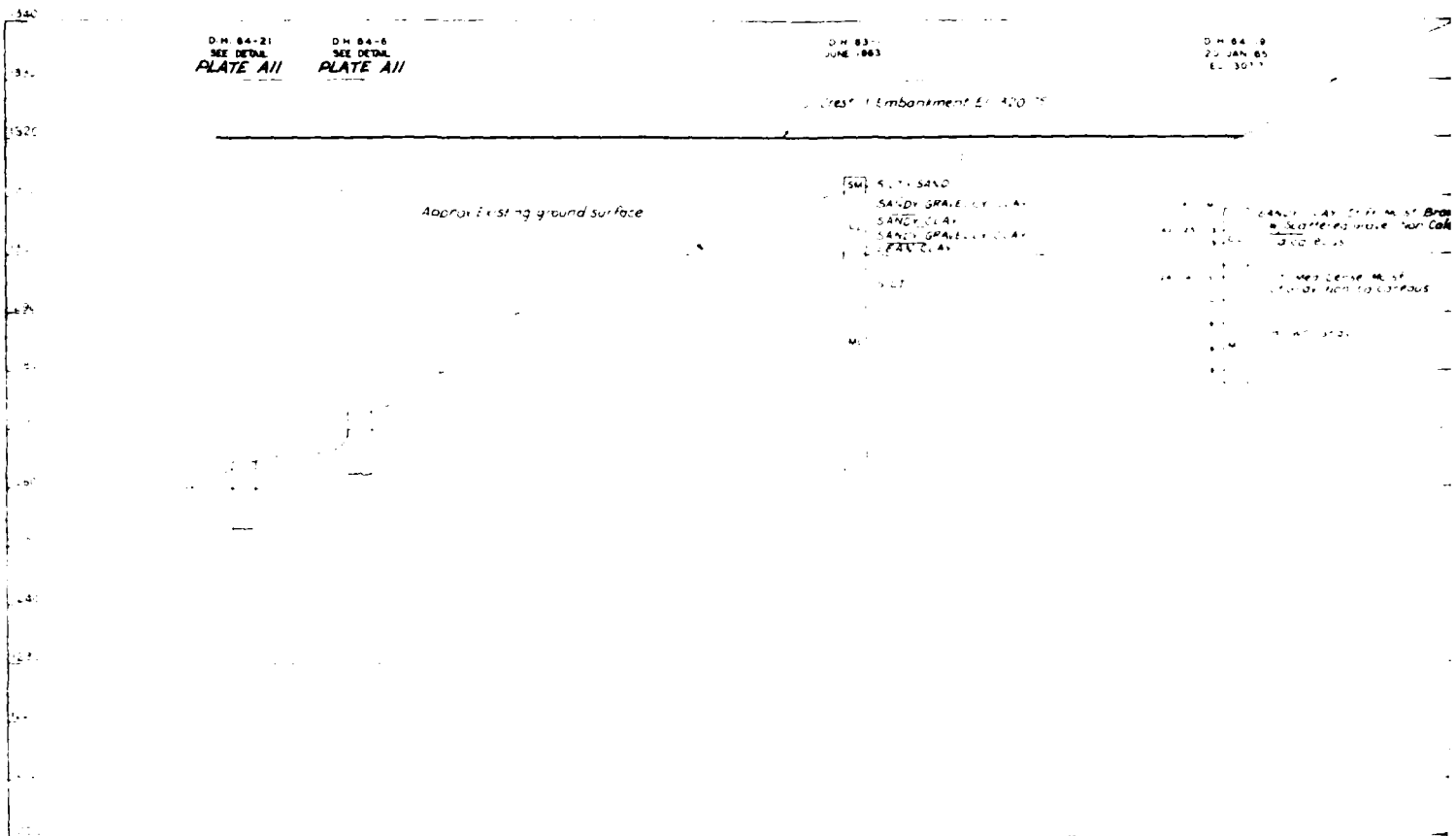
U. S. ARMY ENGINEER DISTRICT, OMAHA
 CORPS OF ENGINEERS
 OMAHA, NEBRASKA

BRANCHED OAK DAM AND LAKE
 SITE NO 18
 RECORD OF BORINGS
 RIGHT ABUTMENT AREA
 SECTIONS II, J, J AND K K

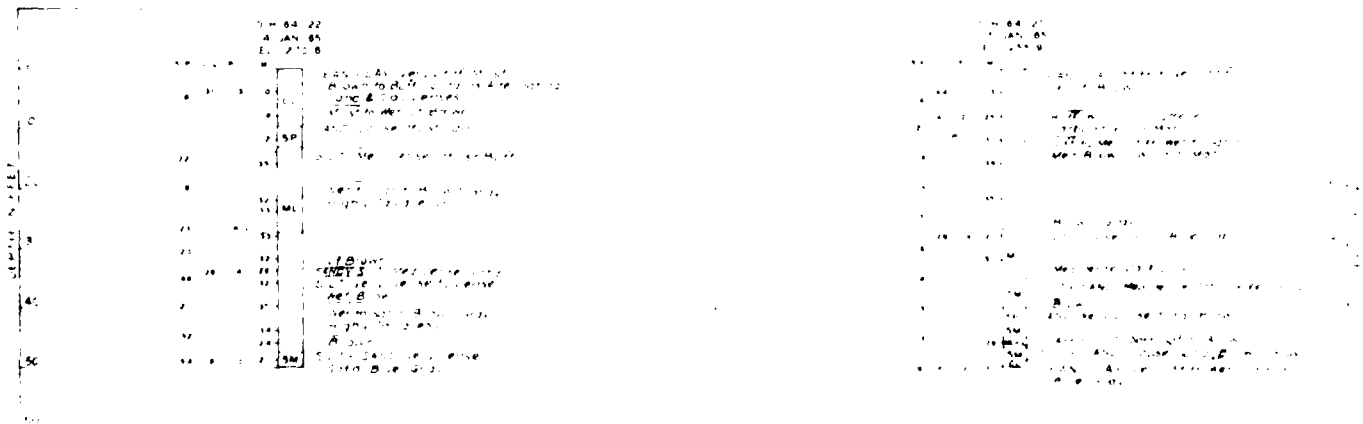


DRAWING BY: J. J. J.
 CHECKED BY: J. J. J.
 DESIGNED BY: J. J. J.
 APPROVED BY: J. J. J.
 DATE: FEB 85
 SCALE: 1" = 10' VERT, 1" = 50' HORIZ
 SHEET NO: 18 OF 20
 PROJECT NO: MSC13-310E29

CORPS OF ENGINEERS



Scale	VEH ^a	HCN ^b + G.FEE ^c
HCORZ	HCN ^b + G.FEE ^c	



EMBANKMENT

100 65 32
34 4.7, 965
6 342

Crest of Embankment $EL: 420.35$

SM. S. L. V. SAND
SANDY GRAVELLY CLAY
LL. SANDY CLAY
SANDY GRAVELLY CLAY
LEAN CLAY

5-47

Hand-drawn stratigraphic column for Site 10. The column is divided into layers with depth markers on the left and descriptions on the right. The layers from top to bottom are:

- 0 - 25: Sandy clay, stiff, med. s. brown, w. scattered gravel, non calcareous
- 25 - 40: Silty med dense, med. s. gray, non calcareous
- 40 - 50: Brown gr. s.

[illegible]

SCALE: VERT. INCH = 0 FEET
HORIZ. INCH = 50 FEET

04 04 20
5 JAN 65
F 255 9

[illegible]

USN 1000 1000

1. All elevations are in feet above
mean low water.

... .., Classification: f 30 13
... .., see PLATE A60

For a list of initials, see L.A. 44



U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

BRANCHED OAK DAM AND LAKE
SITE NO 18
RECORD OF BORING
RIGHT ABUTMENT AREA

[illegible]

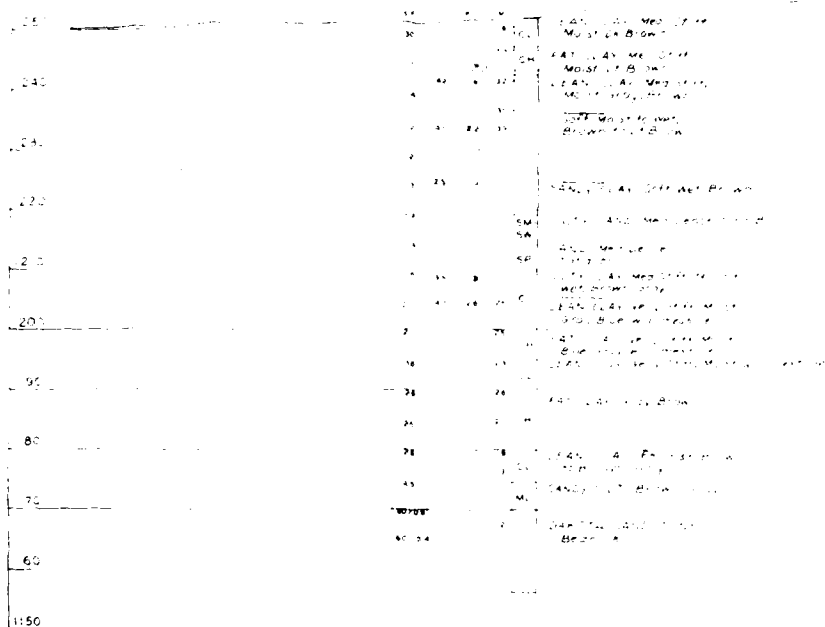
APPROVED: *Robert L. Gray* DATE: *10/11/77*
 CHIEF, COMMUNICATIONS SECTION
4 900 *10/11/77*
 MSC 13-310E 30

CORPS OF ENGINEERS

DE 1962
E. 25 8

.. 24 2
41. 202
2044

Approx. existing ground surface



SECTION E-E

SCAFF VER 1 INCH = 5 FEET
HOR 2 INCH = 20 FEET

A 165 Micro-master Film or a Paper Reproducible Record
Copy Must Be Made Before Every Amendment and/or Modification

AMOUNT	DATE	DESCRIPTION	DATE
--------	------	-------------	------

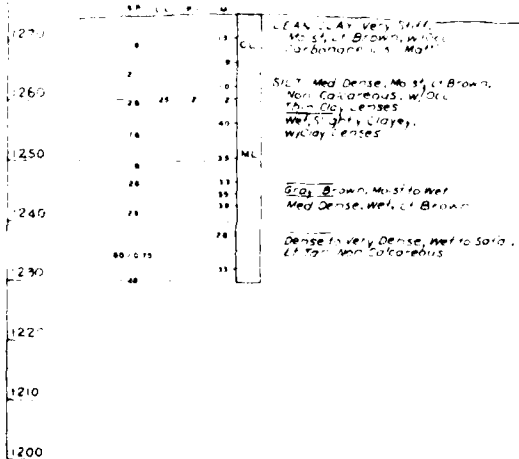
DH 85-1
 2 FEB 1985
 EL 12745

DW 84 B
SEE DETAIL 745 DWG

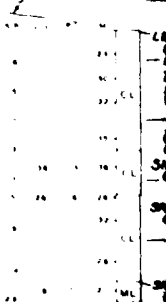
④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫ ⑬ ⑭ ⑮ ⑯ ⑰ ⑱ ⑲ ⑳ ㉑ ㉒ ㉓ ㉔ ㉕ ㉖ ㉗ ㉘ ㉙ ㉚ ㉛ ㉜ ㉝ ㉞ ㉟ ㊱ ㊲ ㊳ ㊴ ㊵ ㊶ ㊷ ㊸ ㊹ ㊺ ㊻ ㊼ ㊽ ㊾ ㊿

CM 65-2
 20 JAN 1965
 E. 2450

UPSTREAM



Approx
Landing Ground



SECTION 17-4

SCALE VERT 1 INCH=10 FEET
HORIZ 1 INCH=20 FEET

DM 84-2
5 JAN 1985
EL 1264.4

DM 84-6
8 JAN 1984
EL 1265.2

SECTION E-E

round surface

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

Stiff

SECTION E-E
VERT. 1 INCH=10 FEET
SCALE HORIZ. 1 INCH=20 FEET

DM 84-8
DETAIL THIS DWG
& Embankment

DM 85-2
29 JAN 1985
EL 1265.0

DOWNSTREAM

Approx
Existing Ground Surface

1.5	CL	LEAN CLAY, Very Stiff, No St. Brown, w. Scattered Carbonaceous Material
1.5	CL	Med Stiff, Moist, Brown, w. Scattered Carbonaceous Material
1.5	CL	Wet
1.5	CL	Brown Gray
1.5	CL	Soft, Solid
1.5	CL	SILTY CLAY, Soft to Med Stiff, Solid, Brown Gray
1.5	CL	SANDY CLAY, Med Stiff to Stiff, Solid, Brown, Non Carbonaceous
1.5	CL	SANDY SILT, Med Dense, Brown, Non Carbonaceous

1290
1280
1270
1260
1250
1240
1230
1220
1210
1200

NOTES:

1. All elevations shown refer to feet above M.S.L. 1954 Gen. Adj.
2. For boring legend, classification of soils and descriptive notes, see PLATE A6.
3. For location of borings, see PLATE A4.

SECTION F-F

VERT. 1 INCH=10 FEET
SCALE HORIZ. 1 INCH=20 FEET



U. S. ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

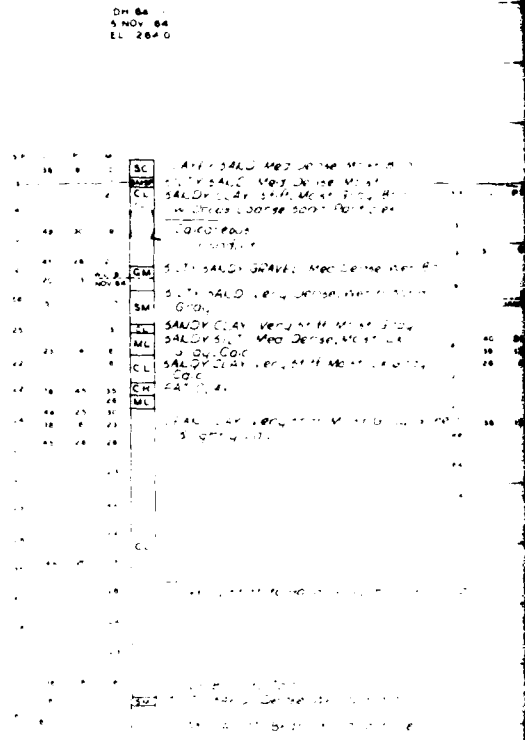
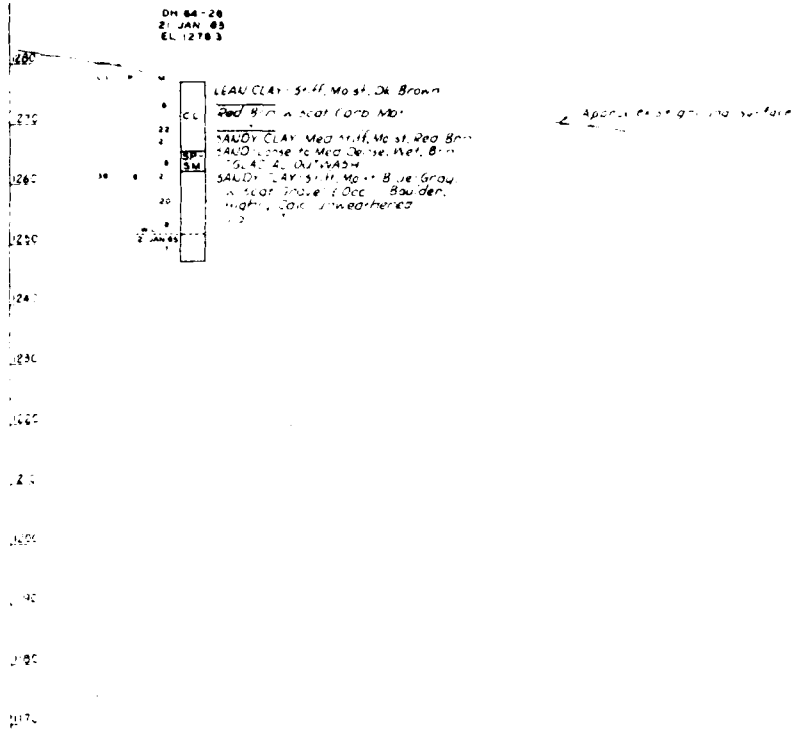
BRANCHED OAK DAM AND LAKE
SITE NO 18
RECORD OF BORINGS
RIGHT ABUTMENT AREA
SECTIONS E-E AND F-F

DATE 118 1985
BY [Signature]
CHECKED [Signature]
APPROVED [Signature]

DATE 118 1985
BY [Signature]
CHECKED [Signature]
APPROVED [Signature]

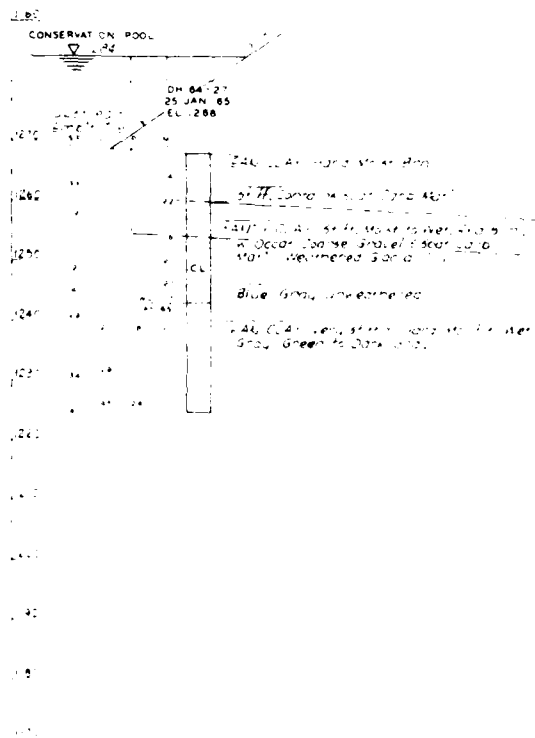
MSC13-310E31

CORPS OF ENGINEERS



A 105 Micromaster Film or a Paper Reproducible Record
 'y' Must Be Made Before Every Amendment and/or Modification

Copy	Amendment	DATE
	MODIFICATION	DATE

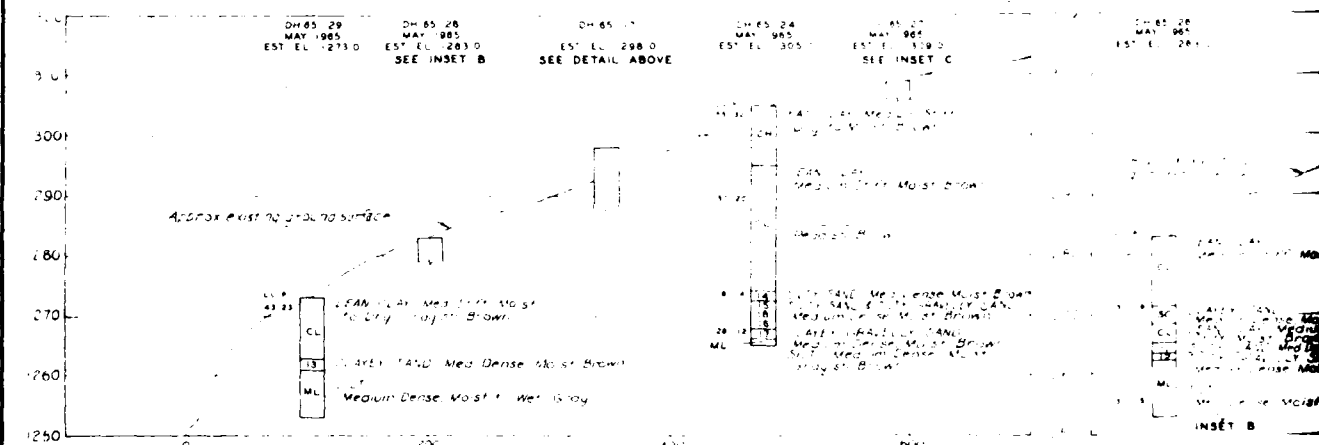
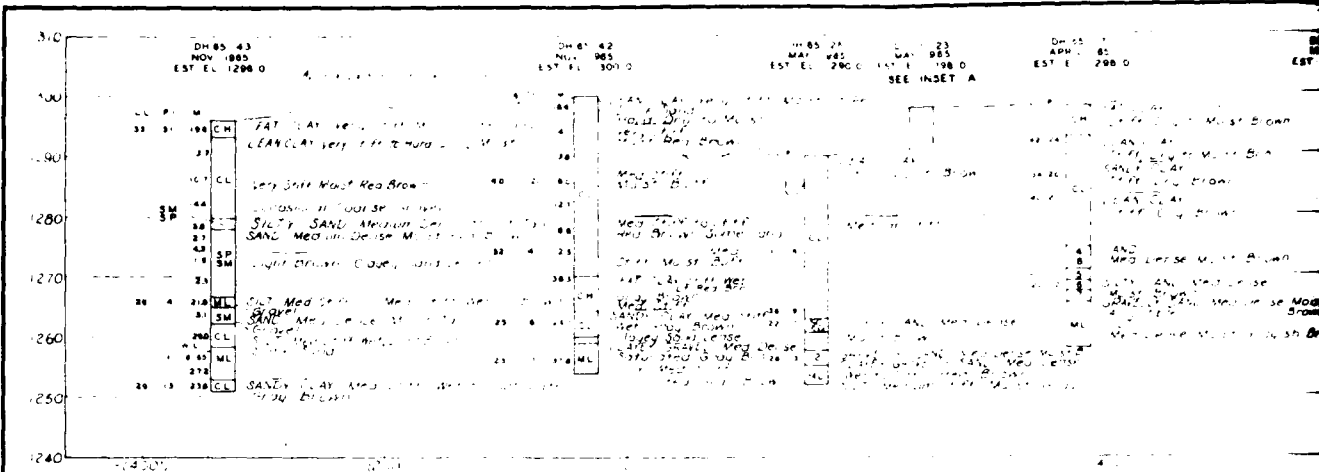


1. SECRET 2. SECRET

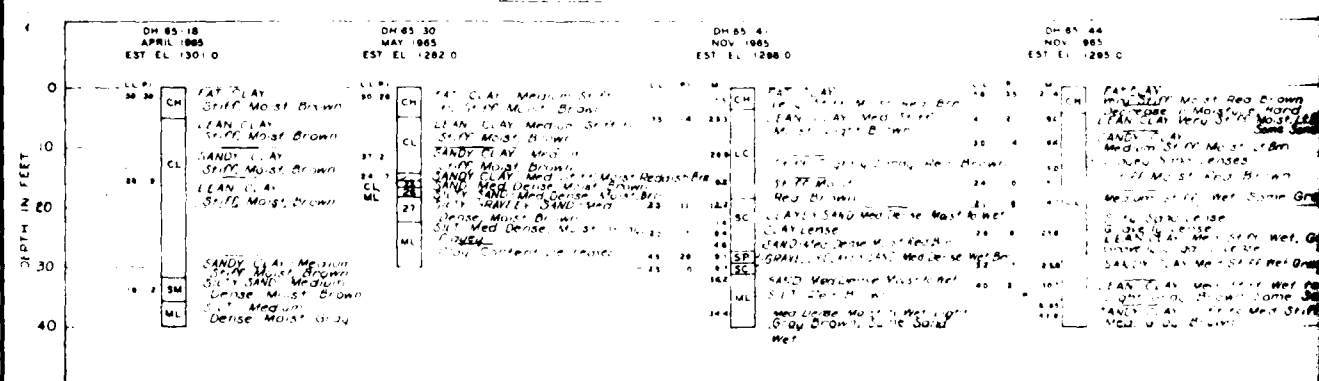
[illegible][illegible]

PLATE A12

CORPS OF ENGINEERS



SECTION M-M



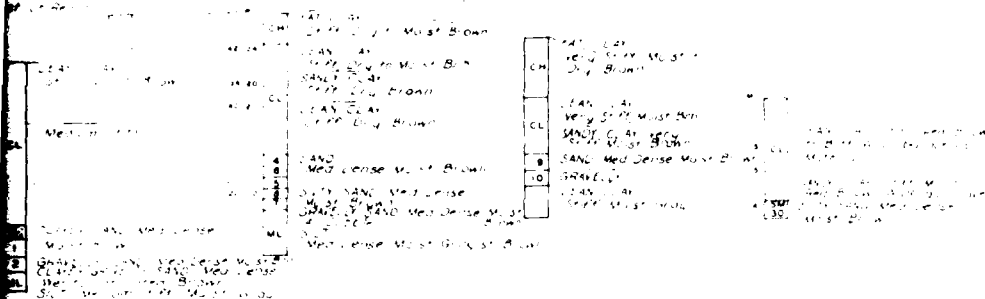
A 100 Micrometer Run or a New Microscopic Test
 Only Must Be Made Before Every Amendment of the
 Section
 DATE
 LOCATION
 UNIT

DN 24 MAY 1985
EST. EL. 1280.0
SEE INSET A

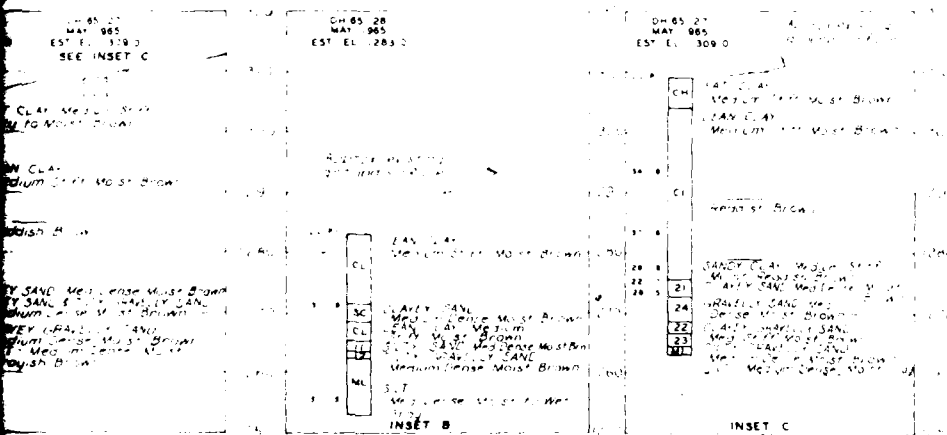
DN 25 MAY 1985
EST. EL. 1280.0

DN 25 MAY 1985
EST. EL. 1284.0

DN 26 MAY 1985
EST. EL. 1284.6



INSET A



INSET B

INSET C

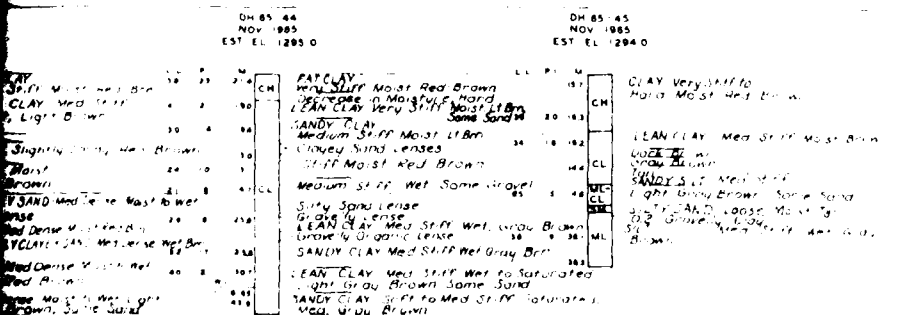
SAMPLE NO.	PLASTICITY INDEX (A.T. P.I.)	GRAIN SIZE (PERCENTS FINER)	U.S. STANDARD SIEVE SIZES				CLASSIFICATION
			200	100	40	10	
1	28	23	12	22	66	56	CLAYEY SAND SP-SH
2	30	21	12	22	66	56	CLAYEY SAND SP-SH
3	30	21	12	22	66	56	CLAYEY SAND SP-SH
4	30	21	12	22	66	56	CLAYEY SAND SP-SH
5	30	21	12	22	66	56	CLAYEY SAND SP-SH
6	30	21	12	22	66	56	CLAYEY SAND SP-SH
7	30	21	12	22	66	56	CLAYEY SAND SP-SH
8	30	21	12	22	66	56	CLAYEY SAND SP-SH
9	30	21	12	22	66	56	CLAYEY SAND SP-SH
10	30	21	12	22	66	56	CLAYEY SAND SP-SH
11	30	21	12	22	66	56	CLAYEY SAND SP-SH
12	30	21	12	22	66	56	CLAYEY SAND SP-SH
13	30	21	12	22	66	56	CLAYEY SAND SP-SH
14	30	21	12	22	66	56	CLAYEY SAND SP-SH
15	30	21	12	22	66	56	CLAYEY SAND SP-SH
16	30	21	12	22	66	56	CLAYEY SAND SP-SH
17	30	21	12	22	66	56	CLAYEY SAND SP-SH
18	30	21	12	22	66	56	CLAYEY SAND SP-SH
19	30	21	12	22	66	56	CLAYEY SAND SP-SH
20	30	21	12	22	66	56	CLAYEY SAND SP-SH
21	30	21	12	22	66	56	CLAYEY SAND SP-SH
22	30	21	12	22	66	56	CLAYEY SAND SP-SH
23	30	21	12	22	66	56	CLAYEY SAND SP-SH
24	30	21	12	22	66	56	CLAYEY SAND SP-SH
25	30	21	12	22	66	56	CLAYEY SAND SP-SH
26	30	21	12	22	66	56	CLAYEY SAND SP-SH
27	30	21	12	22	66	56	CLAYEY SAND SP-SH
28	30	21	12	22	66	56	CLAYEY SAND SP-SH
29	30	21	12	22	66	56	CLAYEY SAND SP-SH
30	30	21	12	22	66	56	CLAYEY SAND SP-SH

GENERAL NOTES:

- All Elevations shown refer to Feet above M.S.L., 1954 General Adjustment.
- For Boring Legend, Classification of Soils and Descriptive Notes, see PLATE A4.
- For Location of Borings, see PLATE A4.
- Estimated Elevations shown on Drill Holes are generally 5 Feet higher than the actual Elevation of the top of ground.

NOTES:

- The number in the Logs refer to the sample numbers of coarse grained material tested and presented in this tabulation.
- The Laboratory Classification of the Clay Soils above the pervious stratum was primarily Lean Clay with some Fat Clay.



SCALE: VERT. 1 INCH = 10 FEET
HORIZ. 1 INCH = 50 FEET



U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

BRANCHED OAK DAM AND LAKE
SITE NO 18
RECORD OF BORINGS
LEFT ABUTMENT AREA
SECTIONS L-L AND M-M

By: [Signature]
Checked: [Signature]
Date: [Date]

MSC-13-310E33

CORPS OF ENGINEERS

DNBS 6
4 FEB 85
02 234 7

DM 85-5
4 FEB 85
E. 2553

[illegible]

1. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

2. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

3. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

4. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

5. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

6. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

7. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

8. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

9. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

10. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

28

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. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820. 821. 822. 823. 824. 825. 826. 827. 828. 829. 830. 831. 832. 833. 834. 835. 836. 837. 838. 839. 840.

VERT. INCH = 10 FEET
HORIZ. INCH = 100 FEET

24 05 8
9 FEB 65
6 220 3

04-05-1
9 FEB 65
F 120' 4

1945 2
1946 8
1947 3 15

1. 1000
2. 1000
3. 1000
4. 1000
5. 1000
6. 1000
7. 1000
8. 1000
9. 1000
10. 1000
11. 1000
12. 1000
13. 1000
14. 1000
15. 1000
16. 1000
17. 1000
18. 1000
19. 1000
20. 1000
21. 1000
22. 1000
23. 1000
24. 1000
25. 1000
26. 1000
27. 1000
28. 1000
29. 1000
30. 1000
31. 1000
32. 1000
33. 1000
34. 1000
35. 1000
36. 1000
37. 1000
38. 1000
39. 1000
40. 1000
41. 1000
42. 1000
43. 1000
44. 1000
45. 1000
46. 1000
47. 1000
48. 1000
49. 1000
50. 1000
51. 1000
52. 1000
53. 1000
54. 1000
55. 1000
56. 1000
57. 1000
58. 1000
59. 1000
60. 1000
61. 1000
62. 1000
63. 1000
64. 1000
65. 1000
66. 1000
67. 1000
68. 1000
69. 1000
70. 1000
71. 1000
72. 1000
73. 1000
74. 1000
75. 1000
76. 1000
77. 1000
78. 1000
79. 1000
80. 1000
81. 1000
82. 1000
83. 1000
84. 1000
85. 1000
86. 1000
87. 1000
88. 1000
89. 1000
90. 1000
91. 1000
92. 1000
93. 1000
94. 1000
95. 1000
96. 1000
97. 1000
98. 1000
99. 1000
100. 1000

| Year | Age | Sex | Location | Notes |
|------|-----|-----|----------|-------|
| 1971 | 2 | ♂ | ... | ... |
| 1972 | 2 | ♂ | ... | ... |
| 1973 | 2 | ♂ | ... | ... |
| 1974 | 2 | ♂ | ... | ... |
| 1975 | 2 | ♂ | ... | ... |
| 1976 | 2 | ♂ | ... | ... |
| 1977 | 2 | ♂ | ... | ... |
| 1978 | 2 | ♂ | ... | ... |
| 1979 | 2 | ♂ | ... | ... |
| 1980 | 2 | ♂ | ... | ... |
| 1981 | 2 | ♂ | ... | ... |
| 1982 | 2 | ♂ | ... | ... |
| 1983 | 2 | ♂ | ... | ... |
| 1984 | 2 | ♂ | ... | ... |
| 1985 | 2 | ♂ | ... | ... |
| 1986 | 2 | ♂ | ... | ... |
| 1987 | 2 | ♂ | ... | ... |
| 1988 | 2 | ♂ | ... | ... |
| 1989 | 2 | ♂ | ... | ... |
| 1990 | 2 | ♂ | ... | ... |
| 1991 | 2 | ♂ | ... | ... |
| 1992 | 2 | ♂ | ... | ... |
| 1993 | 2 | ♂ | ... | ... |
| 1994 | 2 | ♂ | ... | ... |
| 1995 | 2 | ♂ | ... | ... |
| 1996 | 2 | ♂ | ... | ... |
| 1997 | 2 | ♂ | ... | ... |
| 1998 | 2 | ♂ | ... | ... |
| 1999 | 2 | ♂ | ... | ... |
| 2000 | 2 | ♂ | ... | ... |
| 2001 | 2 | ♂ | ... | ... |
| 2002 | 2 | ♂ | ... | ... |
| 2003 | 2 | ♂ | ... | ... |
| 2004 | 2 | ♂ | ... | ... |
| 2005 | 2 | ♂ | ... | ... |
| 2006 | 2 | ♂ | ... | ... |
| 2007 | 2 | ♂ | ... | ... |
| 2008 | 2 | ♂ | ... | ... |
| 2009 | 2 | ♂ | ... | ... |
| 2010 | 2 | ♂ | ... | ... |
| 2011 | 2 | ♂ | ... | ... |
| 2012 | 2 | ♂ | ... | ... |
| 2013 | 2 | ♂ | ... | ... |
| 2014 | 2 | ♂ | ... | ... |
| 2015 | 2 | ♂ | ... | ... |
| 2016 | 2 | ♂ | ... | ... |
| 2017 | 2 | ♂ | ... | ... |
| 2018 | 2 | ♂ | ... | ... |
| 2019 | 2 | ♂ | ... | ... |
| 2020 | 2 | ♂ | ... | ... |

CH 65 33
MAY 85
L 290 EST

OH 85 34
MAY 85
E-1290 (EST)

2004年3月
 2004年3月
 2004年3月



20. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$
 21. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$
 22. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$
 23. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$
 24. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$
 25. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$
 26. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$
 27. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$
 28. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$
 29. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$
 30. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

[illegible][illegible]

DM 85-35
MAY 85
EL 205 (EST)

0405 30
MAY 65
L 1200 EST

2-65 19
2 MAY 65
1 200 45'

[illegible][illegible][illegible]

1. $\frac{1}{2}$ 2. $\frac{1}{3}$ 3. $\frac{1}{4}$ 4. $\frac{1}{5}$ 5. $\frac{1}{6}$ 6. $\frac{1}{7}$ 7. $\frac{1}{8}$ 8. $\frac{1}{9}$ 9. $\frac{1}{10}$ 10. $\frac{1}{11}$

A 105 Micromaster Film or a Paper Reproducible Record Copy Must Be Made Before Every Amendment and/or Modification

AMENDMENT

Date _____

MODIFICATION

EMBAI

OH 65-4
3 FEB 65
EL 254.2

OH 65-3
3 FEB 65
EL 260.6

1. All elevations shown refer to feet above V.S.L., 1954 (adj.).
2. For Boring Legend, Classification of Soils and Descriptive Notes, see PLATE A6.
3. For Location of Borings, see PLATE A4.

1. All elevations shown refer to feet above V.S.L., 1954 (adj.).
2. For Boring Legend, Classification of Soils and Descriptive Notes, see PLATE A6.
3. For Location of Borings, see PLATE A4.

1. All elevations shown refer to feet above V.S.L., 1954 (adj.).
2. For Boring Legend, Classification of Soils and Descriptive Notes, see PLATE A6.
3. For Location of Borings, see PLATE A4.

UPSTREAM BORROW AREA RECORD
DOWNSTREAM
SCALE: VERT. INCH = 10 FEET
HORIZ. INCH = 100 FEET

OH 65-5
29 APR 65
EL 303.157

OH 65-6
28 APR 65
EL 321.157

1. All elevations shown refer to feet above V.S.L., 1954 (adj.).
2. For Boring Legend, Classification of Soils and Descriptive Notes, see PLATE A6.
3. For Location of Borings, see PLATE A4.

1. All elevations shown refer to feet above V.S.L., 1954 (adj.).
2. For Boring Legend, Classification of Soils and Descriptive Notes, see PLATE A6.
3. For Location of Borings, see PLATE A4.

OH 65-37
2 MAY 65
EL 290.157

OH 65-38
2 MAY 65
EL 290.157

1. All elevations shown refer to feet above V.S.L., 1954 (adj.).
2. For Boring Legend, Classification of Soils and Descriptive Notes, see PLATE A6.
3. For Location of Borings, see PLATE A4.

1. All elevations shown refer to feet above V.S.L., 1954 (adj.).
2. For Boring Legend, Classification of Soils and Descriptive Notes, see PLATE A6.
3. For Location of Borings, see PLATE A4.

GENERAL NOTES:

1. All elevations shown refer to feet above V.S.L., 1954 (adj.).
2. For Boring Legend, Classification of Soils and Descriptive Notes, see PLATE A6.
3. For Location of Borings, see PLATE A4.

OH 65-39
2 MAY 65
EL 290.157

1. All elevations shown refer to feet above V.S.L., 1954 (adj.).
2. For Boring Legend, Classification of Soils and Descriptive Notes, see PLATE A6.
3. For Location of Borings, see PLATE A4.

1. All elevations shown refer to feet above V.S.L., 1954 (adj.).
2. For Boring Legend, Classification of Soils and Descriptive Notes, see PLATE A6.
3. For Location of Borings, see PLATE A4.

RE-USE OF AREA IS PROHIBITED

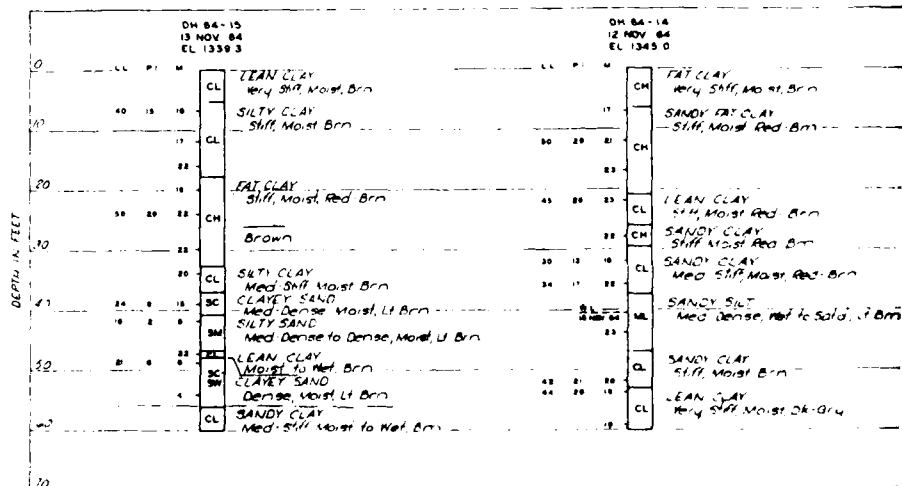
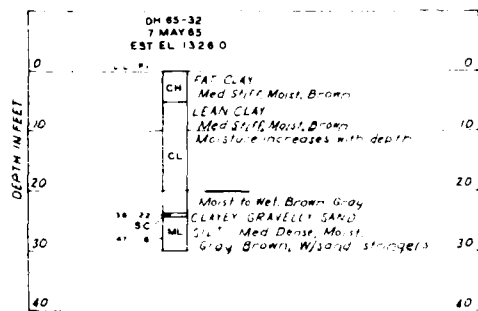
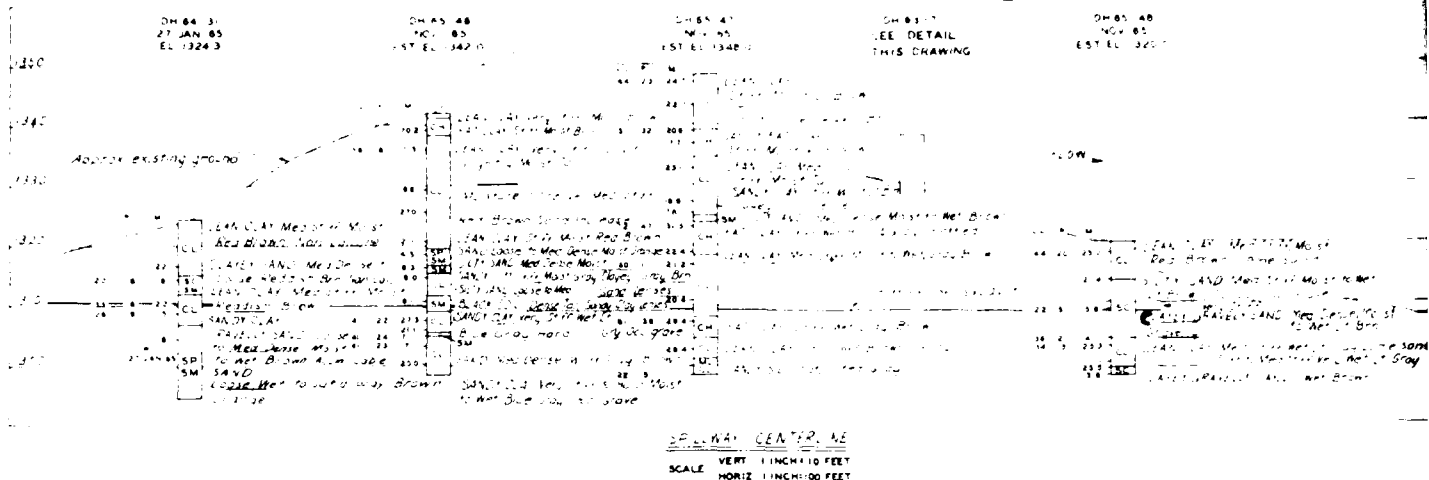


U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

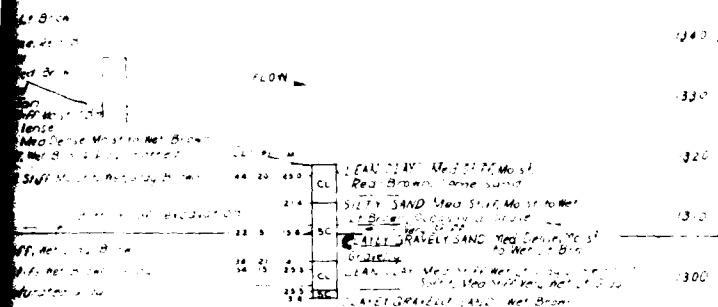
BRANCHED OAK DAM AND LAKE
SITE NO 18
RECORD OF BORINGS
UPSTREAM BORROW AREAS

| | | |
|-------------------------------------|------|---------------|
| DESIGNED BY | DATE | 119 000 |
| DRAWN BY | DATE | 119 000 |
| CHECKED BY | DATE | 119 000 |
| APPROVED BY | DATE | 119 000 |
| APPROVED BY | DATE | 119 000 |
| U. S. ARMY ENGINEER DISTRICT, OMAHA | | MSC13-310E 34 |

CORPS OF ENGINEERS

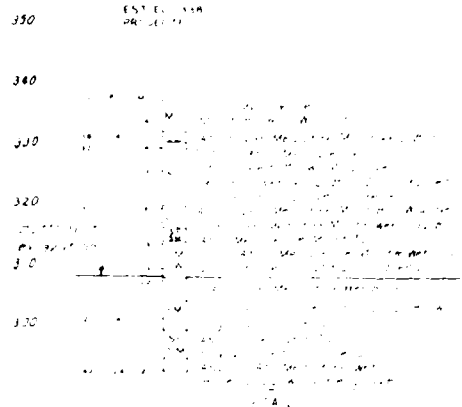


EST E. 13M
PR. 11.1



PLINE

NO FURTHER



| | | OH 64-14 | | 12 NOV 64 | | EL 1345.0 | |
|-------------------------------|----|----------|----|-----------|--------------------------|------------|--|
| CLAY | LL | PI | W | CM | FAT CLAY | | |
| Moist, Brn | | | | | Very Shlt, Moist, Brn | | |
| CLAY | | | | 17 | SANDY FAT CLAY | | |
| Moist, Brn | | | | | Shlt, Moist, Red Brn | | |
| | 50 | 20 | 21 | CM | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| CLAY | | | | | LEAN CLAY | | |
| Moist, Red Brn | 45 | 20 | 23 | CL | Shlt, Moist, Red Brn | | |
| | | | | | | | |
| | | | | 28 | CM | SANDY CLAY | |
| | | | | | Shlt, Moist, Red Brn | | |
| CLAY | 30 | 13 | 16 | CL | SANDY CLAY | | |
| Shlt, Moist, Brn | 34 | 17 | 22 | | Med Shlt, Moist, Red Brn | | |
| TO SAND | | | | | | | |
| Dense, Moist, Lt Brn | | | | 21 | ML | SANDY SILT | |
| | | | | | | | |
| Dense to Dense, Moist, Lt Brn | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| CLAY | | | | | | | |
| Moist, Brn | 42 | 21 | 20 | CL | SANDY CLAY | | |
| TO SAND | 44 | 20 | 19 | | Shlt, Moist, Brn | | |
| Dense, Moist, Lt Brn | | | | | | | |
| CLAY | | | | | LEAN CLAY | | |
| Shlt, Moist to Wet, Brn | | | | | Very Shlt, Moist, Ok Dry | | |

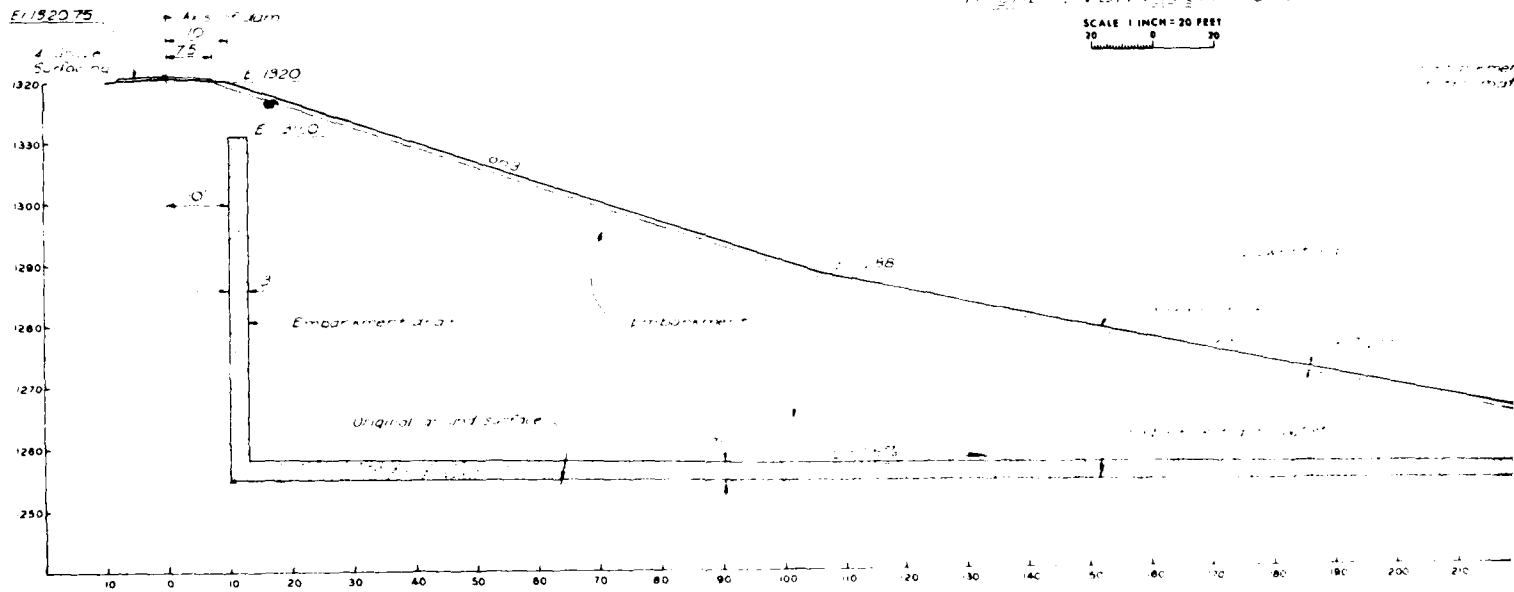
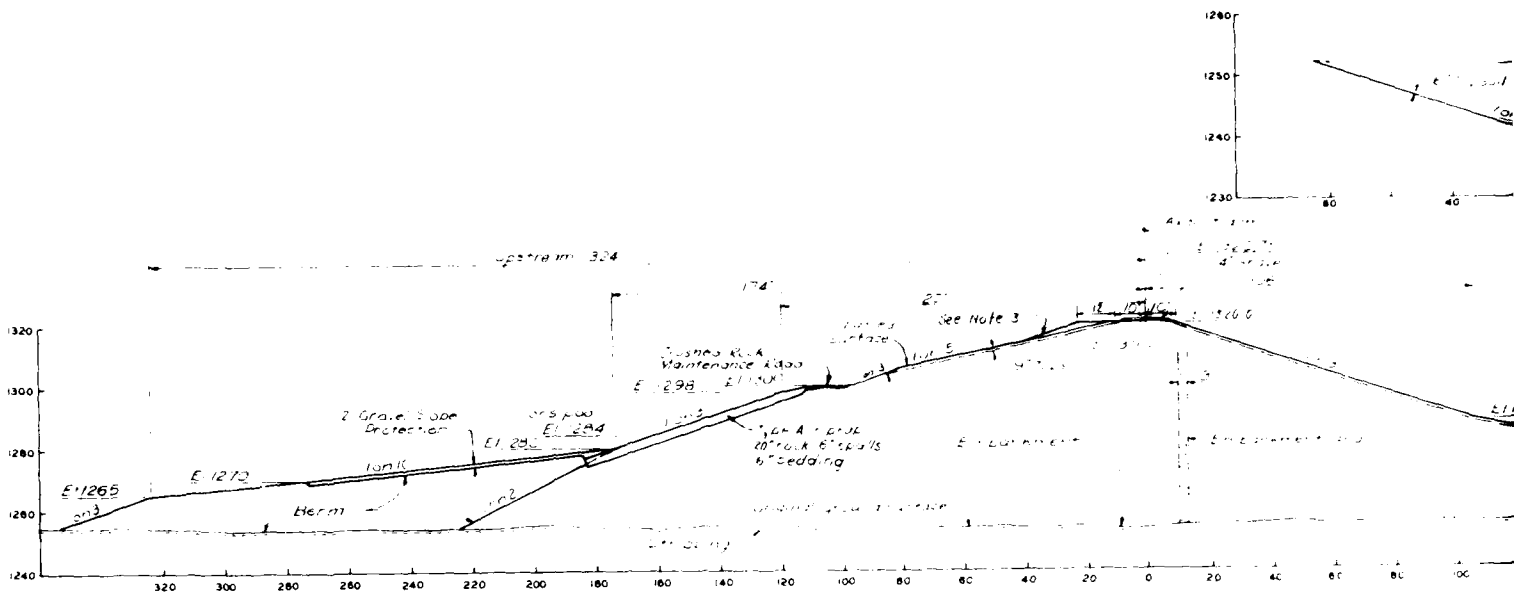
GENERAL NOTES:

1. All elevations shown refer to feet above M.S.L., 1954 Gen. Adj.
2. For Boring Legend, Classification of Soils and Descriptive Notes, see PLATE A6.
3. For location of Borings, see PLATE A4.



| | | | | | |
|--|--|--|--|-------------------|--|
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | | | | | |
| DESIGNED BY _____
<i>(Signature)</i> | | SAFETY OFFICER'S SPECIAL INSPECTION | | | |
| DRAWN BY _____
<i>(Signature)</i> | | BRANCHED OAK DAM AND LAKE
SITE NO 18 | | | |
| CHECKED BY _____
<i>(Signature)</i> | | RECORD OF BORINGS
SPILLWAY AREA | | | |
| APPROVED FOR CONSTRUCTION
<i>(Signature)</i> | | APPROVED
<i>(Signature)</i>
NOT TO BE USED FOR OTHER PURPOSES | | DATE FEB. 1906 | |
| APPROVED
<i>(Signature)</i> | | SCALE AS SHOWN | | SEE US ON DRAWING | |
| | | PROJECT NUMBER | | MISC-3 - 310E35 | |

CORPS OF ENGINEERS

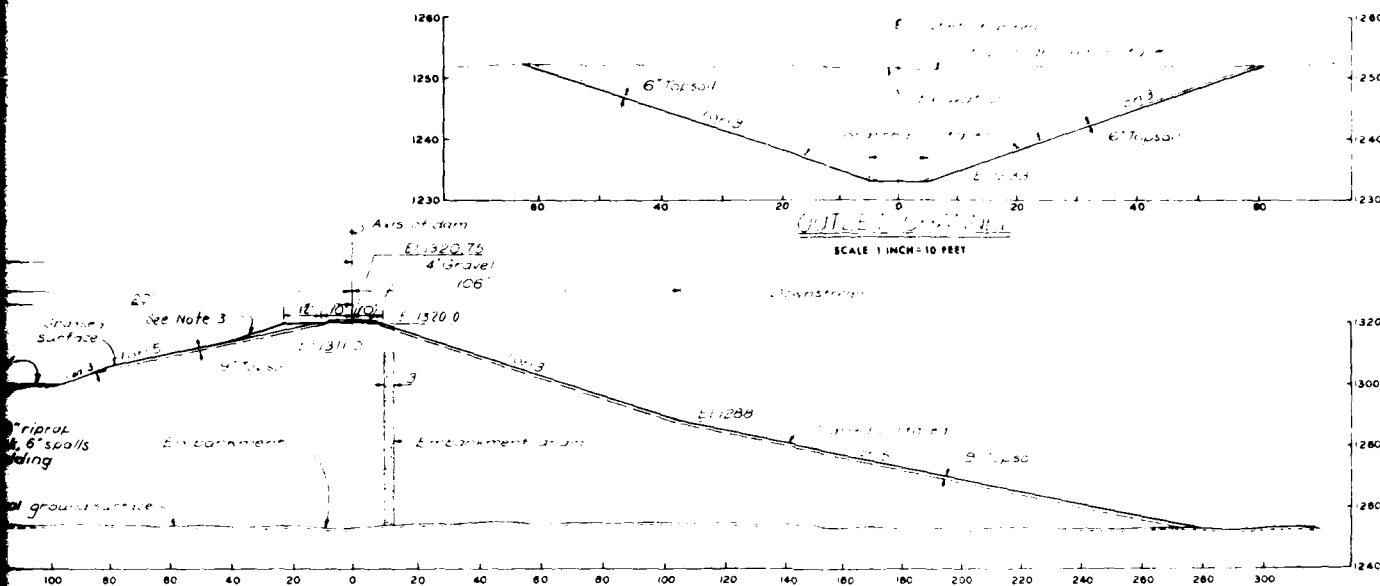


TYPICAL SECTION EMBANKMENT AND DITCH

SCALE 1 INCH = 10 FEET

GEM
1.
M.I
2.
19
3.

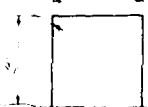
EMBANK



TYPICAL EMBANKMENT SECTION

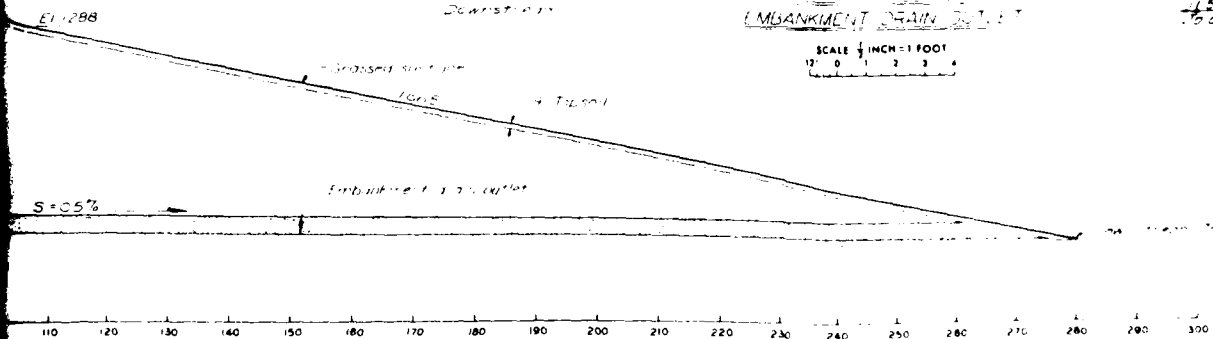
SCALE 1 INCH = 20 FEET

Embarkment drain
filter material



TYPICAL SECTION EMBANKMENT DRAIN OUTLET

SCALE 1 INCH = 1 FOOT



TYPICAL SECTION EMBANKMENT DRAIN OUTLET

SCALE 1 INCH = 20 FEET

GENERAL NOTES:

1. All elevations shown refer to feet above M.S.L., 1954 General Adjustment.
2. This plate supersedes Plate 5 Appendix 'B' 1968 Inspection Report.
3. Crest width widened 12 feet in 1970.



THIS PLAN ACCOMPANIES CONTRACT NO. MODIFICATION NO.

| | | | |
|--|-------------------|----------|------|
| DATE | DESCRIPTION | BY | DATE |
| | | | |
| U. S. ARMY ENGINEER DISTRICT OHAMA
CORPS OF ENGINEERS
OHAMA, NEBRASKA | | | |
| BRANCHED OAK DAM & RESERVOIR
TYPICAL SECTIONS
EMBANKMENT, EMBANKMENT DRAIN
AND OUTLET CHANNEL | | | |
| DESIGNED BY | CHIEF OF DISTRICT | APPROVED | DATE |
| DRAWN BY | | | |
| CHECKED BY | | | |
| APPROVED | | | |
| | | | |

CORPS OF ENGINEERS

UPSTREAM

12% gravel slope pro

Excavation

Embankment berm

Upstream

Approx existing ground surface

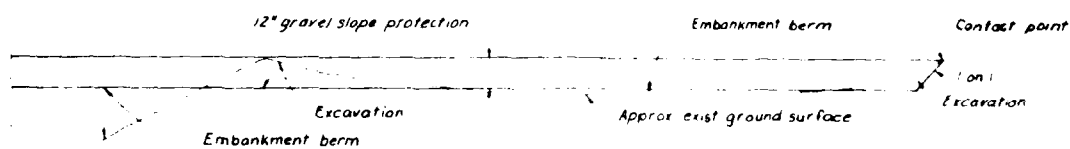
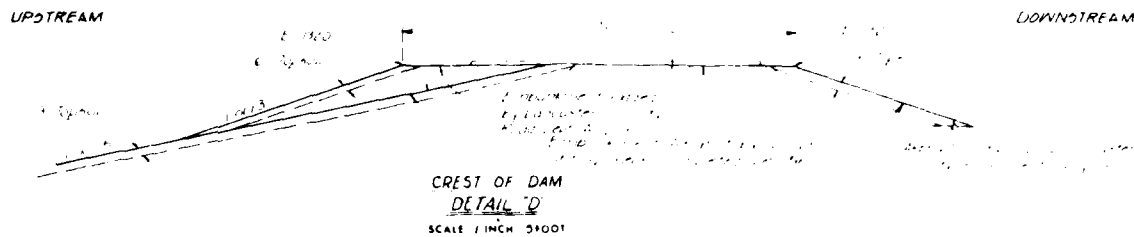
Bedding
Gravel
Type 14 gravel

Gravel

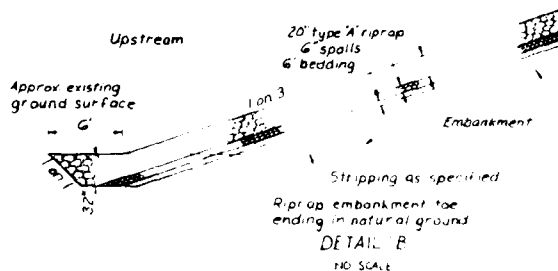
DETAIL "A"

NOTES

EMBA



DETAIL "E"
SCALE 1 INCH = 5 FEET



GENERAL NOTES:

1. All elevations shown refer to feet above M.S.L., 1954 General Adjustment.
2. For location of details, see PLATES A2 and A3.

DETAIL "A"
NO SCALE



| | |
|---|---------------------------------|
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | |
| BRANCHED OAK DAM AND LAKE
SITE NO 18
EMBANKMENT
SECTIONS AND DETAILS | |
| DESIGNED BY
CHECKED BY
APPROVED BY
DATE | DATE
FEB 1966
MSCL3-21020 |

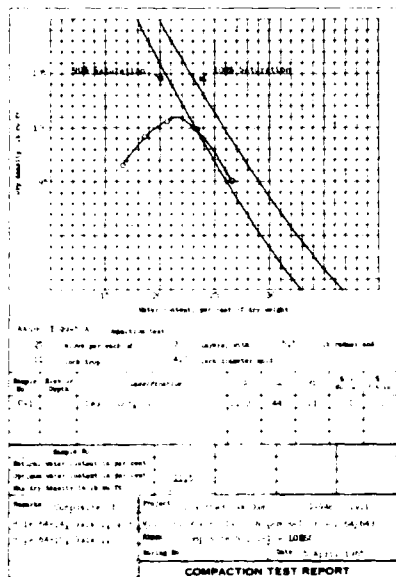


FIGURE 1

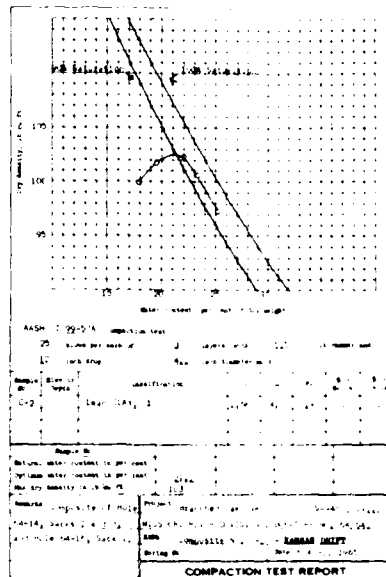


FIGURE 2

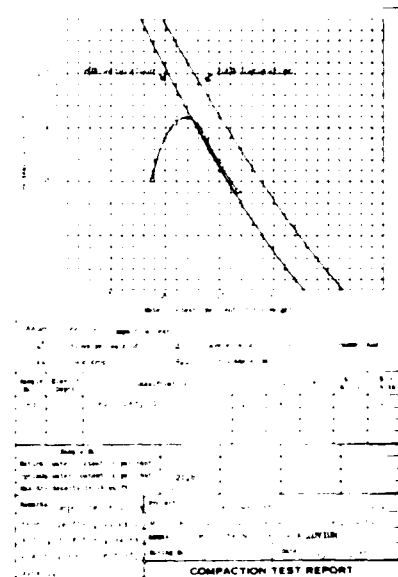


FIGURE 3

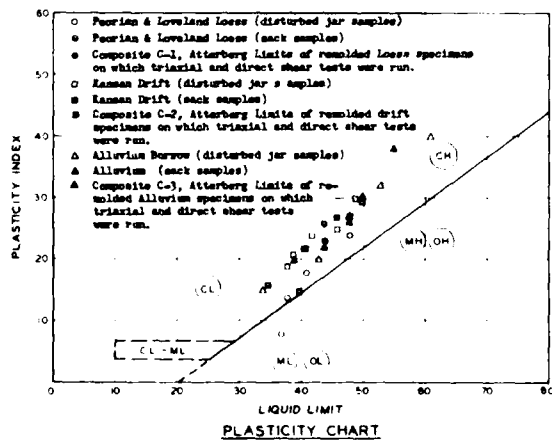


FIGURE 5

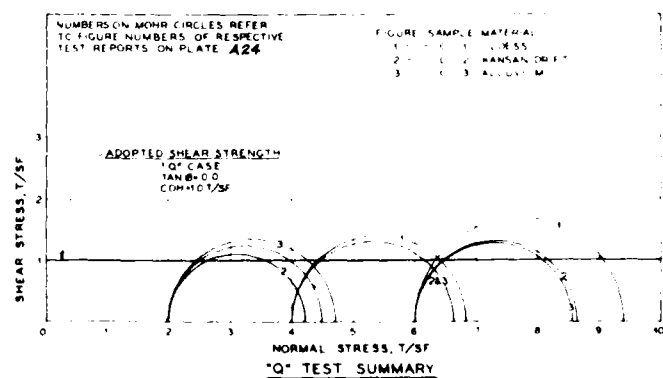


FIGURE 6

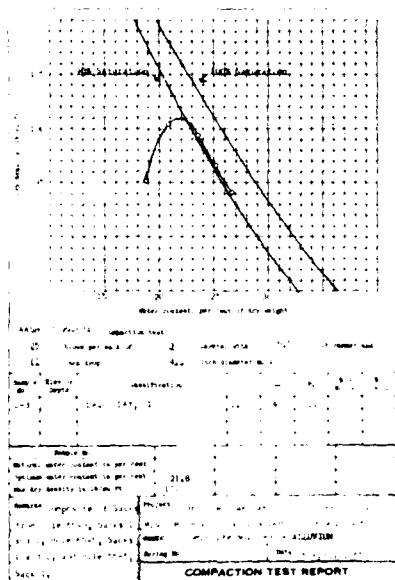


FIGURE 3

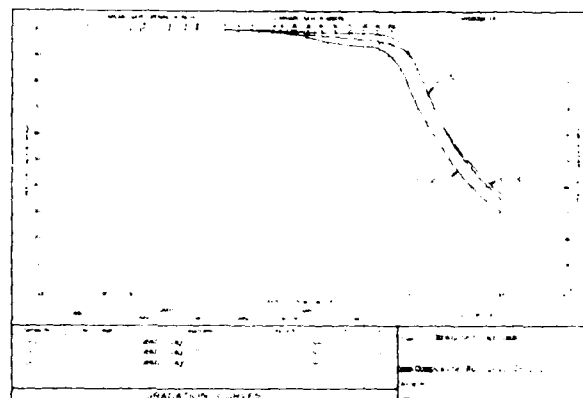


FIGURE 4

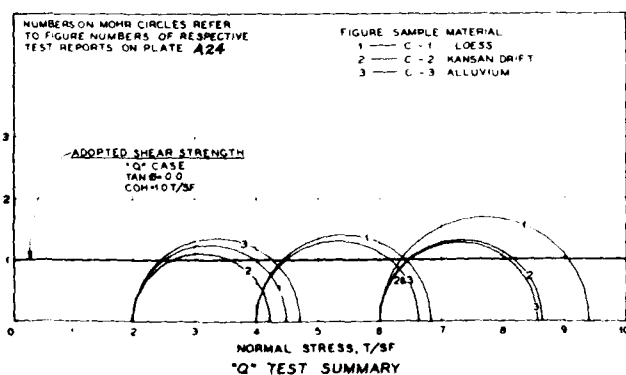


FIGURE 6

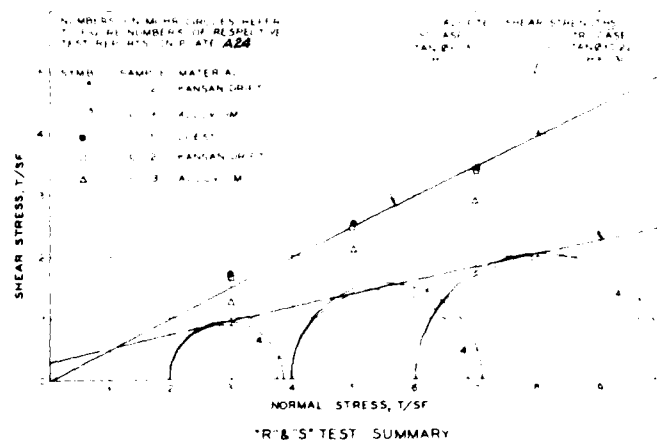


FIGURE 7



THIS PLAN ACCOMPANIES CONTRACT NO. DA-36-066-00 MODIFICATION NO.

| | | | |
|--|-----------------|------|----------|
| DATE | DESCRIPTION | PAGE | APPROVED |
| | REL. 6-0-8 | | |
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | | | |
| SALT CREEK AND ITS TRIBUTARIES, NEBRASKA | | | |
| BRANCHED OAK DAM & RESERVOIR | | | |
| LABORATORY TEST DATA | | | |
| REMOLDED EMBANKMENT MATERIAL | | | |
| COMPACTION TESTS TRIAXIAL AND | | | |
| DIRECT SHEAR TEST SUMMARIES | | | |
| DESIGNED BY | CHECKED BY | DATE | |
| DR. J. H. H. H. | DR. J. H. H. H. | 1983 | |
| APPROVED BY | DATE | | |
| DR. J. H. H. H. | 1983 | | |

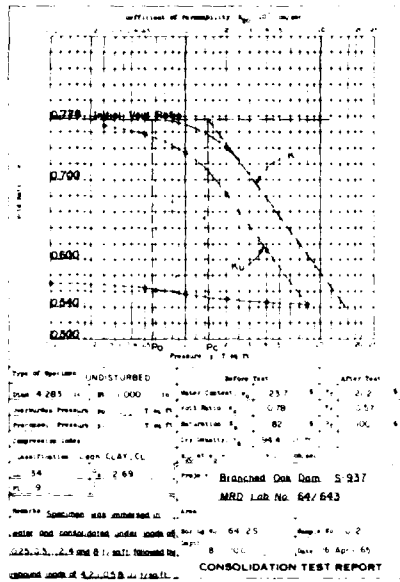


FIGURE 1

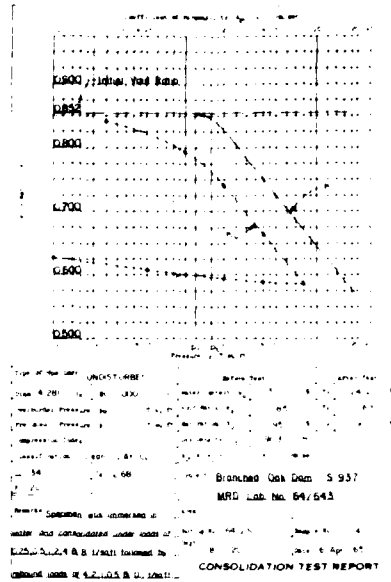


FIGURE 2

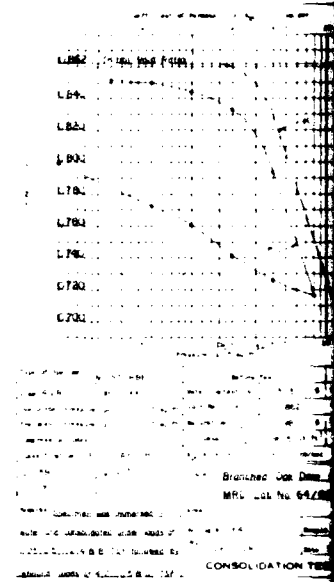


FIGURE 3

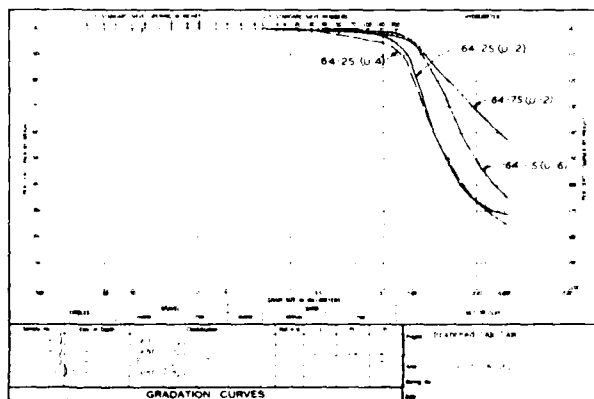


FIGURE 5

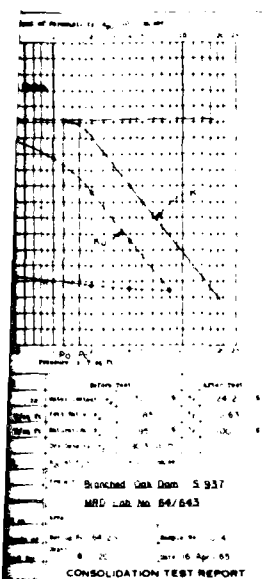


FIGURE 2

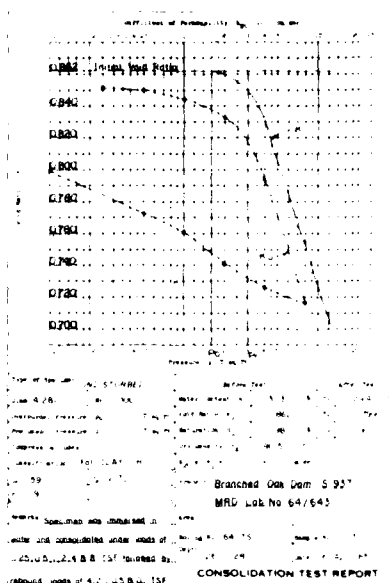


FIGURE 3

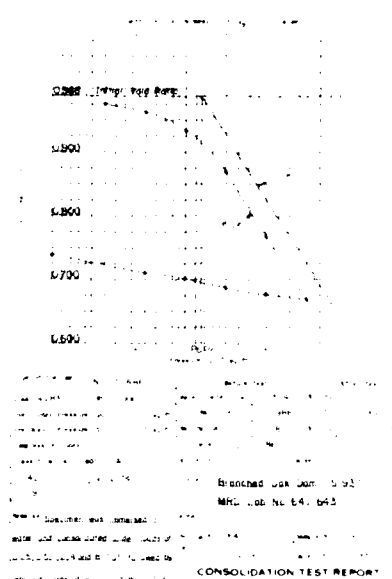


FIGURE 4



THIS PLAN ACCOMPANIES CONTRACT NO.
OA-55-055-49
MODIFICATION NO.

| | | | |
|--|--------------------------|------|----------|
| DATE | DESCRIPTION | DATE | APPROVED |
| | REV. 8-0-59 | | |
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | | | |
| SALT CREEK AND ITS TRIBUTARIES, NEBRASKA
BRANCHED OAK DAM & RESERVOIR | | | |
| LABORATORY TEST DATA | | | |
| CONSOLIDATION TESTS
FLOOD PLAIN ALLUVIUM | | | |
| TESTED BY
J. H. H. H. | TESTED BY
J. H. H. H. | DATE | DATE |
| TESTED BY
J. H. H. H. | TESTED BY
J. H. H. H. | DATE | DATE |
| TESTED BY
J. H. H. H. | TESTED BY
J. H. H. H. | DATE | DATE |

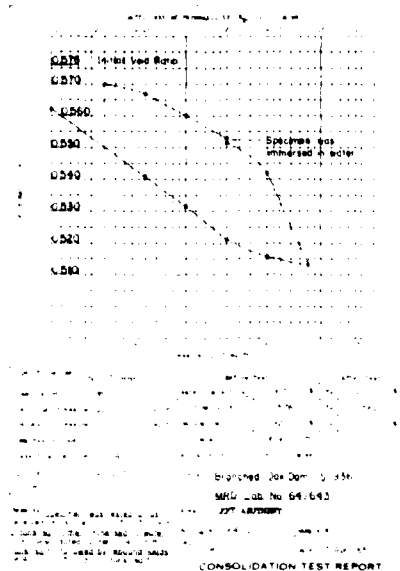


FIGURE 1

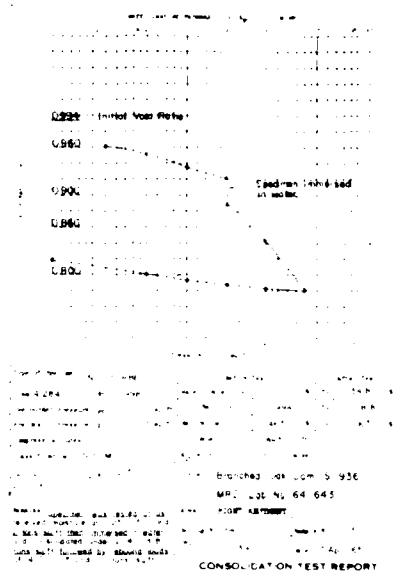


FIGURE 2

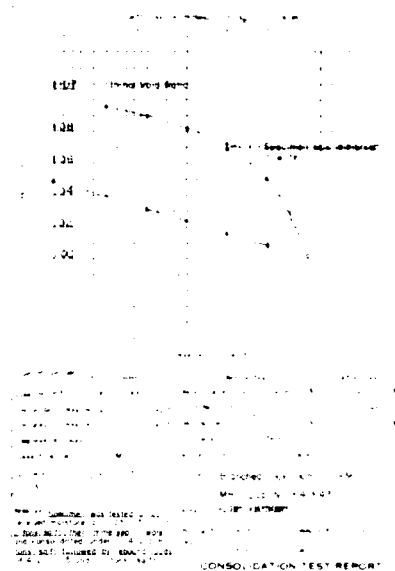


FIGURE 3

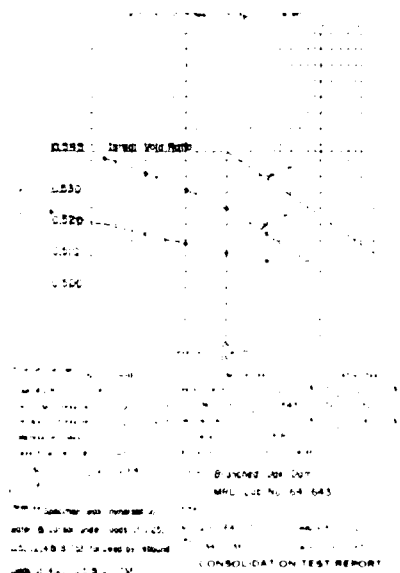


FIGURE 4

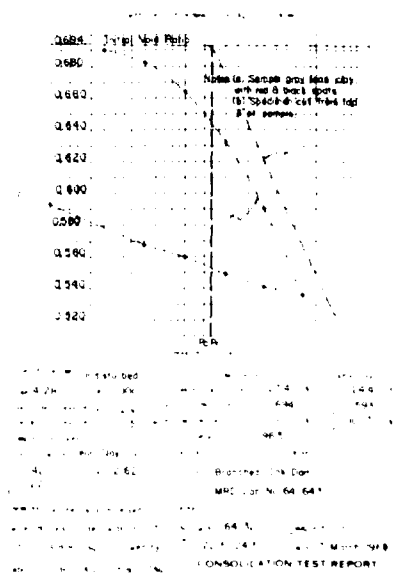


FIGURE 5



FIGURE 6

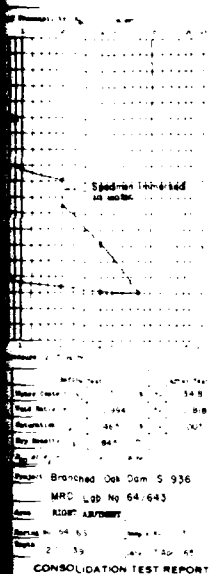


FIGURE 2

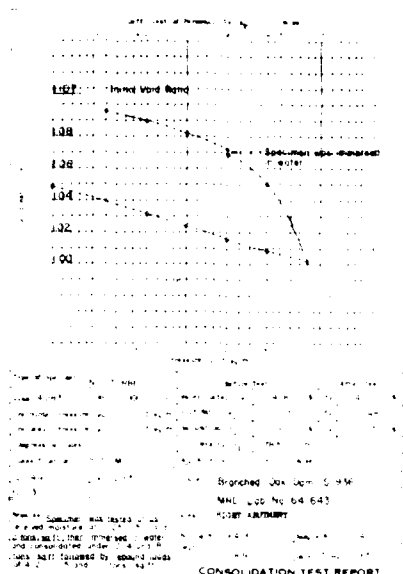


FIGURE 3

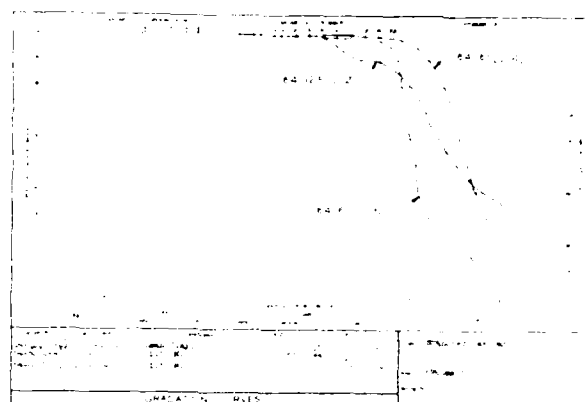


FIGURE 4

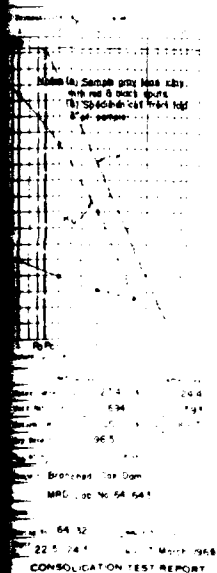


FIGURE 5

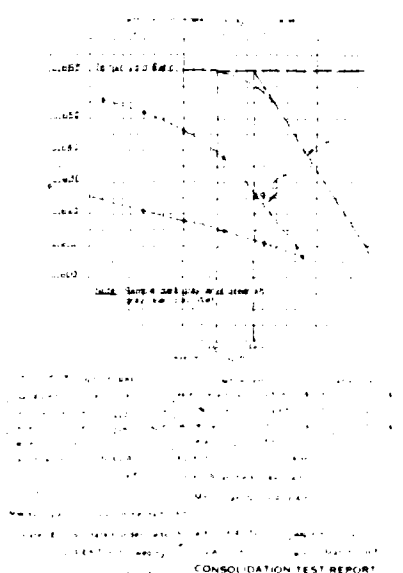


FIGURE 6

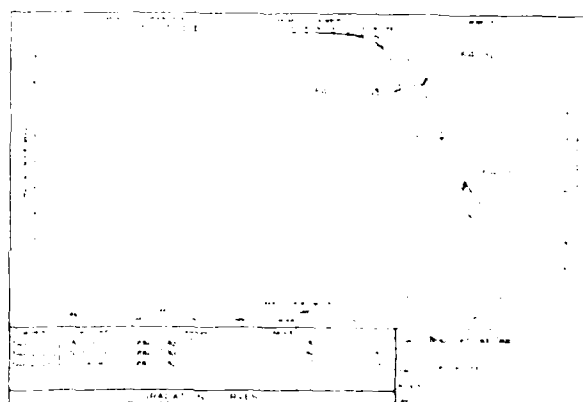


FIGURE 7



THIS PLAN ACCOMPANIES CONTRACT NO.
DA 38 066-000 MODIFICATION NO.

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

SALT CREEK AND ITS TRIBUTARIES, NEBRASKA
BRANCHED OAK DAM & RESERVOIR
LABORATORY TEST DATA
CONSOLIDATION TESTS
ABUTMENT AND OUTLET WORKS AREA

APPROVED: *[Signature]*
DATE: 10-1-53
BY: J. H. HARRIS
TEST NO: 64 643
TEST TYPE: CONSOLIDATION
TEST METHOD: Oedometer
TEST RESULTS: e = 1.00 at log p = 1.5
e = 1.02 at log p = 1.6
e = 1.04 at log p = 1.7
e = 1.06 at log p = 1.8
e = 1.08 at log p = 1.9
e = 1.10 at log p = 2.0
e = 1.12 at log p = 2.1
e = 1.14 at log p = 2.2
e = 1.16 at log p = 2.3
e = 1.18 at log p = 2.4
e = 1.20 at log p = 2.5

CONSOLIDATION TEST REPORT

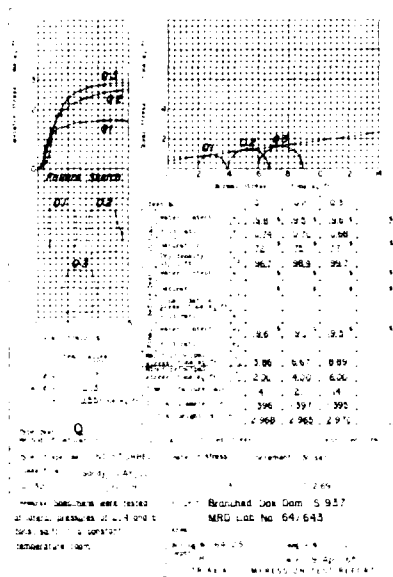


FIGURE 1

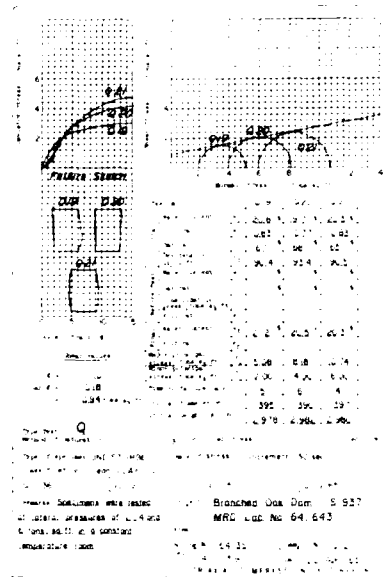


FIGURE 2

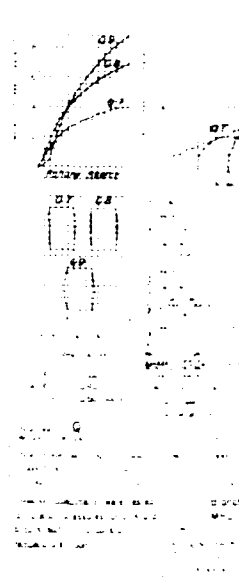


FIGURE 3

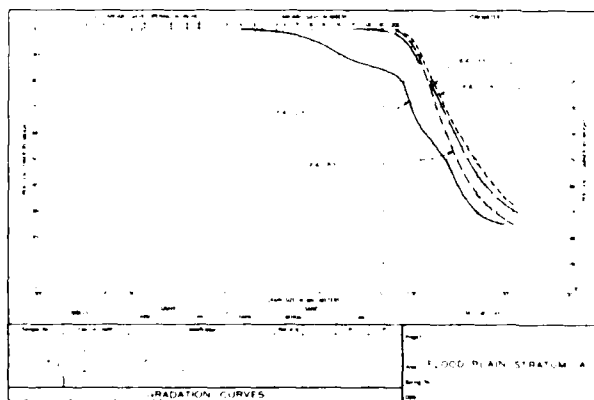


FIGURE 5

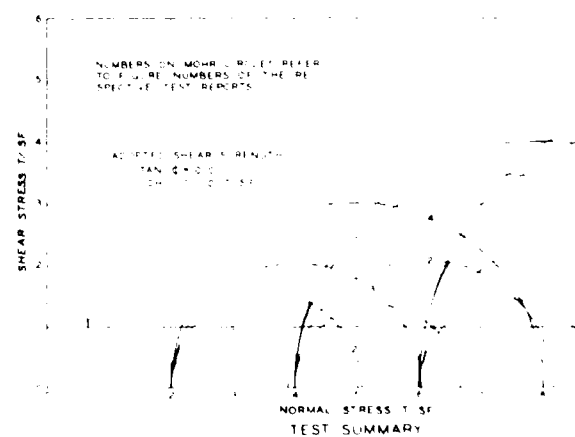


FIGURE 6

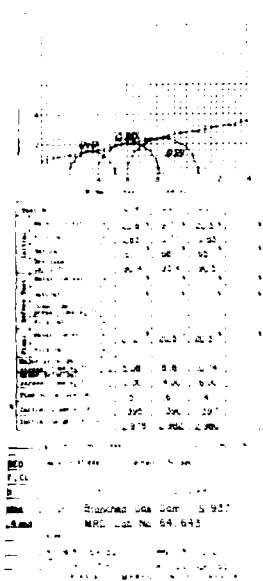


FIGURE 2

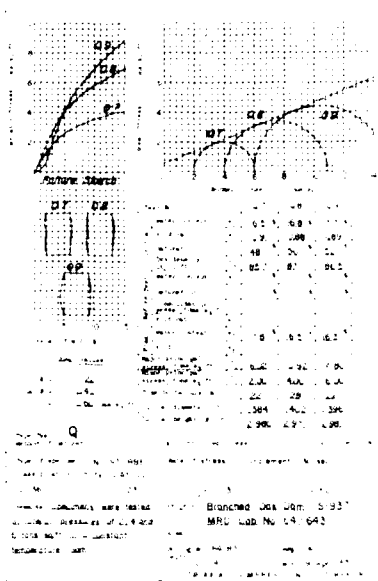


FIGURE 3

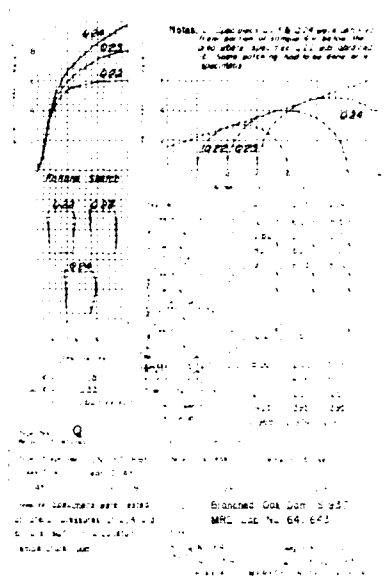


FIGURE 4

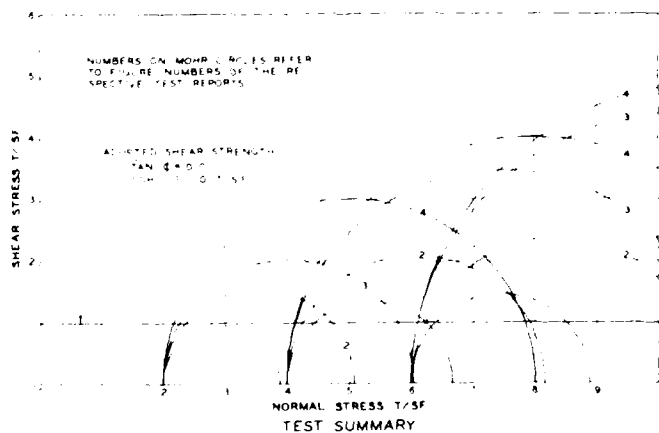


FIGURE 6

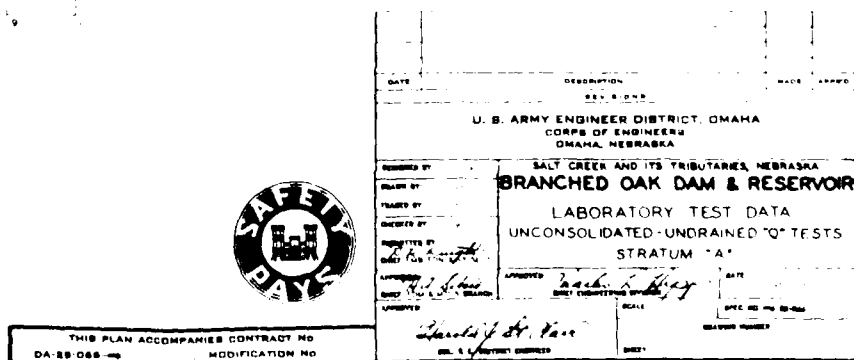


FIGURE 6



EMBANKMENT CRITERIA AND PERFORMANCE REPORT (1983) PLATE A21

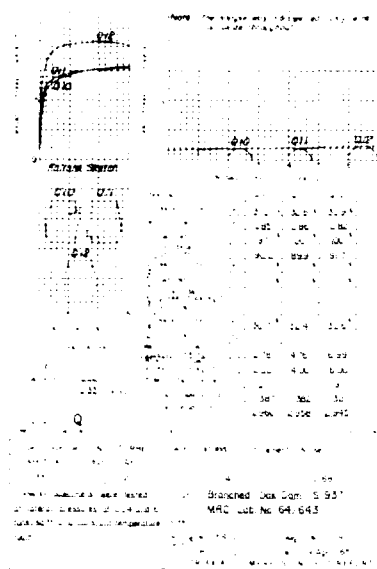


FIGURE 1

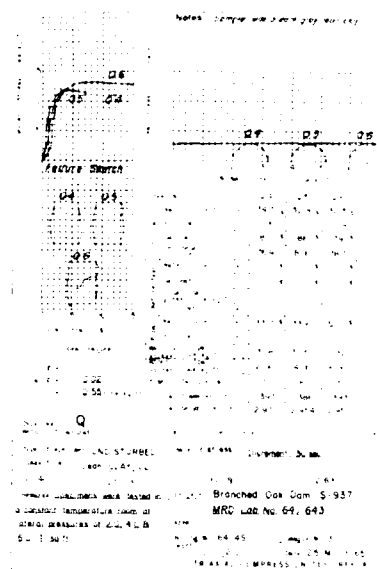


FIGURE 2

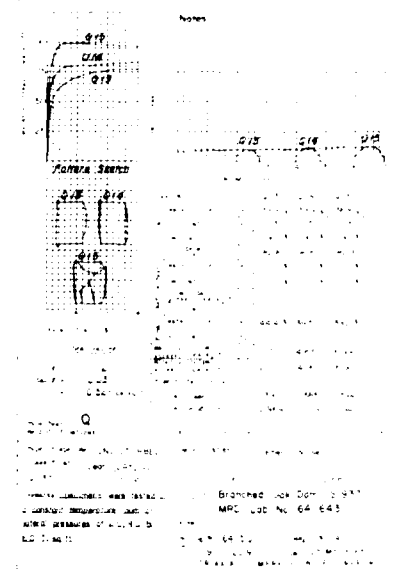


FIGURE 3

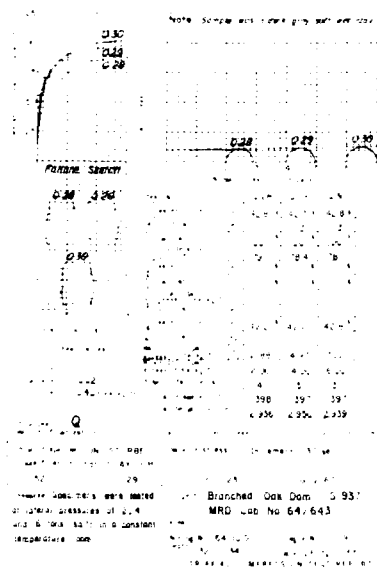


FIGURE 6

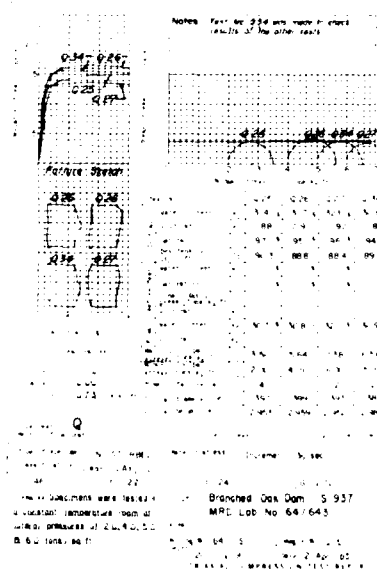


FIGURE 7

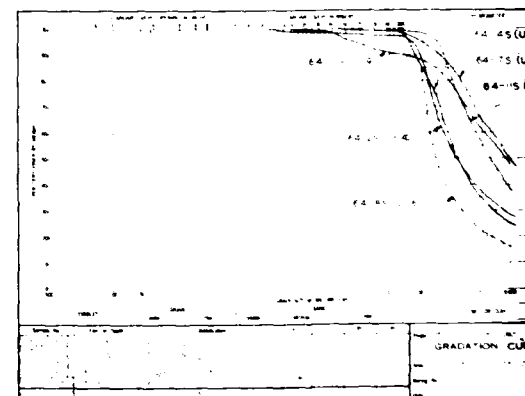


FIGURE 8

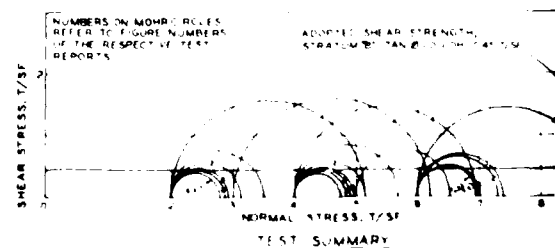
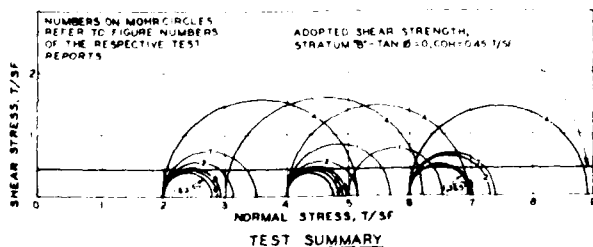
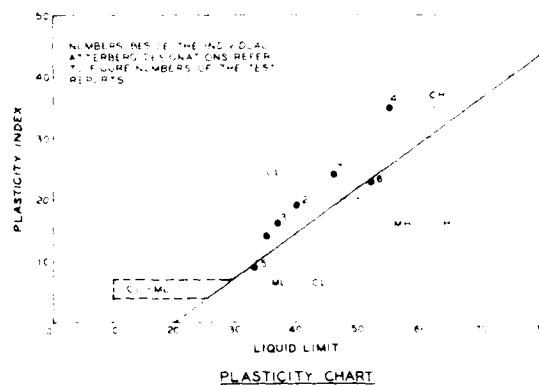
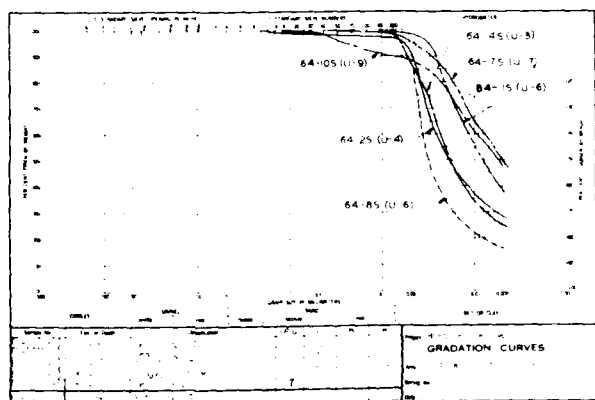
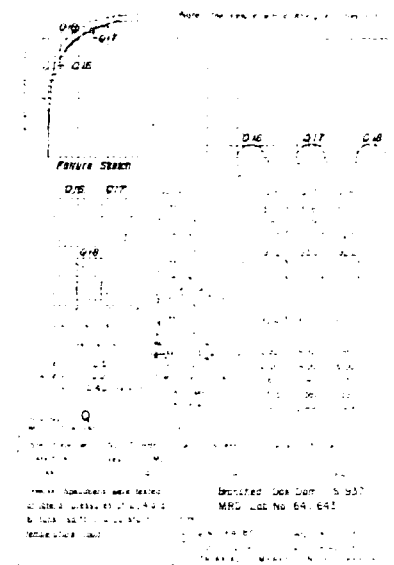
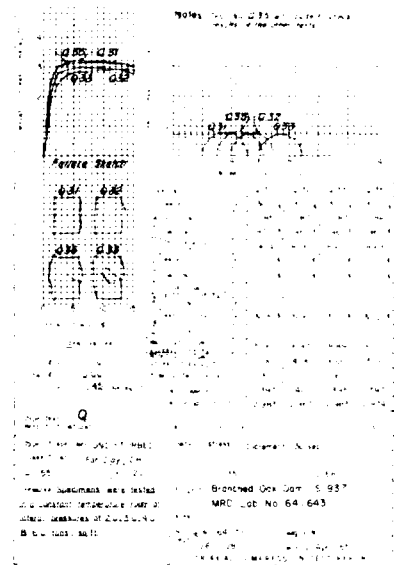
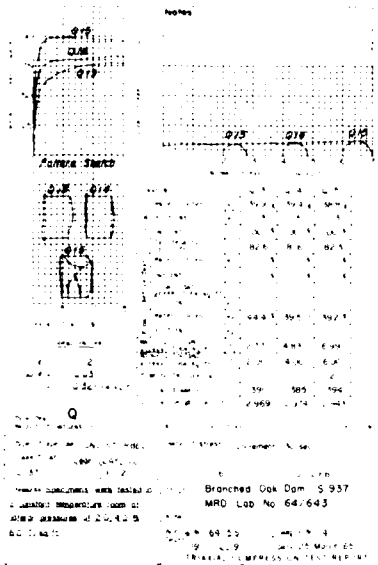


FIGURE 10

[illegible]

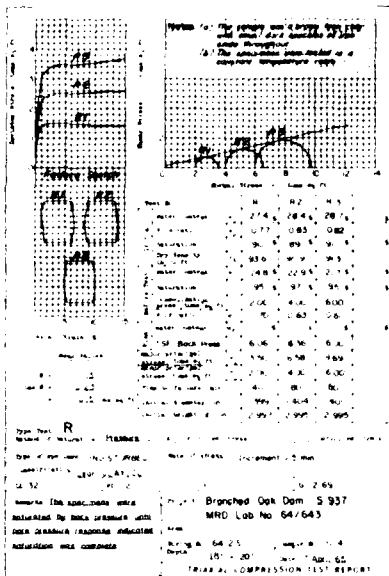


FIGURE 1

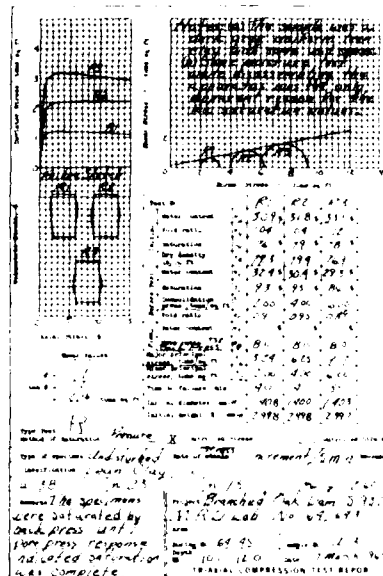


FIGURE 2

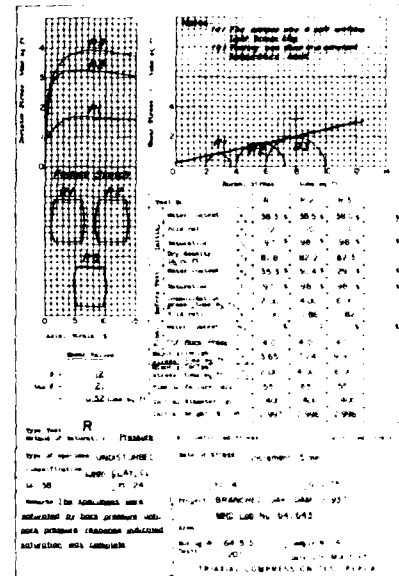


FIGURE 3

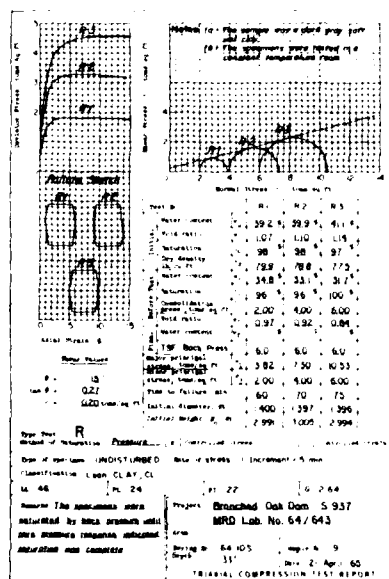


FIGURE 4

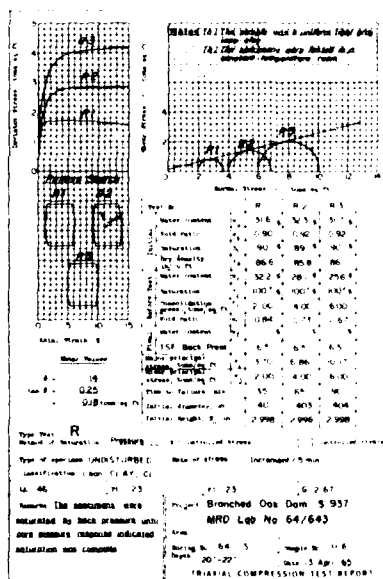


FIGURE 5

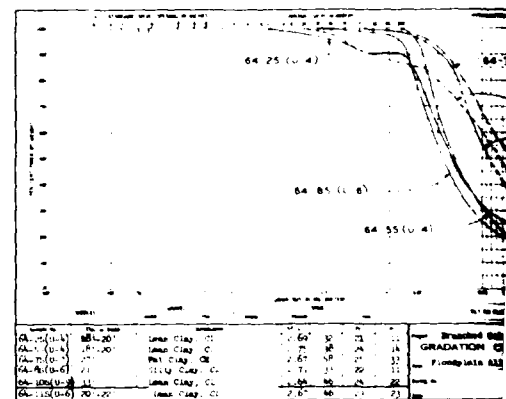


FIGURE 6

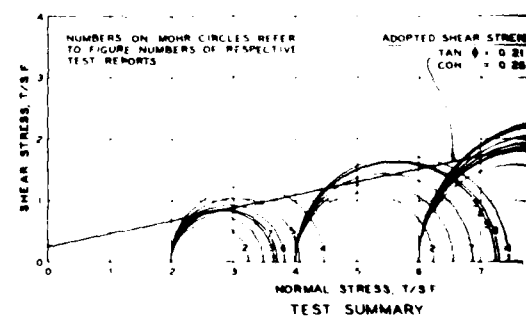


FIGURE 7

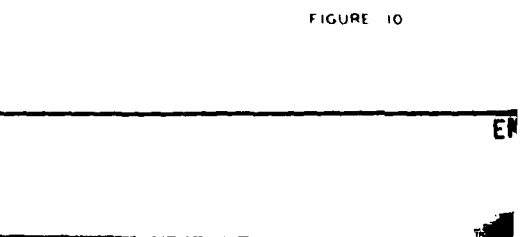


FIGURE 8



FIGURE 9

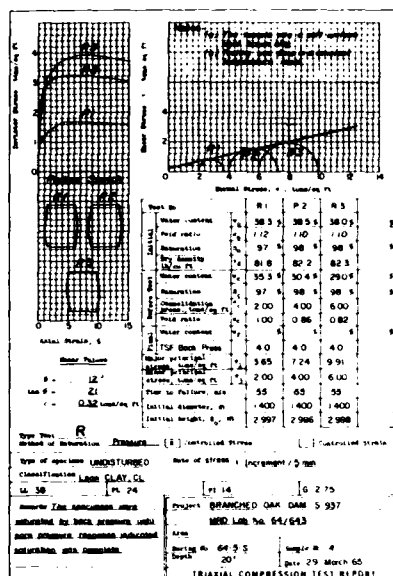


FIGURE 3

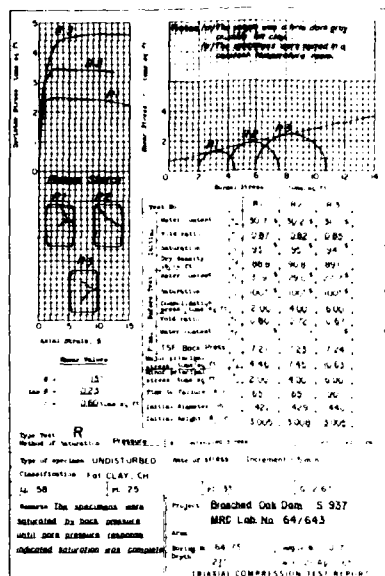


FIGURE 4

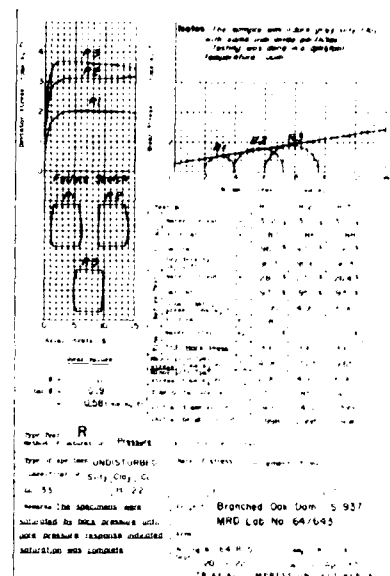


FIGURE 5

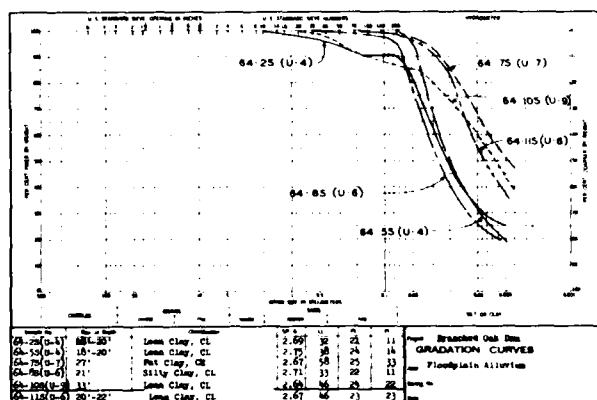


FIGURE 8

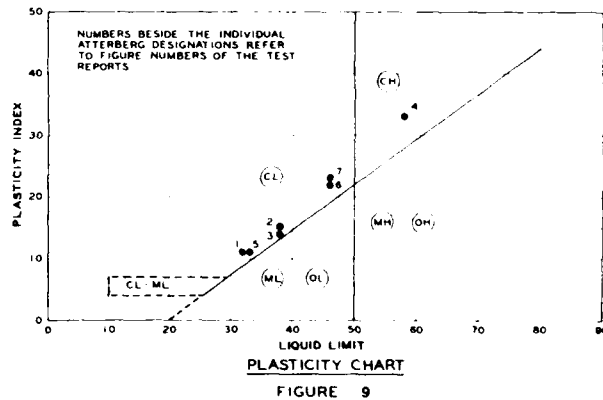


FIGURE 9

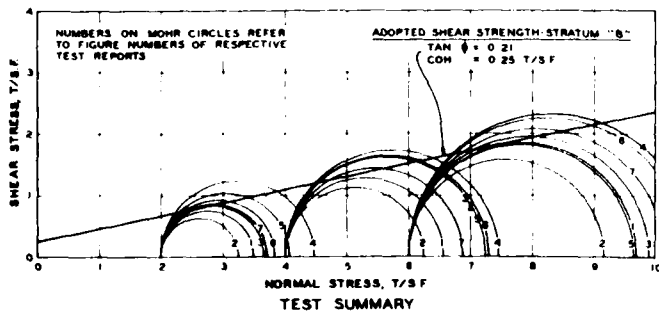


FIGURE 10

THIS DRAWING HAS BEEN REDUCED TO
THREE-EIGHTS THE ORIGINAL SCALE

| | |
|--|--------------------------------|
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | |
| SALT CREEK AND ITS TRIBUTARIES, NEBRASKA | |
| BRANCHED OAK DAM & RESERVOIR | |
| LABORATORY TEST DATA | |
| CONSOLIDATED - UNDRAINED "R" TESTS | |
| Prepared by: <i>[Signature]</i> | Checked by: <i>[Signature]</i> |
| Approved by: <i>[Signature]</i> | Date: <i>[Date]</i> |
| THIS PLAN ACCOMPANIES CONTRACT NO. <i>[Contract No.]</i> | |
| MODIFICATION NO. <i>[Modification No.]</i> | |

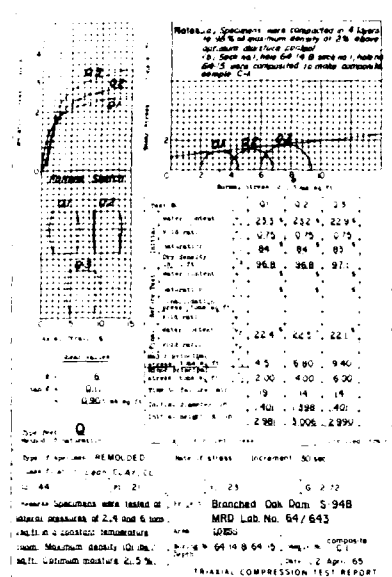


FIGURE 1

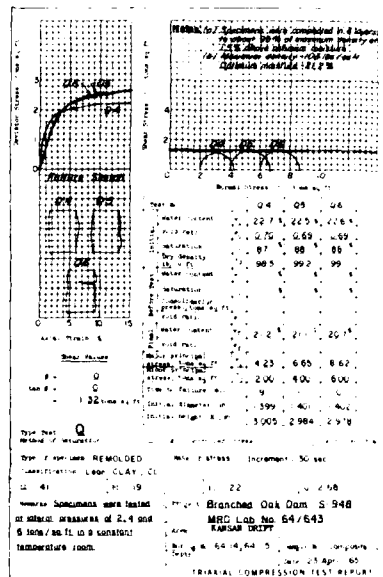


FIGURE 2

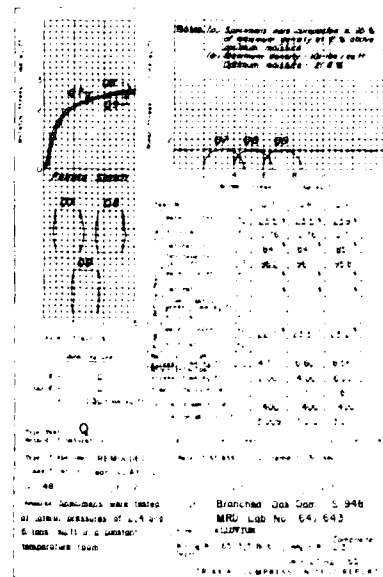


FIGURE 3

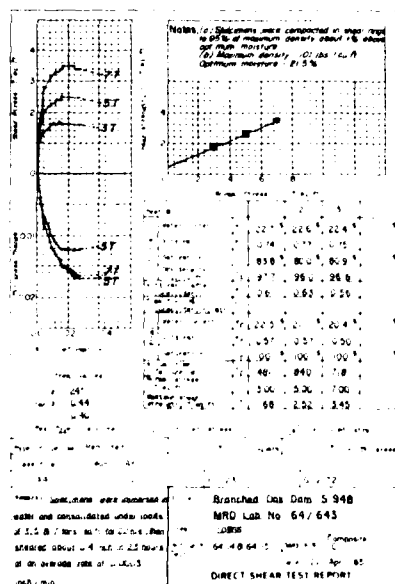


FIGURE 6

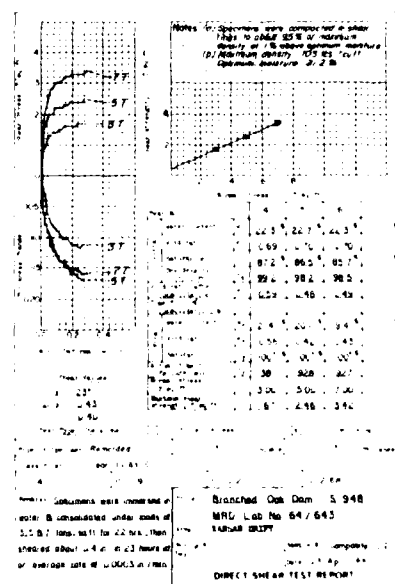
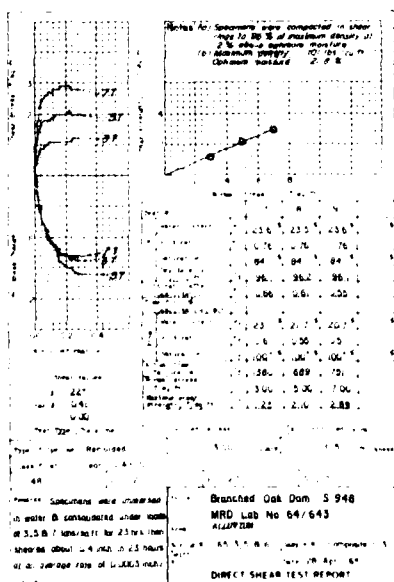
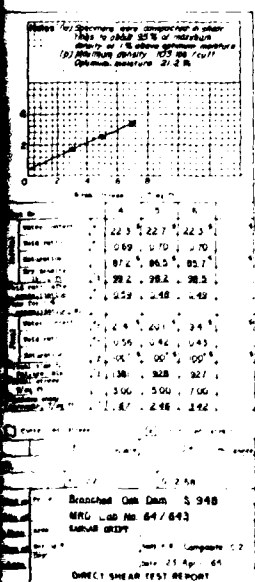
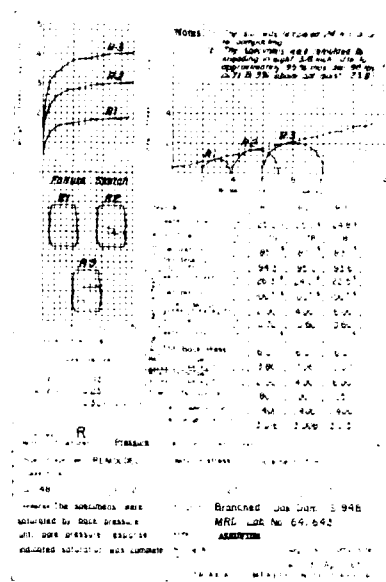
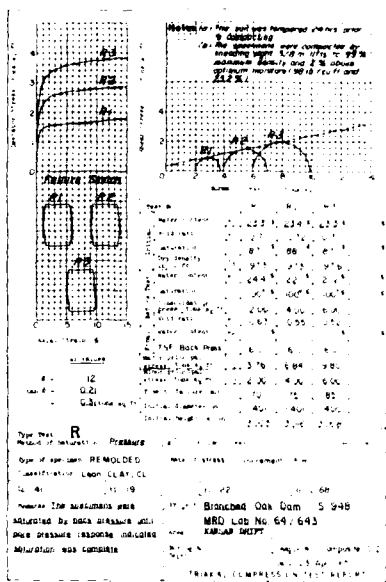


FIGURE 7



FIGURE 8



| | | |
|---|---|------|
| DATE | DESCRIPTION | DATE |
| | REV. 3-0-0 | |
| <p align="center">U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA</p> | | |
| DESIGNED BY | SALT CREEK AND ITS TRIBUTARIES, NEBRASKA | |
| DRAWN BY | BRANCHED OAK DAM & RESERVOIR | |
| TITLED BY | LABORATORY TEST DATA | |
| CHECKED BY | REMODLED EMBANKMENT MATERIAL | |
| REMARKS BY | TRIAXIAL "Q" & "R" & DIRECT SHEAR "S" TESTS | |
| APPROVED | APPROVED | DATE |
| <i>W. J. L. H.</i> | <i>Charles E. Gray</i> | |
| CHIEF ENGINEER'S SIGNATURE | ENGINEER'S SIGNATURE | |
| APPROVED | SCALE 1" = 10' | DATE |
| <i>Harold J. St. Clair</i> | | |
| COL. C. C. GORDON, DISTRICT | ENGINEER | |

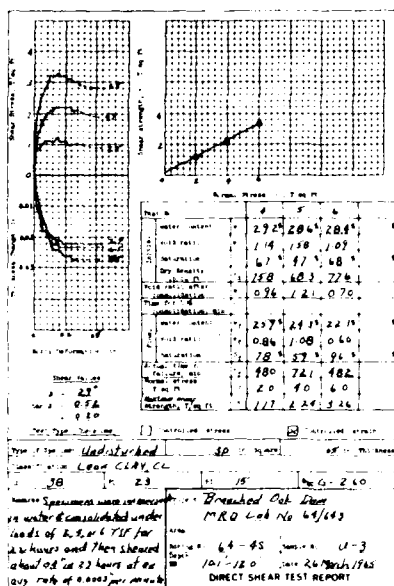


FIGURE 1

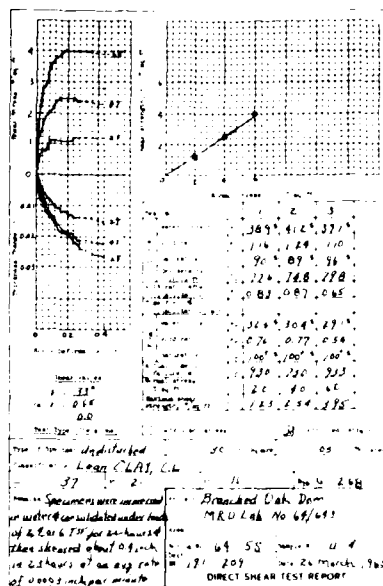


FIGURE 2

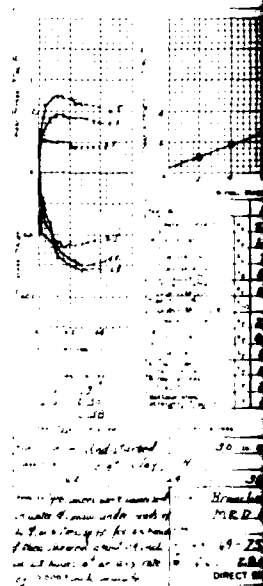


FIGURE 3

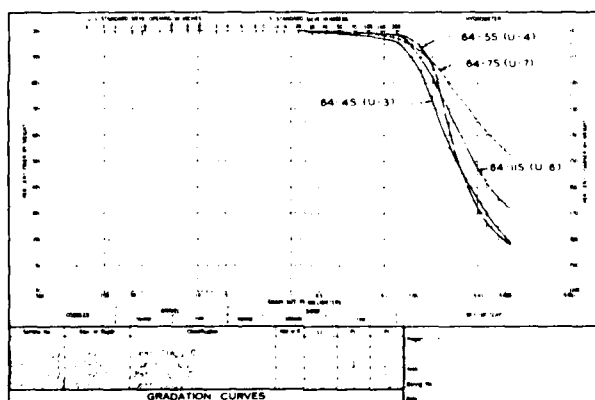


FIGURE 5

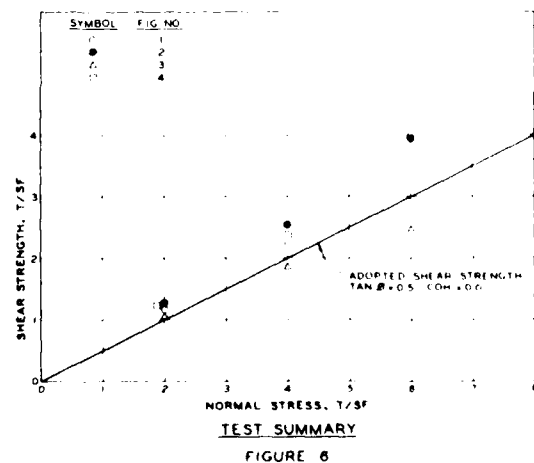


FIGURE 6

NOTE:

1. Test specimens were and consolidated under 6 T/SF for 22 hours at about 0.4° in 23 hours rate of 0.0003 inches

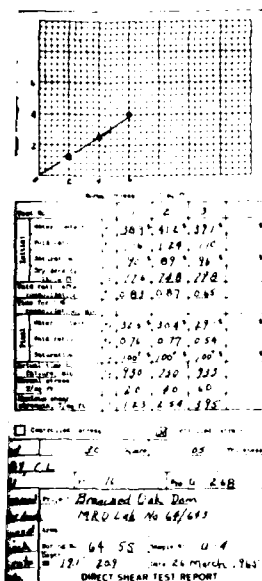


FIGURE 2

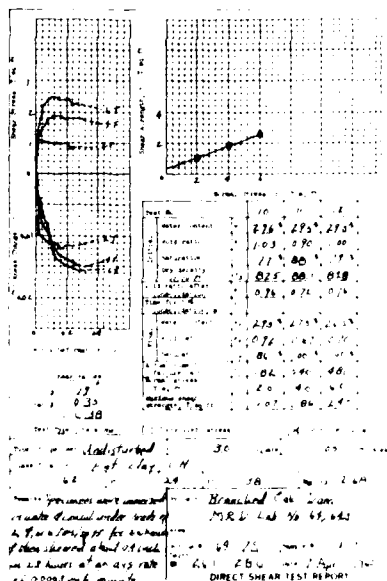


FIGURE 3

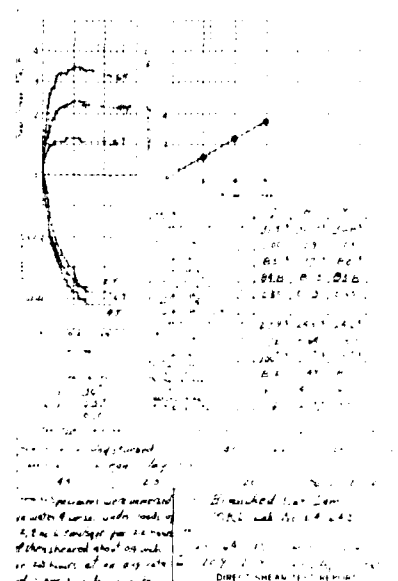
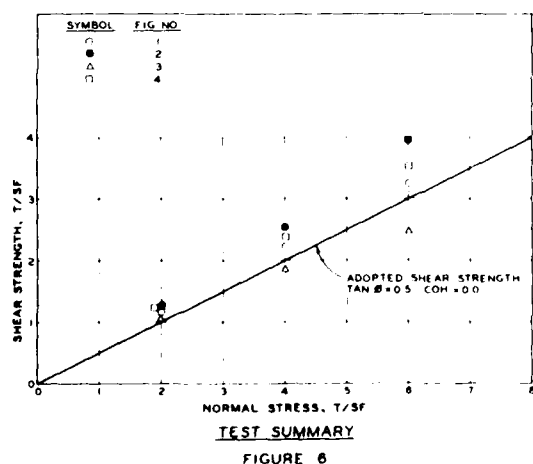
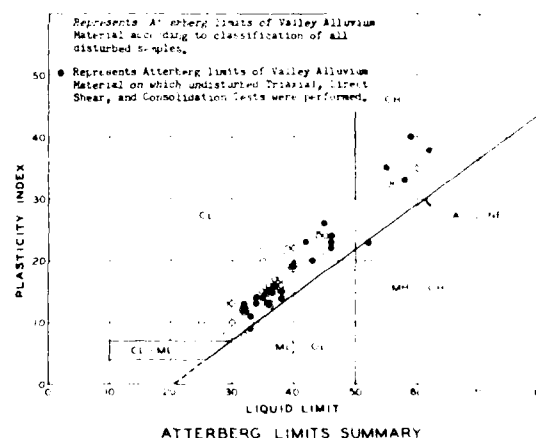


FIGURE 4



NOTE:

1. Test specimens were immersed in water and consolidated under loads of 2, 4, or 6 T/5F for 22 hours and then sheared about 0.4° in 23 hours at an average rate of 0.0003 inches per minute.



| | | | |
|---|--------------|-------------|----------|
| DATE | DESCRIPTION | DATE | APPROVED |
| | REVISION ONE | | |
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | | | |
| SALT CREEK AND ITS TRIBUTARIES, NEBRASKA
BRANCHED OAK DAM & RESERVOIR | | | |
| LABORATORY TEST DATA
DIRECT SHEAR "S" TESTS | | | |
| DESIGNED BY | TESTED BY | APPROVED BY | DATE |
| | | | |
| DRAWN BY | | DATE | |
| | | | |
| CHECKED BY | | DATE | |
| | | | |
| APPROVED BY | | DATE | |
| | | | |

Steady Seepage Case

Steady Seepage

Existing Forces

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$\text{Total Force} = 267.7 + 242.7 = 510.4 \text{ Tons}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

$$E_N \text{ Ton} = 94 \times 400 \times 0.036 \times 0.50 = 267.7 \text{ Ton}$$

$$E_T \text{ Ton} = 94 \times 400 \times 0.036 \times 0.45 = 242.7 \text{ Ton}$$

FORCE ASSAYS

ICE CASE

Outline of proposed dam above trial failure arc having a unit weight equal to water

| ADOPTED DESIGN VALUES | | | | | | |
|-----------------------|---------------------|-----------|----------------|----------------|------------|------------|
| Material | Unit Weight
T/CF | | *G* Case | *R* Case | | *S* Case |
| | Bouyant | Saturated | Coh
T/sq ft | Coh
T/sq ft | Tan ϕ | Tan ϕ |
| Embankment | 0.0288 | 0.06 | 1.0 | 0.30 | 0.22 | 0.45 |
| Foundation | | | | | | |
| Stratum "A" | 0.0288 | 0.06 | 1.0 | 0.25 | 0.21 | 0.50 |
| Stratum "B" | 0.0268 | 0.058 | 0.45 | 0.25 | 0.21 | 0.50 |

| SUMMARY OF STABILITY ANALYSES | | | | |
|-------------------------------|----------------|--------------|-----------------|------------------|
| Case | Shear Strength | Critical Arc | Water Elevation | Factor of Safety |
| End of Construction | G | 4 | 1252 | 1.24 |
| Steady Seepage | R | 5 | 1311.5 to 1252 | 1.42 |
| Steady Seepage | S | 5 | 1311.5 to 1252 | 1.78 |
| Partial Pool | R | 3 | 1274 | 1.54 |
| Sudden Drawdown | R | 3 | 1311.5 to 284 | 1.44 |

NOTE: The factors of safety in this summary were computed by the electronic computer program and show close agreement with the manual computations presented on this plate.



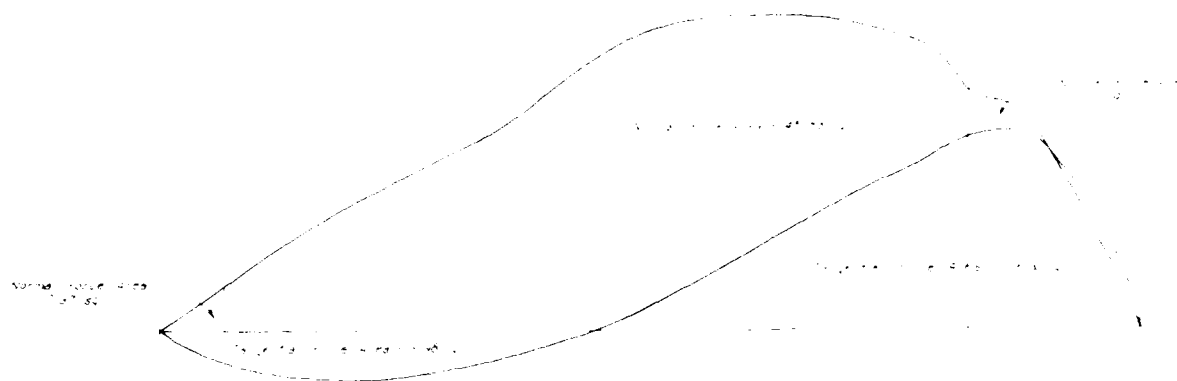
SCALE 1 INCH = 20 FEET
70
10

THIS PLAN ADDENDUM CONTRACT NO.
DA-36-046-40 MODIFICATION NO.

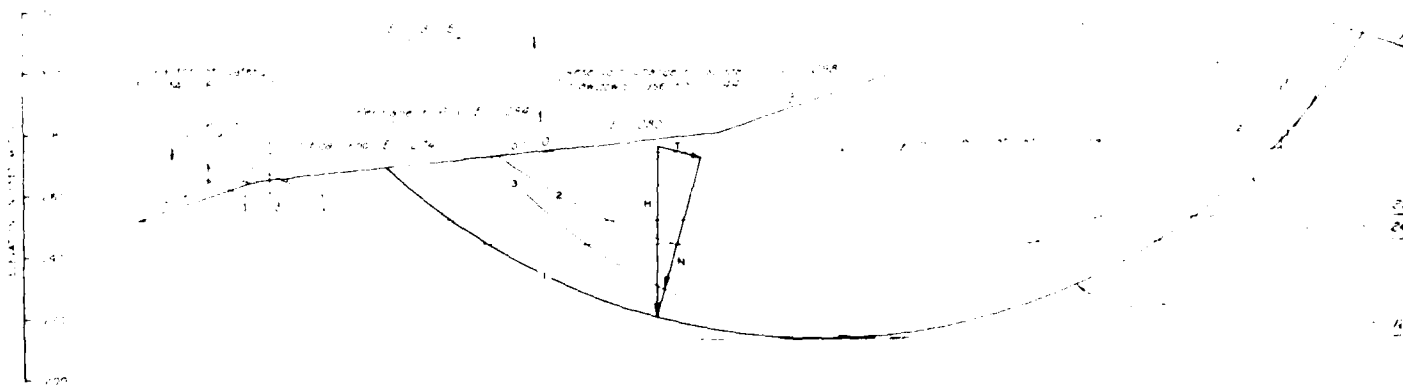
NOMENCLATURE:

- H Equivalent height of slice above failure arc
- N Equivalent normal force on failure arc
- T Effective tangential force on failure arc
- L Length of arc or failure surface

| | | | | | |
|--|-------|-------------|-------|-------------|-------|
| DATE | | DESCRIPTION | | DRAWN | |
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | | | | | |
| SALT CREEK AND ITS TRIBUTARIES, NEBRASKA | | | | | |
| BRANCHED OAK DAM & RESERVOIR | | | | | |
| STABILITY ANALYSES | | | | | |
| CIRCULAR ARC METHOD | | | | | |
| CONSTRUCTION AND SEEPAGE CASES | | | | | |
| DESIGNED BY | CHIEF | DESIGNED BY | CHIEF | DESIGNED BY | CHIEF |
| CHECKED BY | CHIEF | CHECKED BY | CHIEF | CHECKED BY | CHIEF |
| APPROVED BY | CHIEF | APPROVED BY | CHIEF | APPROVED BY | CHIEF |
| H. J. Van | | | | | |



NORMAL AND TANGENT LINE DRAWING



HIDDEN DRAWING AT A PARTIAL RADIUS

for sum 100 000 000
25 = 44

EN DE LA AL. E. LA AL. AL. AL. AL.

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

H Equivalent height of pipe above sea level
 M Equivalent hydraulic friction coefficient
 T Effective tangent of force α to sea
 L Length of arc of failure surface
 Units For adopted design values see plate 42a

[illegible]

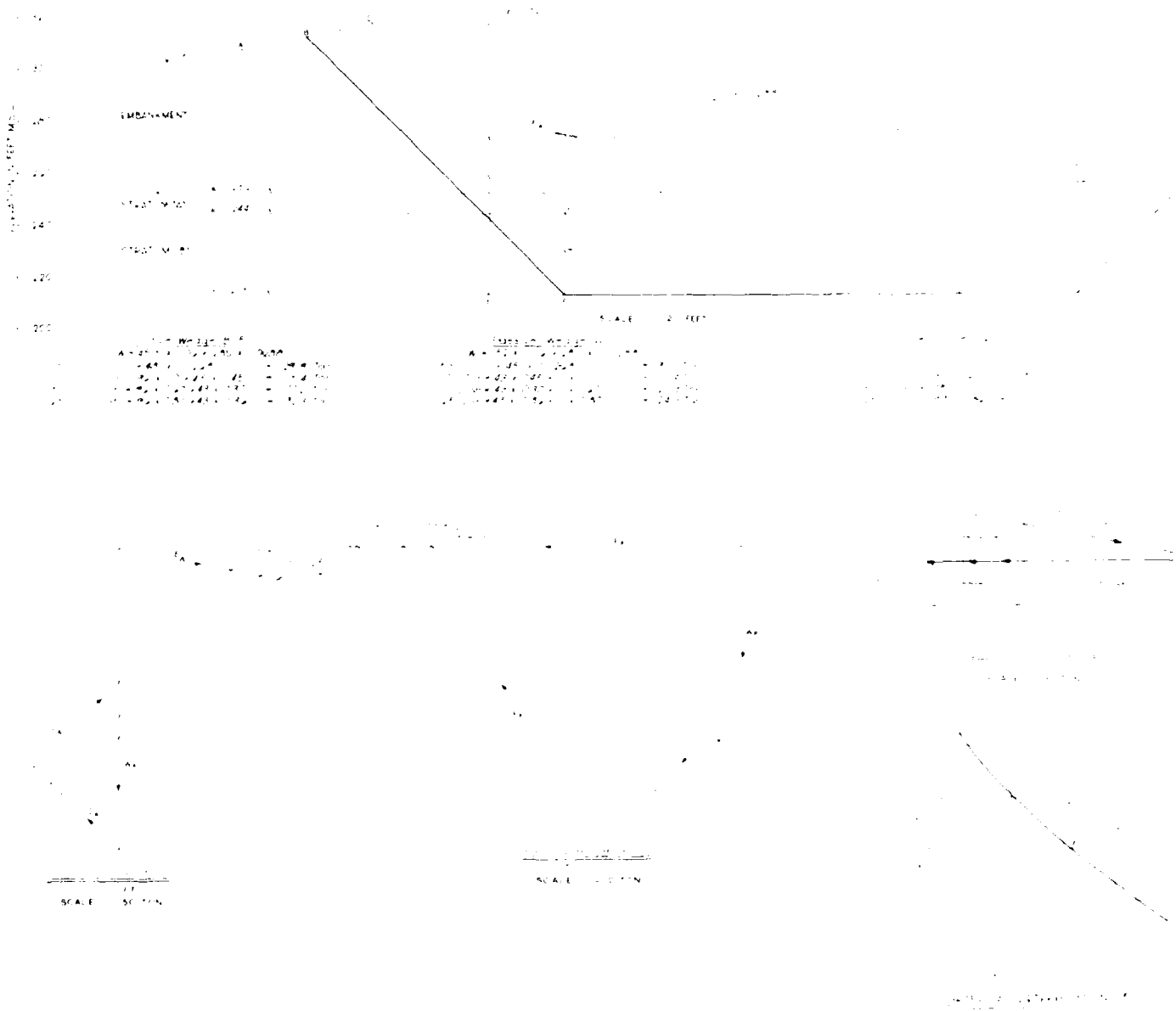
| | | | |
|---|--|-----------------------------------|--------|
| DATE | DESCRIPTION | MADE | LENGTH |
| | 22. 2. 2. 2. | | |
| <p align="center">U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA</p> | | | |
| DESIGNED BY | SALT CREEK AND ITS TRIBUTARIES, NEBRASKA | | |
| DRAWN BY | BRANCHED OAK DAM & RESERVOIR | | |
| TRADED BY | STABILITY ANALYSES | | |
| CHECKED BY | CIRCULAR ARC METHOD | | |
| | SUDDEN DRAWDOWN AND | | |
| | PARTIAL POOL CASES | | |
| REVIEWED BY <i>W. J. Allen</i>
APPROVED <i>W. J. Allen</i>
SPECIAL IN CHARGE
DIVISION OF DAMS
U. S. ARMY ENGINEER DISTRICT
OMAHA, NEBRASKA | DATE <i>10/1/27</i>
SCALE <i>1" = 100'</i>
SHEET NO. <i>1</i>
TOTAL SHEETS <i>1</i> | DATE
SHEET NO.
TOTAL SHEETS | |

SCALE 1 INCH = 20 FEET



THIS PLAN ACCOMPANIES CONTRACT NO. 0A-88-000-
MODIFICATION NO.

CORPS OF ENGINEERS



AD-A142 769

EMBANKMENT CRITERIA AND PERFORMANCE REPORT SALT CREEK
AND TRIBUTARIES NEBRASKA SITE 18 BRANCHED OAK DAM AND
LAKE(U) CORPS OF ENGINEERS OMAHA NE MAY 84

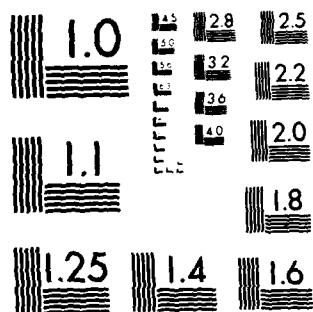
1/2

UNCLASSIFIED

F/G 13/13

NL

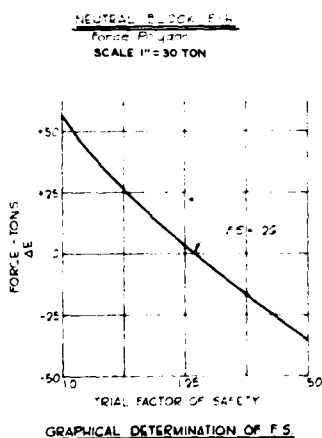
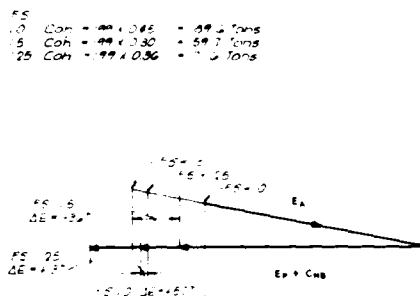
END
DATE
FILMED
8-84
DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

| SUMMARY OF STATIONS | | NO. OF STATIONS |
|---------------------|--|-----------------|
| Slide Plane | | 8 of 8 |
| BEFL | | 1 |
| BEFLW | | 1 |
| BFGK | | 1 |
| BEFL | | 1 |
| BEFLW | | 1 |
| BEFL | | 1 |
| BEFL | | 1 |

- C - Cohesion per unit area
- C₀ - Cohesion developed per unit area
- Cohesion
- Assumed F.S.
- E_a - Resultant earth forces of active wedge
- E_{nb} - Resultant earth forces of neutral block
- E_p - Resultant earth forces of passive wedge
- ΔE - Difference between active and passive forces
- F.S. - Factor of Safety
- = Shear strength assumed
- = Shear strength developed at equilibrium
- W_a - Weight of active wedge
- W_p - Weight of passive wedge
- F_a OR F_p - Effective force on the slide plane and the direction in which it is acting.

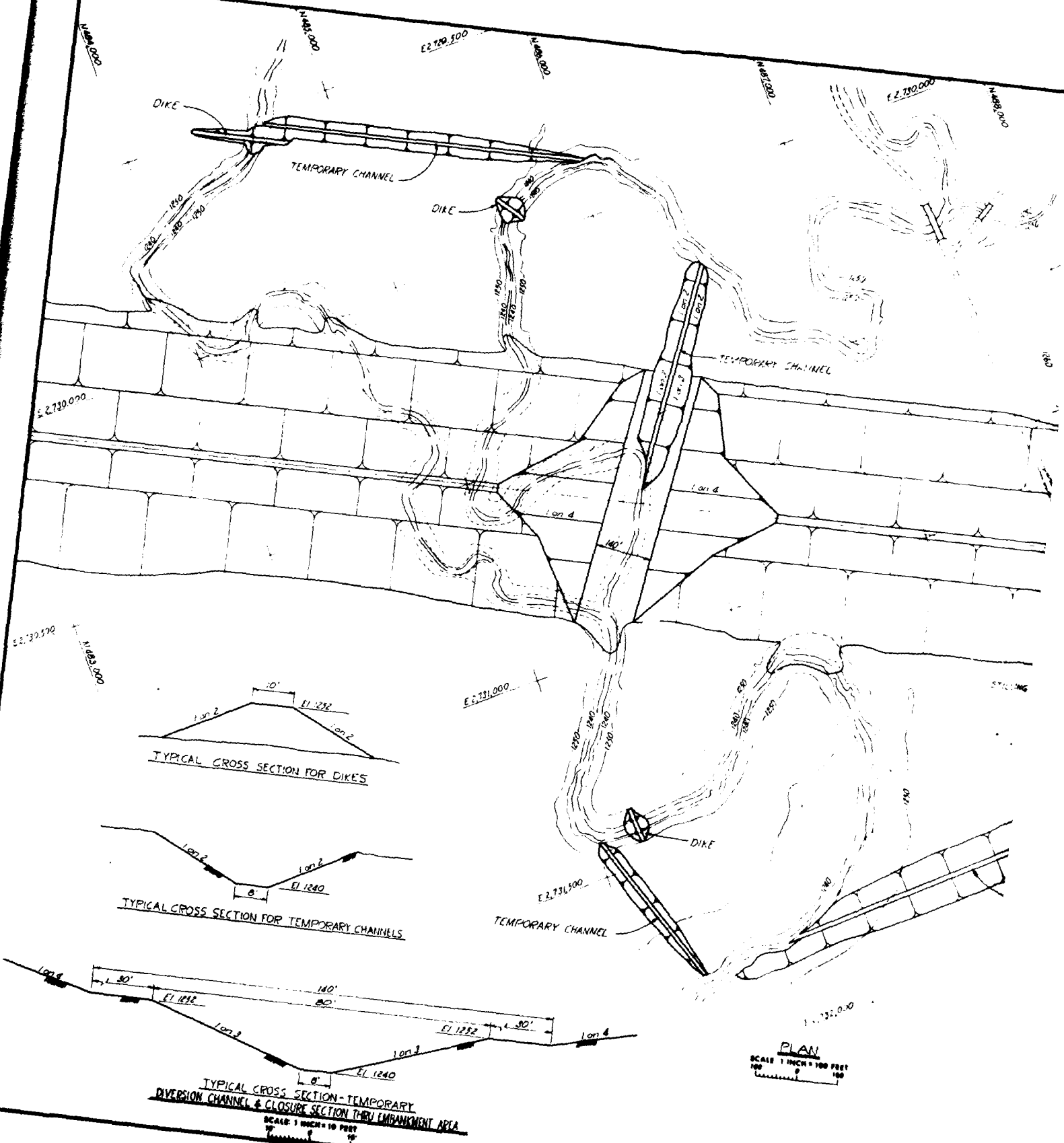


THIS DRAWING HAS BEEN REDUCED TO
FOUR-EIGHTHS THE ORIGINAL SCALE

[illegible]

EMBANKMENT CRITERIA AND PERFORMANCE REPORT (1983) PLATE A28

CORPS OF ENGINEERS



EMBANK

| | | | |
|---|--|---|--|
| | | | |
| | | | |
| | | | |
| DATE | | DESIGNATION | |
| | | | |
| <p align="center">U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA</p> | | | |
| RECEIVED BY: <i>W. J. C.</i>
NAME OF: <i>W. J. C.</i>
GRADE OF: <i>MAJ.</i>
ADDRESS OF: <i>W. J. C.</i>
<i>W. J. C.</i>
MAIL BOX NO. & PLAZA NO. | | <p align="center">SALT CREEK AND ITS TRIBUTARIES, NEBRASKA
BRANCHED OAK DAM & RESERVOIR
DIVERSION AND CLOSURE
PLAN AND SECTION</p> | |
| PROJECT NO. <i>100-1000</i>
DRAWING NO. <i>100-1000</i>
SHEET NO. <i>100-1000</i> | | DATE: <i>June 1947</i>
BY: <i>Charles E. Thompson</i>
TITLE: <i>AS SHOWN</i>
CHECKED BY: <i>AS SHOWN</i>
DESIGNED BY: <i>AS SHOWN</i> | |
| <i>Charles E. Thompson</i>
CHIEF OF DISTRICT | | | |

EMBANKMENT CRITERIA AND PERFORMANCE REPORT (1983) PLATE A29

凡

Topographic map showing contour lines, roads, and drainage features. The map includes labels for "Obliterate road & fill side ditches", "Bladed drain ditch", "Point 521 Curve D", and "Point 520". The map is oriented with North at the top. The left margin contains the text "4493,000" and "4492,500". The right margin contains the text "00052,27" and "00052,27". The bottom margin contains the text "00052,27" and "00052,27".

A 105 Micro-master Film or A Paper Reproducible Record Copy Must Be Made Before Every Addition and/or Modification

C

9

NAME

1995

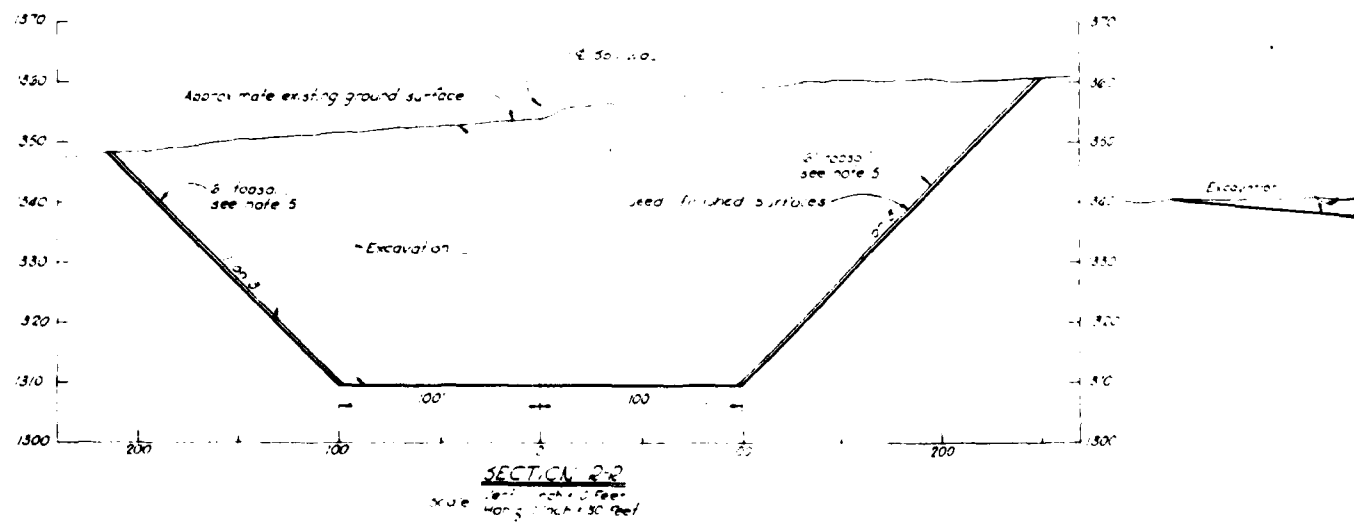
1000

PLAN

SCALE 1 INCH = 100 FEET

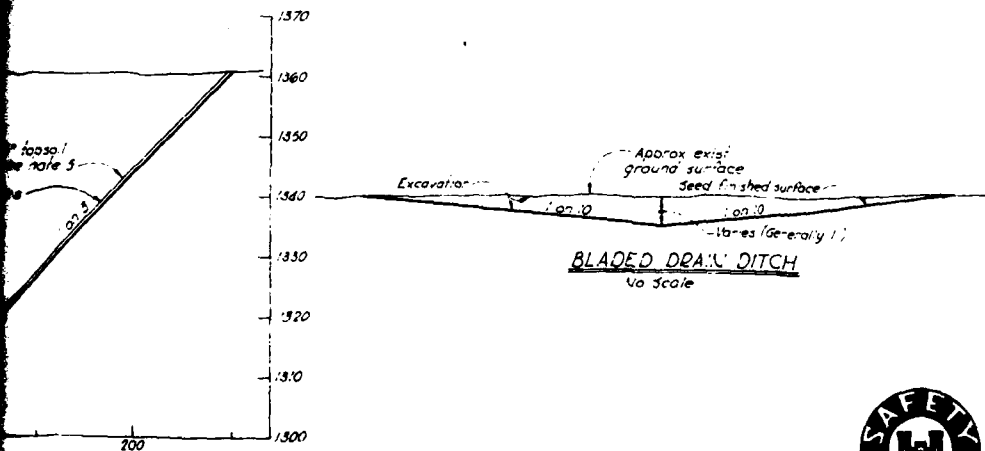
100' 0 100'

100' 0 100'



PLAN

SCALE: 1 INCH = 100 FEET



1. Bladed drain ditches alignment and grade to be established in the field approximately one foot deeper than on 10:1 slopes. Construct small fills where necessary adjacent to top of Spillway side slope to prevent drainage down Spillway Slope.
2. Where Spillway excavation cuts natural Terraces, provide necessary earthwork to prevent drainage down Spillway side slope.
3. All Elevations shown refer to feet above M.S.L., 1954 General Adjustment.
4. For Control Points, see **PLATE A2**.
5. Place 8" layer of topsoil on excavated 1 on 3 slopes of Spillway from bottom of Spillway to the top of the slope.

[illegible]

THIS PLAN ACCOMPANIES CONTRACT NO.

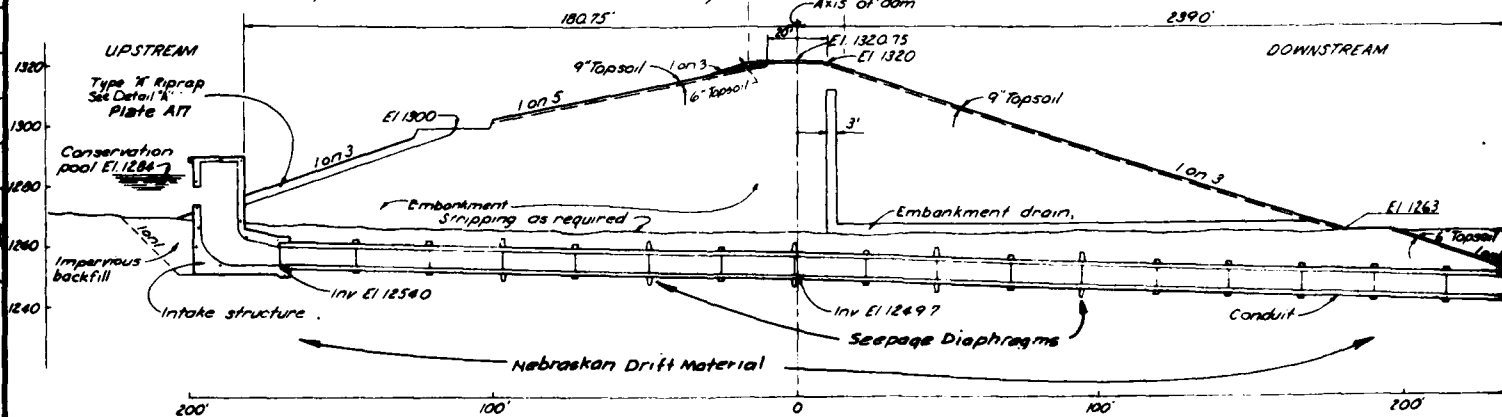
2

PLAN

SCALE 1 INCH = 10 FEET

10' 0' 10'

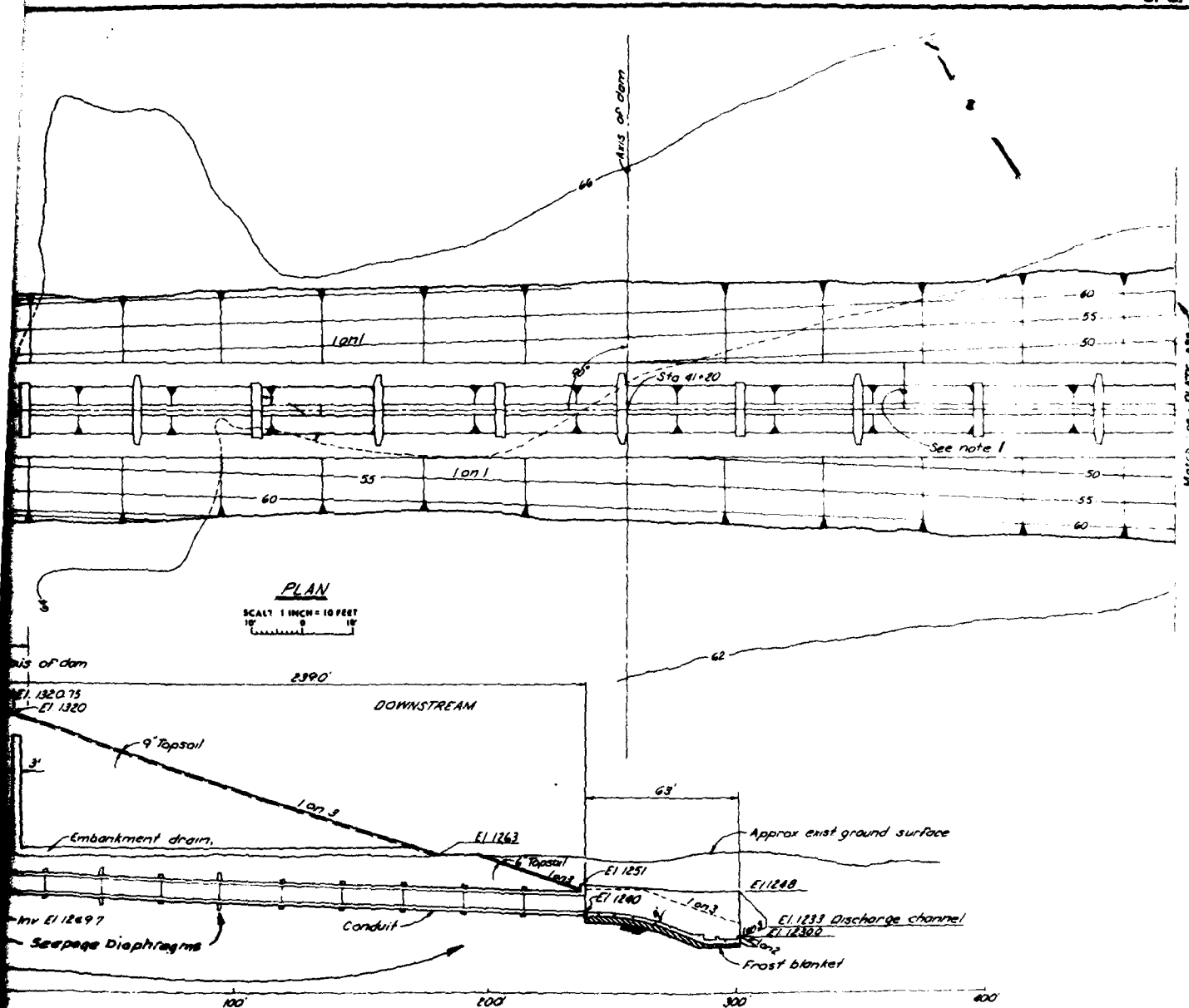
SCALE 1 INCH = 10 FEET



SCALE 1 INCH = 20 FEET

1. 9.5' from E conduit to slope at 0.5' above invert
2. For location of section
3. All elevations shown re M.S.L., 1954 General Adj

EMBANKMENT



THRU OUTLET WORKS

GENERAL NOTES:

1. 9.5' from E. conduit to control for 1 on 1 slope at 0.5' above invert elevation.
2. For location of sections, see PLATE A33.
3. All elevations shown refer to feet above M.S.L., 1984 General Adjustment.



| | |
|---|--|
| U. S. ARMY ENGINEER DISTRICT, CHAMPAIGN
BRANCH OF ENGINEERING
CHAMPAIGN, ILLINOIS | |
| SALT CREEK AND ITS TRIBUTARIES, ILLINOIS
BRANCHED OAK DAM AND LAKE
SITE NO. 18
OUTLET WORKS
EXCAVATION PLAN - SHEET 1 | |
| DESIGNED BY R.J.M.
CHECKED BY R.F.M.
DRAWN BY R.F.M.
SCALE 1/4" = 1'-0" | DATE 1/1/83
BY [Signature]
FOR [Signature] |
| DATE 1/1/83
BY [Signature]
FOR [Signature] | DATE 1/1/83
BY [Signature]
FOR [Signature] |
| MSC13-310E7 | |

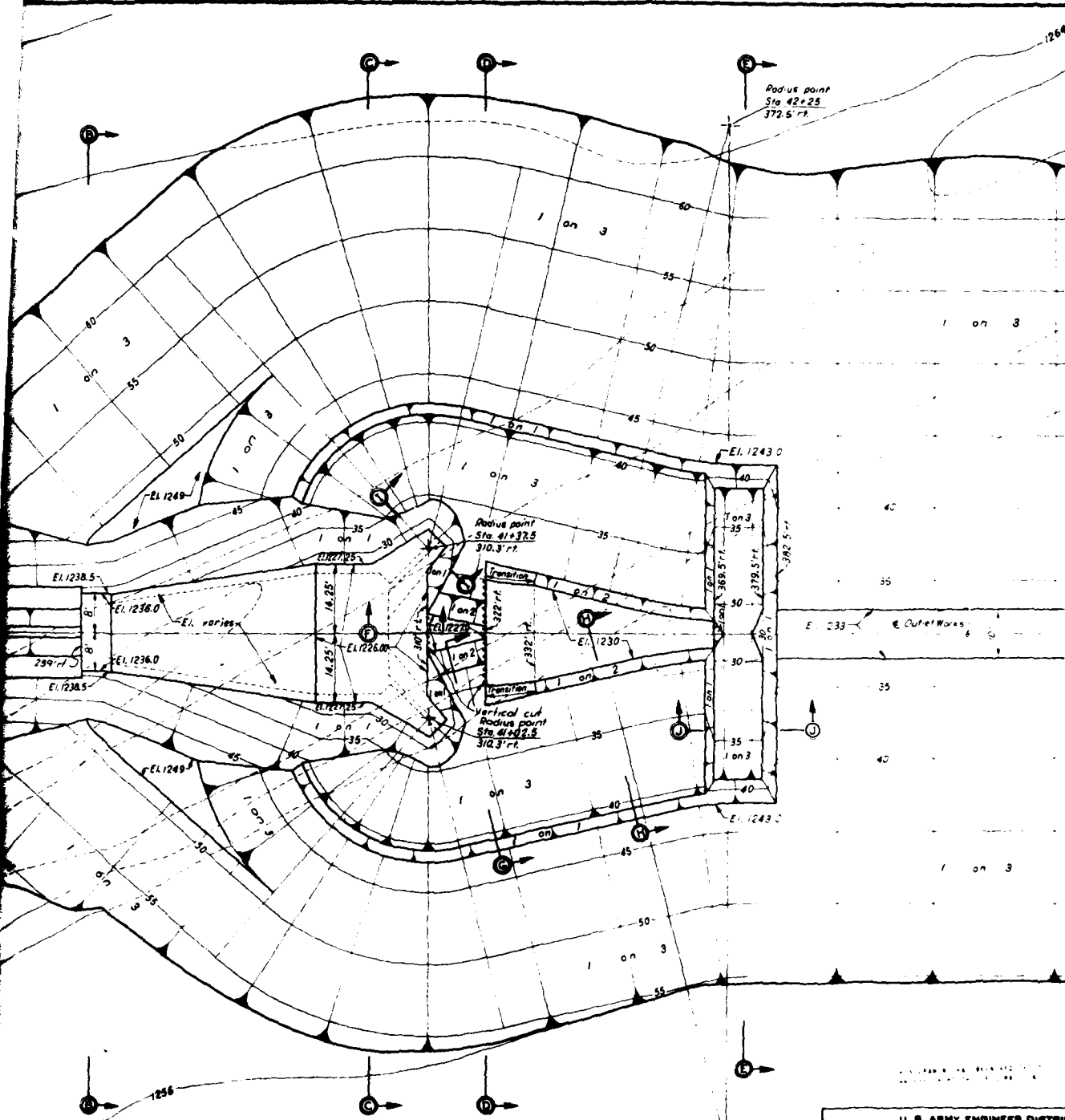
1266
1264
1262
1260
1258
1256

EL 1238.5
EL 1236.0
EL 1249
EL 1226.0

PLAN

GENERAL NOTES:

1. All elevations under 1000 ft. are
M.S.B., 1984 Standard Elevation.



PLAN
SCALE 1 INCH = 10 FEET

GENERAL NOTES:

1. All elevations shown are in feet above M.S.L., 1984 National Mean Sea Level.



| | | | |
|---|--------------------------------------|--------------------------|------------------------------------|
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | | | |
| SAND CREEK AND Y-15 BRIDGES REBRIDGE
BRANCHED OAK DAM AND LAKE
SITE NO. 18
OUTLET WORKS
EXCAVATION PLAN-SHEET 2 | | | |
| DESIGNED BY
<i>W. J. H. H.</i> | CHECKED BY
<i>Charles E. Hopp</i> | DATE
FEB 1980 | DRAWN BY
<i>Sheld'n L. Clew</i> |
| APPROVED BY
<i>Sheld'n L. Clew</i> | DATE IN CHARGE
FEB 1980 | DATE OF REV.
FEB 1980 | |
| PROJECT NUMBER
MSC13-310EB | | | |

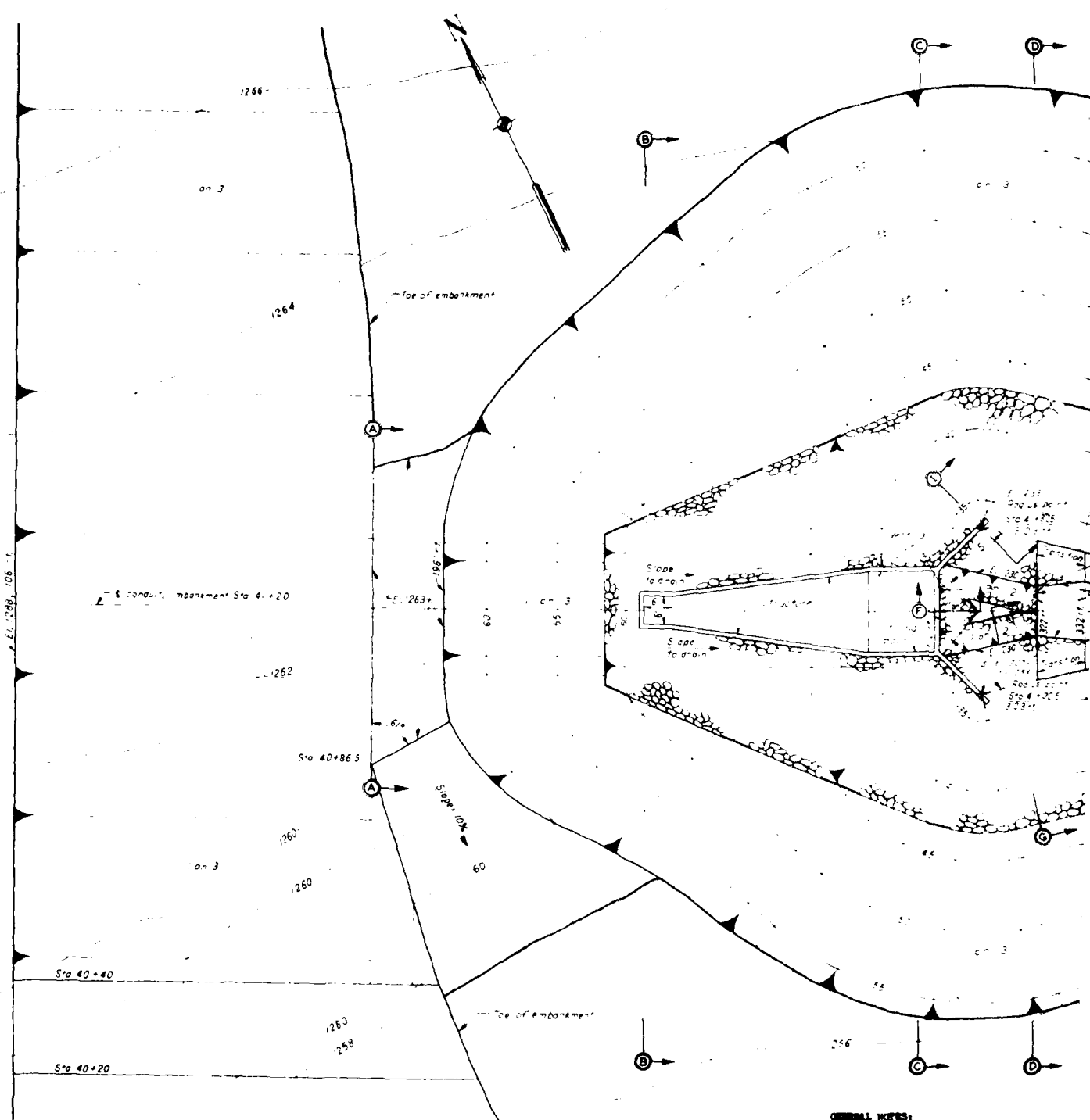
Technical drawing of Outlet Works Embankment Plan. The plan shows an intake structure, various embankments, and details A, B, and C. Elevation markers range from 1240 to 1290. Key features include:

- Intake Structure
- Outlet Works Sta 40+20
- Bedding
- Type A Riprap
- Spills
- Gravel Slope Protection
- Radius Point Sta 40+82.211' LT
- Toe
- DETAIL A, B, C
- Elevations: 1290, 1280, 1270, 1260, 1250, 1240

OUTLET WORKS EMBANKMENT PLAN

OUTLET WORKS EMBANKMENT PLAN

CORPS OF ENGINEERS

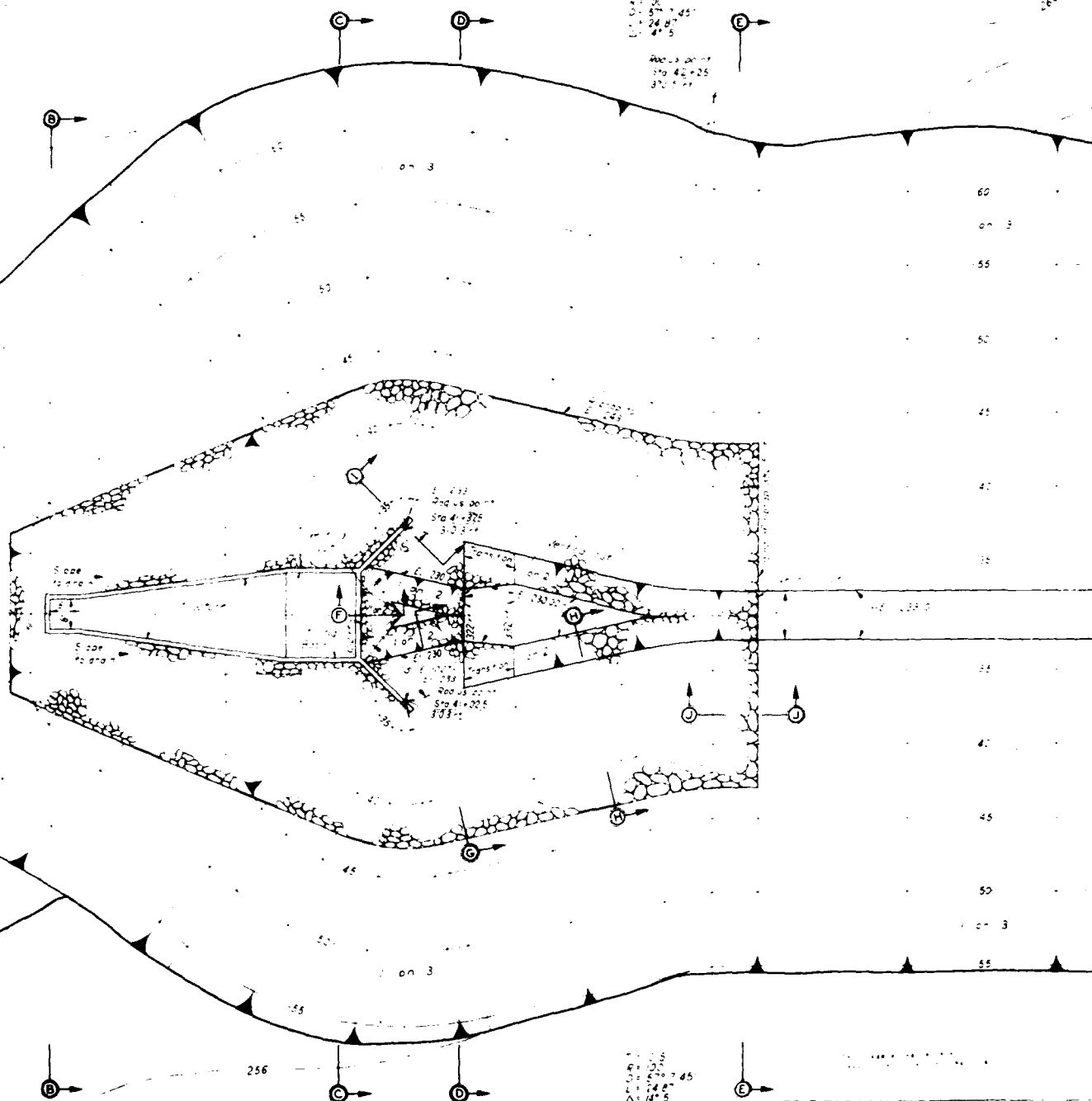


- GENERAL NOTES:**
1. All Elevations shown refer to Feet at 1954 General Adjustment.
 2. For location of Sections, see PLATE
 3. All distances shown as St., are mean Axis of Dam.

PLAN

SCALE 1 INCH = 10 FEET

EMBANKMENT



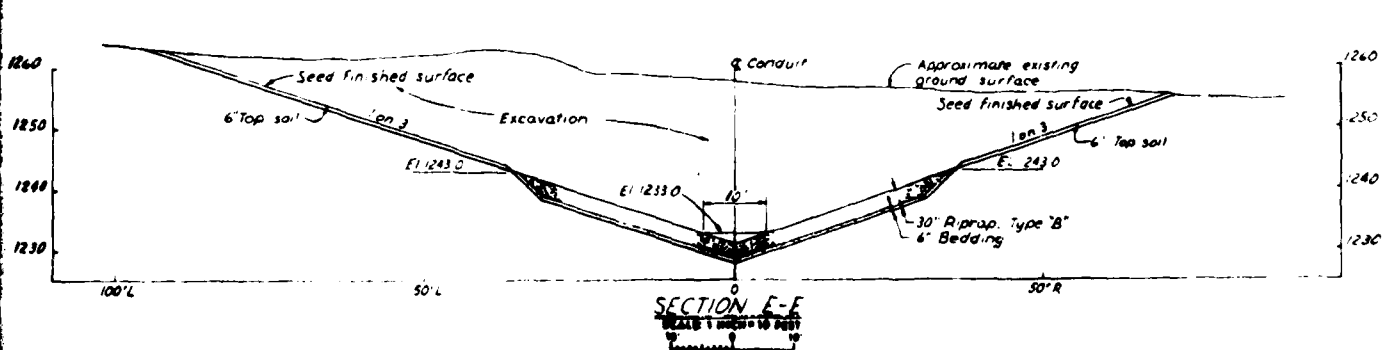
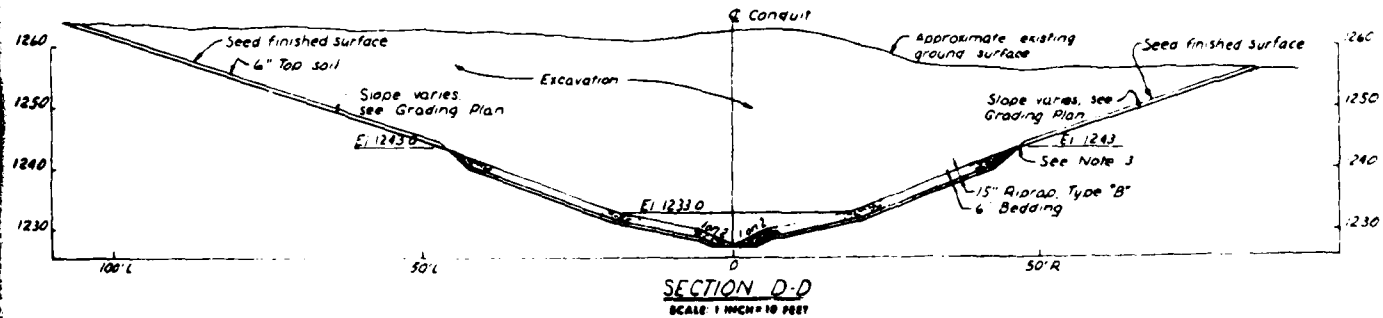
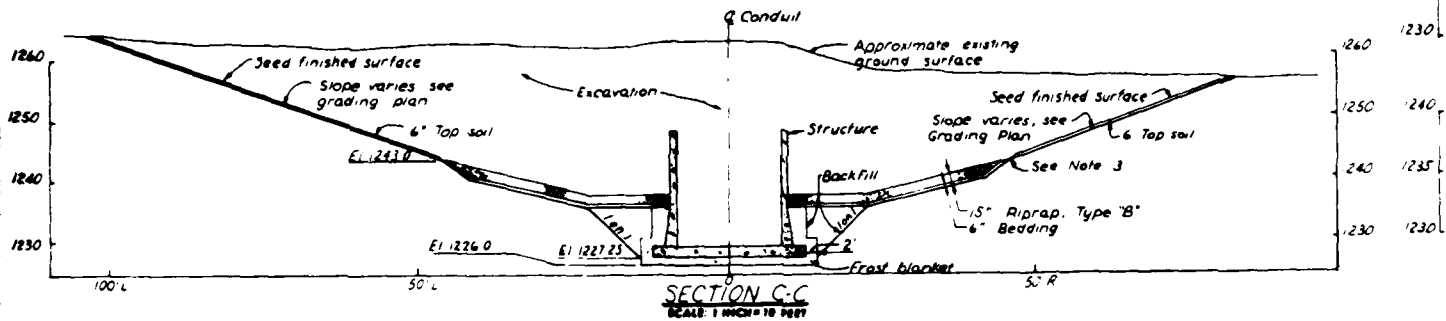
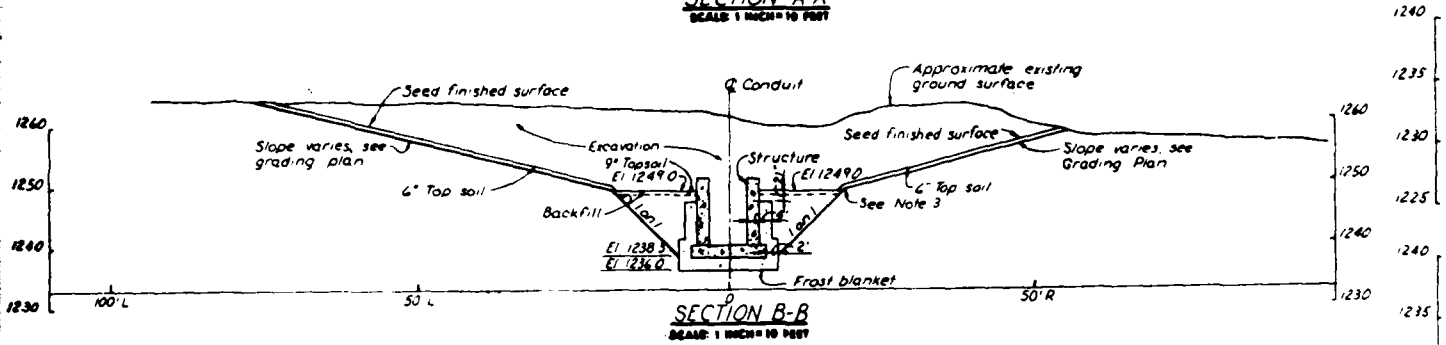
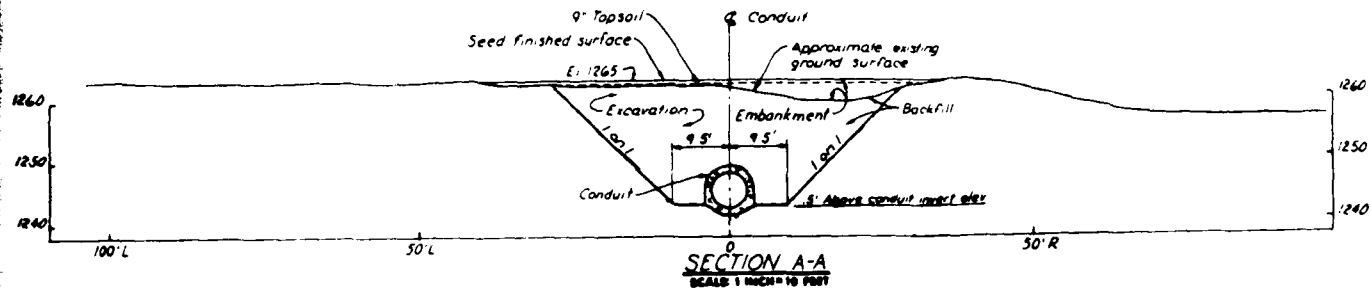
GENERAL NOTES:

1. All Elevations shown refer to Feet above M.S.L., 1954 General Adjustment.
2. For location of Sections, see PLATE A35.
3. All distances shown as R.L. are measured from Axis of Dam.

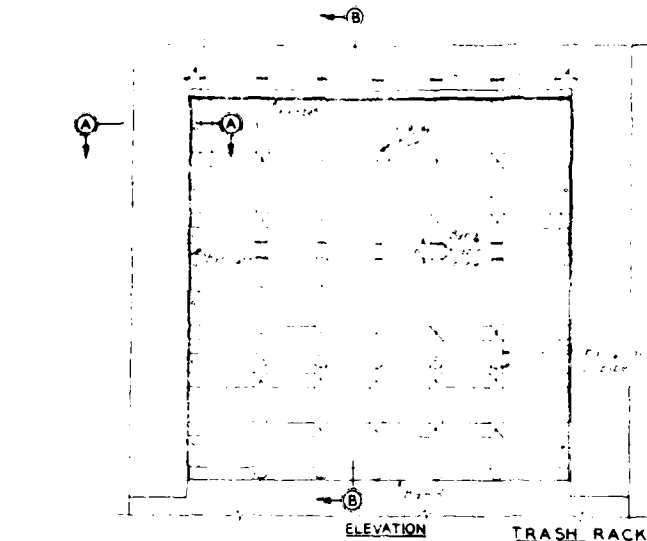
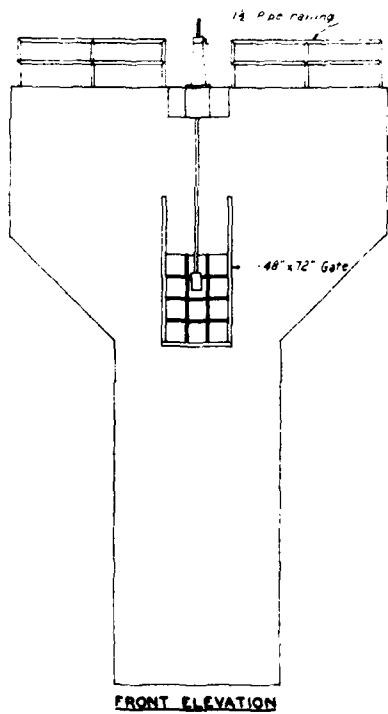
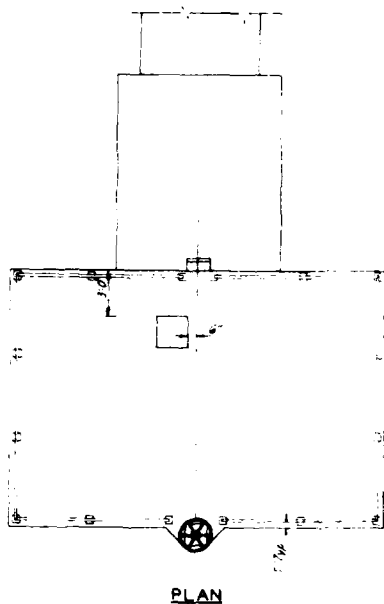
PLAN
SCALE 1 INCH = 10 FEET



| | |
|---|------------------------------|
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | |
| BRANCHED OAK DAM AND LAKE
SITE NO. 18
OUTLET WORKS
EMBANKMENT PLAN-SHEET 2 | |
| DESIGNED BY: <i>[Signature]</i> | APPROVED: <i>[Signature]</i> |
| DRAWN BY: <i>[Signature]</i> | CHECKED: <i>[Signature]</i> |
| DATE: <i>[Date]</i> | DATE: <i>[Date]</i> |
| PROJECT NO. <i>[Number]</i> | |
| DRAWING NO. <i>[Number]</i> | |
| SHEET NO. <i>[Number]</i> | |
| PROJECT NAME: <i>[Name]</i> | |
| PROJECT LOCATION: <i>[Location]</i> | |
| PROJECT STATUS: <i>[Status]</i> | |
| PROJECT NO. <i>[Number]</i> | |
| DRAWING NO. <i>[Number]</i> | |
| SHEET NO. <i>[Number]</i> | |
| PROJECT NAME: <i>[Name]</i> | |
| PROJECT LOCATION: <i>[Location]</i> | |
| PROJECT STATUS: <i>[Status]</i> | |



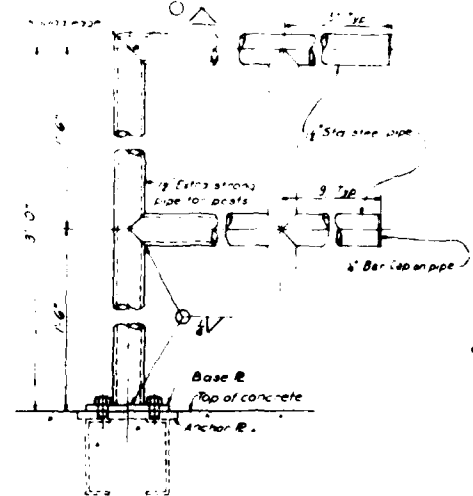
CORPS OF ENGINEERS



TRASH RACK DETAILS

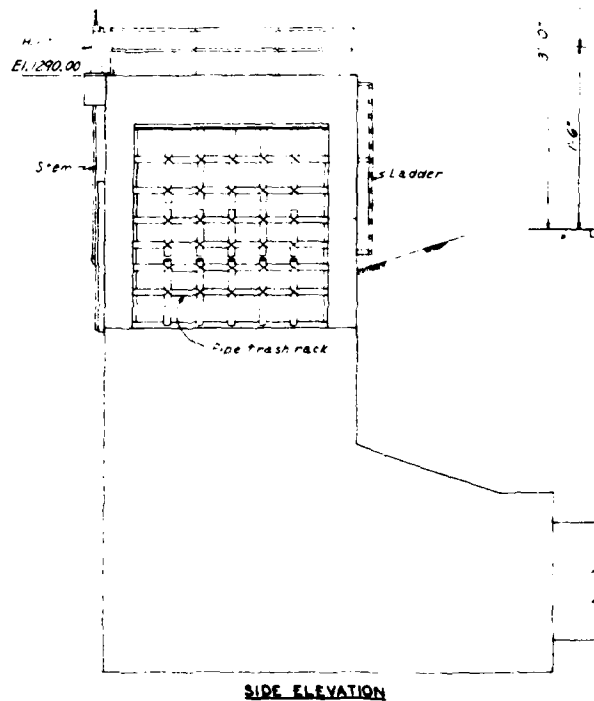
SCALE: 1/4\"/>

SECTION B-B



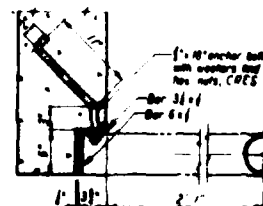
ELEVATION

TYPICAL STEEL PIPE GUARD



INTAKE STRUCTURE

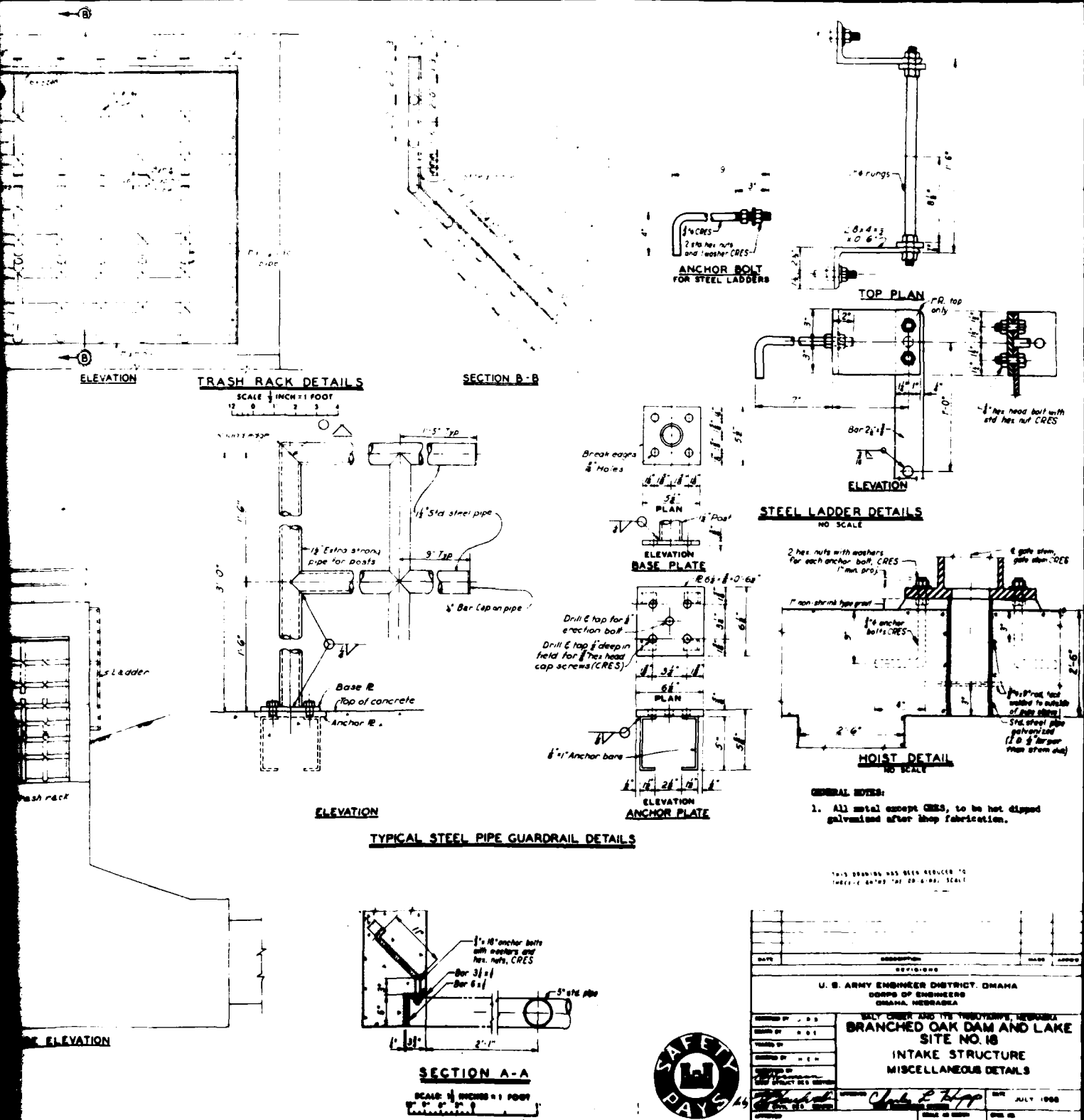
SCALE: 1/4\"/>



SECTION A-A

SCALE: 1/4\"/>

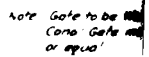
EMBANKMENT



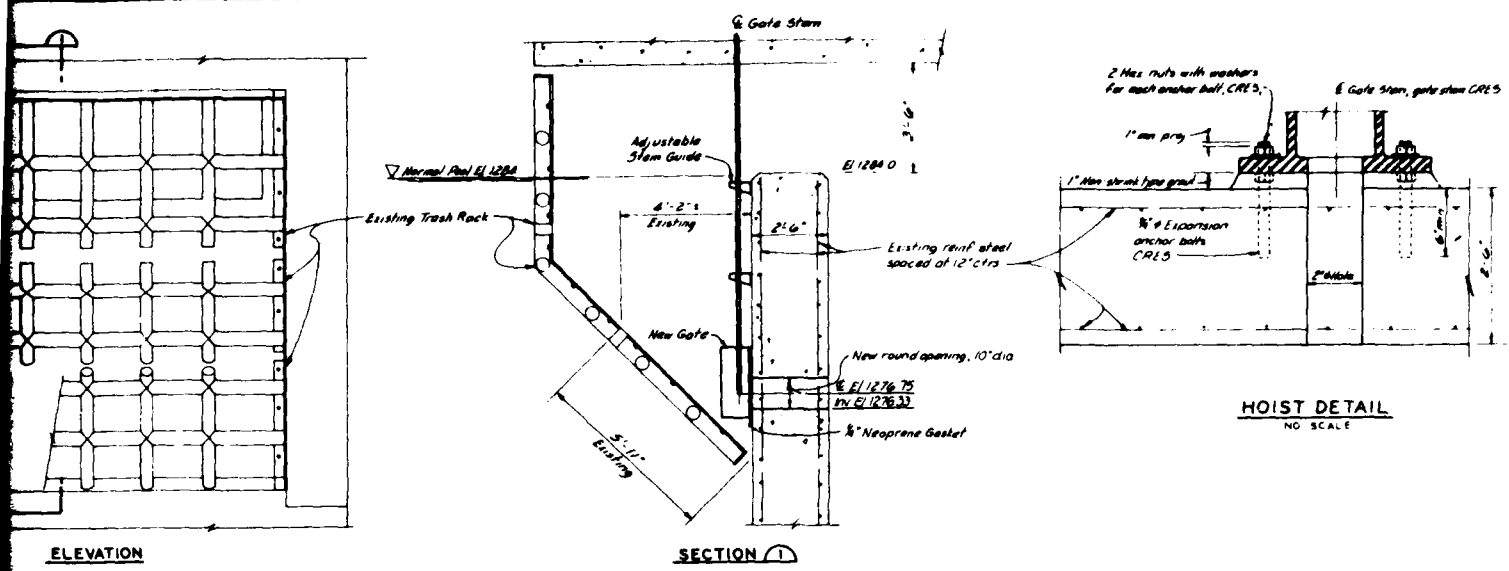
25



SCALE $\frac{1}{2}$ INCH = 1 FOOT

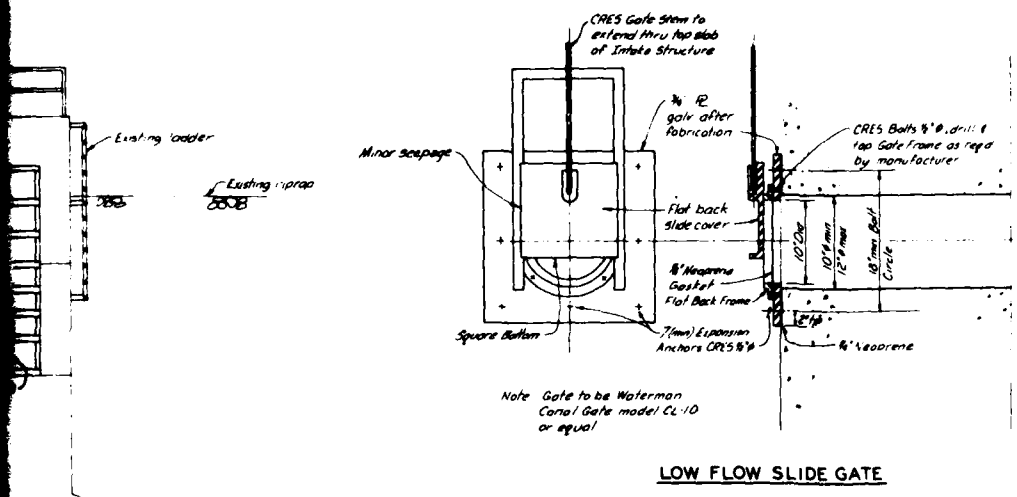


SCALE $\frac{1}{2}$ INCH = 1 FOOT



NEW GATE DETAIL
SCALE 1/4" INCH = 1 FOOT
12 0 1 2 3 4

HOIST DETAIL
NO SCALE



LOW FLOW SLIDE GATE

- Notes
- 1 Contractor shall verify that existing trash rack can be replaced if removed and does not interfere with new gate
 - 2 CRES - Corrosion Resisting Steel

THIS DRAWING HAS BEEN REDUCED TO
THREE EIGHTHS THE ORIGINAL SCALE

| | | | |
|---|---------------------------|-------------------|--------------------------|
| U. S. ARMY ENGINEER DISTRICT, OMAHA
BRAIN OF ENGINEERS
OMAHA, NEBRASKA | | | |
| SALT CREEK AND ITS TRIBUTARIES, NEBRASKA
BRANCHED OAK DAM AND LAKE
SITE NO. 16
WATER RIGHTS GATE
DETAILS | | | |
| DESIGNED BY
C. A. Stolt | CHECKED BY
R. B. Bunch | DATE
MAY 1983 | DRAWN BY
J. S. H. Jr. |
| SCALE
AS SHOWN | DATE
MAY 1983 | SCALE
AS SHOWN | |
| PROJECT NO.
MSC30-61E2 | | | PLATE A37 |

EL 1890.0
EL 1266.0
EL 1274.0

EL 1290.0
EL 1280.0
EL 1265.9

3:1
10:1

Widened to 32' in 1970.
See PLATE A17.

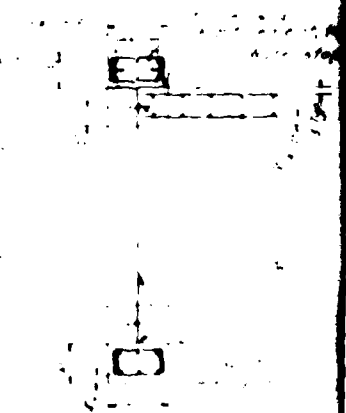
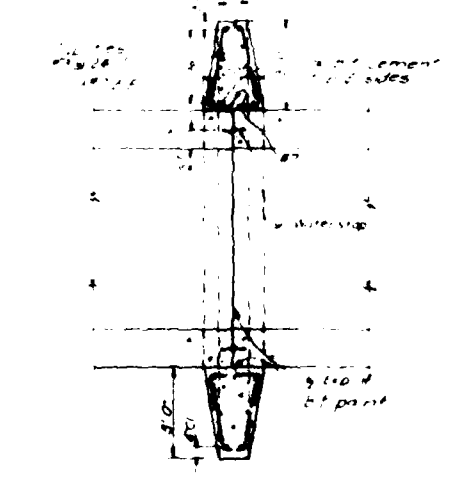
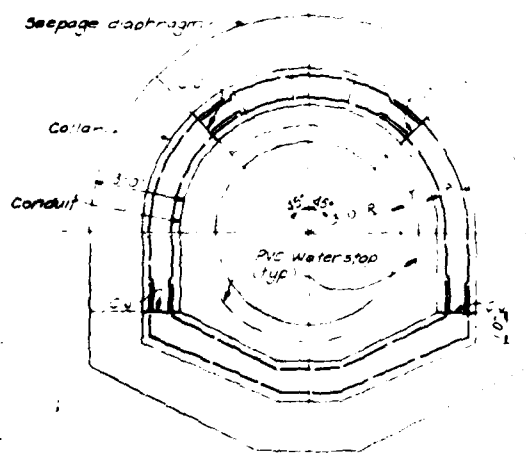
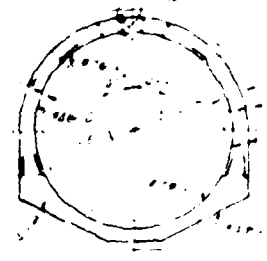
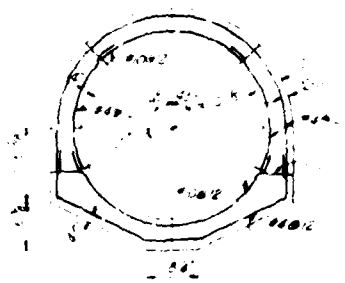
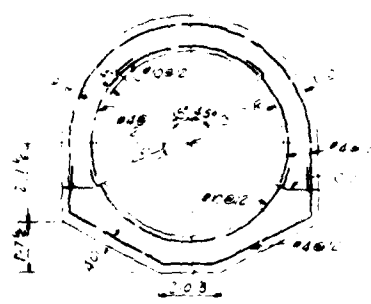
Exist ground line
inv EL 1265.9

Conc seepage diaphragm

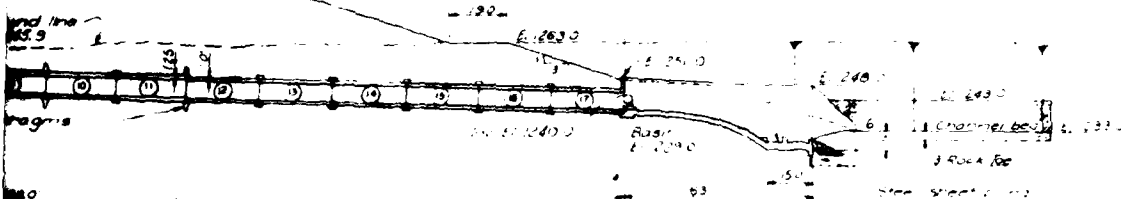
190.50'
212.0'

29.5'

1" = 40'

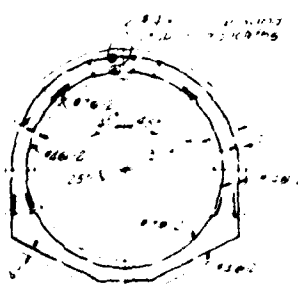


lined to 32' in 1970.
1 PLATE A17.



SECTION THRU STRUCTURE

SCALE 1 INCH = 1 FOOT



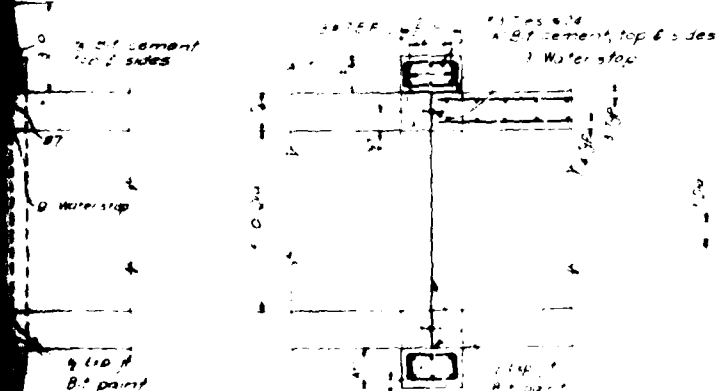
MONOLITHS 14 THRU 17

STEP-UP COLLAR DETAIL

SCALE 1/2 INCH = 1 FOOT

GENERAL NOTES:

1. Clear distance of reinforcement from exposed surfaces shall be 4".
2. Reinforcement is not continuous through monolith joints.



MONOLITH JOINT & COLLAR DETAIL

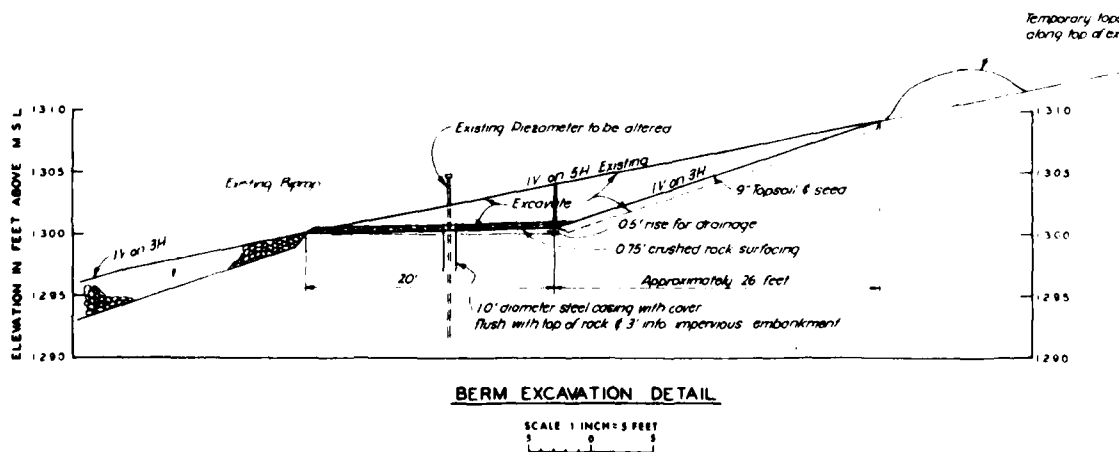
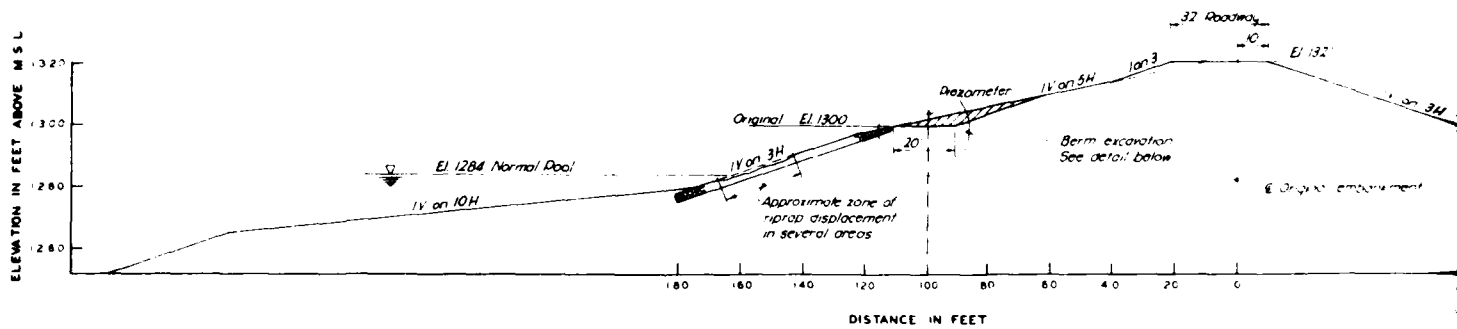
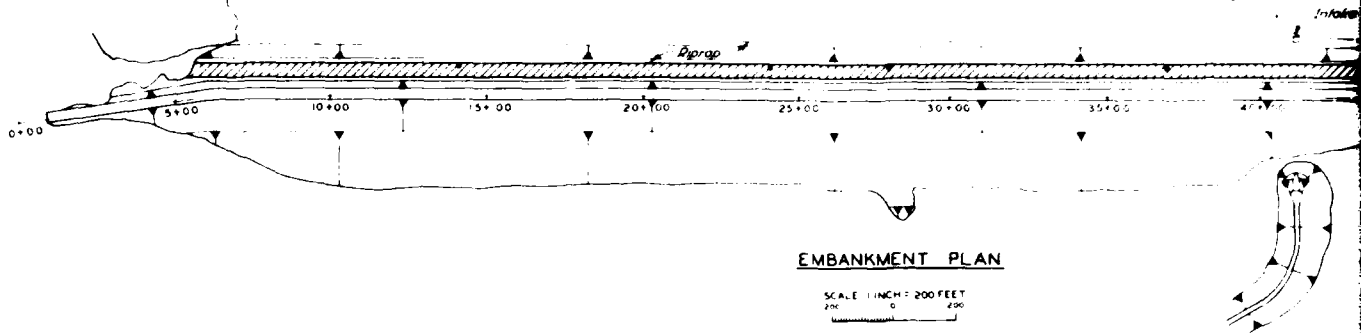
SCALE 1/2 INCH = 1 FOOT

WATERSTOP DETAIL

SCALE 3 INCHES = 1 FOOT



| | |
|---|----------------------------------|
| U. S. ARMY ENGINEER DISTRICT, CHAMPAIGN
CORPS OF ENGINEERS
CHAMPAIGN, ILLINOIS | |
| BRANCHED OAK DAM AND LAKE
SITE NO 18
OUTLET WORKS
CONDUIT - CONC AND REINF DETAILS | |
| DESIGNED BY
<i>[Signature]</i> | CHECKED BY
<i>[Signature]</i> |
| DATE
11/1/77 | DATE
11/1/77 |
| MSC13-311E1 | |

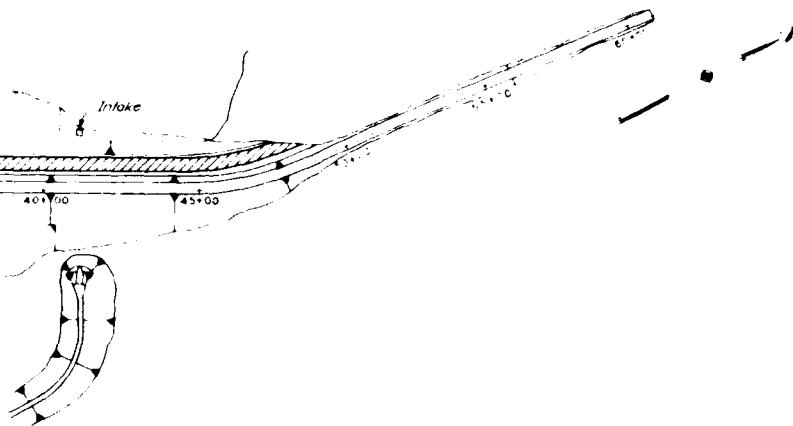


Quantity Computations

| | |
|------------------------|--|
| Excavation for Berm | $3.5 \times \frac{42}{27} \times 432$ |
| Excavation for Topsoil | $0.75 \times \frac{27}{27} \times 432$ |
| Total Excav | |
| Topsoil Backfill | 3.5×432 |
| Rock Surfacing | $0.75 \times 20 \times 432 \times 6$ |
| Seeding | $40 \times 432 \times 4 \times 1.5$ |
| | 43,560 |

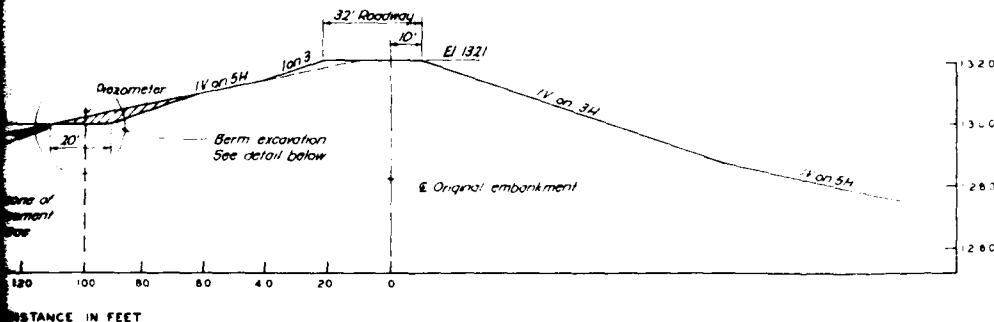
EMBANKMENT PLAN

SCALE 1 INCH = 200 FEET
0 200 400



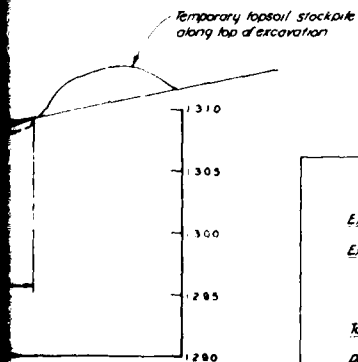
LEGEND:

- ▨ Area of Excavation for Berm Construction
- Piezometer to be Altered



TYPICAL SECTION

SCALE 1 INCH = 20 FEET
20 0 20



Quantity Computations

$$\begin{aligned} \text{Excavation for Berm} &= \frac{3.5 \times \frac{1}{2} \times 4300}{27} = 13,100 \text{ CY} \\ \text{Excavation for Topsoil} &= \frac{0.75 \times 20' \times 4300}{27} = 3,300 \text{ CY} \\ \text{Total Excavation} &= 16,400 \text{ CY} \end{aligned}$$

$$\begin{aligned} \text{Topsoil Backfill} &= 3,300 \text{ CY} \\ \text{Rock Surfacing} &= \frac{0.75 \times 20' \times 4300 \times 1.65}{27} = 3,975 \text{ Tons} \\ \text{Seeding} &= \frac{40 \times 4300}{43,560} = 4 \text{ Acres} \end{aligned}$$



THIS PLAN ACCOMPANIES CONTRACT NO. D4CAG5 MODIFICATION NO.

| | | | |
|---|----------------------------|----------------|----------|
| DATE | DESCRIPTION | MADE | APPROVED |
| | REV. 5-0-81 | | |
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | | | |
| SALT CREEK
BRANCHED OAK DAM AND RESERVOIR
EMBANKMENT BERM
PLAN AND SECTION | | | |
| DESIGNED BY | APPROVED | DATE | |
| DRAWN BY | CHIEF ENGINEERING DIVISION | APRIL 67 | |
| CHECKED BY | SCALE AS SHOWN | D4CAG5 | |
| ENGINEER | DESIGNED BY | DRAWING NUMBER | |
| APPROVED | DATE | | |

APPENDIX B
PHOTOGRAPHS



PHOTO NO. 1 - October 1973, aerial view of project. Pool elevation is 1286.6, approximately 2.6' above normal operating pool. Note: This is the highest pool elevation ever recorded at Branched Oak Dam.



PHOTO NO. 2 - October 1973, aerial view of project.
High pool condition.

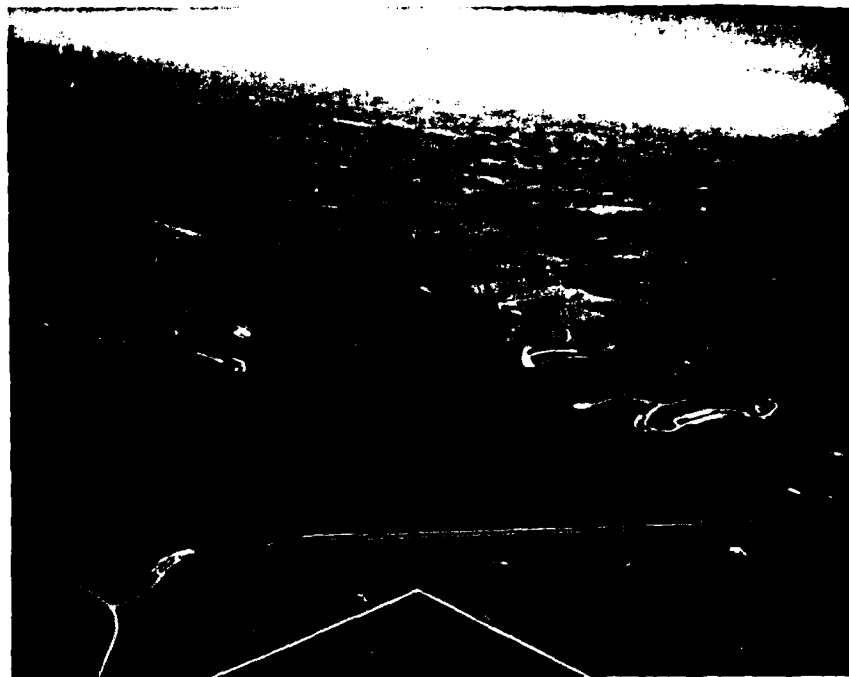


PHOTO NO. 1 - October 1973, aerial view of project. Pool elevation is 1286.6, approximately 2.6' above normal operating pool. Note: This is the highest pool elevation ever recorded at Branched Oak Dam.



PHOTO NO. 2 - October 1973, aerial view of project.
High pool condition.



PHOTO NO. 3 - October 1973, aerial view of project. High pool condition. Note: Emergency spillway is shown in the lower right hand side of the photo.

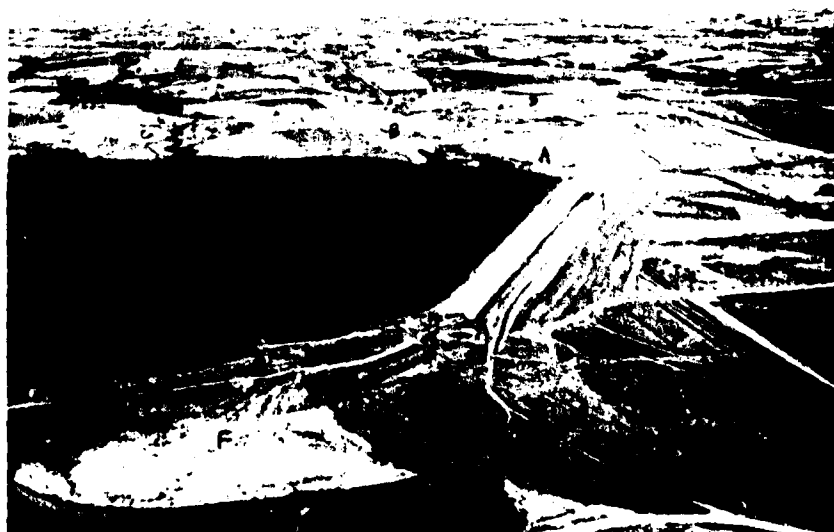


PHOTO NO. 4 - August 1968, aerial view of project during ponding of the reservoir. Note: Letters indicate Borrow Areas A, B, C and F and the Emergency Spillway(S).



PHOTO NO. 5 - View of upstream embankment slope, crushed rock surfaced service road, and upstream slope riprap protection from the left abutment. September 1982



PHOTO NO. 6 - View of upstream embankment slope, crushed rock surfaced service road, and upstream slope riprap protection from the right abutment. September 1982



PHOTO NO. 7 - Overview of dam crest, downstream slope, and right abutment. September 1982

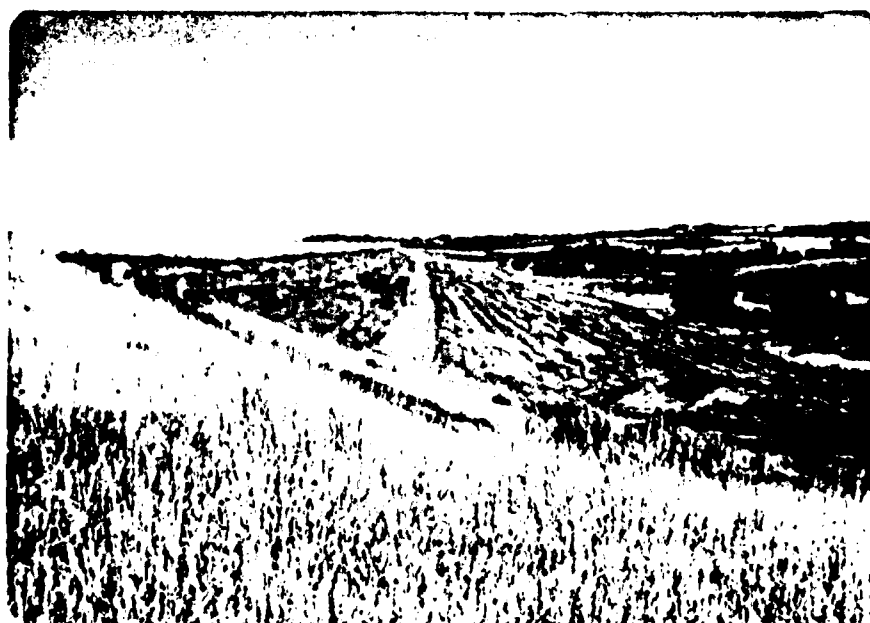


PHOTO NO. 8 - View of downstream slope of the dam from the right abutment. September 1982



PHOTO NO. 9 - View of upstream embankment slope, crushed rock surfaced service road, riprap slope protection and outlet works intake tower, from the left abutment. September 1982



PHOTO NO. 10 - View of riprap slope protection on the IV on 3H upstream embankment slope. September 1982



PHOTO NO. 11 - View of riprap slope protection on right abutment shoreline area. September 1982



PHOTO NO. 12 - View of upstream end of emergency spillway. Highway shown crosses dam to left. September 1982



PHOTO NO. 13 - View of emergency spillway channel looking
downstream from near highway.
September 1982

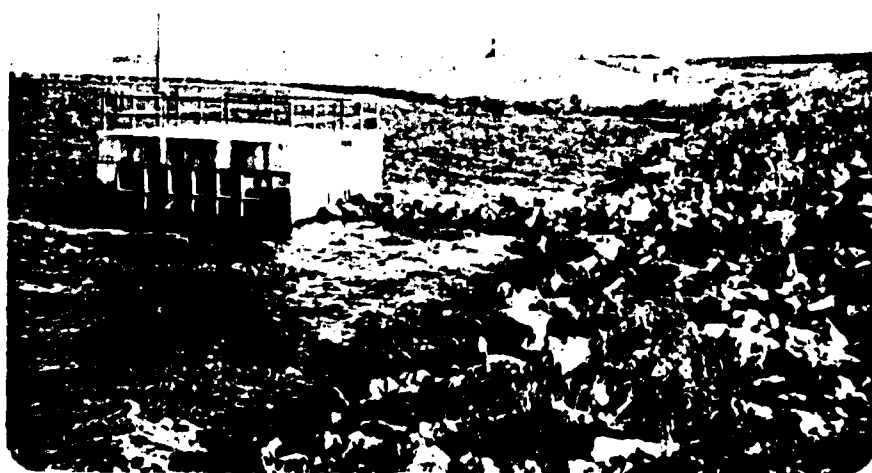


PHOTO NO. 14 - View of outlet works intake structure and
riprap near north end of the embankment.
September 1982

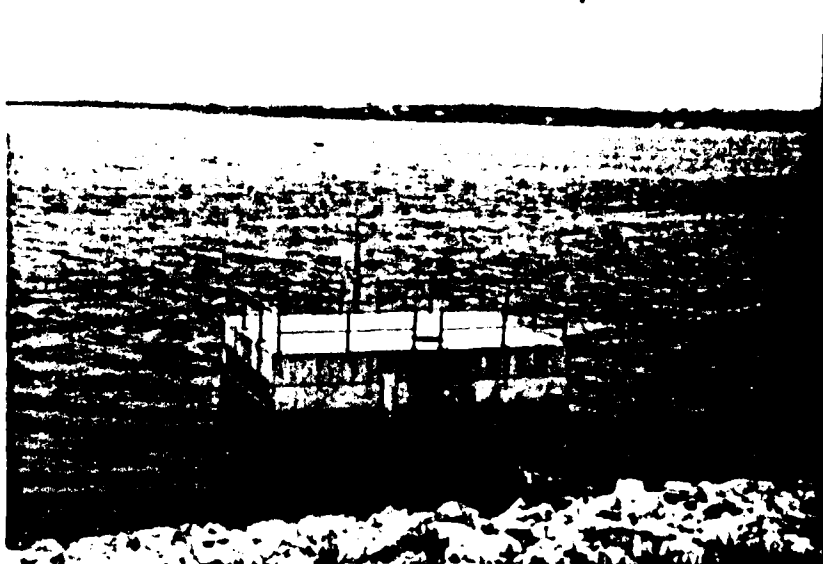


PHOTO NO. 15 - View of outlet works intake structure at
conservation pool level. (1284.0' m. s. l.)
May 1974

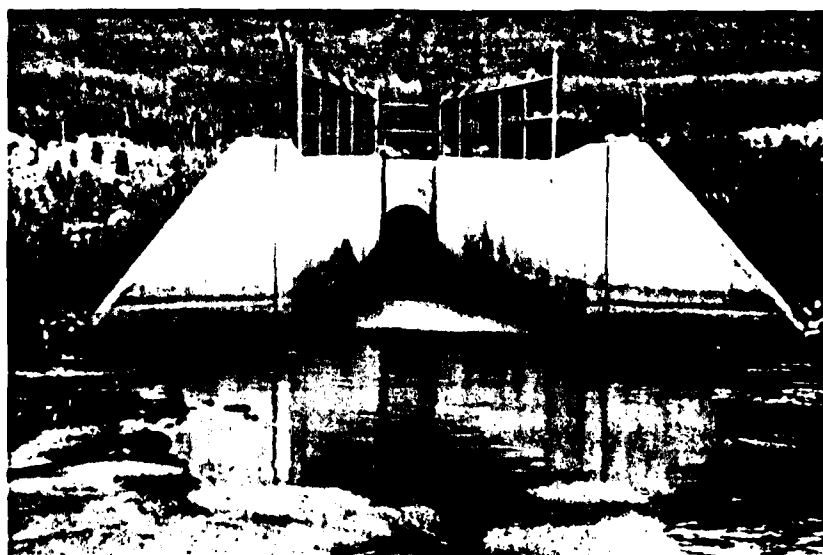


PHOTO NO. 16 - View of stilling basin structure and conduit
portal. June 1974



PHOTO NO. 17 - View of hydraulic jump created in stilling basin.
The jump dissipates the energy of the flowing water,
and therefore reduces erosion in the downstream
channel. April 1973



PHOTO NO. 18 - View of stilling basin and discharge channel.
September 1982



PHOTO NO. 19 - View of outlet channel from crest of dam.
September 1982



PHOTO NO. 20 - View of crushed rock surfaced service road
during construction. November 1976



PHOTO NO. 21 - View of crushed rock surfaced service road during construction. November 1976



PHOTO NO. 22 - View of outlet end of downstream valley relief well (on right side - flap lid) and parallel drain pipe (to left w/screen). Relief well flow is about 17 gpm and drain flow is about 5 gpm. September 1982

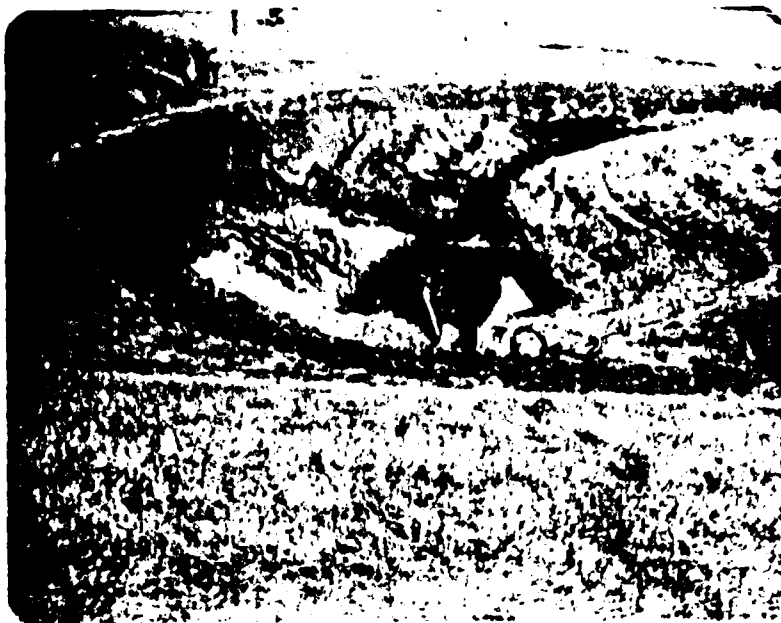


PHOTO NO. 23 - View of stilling basin from crest of dam.
 Arrow #1 points to 4" seepage drain
 (See Photo No. 25) and Arrow #2 points to
 a 2" seepage drain (See Photo No. 24). September 1982



PHOTO NO. 24 - View of 2" seepage drain which was installed
 in the outlet end of an embankment sand drain
 just upstream of the stilling basin structure.
 Flow is approx. 1.4 gpm. September 1982



PHOTO NO. 25 - View of 4" seepage drain installed along the left crest slope of the stilling basin. Flow is approx. 23.5 gpm. September 1982

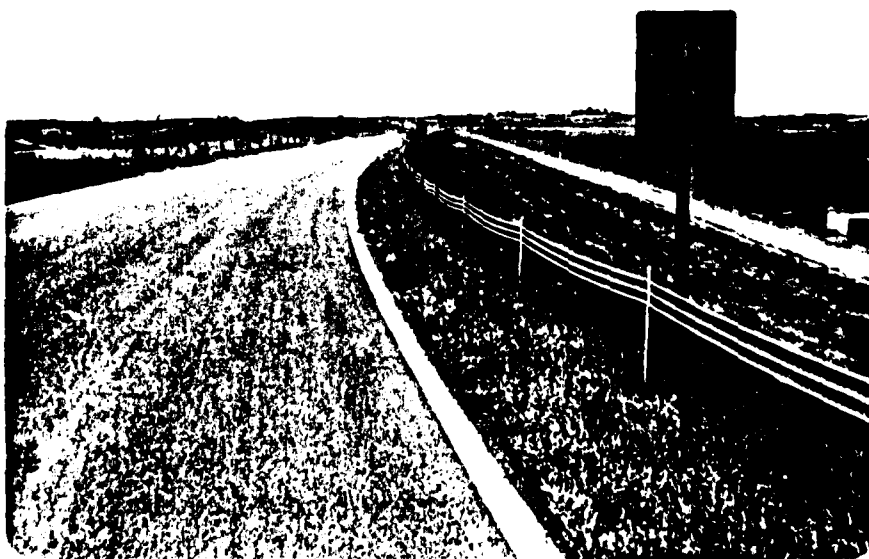
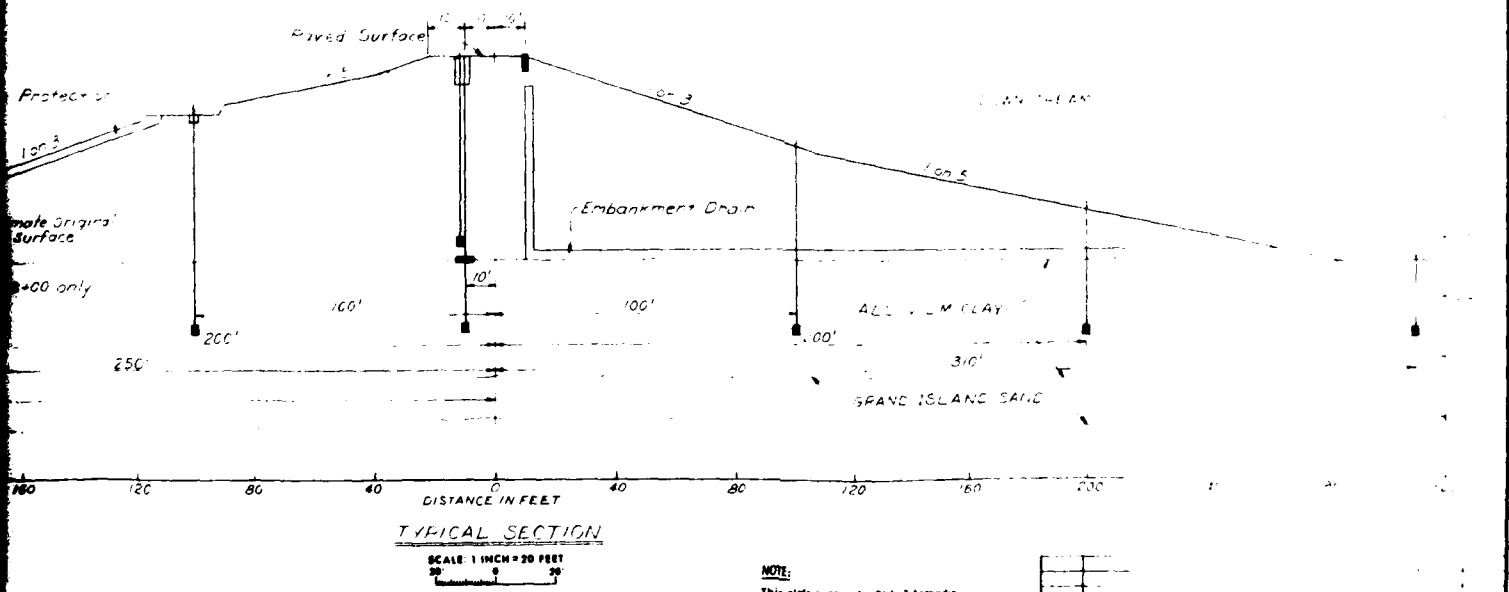
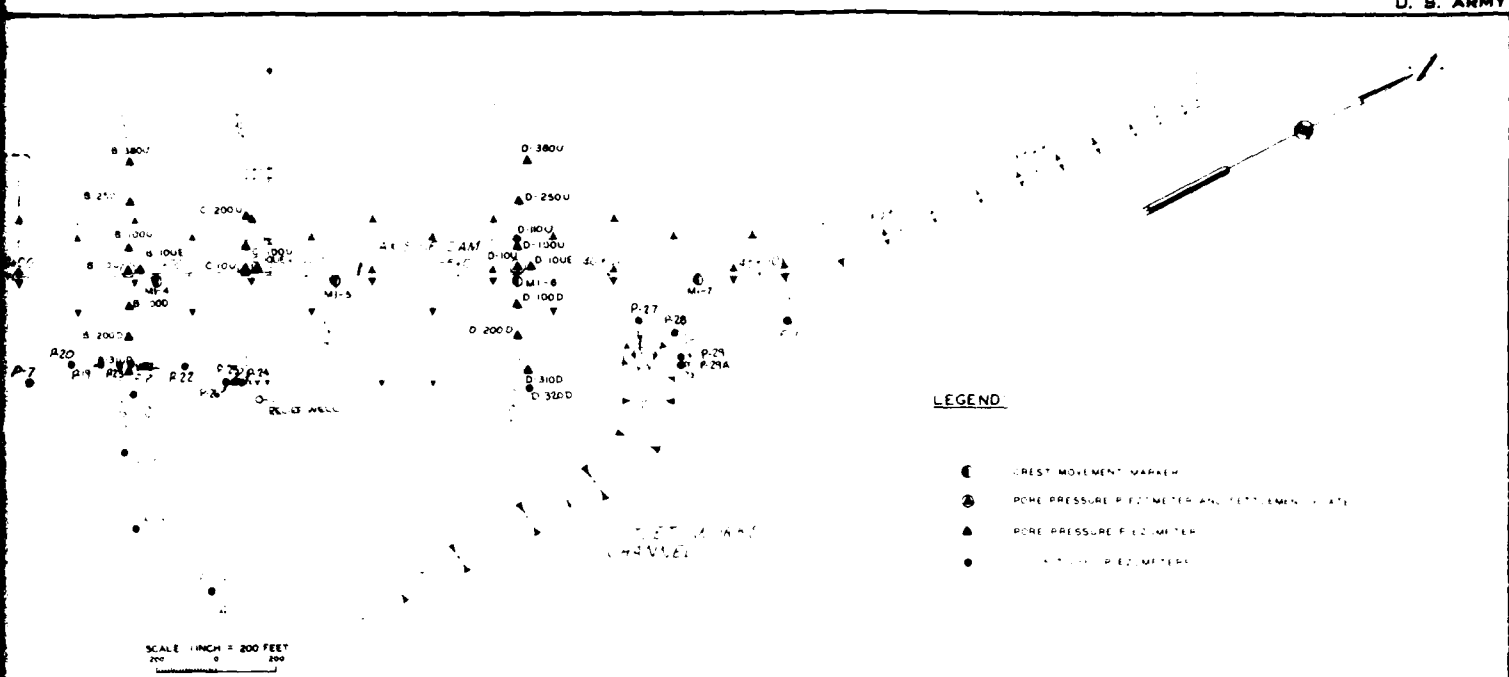


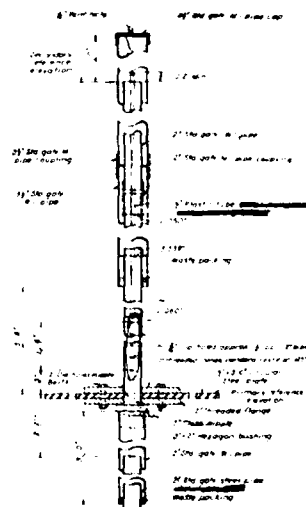
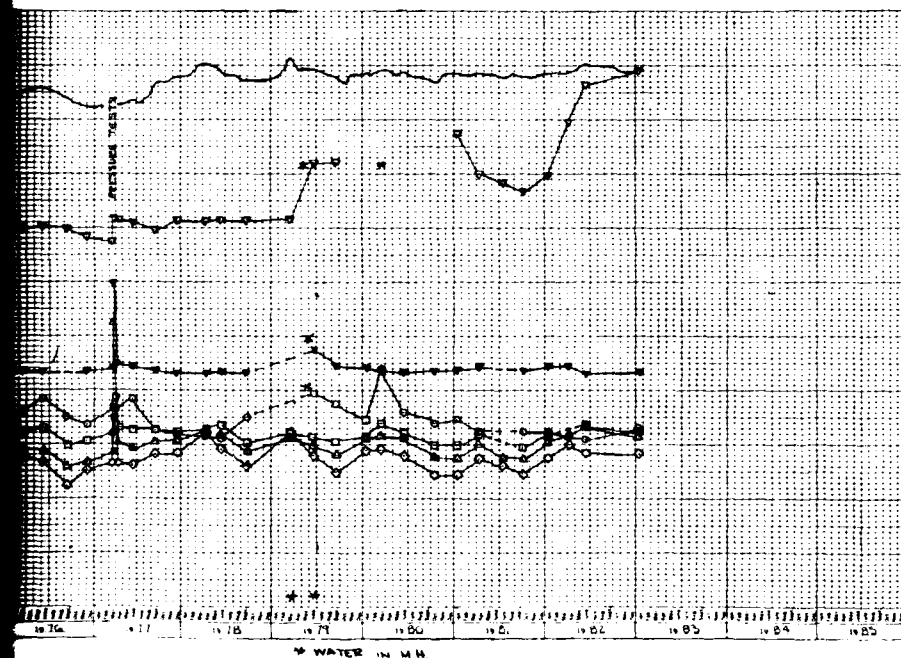
PHOTO NO. 26 - View of dam crest and paved highway which runs along the crest of the dam. Photo was taken from the upstream side of the embankment near the left abutment. September 1982



PHOTO NO. 27 - View of dam crest and paved highway which runs along the crest of the dam. Photo was taken from near the right abutment of the dam. September 1982

APPENDIX C
INSTRUMENTATION





COMMITTEE ON THE JUDICIAL BRANCH
DEPARTMENT OF JUSTICE
WASHINGTON, D.C.

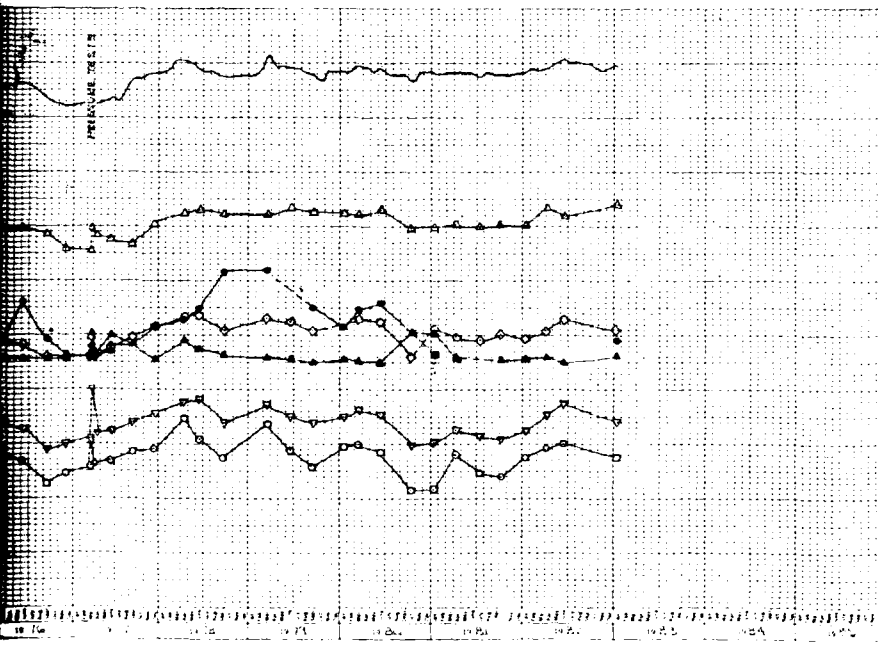
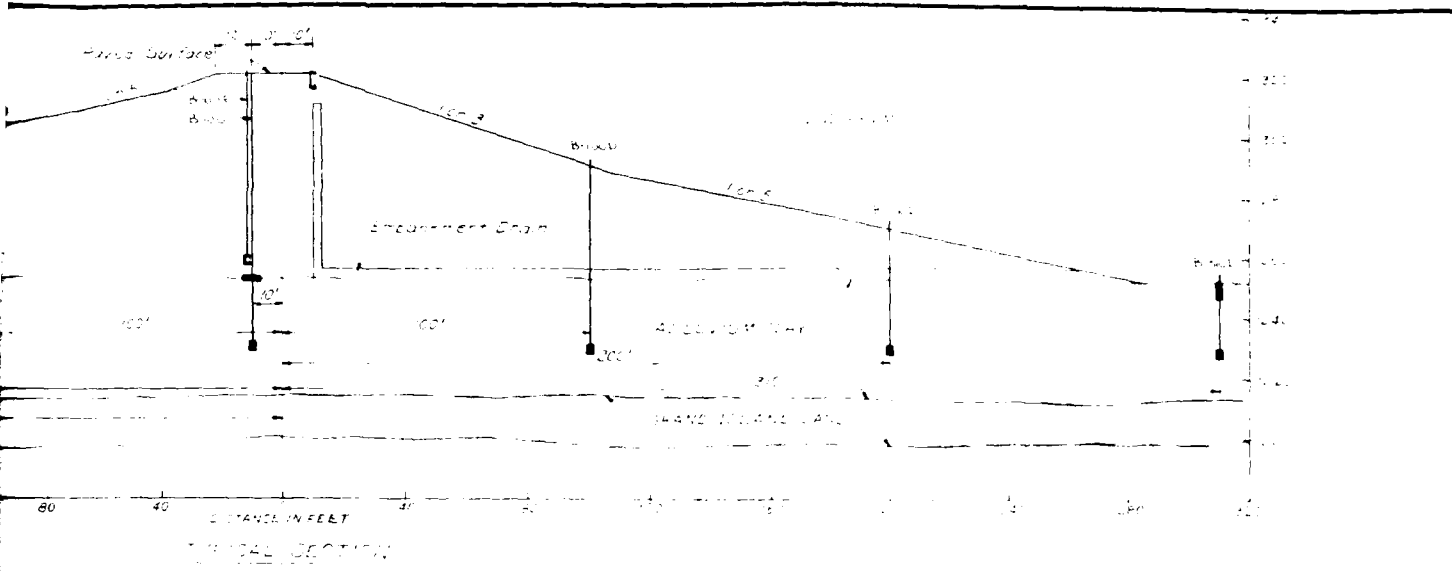
[illegible]

EMBANKMENT CRITERIA AND PERFORMANCE REPORT (1983)

PLATE C2

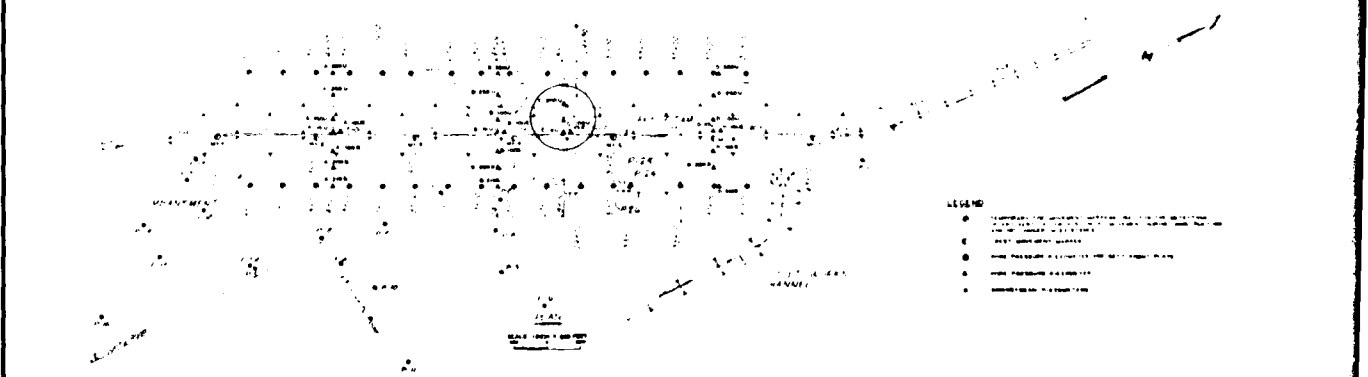
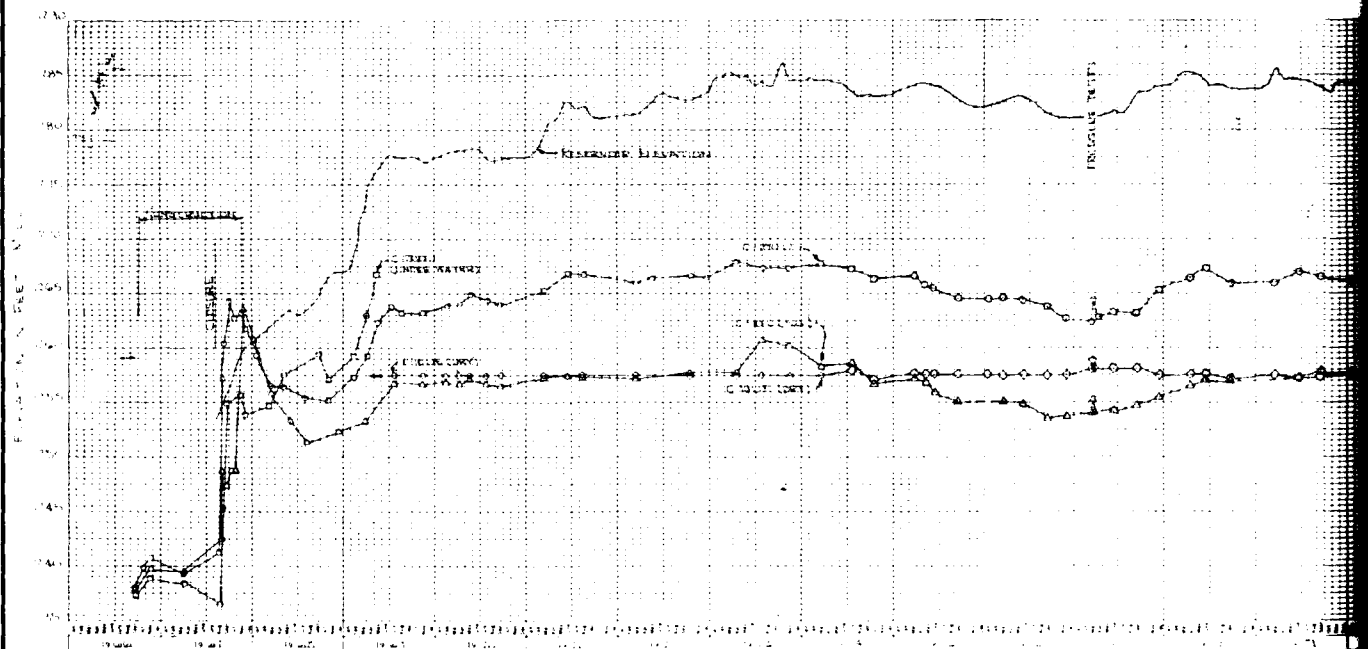
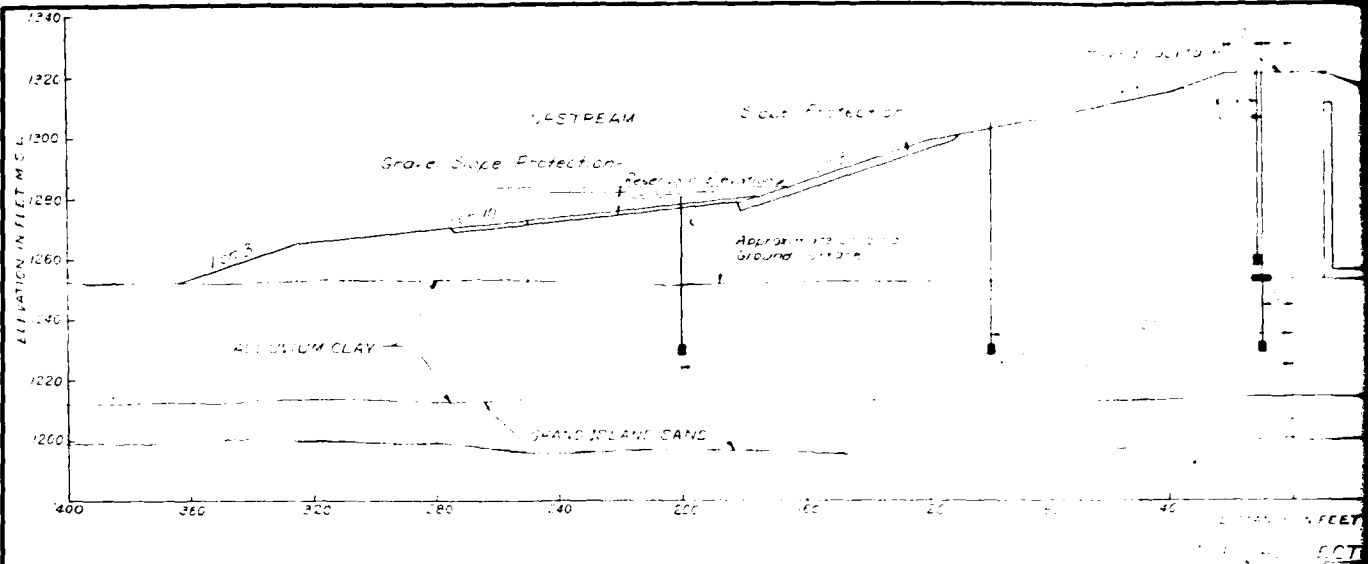


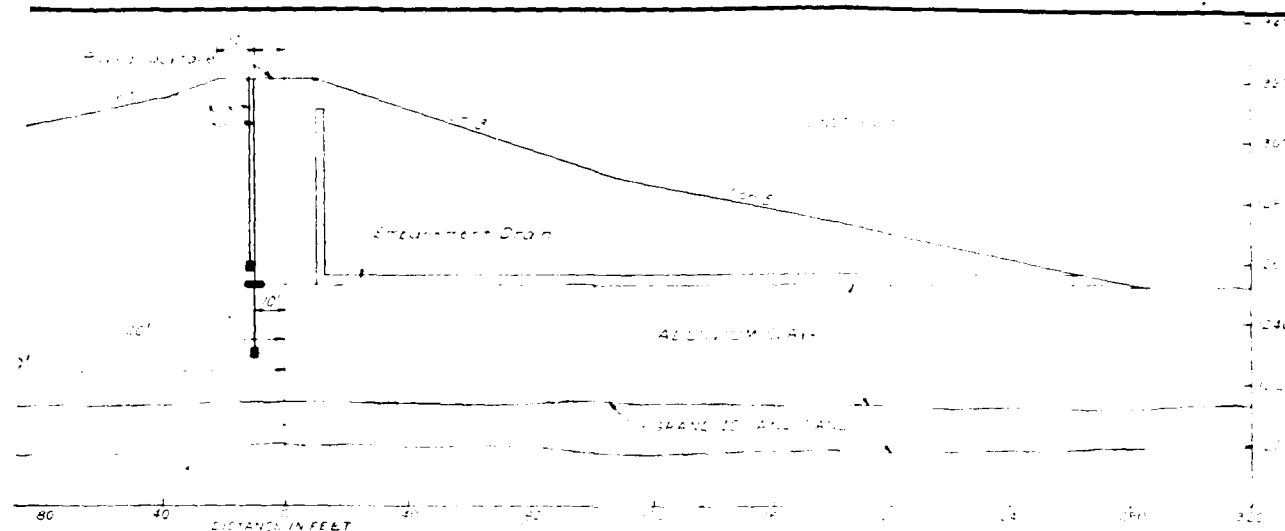
THIS PLAN ACCOMPANIES CONTRACT NO.
MODIFICATION NO.



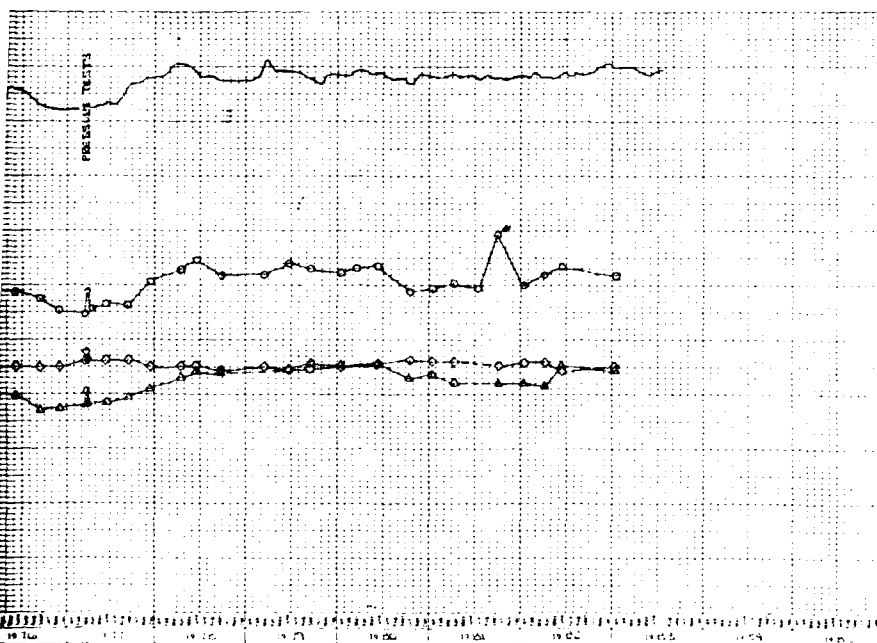
THIS PLAN ACCOMPANIES CONTRACT NO. _____
MODIFICATION NO. _____

| | | | | | |
|--|----------------|-------------|------|------|----------|
| DATE | | DESCRIPTION | | MADE | APPROVED |
| REVISIONS | | | | | |
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | | | | | |
| DRAWN BY | CHECKED BY | | | | |
| CHECKED BY | APPROVED BY | | | | |
| DESIGNED BY | DATE | | | | |
| DISTRICT | SECTION | APPROVED | DATE | | |
| DISTRICT | SECTION | APPROVED | DATE | | |
| APPROVED | SCALE AS SHOWN | DATE | | | |
| SIGNED | | DATE | | | |





100-44280-1

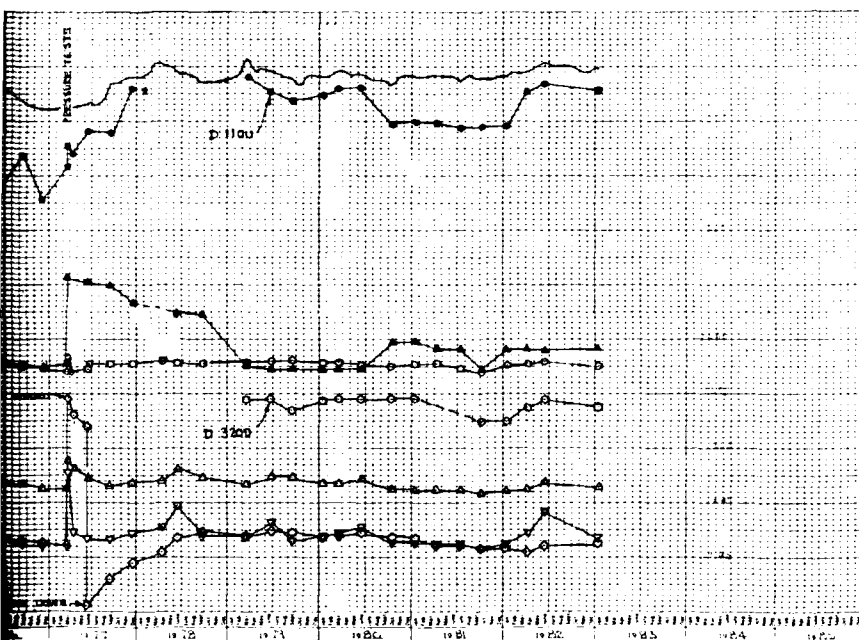
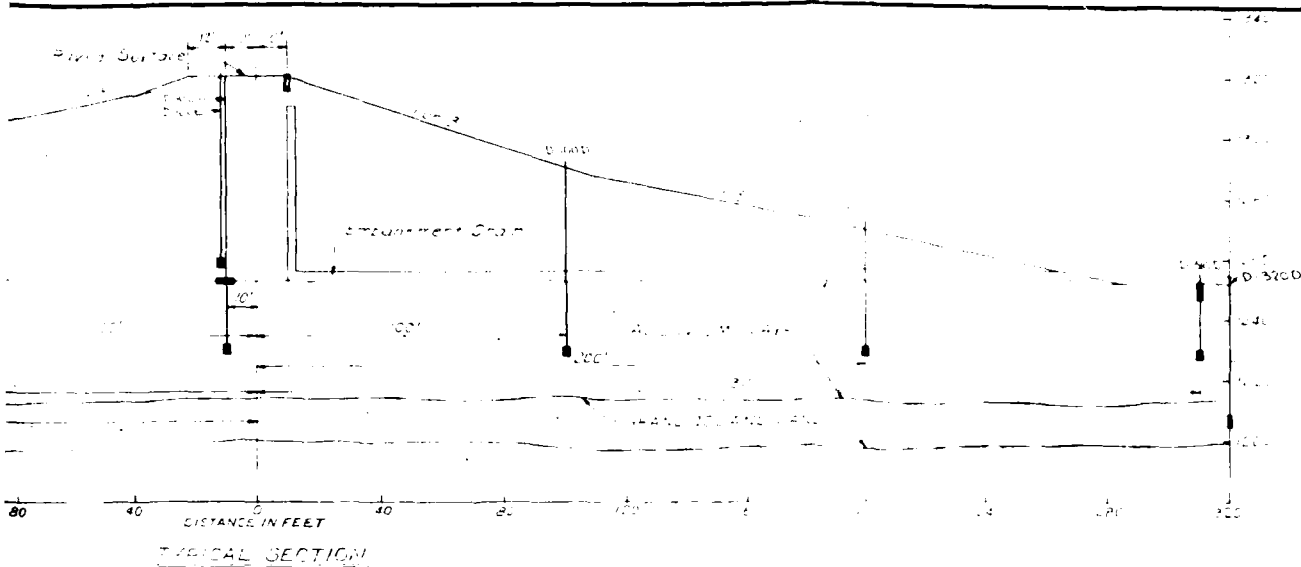
[illegible]

THIS PLAN ACCOMPANIES CONTRACT NO
MODIFICATION NO.

[illegible]

EMBAKMENT CRITERIA AND PERFORMANCE REPORT (1983)

PLATE C

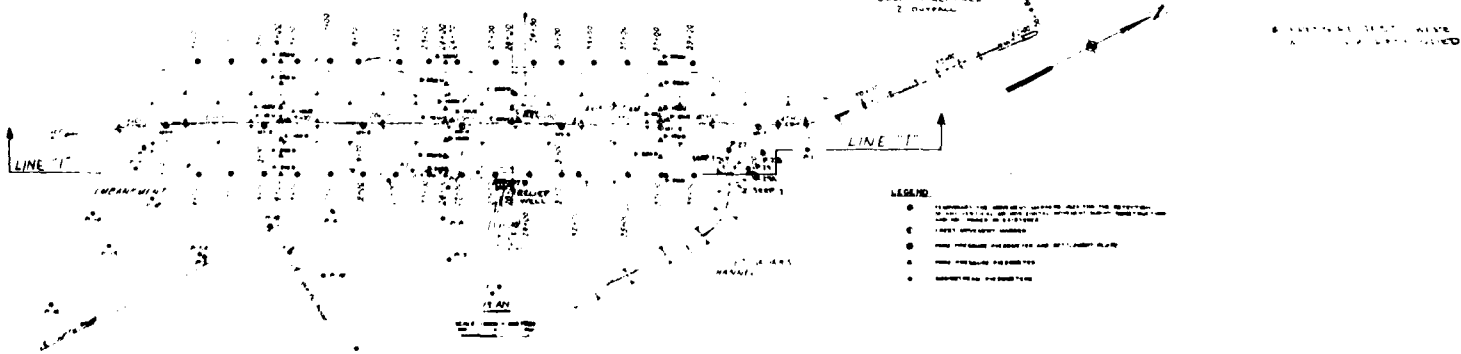
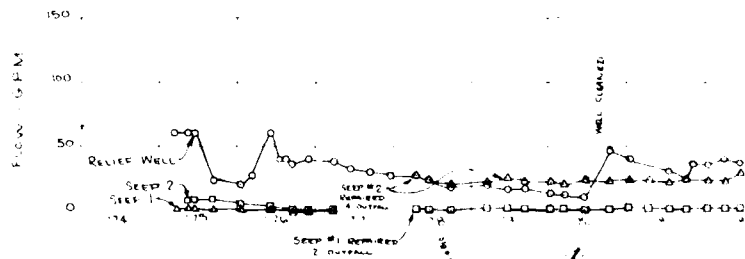
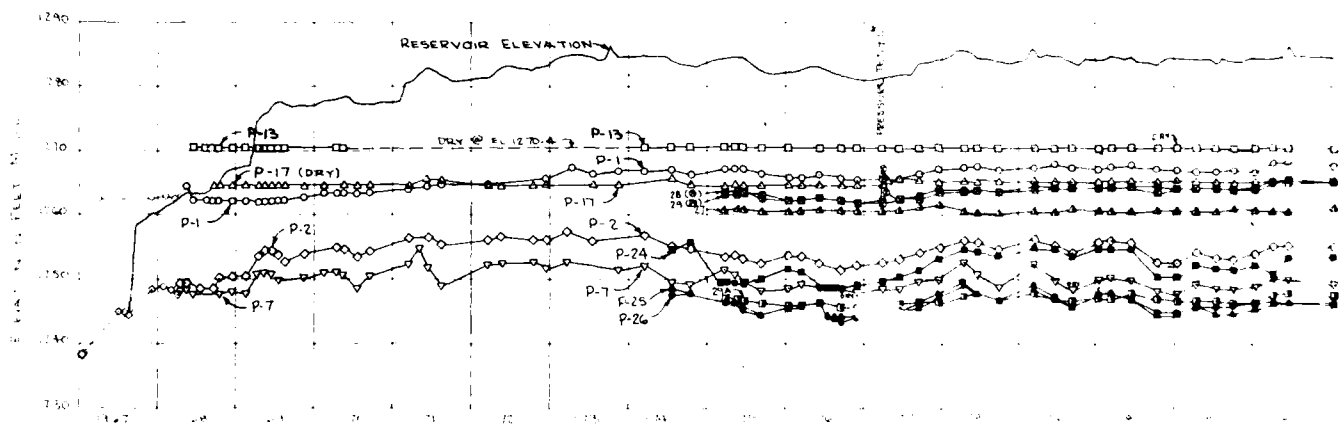
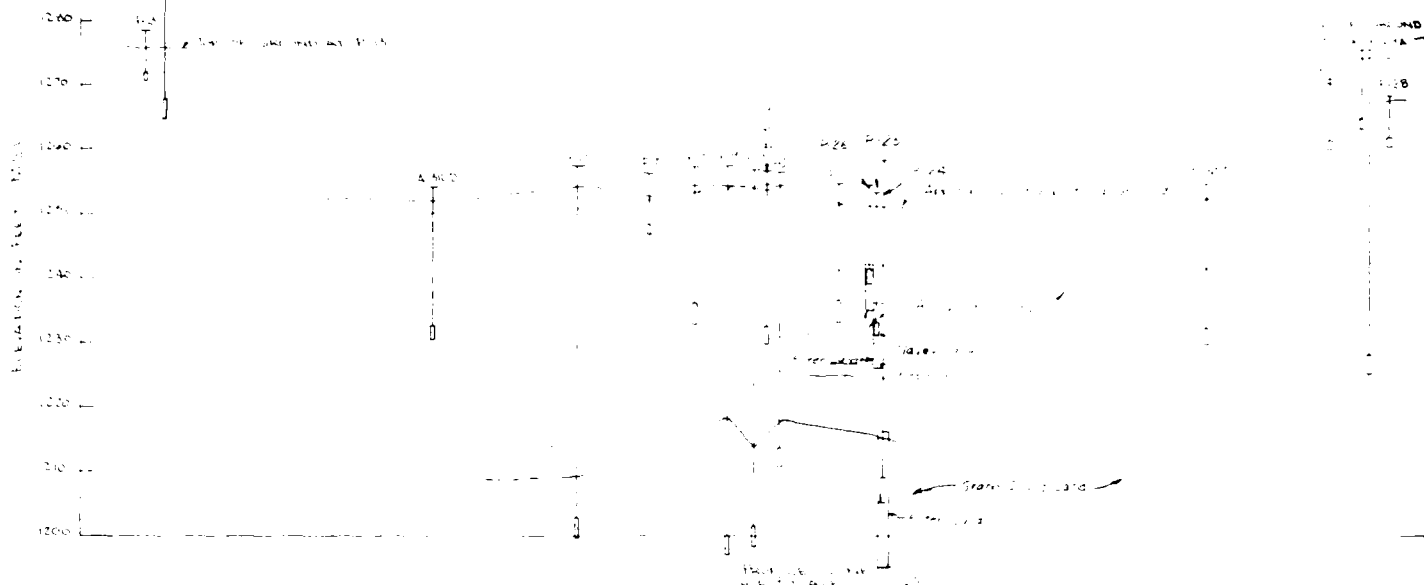


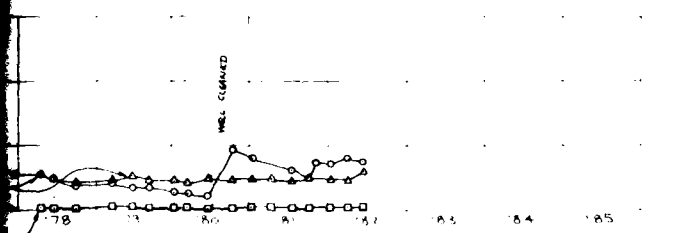
* PIEZ D-100U NG REPLACED
WITH PIEZ D110U
PIEZ. D320D IS AN ADDED
PIEZ. INSTALLED INTO THE G.I. SAND



THIS PLAN ACCOMPANIES CONTRACT NO. _____
MODIFICATION NO. _____

[illegible]





1. THE UNITED STATES OF AMERICA
 2. OF THE DISTRICT OF COLUMBIA
 3. DO hereby certify that
 4. the following is a true and correct copy
 5. of the original as the same appears
 6. in the records of the
 7. Department of the Interior
 8. at Washington, D. C.
 9. this 1st day of January, 1900.
 10.

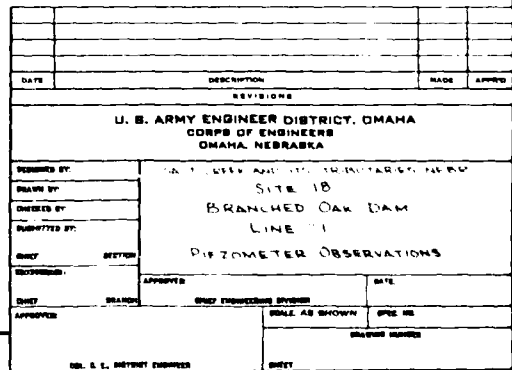
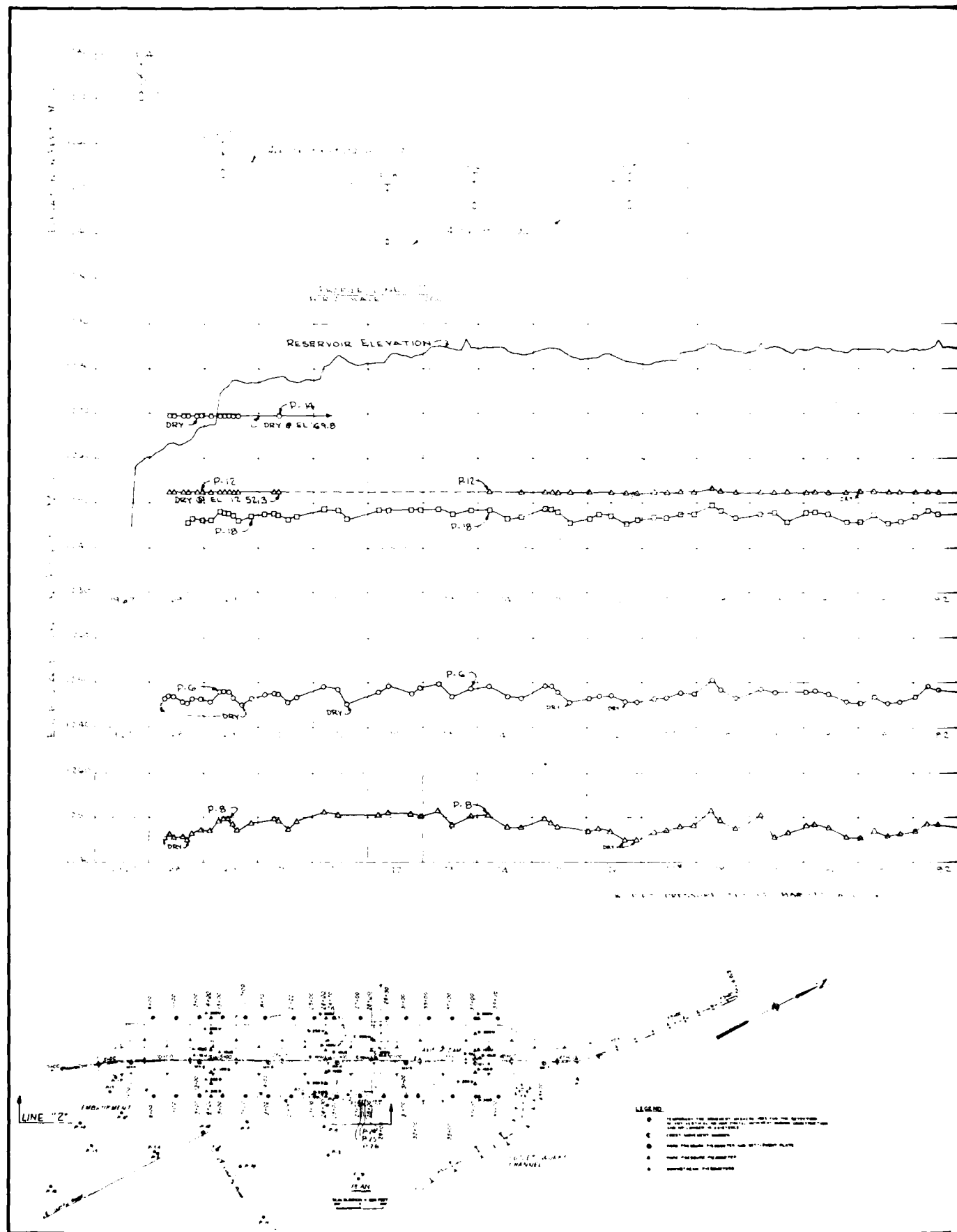
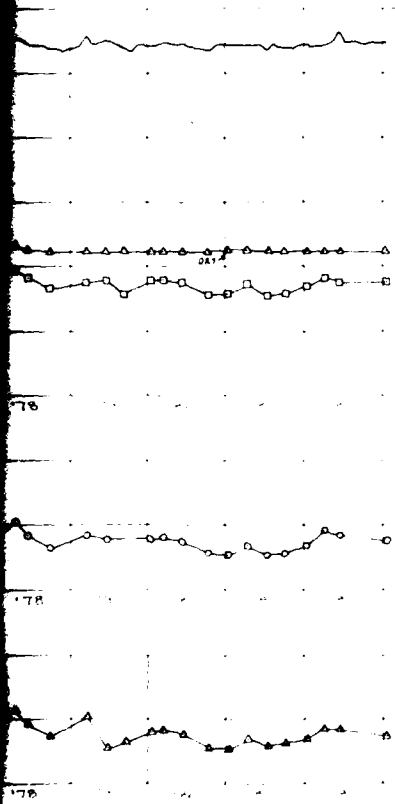


PLATE C6





SEE TECHN. MAP 111 A-11-11



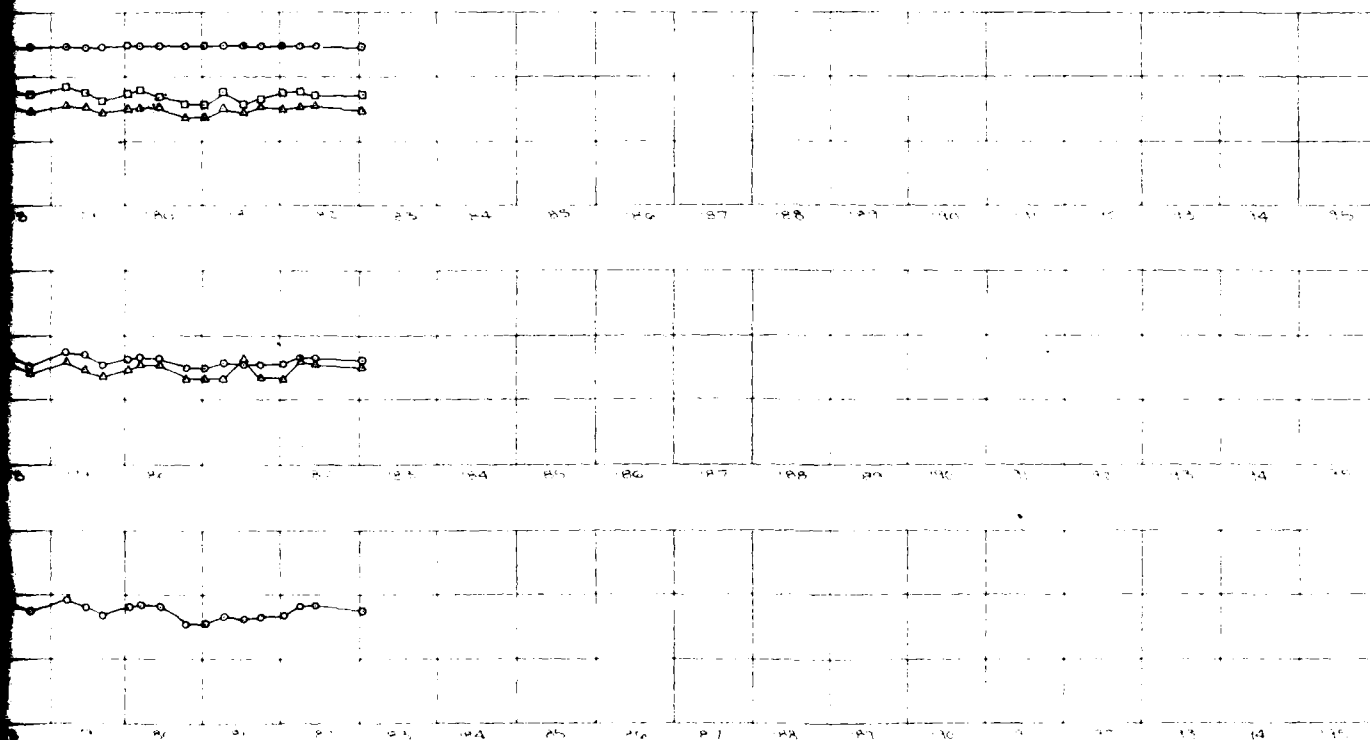
THE FOLLOWING INFORMATION IS FOR THE INFORMATION OF THE DISTRICT ENGINEER AND IS NOT TO BE USED FOR ANY OTHER PURPOSE WITHOUT THE WRITTEN CONSENT OF THE DISTRICT ENGINEER.



THIS PLAN ACCOMPANIES CONTRACT NO. _____
MODIFICATION NO. _____

| | | | | | |
|--|--|--|--|----------------|--------|
| DATE | | DESCRIPTION | | NAME | APPROV |
| REVISIONS | | | | | |
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | | | | | |
| DESIGNED BY: | | SITE 18
BRANCHED OAK DAM
LINE "2"
PIEZOMETER OBSERVATIONS | | | |
| DRAWN BY: | | | | | |
| CHECKED BY: | | | | | |
| SUBMITTED BY: | | | | | |
| SUPERVISOR: | | APPROVER: | | DATE: | |
| DESIGNED BY: | | DRAWN BY: | | CHECKED BY: | |
| APPROVER: | | DATE: | | SCALE AS SHOWN | |
| | | | | SHEET NO. | |
| | | | | DRAWING NUMBER | |
| | | COL. R. E. BENTLEY, CHIEF | | SHEET | |

161

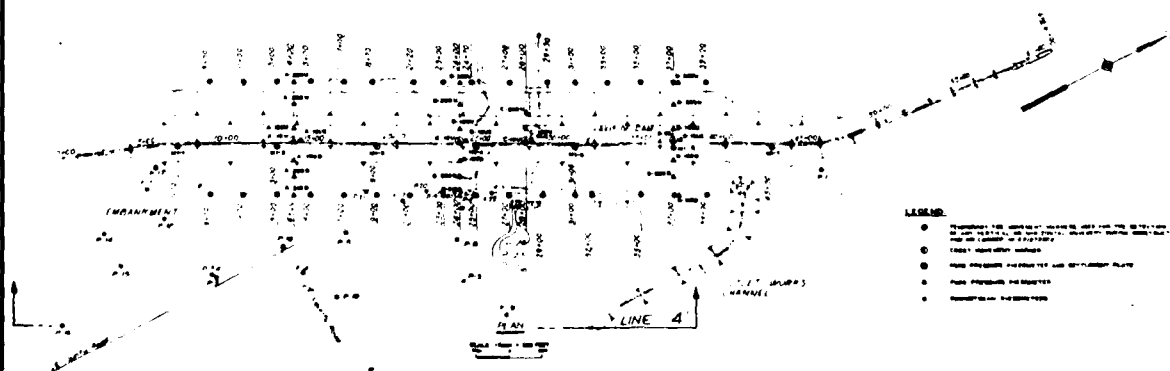
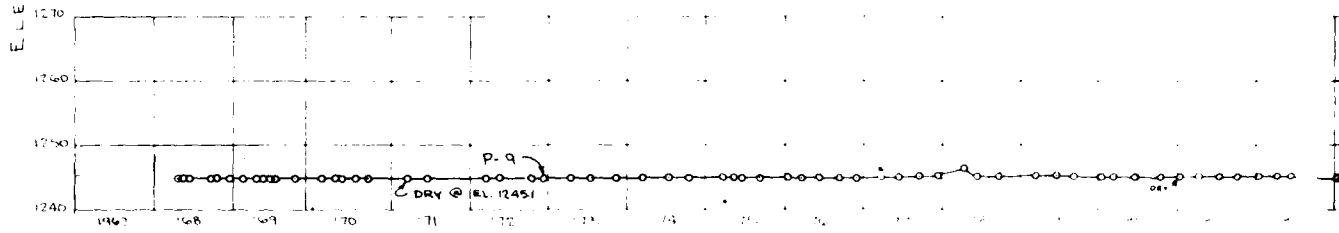


Note See Plate C-6 for Reservoir Elevation
 4 PIEZ PRESSURE TESTED MAR '77, ALL OK

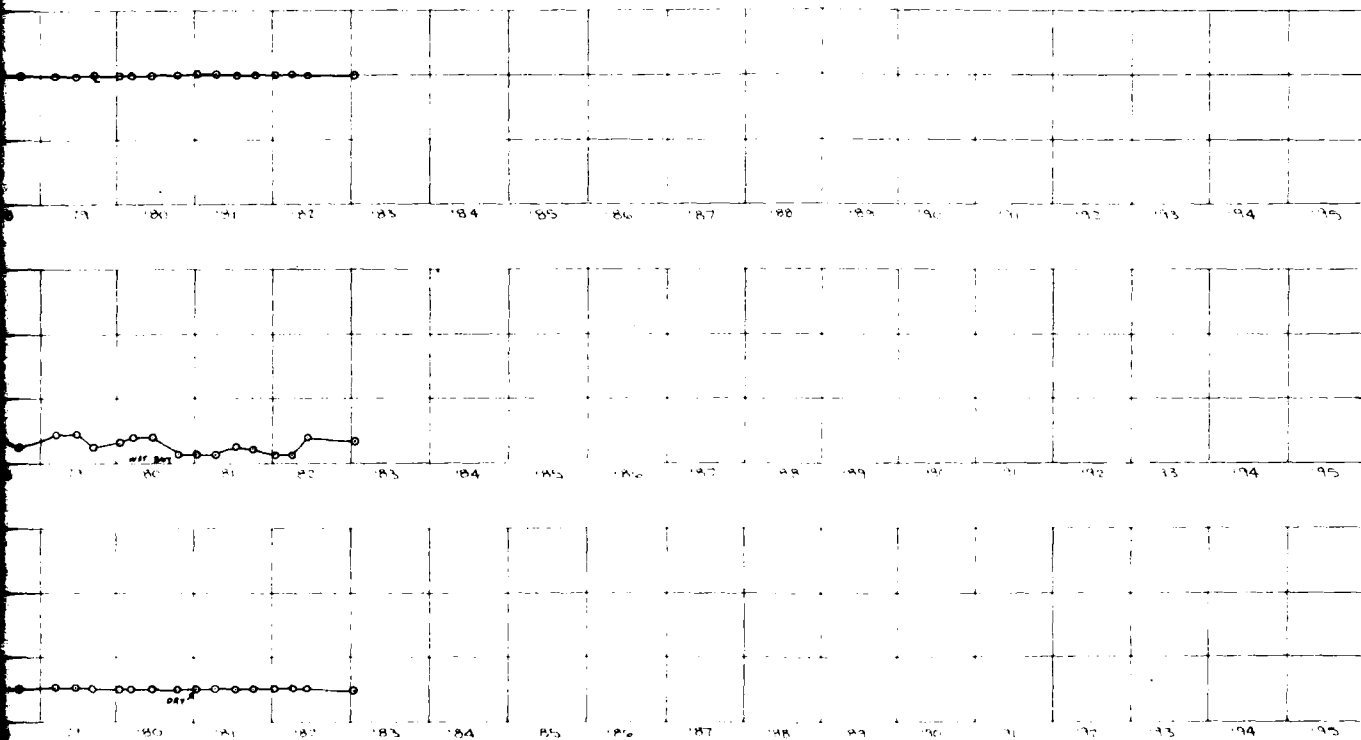


THIS PLAN ACCOMPANIES CONTRACT NO.
 MODIFICATION NO.

| | | | | | |
|--|------------------------------------|-------------------------|--|------|------|
| DATE | | DESCRIPTION | | NAME | APPV |
| REVISIONS | | | | | |
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | | | | | |
| DESIGNED BY: | SALT LAKE AND ITS TRIBUTARIES NEPA | | | | |
| DRAWN BY: | SITE 18 | | | | |
| ENGINEERED BY: | BRANCHED OAK DAM | | | | |
| CONSTRUCTED BY: | LINE "3" | | | | |
| DATE | SECTION | PIEZOMETER OBSERVATIONS | | | |
| APPROVED: | DATE | | | | |
| APPROVED: | DATE | | | | |
| APPROVED: | | APPROVED: | | DATE | |
| APPROVED: | | APPROVED: | | DATE | |
| APPROVED: | | APPROVED: | | DATE | |



p.9



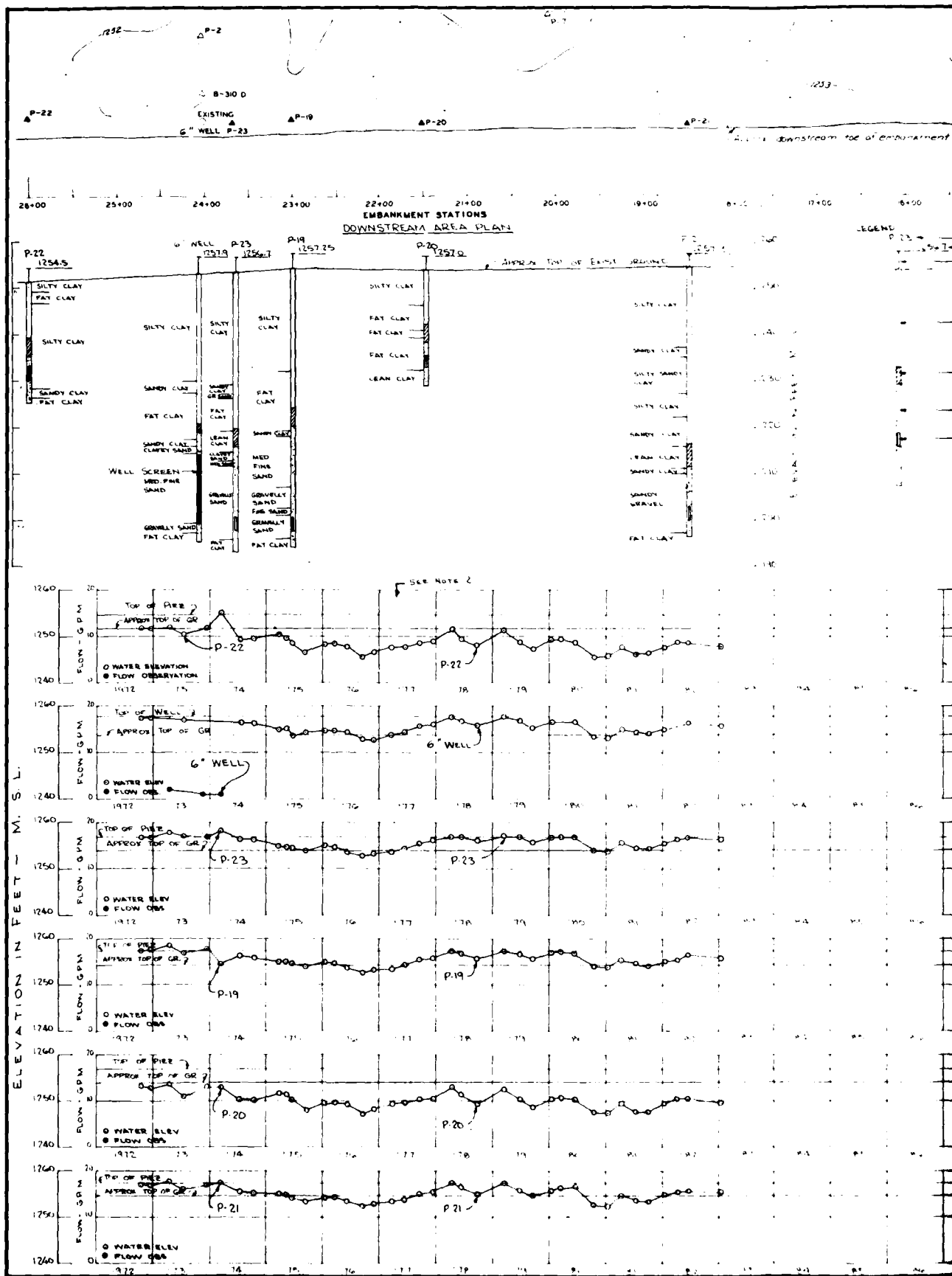
Note. See Plate C-6 for Reservoir Elevation



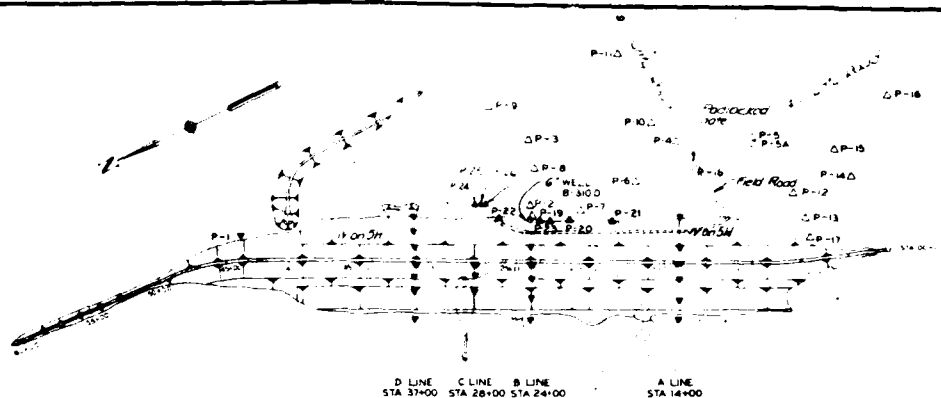
THIS PLAN ACCOMPANIES CONTRACT NO. MODIFICATION NO.

| | | | | | |
|--|---|-------------|----------------|------|----------|
| DATE | | DESCRIPTION | | MADE | APPROVED |
| REVISIONS | | | | | |
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | | | | | |
| DESIGNED BY: | SALT CREEK AND ITS TRIBUTARIES, WYOMING | | | | |
| DRAWN BY: | SITE 18 | | | | |
| REGISTERED BY: | BRANCHED OAK DAM | | | | |
| | LINE 14 | | | | |
| | PIEZOMETER OBSERVATIONS | | | | |
| DATE | SECTION | APPROVED | DATE | | |
| DATE | SECTION | DATE | SECTION | DATE | SECTION |
| APPROVED | SCALE AS SHOWN | DATE | CHANGED SHEETS | | |
| U.S. ARMY ENGINEER DISTRICT, OMAHA | | | | | |

12



Approx. downstream toe of embankment



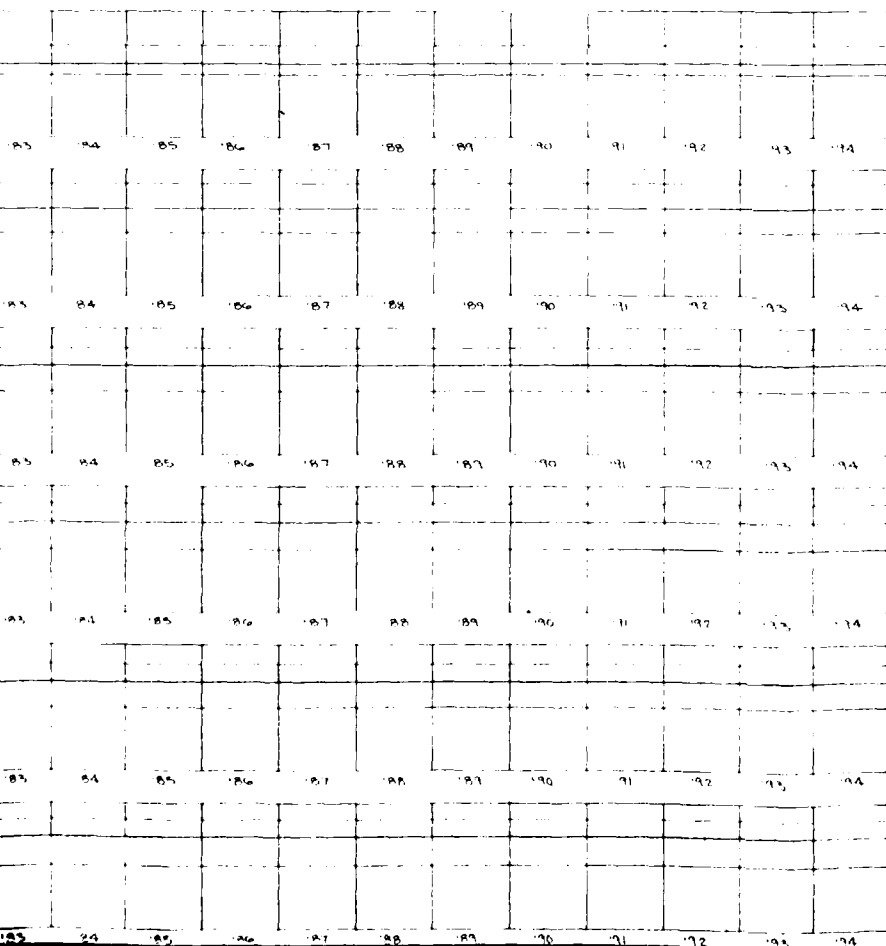
PLAN

SCALE 1 INCH = 400 FEET

LEGEND
P-23 — PIEZ. NO.
125+7 — TOP ELEV.
— — — — — PIEZ. TUBE

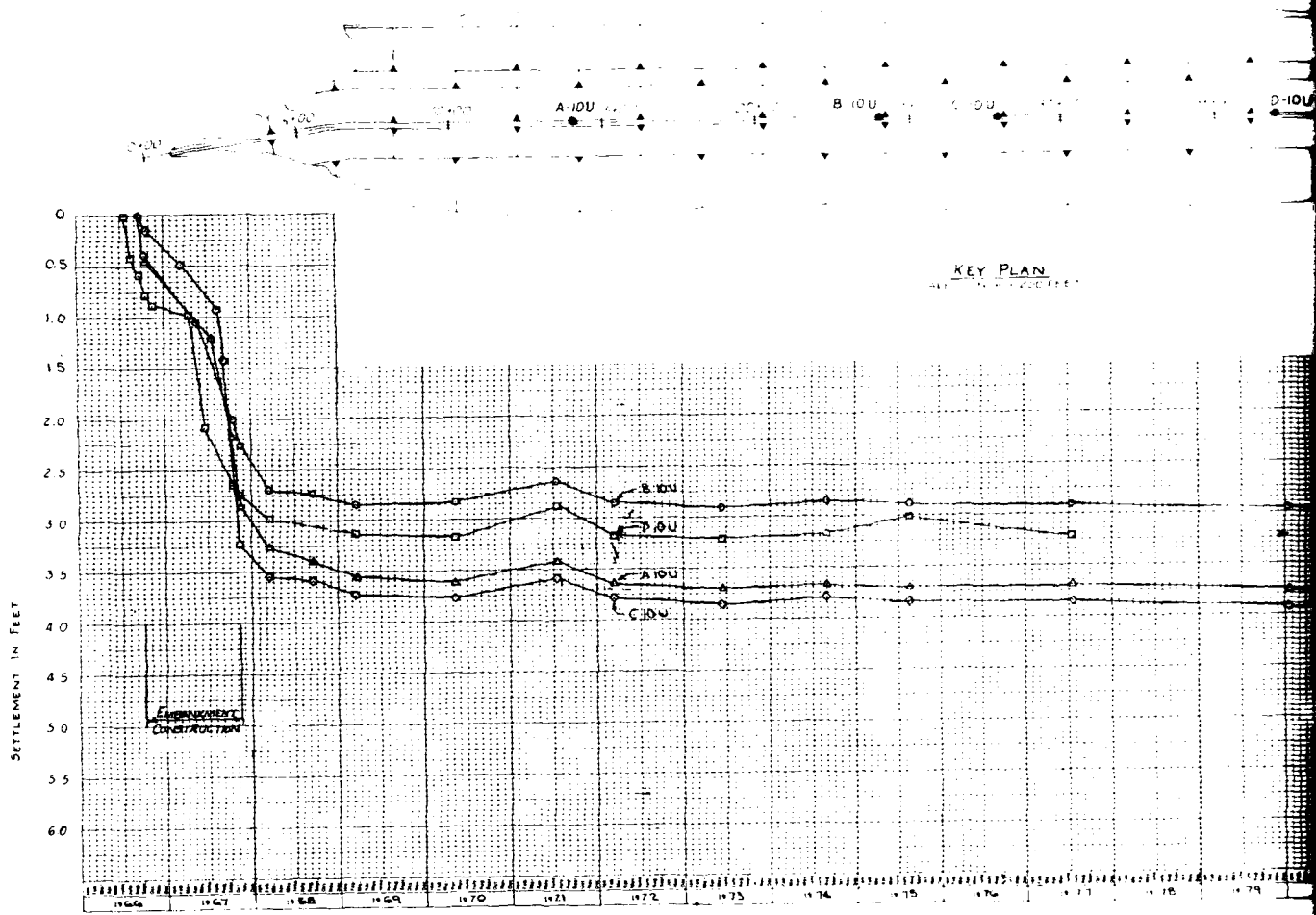
— — — — — IMPERVIOUS BACKFILL
— — — — — BENTONITE SEAL
— — — — — PERVIOUS SAND BACKFILL
— — — — — WELL POINT

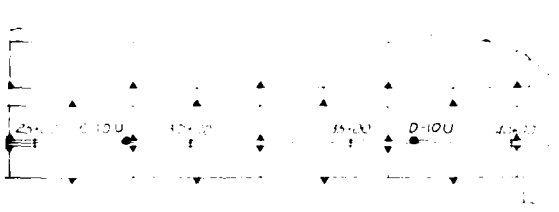
ELEVATION IN FEET - 2.0



NOTE
See Plate C-6 for Reservoir Elevation
2 PIEZ. PRESSURE TESTED MAR. 17, 1964

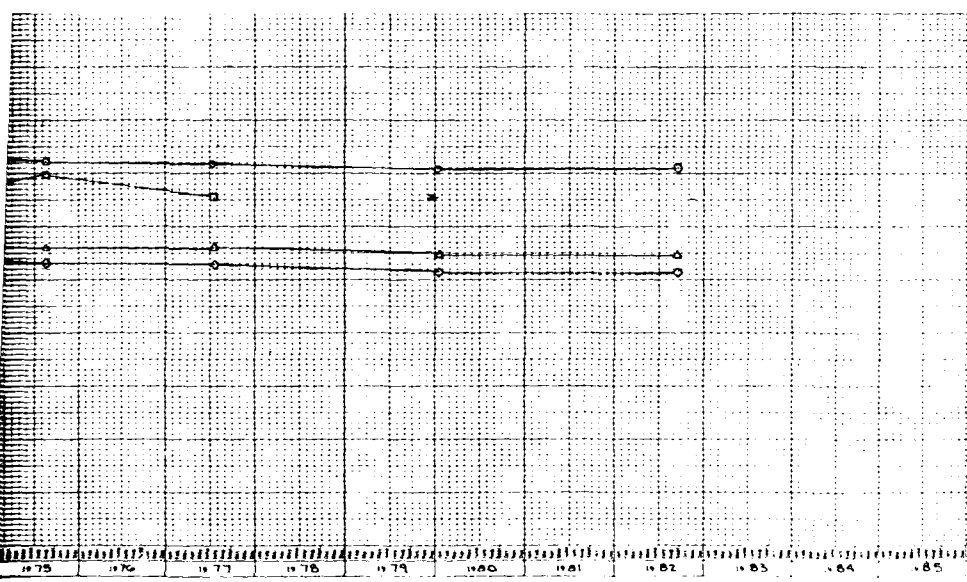
| | | | | | |
|--|---------------------------------------|-----------------|----------|-----------------|----------|
| DATE | | REVISIONS | | NAME | APPROVED |
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | | | | | |
| DESIGNED BY: | SALT REEF AND ITS TOWNSHIP, NEBRASKA | | | | |
| DRAWN BY: | SITE 18 | | | | |
| CHECKED BY: | KRAMER, J. L. | | | | |
| QUANTITY BY: | DOWNSTREAM TOE ELEVATION OBSERVATIONS | | | | |
| DATE | DATE | DATE | DATE | DATE | DATE |
| APPROVED | APPROVED | APPROVED | APPROVED | APPROVED | APPROVED |
| BY: S. L. BERRY | | BY: S. L. BERRY | | BY: S. L. BERRY | |





Legend
 A-100 Settlement of slope

KEY PLAN
 SCALE 1" = 200 FEET

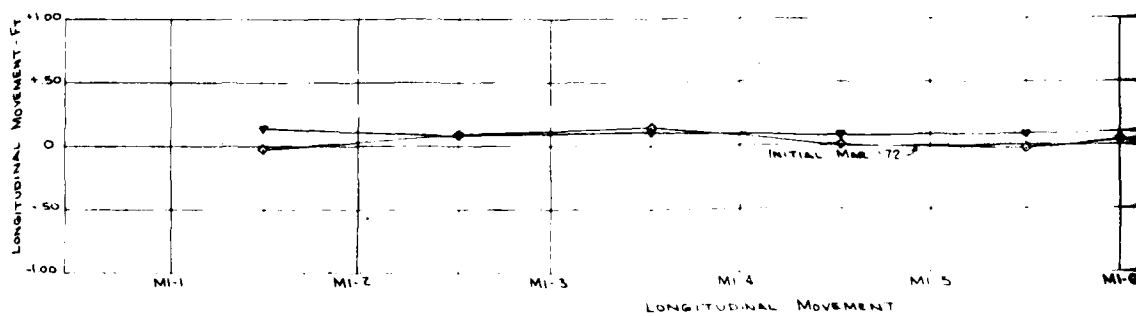
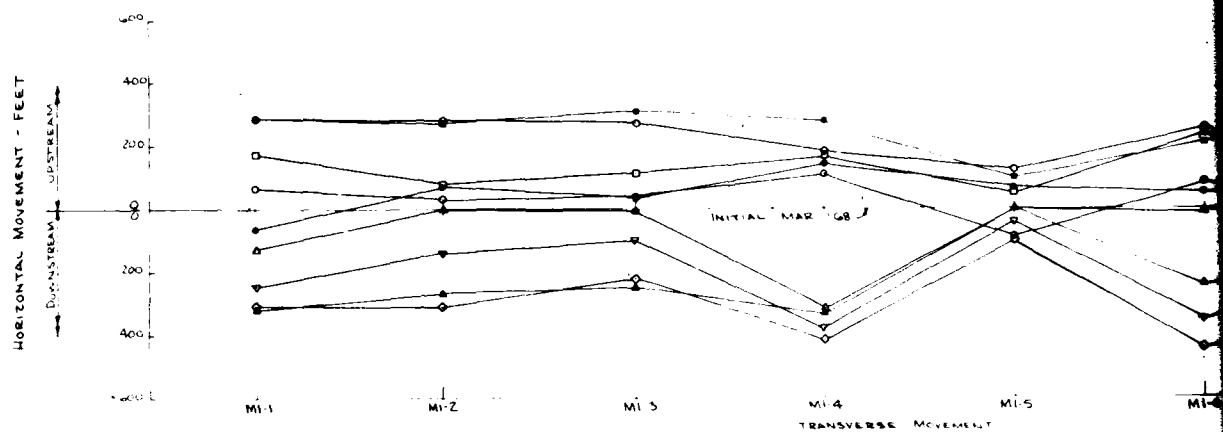
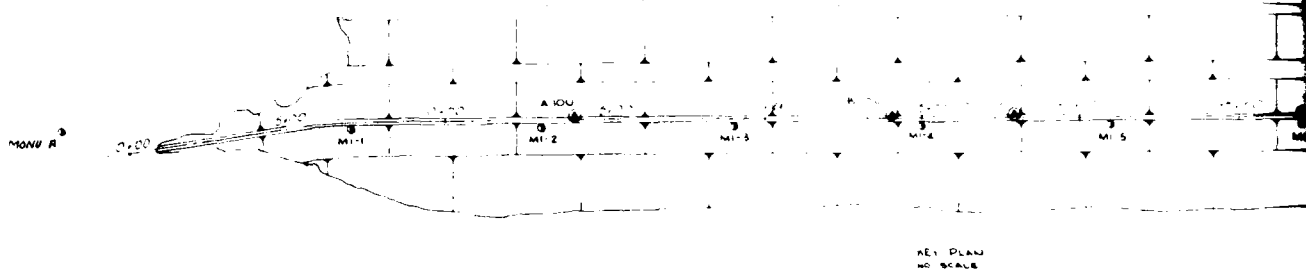


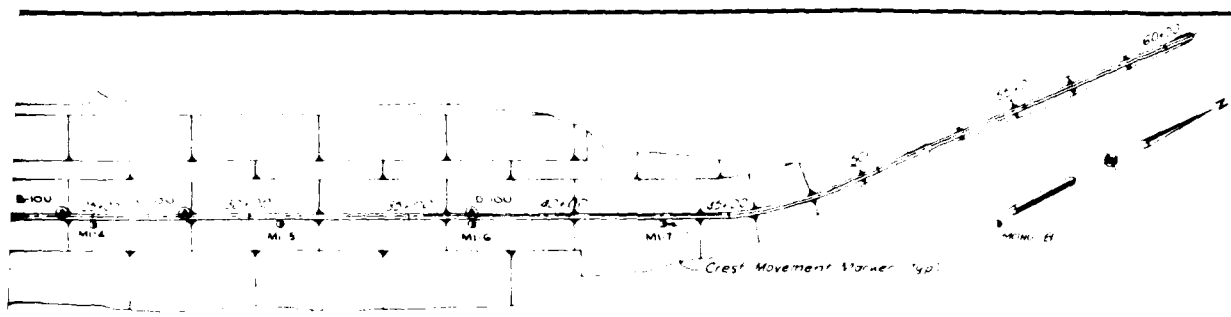
* D100 not surveyed Jan 80



THIS PLAN ACCOMPANIES CONTRACT NO. _____
 MODIFICATION NO. _____

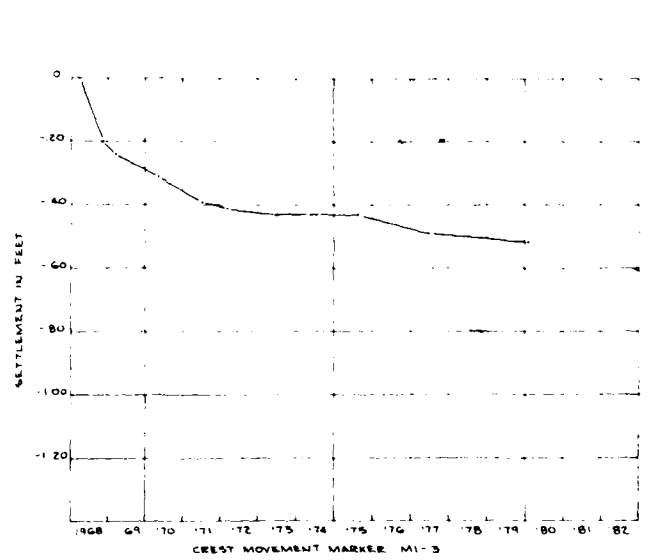
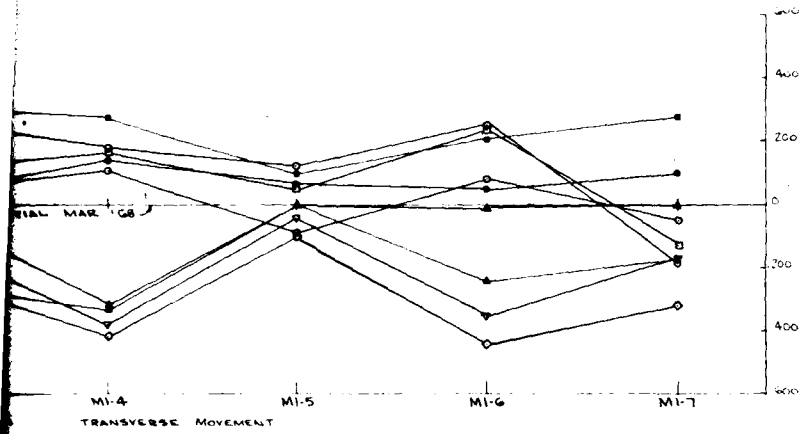
| | | | |
|--|--|-----------|----------|
| DATE | DESCRIPTION | DATE | APPROVED |
| REVISIONS | | | |
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | | | |
| DESIGNED BY | J. L. PIER AND J. L. TRANTER, NEBRASKA | | |
| PLANNED BY | BRANCHED OAK DAM & RESERVOIR | | |
| DRAWN BY | FOUNDATION SETTLEMENT DATA | | |
| RIGHTS BY | VERTICAL MOVEMENT | | |
| CHECK | SECTION | APPROVED | DATE |
| RECORDED | SECTION | APPROVED | DATE |
| CHECK | SECTION | APPROVED | DATE |
| APPROVED | SECTION | APPROVED | DATE |
| U. S. E. DISTRICT ENGINEER | | SHEET | |
| SCALE AS SHOWN | | SHEET NO. | |
| DRAWING NUMBER | | SHEET | |



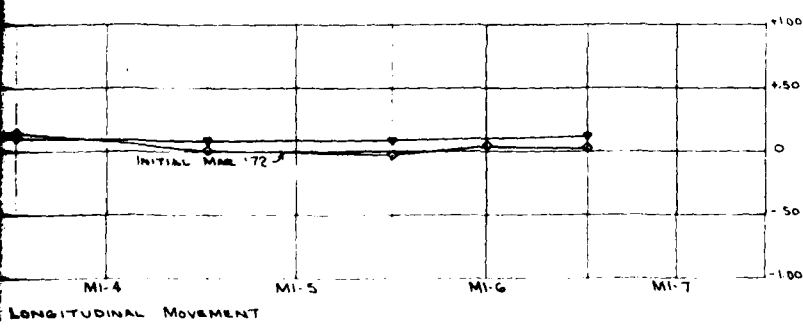


KEY PLAN
NO SCALE

LEGEND
 ○ CREST MOVEMENT MARKERS
 ● FOUNDATION SETTLEMENT MARKERS

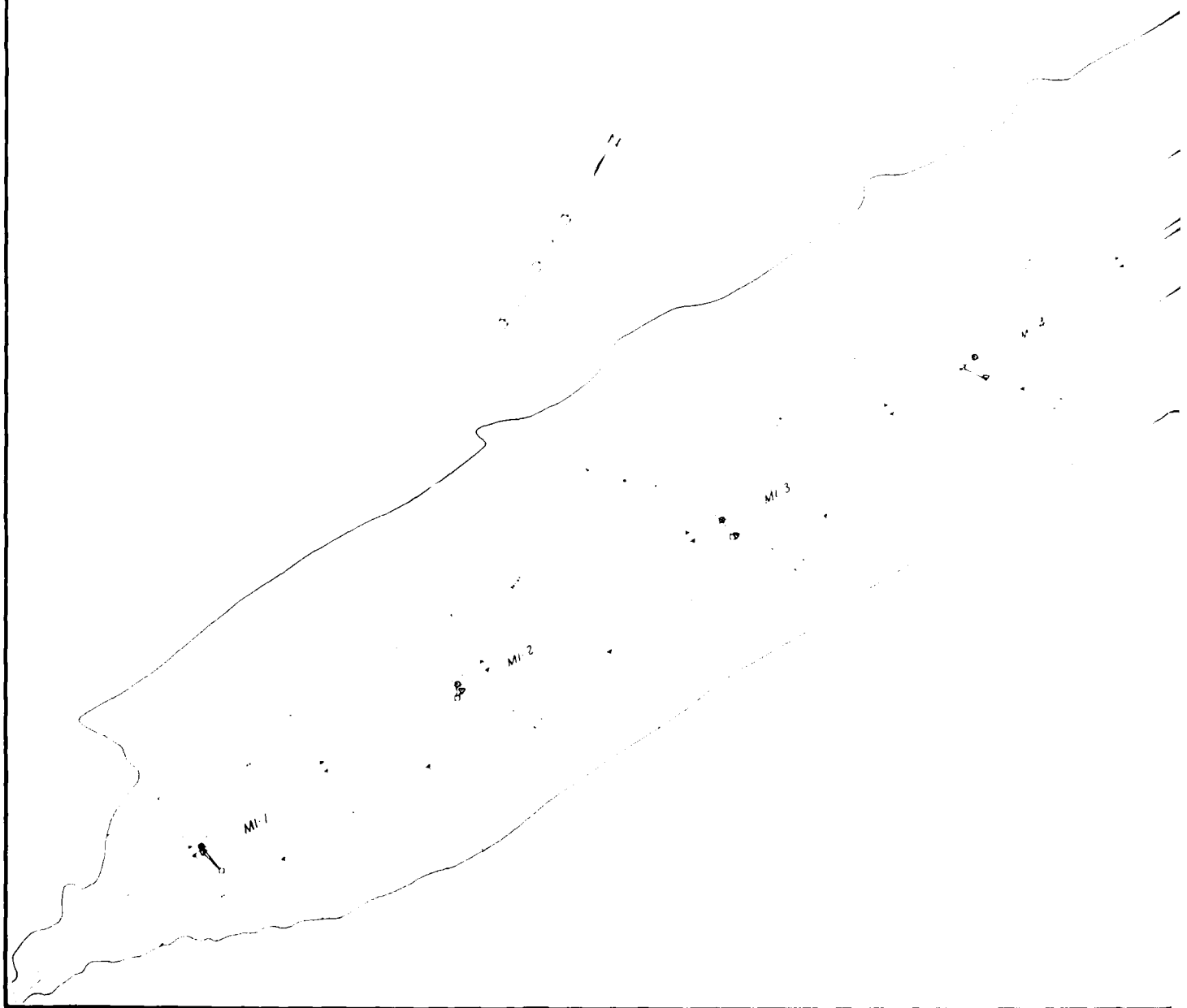


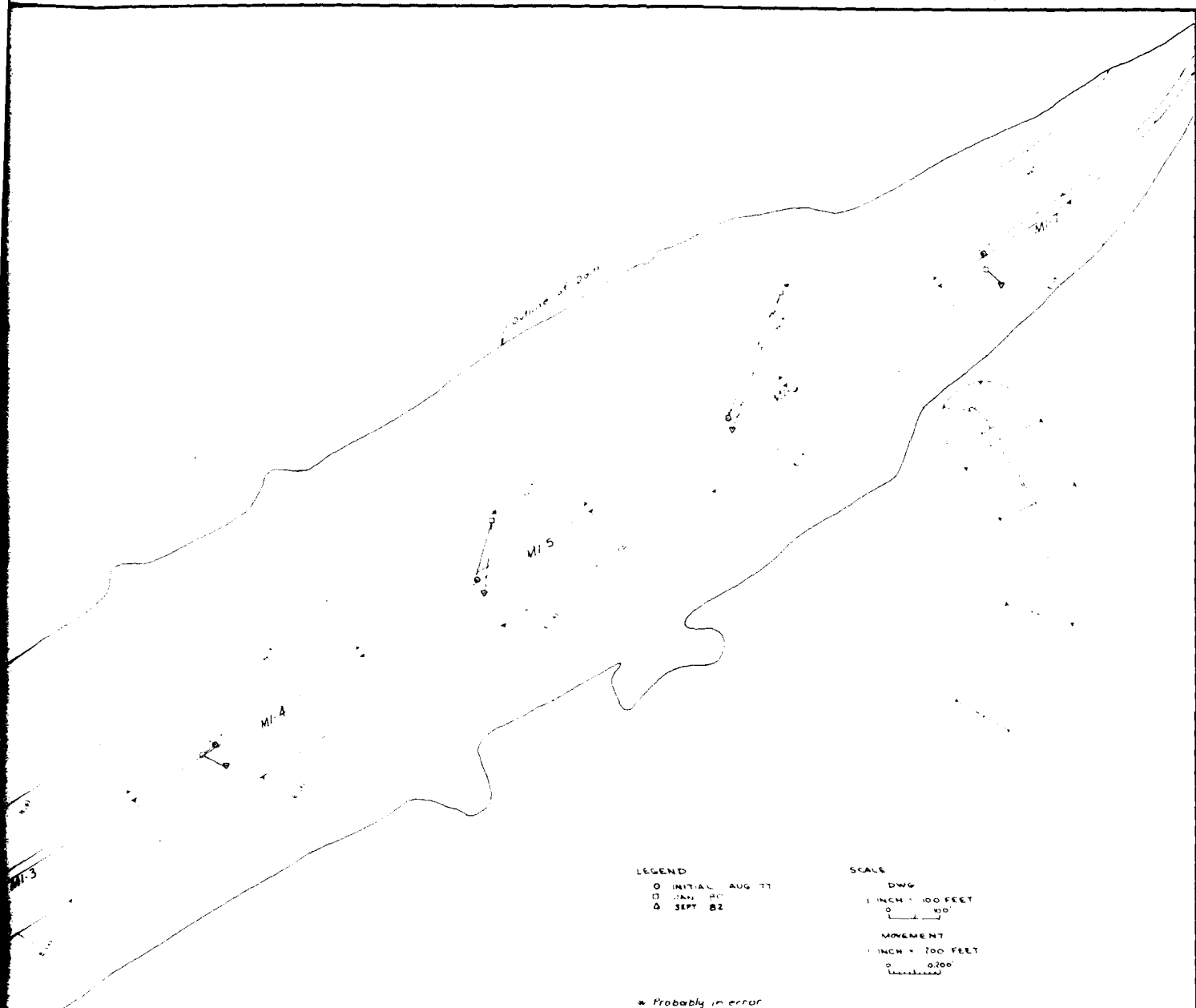
LEGEND
 ○ NOV '68
 ● MAR '69
 △ MAY '70
 □ JULY '71
 ○ MAR '72
 ● JUNE '73
 ○ AUG '74
 ● AUG '75
 △ JUL '77



THIS PLAN ACCOMPANIES CONTRACT NO. _____
MODIFICATION NO. _____

| | | | | | |
|--|----------|--|----------|-------------------------------------|----------|
| DATE | | REVISION | | DATE | APPROVED |
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | | | | | |
| DESIGNED BY | | SACT CREEK AND ITS TRIBUTARIES, NEBRASKA | | | |
| DRAWN BY | | BRANCHED OAK DAM & RESERVOIR | | | |
| CHECKED BY | | CREST MOVEMENT | | | |
| APPROVED BY | | LONGITUDINAL, TRANSVERSE / VERTICAL MOVEMENT | | | |
| DATE | APPROVED | DATE | APPROVED | DATE | APPROVED |
| DATE | APPROVED | DATE | APPROVED | DATE | APPROVED |
| U. S. ARMY ENGINEER DISTRICT, OMAHA | | U. S. ARMY ENGINEER DISTRICT, OMAHA | | U. S. ARMY ENGINEER DISTRICT, OMAHA | |





LEGEND

- INITIAL AUG 77
- MAY 80
- △ SEPT 82

SCALE

DWG
1 INCH = 100 FEET
0 100'

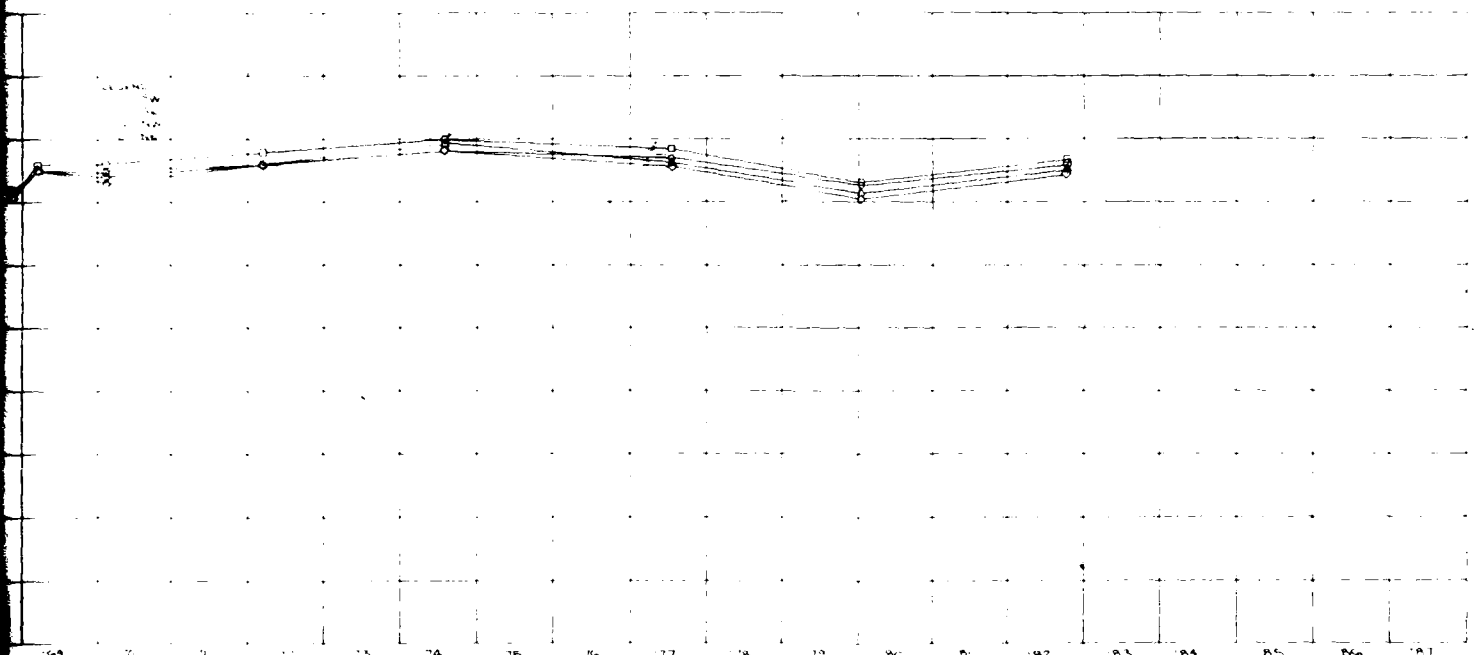
MOVEMENT
1 INCH = 700 FEET
0 700'

* Probably in error

| | | | | | |
|--|--|-------------|----------------------------|------|--------|
| DATE | | DESCRIPTION | | MADE | APPROV |
| REVISIONS | | | | | |
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | | | | | |
| DESIGNED BY | SALT CREEK AND ITS TRIBUTARIES, NEBRASKA | | | | |
| DRAWN BY | BRANCHED OAK DAM | | | | |
| CHECKED BY | CREST MOVEMENT MARKERS | | | | |
| SUBMITTED BY | HORIZONTAL MOVEMENT | | | | |
| DATE | BY | SECTION | APPROVED | DATE | |
| | | | CHIEF ENGINEERING DIVISION | | |
| APPROVED | SCALE AS SHOWN | SHEET NO. | DRAWING NUMBER | | |
| DR. S. C. BRYANT ENGINEER | | | SHEET | | |



THIS PLAN ACCOMPANIES CONTRACT NO.
MODIFICATION NO.

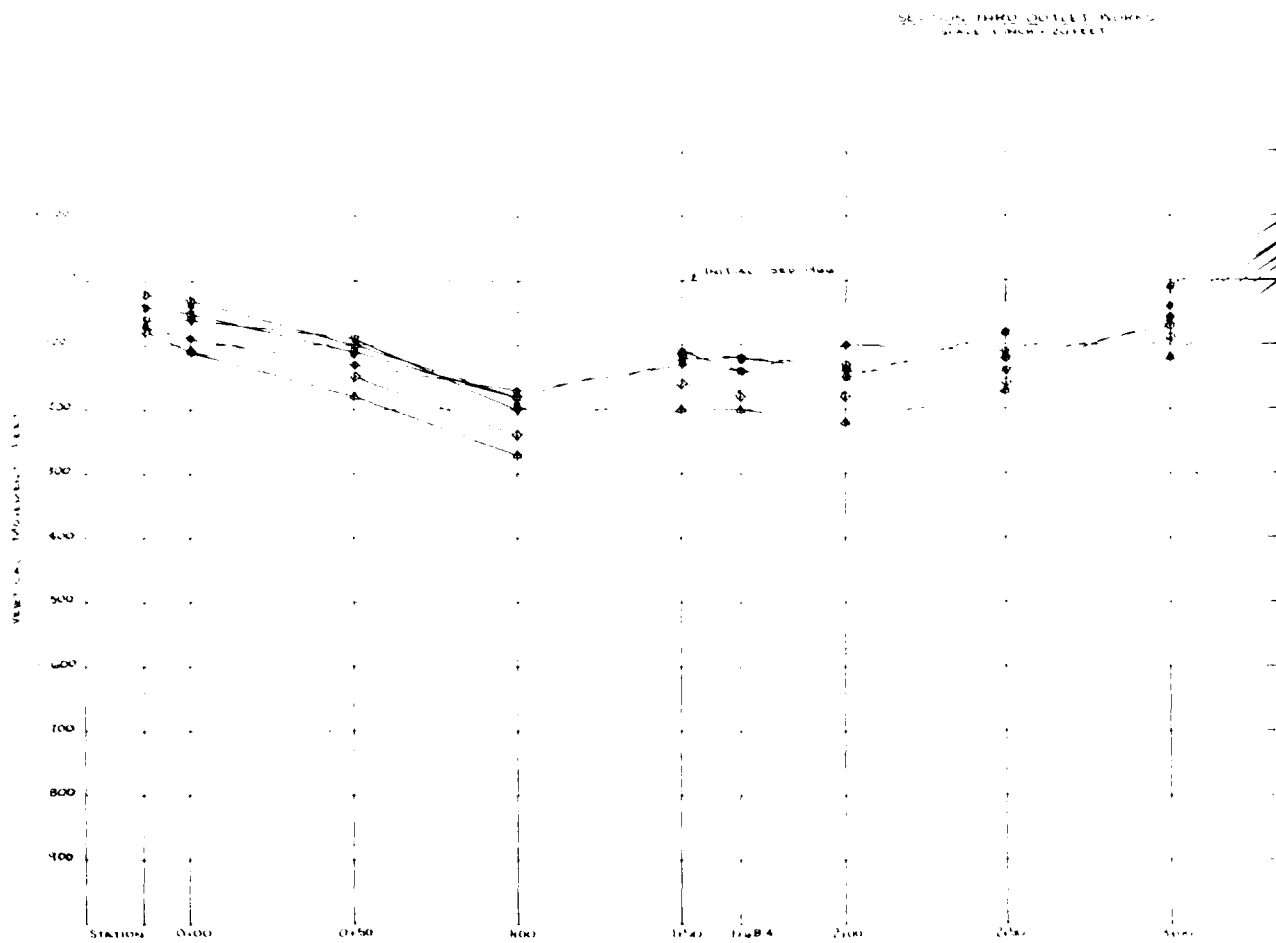
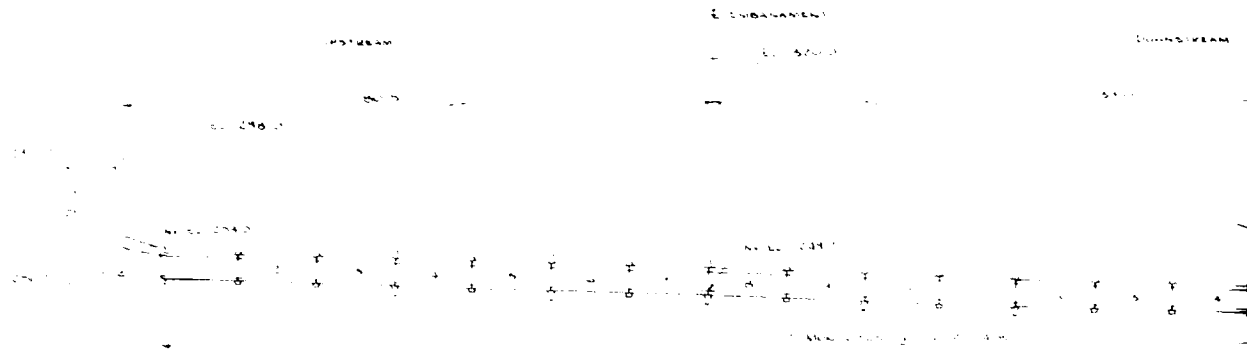


INTAKE STRUCTURE
VERTICAL MOVEMENT VS TIME



THIS PLAN ACCOMPANIES CONTRACT NO.
MODIFICATION NO.

| | | | | | |
|--|-------------------------------------|-------------|-------------|------|--------|
| DATE | | DESCRIPTION | | PAGE | APPROV |
| REVISIONS | | | | | |
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | | | | | |
| DESIGNED BY: | SALT CREEK AND ITS TRIBUTARIES NEBR | | | | |
| DRAWN BY: | SITE 18 | | | | |
| CHECKED BY: | BRANCHED OAK DAM | | | | |
| APPROVED BY: | INTAKE STRUCTURE | | | | |
| DATE | APPROVED | | DATE | | |
| SCALE AS SHOWN | SHEET NO. | | DRAWING NO. | | |



DOWNSTREAM

239.0'

EL. 1265.0

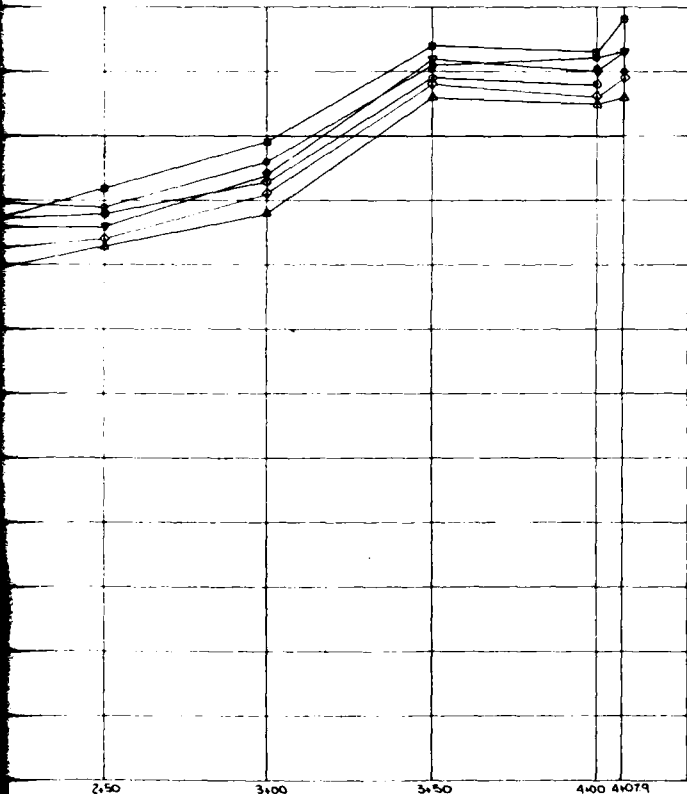
EL. 1248.0

Inv. EL. 1240.0

24' 0" 408'

SECTION THRU OUTLET WORKS

SCALE: 1 INCH = 20 FEET



LEGEND

- MAR 1967
- JAN 1968
- △ NOV 1968 (SURVEY ASSUMED TO BE IN ERROR)
- MAY 1970
- ◇ MAR 1972
- ◊ MAY 1974
- JUL 1977

NOTE
CONSTRUCTION SEP 1966 TO NOV 1967



THIS PLAN ACCOMPANIES CONTRACT NO.
MODIFICATION NO.

| | | | | | |
|--|----------|--|----|-----------|----------|
| DATE | | REVISIONS | | DATE | APPROVED |
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | | | | | |
| DESIGNED BY: | | SALT CREEK AND ITS TRIBUTARIES, NEBRASKA | | | |
| DRAWN BY: L. J. L. | | BRANCHED OAK DAM & RESERVOIR | | | |
| CHECKED BY: | | CONDUIT SETTLEMENT | | | |
| APPROVED: | | PROFILE | | | |
| DATE | APPROVED | DATE | TO | DATE | APPROVED |
| | | | | | |
| DESIGNED BY: | | CHECKED BY: | | APPROVED: | |
| | | | | | |
| DATE | | DATE | | DATE | |
| | | | | | |

EMBANKMENT CRITERIA AND PERFORMANCE REPORT (1963)

PLATE C15

177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194

See Plate C-5 for Outlet Works
and vertical movement profile



THIS PLAN ACCOMPANIES CONTRACT NO.
MODIFICATION NO.

| | | | | | |
|--|-----|---------------------------------------|-----|-----------------------------|----------|
| DATE | | DESCRIPTION | | MADE | APPROVED |
| REVISIONS | | | | | |
| U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA | | | | | |
| DESIGNED BY: | | SANTO LERK AND ITS SUBSIDIARIES, INC. | | | |
| DRAWN BY: | | SITE 18 | | | |
| CHECKED BY: | | BRANCHED OAK DAM | | | |
| EXAMINED BY: | | OUTLET WORKS - CONDUIT | | | |
| BY: | | METHOD: | | VERTICAL MOVEMENT HISTORIES | |
| DATE | BY: | APPROVER | BY: | DATE | |
| DATE | BY: | APPROVER | BY: | DATE | |
| SCALE AS SHOWN | | SHEET NO. | | | |
| SHEET NO. | | SHEET NO. | | | |

ATE
MED
-8