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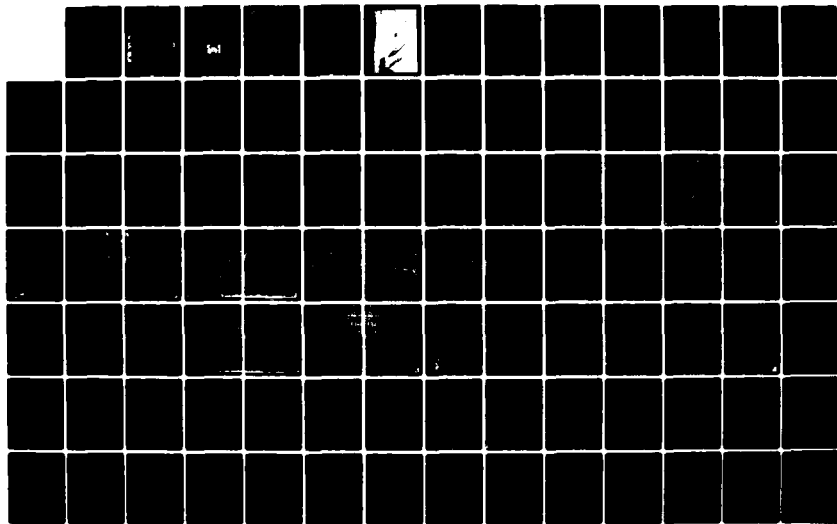
BROOKVILLE LAKE GREATER MIAMI RIVER BASIN INDIANA
EMBANKMENT CRITERIA AND PERFORMANCE REPORT(U) ARMY
ENGINEER DISTRICT LOUISVILLE KY SEP 82

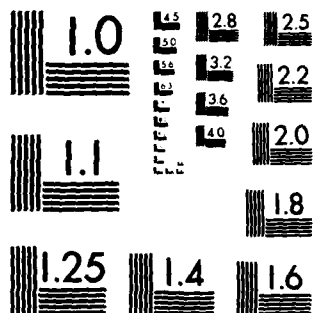
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The embankment criteria and performance report provides a summary record of significant design data, design assumptions, design computations, specification requirements, construction equipment, construction procedures, construction experience, field control and record control test data and embankment performance as monitored by instrumentation during construction and during initial lake filling.		

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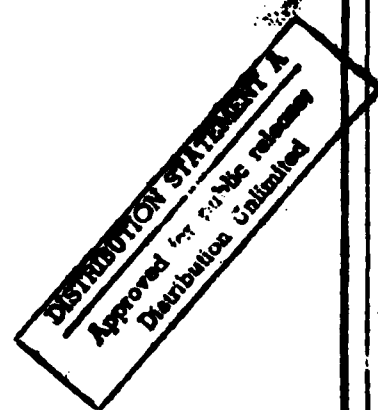
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**BROOKVILLE LAKE
GREATER MIAMI RIVER BASIN
INDIANA**

**EMBANKMENT CRITERIA AND
PERFORMANCE REPORT**



**PREPARED BY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS**

SEPTEMBER 1982

88 04 18 034



DEPARTMENT OF THE ARMY
LOUISVILLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 59
LOUISVILLE, KENTUCKY 40201

ORLED-G

6 April 1983

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for *PH Hasselwander*
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BROOKVILLE LAKE
EAST FORK WHITEWATER RIVER
INDIANA

EMBANKMENT CRITERIA
AND
PERFORMANCE REPORT

Prepared by
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS

SEPTEMBER 1982

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Aerial View of Brookville Lake (20 Mar 75)

BROOKVILLE LAKE
EAST FORK WHITEWATER RIVER, INDIANA
EMBANKMENT CRITERIA AND PERFORMANCE REPORT

Table of Contents

<u>Paragraph No.</u>	<u>Paragraph Title</u>	<u>Page No.</u>
	Pertinent Data	1
1.	General	1
	a. Authority	1
	b. Project Purpose	1
	c. Project Location	1
	d. History of Construction	1
2.	Site Geology	8
	a. General	8
	b. Valley Deposits	9
	c. Bedrock	9
3.	Foundation and Abutment Treatment	10
	a. Valley	10
	b. Abutments	10
4.	Embankment	10
	a. General	10
	b. Slope Stability	11
	c. Seepage Control	12
5.	Instrumentation	14
	a. Settlement Plates	14
	b. Movement Monuments	14
	c. Piezometers	14
	d. Instrumentation Evaluation	14
	(1) General	14
	(2) Piezometers	16
	(3) Relief Wells	17
	(4) Movement Monuments	17
6.	Construction Notes	17

BROOKVILLE EMBANKMENT CRITERIA AND PERFORMANCE REPORT

Plates

<u>No.</u>	<u>Title</u>
1-4	Site Plan
5	General Plan
6	Rock Contours
7-8	Geologic Profile of Dam
9	Grouting Plan & Profile
10	Isopach of Colluvium Along Right Bank
11-13	Boring Location Plan
14-15	Typical Section
15A	Additional Horizontal Drains
15B	Revision of Horizontal Drain
15C	Temporary Dike
16	Geologic Sections & Location Map
17	Flow Meter & Permeability Data, Drawdown Curve & Detail of Pump Well
18	Toe Drainage System - Plan
19	Toe Drainage System - Profile
20	Piezometer Installations
21	Instrumentation Plan
22-34	Piezometer Plots
35	Relief Well Plots
36	Relief Well Soundings
37-41	Movement Monument Plots
42-51	Field Control Test Locations
52	Summary of Field Compaction Control Test Data & Design Placement Requirements

Tables

<u>No.</u>	<u>Title</u>	<u>Page No.</u>
1	Adopted Shear Values	12A
2	Summary of Minimum Safety Factors for Arc Method of Analysis	12B
3	Summary of Minimum Safety Factors for Block and Wedge Method of Analysis	12C

5. Lake.

<u>Item</u>	(feet MSL)	Acres	Acre Feet	Inches Runoff
Minimum pool	713	2,250	55,600	2.75
Water supply pool	740	4,510	144,900	7.17
Seasonal pool	748	5,260	184,900	9.10
Flood pool	775	7,790	359,600	17.79
Allocated to flood storage	740-775	3,280	214,700	10.62
Allocated to seasonal flow regulation	740-748	--	39,100	1.93
Allocated to water supply	713-740	--	89,300	4.42

6. Dam.

a. Embankment.

Type	Earthfill
Top elevation	809
Maximum height, feet	181
Length, feet	2,900
Top width, feet	30

b. Spillway.

Type	Open cut through right abutment
Crest elevation	775

c. Outlet Works.

Type	Circular - concrete
Diameter, feet	12
Control gates, number, size, feet	2 service, 2 emergency 5.25 x 12 (service) 5.25 x 12 (emergency)
Invert elevation to outlet works	630

7. Land Acquisition.

Fee, acres	11,050
------------	--------

8. Relocations.

a. State Highways	Indiana 101, 8.8 miles Indiana 44, 0.5 mile
b. County Roads	Franklin County, one location, 3.9 miles Union County, nine locations
c. Electric, telephone, & other related utilities as required	

9. Public Access.

No. of Sites	7
--------------	---

10. Lake Clearing.

Area, acres

840

11. Hydroelectric Power.

UNIT ADDED ON
NOT OPERATIONAL YET

12. Annual Charges.

\$1,305,000

13. Annual Benefits.

a. Flood control

\$ 795,000

b. Recreation

1,047,000

Total

\$1,842,000

14. Ratio, Benefits to Cost.

1.4 to 1

15. Construction Time.

4 years

BROOKVILLE DAM
EAST FORK OF WHITEWATER RIVER, INDIANA
EMBANKMENT CRITERIA AND PERFORMANCE REPORT

1. General.

a. Authority. Authority for preparation of the Embankment Criteria and Performance Report for Brookville Dam is contained in ER-1110-2-1901, dated 1 Aug 72.

b. Project Purpose. Brookville Lake is a unit in the comprehensive plan for flood control and allied purposes in the Ohio River Basin. Operation of the lake will reduce flooding along the Whitewater River and through the City of Brookville on the East Fork and contribute to reduction of flooding along the short section of the Miami River before its entrance into the Ohio River.

c. Project Location. The project is located at Brookville, Indiana, in the southeast corner of the State about 60 air miles southeast of Indianapolis. The damsite is 35 air miles northwest of Cincinnati, Ohio, and 90 air miles northeast of Louisville, Kentucky. The lake area lies in Franklin, Fayette, and Union Counties, with its upper extremity near the southern border of Wayne County. The drainage area above the dam is 379 square miles. At the spillway crest level, elevation 775, the lake extends upstream from the dam a distance of 21 miles. The site plan is shown on Plates 1-4.

d. History of Construction. Contract DACW27-70-C-0079, Construction of Dam and Spillway, Brookville Reservoir, East Fork Whitewater River, Indiana, was awarded on 31 March 1970 to Guy H. James Construction Co. of Oklahoma City, Oklahoma, and notice to proceed was received on 25 April 1970. The contract was accepted as being physically complete on 5 June 1975.

Work began with some survey work on 30 April 1970 and clearing started on 27 May 1970, and stripping began on 16 June 1970.

The following is a compilation of significant starting dates.

27 May 1970	Started stripping dam foundation
7 July 1970	Change in horizontal drain Sta. 16+00 to 23+50 (Mod #1)
8 July 1970	Started placing embankment
23 July 1970	Changed granular material to random incline drain to centerline Sta. 10+00 to 21+00
28 July 1970	Started placing piezometers
24 Aug 1970	Started 2nd shift
16 Sept 1970	Started grouting lt. abutment
22 Sept 1970	Started excavation for toe drain system
23 Oct 1970	Started drilling relief wells
18 Dec 1970	Shut down embankment placement for winter
9 April 1971	Started placing embankment again
3 May 1971	Started excavating spillway

5 May 1971	Started excavating retreat channel
11 May 1971	Started excavating intake channel
17 Dec 1971	Shut down embankment placement for winter
3 April 1972	Started placing embankment again
8 July 1972	Diverted stream through outlet works
13 Nov 1972	Shut down embankment placement for winter
19 & 20 Dec 1972	Built shale dike on dam embankment to el. 717 protection
28 April 1973	Started placing embankment again
13 Oct 1973	Ended 2nd shift
16 Oct 1973	Embankment placement completed
5 June 1975	Job accepted as being physically complete

FOUNDATION AND ABUTMENT TREATMENT

a. Stripping. The foundation and required excavation extending 2,000 feet upstream of the toe of the dam was stripped of topsoil to clay or granular material. The topsoil was used in the 4-foot compacted earth slope protection on the downstream side of the dam.

b. Streambed. See Photos 5 through 7. The area of the first bottom and streambed excavation was stripped to undisturbed granular or

rock. The best of the material in this area was used in the random area while some materials had to be placed in the waste area below the dam.

c. Right Abutment. This area was very steep and was stripped with a frontend loader just ahead of the fill.

d. Cutoff Trench. The cutoff trench was cut to the top of the unweathered limestone and shale under the impervious core on both abutments. After grouting, the limestone ledges were swept clean just prior to placement of the impervious fill. See Photo Nos. 2 and 7.

e. Grouting. The grouting consisted of a single line grout curtain within the abutments beneath the cutoff trench. A horizontal distance of approximately 640 feet on the left abutment and approximately 620 feet on the right abutment was grouted. The drilling and grouting was done by zones, using the split spacing, stage grouting method with two zones. The primary holes were spaced on 20-foot centers and were drilled 20 degrees landward from vertical. The split spacing method was used for placing the secondary and tertiary holes, which were drilled and grouted as necessary at the direction of the field personnel. Due to the nature of rock, thin beds of limestone within shale, grouting pressure was 5 p.s.i. maximum. In the cutoff trenches, the soft shale created by the exposure period was removed to the limestone ledges after grouting. The final cleanup of the rock surface was performed just prior to the initial impervious placement.

f. Dewatering. In order to dewater the streambed, which is sand and gravel, a deep well was drilled 200 feet downstream of Station 23+75. The well was pumped continuously and dried up the area to just below the surface. To check the results of this method, three test pits were dug after 6 feet of material had been placed. The pervious contact was found to be in good condition.

g. Blanket Area. The required stripping upstream of the dam embankment was cut to clay or elevation 637 in the area of the blanket. Where the clay was encountered above 637, the area was drilled 6 feet deep on a 100-foot grid to make sure of a good cutoff. Granular material was not encountered in any borings.

h. Slides. Two slides developed on the right abutment in the dam foundation. The first was on 8 October 1970 on the upstream side of the cutoff trench Sta. 25+00 to 26+00+ during the excavation of the cutoff trench. The second slide developed during placement from the downstream side of the cutoff trench extending downstream to the toe of the dam Station 27+00 to 29+00+ on 7 May 1973. All loose material was removed to the slide plane as the embankment was placed. Photographs of these slide areas are included with the foundation report.

i. Material Quantities (Excavation).

(1) Stripping dam foundation	3,631,000 cu. yd.
(2) Spillway and channel	2,137,000 cu. yd.
(3) Borrow	2,235,000 cu. yd.
(4) Intake channel slide	11,000 cu. yd.
(5) Spillway channel slide (Right side)	8,000 cu. yd.
(6) Dam right abutment slide	20,000 cu. yd.

All useable material was placed in the dam. There was no separate computation for amounts placed in impervious, random granular or waste below dam in old streambed as all compacted fill with the exception of

filter zones was one bid item. A total of 6,574,000 cu. yds. of compacted embankment was placed.

EMBANKMENT

a. Sources of Embankment Materials. The materials used for construction were obtained from required excavation, spillway, retreat channel, intake channel and toe drainage system, and borrow area upstream of the dam. All areas produced some impervious, granular, and random materials with the bulk of random rock from the spillway and minor amounts from the intake and retreat channels.

b. Material was hauled to the dam in Caterpillar Models 666 and 647 scrapers with the exception of the incline drain material which was trucked to the site.

(1) Zone 1. Impervious material was spread in 8-inch layers with dozer blade and disc, wet or dried to within 2 percent $\pm$ of optimum moisture content and compacted with six passes of a Ferguson Self-Propelled Sheepsfoot roller.

(2) Zone 3. Granular materials were placed on the fill then spread and leveled in 8-inch layers with an A16 grader and compacted with four passes of a self-propelled 50-ton pneumatic (Lopland Choate) roller. In some instances when both 50-ton pneumatic rollers were broken down, a self-propelled vibrating (Tampo) roller was used to compact the lift until repairs could be made on one of the pneumatic rollers.

(3) Zone 2. Filter Drainage. The horizontal layer was hauled in scrapers, spread with a 16 grader in 8-inch layers and compacted with a self-propelled (Ferguson or Shovel Supply Co.) vibrating roller. The

sand for the inclined sand drain was hauled in trucks and dumped in small piles in the inclined drain and spread with a small dozer in 8-inch lifts and compacted with a minimum of four passes with a self-propelled vibrating roller. When additional moisture was needed to obtain the desired compaction, a water truck with a spray bar would be driven slowly on the inclined drain followed closely by the self-propelled vibrating roller. See Photos 9, 10, and 11. The material for the filter drain was processed on the jobsite.

(4) Zone 4. Random Material. These materials were mostly granular and compacted as the granular above. Some of the material had silts and clays and had to be compacted with a sheepsfoot roller as described above.

(5) Zones 7 & 8. Rock Material. This consisted of shale with thin interbedded limestone beds and was spread in 8-inch layers and compacted with six passes of the sheepsfoot roller which broke the limestone into small pieces and pulverized the shale. This layer was also compacted with two passes of a 50-ton rubber-tired roller.

SEEPAGE CONTROL

There was a little seepage on the right abutment which caused several slides. Also, some seepage was encountered in the excavation for the drainage gallery.

DIVERSION AND CLOSURE

The inlet and retreat channels were excavated during the 1971 construction season with final completion of the intake channel prior to the diversion of the stream and start of completion of the closure dam on 8 July 1971. No problems were incurred in the diversion of the stream.

2. Site Geology.

a. General. At the damsite, the valley walls stand on moderately steep slopes with shale only a few feet from the surface, as shown on the geologic profile of the dam, Plates 7 and 8. The right abutment slope is steeper than the left. The difference in slopes is due to the westward dip of the rock which dips from the left abutment to the right. The left abutment is 4 horizontal to 1 vertical and the right abutment slope is 3 horizontal to 1 vertical. The bottom lands are divisible into two parts, a flood plain roughly 15 feet above the river and a higher terrace at elevation 680, some 50 feet above the river. The bedrock profile drops off rapidly under the glacial outwash which has a thickness of 160 feet at its deepest point.

Prior to the Illinoian glacial stage, the bedrock valley was cut by preglacial rivers of considerable size. During the Illinoian glacial stage, the valley was partially filled with glacial till and outwash deposits; also, a thin layer of till was deposited on the uplands. Preceding and during the Wisconsin glacial stage, the bulk of the Illinoian deposits were stripped from the valley and uplands. During the advance of the Wisconsin ice sheet, till was deposited on the hills and in the valley. The bulk of the till was in the valley. During a subglacial ice retreat, outwash sands and gravels were deposited on the till in the valley. A thin till, 3 to 15 feet thick, was left on the hilltops. At a later stage in the Wisconsin, the stream was

reentrenched to bedrock on the right bank leaving a 600-foot wide flood plain. It was during this time that the clay till in the valley between elevation 643 and 633 was truncated at Station 21+50. Also at this time, a landslide occurred along the toe of the right abutment. The slide material is highly weathered shale and clay with interbedded limestone which slid from the steep right abutment slope. During the last retreat of the Wisconsin glacier, the entrenched flood plain was filled with outwash sand and gravel. Thick deposits of glacial till (60 feet +) can be found along tributary streams where the bedrock valley walls protected the till. A good example of this can be found at the toe of the left abutment on the hillside of Highway 101. The clay till, with sand and gravel seams, extends from 500 feet upstream of the centerline of dam to the tributary 1,200 feet downstream from the centerline.

b. Valley Deposits. The 160 feet of valley deposits are essentially outwash sand and gravel with lenses of impervious clay till as shown on the geologic profile of the dam, Plates 7 and 8. Overlying bedrock is 110 feet of pervious sand and gravel with boulder and cobble size glacial erratics. Overlying the pervious sand and gravel is 20 to 30 feet of impervious silty gravelly clay till. The clay till is fairly uniform in thickness beneath the centerline of dam from the left abutment to the present flood plain, Station 21+50+. Top of till varies from elevation 640 to 660. Beneath the flood plain, the clay till has been eroded out by glacial melt waters and replaced by outwash sand and gravel.

c. Bedrock. Bedrock at the damsite consists of Ordovician interbedded calcareous clay shales and hard limestones of the Cincinnati Series. The geologic columnar section, Table 1, D.M. No. 4, was taken from the right abutment.

3. Foundation and Abutment Treatment.

a. Valley. The dam was founded on four different types of foundations. The foundation between Stations 0+00 and 7+50 and Station 27+00 and end of dam consists of lean clay overlying bedrock. The foundation between Stations 0+50 and 21+00 consists of a thin strata of lean clay overlying 10-70 feet of sand and gravel, 35-40 feet of clay till, and up to 60 feet of sand and gravel. Between Station 21+00 and the right abutment, the till had been removed and the embankment was set on sand and gravel for about 200 feet. The remainder of the embankment was set on a variable depth of colluvial material overlain by sand and gravel.

b. Abutments. The abutments have 5 to 15 feet of residual clay overlying bedrock. The left abutment has 10 to 15 feet of residual clay and the right abutment has 5 feet. The top 10 to 20 feet of shale is highly weathered with some thin limestone beds. This highly weathered shale was removed beneath the cutoff trench. A grout curtain was installed to cut off any seepage that might develop through the highly jointed thin limestone beds. A 20-foot center to center single line grout curtain was installed from Station 2+26 to Station 8+25 in the left abutment and Station 26+75 to the right bank of the spillway. The grout curtain is 40 feet deep and was grouted as a single zone. The holes were angled 20 degrees into the abutments and all holes were drilled from the cutoff trench except the spillway holes which were drilled from bottom of excavation. No grout was placed above spillway crest.

4. Embankment.

a. General. Top of dam is elevation 809 and height of dam is approximately 181 feet above streambed. The basic dam section consists

of symmetrical 1 vertical on 3 horizontal exterior slopes with a 30-foot top width. It has an interior upstream impervious sloping core. The core has an interior slope of 1 vertical on 1.5 horizontal and an exterior slope of 1 vertical on 2.2 horizontal. The upstream shell is compacted granular fill and the portion of the dam downstream of the core is compacted random rockfill and compacted granular fill. (See PLATES 14 and 15 for details.) A 100-foot wide upstream berm was constructed at elevation 700 between Stations 21+00 and 23+60. Both upstream and downstream, 200-foot wide berms were constructed at elevation 700 between Stations 23+60 and 25+60. A filter drain was placed on the downstream side of the impervious core. The inclined drain has an 8-foot horizontal thickness and the horizontal drain is 3 feet thick. The top of the drain is elevation 775, Spillway Crest. The downstream slope is protected by a 4-foot thickness of rock from the spillway excavation. Protection against wave wash of the upstream slope was accomplished by a 2-foot thickness of 150 pound maximum size quarry stone between elevation 710 and 809. A 4-foot thickness of rock from the spillway excavation provides protection below elevation 710. Specifications required that the impervious material be compacted by at least six passes over each 6-inch lift with a sheepsfoot roller. The granular materials were compacted by at least four passes over each 6-inch lift with a 50-ton rubber tired roller.

b. Slope Stability. Laboratory testing for the foundation and impervious embankment materials was done by the Ohio River Division Laboratories, Cincinnati, Ohio. Testing of granular material was performed by the South Pacific Division Laboratories, Sausalito, California. Materials were subjected to shear, consolidation, compaction, permeabilities, and tests associated with classification. A limited number of degradation studies were made on the granular materials. One boring from the spillway area was subjected to shear, wetting and drying, and freeze and thaw tests.

The adopted shear strengths used in the design of the dam are shown in Table 1. Both the arc and block and wedge method of analysis were used for the design. The procedures outlined in Appendix III and IV of EM 1110-2-1902, dated 27 December 1960, were followed for this design. Sections were analyzed at Stations 10+40, 15+00, 23+00, and 25+45 by both methods of design. Tables 2 and 3 list the minimum safety factors for all cases and for both methods of analysis. Stability analysis plates are located in Appendix V, D.M. No. 4. The stability analyses were run with top of dam at elevation 805. Subsequent to the analysis, the top of dam was raised 4 feet to elevation 809. However, the additional height would reduce the factors of safety only slightly, thus the analyses were not rerun. Also, more recent stability criteria would result in using a combined strength envelope for steady seepage, but, it is not considered necessary to reanalyze the dam.

c. Seepage Control. The dam impounds 112 feet of water at water supply pool, elevation 740. This coupled with a deep pervious foundation indicated seepage losses with a possibility of these being dangerous if not controlled. Essentially, control measures consist of blankets, cutoffs, relief drains, and relief wells. A geological profile along the axis of the dam (presented on Plates 7 and 8) indicated a low rock elevation of 518 as found by seismic explorations. Consideration was given to a positive cutoff to rock. At a conference held with ORD and OCE personnel, it was determined that such treatment was not necessary or economically feasible. Studies of seepage characteristics and quantities were made by using the till horizon, where found, to serve as a marker and impervious zone within the pervious materials. It was found that minor amounts of water moved through the deep foundation below the till when compared with the seepage potential of the sand and gravels above the till. An impervious blanket was provided upstream of the dam for a distance of 2,500 feet from the centerline. The blanket is 10 feet thick at the dam and slopes to 5 feet thick at the upstream end.

TABLE NO. 1

ADOPTED SHEAR VALUES

Material	Moist Wt. lbs/ft ³	Sat. Wt. lbs/ft ³	Sub. Wt. lbs/ft ³	Shear Data		
				Type Test	Tan ϕ	C T/SF
Embankment Compacted Impervious Fill	123.0	127.5	65	Q	0.000	0.90
				R	0.300	0.45
				S	0.450	0.00
Embankment Compacted Pervious Fill	125.0	127.5	65	Q	0.650	0.00
				R	0.650	0.00
				S	0.650	0.00
Foundation Lean Clay	125.0	127.5	65	Q	0.100	0.90
				R	0.300	0.40
				S	0.530	0.00
Foundation Glacial Till	--	--	65	Q	0.000	1.38
				R	0.420	0.70
				S	0.550	0.00
Foundation Colluvial Clay	--	--	65	Q	0.026	0.86
				R	0.340	0.30
				S	0.300	0.00
Foundation Sand & Gravel	--	--	65	Q	0.650	0.00
				R	0.650	0.00
				S	0.650	0.00

TABLE NO. 2

SUMMARY OF MINIMUM SAFETY FACTORS
FOR ARC METHOD OF ANALYSIS

Station	UPSTREAM SLOPE			DOWNSTREAM SLOPE		
	After Const.	Draw- down	Partial Pool	Steady Seepage		After Const.
				"R"	"S"	
10+40	1.42	1.13	1.52 Pool @ El. 713	1.54	1.68	1.27
15+00	1.31	1.41	--	1.75	1.63	--
23+00	1.36	1.20	1.57 Pool @ 713	1.84	1.84	1.87
25+45	1.25	1.20	1.57 Pool @ 713	1.77	1.53	1.27
Berm Slope @ 25+45	1.35	1.39	--	2.00	1.49	1.88

TABLE NO. 3

SUMMARY OF MINIMUM SAFETY FACTORS
FOR BLOCK AND WEDGE METHOD OF ANALYSIS

Station	UPSTREAM SLOPE						DOWNSTREAM SLOPE		
	Through Core			Through Sand and Gravel			Steady Seepage		After Const- ruction
	After Const.	Draw-down	Partial Pool	After Const.	Draw-down	Partial Pool	"R"	"S"	
10+40	1.52	1.47	1.70 Pool @ 713	1.56	1.20	1.75 Pool @ 740	1.72	1.75	1.56
23+00	1.38	1.61	1.84 Pool @ 713	1.88	1.49	2.07 Pool @ 713	--	--	--
25+45	1.50	2.04	2.16 Pool @ 713	1.29	1.50	1.73 Pool @ 713	1.95	1.60	1.29
Berm Slope @ 25+45	--	--	--	1.58	--	--	--	1.58	--

A pumping test was made to determine a field value of the overburden permeability to use in underseepage calculations. The test was located on the left bank flood plain near the river as shown on Plate 16. It was concluded that maximum underseepage would occur in this area where there was no natural blanket of near-impervius material. Seventeen piezometers were drilled 10 to 310 feet from a pump well and the piezometers were set to depths indicated on Plate 16. Details of a typical piezometer are shown on Plate 17. All piezometers were set without the use of drilling mud. The holes were kept open by either continuous water circulation or the use of casing which was pulled as gravel packing was poured around the well point and pipe.

Details of the pump well are shown on Plate 17. It was necessary to add four 100-pound sacks of aquagel and one 100-pound sack of lime to the drill water during drilling in order for the hole to remain open. The resulting filter cake was easily flushed from the hole after gravel packing and did not affect the well performance in any way.

The pump well was pumped at a constant rate of 1,170 gpm for 8 hours with a 10-inch stage pump. All piezometers essentially stabilized in 3 hours with very minor adjustments in the last 5 hours of pumping.

The permeability between adjacent piezometers was computed using the indicated formula, which is an adaptation of the Theim Formula. All of the piezometers functioned properly and the individual values agreed closely. The permeability value of 0.240 ft/min. was considered to be an accurate measure of the average horizontal permeability of all material between the water table and the lower impermeable boundary (which is the top of rock in most cases) within the pump test area. The drawdown curve plotted on a semilog on Plate 17 indicated the effective radius of influence to be 900 feet. The underflow was estimated to be about 35 cfs for the flood pool and about 28 cfs for the seasonal pool.

In order to control the seepage, a total of 32 relief wells were intalled along the downstream toe of the dam. A flood pool has not occurred since the impoundment and the maximum underflow at seasonal pool has been 17.5 cfs. Therefore, the estimated underflow was slightly high.

5. Instrumentation. The instrumentation plan consists of settlement plates, movement monuments, and piezometers. The settlement plates measure any settlement that occurs. The movement monuments measure horizontal and vertical movement. The piezometers measure pore pressures.

a. Settlement Plates. Three settlement plates were installed. They are located 20 feet downstream of Stations 12+00, 21+00, and 26+00.

b. Movement Monuments. Three rows of movement monuments were installed. One line is located 400 feet upstream of centerline, one 15 feet downstream, and one 400 feet downstream.

c. Piezometers. A total of 49 piezometers were installed to measure pore pressures. Six piezometers are Casagrande Type, 37 piezometers are gas actuated, and six are Wellpoints.

d. Instrumentation Evaluation.

(1) General. Most of the closed system piezometers initially installed in the dam have become inoperative and, where possible, were recently replaced by Casagrande type piezometers. The following table summarizes the status of the closed system piezometers as of 1 July 1979.

Piezometer**Number****Status as of September 1982**

6-1		Replaced
6-2		Replaced
6-3		Replaced
6-4		Replaced
6-5	Broken	
6-6	Broken	
12-1		Replaced
12-2		Operative
12-3		Replaced
12-4		Replaced
12-5	Broken	
12-6	Broken	
12-7	Broken	
12-8		Operative
12-9	Broken	
12-10		Operative
12-11	Broken	
21-1		Replaced
21-2		Replaced
21-3		Replaced
21-4	Broken	
21-6		Operative
21-7		Operative
21-8	Broken	
26-1	Broken	
26-2		Replaced
26-3		Operative
26-4		Replaced
26-5		Operative

26-6		Replaced
26-7		Operative
26-8	Broken	
26-9		Operative
26-10		Operative
26-11		Operative
26-12		Operative

(2) Piezometers.

(a) Station 6+00--The replacement piezometers are the only operative piezometers at this station. These piezometers were recently set and have not stabilized yet.

(b) Station 12+00--The piezometers at this section indicate that controlled seepage is occurring beneath the dam.

(c) Station 21+00--The piezometers at this section also indicate that controlled seepage is occurring beneath the dam.

(d) Station 26+00--The piezometers at this section indicate that the core is effectively reducing the seepage.

(e) Toe Drain Wellpoints--The wellpoint piezometers do not indicate a buildup of pore pressure at the base of the dam. During the Fifth Periodic Inspection, it appeared that the 18-inch BCCMP toe drain was inoperative. Therefore, the adequacy of the toe drain was studied. A weir box was constructed to check the flows from the individual sections of the toe drain. It was determined that the toe drain is working. Nine well points have been added to monitor the dam toe.

(3) Relief Wells. Thirty-two relief wells are located along the toe of the dam to collect underseepage and reduce uplift pressures. The relief wells were last sounded on 14 May 1979. No significant silting of the relief wells has occurred. Measurements of the flows from the undivided relief wells were taken on 15 May 1979. Based on these readings, there is a continuing reduction in seepage beneath the dam. The reduced flow is apparently due to silting of the lake.

(4) Movement Monuments. The readings indicate the embankment has essentially stabilized.

6. Construction Notes. Changes in Embankment Design During Construction.

a. After the contract was awarded, a review of the contract plans ascertained that drainage from the 3-foot horizontal drain in the lower base of the dam was not adequately connected to the toe drainage system. Therefore, it was determined necessary to control the seepage outlet from the horizontal blanket and preclude the development of unsightly wet areas at the downstream base of the embankment. Two 50-foot wide by 2-foot deep inclined connector drains were installed. One was installed between Stations 11+75 and 12+25. The other was installed at Stations 19+50 and 20+00. The design plan for this change is included in Plate No. 15A. This design change was accomplished by Mod. No. 7.

b. The foundation surface between stations about 15+00 to 21+00 after stripping was an irregular surface due to a natural low area. To assure drainage within the 3-foot horizontal drain, some additional stripping and revision of the horizontal drain was necessary as outlined on Plate No. 15B. This design change was accomplished by Mod. No. P00015.

c. A major portion of the dam embankment overlies glacial outwash sands and gravels. The outwash sands and gravels were adequate to support the load of the embankment. However, the design called for downstream relief wells and an upstream impervious blanket to control the underseepage through the sands and gravels. After stripping the upstream blanket area, the plans called for excavating the area of glacial outwash material down to elevation 637 or clay (glacial till). This material consisted of SP, SM, and SC materials and it was planned to use these materials in the granular zone of the dam embankment. However, the specifications for the granular zone specified that the granular zone material should not have more than 10 percent by weight passing the Standard No. 200 sieve. As the excavation progressed, it was found that the contact with the underlying till was an irregular surface and the materials were layered and when picked up by scrapers, contamination and segregation occurred to the extent that the material would not meet the gradation requirements of the granular zone. To prevent wasting of this random material, it was determined to be in the best interest of the Government to rezone the embankment in order to use this material as random fill. This rezoned area was located below elevation 740 between Stations 8+25 and 23+00 and extended from centerline upstream to the inclined drain. This change is depicted on Plate Number 14. This change was accomplished by Modification No. P0001.

d. As work progressed, it became evident that the previously designated area of rezoning from granular zone to random zone was not large enough to accommodate the amount of materials being excavated from beneath the upstream blanket area. Again an area between Stations 8+25 and 23+00 and extending from centerline to 100 feet downstream below elevation 740 of the embankment was rezoned from granular to random fill to accommodate the use of this material. This change was accomplished by Modification P00032. This change is depicted on Plate Number 14.

e. In order to reduce the risk of overtopping of the existing embankment in the closure section of the embankment, the contract specified that the embankment should be constructed to elevation 717 prior to the end of the 1972 construction season. Prior to the month of November 1972, the Contractor was progressing on the embankment placement at a rate which left little doubt that the 717 elevation would be attained. However, due to causes beyond the control of the Contractor, specifically unfavorable weather conditions during November, it became apparent that the embankment would not reach elevation 717. In order to provide the needed protection, the Contractor was directed to construct a temporary dike to elevation 717 across the closure section of the embankment. The portion of the material placed over the inclined drain and impervious zones was reexcavated at the beginning of next construction season. This area of the embankment was the only area in which rock type material (shale) was placed against the inclined drain. In the process of cutting the inclined slope within this shale embankment, it was difficult to maintain a uniform slope in the compacted shale fill for the incline drain to be placed and compacted against. After this, in areas where the plans allowed for placement of random rock materials next to the inclined drain, granular clay type random materials were used for at least one scraper to facilitate overbuilding of the design line and recutting to the line to form a face of compacted random material to place the incline drain against. A typical section of this temporary dike embankment design is shown on Plate No. 15C.

f. The specifications called for a towed vibratory roller with a width between 5.5 and 6.5 feet to compact an 8-foot wide inclined filter zone. As work progressed, problems were encountered in obtaining the required compaction with the specified towed vibratory roller. Essen-

tially, two problems were encountered with the towed vibratory roller. One was in obtaining of the required compaction close to the face of the next zone with a vibratory roller which was towed with a tractor with a track width wider than the roller. Also, if the filter drain material was not leveled off after placement and prior to compaction at a close tolerance, the machine tended to migrate to one side or the other. To overcome these problems, the Contractor was directed to provide a self-propelled roller which could be controlled better and which eliminated the problems in obtaining the required compaction. The Contractor provided a Ferguson SP 75B roller for this purpose. This change was accomplished by Modification No. P00042.

g. As the embankment placement progressed, it was determined that an error in the calculated yield of shale from the spillway excavation had been made. This necessitated another rezoning of the embankment. The random zone above elevation 740 was rezoned from compacted random fill to compacted random rockfill. Also, a 30-foot width zone of random fill to be placed above elevation 710 on the downstream slope and beneath the 4-foot width of compacted earth was designated. This was accomplished by Modification No. 47 and is shown on Contract Drawing EFW-2.2-12.3/19 Rev. No. 3.

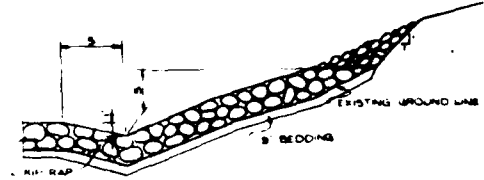
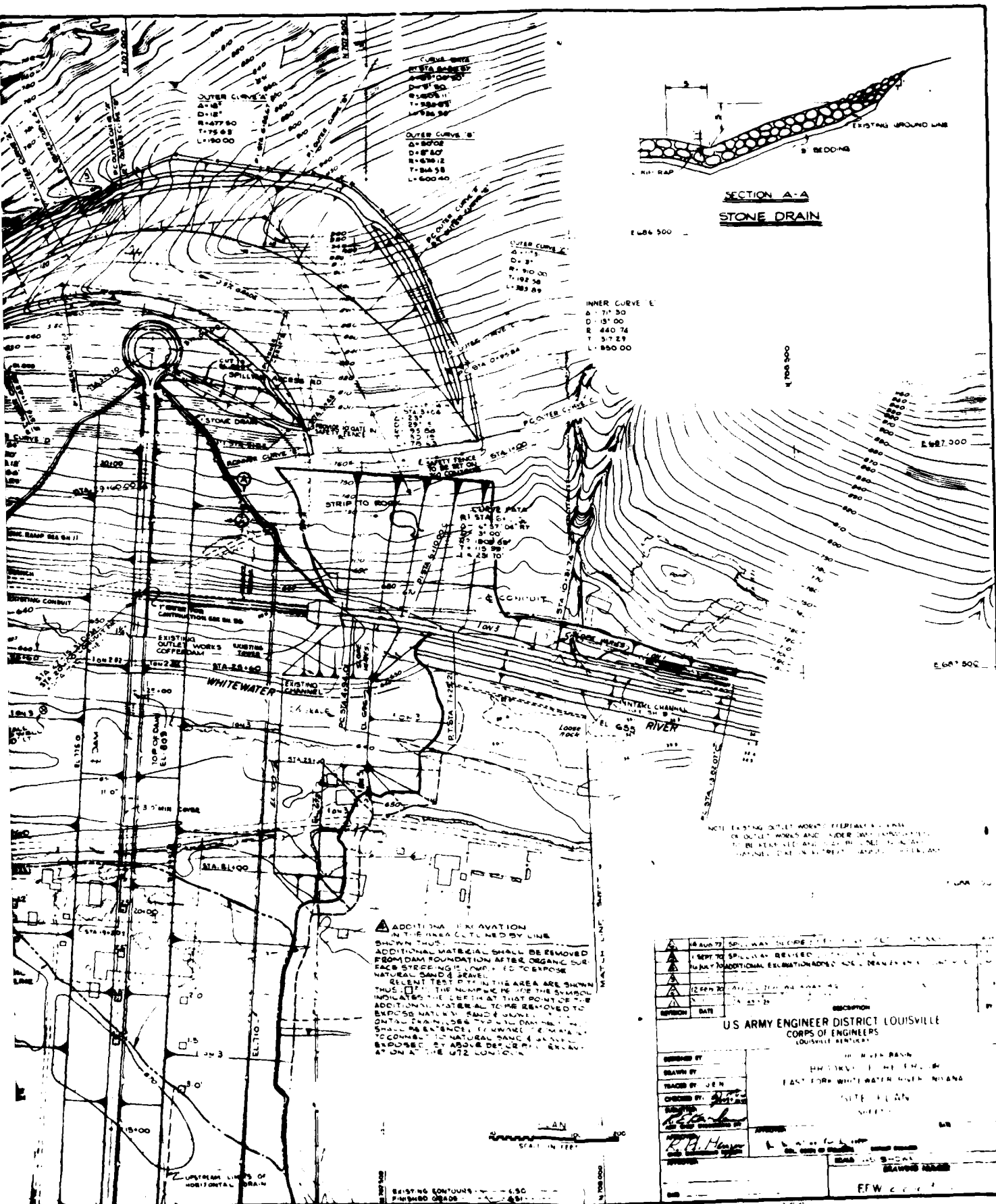
Modifications List See Foundation Report

Construction Equipment. The equipment listed below was in use June 1972.

- 4 Caterpillar 666 scrapers
- 4 Caterpillar 647 scrapers
- 1 Shovel Supply Co. self-propelled vibrating roller
- 2 Ferguson self-propelled vibrating roller
- 2 Ferguson self-propelled sheepsfoot roller

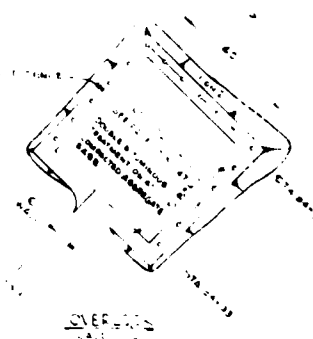
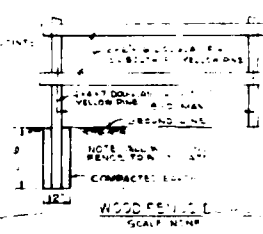
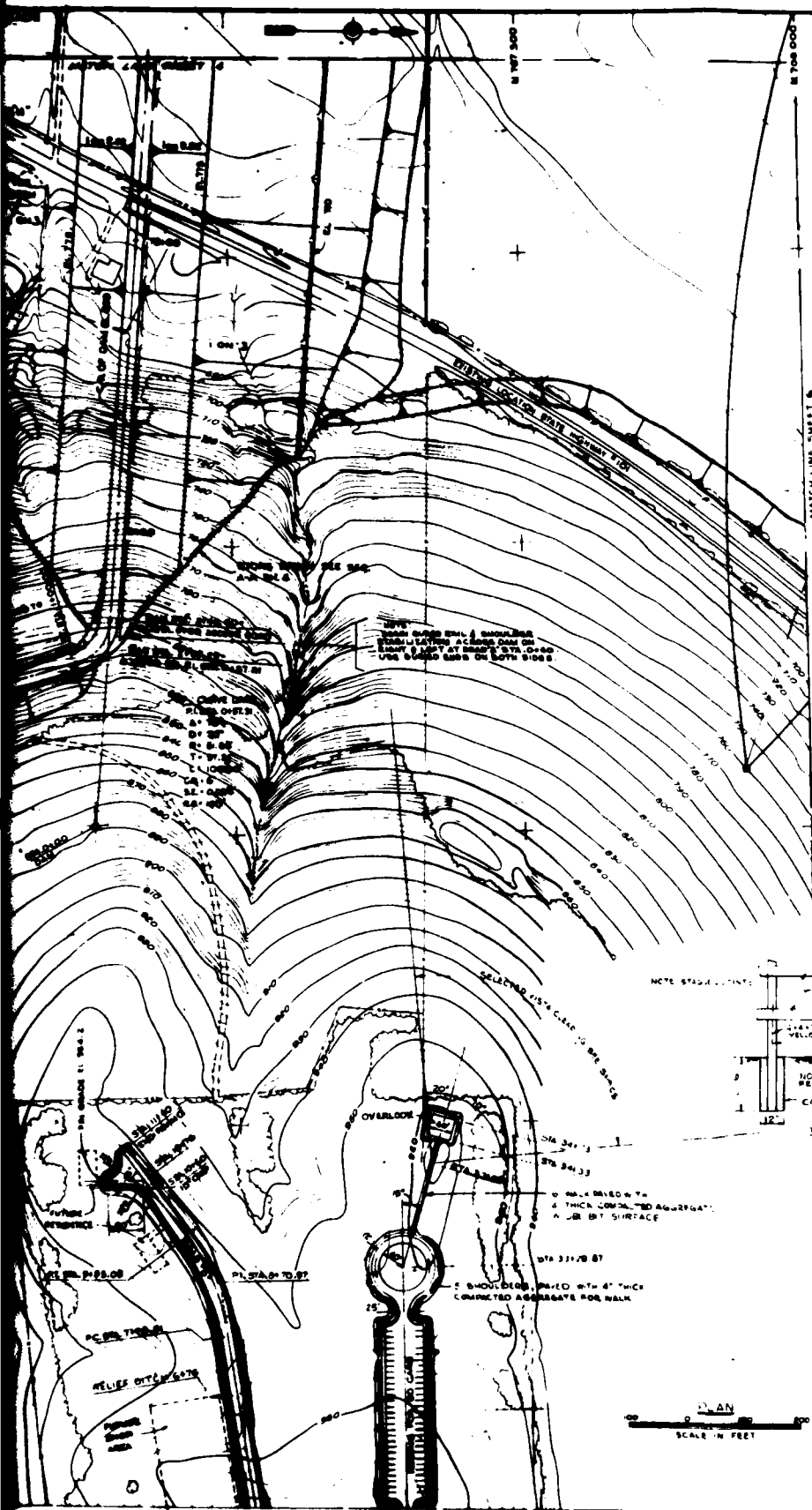
1 50T Tampo Caterpillar self-propelled (pneumatic) roller
1 50T Laplant Choate self-propelled (pneumatic) roller
6 Caterpillar D-8 dozers
3 Caterpillar D-9 dozers
1 Caterpillar Traxcavator
2 Caterpillar 16 Graders
1 A-C M-100 grader
1 American 5299 crane
1 Manitowoc 3900 crane
1 Bantam T-350 crane
1 Rome HD plow
1 Caterpillar water wagon
1 Kelly ripper
4 Caterpillar light plants
4 Jaeger pumps 6-inch
3 Dump trucks
1 Ingersoll-Rand compressor
2 Lincoln welders

[illegible]



SECTION A-A
STONE DRAIN

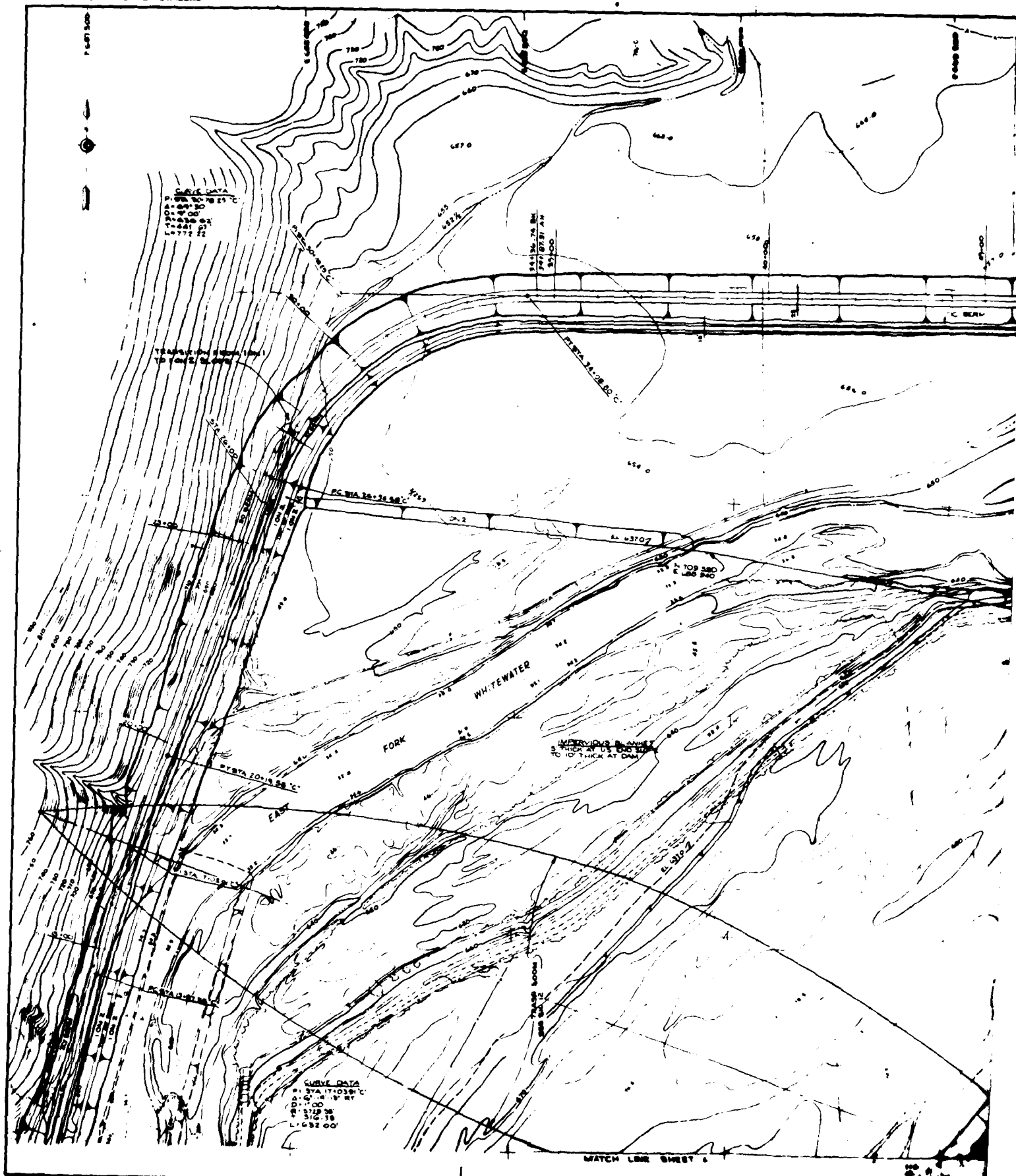
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2	1 SEPT 73	SPILLWAY REDESIGNED TO BE 100' WIDE AT 100' ELEVATION
3	16 JULY 74	ADDITIONAL ESTIMATION ADDED FOR DRAINAGE AND EROSION CONTROL
4	12 FEB 75	ADDITIONAL ESTIMATION ADDED FOR DRAINAGE AND EROSION CONTROL
5	12 FEB 75	ADDITIONAL ESTIMATION ADDED FOR DRAINAGE AND EROSION CONTROL
6	12 FEB 75	ADDITIONAL ESTIMATION ADDED FOR DRAINAGE AND EROSION CONTROL
U.S. ARMY ENGINEER DISTRICT LOUISVILLE CORPS OF ENGINEERS LOUISVILLE, KENTUCKY DESIGNED BY: [Signature] CHECKED BY: [Signature] APPROVED BY: [Signature] DATE: [Date] PROJECT: [Project Name] SHEET: [Sheet Number] SCALE: [Scale] EFW [Signature]		



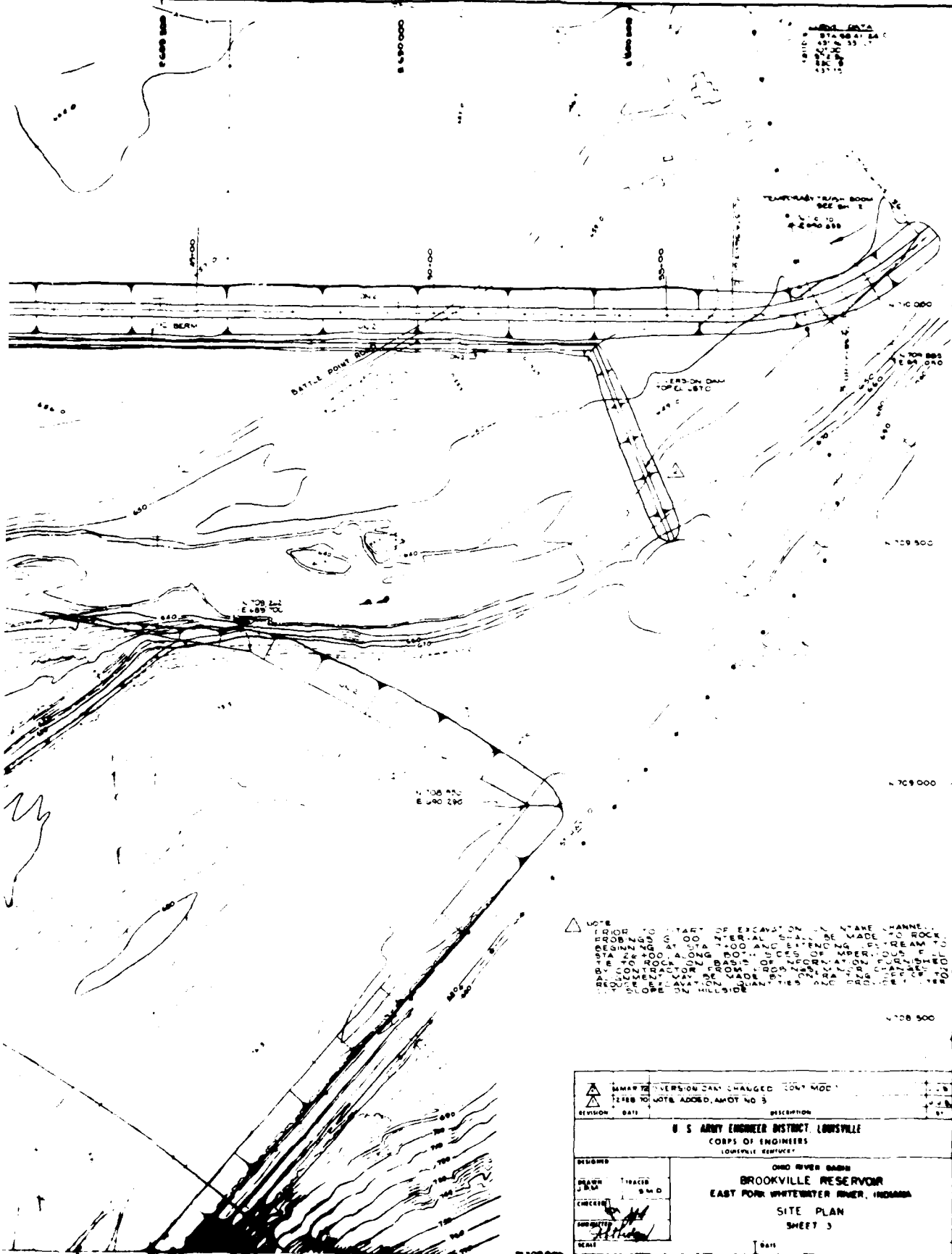
DESIGNED BY DRAWN BY CHECKED BY APPROVED BY		U.S. ARMY ENGINEER DISTRICT, LOUISVILLE CORPS OF ENGINEERS LOUISVILLE, KENTUCKY	
DATE REVISION		OHIO RIVER BASIN BROOKVILLE RESERVOIR EAST FORK WHITEWATER RIVER, INDIANA SITE PLAN SHEET 2	
EFW 22-123/5		RECORD DRAWING - AS BUILT	

RECORD DRAWING - AS BUILT

PLATE NO. 2



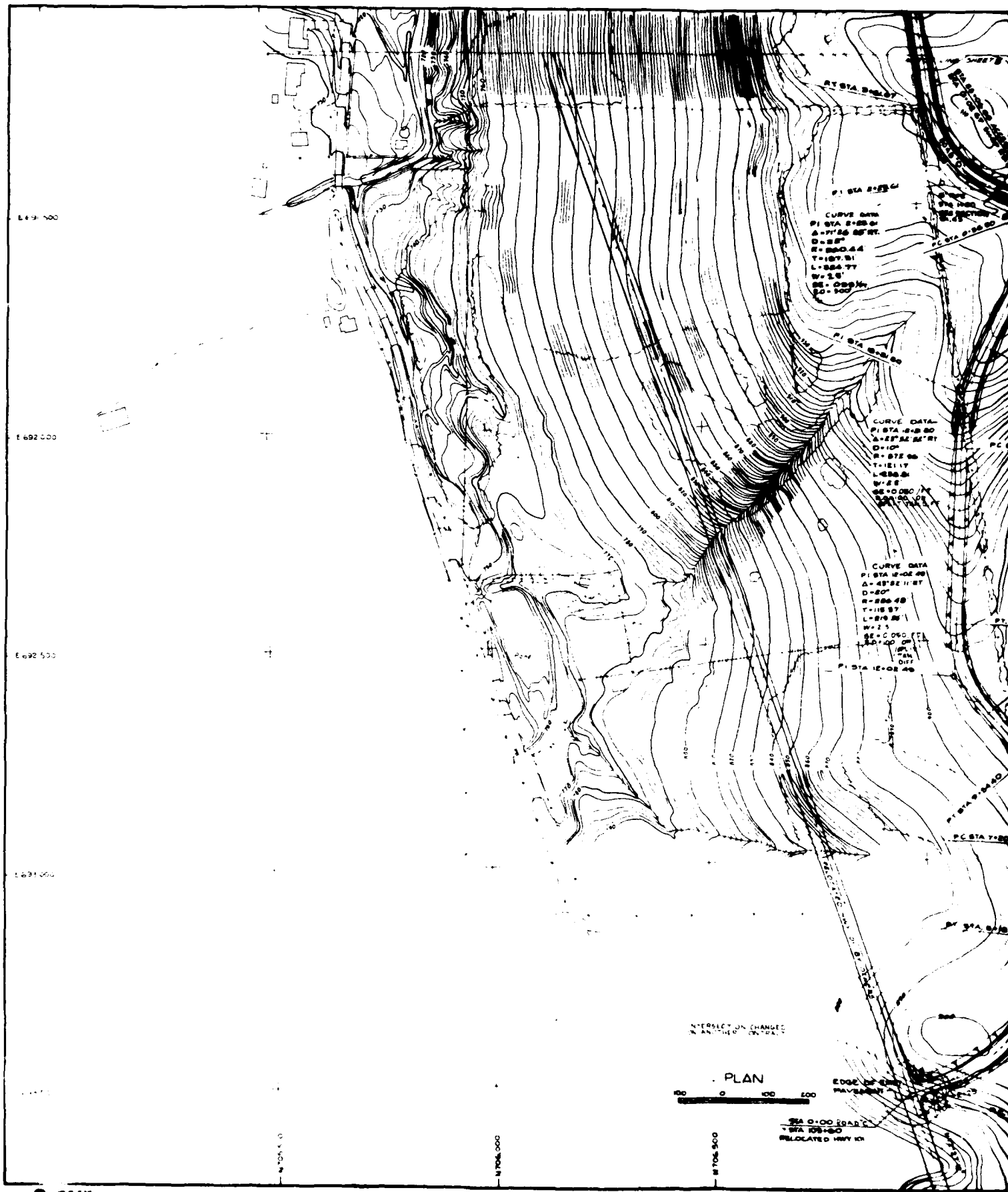
U S ARMY

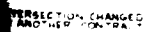


NOTE
PRIOR TO START OF EXCAVATION IN TAKE CHANNEL,
PROBING TO 10' DEPTH SHALL BE MADE TO ROCK
BEGINNING AT STA 1+00 AND EXTENDING UPSTREAM TO
STA 2+00 ALONG BOTH SIDES OF PREVIOUS FILL
TO ROCK ON BASIS OF INFORMATION FURNISHED
BY CONTRACTOR FROM PROSING. ANY CHANGES TO
ALIGNMENT MAY BE MADE BY CONTRACTOR TO
REDUCE EXCAVATION QUANTITIES AND PROVIDE BETTER
SLOPE ON HILLSIDE

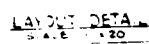
REVISION DATE DESCRIPTION	
U S ARMY ENGINEER DISTRICT LOUISVILLE CORPS OF ENGINEERS LOUISVILLE DISTRICT	
DESIGNED DRAWN CHECKED APPROVED SCALE	CHD RIVER BASIN BROOKVILLE RESERVOIR EAST FORK WHITEWATER RIVER, INDIANA SITE PLAN SHEET 3 DATE DRAWING NUMBER
PLATE NO. 3 EFW-22-12346	

RECORD DRAWING - AS BUILT





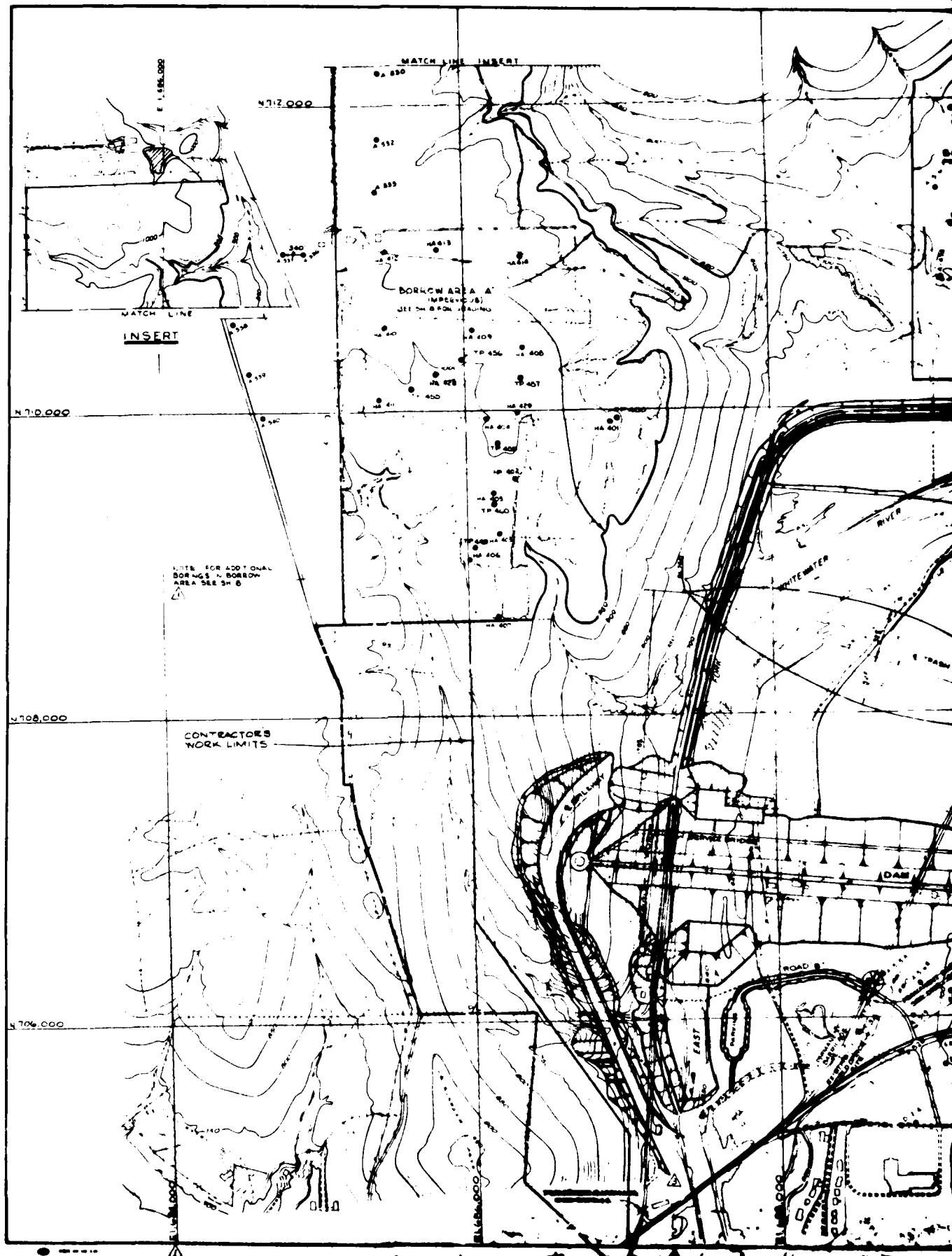
CURVE DATA
PI 574.2-25.00
A=66°50'17"LT
D=15°
R=261.97
T=252.08'
L=445.59
W=35'
SE=0.0A' LT
RO= HIGH

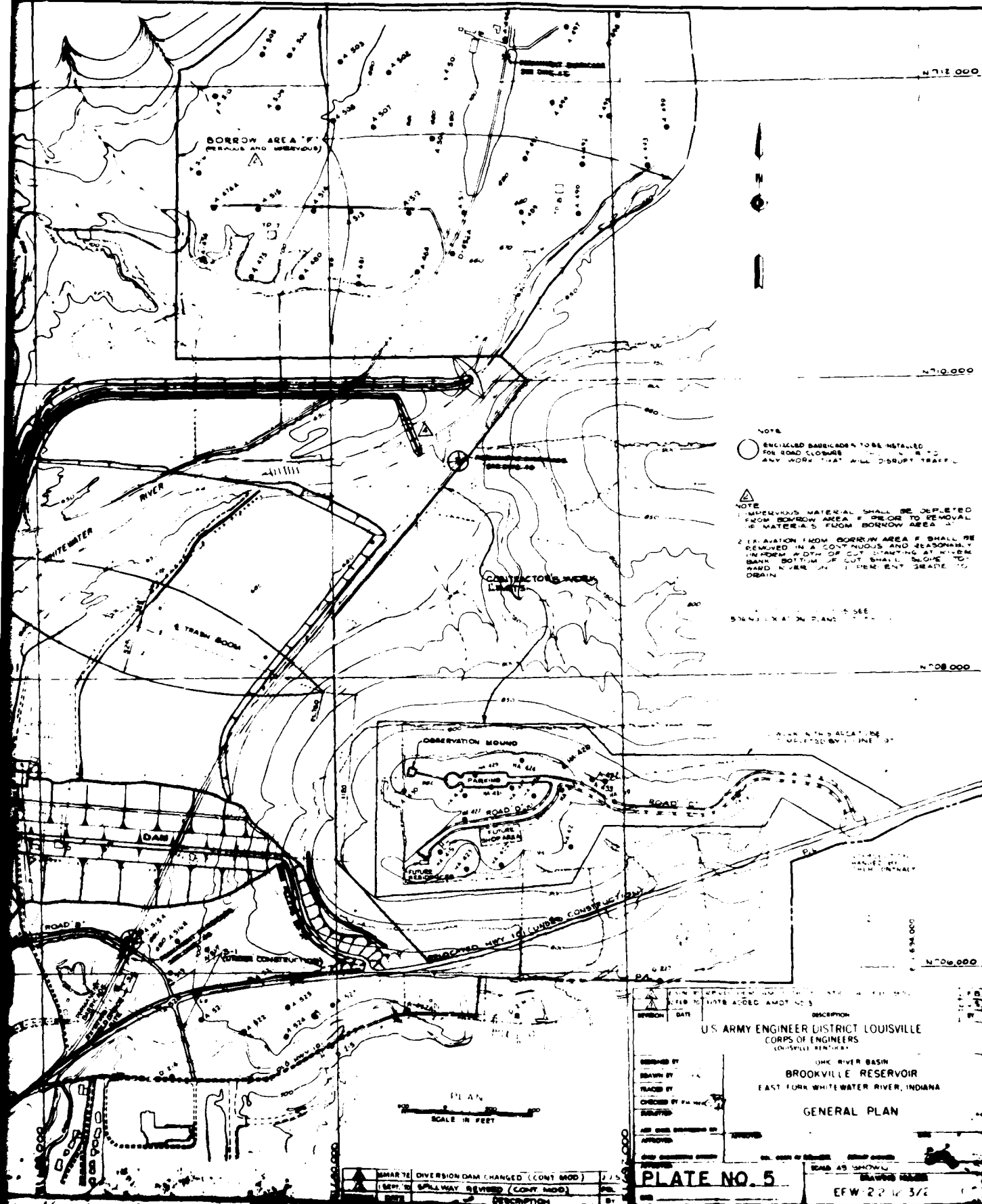


NOTE REVISION
S = 0.50 FT / FT
W = 2.5 FT ON CURVES
R = 100 FT MAX OR
1/2 OF AVAILABLE
DISTANCE

SCALE 25 9-KWU
DRAWN MADE
EFW-2 2-12 3/7

RECORD DRAWING." AS BUILT





NOTE
ENCLOSED BARRICADE TO BE INSTALLED FOR ROAD CLOSURE - R-10 ANY WORK THAT WILL DISRUPT TRAFFIC

NOTE
IMPERVIOUS MATERIAL SHALL BE DEPLETED FROM BORROW AREA F PRIOR TO REMOVAL OF MATERIALS FROM BORROW AREA J

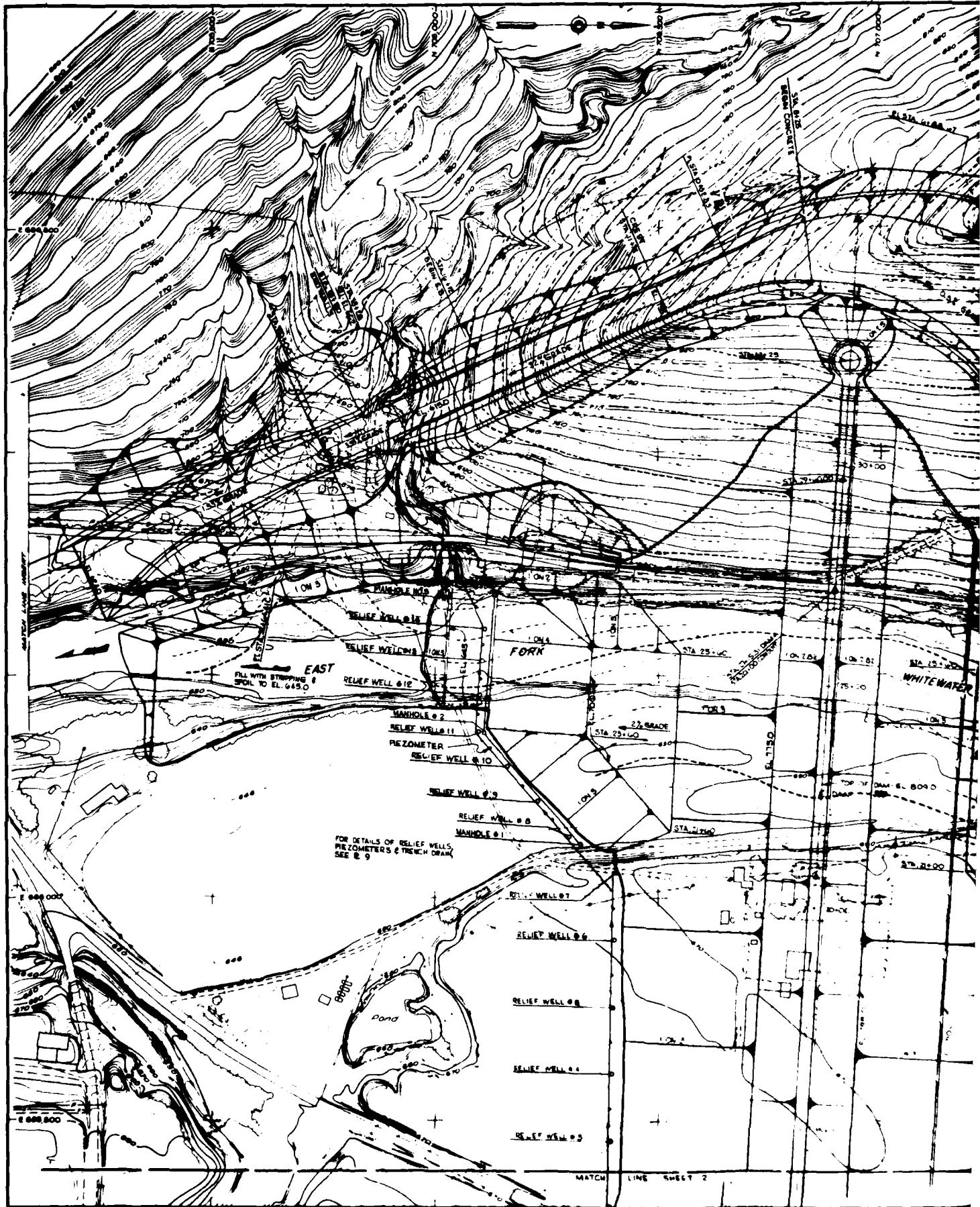
2. ELEVATION FROM BORROW AREA F SHALL BE REMOVED IN A CONTINUOUS AND REASONABLE MANNER WIDTH OF CUT STARTING AT RIVER BANK BOTTOM OF CUT SHALL SLOPE TO HARBOR RIVER ON EXISTENT GRADE TO DRAIN

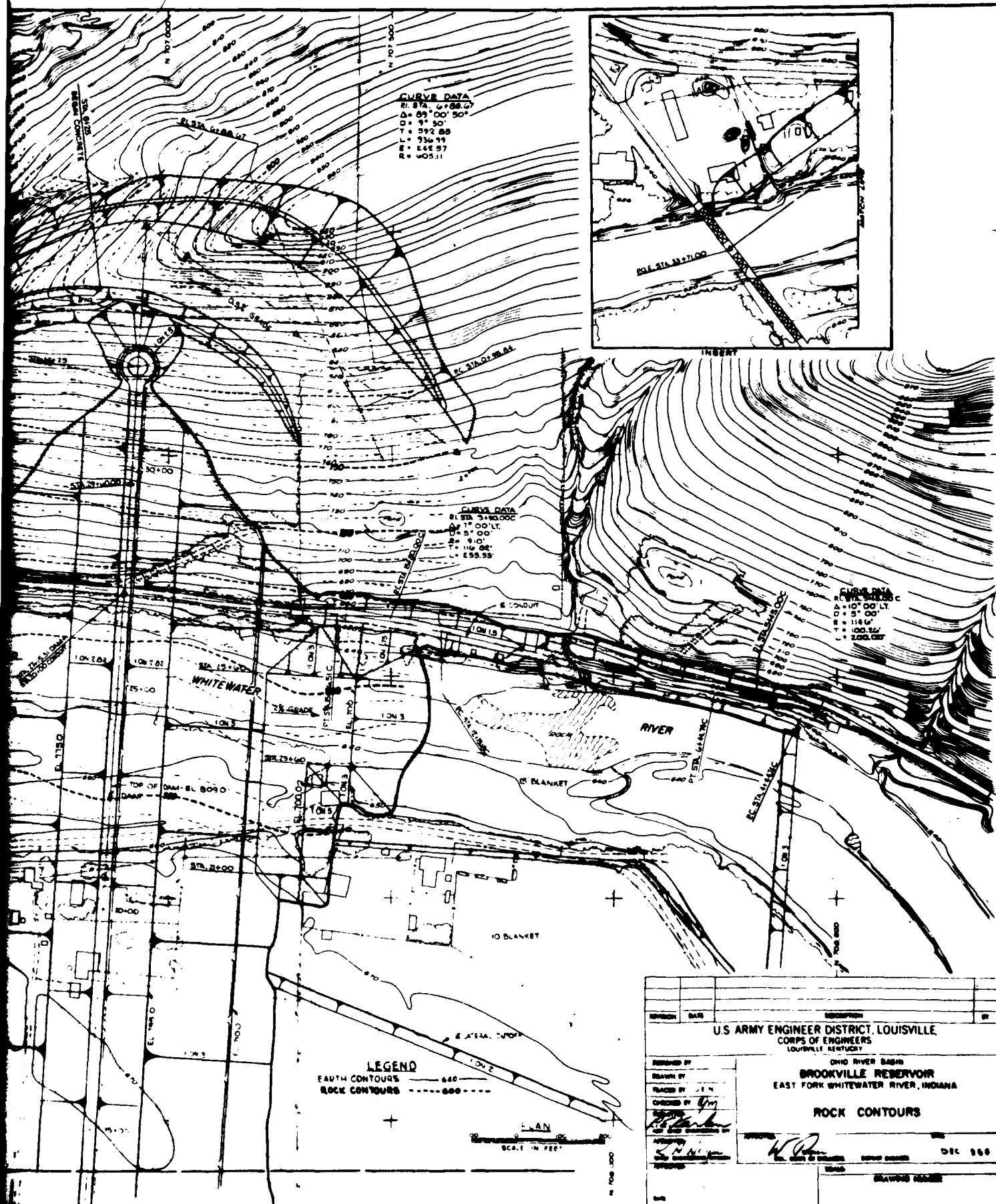
SEE
SHEET 1 X 1 X 1 PLAN

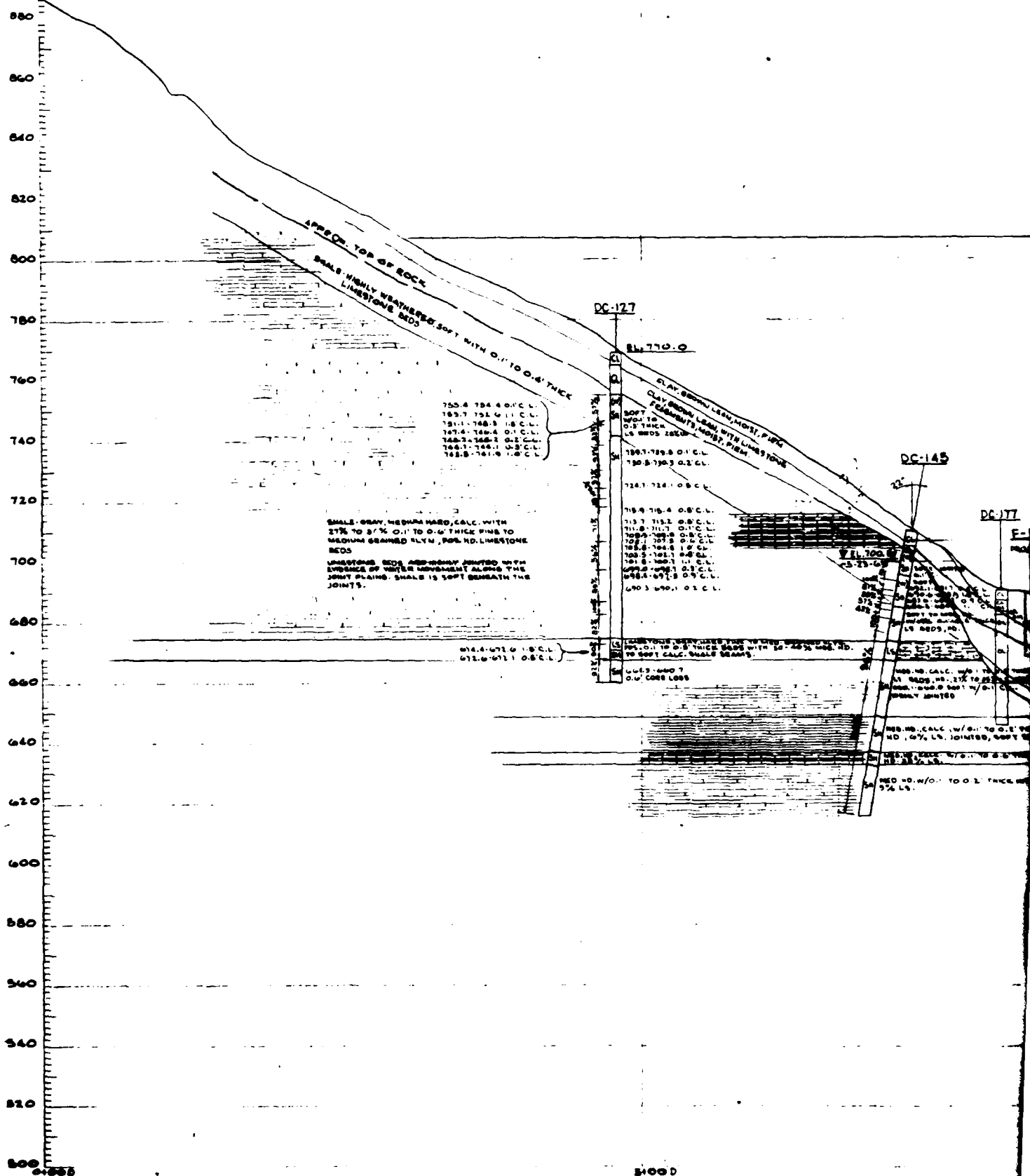
U.S. ARMY ENGINEER DISTRICT LOUISVILLE CORPS OF ENGINEERS LOUISVILLE, KENTUCKY	
(ONE) RIVER BASIN BROOKVILLE RESERVOIR EAST FORK WHITEWATER RIVER, INDIANA	
GENERAL PLAN	
DESIGNED BY DRAWN BY CHECKED BY APPROVED BY	DATE TITLE PROJECT NO.
PLATE NO. 5	
EFW 22 12 3/2	

1. DIVERSION DAM CHANGED (CONT MOD) 7.7.5
 2. SPILLWAY REVISED (CONT MOD) 7.7.5
 3. DESCRIPTION BY

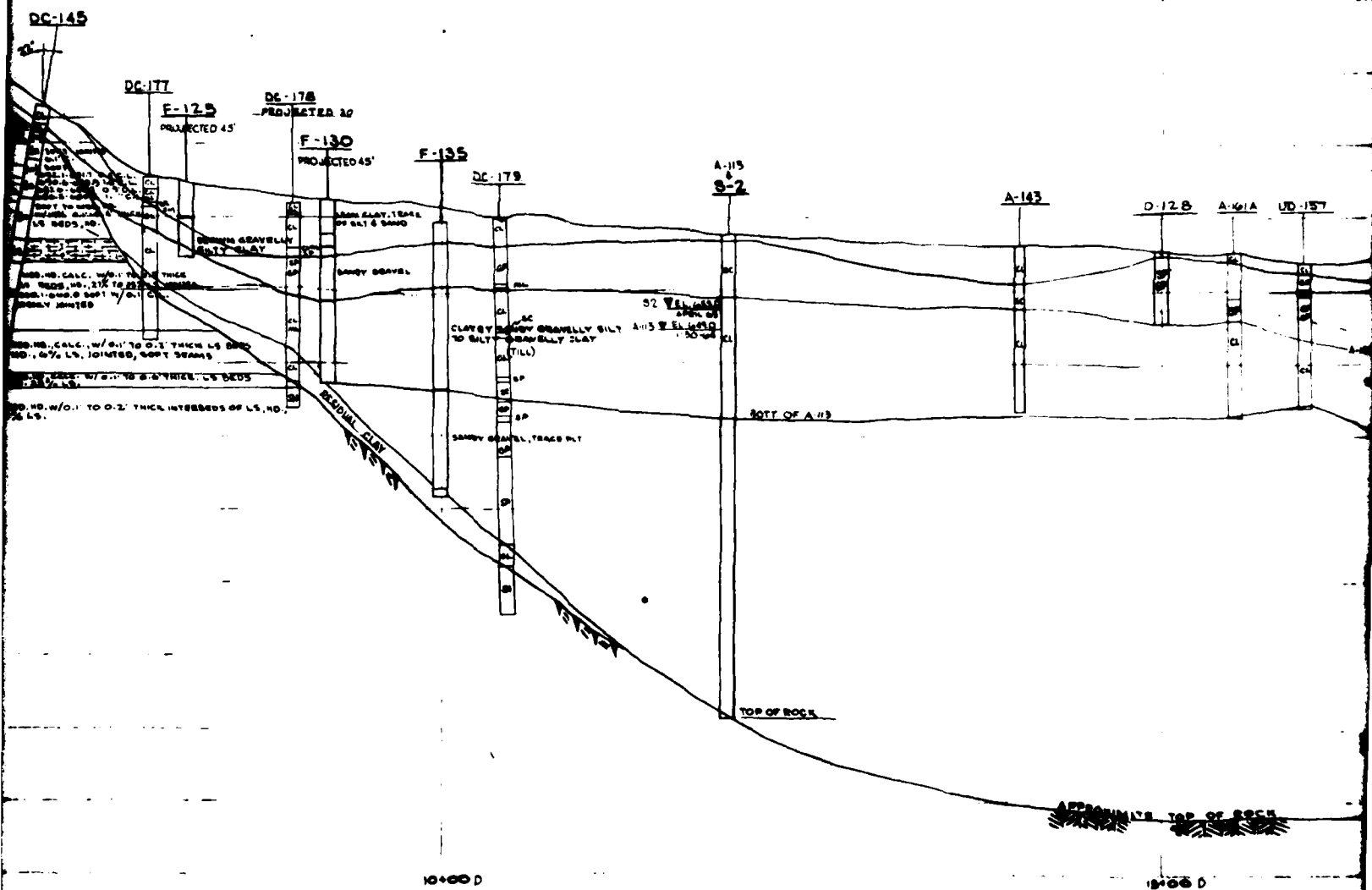
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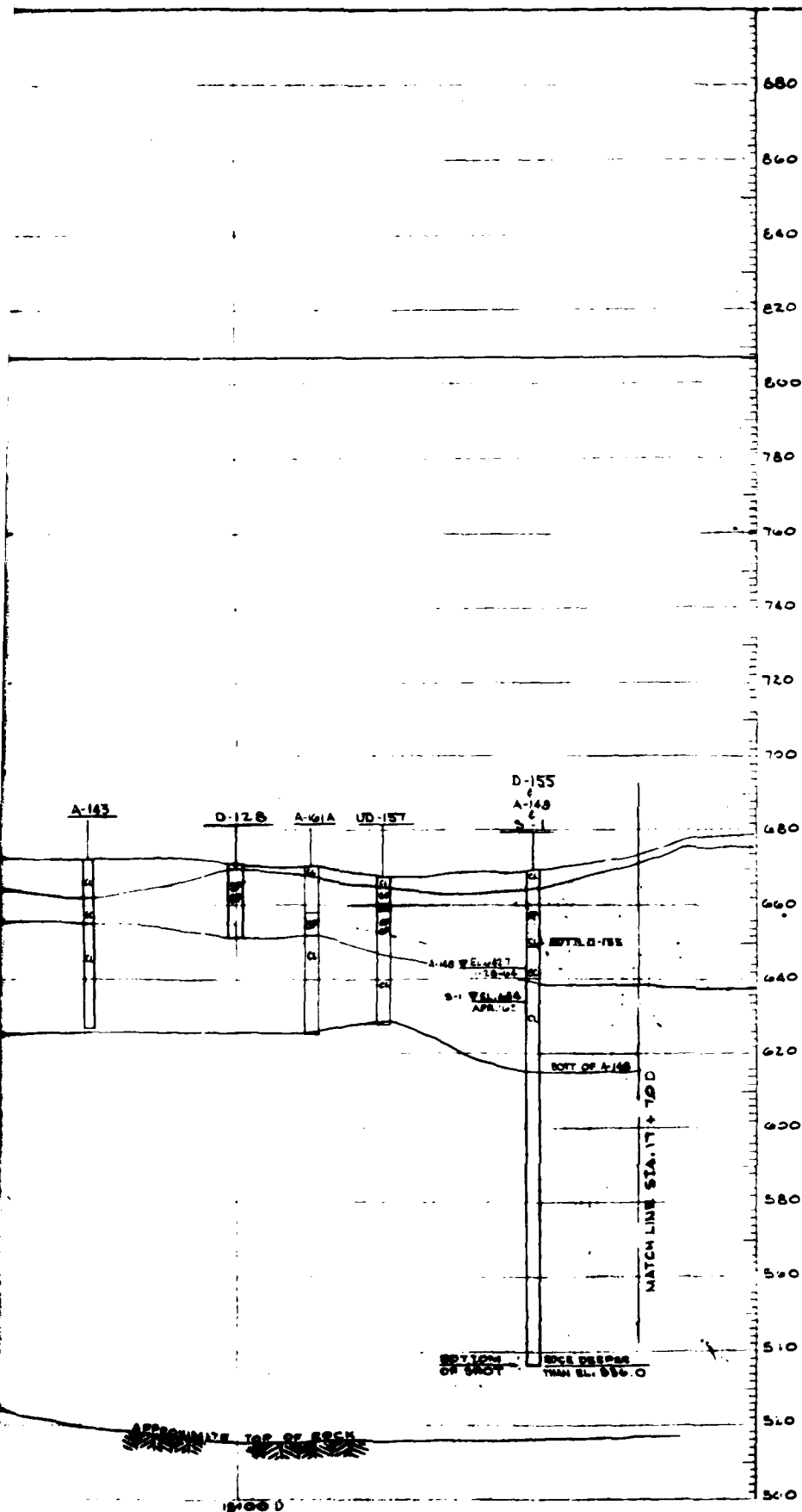






TOP OF DAM EL. 807.0





REV. 11-10-64

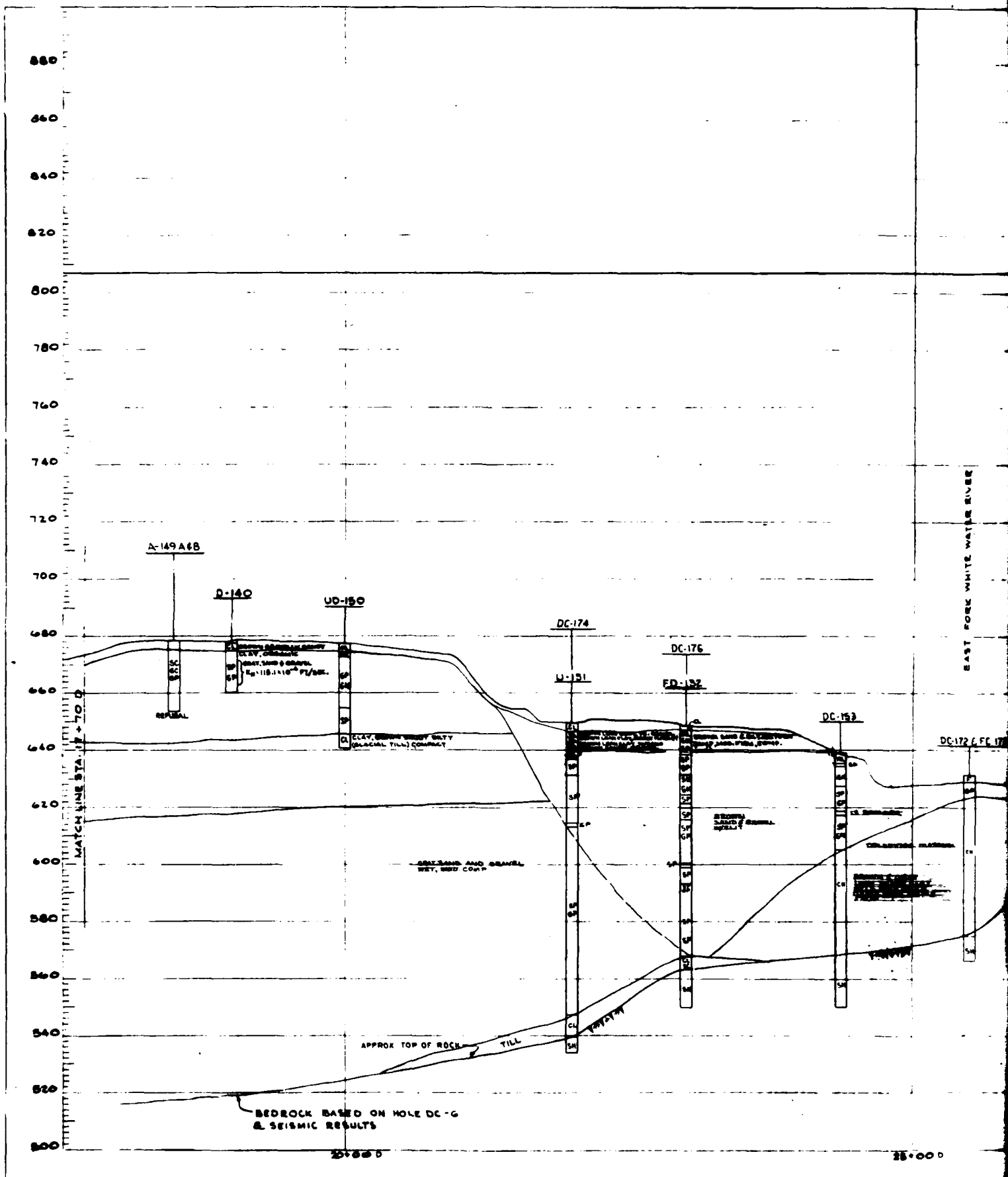
OHIO RIVER BASIN
BROOKVILLE RESERVOIR
EAST FORK WHITewater RIVER, INDIANA
GEOLOGIC PROFILE OF DAM

PLS
SHEET NO. 1

DM. NO 4

PLATE NO. 7

3



CORPS OF ENGINEERS

840 LEFT ABUTMENT

820

800

780

760

740

720

700

680

660

640

620

600

580

560

540

520

500

480

460

440

420

400

380

360

340

320

300

280

260

240

220

200

180

160

140

120

100

80

60

40

20

0

-20

-40

-60

-80

SEIGN
GROUT CURTAIN

TOP OF DAM EL. 808.0

20 C.C. 20'

CUTOFF TRENCH

ZONE 2

ZONE 3

APPROX. UNWEATHERED SHALE 1
MISPOLE 100' X 100'

ZONE 4

ZONE 5

WEATHERED ROCK

BOTTOM OF
SEIGN CURTAIN

ORIGINAL EL.
312' DAM

100

2000

PLAN

10 20 300 600
SCALE IN FEET

C.C. 20'

20

20

20

20

20

20

20

20

20

20

20

20

20

20

20

20

20

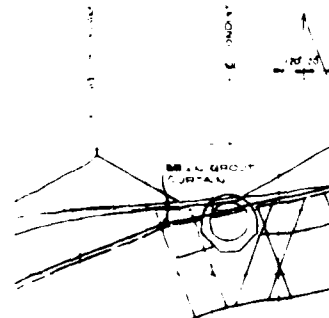
20

20

20

20

20



SINGLE GROUT CURTAIN SPACING
SCALE 1" = 20'
GROUT HOLES SPACED 20 C.C.
INITIALLY. ADDITIONAL HOLES MAY
BE DRILLED AND GROUTED BY THE
FIELD SPACING METHOD IN THE FIELD

840

14100

34+15 PROFILE
20+75 DAM

79 1900

76 1900

71 1900

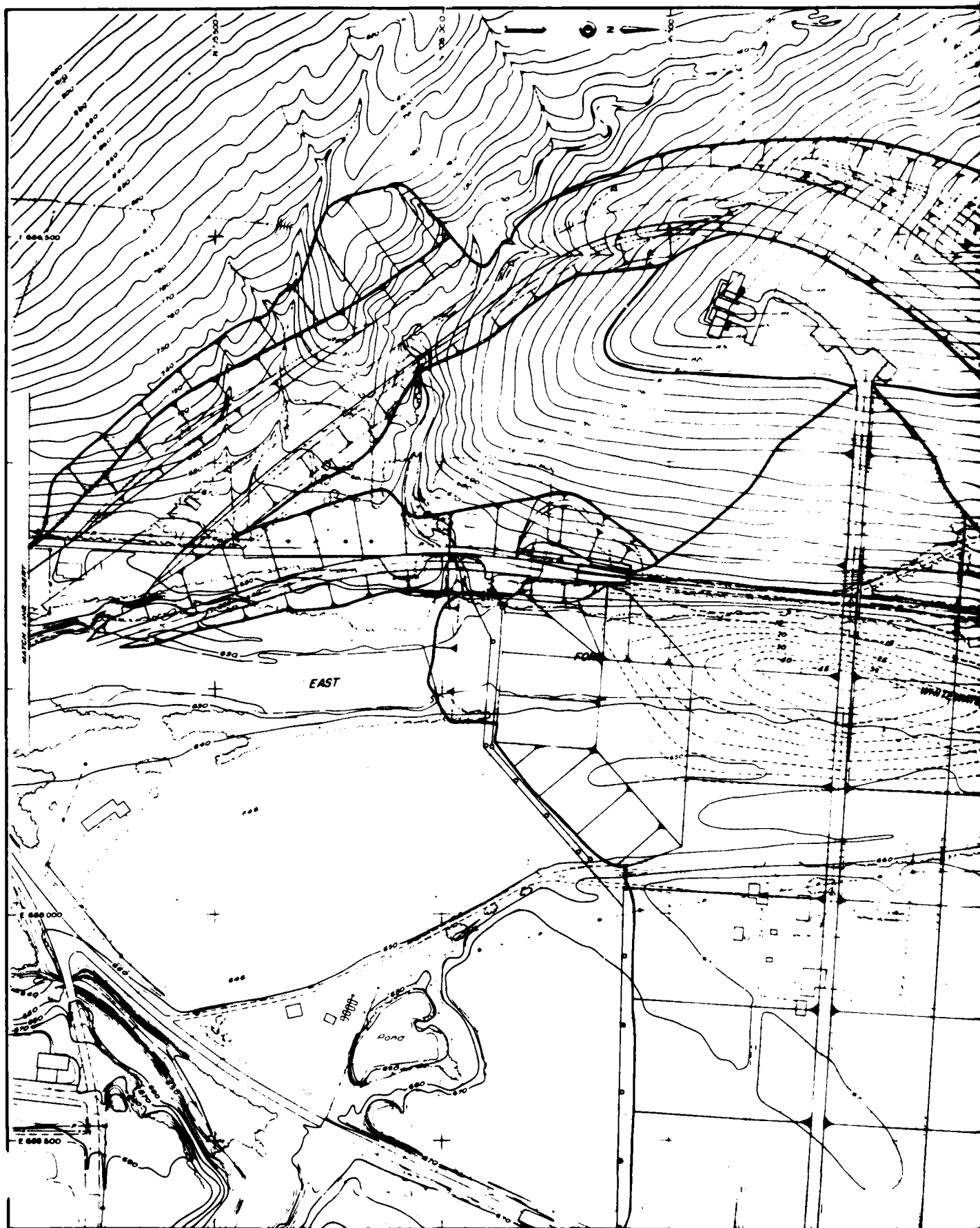
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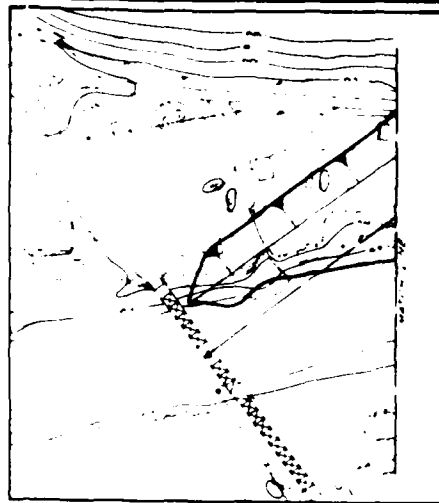
I MAKE NO ABOUT PRESSURE AND
AT THE 40 OF GROUT HERE

2004-05-01 10:00 AM

REVISION	DATE	DESCRIPTION	BY
U S ARMY ENGINEER DISTRICT, LOUISVILLE CORPS OF ENGINEERS LOUISVILLE, KENTUCKY			
DESIGNED		OHIO RIVER BASIN	
DRAWN	TRACED JWM	BROOKVILLE RESERVOIR	
CHECKED		EAST FORK WHITE WATER RIVER, INDIANA	
		DAM	
REVIEWED		GROUTING PLAN AND PROFILE	
APPROVAL SIGNATURE		DESIGNED	DATE
AND OTHER ENGINEERING BY APPROVED		CHIEF, CORPS OF ENGINEERS SCALE	DISTRICT ENGINEER
PLATE NO. 9		DRAWING NUMBER EFW-22-123/24	

RECORD DRAWING, AS BUILT





INSERT



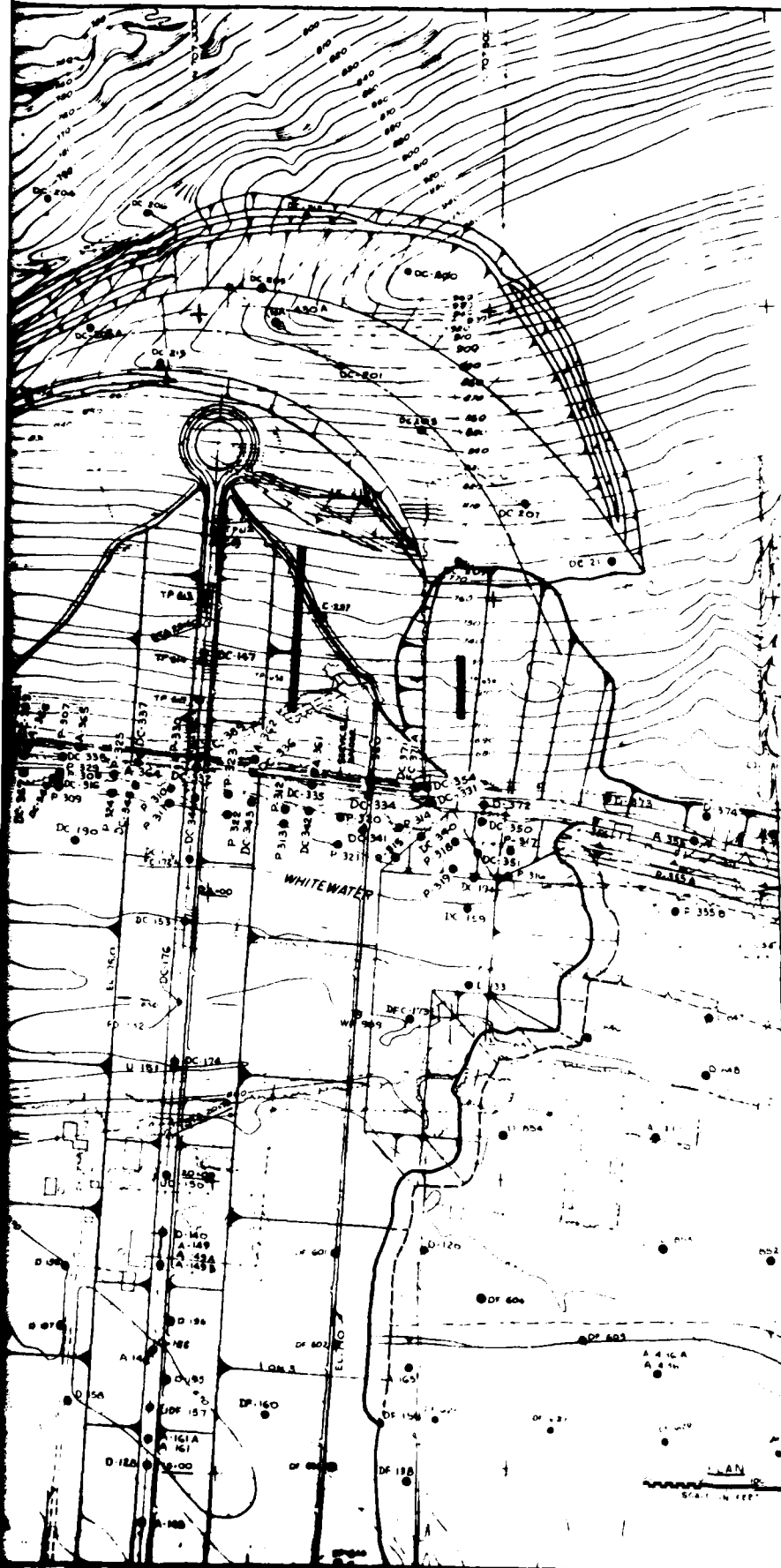
LEGEND
EARTH CONTOURS — 670 —
ISOPACH OF COLLUVIUM - - - - - 40 - - - - -

SCALE IN FEET
0 1/4 1/2 3/4 1

DIVISION		DATE		DESCRIPTION	
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE CORPS OF ENGINEERS LOUISVILLE, KENTUCKY					
DESIGNED BY		OHIO RIVER BASIN			
DRAWN BY		BROOKVILLE RESERVOIR			
CHECKED BY		EAST FORK WHITEWATER RIVER, INDIANA			
APPROVED BY		ISOPACH OF COLLUVIUM			
APPROVED BY		ALONG RIGHT BANK			
APPROVED BY		DATE		DEC 1968	
APPROVED BY		SCALE		DRAWING NUMBER	

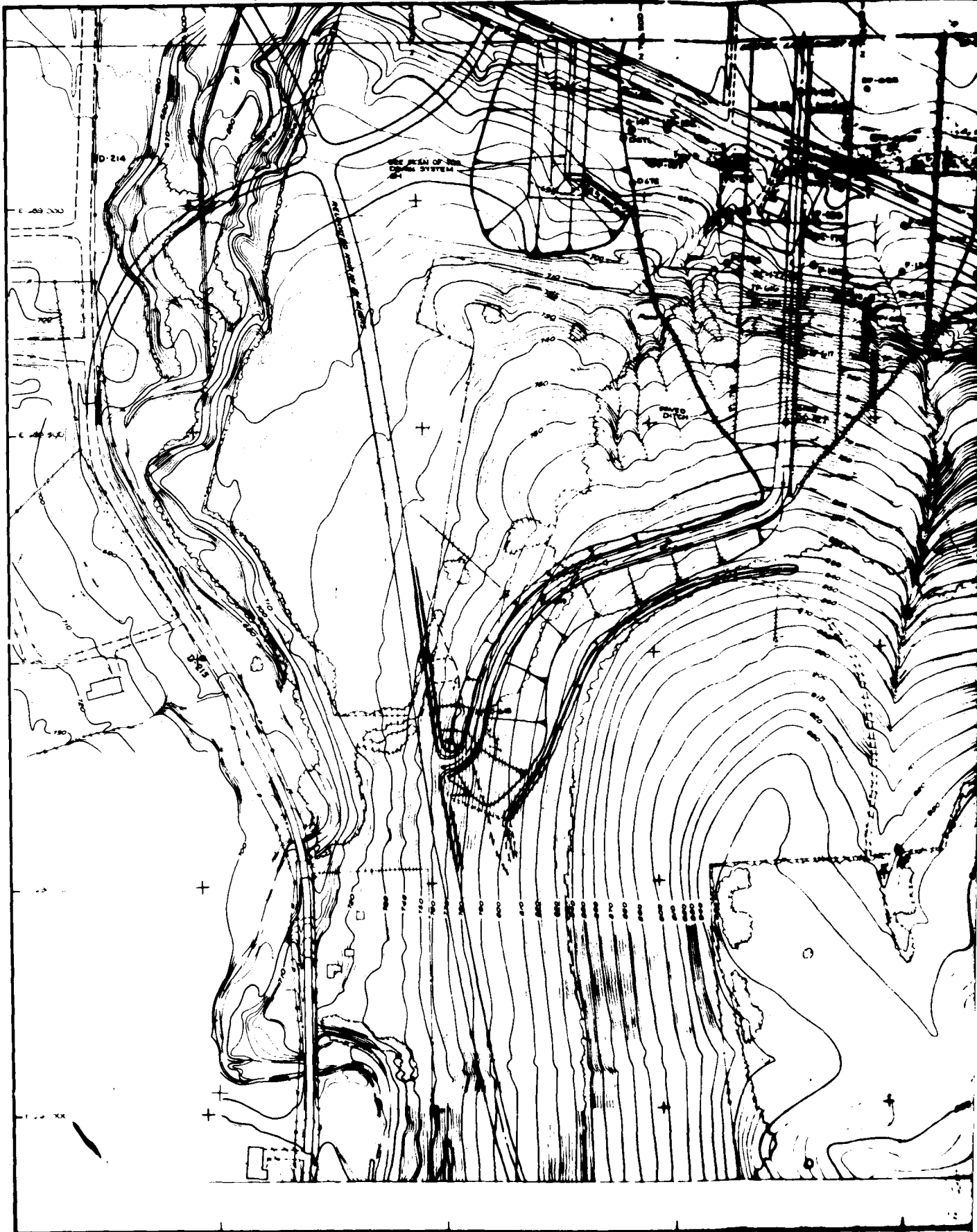
DM No 4

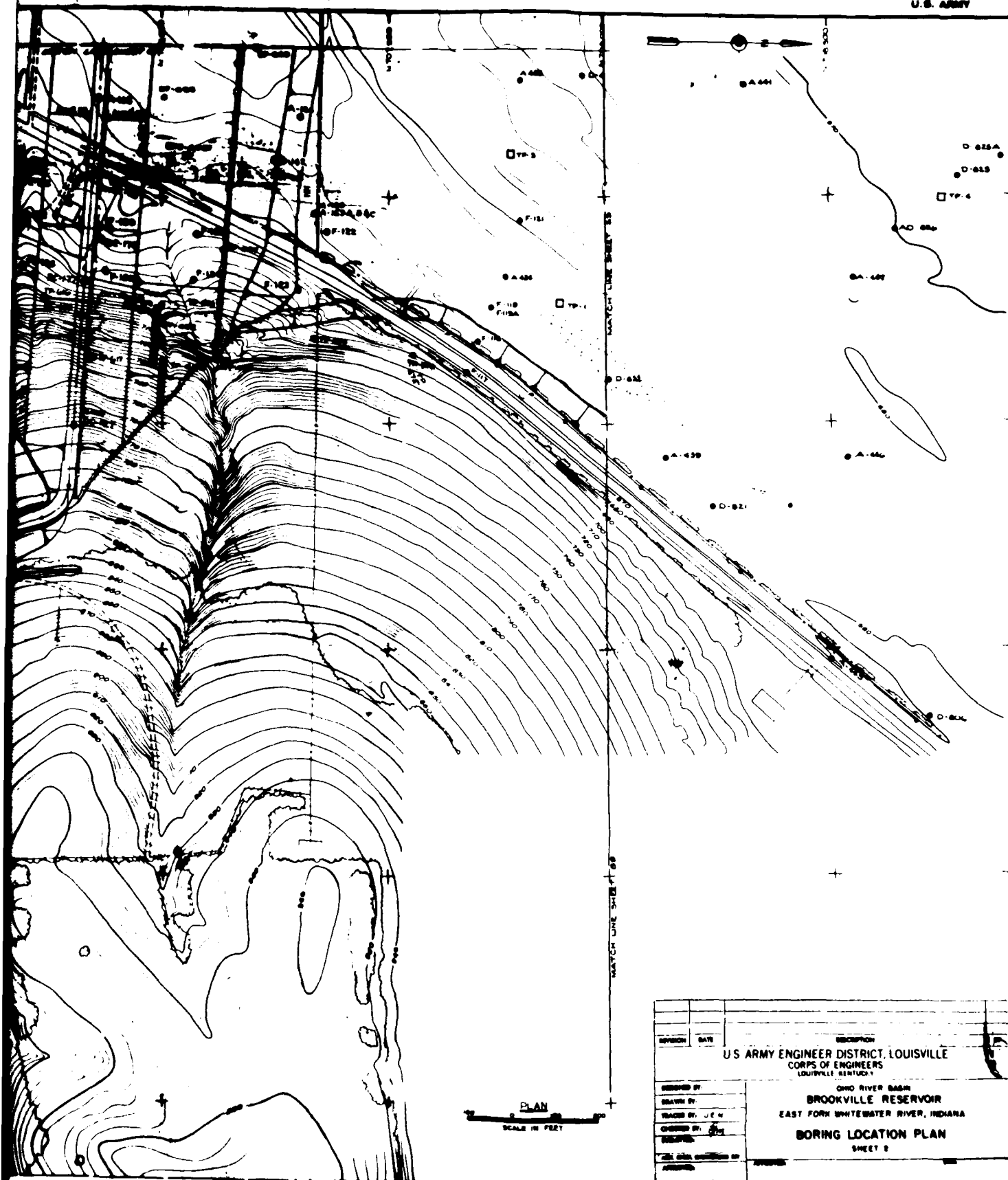
PLATE NO. 10

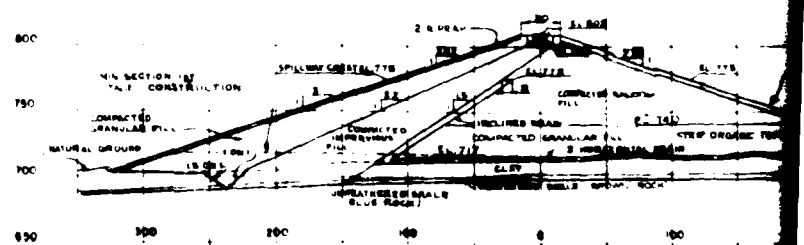
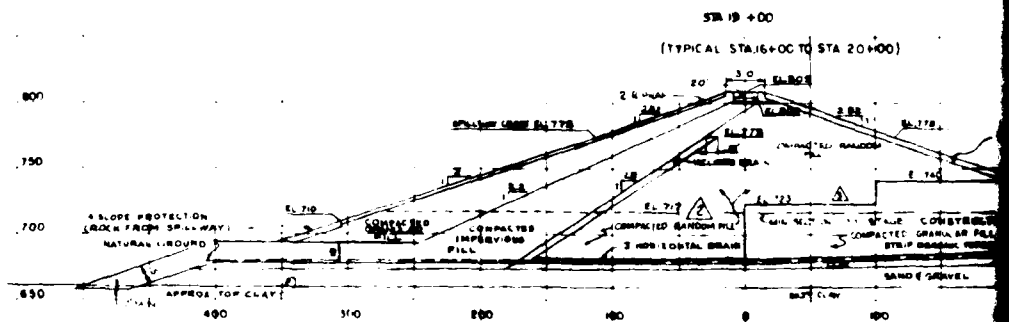
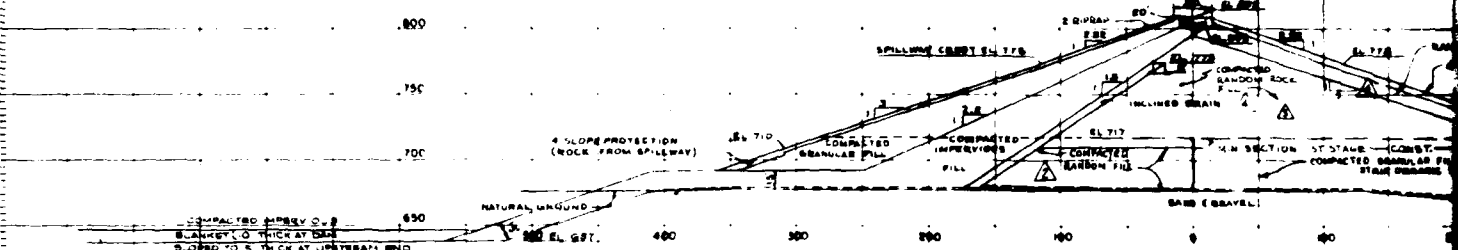
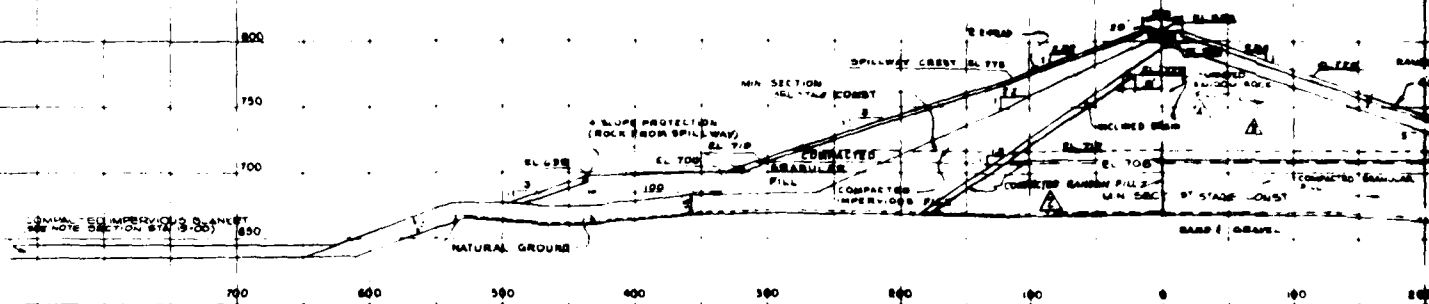


DESIGNED BY	CHICAGO DISTRICT
DRAWN BY	CHICAGO DISTRICT
TRACED BY	CHICAGO DISTRICT
CHECKED BY	CHICAGO DISTRICT
APPROVED	CHICAGO DISTRICT
U.S. ARMY ENGINEER DISTRICT LOUISVILLE CORPS OF ENGINEERS CHICAGO DISTRICT	
CHICAGO DISTRICT BROOKVILLE RESERVOIR EAST FORK WHITEWATER RIVER INDIANA BORING LOCATION PLAN SHEET 1	
DATE 12/23/57	
SCALE 1" = 100'	
PLATE NO. 11	
EW 22423-57	

RECORD DRAWING AS BUE

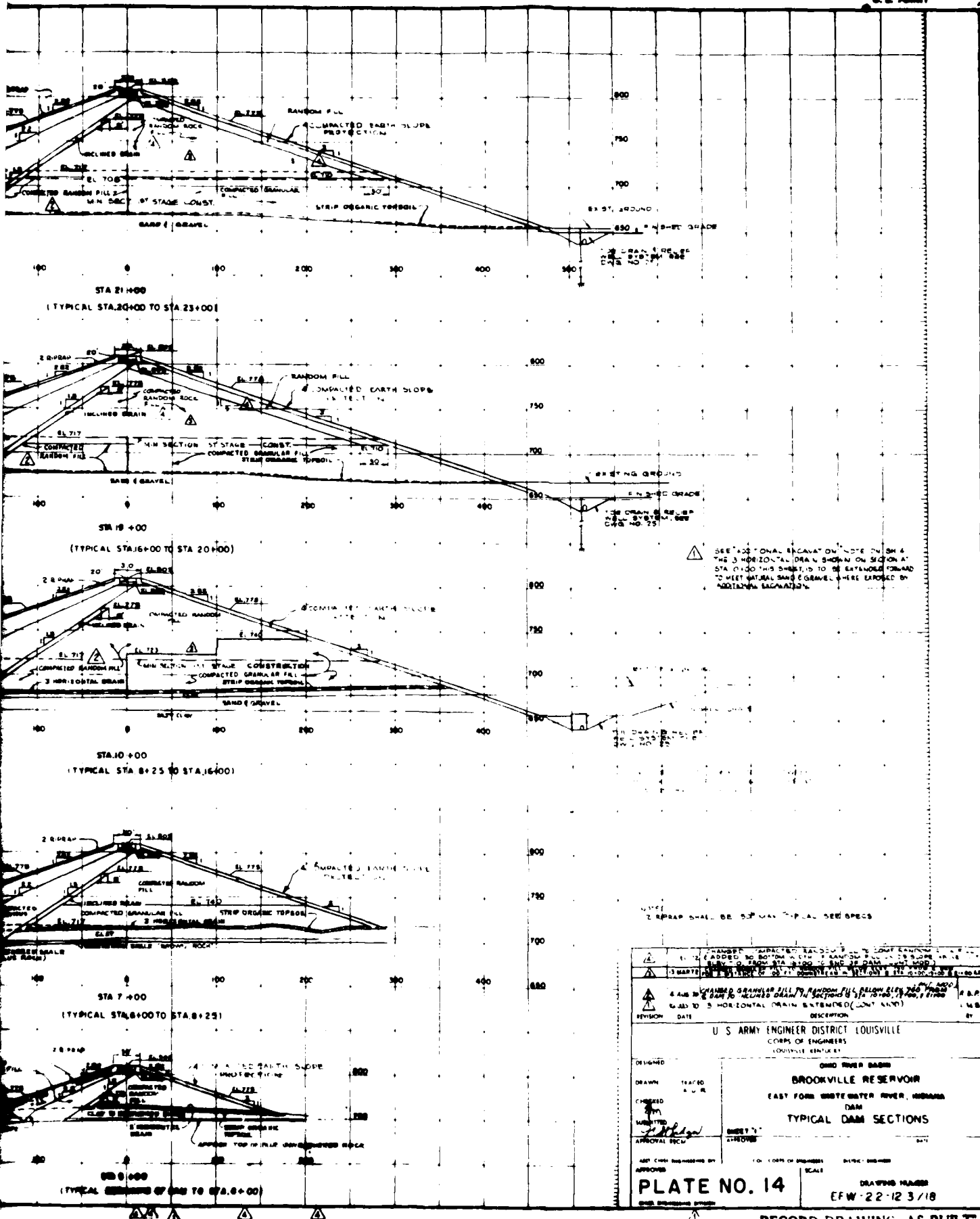


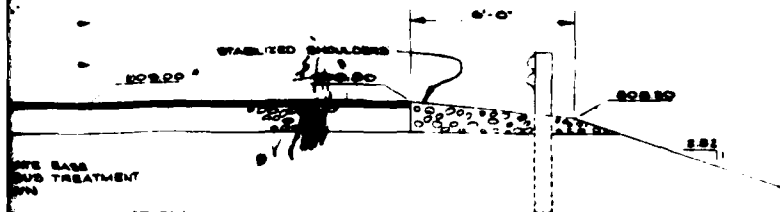




1' STAGE COUNT

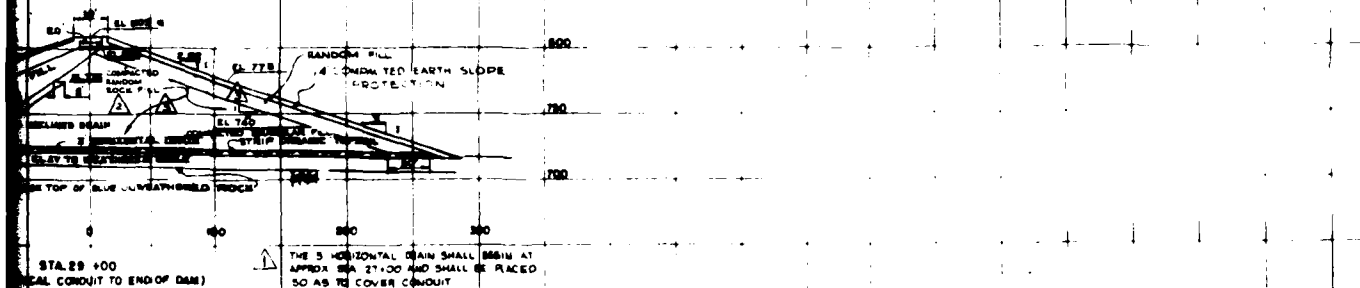
1' STAGE COUNT



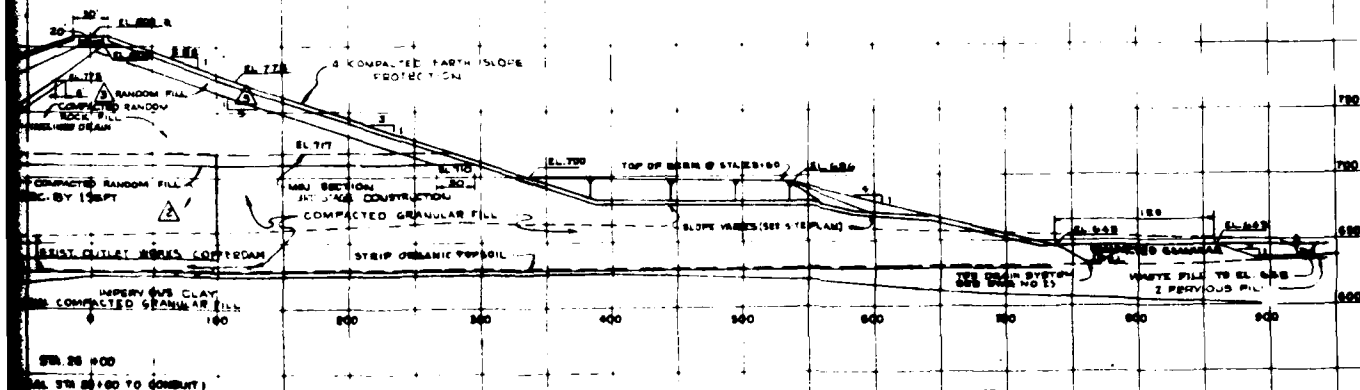


TYPICAL SECTION

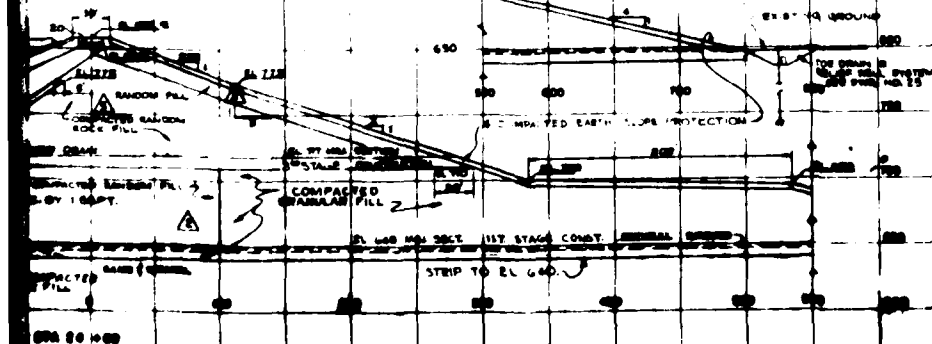
SEE DAM CAMBER FOR CONST. EL. SH. IS
TYP. FOR ALL SECTIONS SH. IS 4.15



STA. 29+00
TYPICAL CONDUIT TO END OF DAM



NOTE: SLOPE SHALL BE 1:1 MAX. (TYPICAL) SEE SPEC.

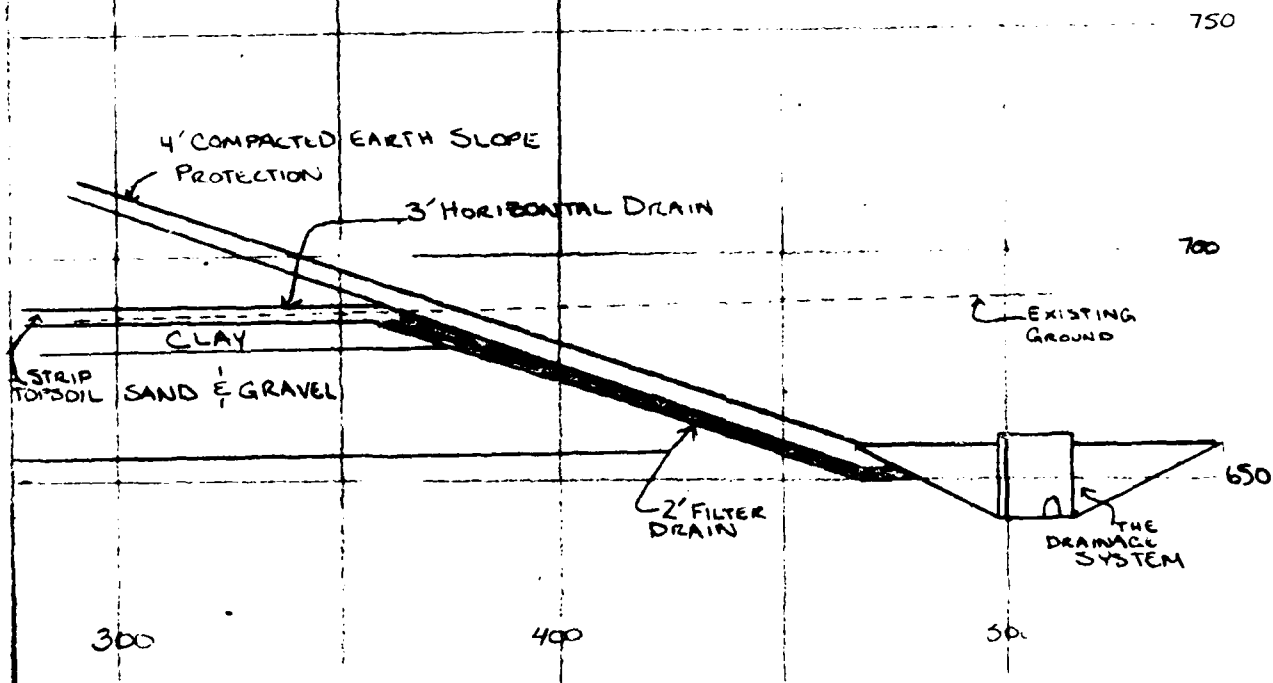


5 DEC 78	CHANGED COMPACTED RANDOM FILL TO COMP. RANDOM ROCK FILL AND ADDED 30' BOTTOM WIDTH OF RANDOM FILL ON S.S. SLOPE, ABOVE EL. 710, FROM STA. 15+00 TO END OF DAM (CONTR. 1580)	DLT
5 APR 79	CHANGED RANDOM FILL TO COMP. RANDOM ROCK FILL AND ADDED 30' BOTTOM WIDTH OF RANDOM FILL ON S.S. SLOPE, ABOVE EL. 710, FROM STA. 15+00 TO END OF DAM (CONTR. 1580)	DLT
20 JUL 79	CHANGED RANDOM FILL TO COMP. RANDOM ROCK FILL AND ADDED 30' BOTTOM WIDTH OF RANDOM FILL ON S.S. SLOPE, ABOVE EL. 710, FROM STA. 15+00 TO END OF DAM (CONTR. 1580)	DLT

U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE DISTRICT

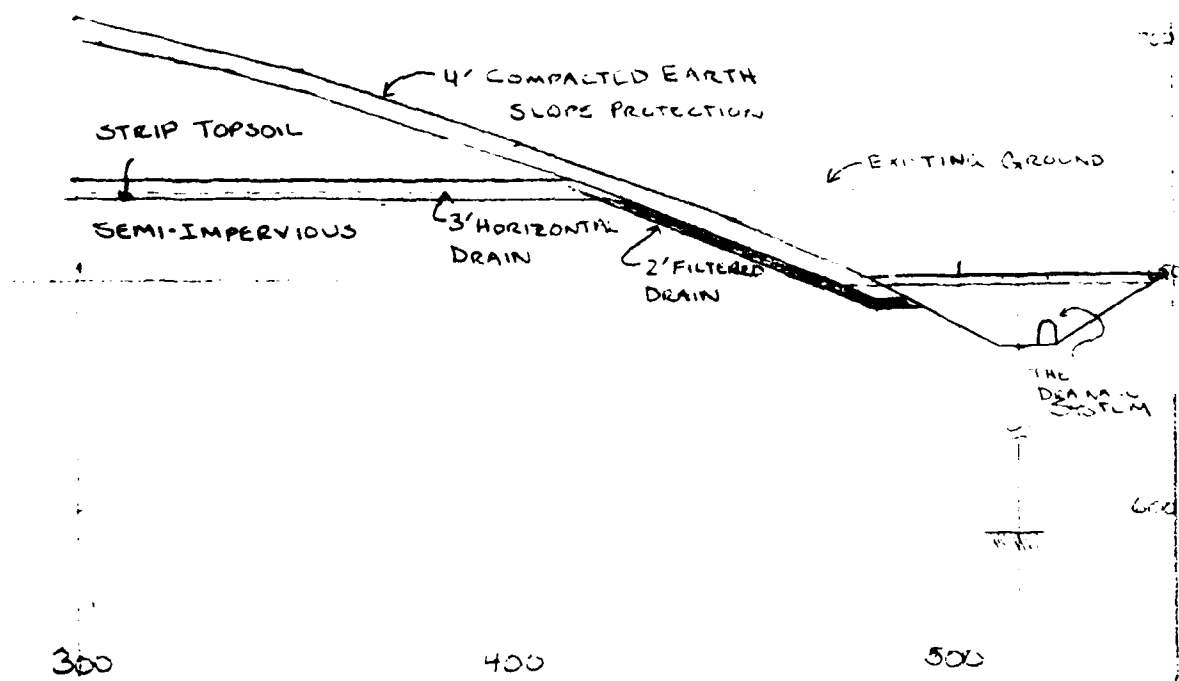
DESIGNED	BY	CHAS. H. BROWN
DRAWN	BY	JOHN A. J. R.
CHECKED	BY	JOHN A. J. R.
ORIGINAL	BY	JOHN A. J. R.

PLATE NO. 15
BROOKVILLE RESERVOIR
EAST FORK MISSOURI RIVER, MISSOURI
TYPICAL DAM SECTIONS
SPW-23-23/10
RECORD DRAWING: AS



TREATMENT BETWEEN 11+75-12+25

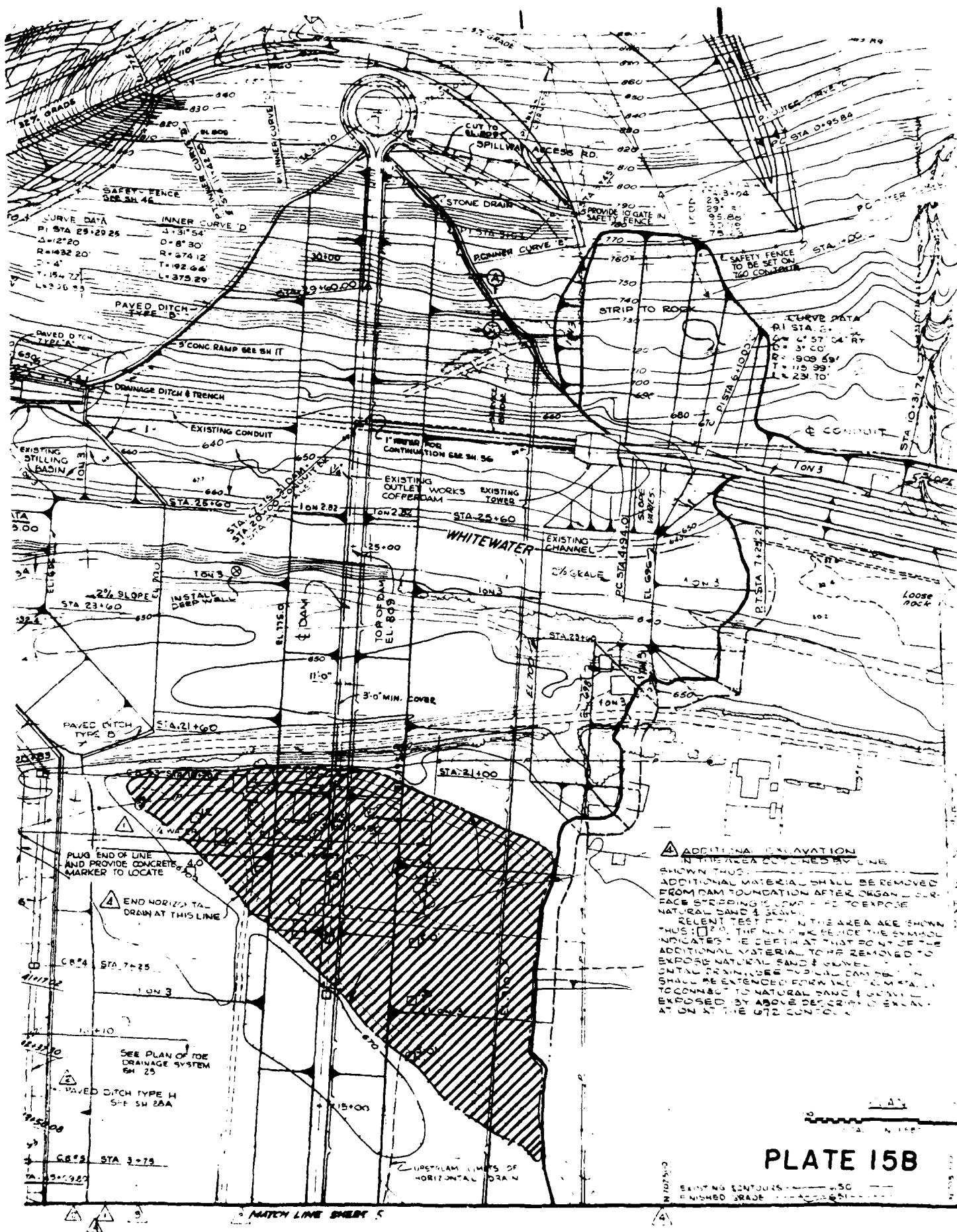
BROOKVILLE LAKE
 ADDITIONAL HORIZONTAL DRAINS
 SHEET 1 OF 2

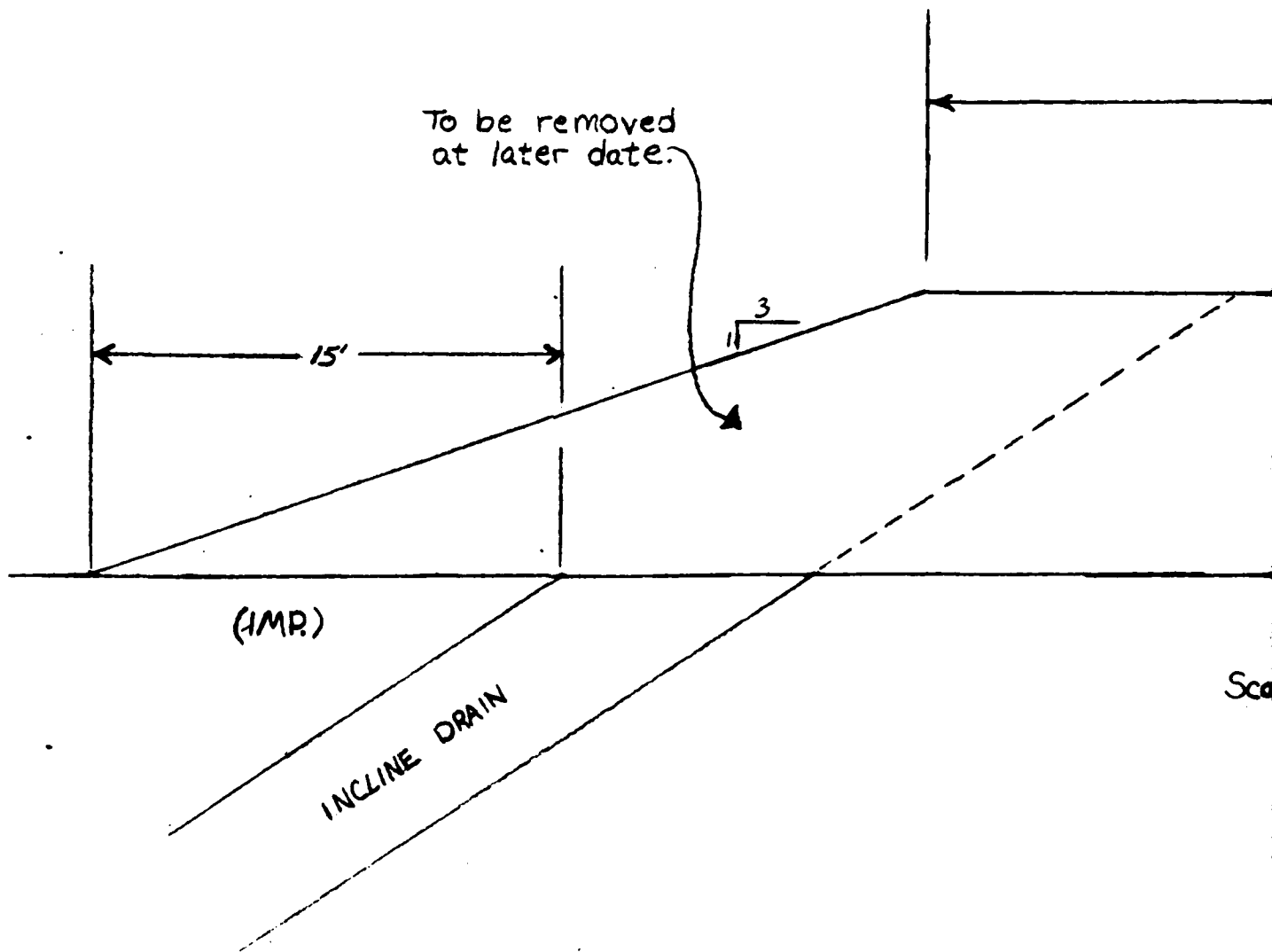


TREATMENT BETWEEN 19+50 - 20+00

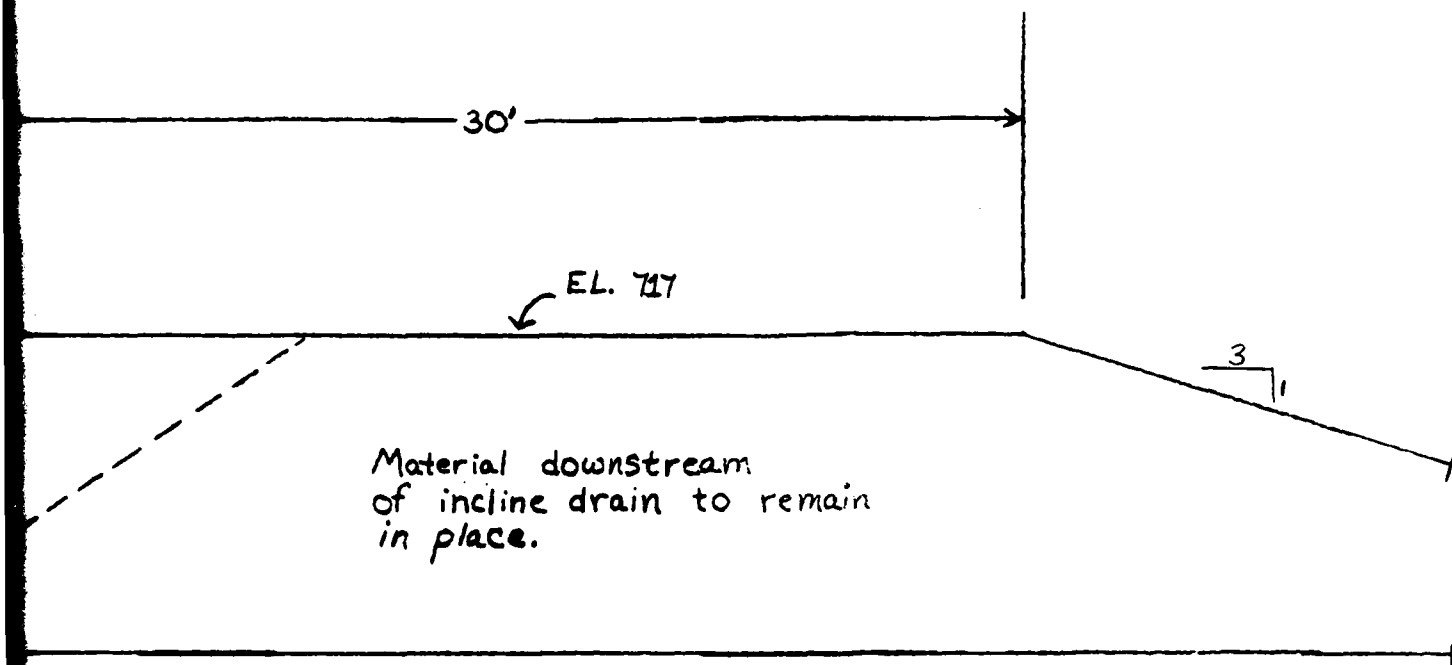
BROOKVILLE LAKE
ADDITIONAL HORIZONTAL DRAINS
SHEET 2 OF 2

PLATE 15A





Upstream toe of dike is to be a minimum of 15 ft. upstream of upstream edge of the incline drain and constructed on a 3 on 1 slope to a minimum elev. of 717.



(RANDOM)

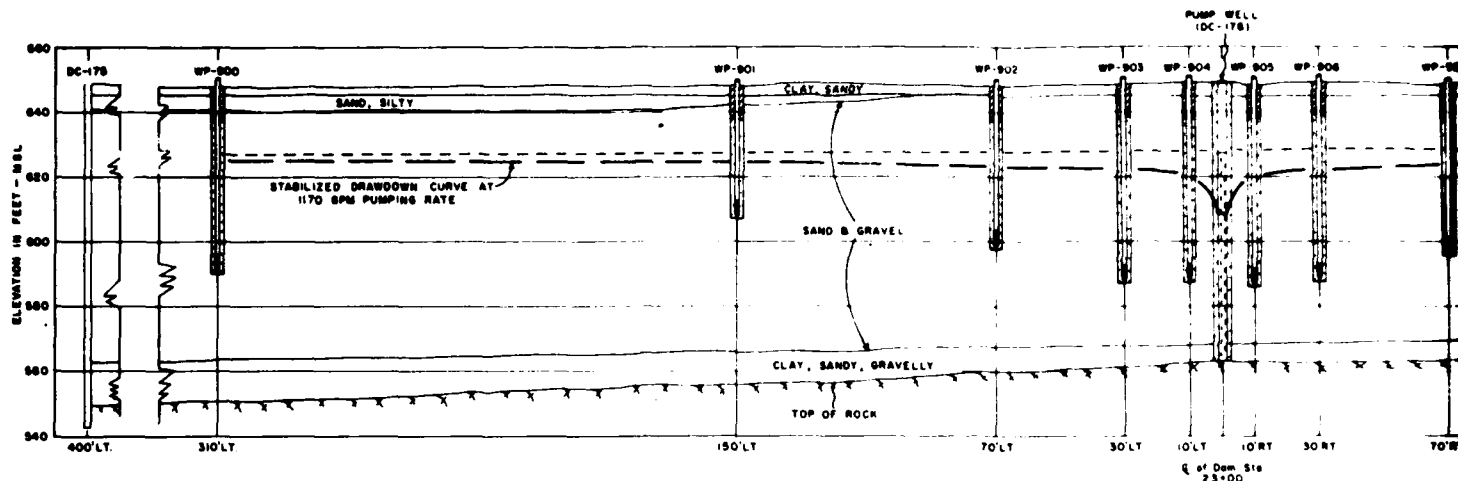
Scale: 1" = 5'

Temporary Protection Dike

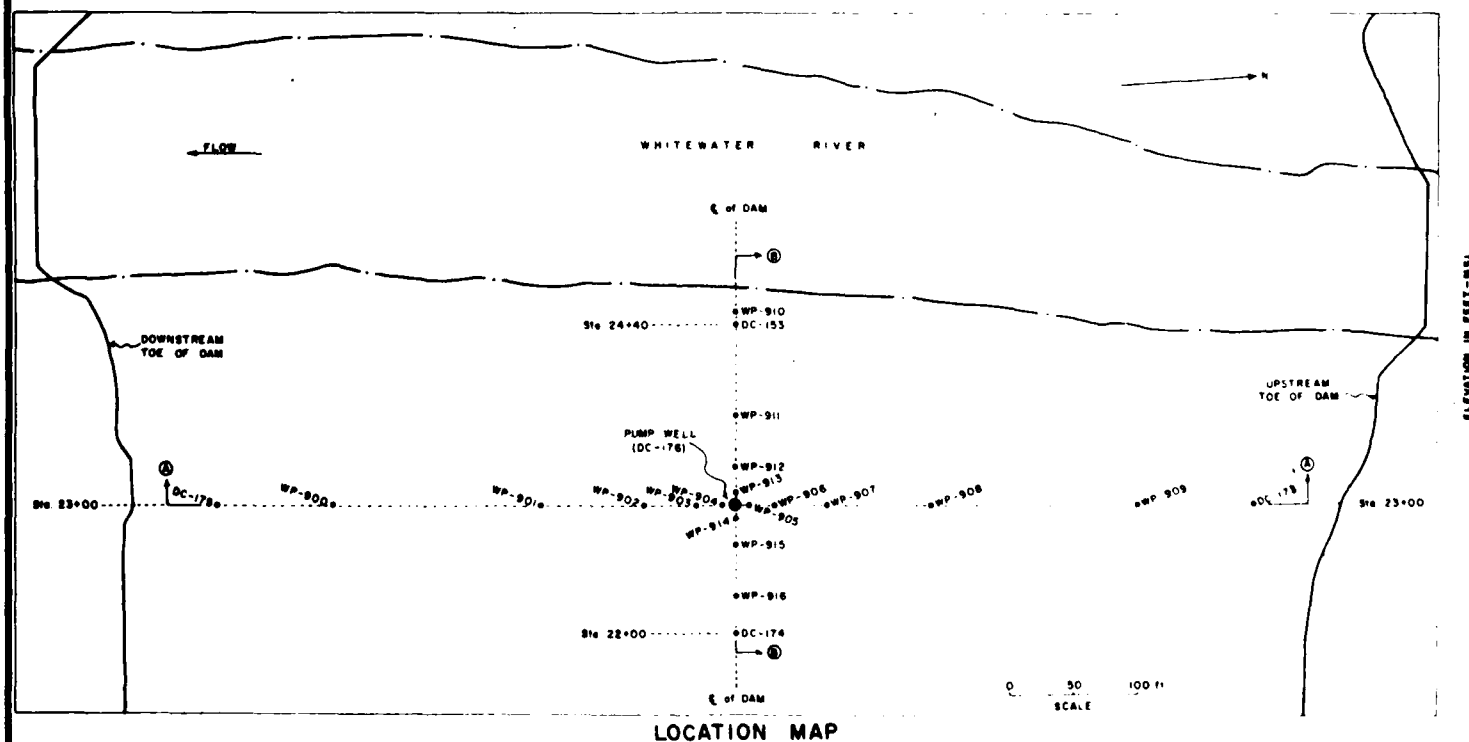
Dwg. No. BRO SK-1

Contr. No. DACW27-70-C-0079

Plate 15C

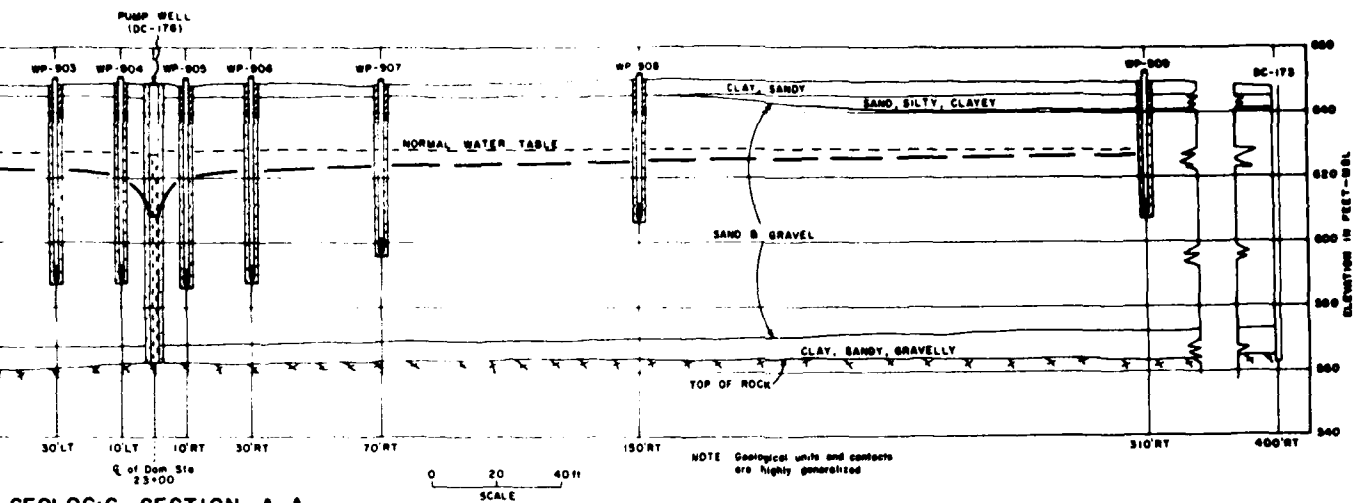


GEOLOGIC SECTION A-A

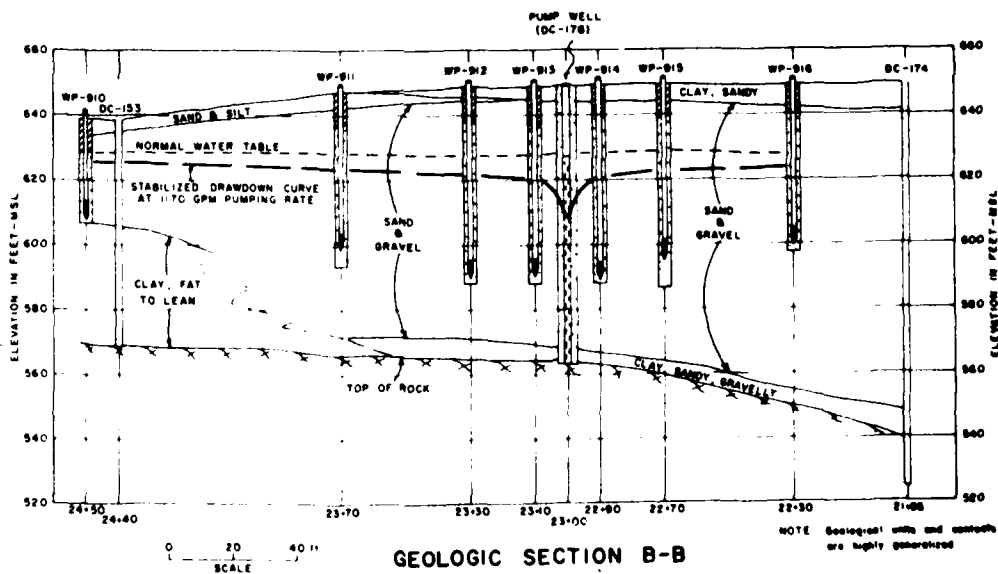


LOCATION MAP

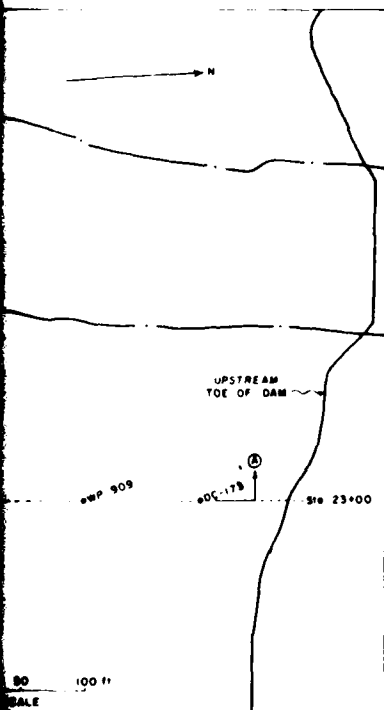
REVISIONS			
NO.	DATE	DESCRIPTION	BY



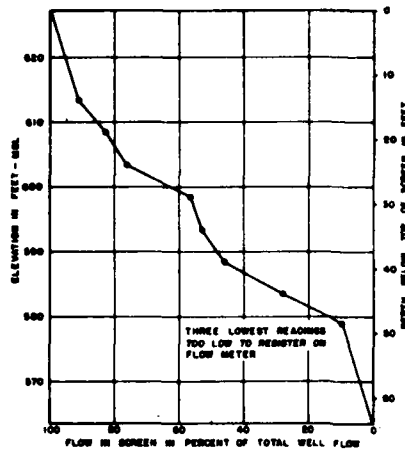
GEOLOGIC SECTION A-A



GEOLOGIC SECTION B-B

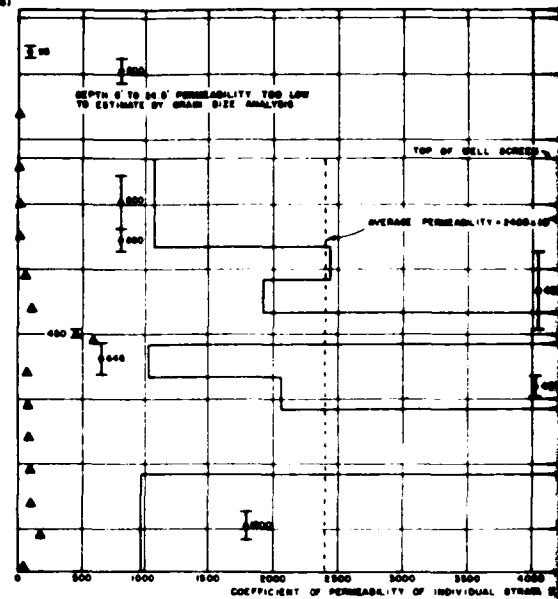


U. S. ARMY DIST. LOWVILLE CORPS OF ENGINEERS LOWVILLE DISTRICT LOWVILLE, N.Y.		U. S. ARMY DIST. LOWVILLE CORPS OF ENGINEERS CORPS OF ENGINEERS LOWVILLE, N.Y.	
BROOKVILLE RESERVOIR WHITewater RIVER, INDIANA			
GEOLOGIC SECTIONS AND LOCATION MAP			
BY: WP-910	DATE: 10-1-50	BY: WP-910	DATE: 10-1-50
SCALE: 1" = 40'	BY: WP-910	DATE: 10-1-50	BY: WP-910

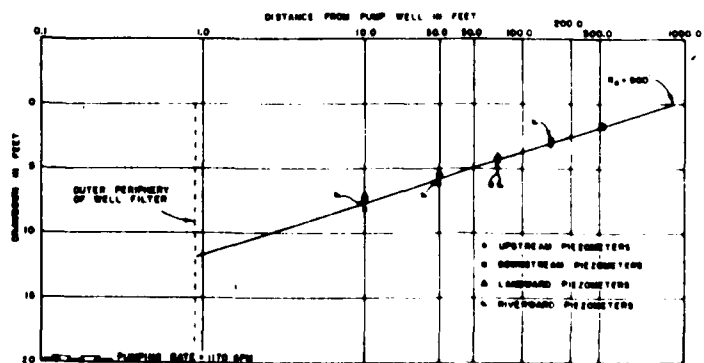


FLOW IN WELL AT VARIOUS DEPTHS
IN PERCENT OF TOTAL FLOW

PUMP WELL
(SAMPLE LOG SC-176)



COEFFICIENT OF PERMEABILITY OF INDIVIDUAL STRATA



DRAWDOWN CURVE

(SEE .00 SCALE)

PERMEABILITY TOO LOW

COEFFICIENT OF PERMEABILITY OF INDIVIDUAL STRAIN $\times 10^{-4}$ FT/MIN

TOP OF WELL SCREEN

AVERAGE PERMEABILITY = 2400×10^{-4} FT/MIN.

600

500

400

300

200

170

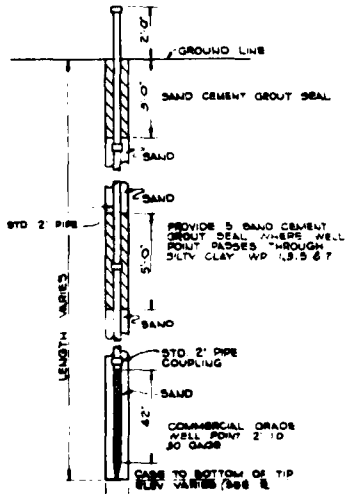
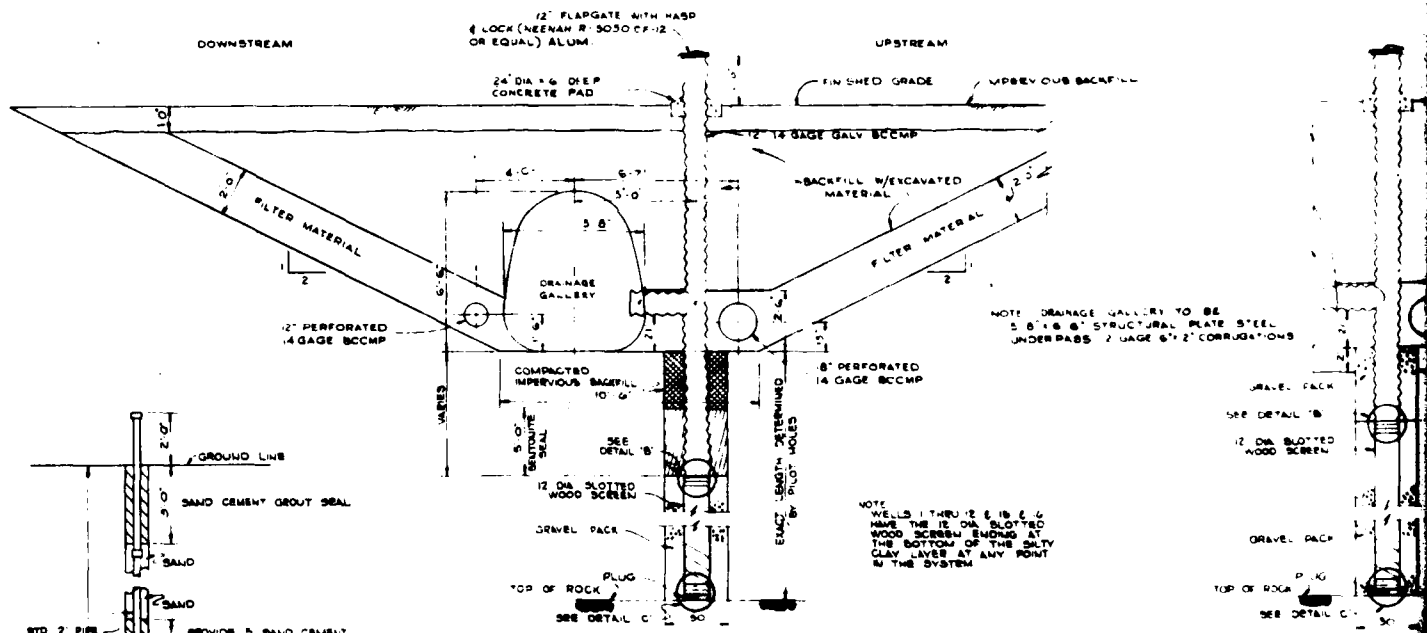
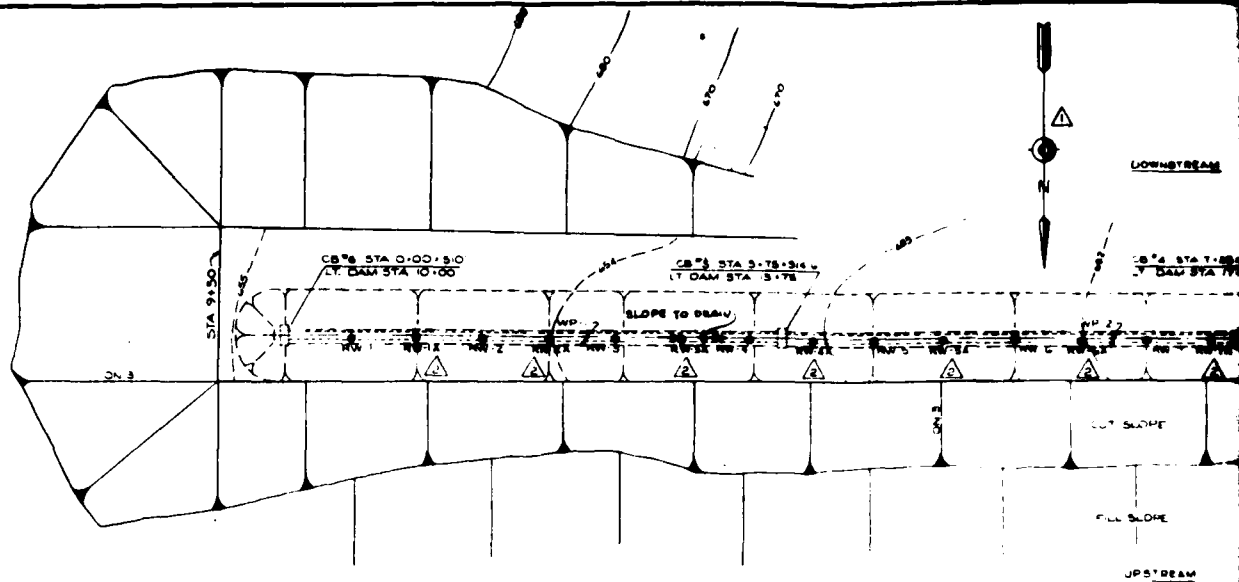
1000 2000 3000 4000 5000 6000

EL. 000.0 TOP OF CASING
EL. 000.7 SCREEN SURFACE
1/2" STEEL CASING PIPE
EL. 007.4 TOP OF WELL SCREEN
GRAVEL FILTER

1/2" I.D. WELL SCREEN,
STEEL, SLOTTED TYPE
OF 1/16" OPENINGS
36" DIA. SILL HOLE

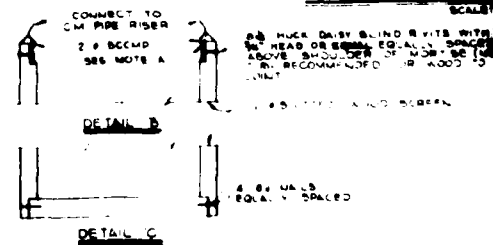
EL. 000.0 BOTTOM OF CASING
EL. 000.0 TOP OF CASING
EL. 000.0 BOTTOM OF SILL

U.S. GEOLOGICAL SURVEY WATER RESOURCES DIVISION LANSING, MICHIGAN		U.S. GEOLOGICAL SURVEY WATER RESOURCES DIVISION ANN ARBOR, MICHIGAN	
GRANDVILLE RESERVOIR WATERWAY AVENUE, GRANDVILLE, MICHIGAN			
FLOW METER & PERMEABILITY DATA, DRAWDOWN CURVE AND DETAIL OF PUMP WELL & TYPICAL PIEZOMETER			
DATE: 1961		PAGE: 10	
DRAWN BY: JES		CHECKED BY: JES	

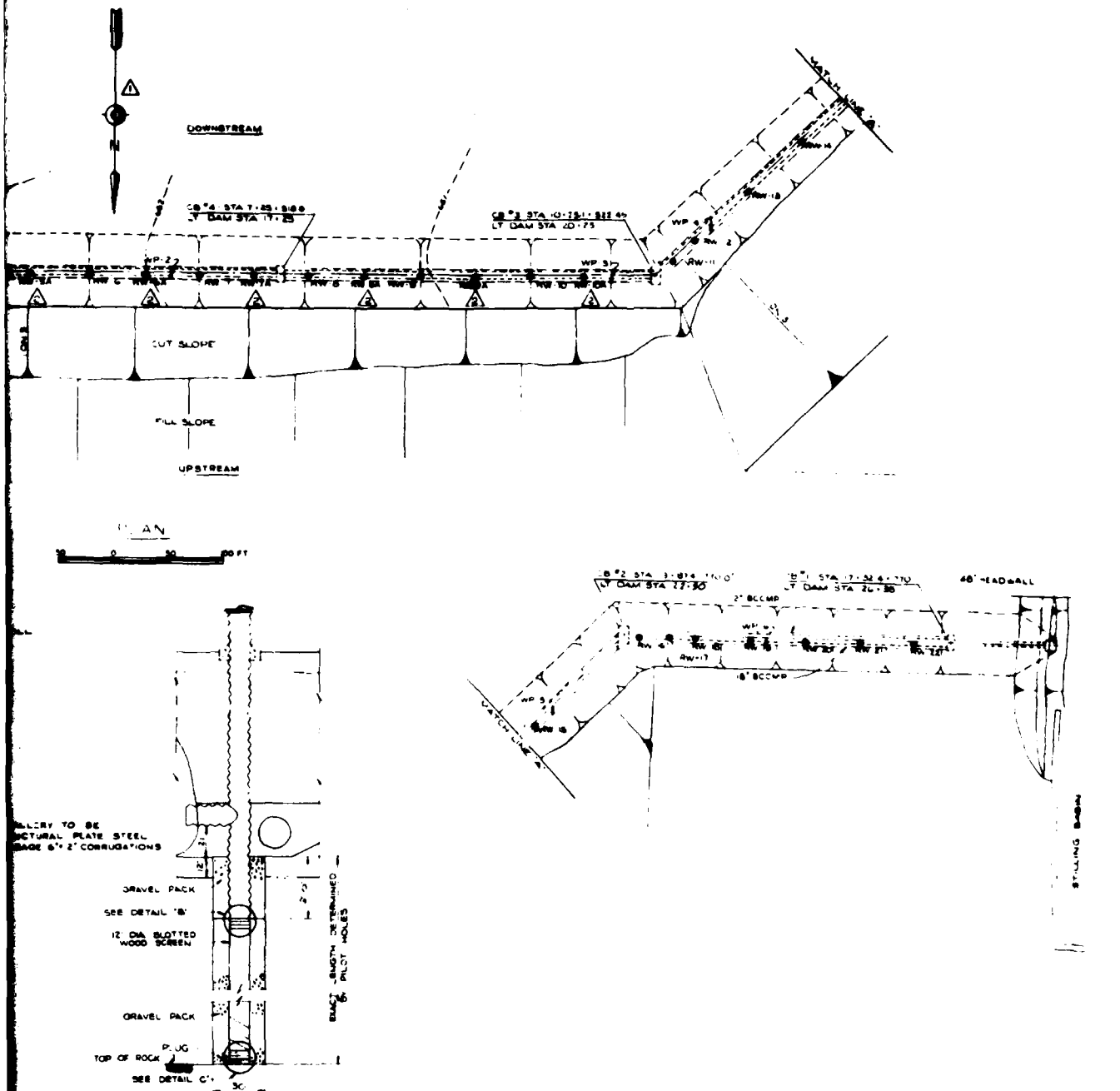


WELL POINT DETAIL
SCALE: 1"=20'

TYPICAL SECTION - WELLS 1 THRU 12, 6, 15 & 16
SCALE: 1/2"=1'-0"



NOTE: CUT 2\"/>



TYPICAL SECTION - WELLS 3, 4 & 7 THRU 22

2" HUCK BOLT BLIND RIVETS WITH
BY HEAD OR TAIL - EQUALLY SPACED - 16"
ABOVE SHOULDER OF MORTISE (NO 12")
R. RECOMMENDED FOR WOOD TO WOOD
JOINT

1" SLOTTED WOOD SCREEN

6" x 2" NAILS
EQUALLY SPACED

6" x 1/2" VALVE SO AS TO GET A
WY IN ABOVE MORTISE SHOULDER
WITH WASTIC

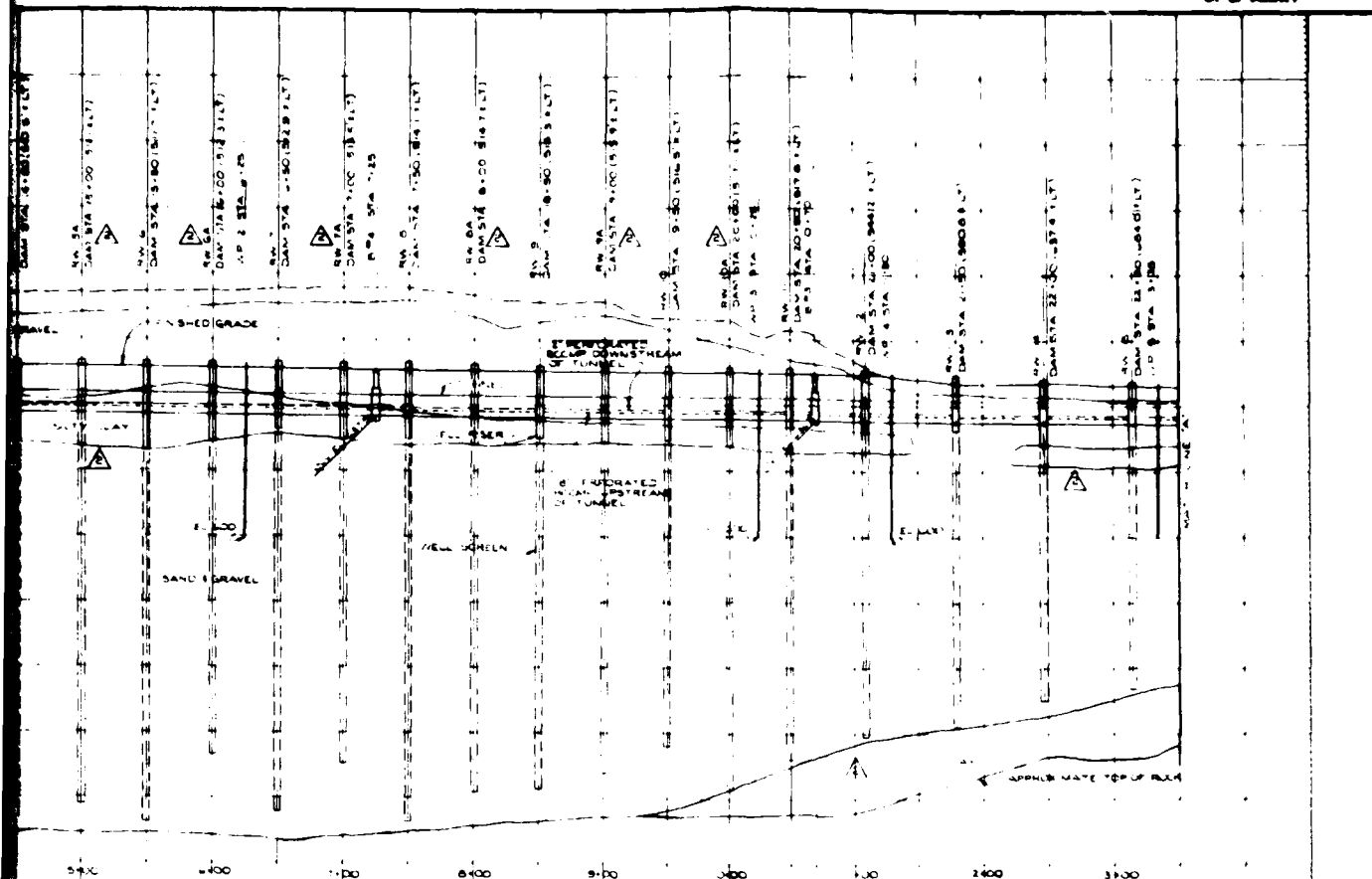
NOV 10	ADDED ADDITIONAL RELIEF WELLS - CONT MOD 1	AME
1940	1940 TO REV. HERE AND NO 1 DATED 4 FEB 1970	AME
DATE	DESCRIPTION	BY
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE		
CORPS OF ENGINEERS		
LOUISVILLE DISTRICT		
DESIGNED	CHAS EVER GARD	
DESIGN	TRACED BY M. D.	
REVIEWED		
SCALE	AS SHOWN	
T.S.N.		
DRAWING NUMBER		
EFW-22-123/25		
PLATE NO. 18		

RECORD DRAWING - AS BUILT

The drawing consists of two main parts: a longitudinal section at the top and a plan view at the bottom.

- Longitudinal Section:** Shows the dam structure from its upstream face to the downstream toe. It features multiple vertical piles or columns embedded in the foundation. Elevation markings are present along both the horizontal and vertical axes. Labels such as "SAND & GRAVEL" indicate the composition of the foundation materials.
- Plan View:** Illustrates the layout of the dam and associated structures, including what appears to be a powerhouse and various gates. It includes specific annotations for structural components like "GATE", "PIERS", and "SPILLWAYS". Stationing is used to locate different points along the length of the dam.

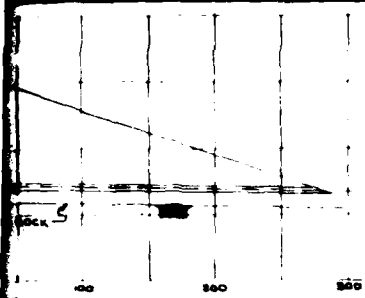
Throughout the drawing, there are numerous numerical values representing elevations and stations, as well as descriptive text identifying materials and structural elements.



225' DAM STA
100'

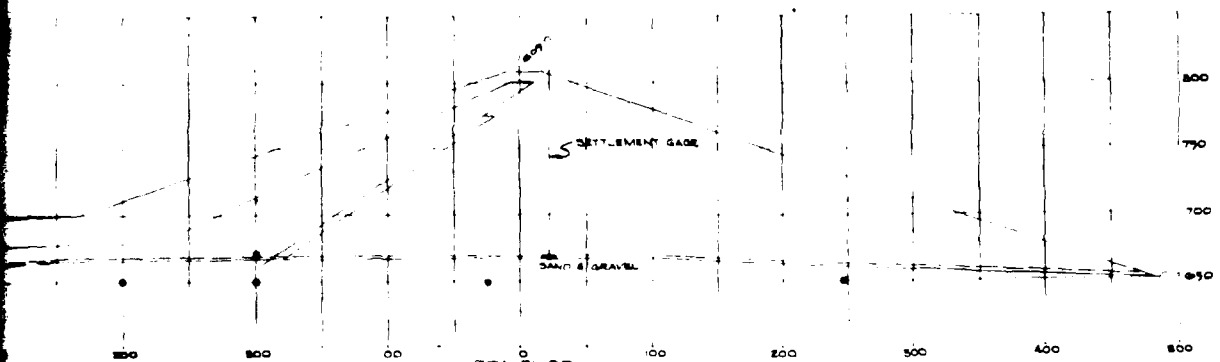
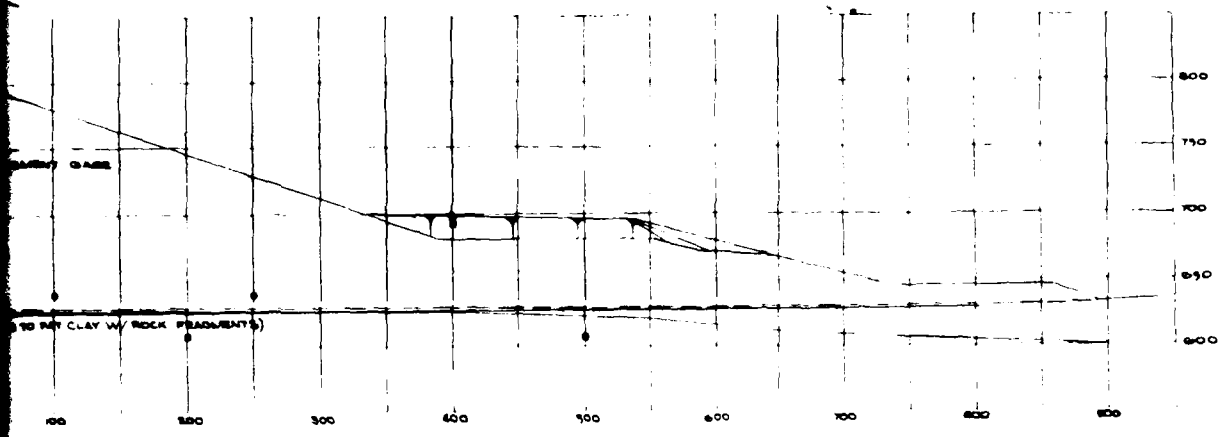
U. S. ARMY ENGINEER DISTRICT LOUISVILLE CORPS OF ENGINEERS LOUISVILLE DISTRICT	
DESIGNED DRAWN CHECKED APPROVED DATE	OHIO RIVER BASIN BROOKVILLE RESERVOIR EAST FORK WHITEWATER RIVER, INDIANA TOE DRAINAGE SYSTEM PROFILE DRAWING NUMBER EFW-22-123/26
PLATE NO. 19	

RECORD DRAWING AS BUILT



MOVEMENT MONUMENTS - 8			
DAM STATION	400 FT US	15 FT DS	400 FT DS
8 8:50	X		X
9:00		X	
9:10			
9:30	X	X	X
10:00	X		
12:00	X	X	X
14:00		X	X
18:00		X	X
18:30	X	X	
20:00		X	X
22:00	X		
24:00	X	X	X
28:00	X		X
28:30	X		X
30:00			
32:25	X		X
32:40		X	

SETTLEMENT PLATE	
DATE/TIME	OFFICER
12:00	27 05
21:00	20 08
24:00	20 05

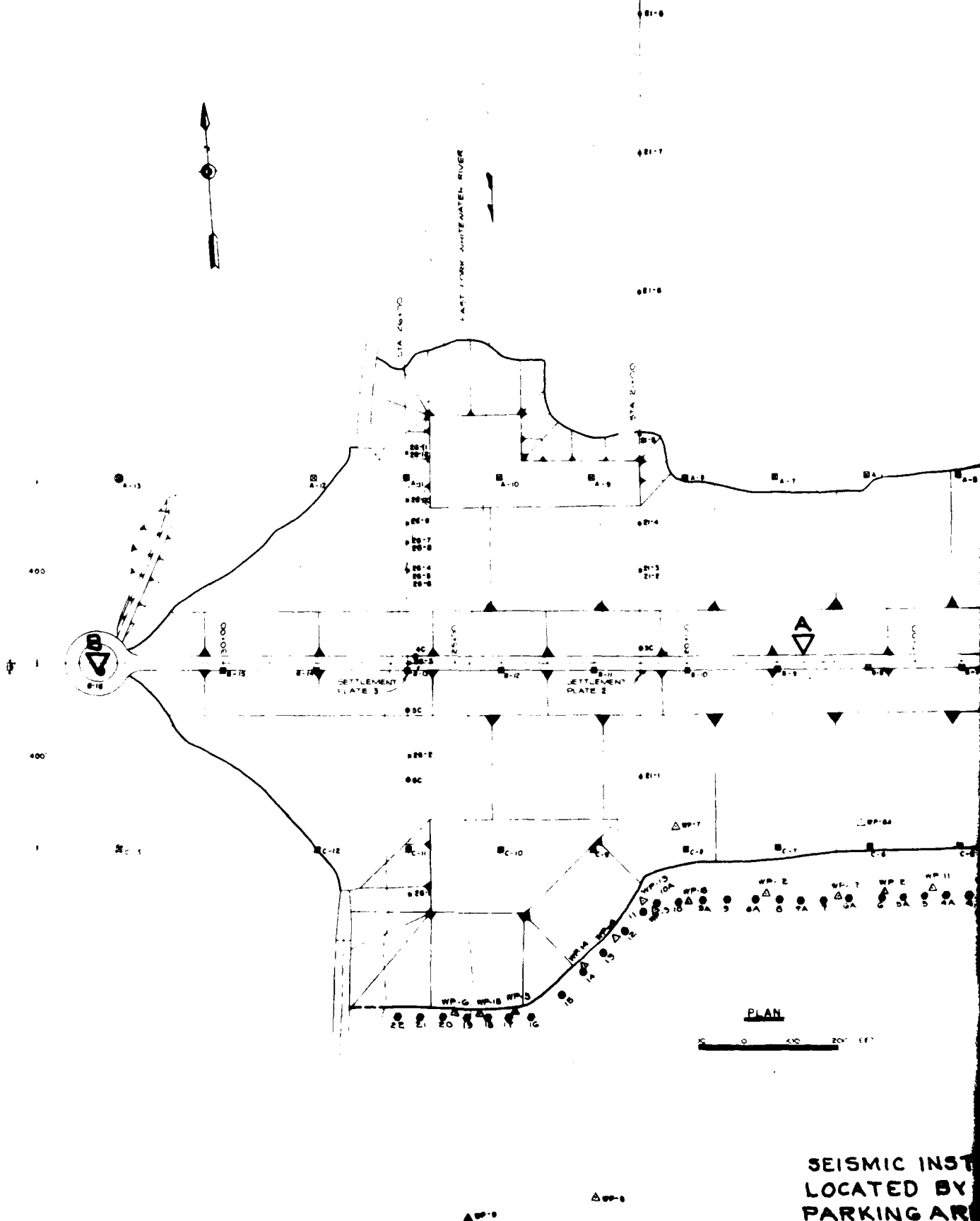
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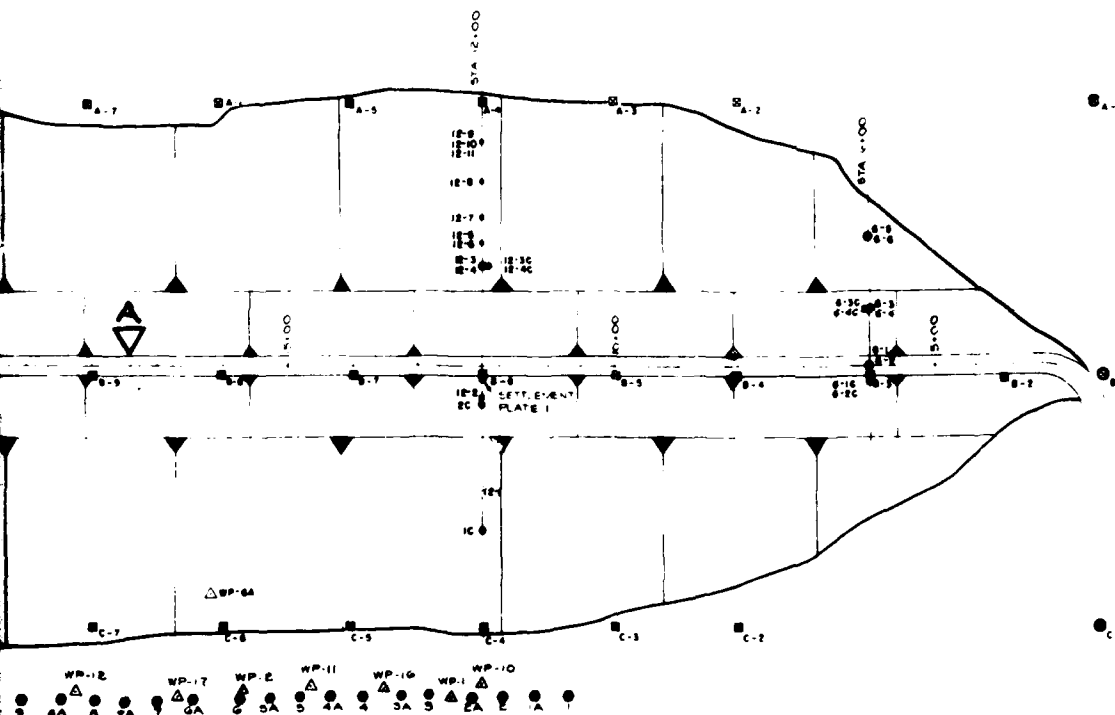
025 - 2E - AD2E
 025 - 2E - 350 LT
 025 - 2E - 350 LT
 025 - 2E - 400 LT
 025 - 2E - 200 LT

- CASABLANCA TYPE PRISONERS
- A-24 A-25 A-26 A-27 A-28 A-29 A-30 A-31 A-32 A-33 A-34 A-35 A-36 A-37 A-38 A-39 A-40 A-41 A-42 A-43 A-44 A-45 A-46 A-47 A-48 A-49 A-50 A-51 A-52 A-53 A-54 A-55 A-56 A-57 A-58 A-59 A-60 A-61 A-62 A-63 A-64 A-65 A-66 A-67 A-68 A-69 A-70 A-71 A-72 A-73 A-74 A-75 A-76 A-77 A-78 A-79 A-80 A-81 A-82 A-83 A-84 A-85 A-86 A-87 A-88 A-89 A-90 A-91 A-92 A-93 A-94 A-95 A-96 A-97 A-98 A-99 A-100 A-101 A-102 A-103 A-104 A-105 A-106 A-107 A-108 A-109 A-110 A-111 A-112 A-113 A-114 A-115 A-116 A-117 A-118 A-119 A-120 A-121 A-122 A-123 A-124 A-125 A-126 A-127 A-128 A-129 A-130 A-131 A-132 A-133 A-134 A-135 A-136 A-137 A-138 A-139 A-140 A-141 A-142 A-143 A-144 A-145 A-146 A-147 A-148 A-149 A-150 A-151 A-152 A-153 A-154 A-155 A-156 A-157 A-158 A-159 A-160 A-161 A-162 A-163 A-164 A-165 A-166 A-167 A-168 A-169 A-170 A-171 A-172 A-173 A-174 A-175 A-176 A-177 A-178 A-179 A-180 A-181 A-182 A-183 A-184 A-185 A-186 A-187 A-188 A-189 A-190 A-191 A-192 A-193 A-194 A-195 A-196 A-197 A-198 A-199 A-200 A-201 A-202 A-203 A-204 A-205 A-206 A-207 A-208 A-209 A-210 A-211 A-212 A-213 A-214 A-215 A-216 A-217 A-218 A-219 A-220 A-221 A-222 A-223 A-224 A-225 A-226 A-227 A-228 A-229 A-230 A-231 A-232 A-233 A-234 A-235 A-236 A-237 A-238 A-239 A-240 A-241 A-242 A-243 A-244 A-245 A-246 A-247 A-248 A-249 A-250 A-251 A-252 A-253 A-254 A-255 A-256 A-257 A-258 A-259 A-260 A-261 A-262 A-263 A-264 A-265 A-266 A-267 A-268 A-269 A-270 A-271 A-272 A-273 A-274 A-275 A-276 A-277 A-278 A-279 A-280 A-281 A-282 A-283 A-284 A-285 A-286 A-287 A-288 A-289 A-290 A-291 A-292 A-293 A-294 A-295 A-296 A-297 A-298 A-299 A-300 A-301 A-302 A-303 A-304 A-305 A-306 A-307 A-308 A-309 A-310 A-311 A-312 A-313 A-314 A-315 A-316 A-317 A-318 A-319 A-320 A-321 A-322 A-323 A-324 A-325 A-326 A-327 A-328 A-329 A-330 A-331 A-332 A-333 A-334 A-335 A-336 A-337 A-338 A-339 A-340 A-341 A-342 A-343 A-344 A-345 A-346 A-347 A-348 A-349 A-350 A-351 A-352 A-353 A-354 A-355 A-356 A-357 A-358 A-359 A-360 A-361 A-362 A-363 A-364 A-365 A-366 A-367 A-368 A-369 A-370 A-371 A-372 A-373 A-374 A-375 A-376 A-377 A-378 A-379 A-380 A-381 A-382 A-383 A-384 A-385 A-386 A-387 A-388 A-389 A-390 A-391 A-392 A-393 A-394 A-395 A-396 A-397 A-398 A-399 A-400 A-401 A-402 A-403 A-404 A-405 A-406 A-407 A-408 A-409 A-410 A-411 A-412 A-413 A-414 A-415 A-416 A-417 A-418 A-419 A-420 A-421 A-422 A-423 A-424 A-425 A-426 A-427 A-428 A-429 A-430 A-431 A-432 A-433 A-434 A-435 A-436 A-437 A-438 A-439 A-440 A-441 A-442 A-443 A-444 A-445 A-446 A-447 A-448 A-449 A-450 A-451 A-452 A-453 A-454 A-455 A-456 A-457 A-458 A-459 A-460 A-461 A-462 A-463 A-464 A-465 A-466 A-467 A-468 A-469 A-470 A-471 A-472 A-473 A-474 A-475 A-476 A-477 A-478 A-479 A-480 A-481 A-482 A-483 A-484 A-485 A-486 A-487 A-488 A-489 A-490 A-491 A-492 A-493 A-494 A-495 A-496 A-497 A-498 A-499 A-500 A-501 A-502 A-503 A-504 A-505 A-506 A-507 A-508 A-509 A-510 A-511 A-512 A-513 A-514 A-515 A-516 A-517 A-518 A-519 A-520 A-521 A-522 A-523 A-524 A-525 A-526 A-527 A-528 A-529 A-530 A-531 A-532 A-533 A-534 A-535 A-536 A-537 A-538 A-539 A-540 A-541 A-542 A-543 A-544 A-545 A-546 A-547 A-548 A-549 A-550 A-551 A-552 A-553 A-554 A-555 A-556 A-557 A-558 A-559 A-560 A-561 A-562 A-563 A-564 A-565 A-566 A-567 A-568 A-569 A-570 A-571 A-572 A-573 A-574 A-575 A-576 A-577 A-578 A-579 A-580 A-581 A-582 A-583 A-584 A-585 A-586 A-587 A-588 A-589 A-590 A-591 A-592 A-593 A-594 A-595 A-596 A-597 A-598 A-599 A-600 A-601 A-602 A-603 A-604 A-605 A-606 A-607 A-608 A-609 A-610 A-611 A-612 A-613 A-614 A-615 A-616 A-617 A-618 A-619 A-620 A-621 A-622 A-623 A-624 A-625 A-626 A-627 A-628 A-629 A-630 A-631 A-632 A-633 A-634 A-635 A-636 A-637 A-638 A-639 A-640 A-641 A-642 A-643 A-644 A-645 A-646 A-647 A-648 A-649 A-650 A-651 A-652 A-653 A-654 A-655 A-656 A-657 A-658 A-659 A-660 A-661 A-662 A-663 A-664 A-665 A-666 A-667 A-668 A-669 A-670 A-671 A-672 A-673 A-674 A-675 A-676 A-677 A-678 A-679 A-680 A-681 A-682 A-683 A-684 A-685 A-686 A-687 A-688 A-689 A-690 A-691 A-692 A-693 A-694 A-695 A-696 A-697 A-698 A-699 A-700 A-701 A-702 A-703 A-704 A-705 A-706 A-707 A-708 A-709 A-710 A-711 A-712 A-713 A-714 A-715 A-716 A-717 A-718 A-719 A-720 A-721 A-722 A-723 A-724 A-725 A-726 A-727 A-728 A-729 A-730 A-731 A-732 A-733 A-734 A-735 A-736 A-737 A-738 A-739 A-740 A-741 A-742 A-743 A-744 A-745 A-746 A-747 A-748 A-749 A-750 A-751 A-752 A-753 A-754 A-755 A-756 A-757 A-758 A-759 A-760 A-761 A-762 A-763 A-764 A-765 A-766 A-767 A-768 A-769 A-770 A-771 A-772 A-773 A-774 A-775 A-776 A-777 A-778 A-779 A-780 A-781 A-782 A-783 A-784 A-785 A-786 A-787 A-788 A-789 A-790 A-791 A-792 A-793 A-794 A-795 A-796 A-797 A-798 A-799 A-800 A-801 A-802 A-803 A-804 A-805 A-806 A-807 A-808 A-809 A-810 A-811 A-812 A-813 A-814 A-815 A-816 A-817 A-818 A-819 A-820 A-821 A-822 A-823 A-824 A-825 A-826 A-827 A-828 A-829 A-830 A-831 A-832 A-833 A-834 A-835 A-836 A-837 A-838 A-839 A-840 A-841 A-842 A-843 A-844 A-845 A-846 A-847 A-848 A-849 A-850 A-851 A-85

APPROVAL	DATE	DESCRIPTION	BY
		U S ARMY ENGINEER DISTRICT LOUISVILLE CORPS OF ENGINEERS LOUISVILLE DISTRICT	
DESIGNED		OHIO RIVER BASIN	
DRAWN D.P.H.		BROOKVILLE RESERVOIR	
CHECKED G.B.B.		EAST FORK WHITEWATER RIVER, INDIANA	
BY		DAM	
REVIEWED <i>[Signature]</i>		PIEZOMETER INSTALLATION	
APPROVAL SIGN		ISSUES	DATE
BY CHIEF ENGINEER OF DISTRICT		APPROVED	
APPROVED		SCALE	DRAWING NO. : EPW-22-12379

RECORD DRAWING, AS BUILT





LEGEND

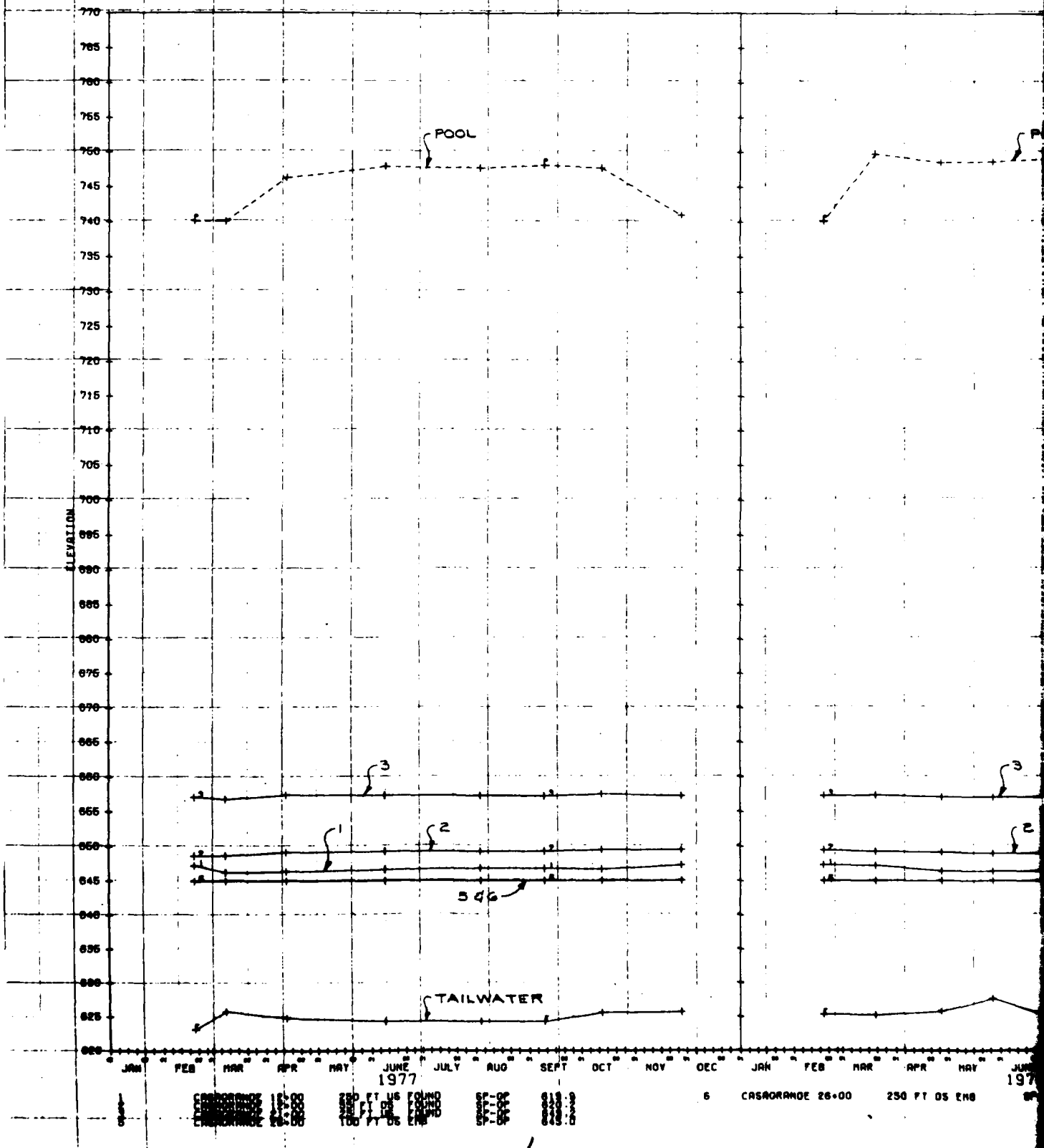
- GAS ACTUATED PIEZOMETER
- CASAGRANDE TYPE PIEZOMETER
- MOVEMENT MONUMENTS
- REFERENCE MONUMENTS
- △ WELL CONTROL TYPE PIEZOMETER
- SETTLEMENT PLATES
- RELIEF WELLS
- NONOPERATIVE GAS ACTUATED PIEZOMETER

SEISMIC INSTRUMENTS

SEISMIC INSTRUMENT "C" IS
LOCATED BY THE TAILWATER
PARKING AREA

REVISION	DATE	DESCRIPTION	BY
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE CORPS OF ENGINEERS LOUISVILLE DISTRICT			
OHIO RIVER BASIN BROOKVILLE RESERVOIR EAST FORK WHITEWATER RIVER, INDIANA DAM INSTRUMENTATION PLAN			
DESIGNED	DATE		
CHECKED	DRAWING NUMBER		

BROOKVILLE CASAGRANDE PIEZOMETERS



CASAGRANDE 18-00
CASAGRANDE 26-00

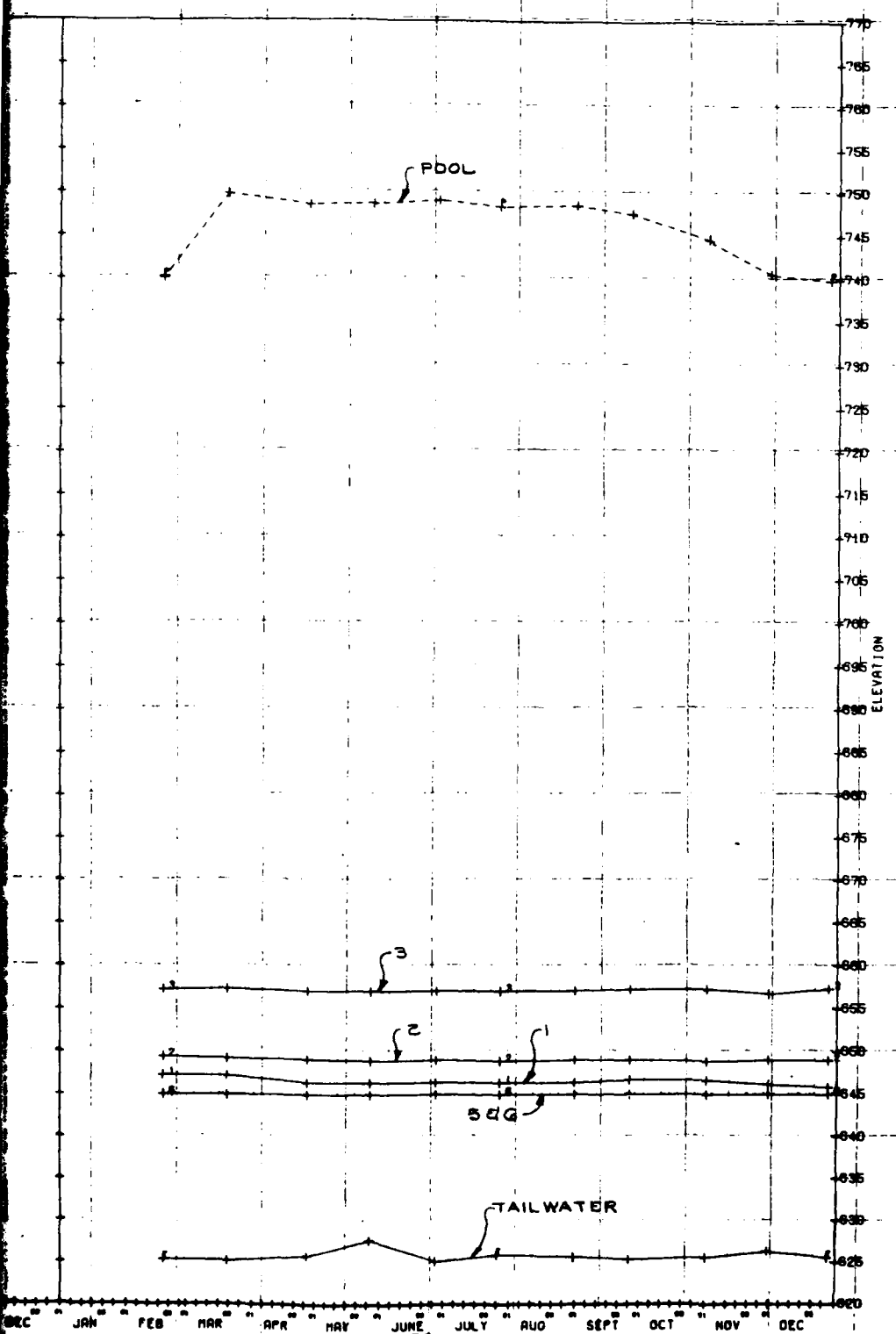
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100 FT DS END

25-00 25-00
25-00 25-00

6 CASAGRANDE 26-00 250 FT DS END

1977

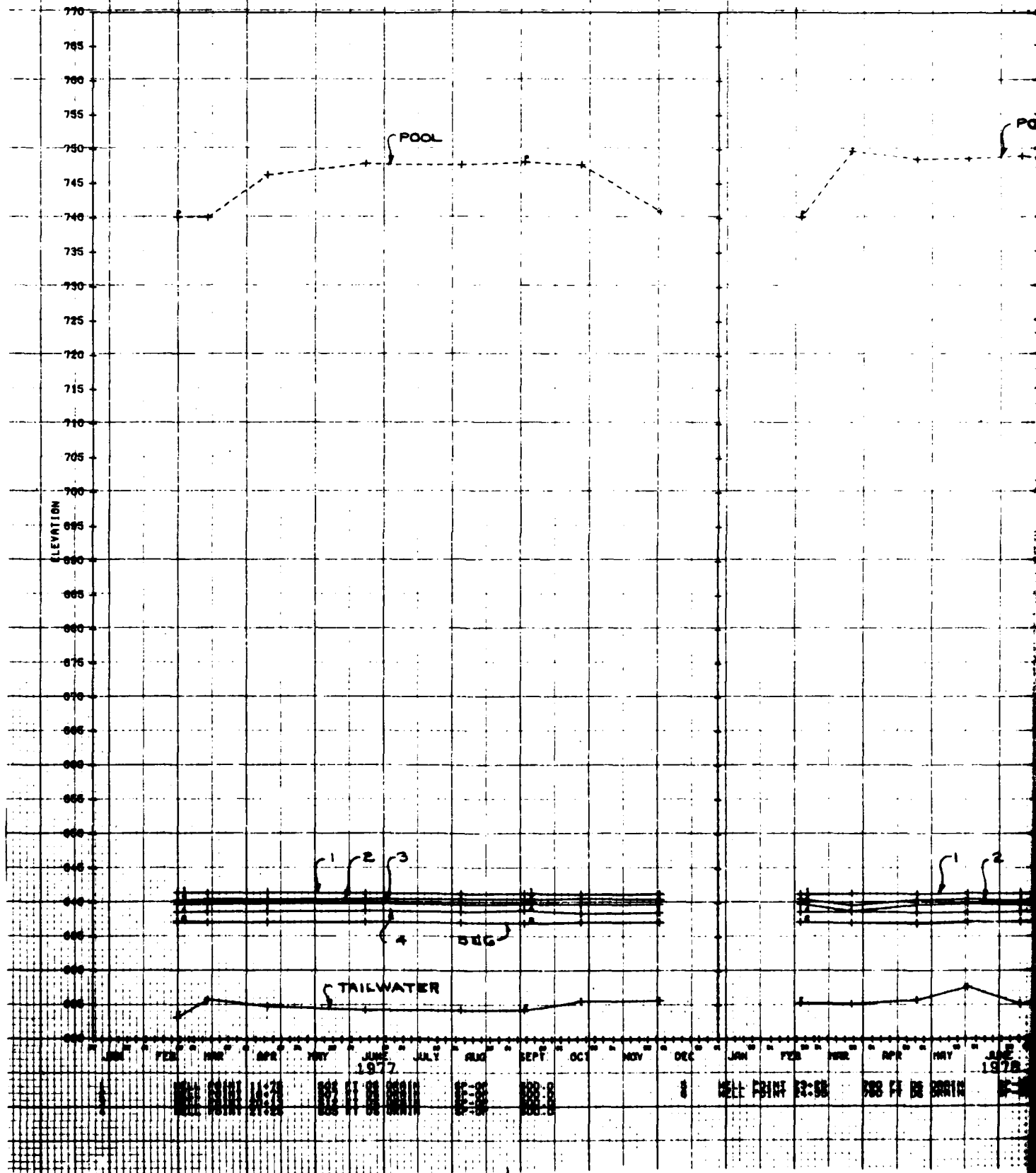
CASABORANGE PIEZOMETERS



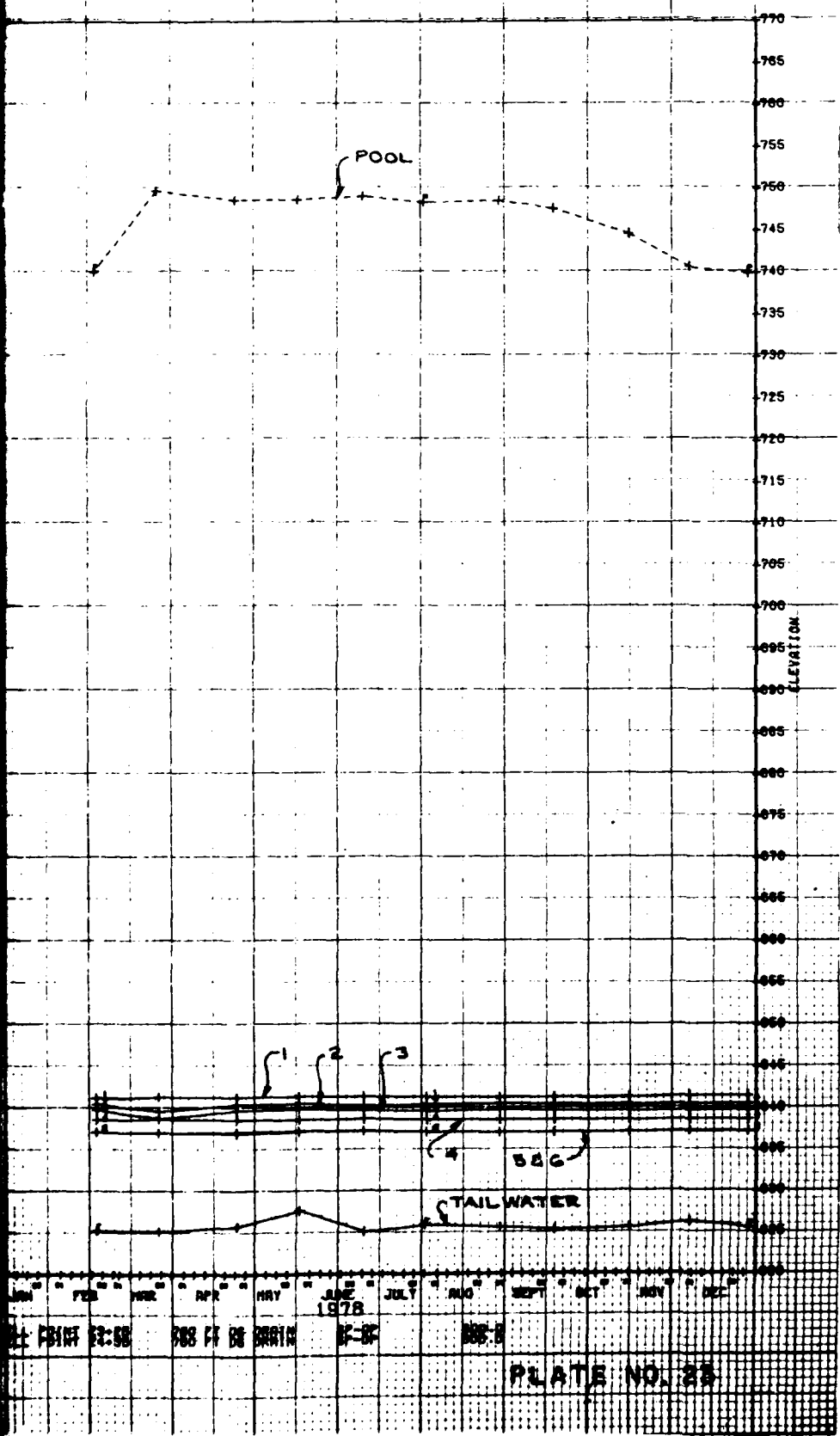
DEC JAN FEB MAR APR MAY JUNE 1978 JULY AUG SEPT OCT NOV DEC

PLATE NO. 22

BROOKVILLE WELLPPOINT TOE DRAIN PIEZOMETERS



TOE DRAIN PIEZOMETERS



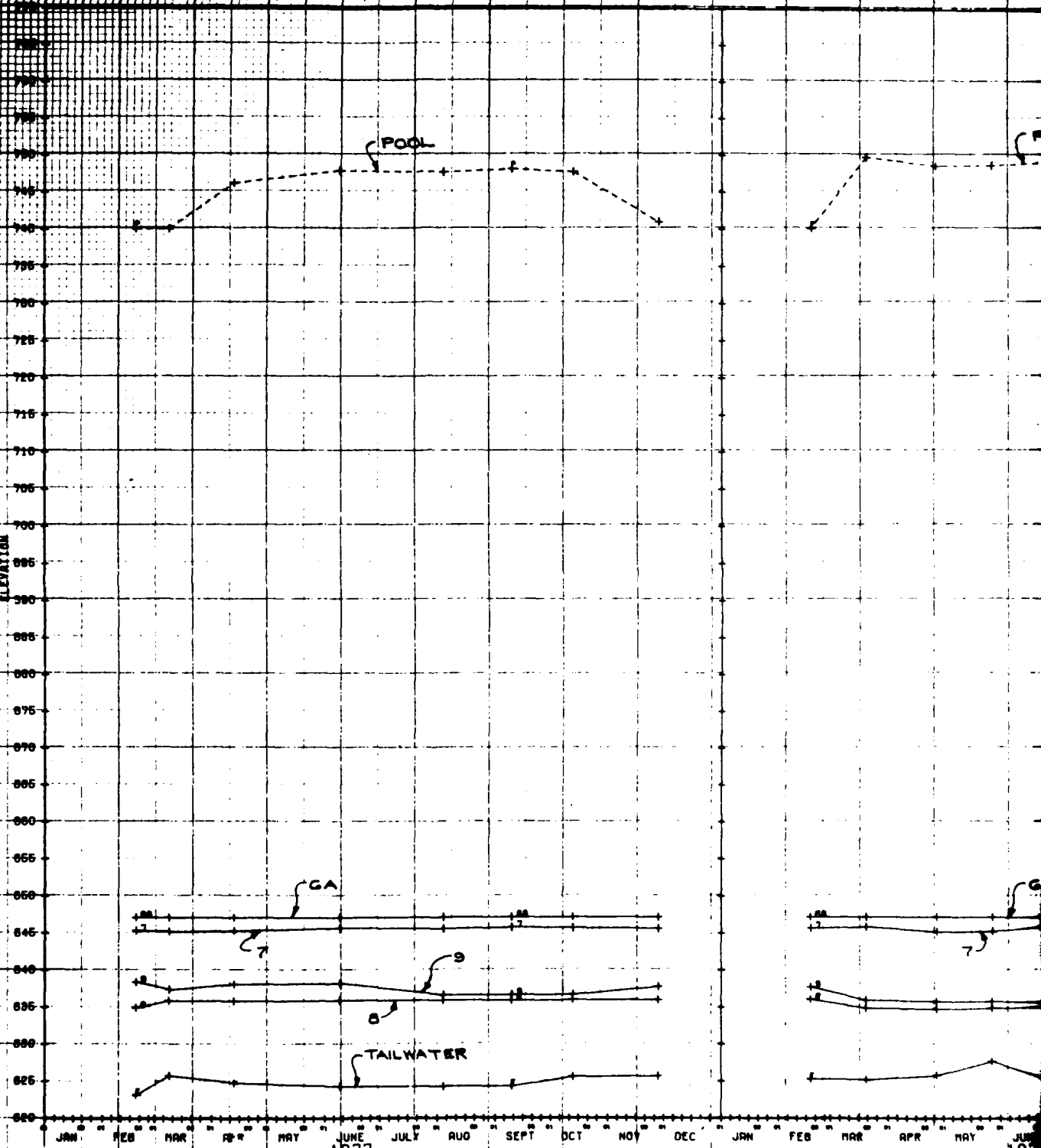
JAN FEB MAR APR MAY JUNE 1978 JULY AUG SEPT OCT NOV DEC

POINT 52-58 508 FT DE DRAIN 52-58 508-5

PLATE NO. 25

BROOKVILLE WELLPPOINT D.S. FOUNDATION PIEZOMETERS

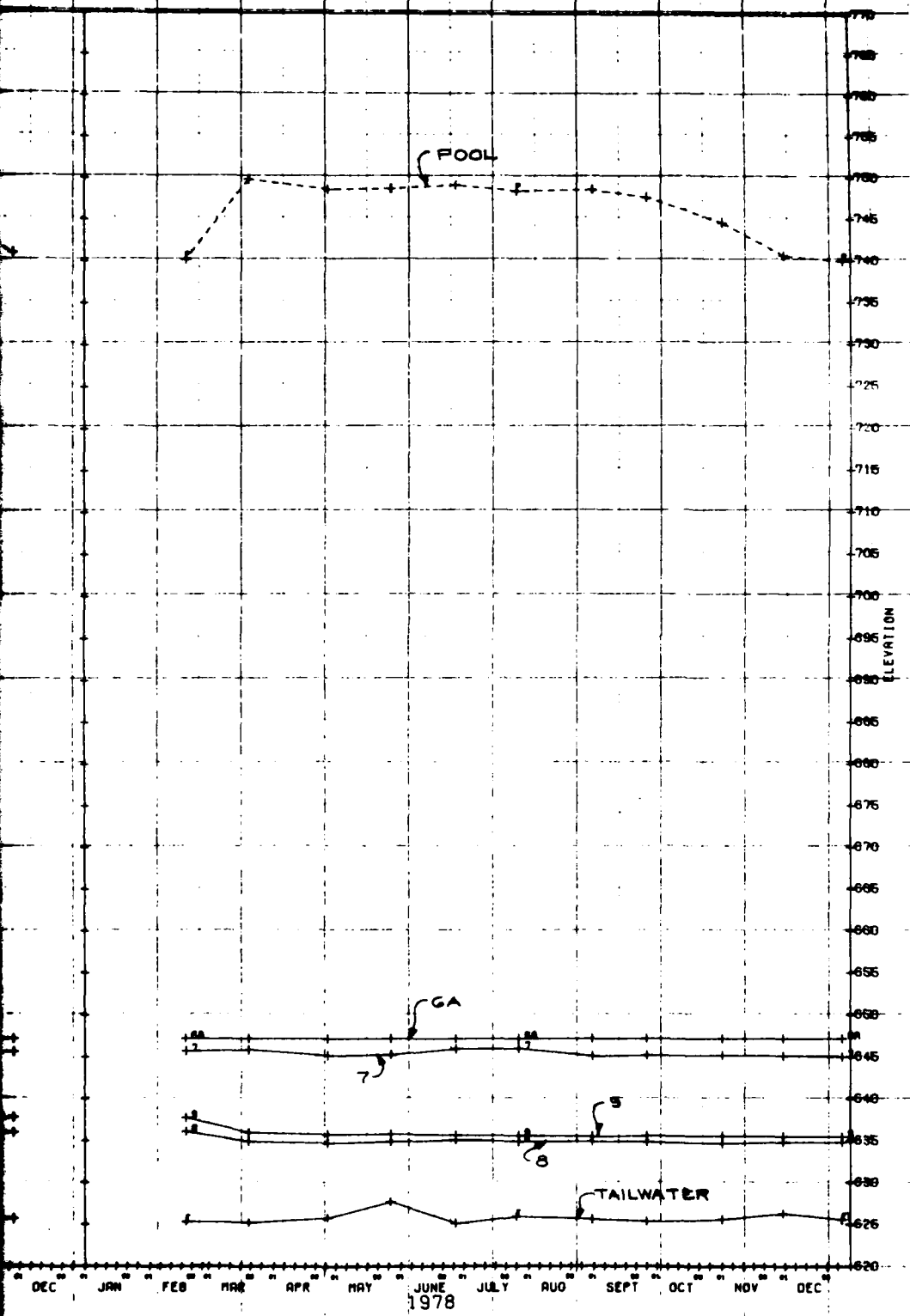
ELEVATION



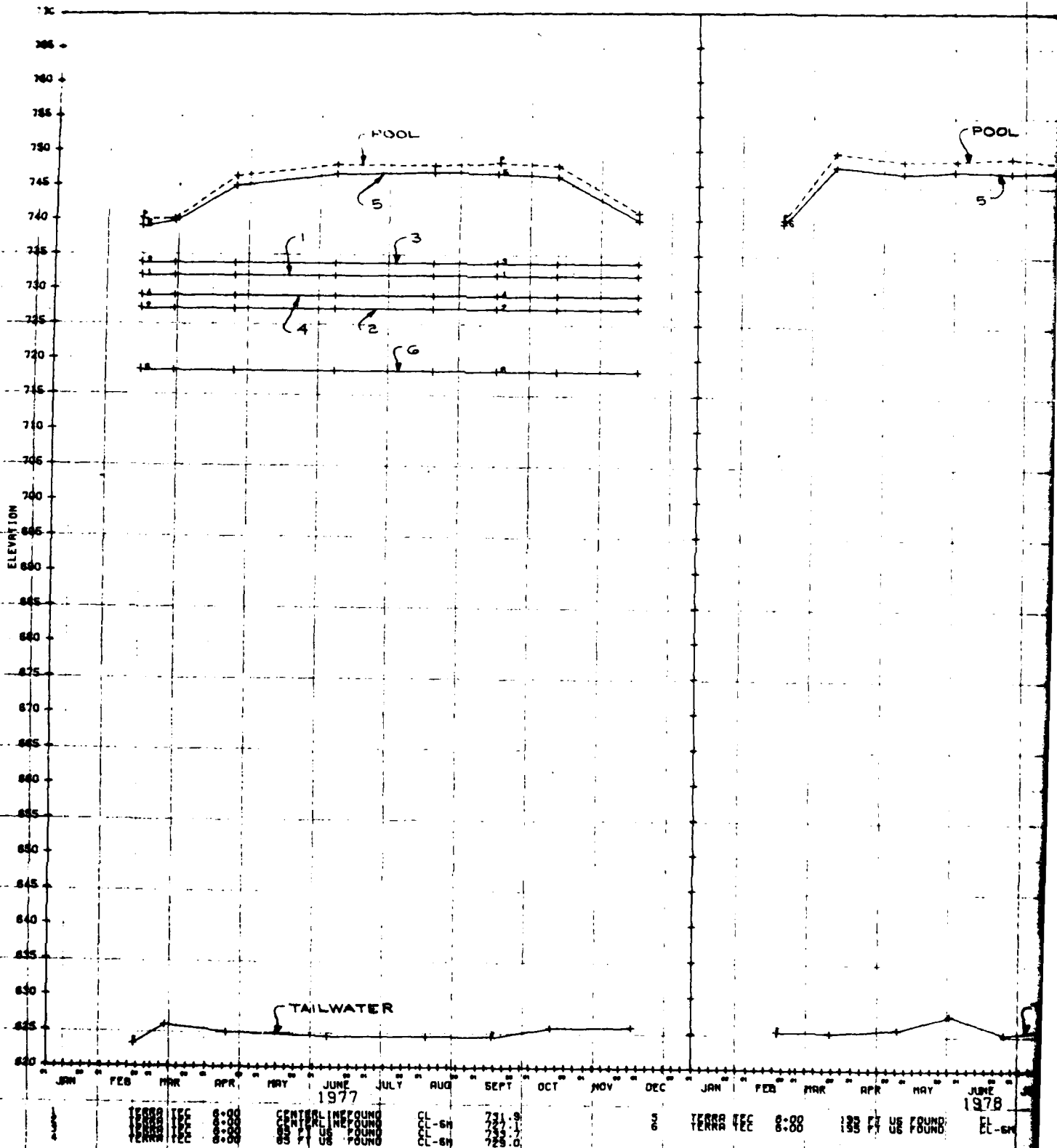
JAN FEB MAR APR MAY JUNE 1977 JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE 1977

GA
WELL POINT 18-25 380 FT DE ORIGIN 647-3
WELL POINT 22-25 1200 FT DE ORIGIN 641-3

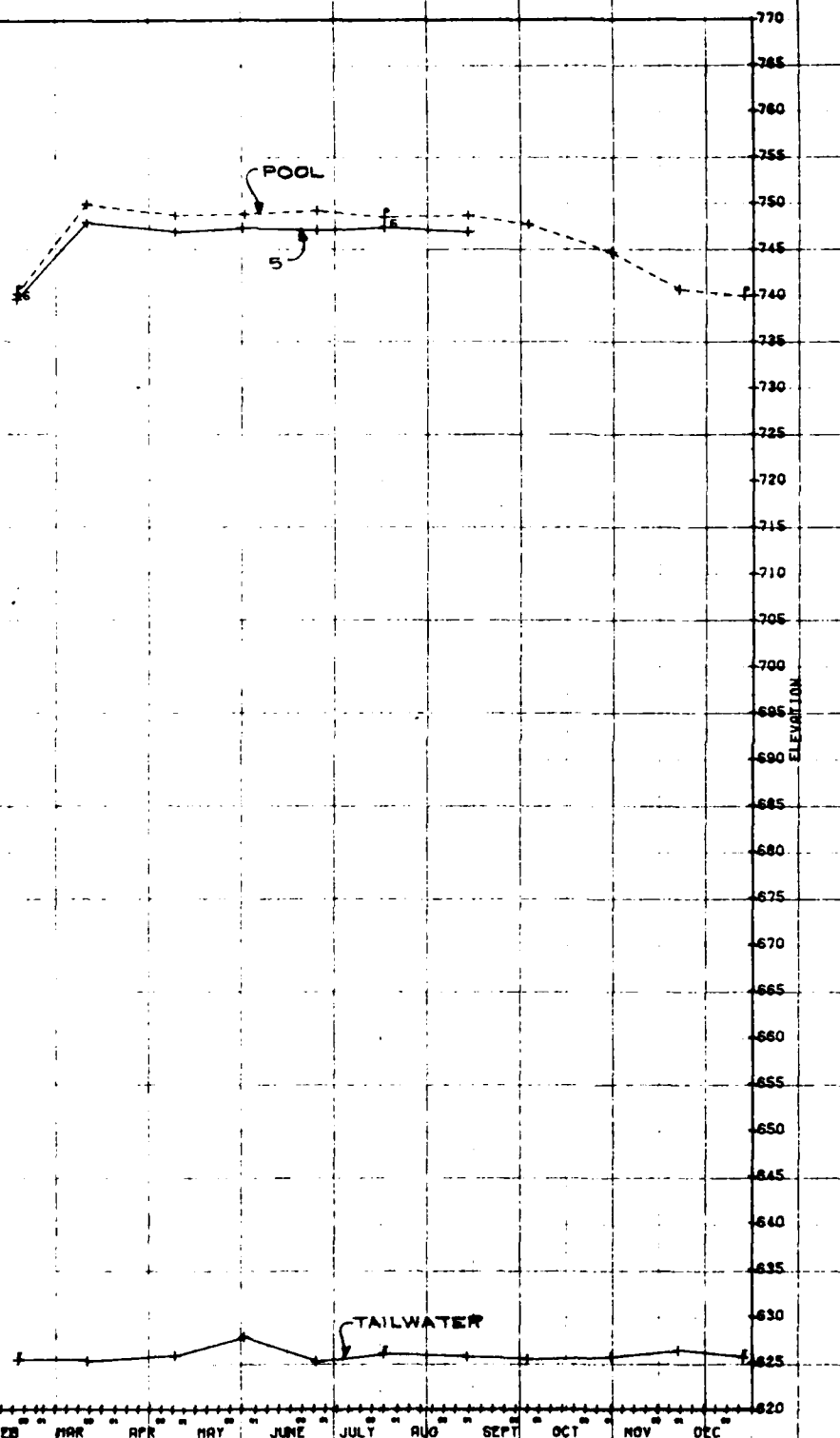
POINT D.S. FOUNDATION PIEZOMETERS



BROOKVILLE U.S. FOUND PIEZ. STA 6+00



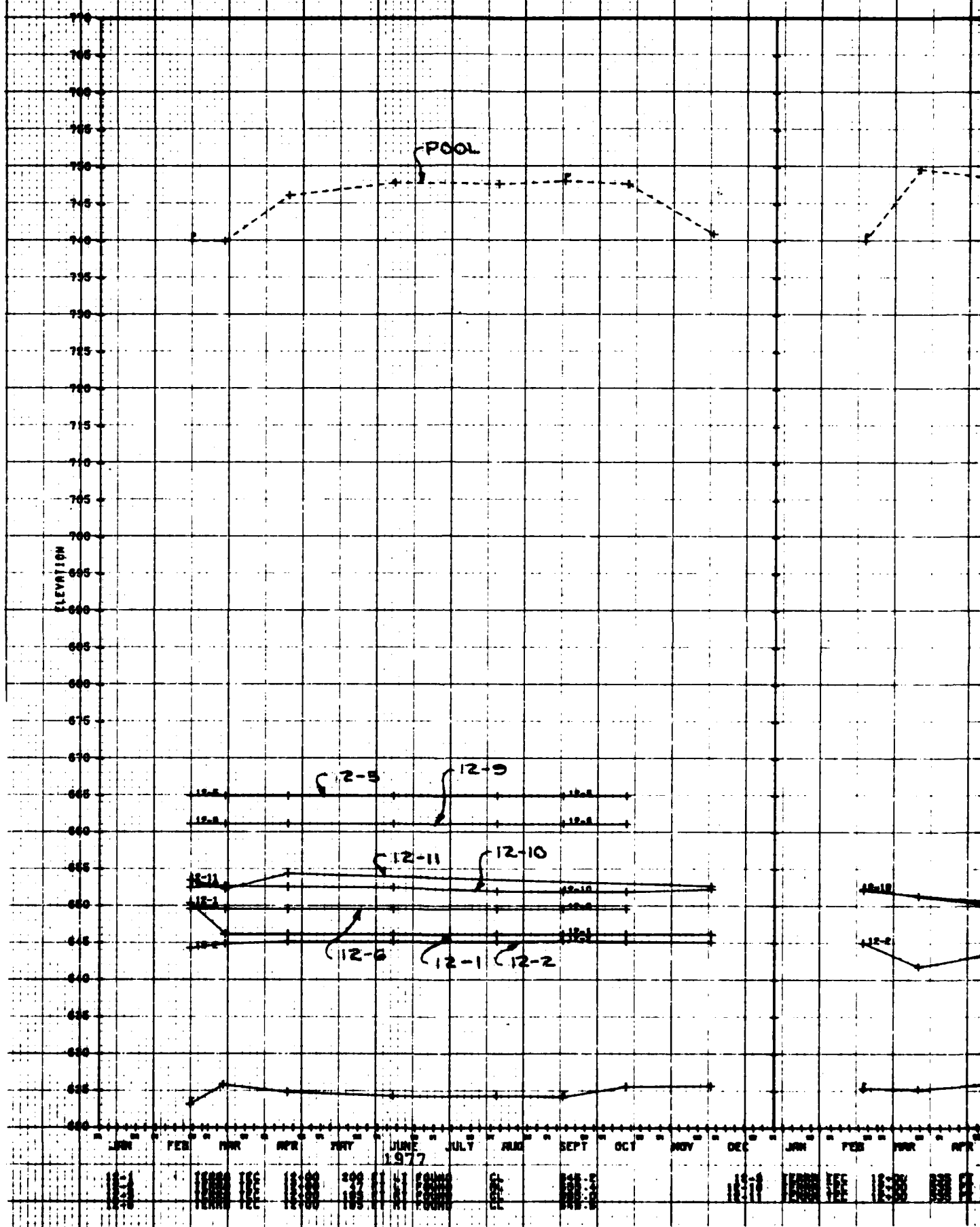
FOUND PIEZ. STA 6+00



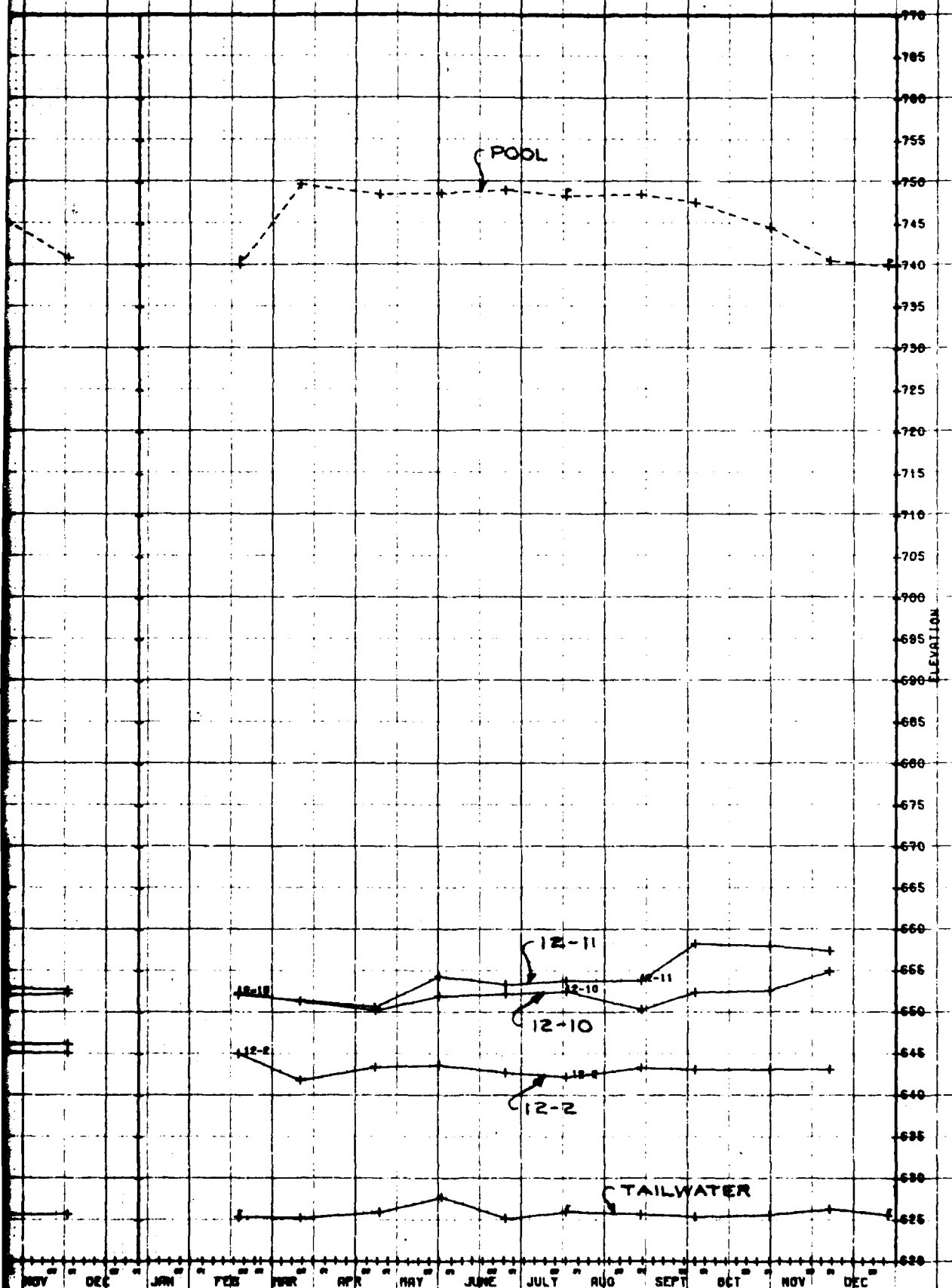
2 TERRA TEE 8:08 133 FT US FOUND EL-SH 278.3

PLATE NO. 25

BROOKVILLE FOUNDATION PIEZOMETERS STA.



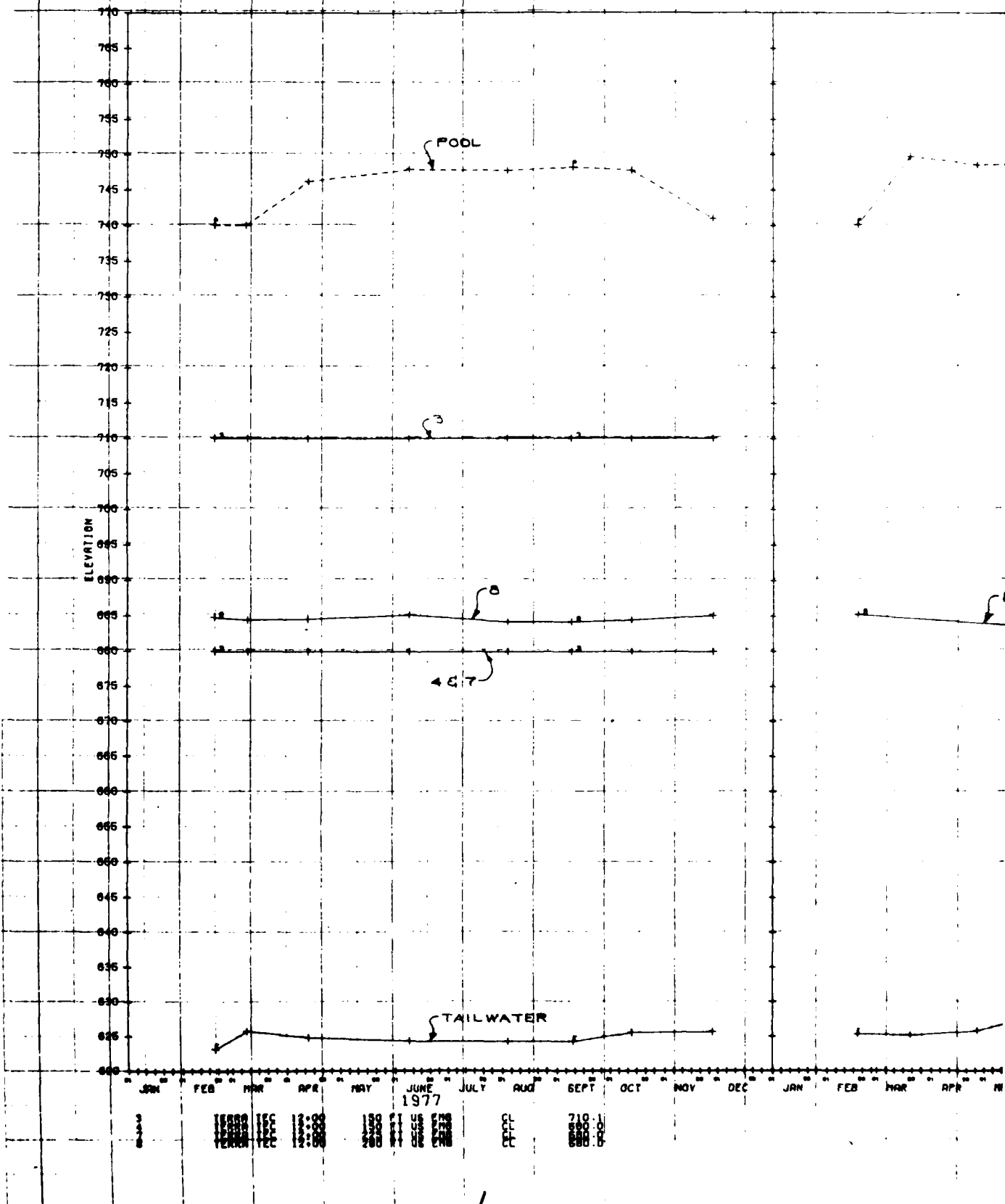
FOUNDATION PIEZOMETERS STA. 12+00



12-11 12-10 12-2

PLATE NO. 26

BROOKVILLE PIEZOMETERS STA. 12+00



ERS STR. 12+00

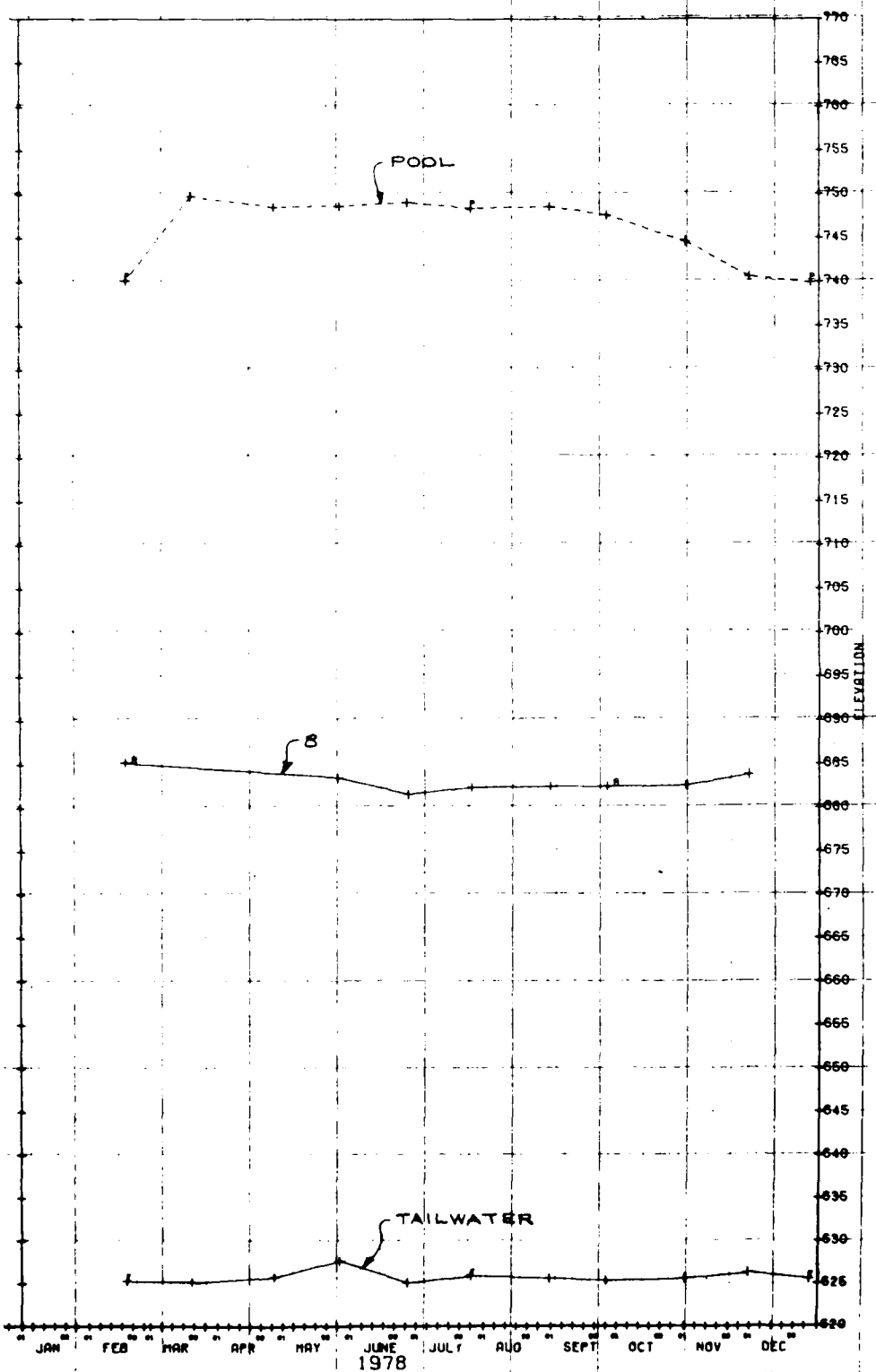


PLATE NO. 27

AD-A127 465

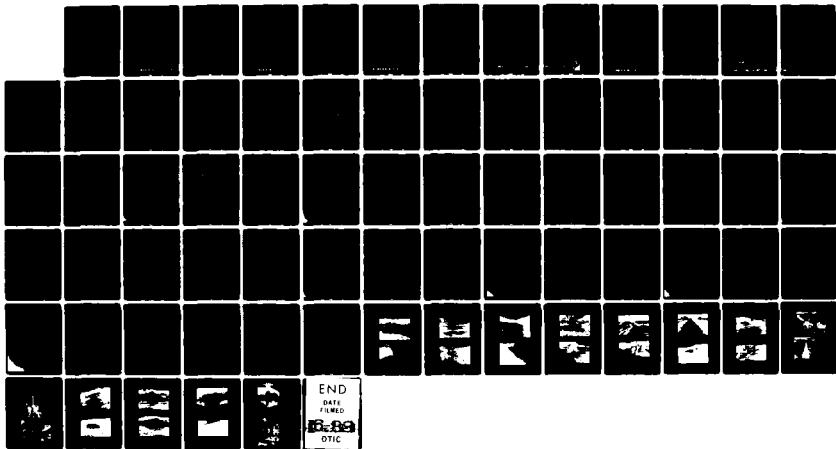
BROOKVILLE LAKE GREATER MIAMI RIVER BASIN INDIANA
EMBANKMENT CRITERIA AND PERFORMANCE REPORT(U) ARMY
ENGINEER DISTRICT LOUISVILLE KY SEP 82

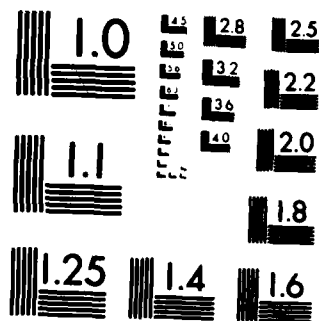
2/2

UNCLASSIFIED

F/G 8/7

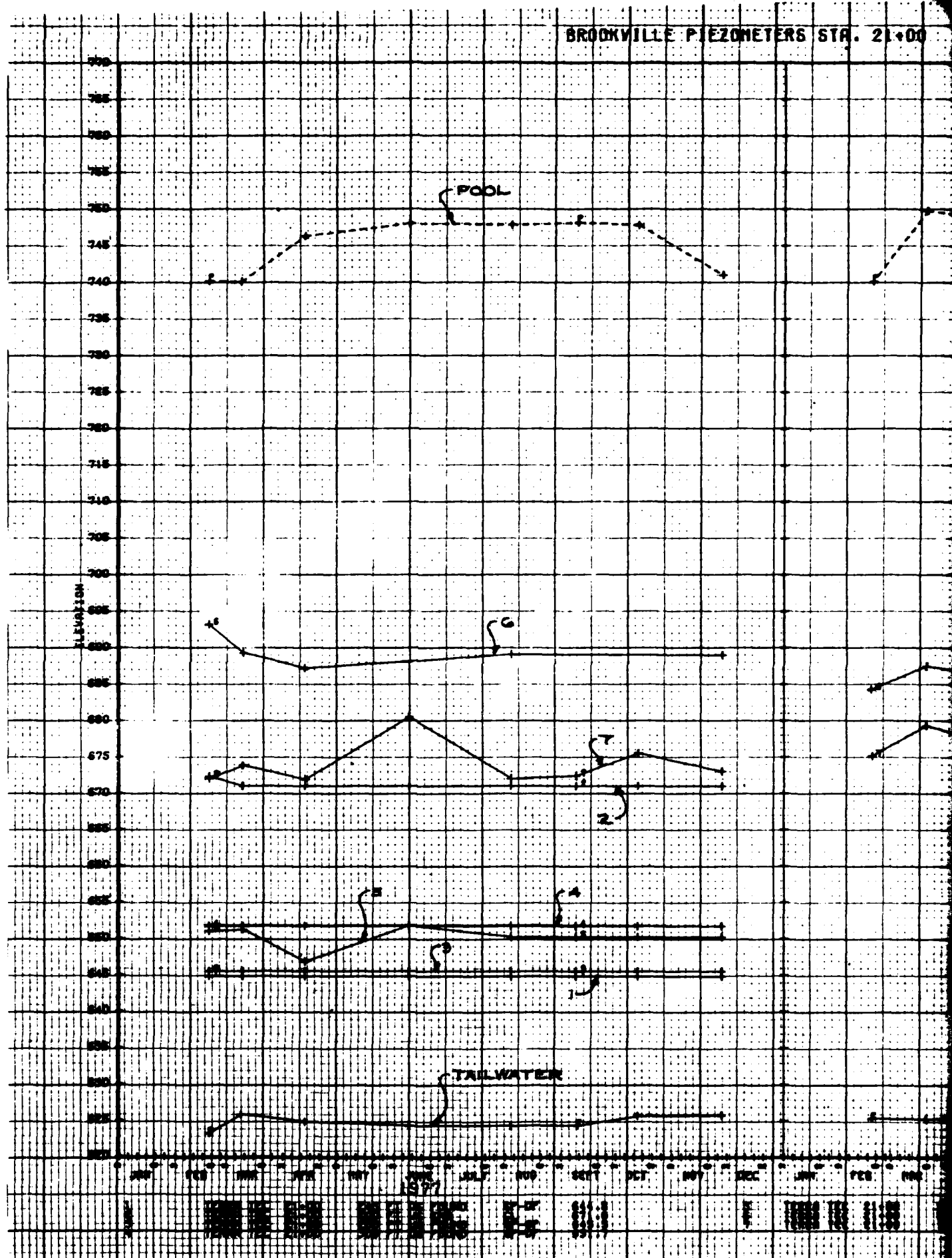
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

BROOKVILLE PIEZOMETERS STA. 21+00									
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PIEZOMETERS STA. 21+00

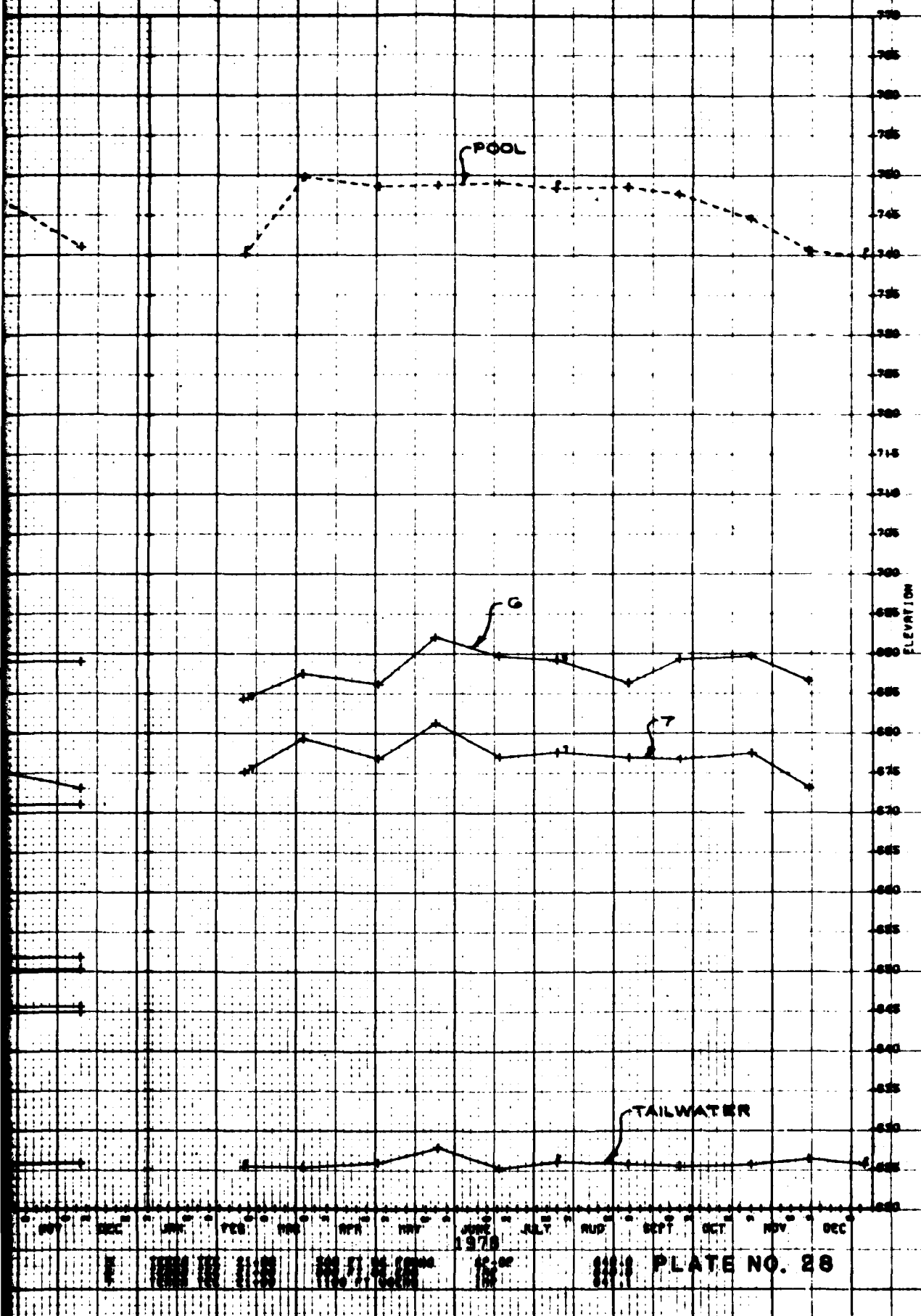
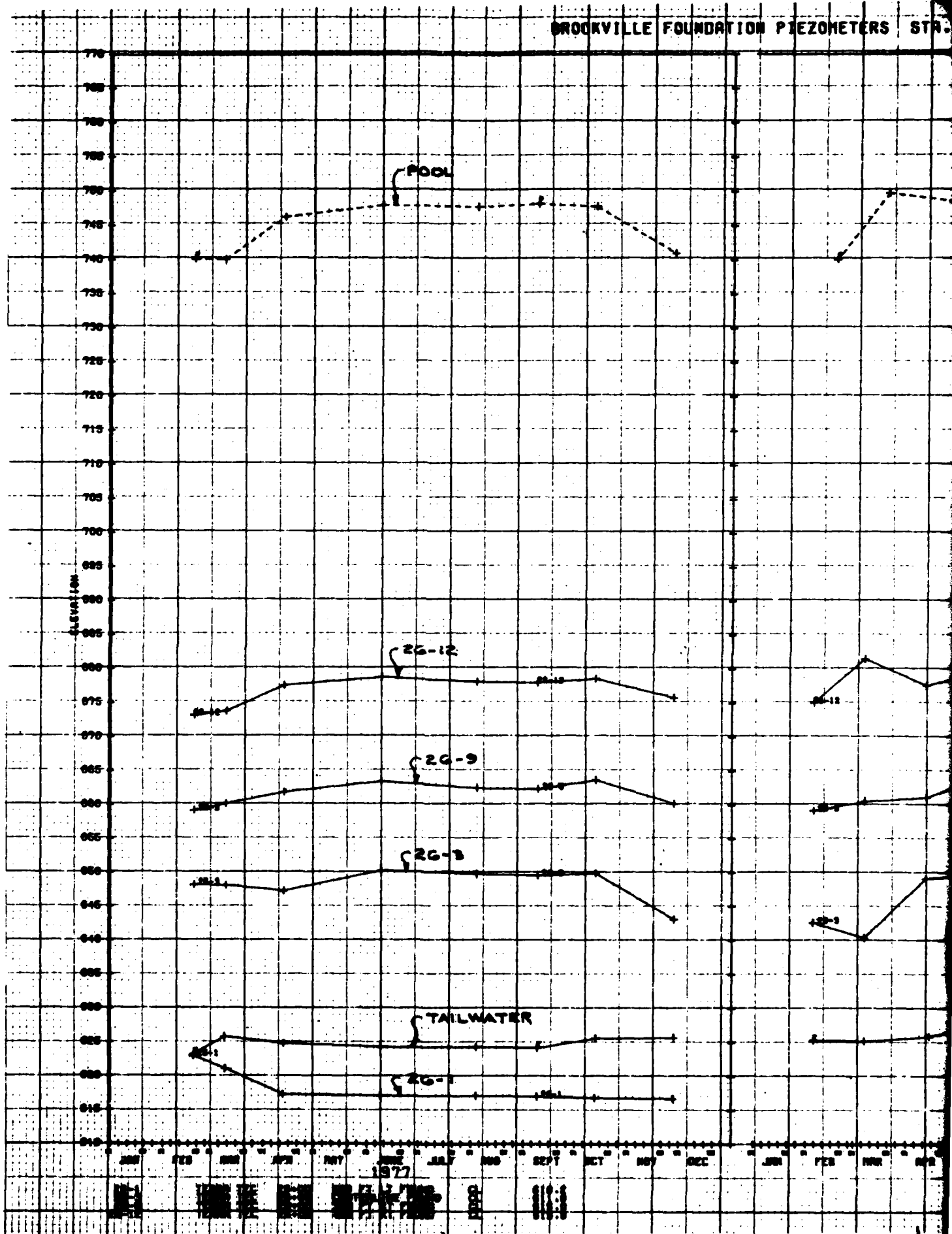


PLATE NO. 28

1

2

BROOKVILLE FOUNDATION PIEZOMETERS STA.



FOUNDATION PIEZOMETERS STR. 26+00

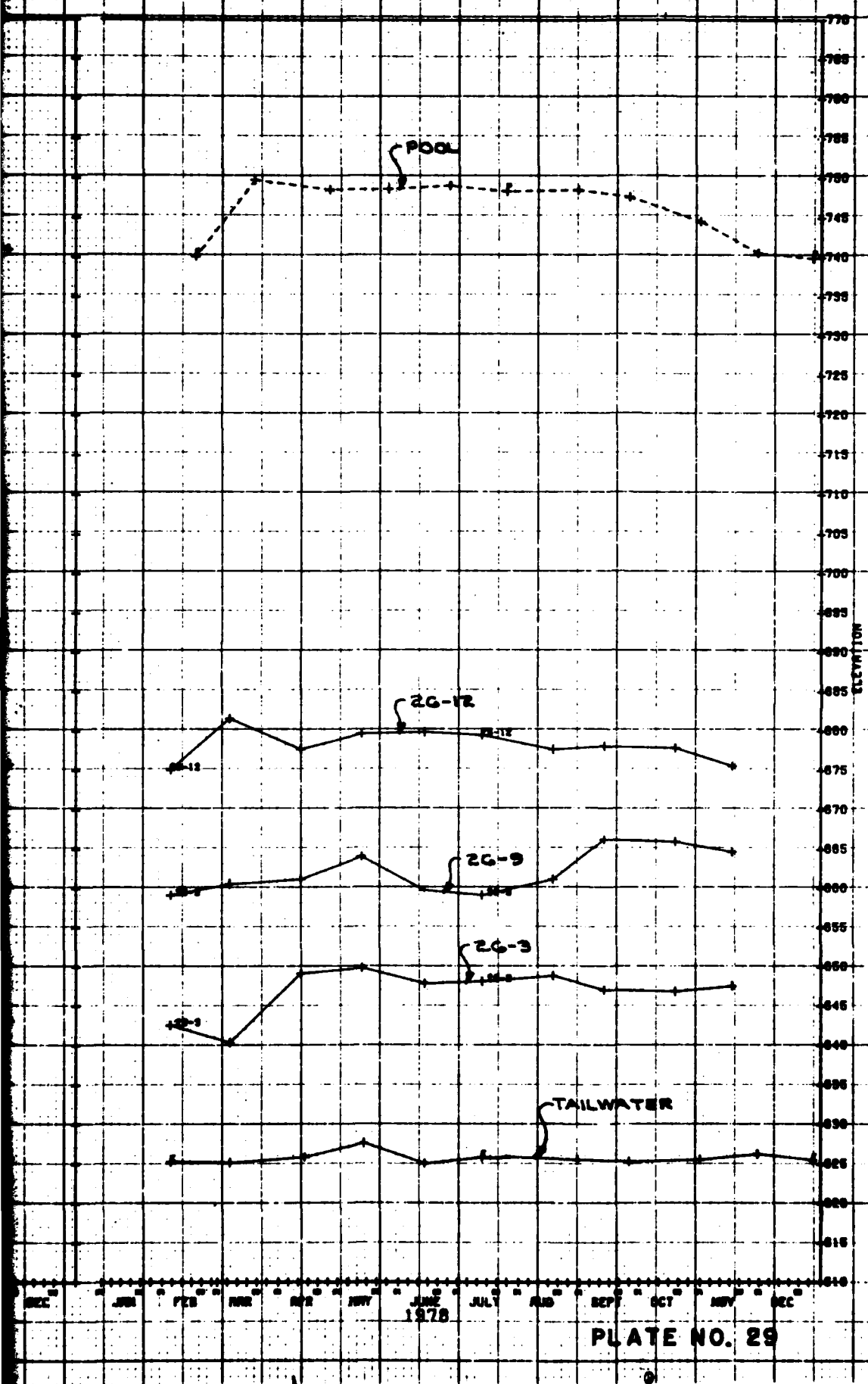
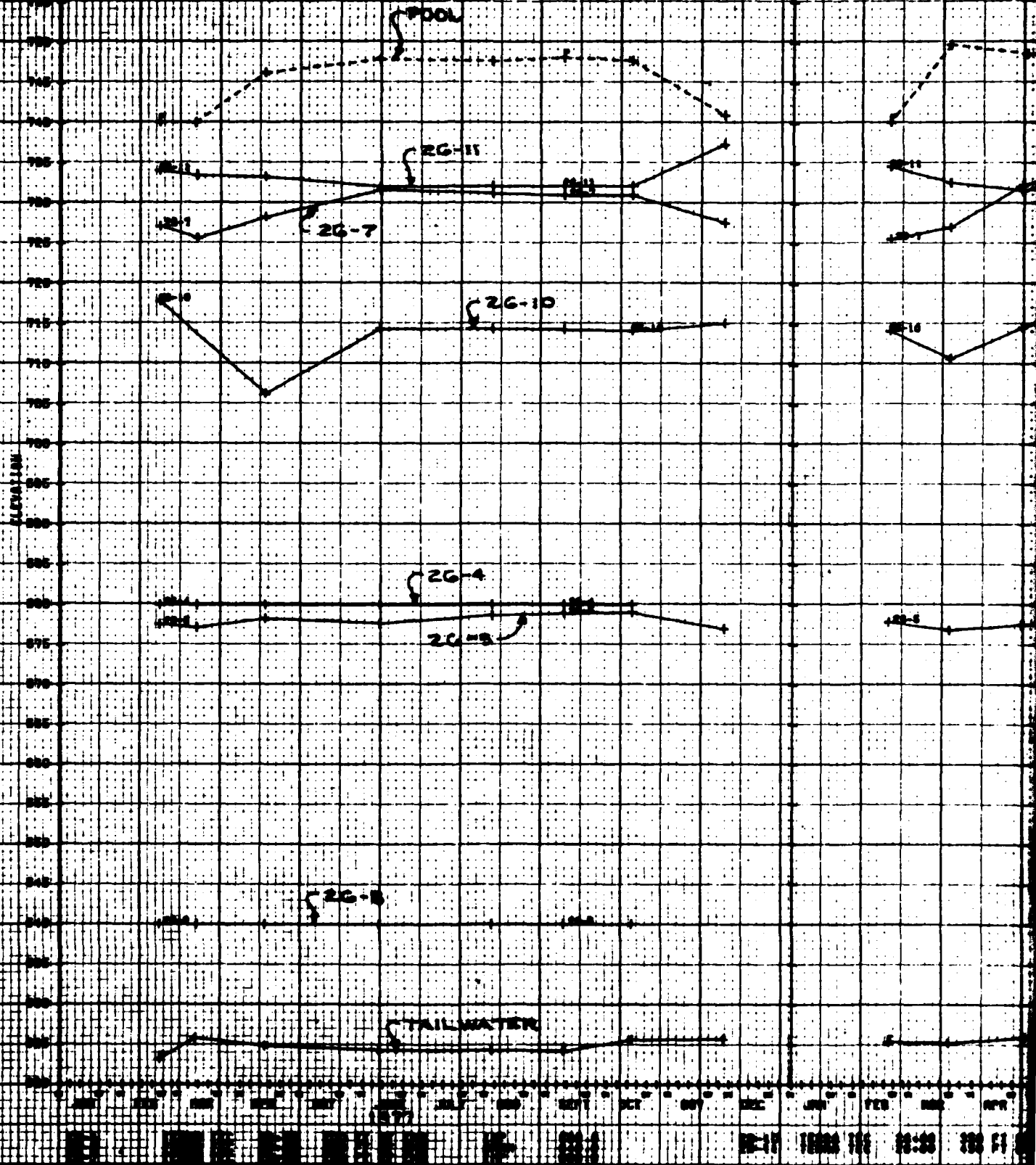


PLATE NO. 29

BROOKVILLE U. S. EMBANKMENT PIEZOMETERS



700 710 720 730 740 750

EMERGENT PIEZOMETERS STA. 26+00

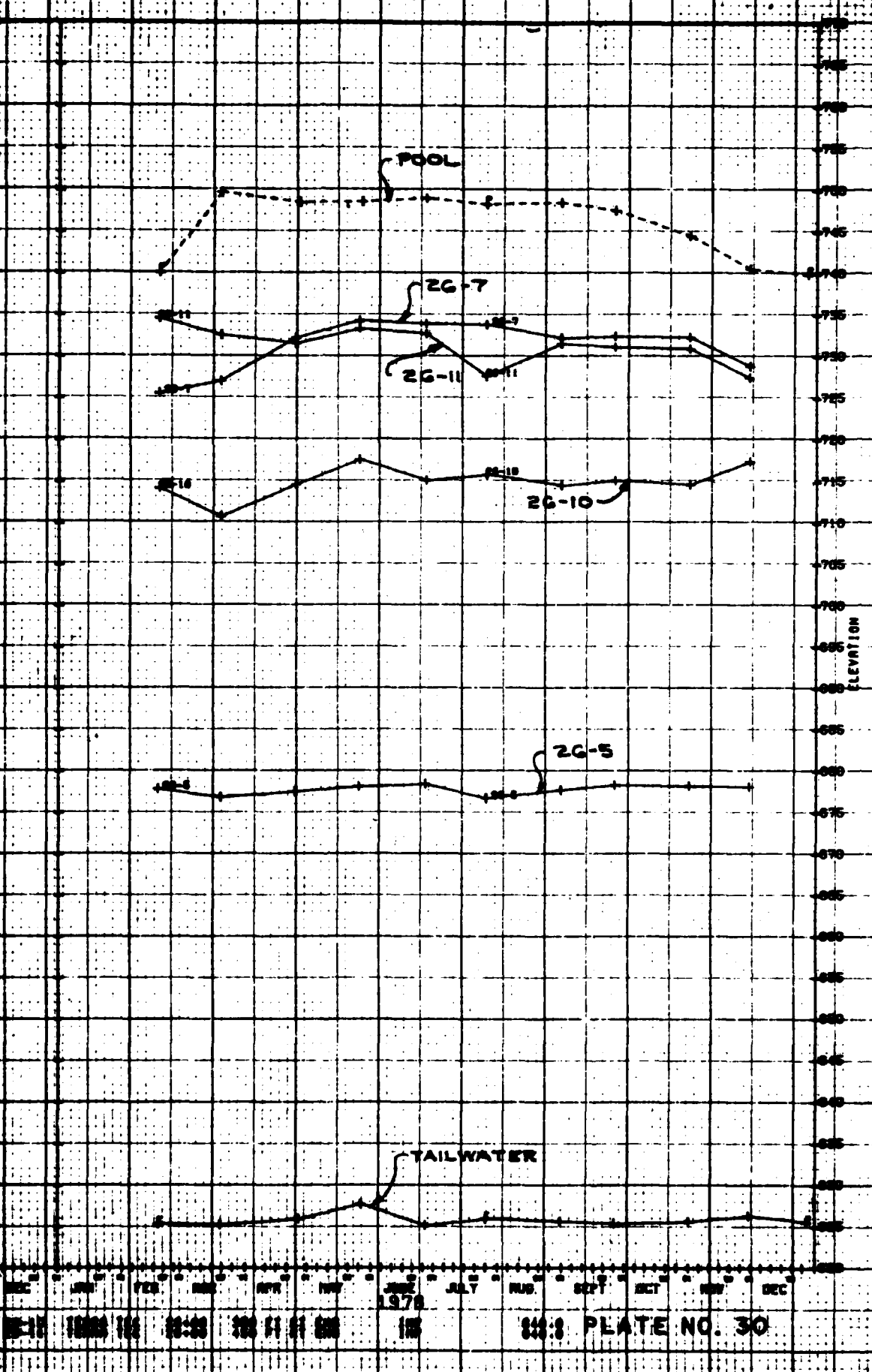
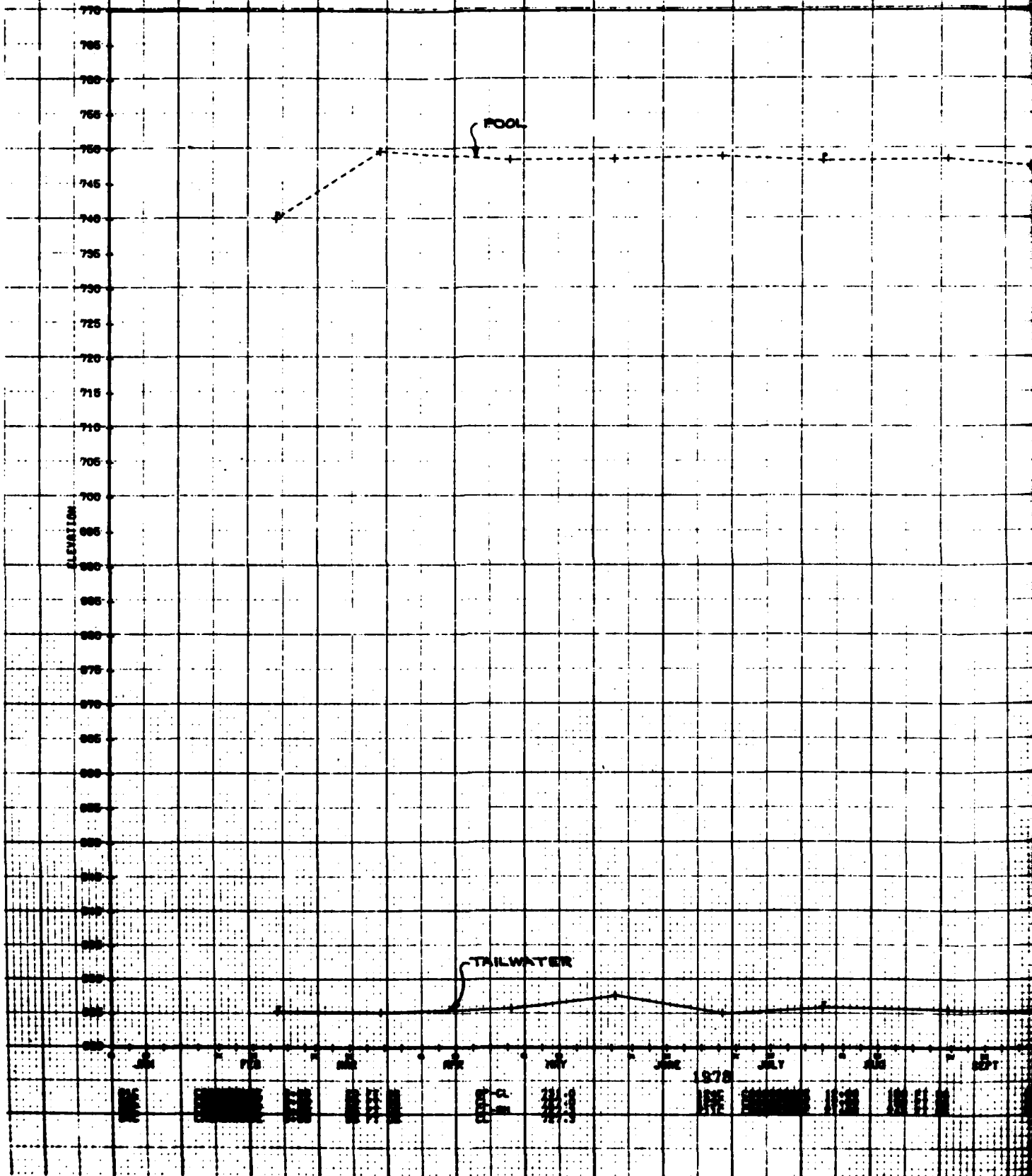
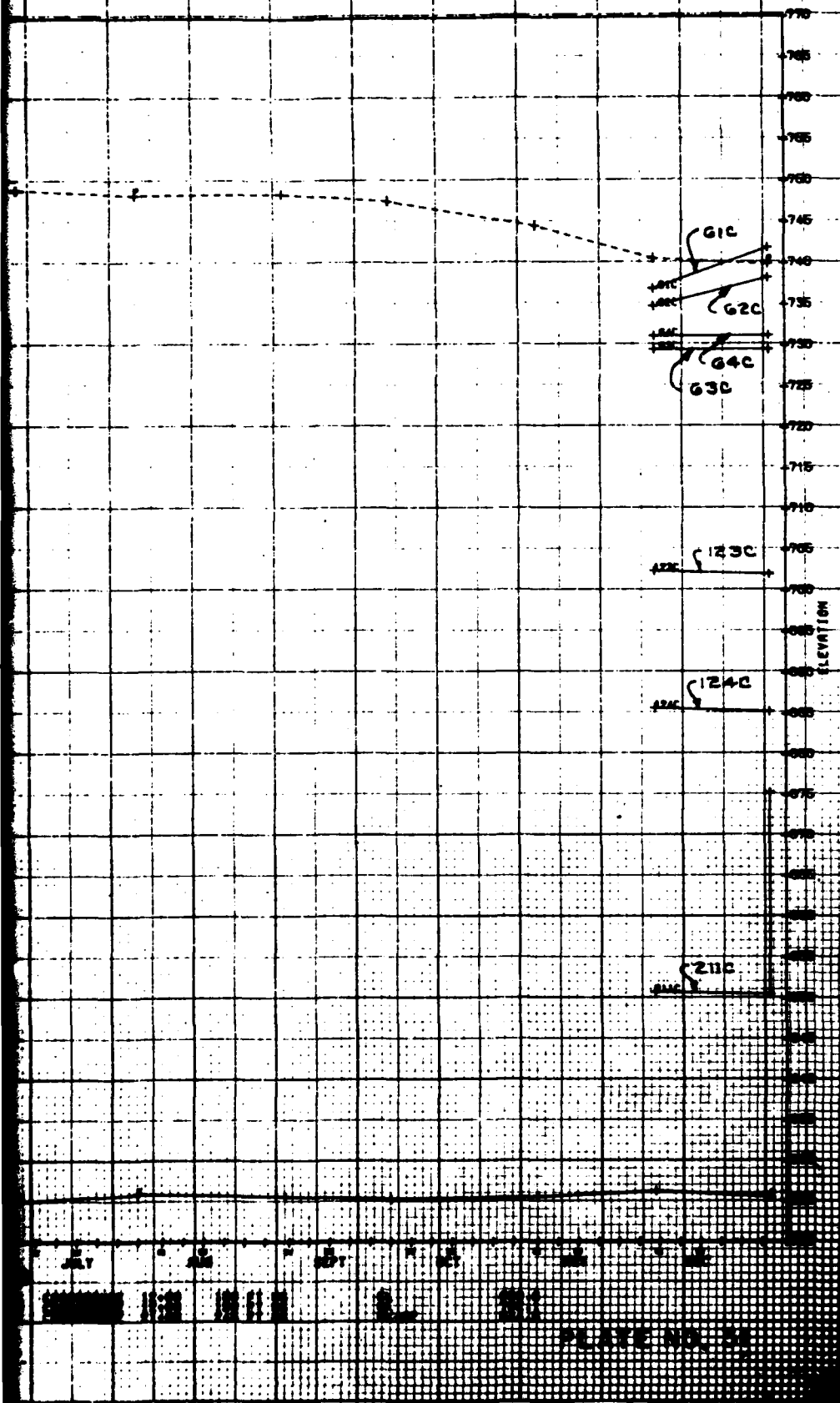


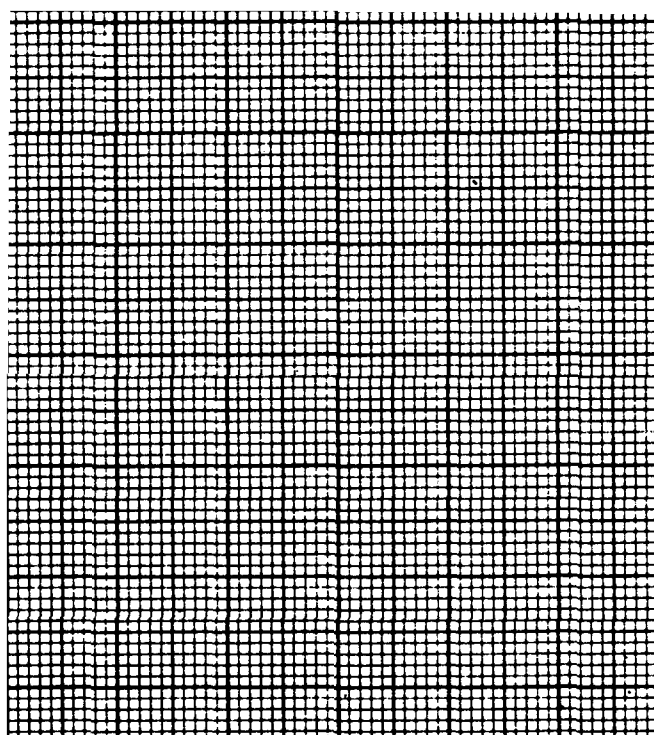
PLATE NO. 30

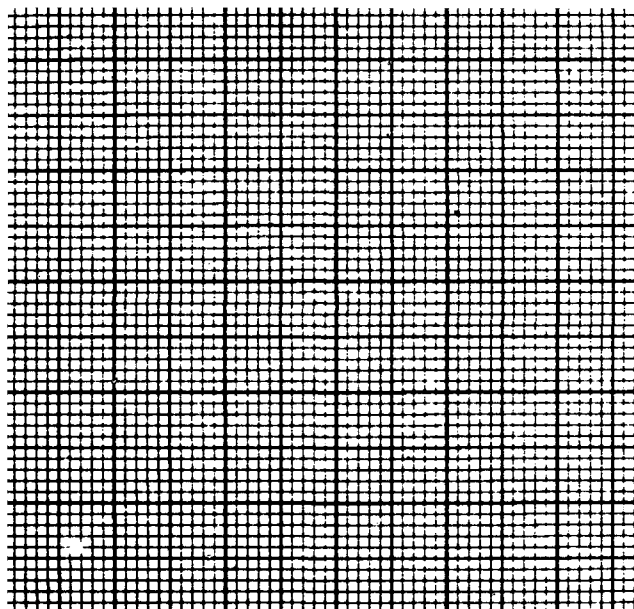
BROOKVILLE REPLACEMENT PIEZOMETERS CASAGRANDE

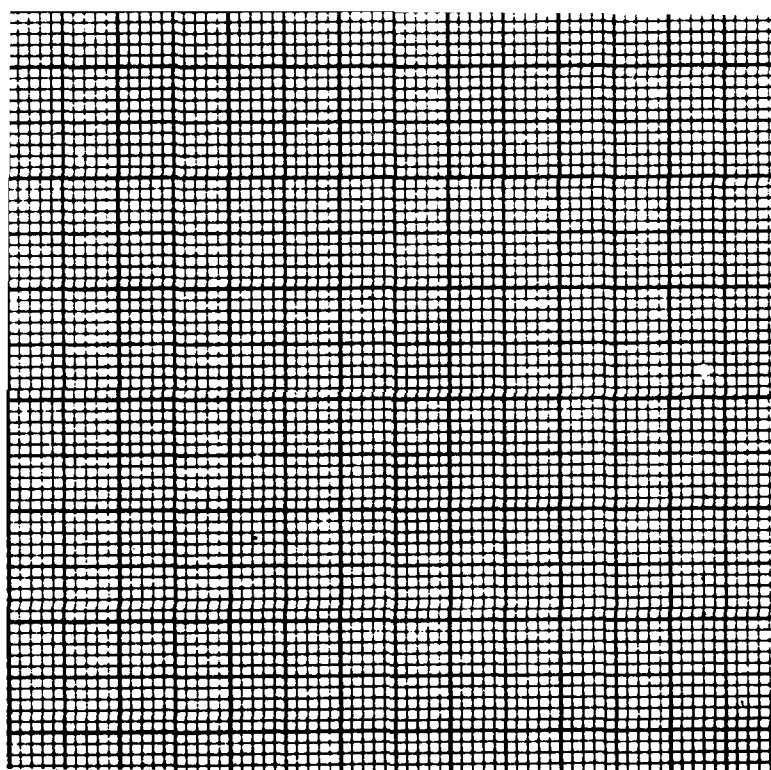


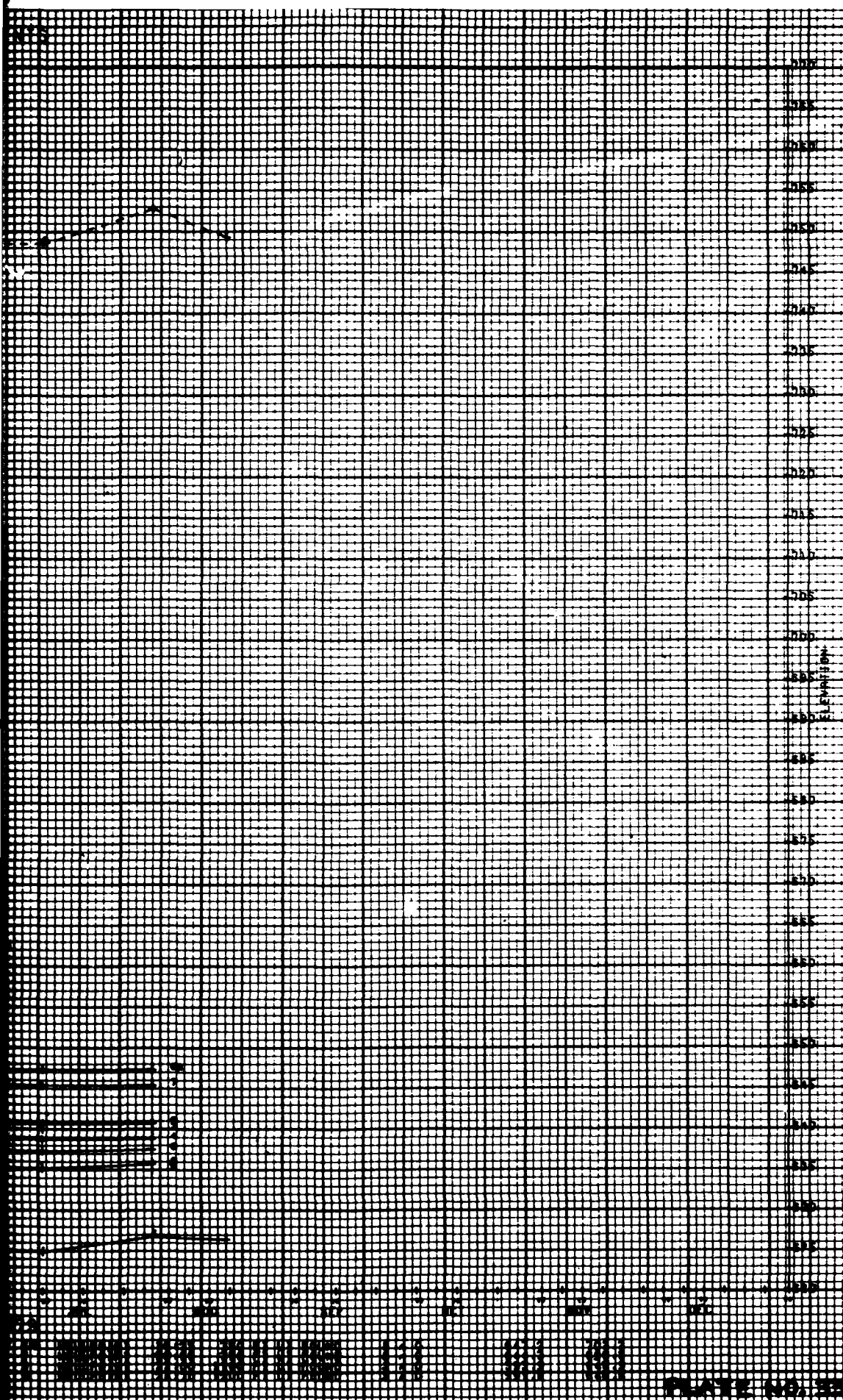
ENT PIEZOMETERS CASAGRANDE



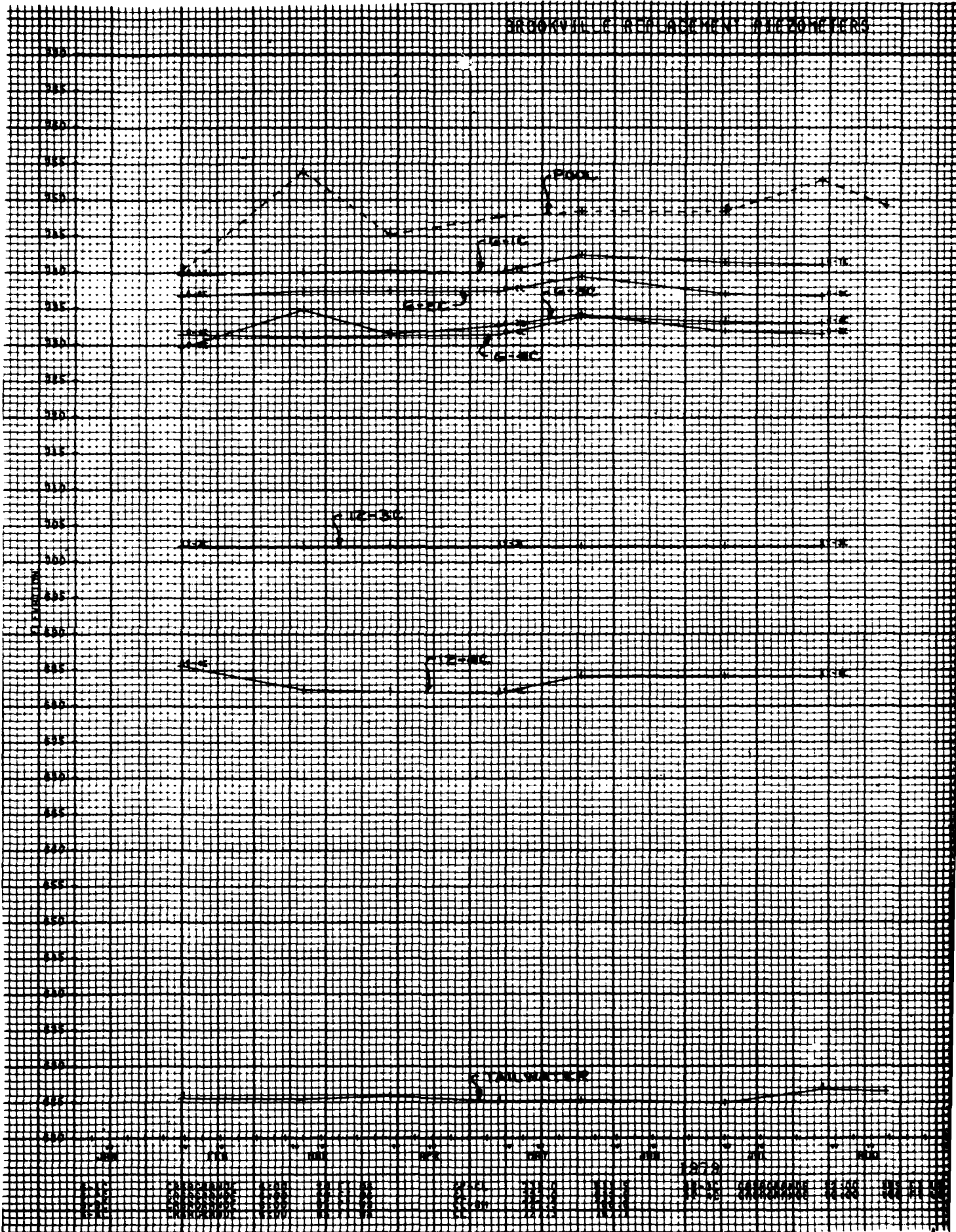


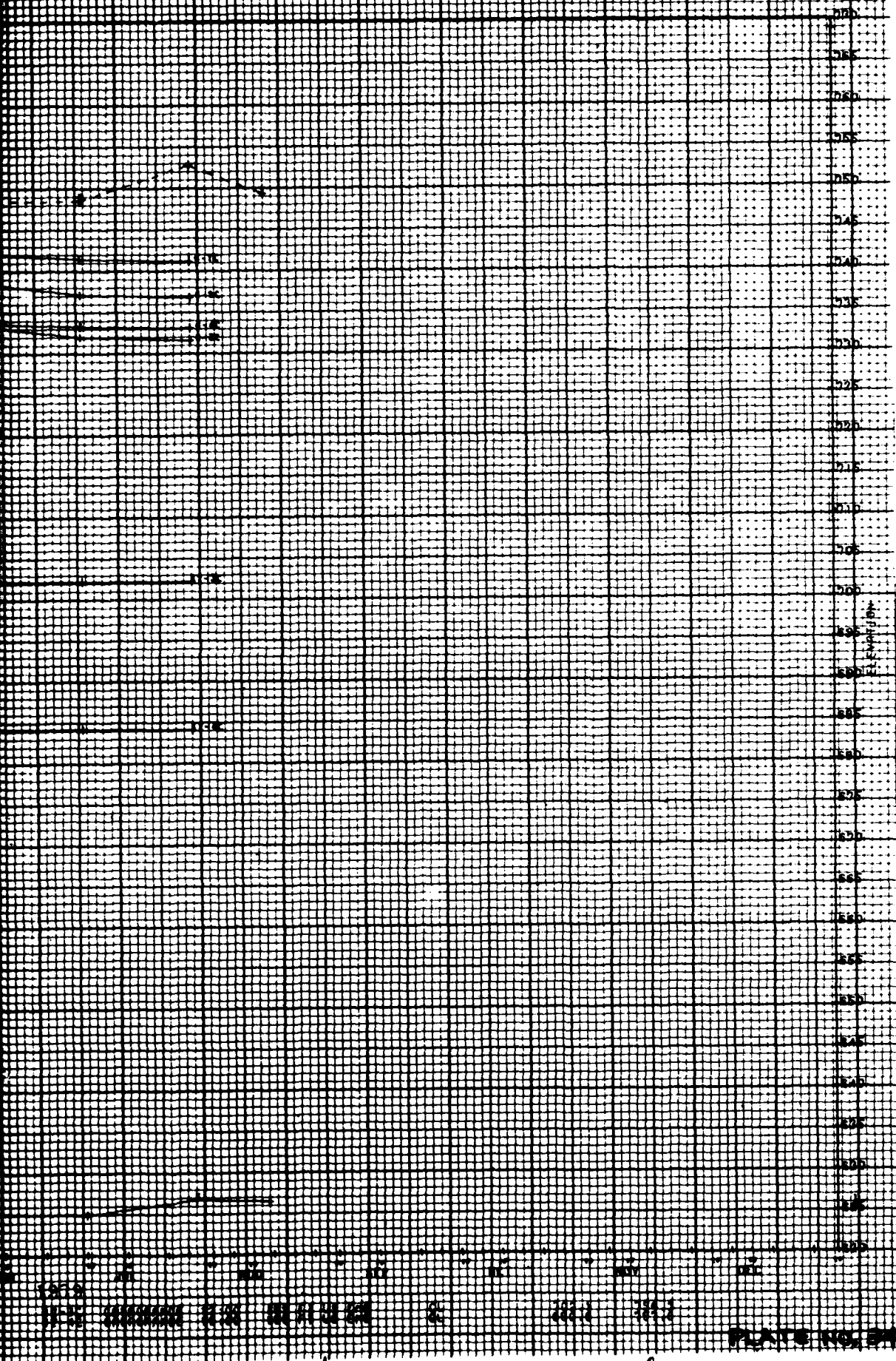






BRIDGEMAN'S ATTACHMENT MICROMETERS





CORPS OF ENGINEERS, U.S. ARMY OHIO RIVER DIVISION		COMPUTATION SHEET	PAGE OF PAGES DATE 1 FEB 79
INSTALLATION		SUBJECT BROOKVILLE LAKE, INDIANA	
COMPUTED BY JAJ		COMPUTATION RELIEF WELL FLOWS	
CHECKED BY		NUMBER	

TOTAL RELIEF WELL FLOW ADJUSTED TO POOL ELEV = 748'

$$\Delta = \text{THEORETICAL FLOW FROM PUMPING TEST (DMG-APPL)} \\ = \left(\frac{748-640}{778-640} \right) \left(\frac{23.7 \text{ FT}^3}{\text{SEC}} \right) = 19.0 \frac{\text{FT}^3}{\text{SEC}}$$

$$\odot = \text{ACTUAL FLOW ADJUSTED TO POOL ELEV 748} \\ Q_{748} = \left(\frac{748-640}{\text{POOL ELEV}-640} \right) Q_{\text{POOL}}$$

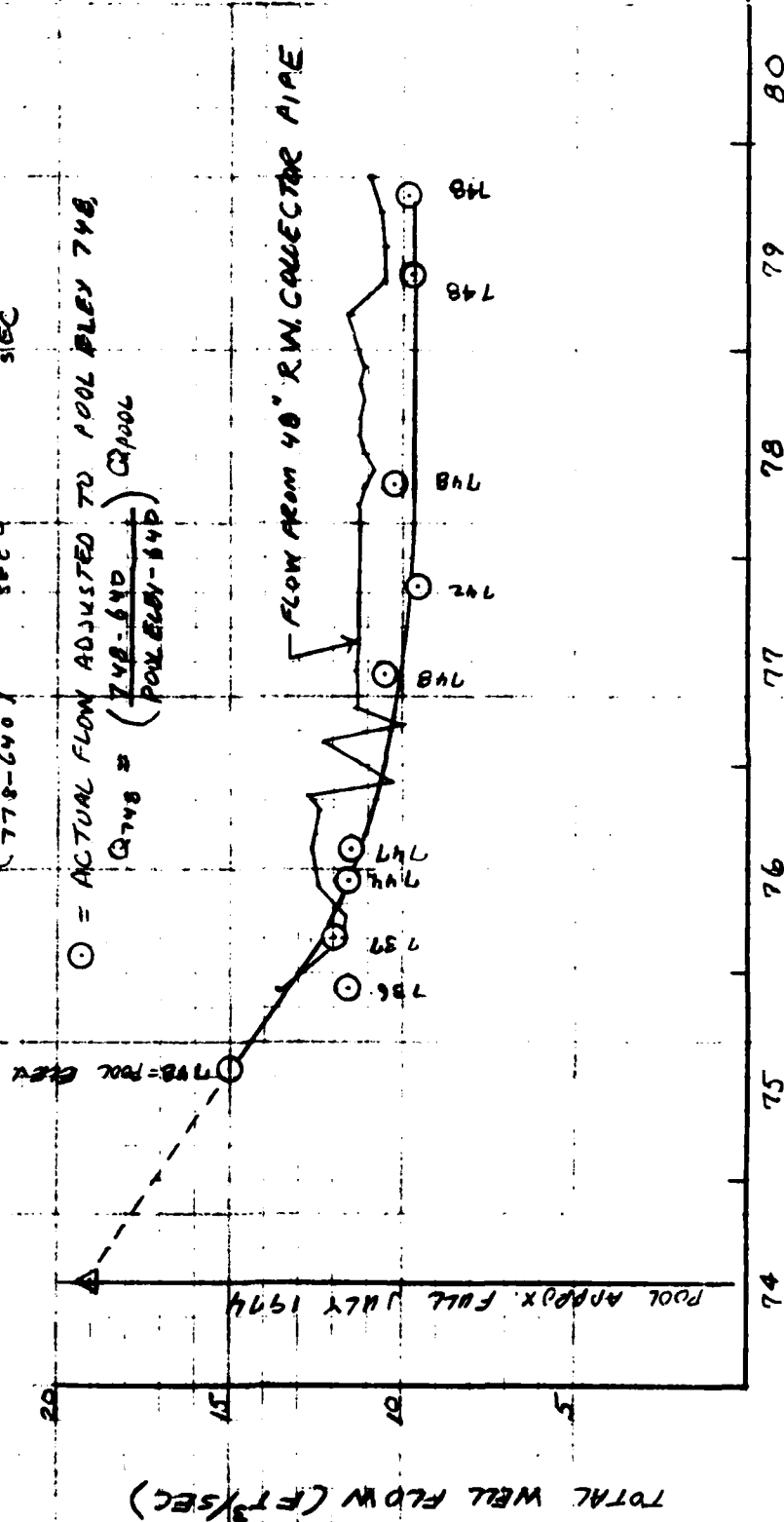


PLATE NO. 35

BROOKVILLE LAKE, INDIANA

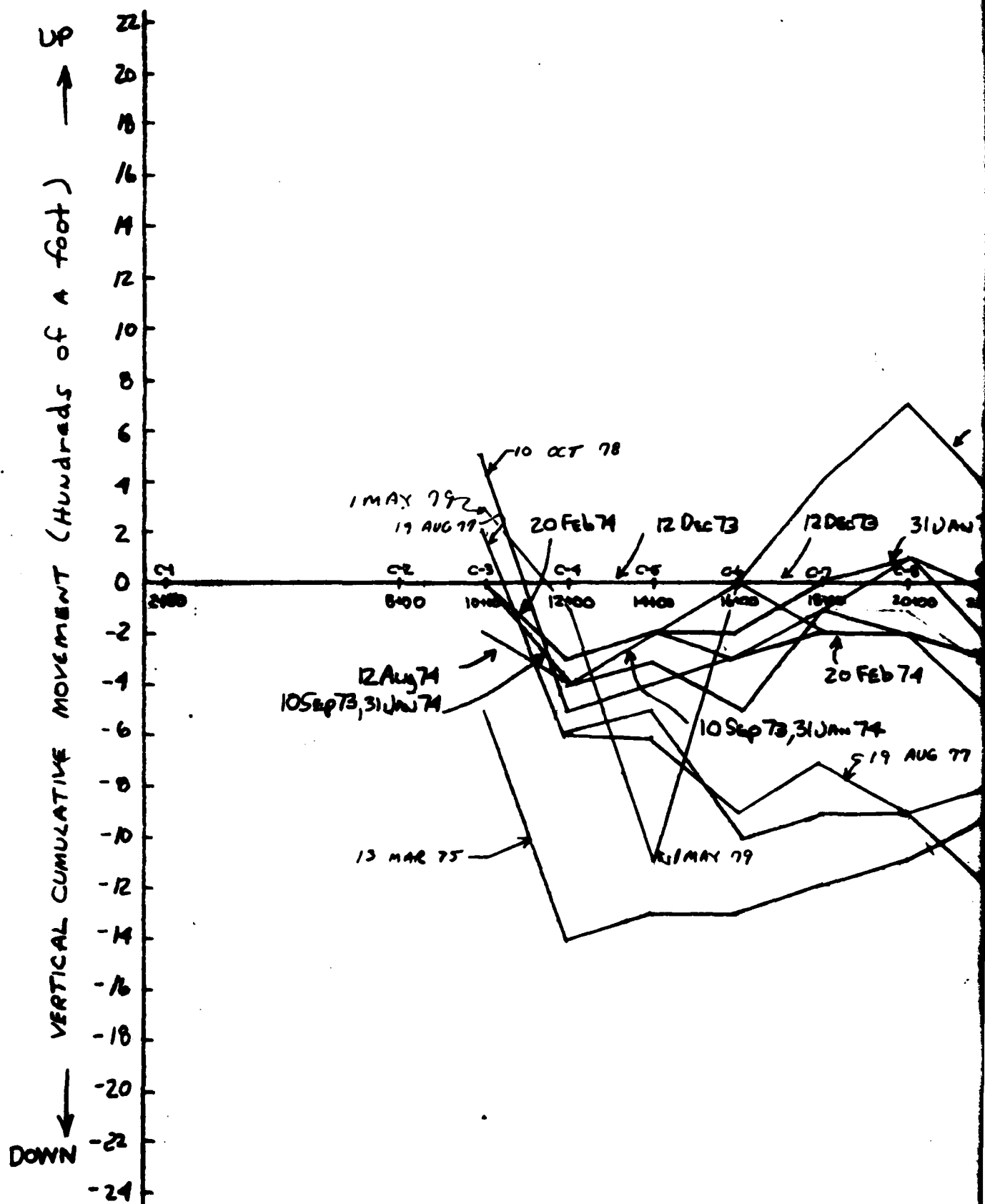
RELIEF WELL SOUNDINGS

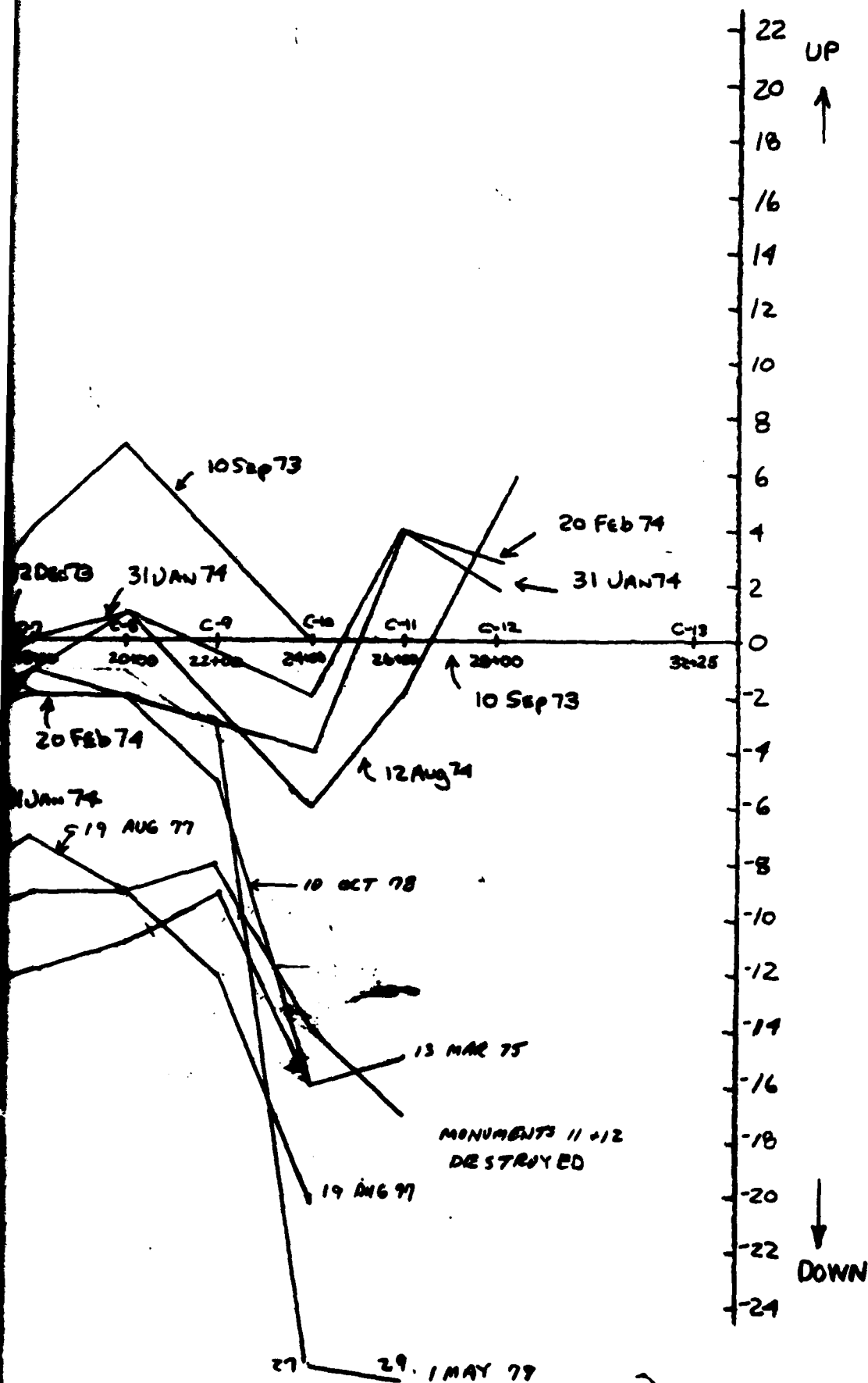
RELIEF WELL NO.	TOP RISER ELEVATION	BOTTOM ELEVATION	11 AUG 75		29 APR 77	
			SOUNDED BOTTOM	SILTATION	SOUNDED BOTTOM	SILTATION
1	656.88	613.3	613.29	- .01	613.33	+ .03
1A	656.46	573.7	574.20	+ .50	574.21	+ .51
2	656.36	559.4	560.81	+ 1.41	560.83	+ 1.43
2A	656.13	550.5	550.31	- .19	550.34	- .16
3	656.06	535.5	536.17	+ .67	536.17	+ .67
3A	655.66	529.7	528.76	- .94	528.78	- .92
4	653.52	515.4	516.16	+ .76	516.13	+ .73
4A	655.17	518.0	518.26	+ .26	518.27	+ .27
5	655.01	513.8	514.73	+ .93	514.75	+ .95
5A	655.16	527.5	527.84	+ .34	527.88	+ .38
6	654.85	512.1	512.12	+ .02	512.15	+ .05
6A	654.54	533.0	532.92	- .08	532.93	- .07
7	654.49	515.3	514.96	- .34	514.98	- .32
7A	654.42	530.5	530.27	- .23	530.26	- .24
8	654.03	512.2	515.38	+ 3.18	515.44	+ 3.24
8A	654.17	521.4	521.84	- .06	521.82	- .08
9	653.83	522.5	522.16	- .34	522.24	- .26
9A	653.82	527.3	527.59	+ .29	527.38	+ .08
10	653.40	536.0	535.25	- .75	535.14	- .86
10A	652.62	524.5	524.68	+ .18	524.67	+ .17
11	651.95	531.7	533.80	+ 2.10	533.78	+ .08
12	651.87	538.9	539.64	+ .79	539.11	+ .21
13	651.24	542.1	543.33	+ 1.23	543.33	+ 1.23
14	650.38	549.9	550.02	+ .12	550.01	+ .11
15	647.96	553.8	554.75	+ .95	554.66	+ .86
16	648.00	557.2	559.31	+ 2.11	559.24	+ 2.04
17	647.85	570.0	569.53	- .47	569.52	- .48
18	646.97	584.1	583.98	- .12	584.01	- .09
19	647.05	593.7	593.65	- .05	593.66	- .04
20	646.98	607.4	607.67	+ .27	607.74	+ .34
21	646.77	619.5	620.74	+ 1.24	620.72	+ 1.22
22	646.52	619.6	619.92	+ .32	620.06	+ .46

INDIANA

INGS

29 APR 77		24 APR 78		14 MAY 79		2 JUNE 80	
SOUNDED BOTTOM	SILTATION	SOUNDED BOTTOM	SILTATION	SOUNDED BOTTOM	SILTATION	SOUNDED BOTTOM	SILTATION
613.33	+ .03	613.19	- .11	613.21	-0.09	613.18	-0.12
574.21	+ .57	574.12	+ .42	574.13	+0.43	574.11	+0.41
560.83	+1.43	560.82	+1.42	560.83	+1.43	560.81	+1.41
550.34	- .16	550.33	- .17	550.68	+0.18	550.33	-0.17
536.17	+ .67	536.17	+ .67	536.33	+0.83	536.21	+0.71
528.78	- .92	528.78	- .92	528.88	-0.82	528.81	-0.89
516.13	+ .73	516.12	+ .72	516.30	+0.90	516.12	+0.72
518.27	+ .27	518.25	+ .25	518.42	+0.42	518.27	+0.27
514.75	+ .95	514.75	+ .95	515.01	+1.21	514.76	+0.96
527.88	+ .38	527.86	+ .38	528.16	+0.66	527.86	+0.36
512.15	+ .05	512.13	+ .03	512.51	+0.41	512.20	+0.10
532.93	- .07	532.92	- .06	533.31	+0.31	532.94	-0.06
514.98	- .32	514.98	- .32	515.26	-0.04	514.99	-0.31
530.26	- .24	530.26	- .24	530.26	-0.24	530.27	-0.23
515.44	+3.24	515.35	+3.15	515.35	+3.15	515.78	+3.58
521.82	- .08	521.82	- .08	522.17	+0.27	521.82	-0.08
522.24	- .26	522.24	- .26	522.38	-0.12	522.23	-0.27
527.38	+ .08	524.38	+ .08	527.49	+0.19	527.42	+0.12
535.14	- .86	535.24	- .76	535.24	-0.76	535.25	-0.75
524.67	+ .17	524.66	+ .16	524.82	+0.32	524.72	+0.22
533.78	+ .08	533.77	+2.07	533.87	+2.17	533.80	+2.10
539.11	+ .21	539.64	+ .74	539.63	+0.73	539.67	+0.77
543.33	+1.23	543.41	+1.31	543.40	+1.3	543.44	+1.34
550.01	+ .11	549.97	+ .07	549.98	+0.08	549.98	+0.08
554.66	+ .86	554.65	+ .85	554.67	+0.87	554.66	+0.86
559.24	+2.04	559.19	+1.99	559.31	+2.11	559.30	+2.10
569.52	- .48	569.54	- .46	569.57	-0.43	569.55	-0.45
584.01	- .09	584.04	- .06	584.15	+0.05	584.02	-0.08
593.66	- .04	593.82	+ .12	593.79	+0.09	593.80	+0.10
607.74	+ .34	607.69	+ .29	607.81	+0.41	607.68	+0.28
620.72	+1.22	620.72	+1.21	621.09	+1.59	620.72	+1.22
620.06	+ .46	619.91	+ .31	620.12	+0.22	619.87	+0.27

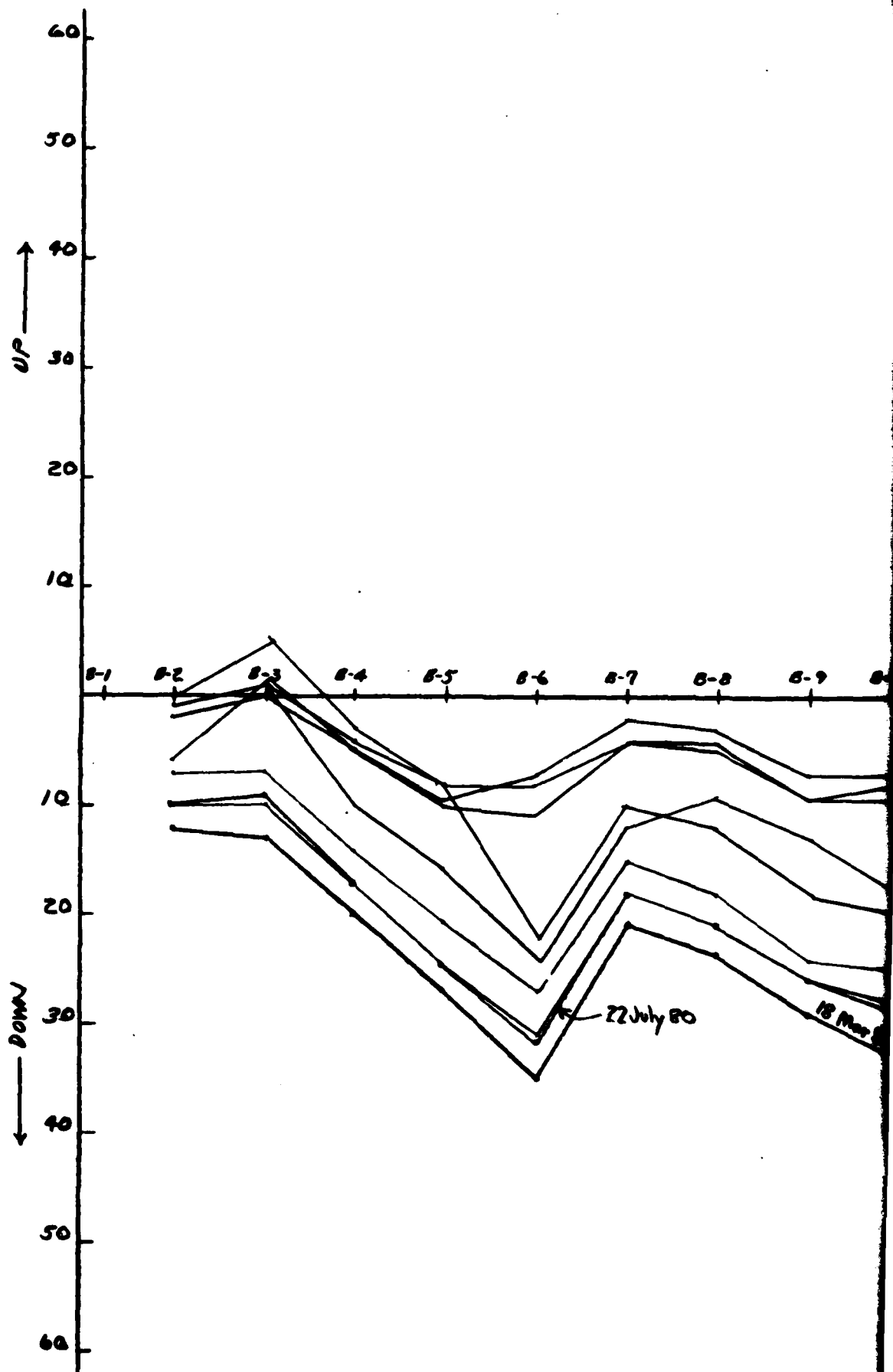


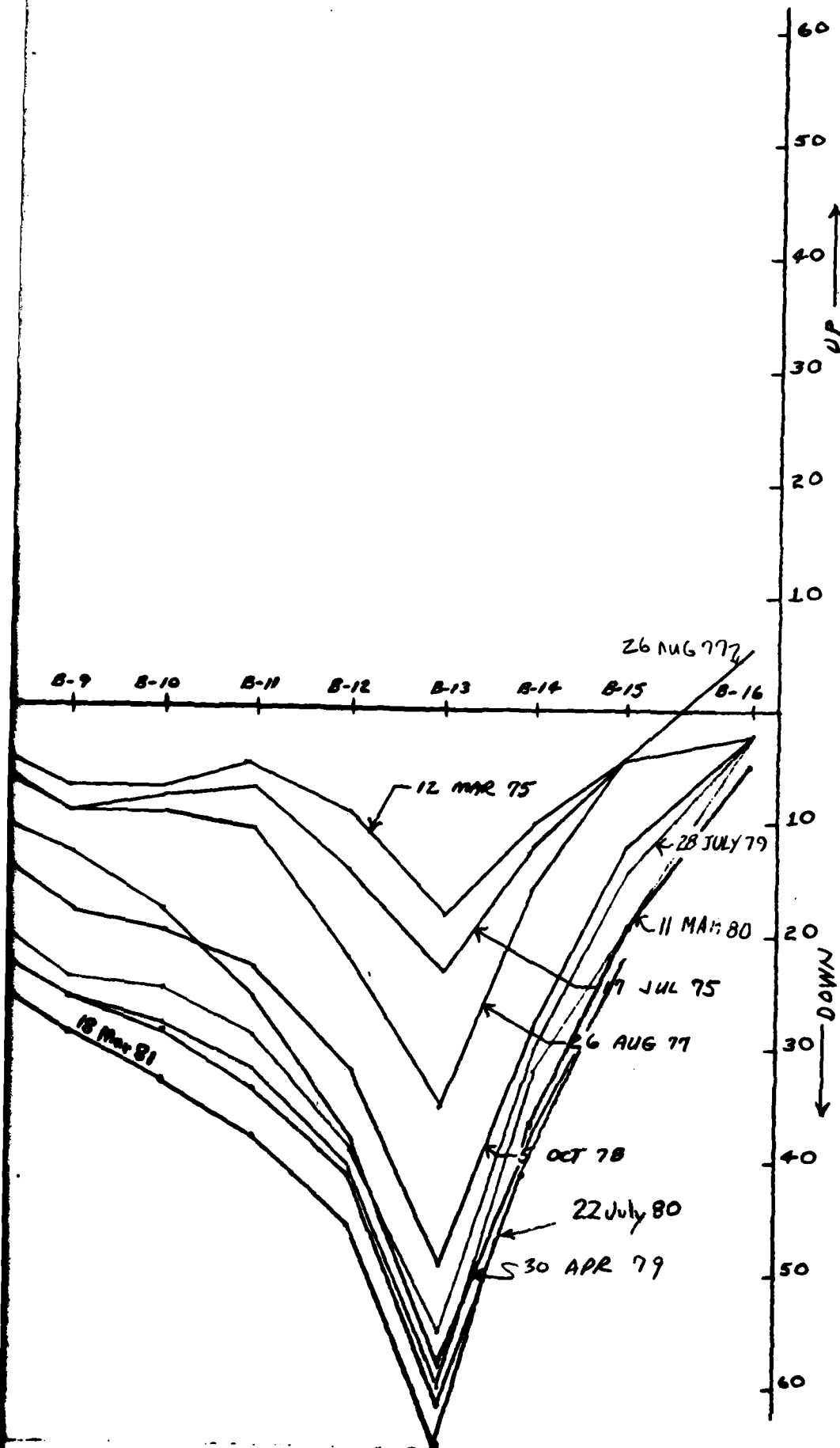


27 July 73	
INITIAL READING	
MON. NO.	ELEV.
C-3	678.12
C-4	679.36
C-5	678.50
C-6	678.34
C-7	678.65
C-8	678.90
C-9	694.86
C-10	700.01
C-11	686.50
C-12	680.13
C-13	808.86

BROOKVILLE LAKE
MOVEMENT MONUMENTS
400' DOWNSTREAM &
VERTICAL MOVEMENT

PLATE 37





INITIAL READING 21 AUG 74	
MON	ELEV.
B-2	808.80
B-3	808.79
B-4	809.26
B-5	809.78
B-6	809.67
B-7	809.63
B-8	809.87
B-9	809.73
B-10	809.92
B-11	809.82
B-12	809.49
B-13	809.80
B-14	809.60
B-15	808.56
B-16	810.71

BROOKVILLE LAKE
MOVEMENT MONUMENTS
B LINE 15' DS
VERTICAL MOVEMENT

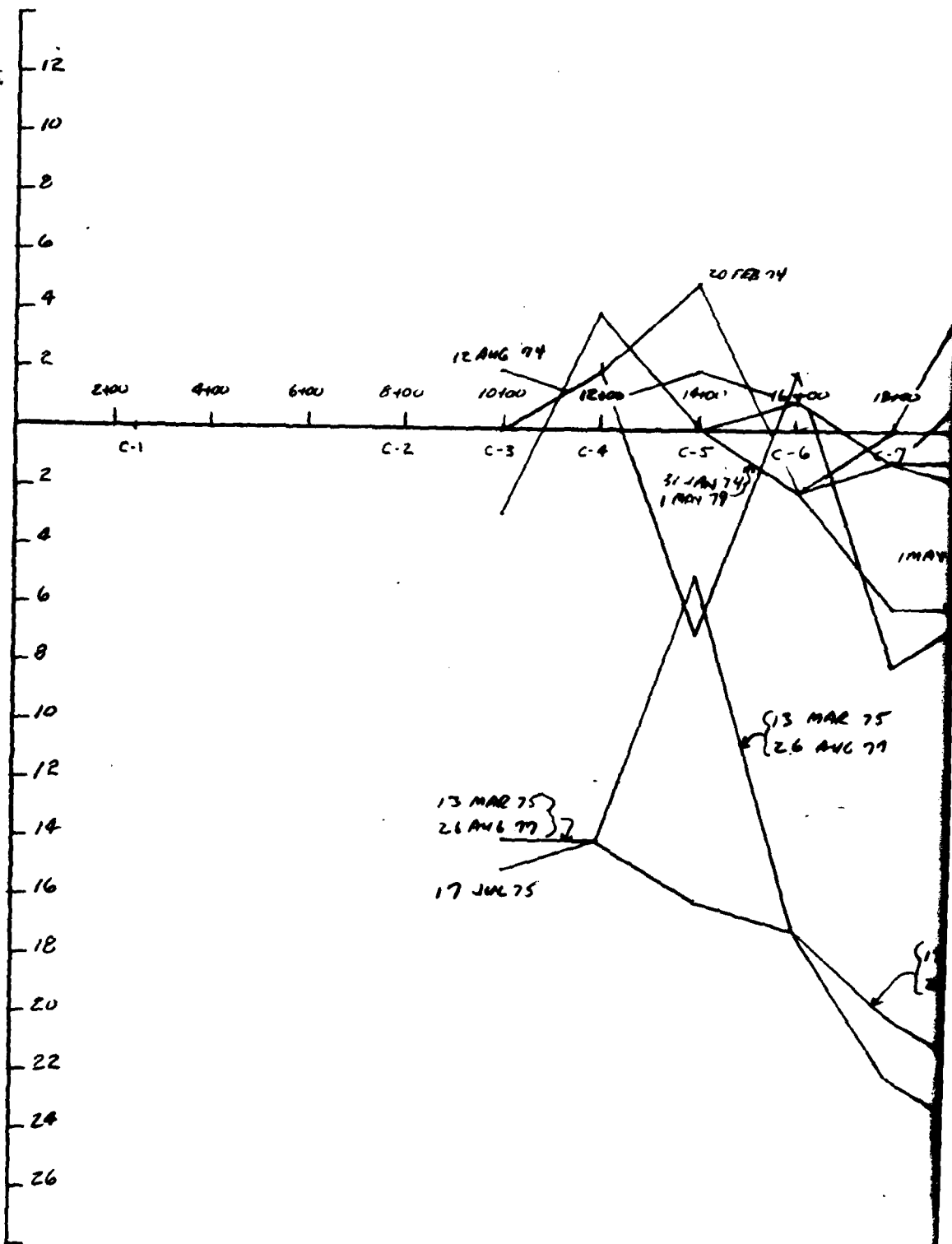
PLATE 38

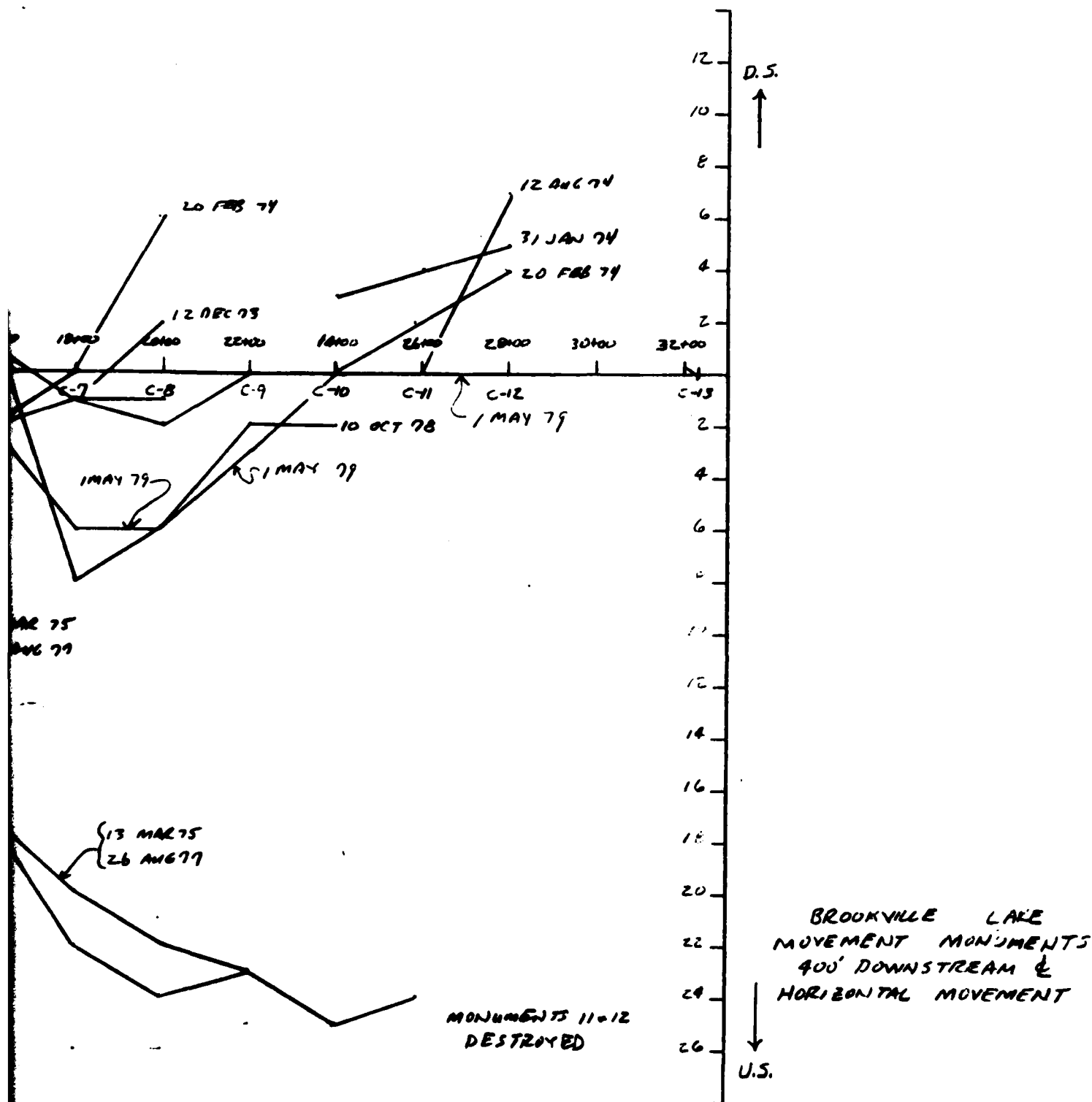
HORIZONTAL CUMULATIVE MOVEMENT (HUNDRETHS OF A FOOT)

0.5



0.5

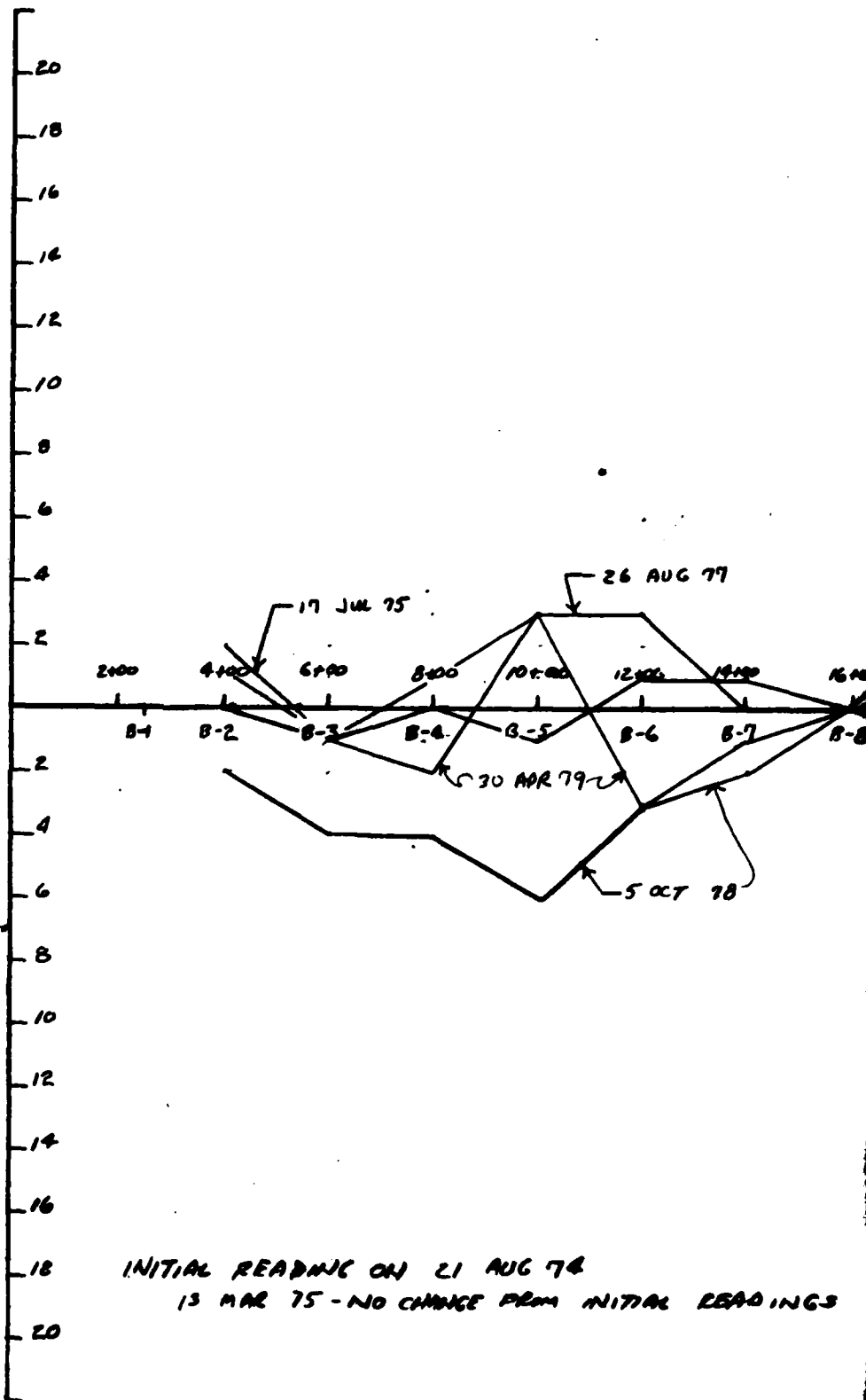


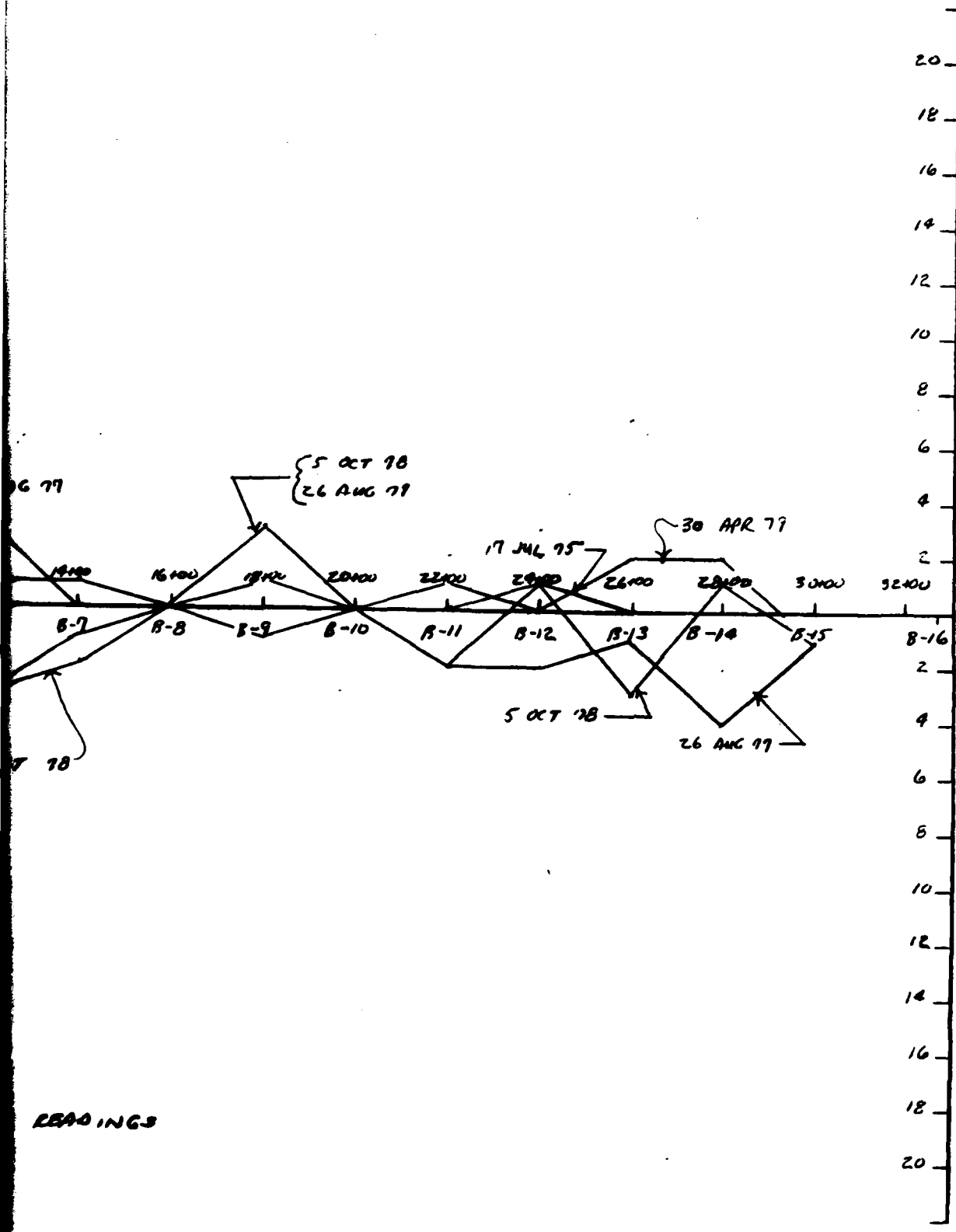


HORIZONTAL CUMULATIVE MOVEMENT (HUNDRETHS OF A FOOT)

D.S.
↑

U.S.
↓

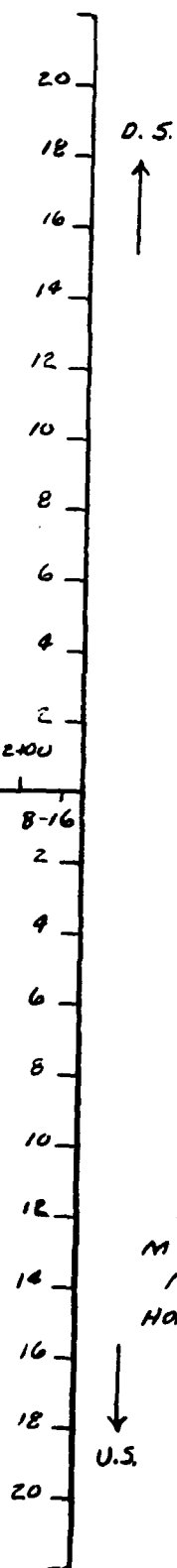




D.S.
↑

BROOKVILLE LA
MOVEMENT MONUM
15' DOWNSTREAM
HORIZONTAL MOVEMENT

↓
U.S.

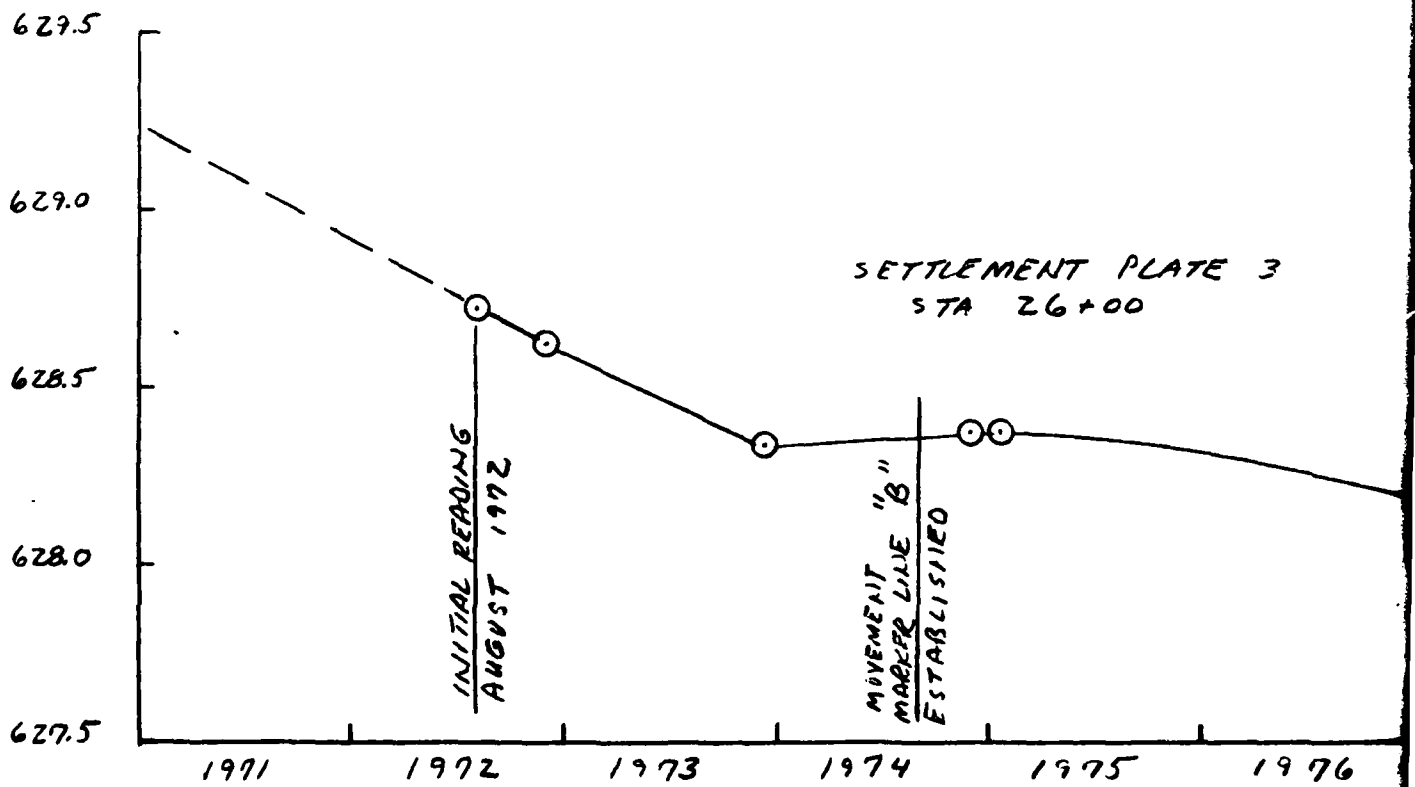
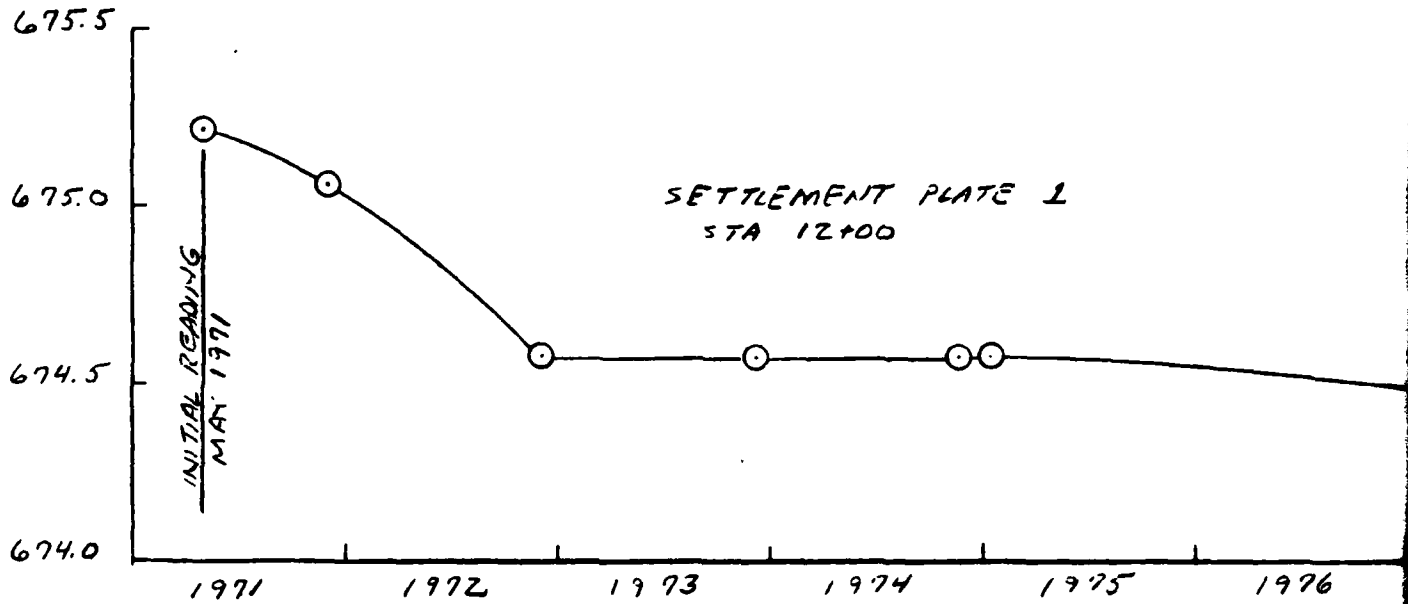


BROOKVILLE LAKE
MOVEMENT MONUMENTS
15' DOWNSTREAM &
HORIZONTAL MOVEMENT

PLATE 40

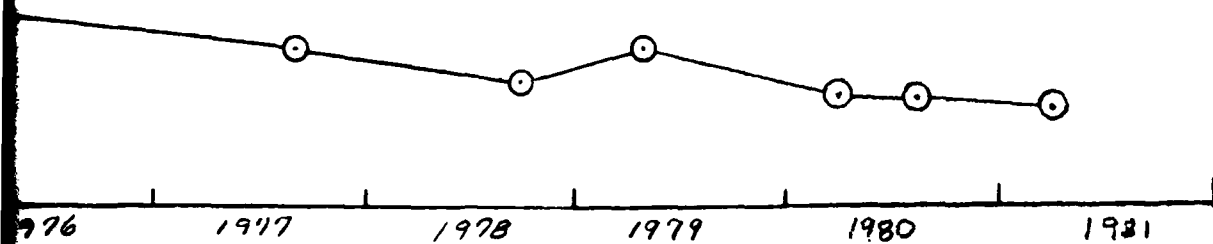
BROOKVILLE LAKE, IND

SETTLEMENT PLATES



INDIANA

5



BROOKVILLE LAKE
SETTLEMENT RATES

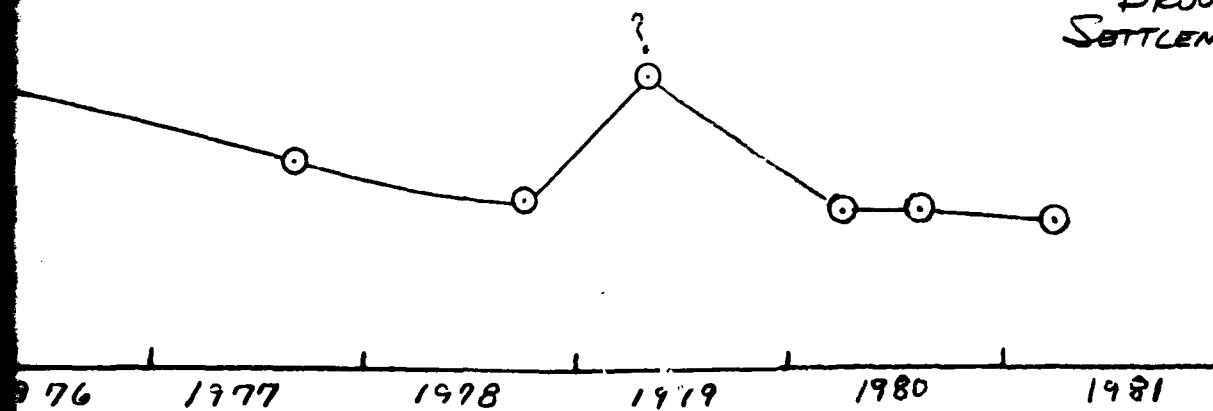
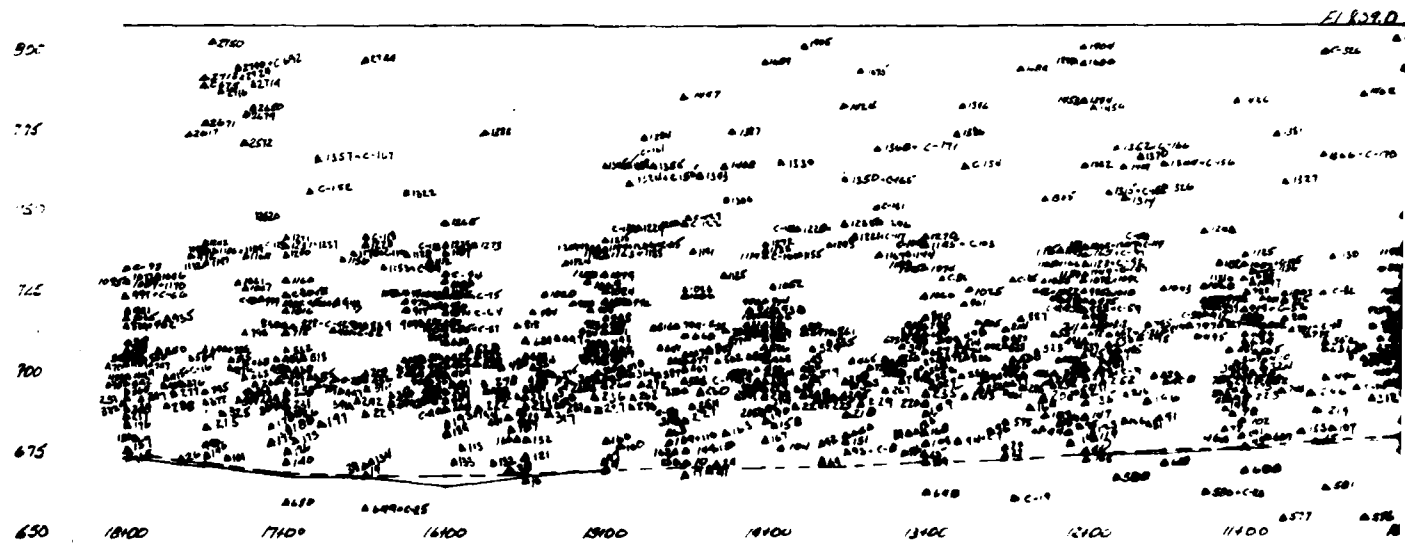
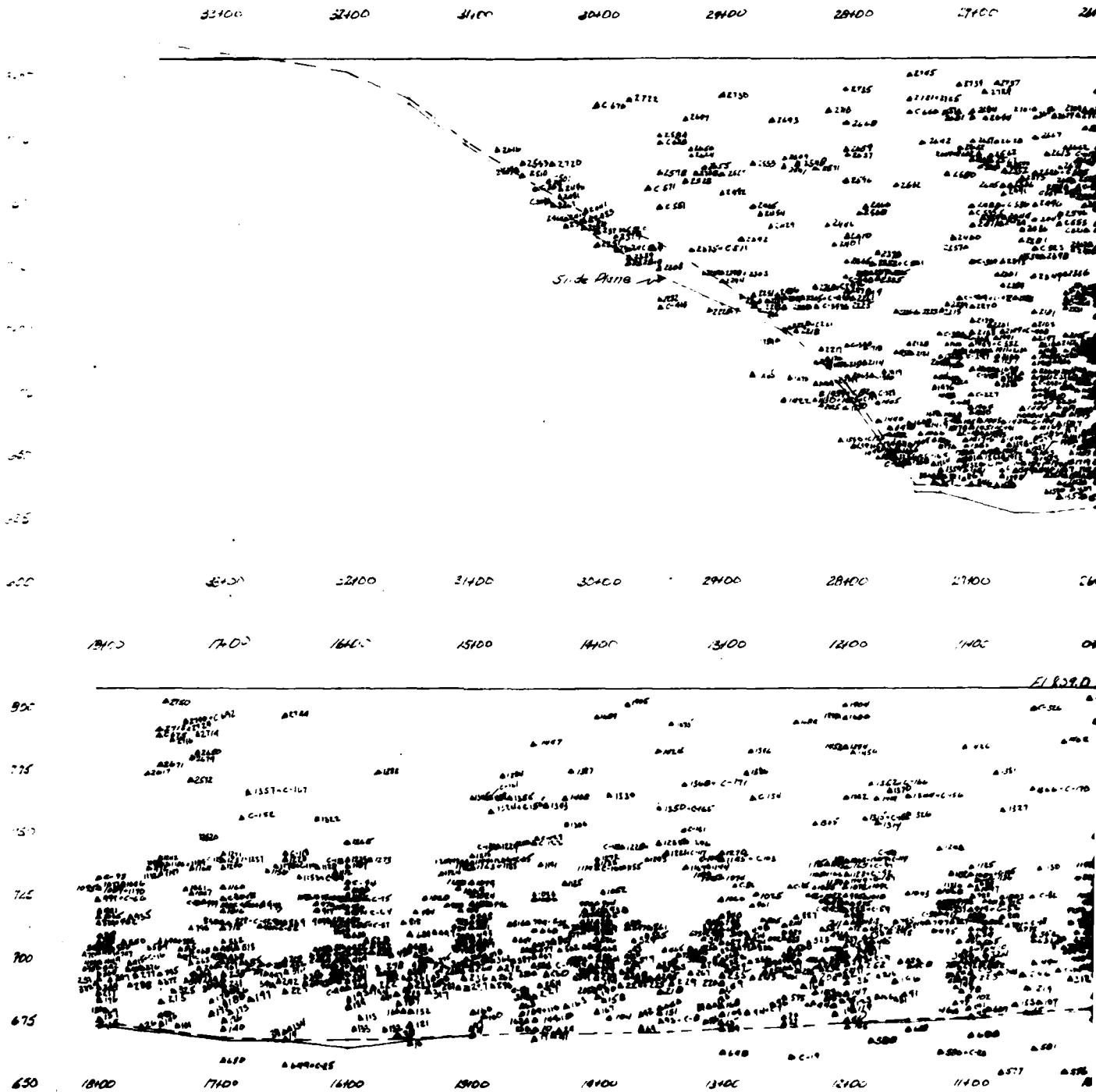


PLATE 41

2

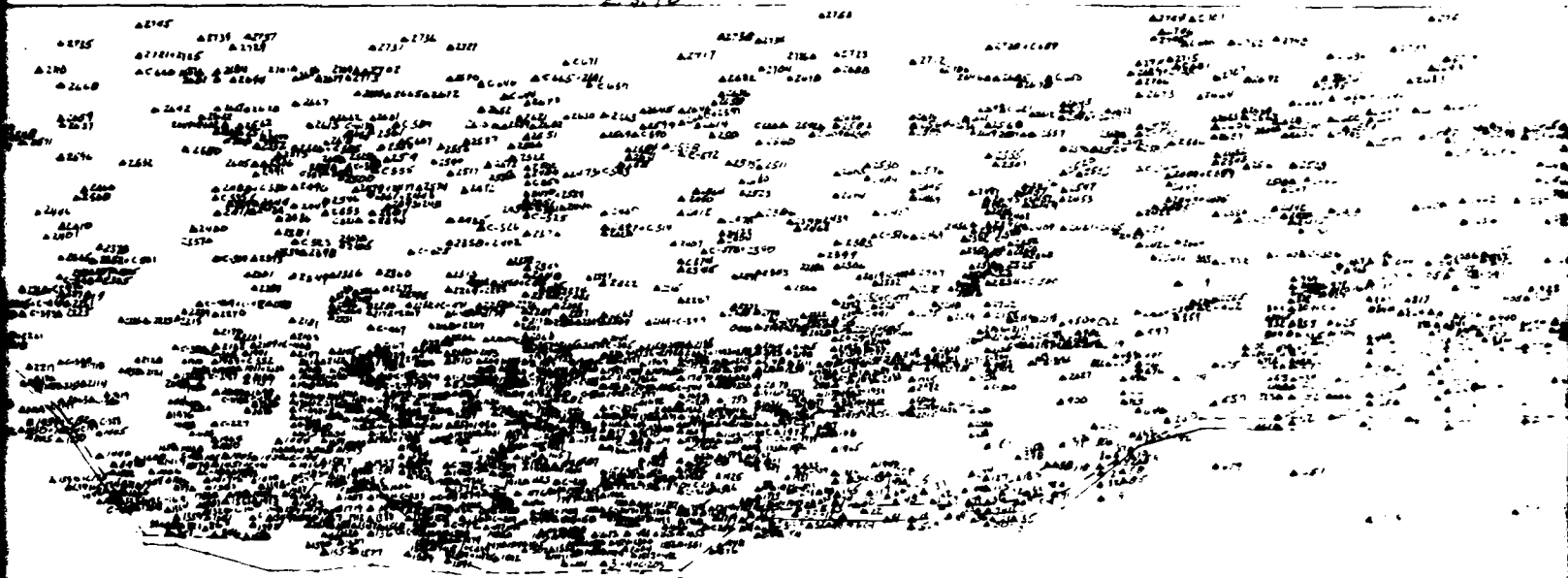
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3



28400 27400 26400 25400 24400 23400 22400 21400 20400

EL 870

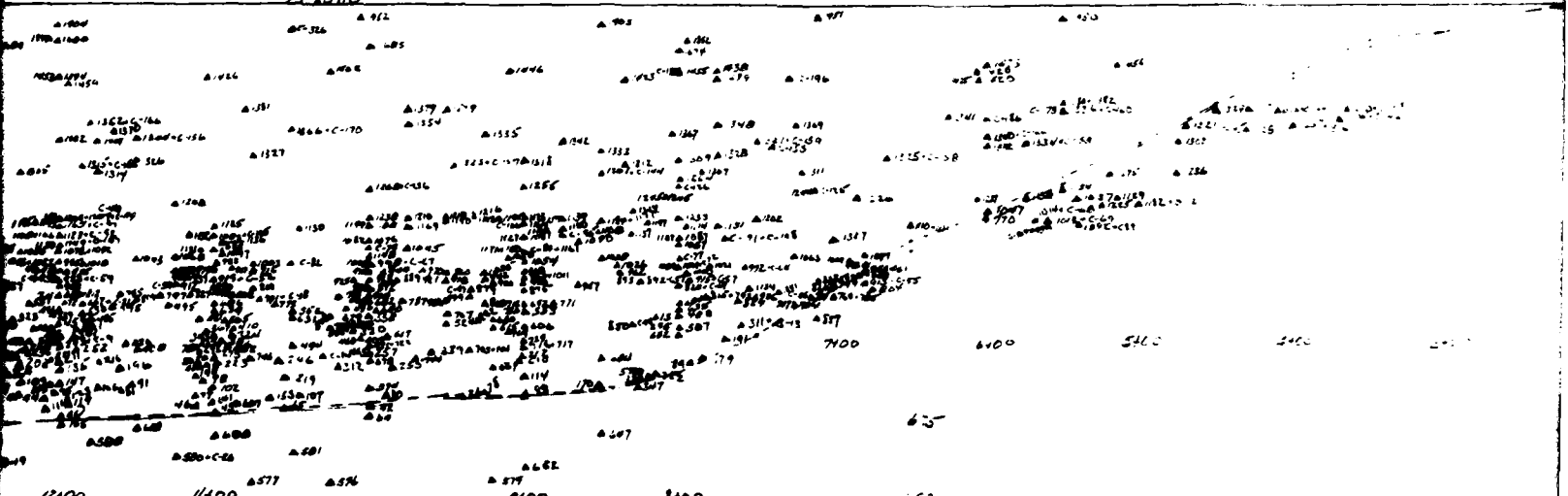


Centerline Profile

28400 27400 26400 25400 24400 23400 22400 21400 20400

12400 11400 10400 9400 8400 7400 6400 5400 4400

EL 890

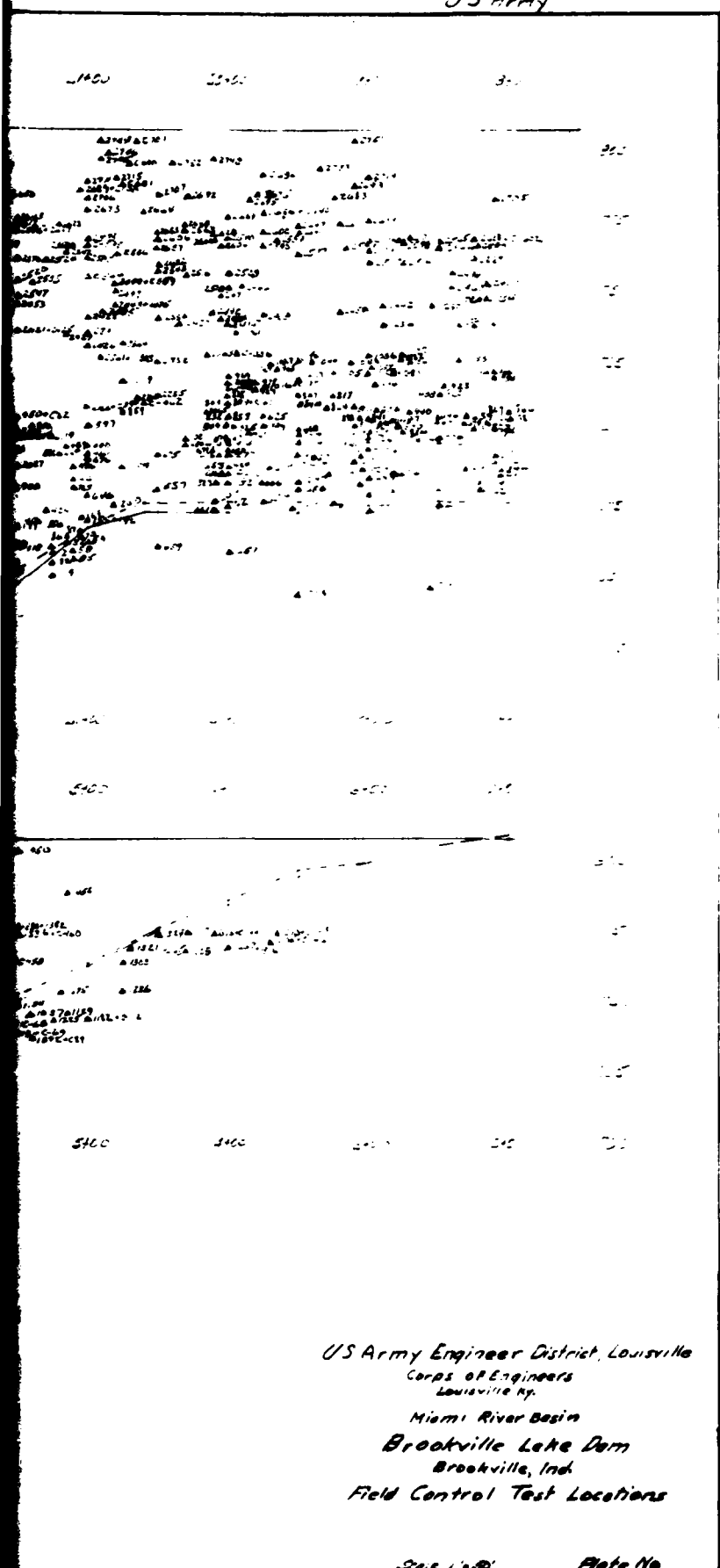


Centerline Profile

12400 11400 10400 9400 8400 7400 6400 5400 4400

US Army Eng
Corps
Miami
Brook
Field Cont

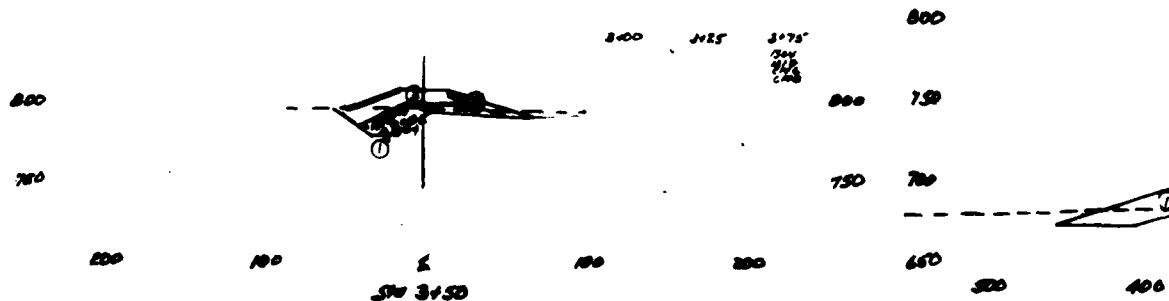
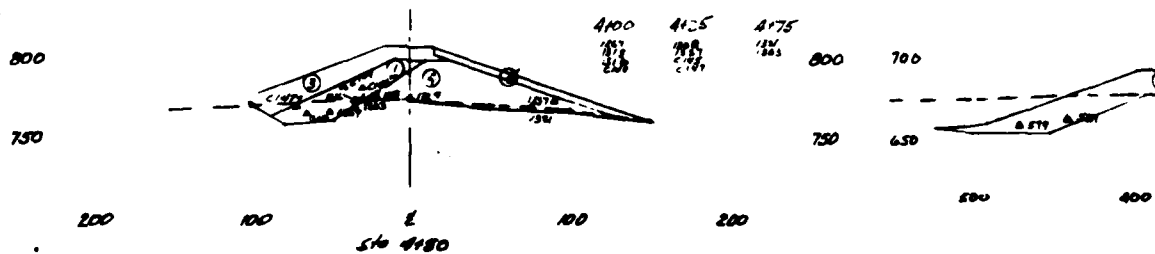
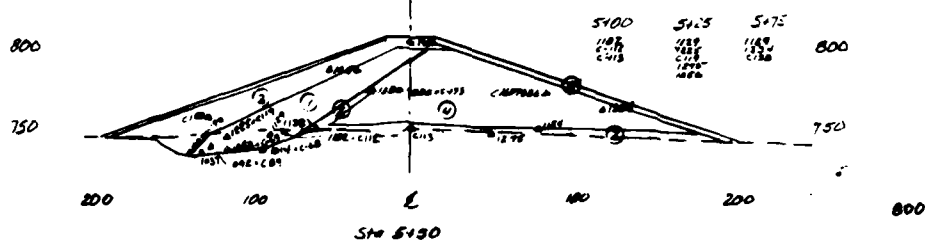
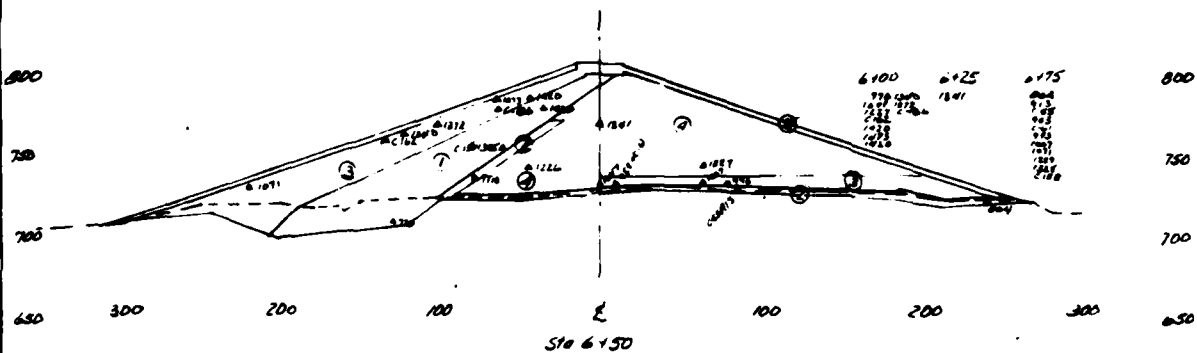
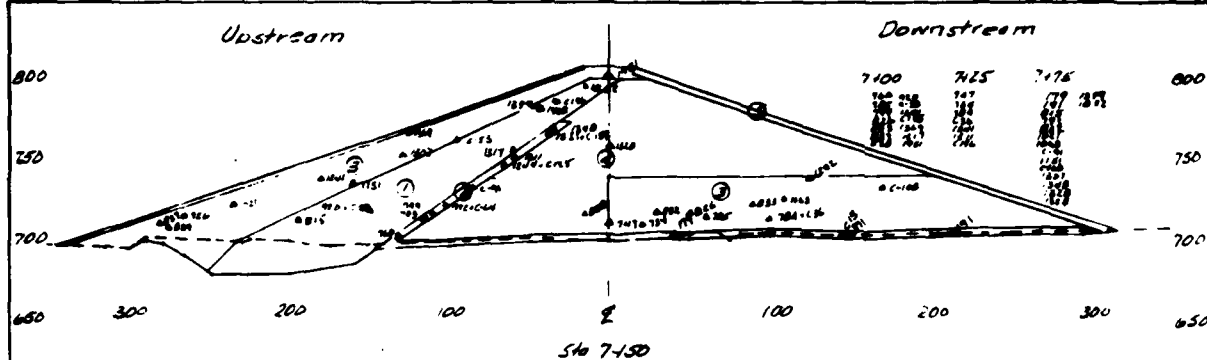
US Army

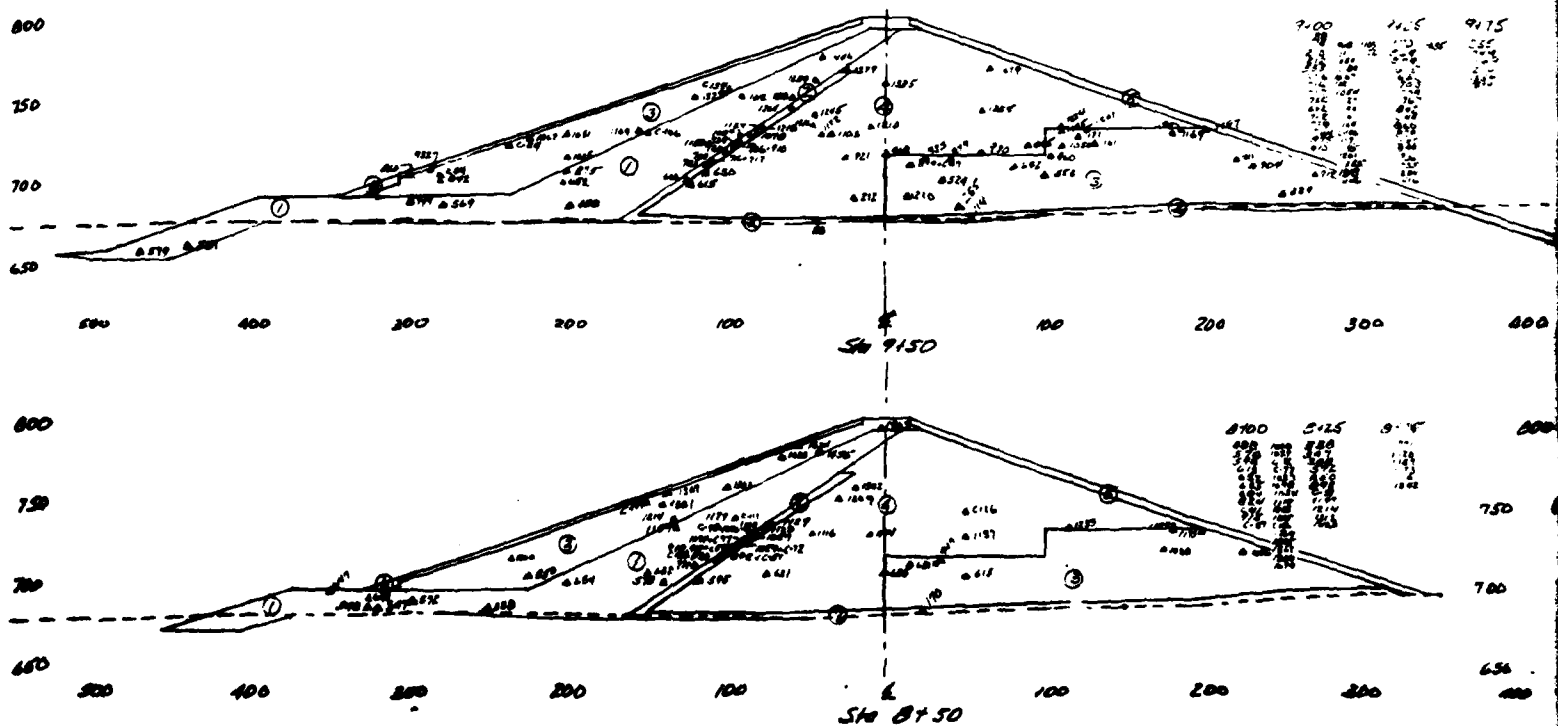
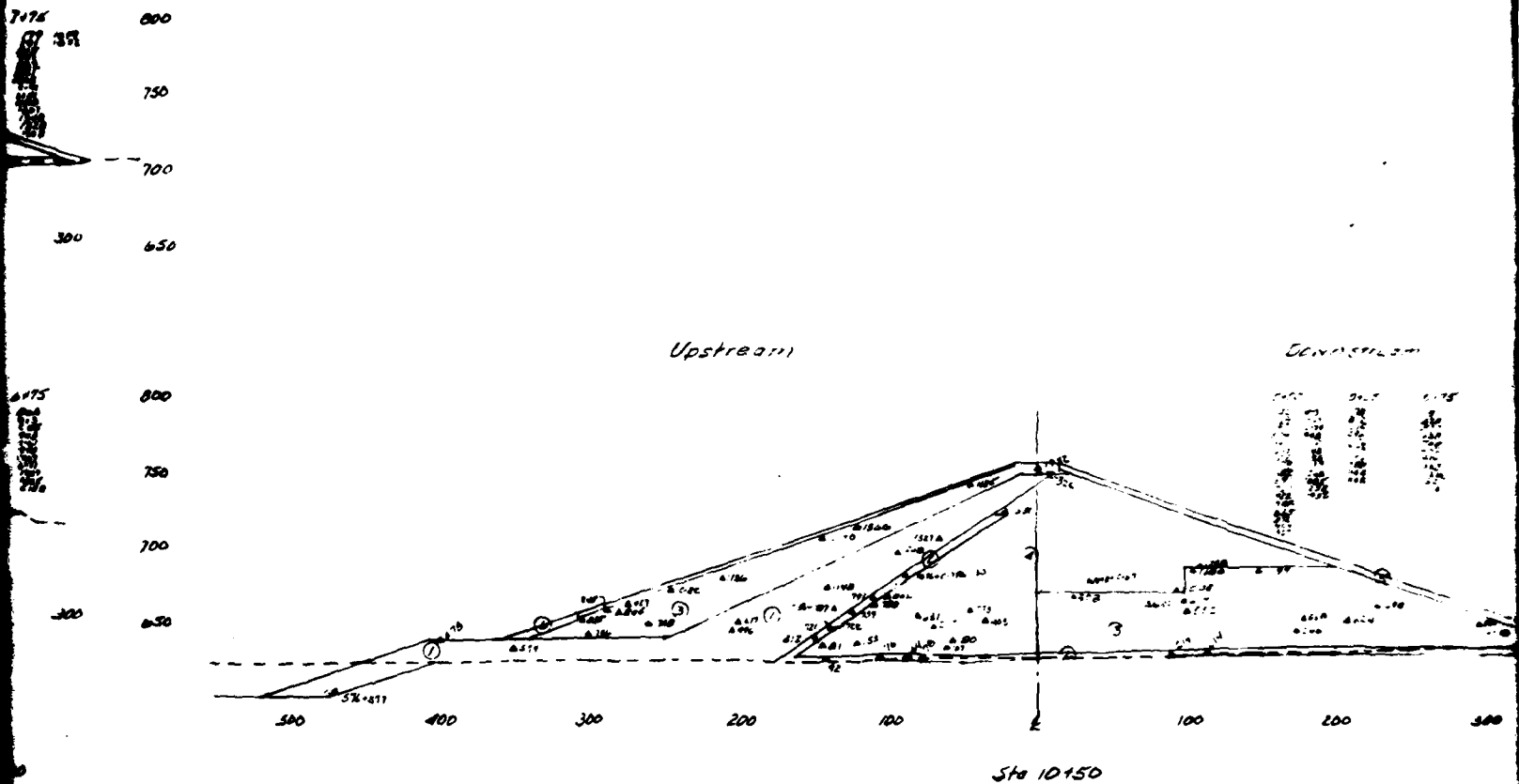


N

3

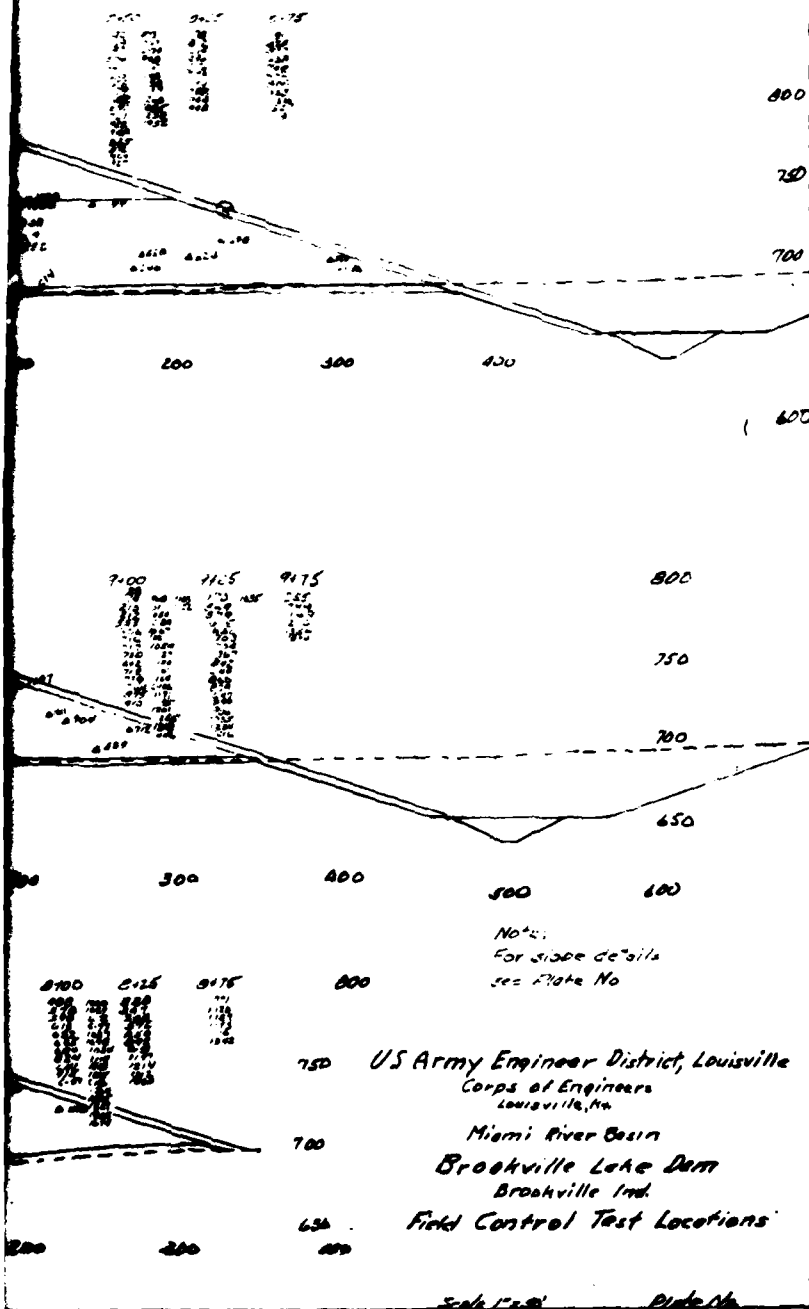
Corps of Engineers





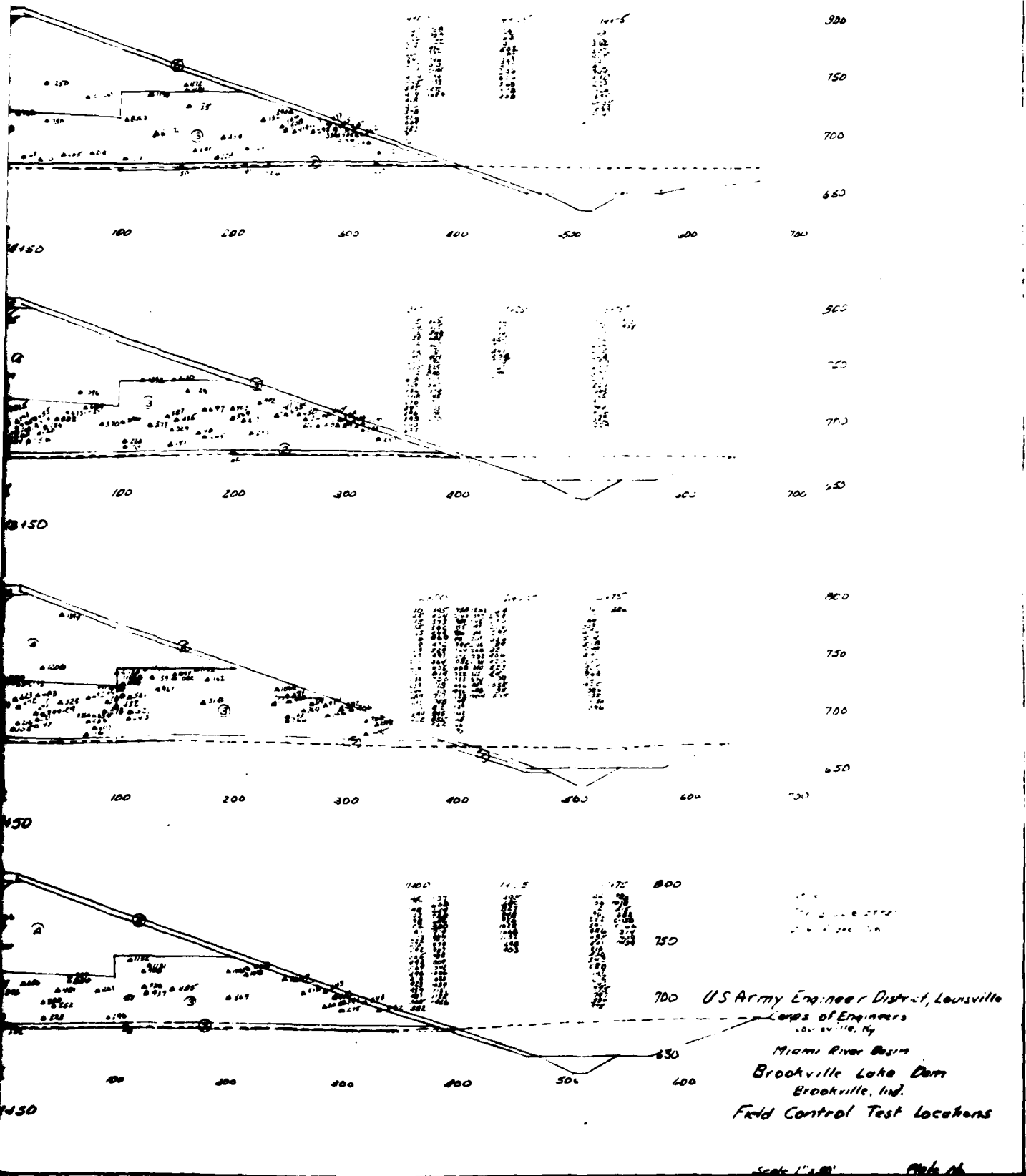
U. S. Army

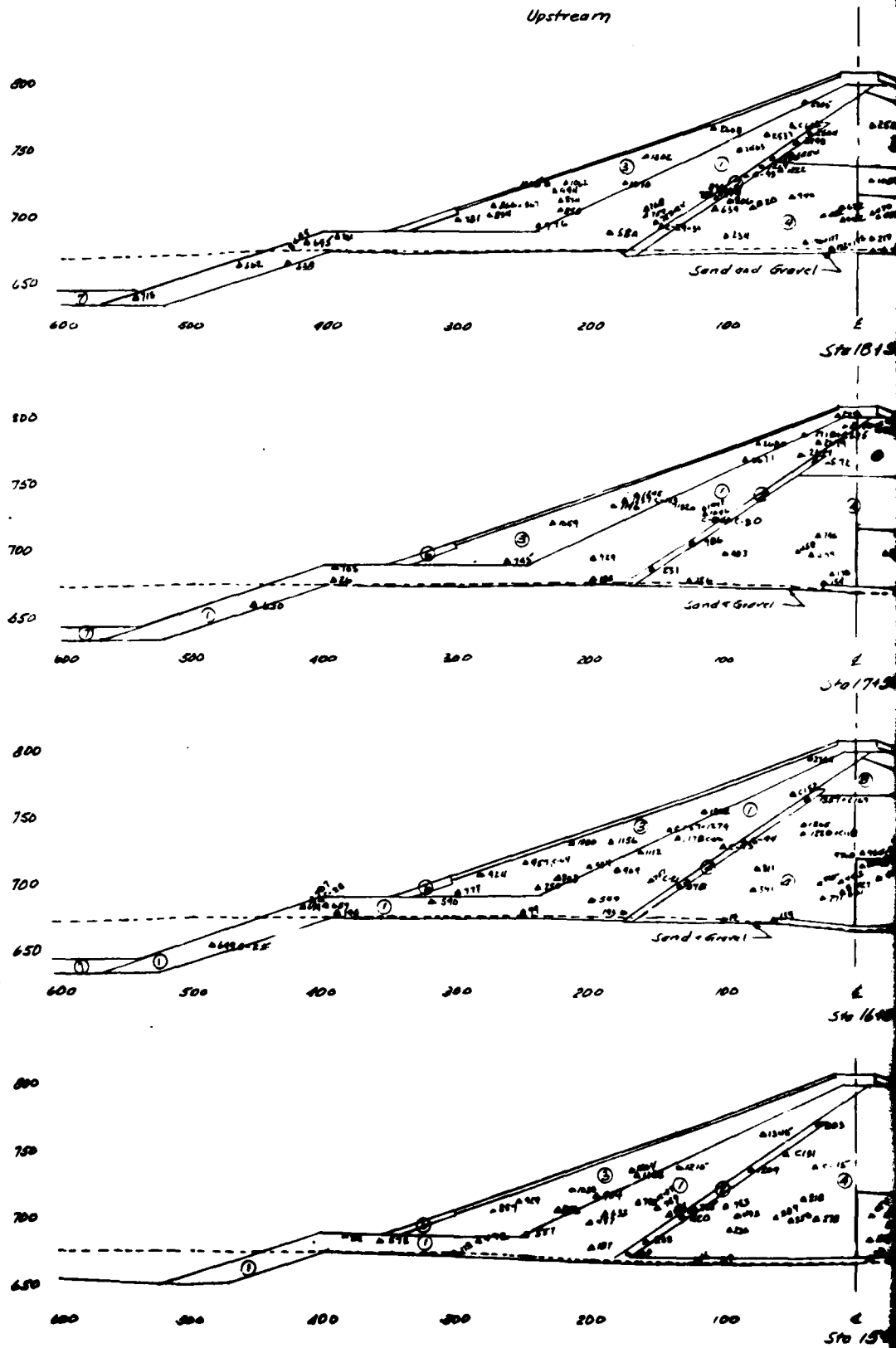
CONSTRUCTION

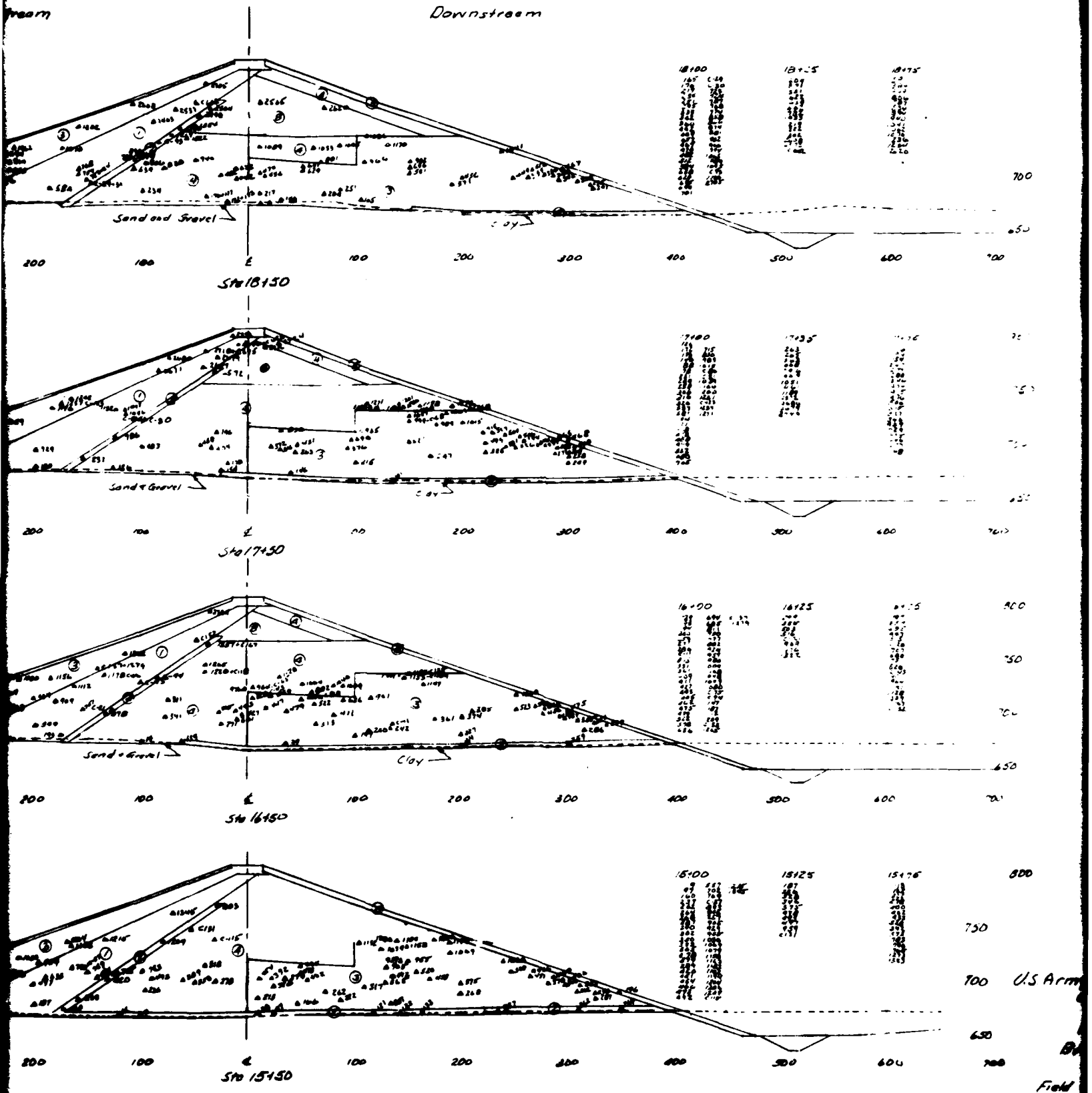


3 PLATE NO. 43

Downstream







700

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700 U.S. Army Engineer District, Louisville
Corps of Engineers
Louisville, Ky
650 Miami River Basin
Brookville Lake Dam
700 Brookville, Ind.
Field Control Test Locations

Note
for 5.000 cc
see Page 40

650

Scale 1"=50' 5/15/06

800

Upstream

750

700

650

700

600

500

400

300

200

100

800

750

700

650

700

600

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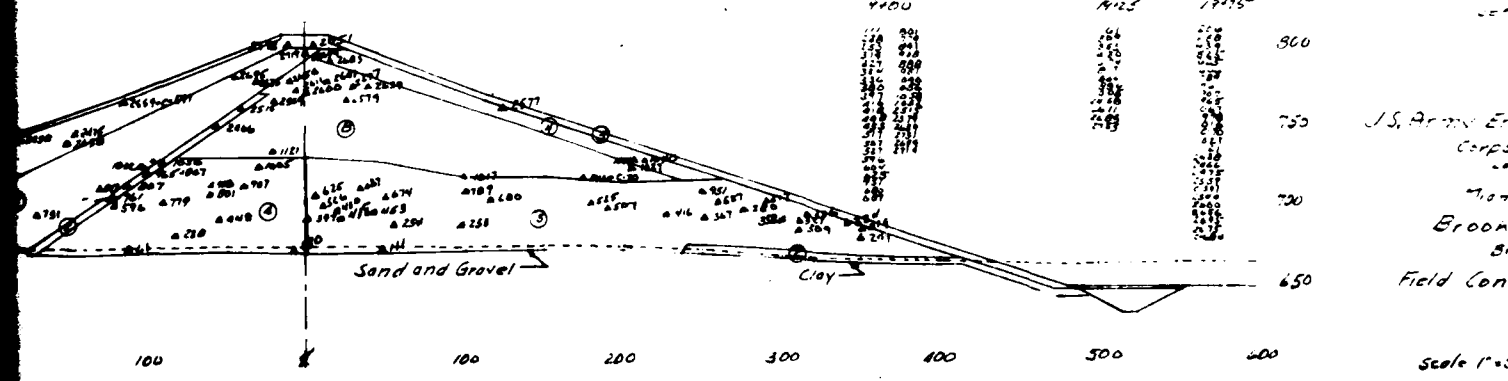
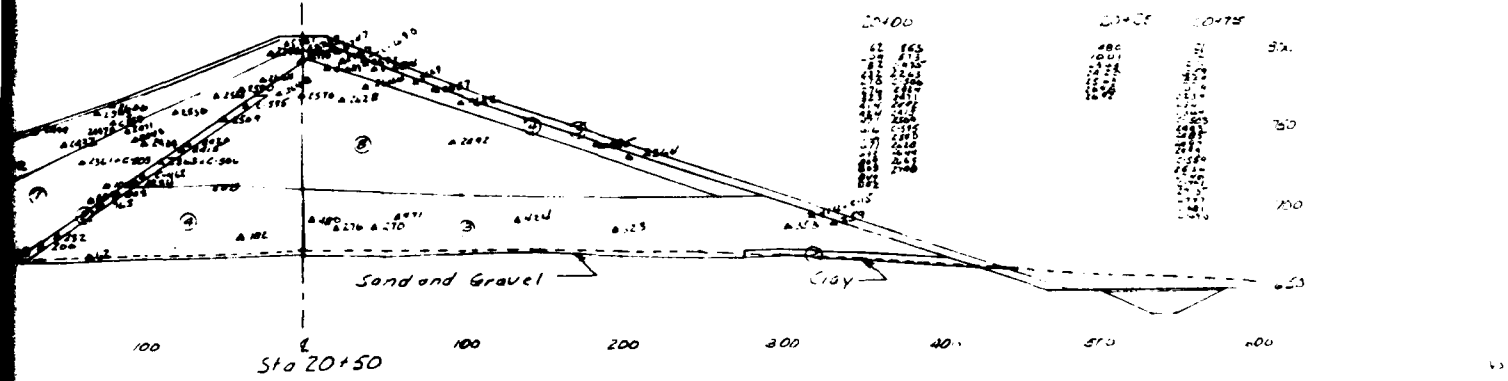
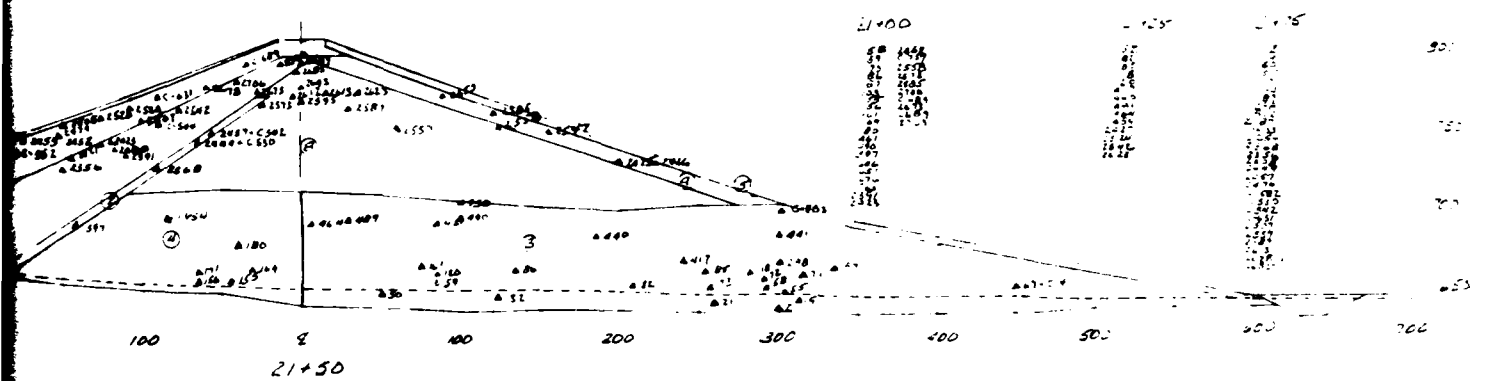
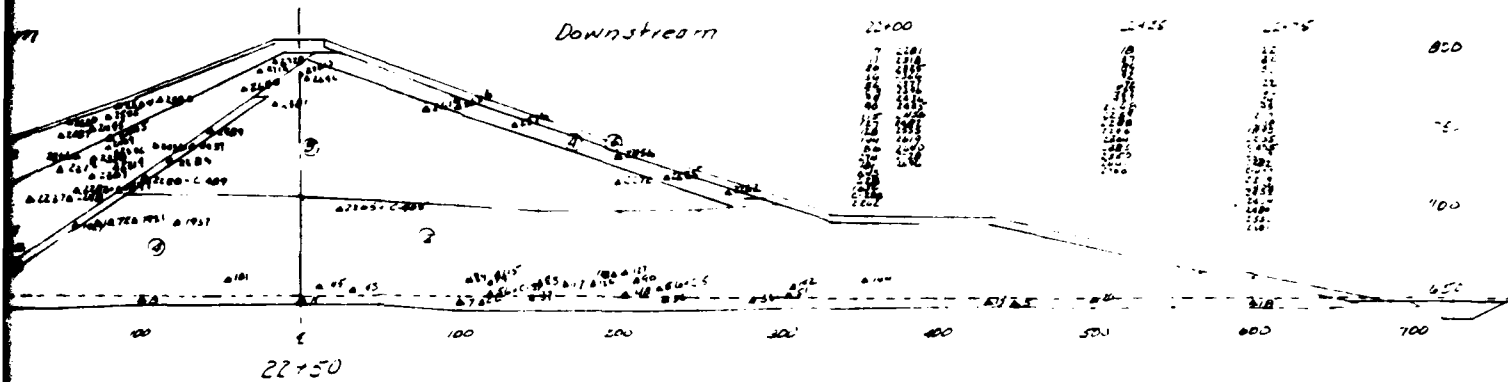
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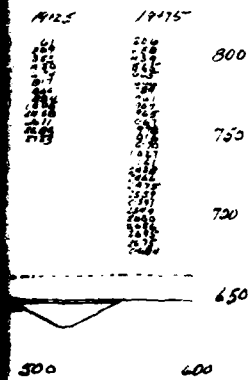
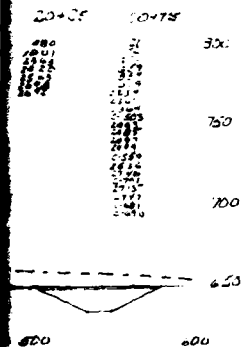
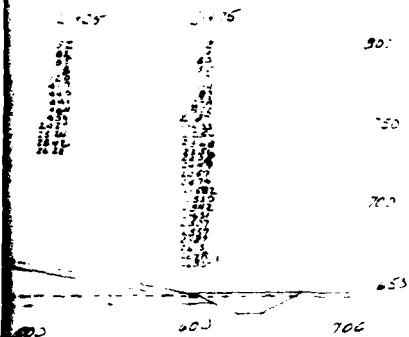
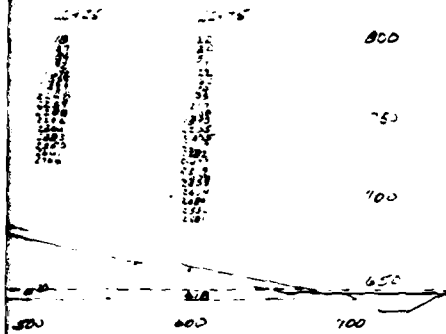


NOTE
For 8' rise across
see page 10

U.S. Army Engineer
Corps of Engineers
Louisville, Ky.
Miami River
Brookville, La.
Brookville, La.
Field Control Test

Scale 1"=50'

U.S. Army



Note
For gage control
see Plate 70

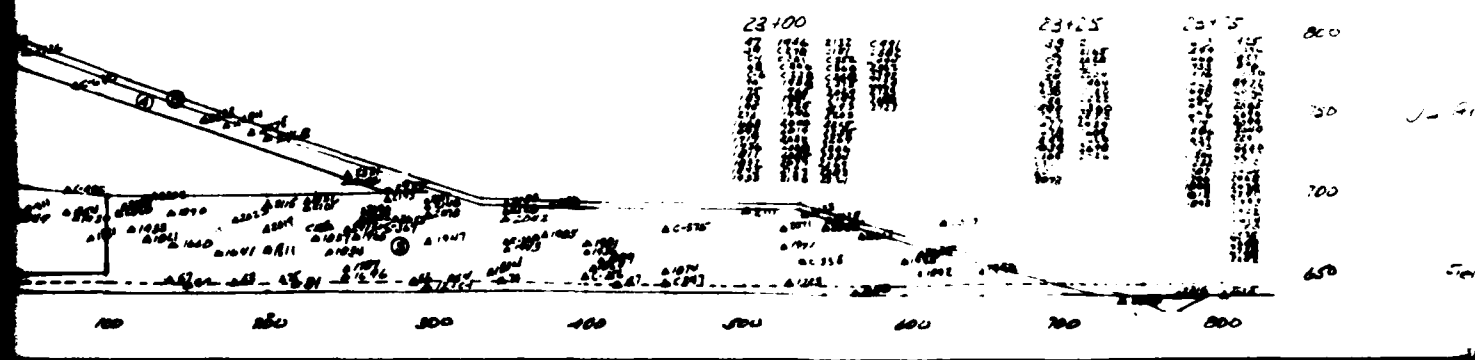
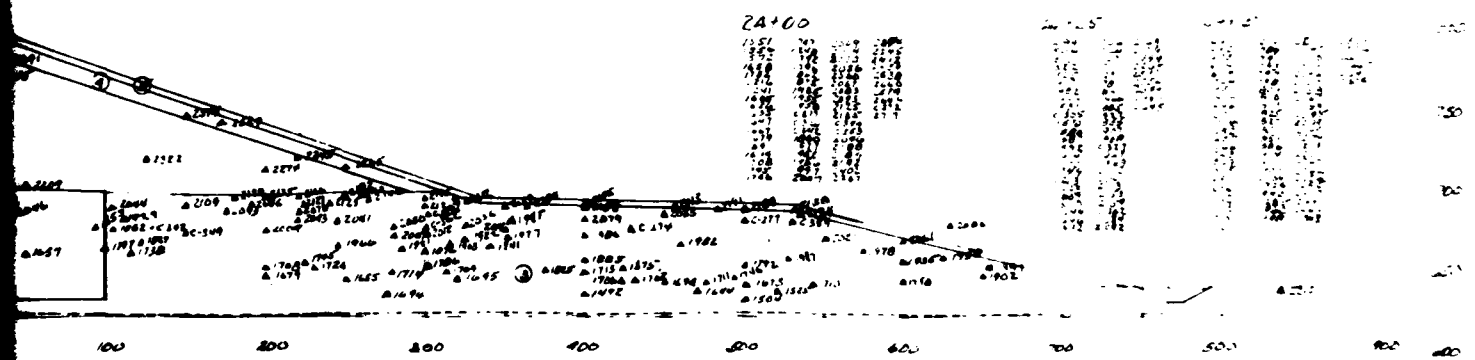
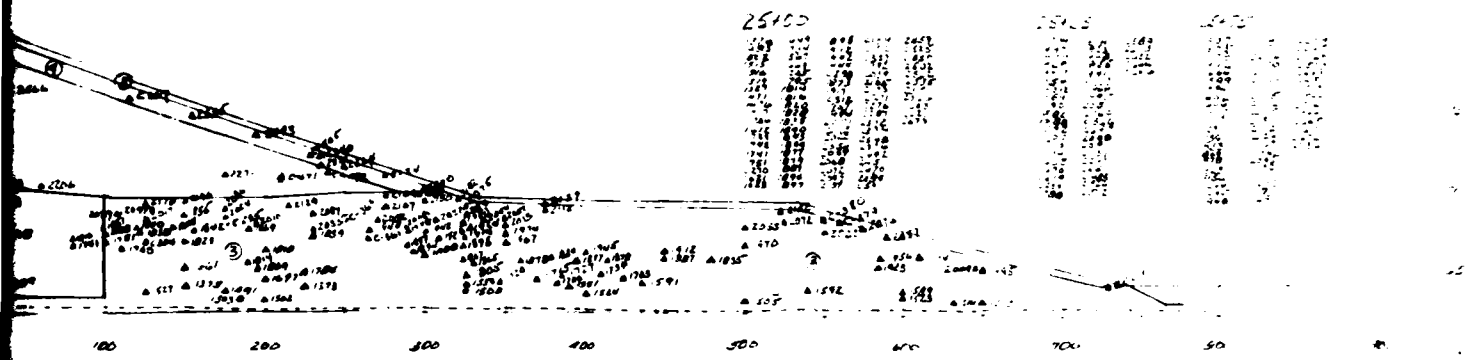
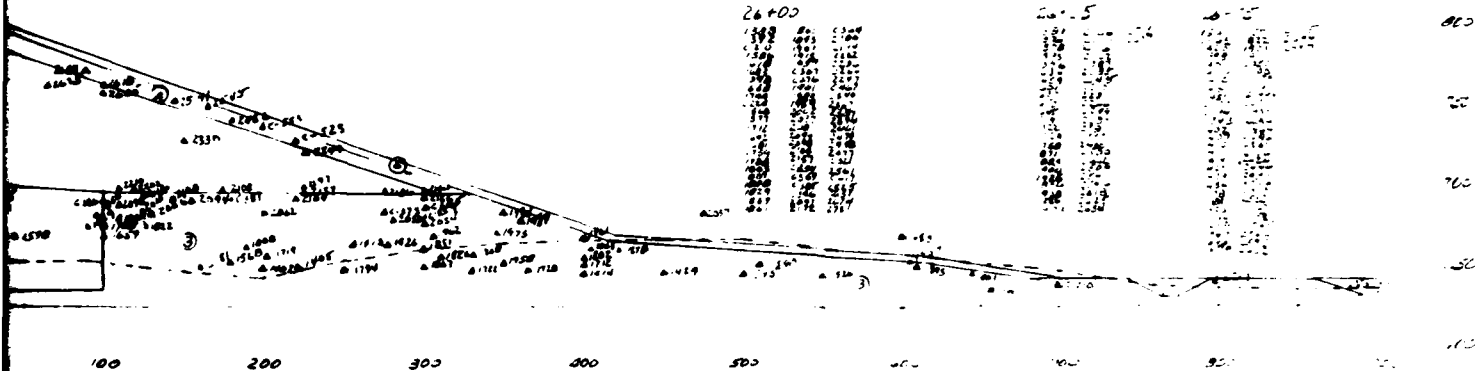
U.S. Army Engineer District, Louisville
Corps of Engineers
Louisville Ky.
Miami River Basin
Brookville Lake Dam
Brookville, Ind.
Field Control Test Locations

Scale 1"=30'

Plate No

Upstream

DOWNSTREAM



U.S. Army Engineer
Corps of Engineers
Mem. Riv.
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Brown
Field Control

Scale 1" = 50'

2

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US Army

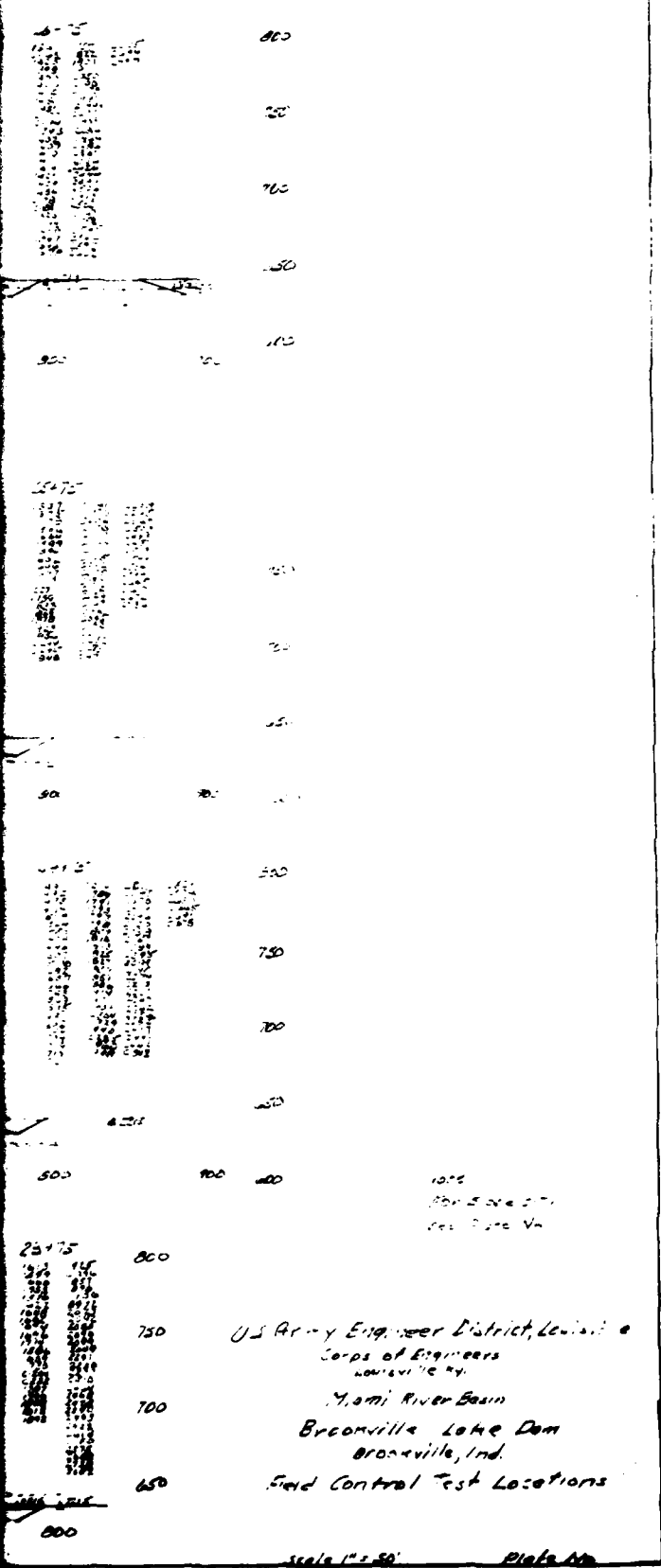
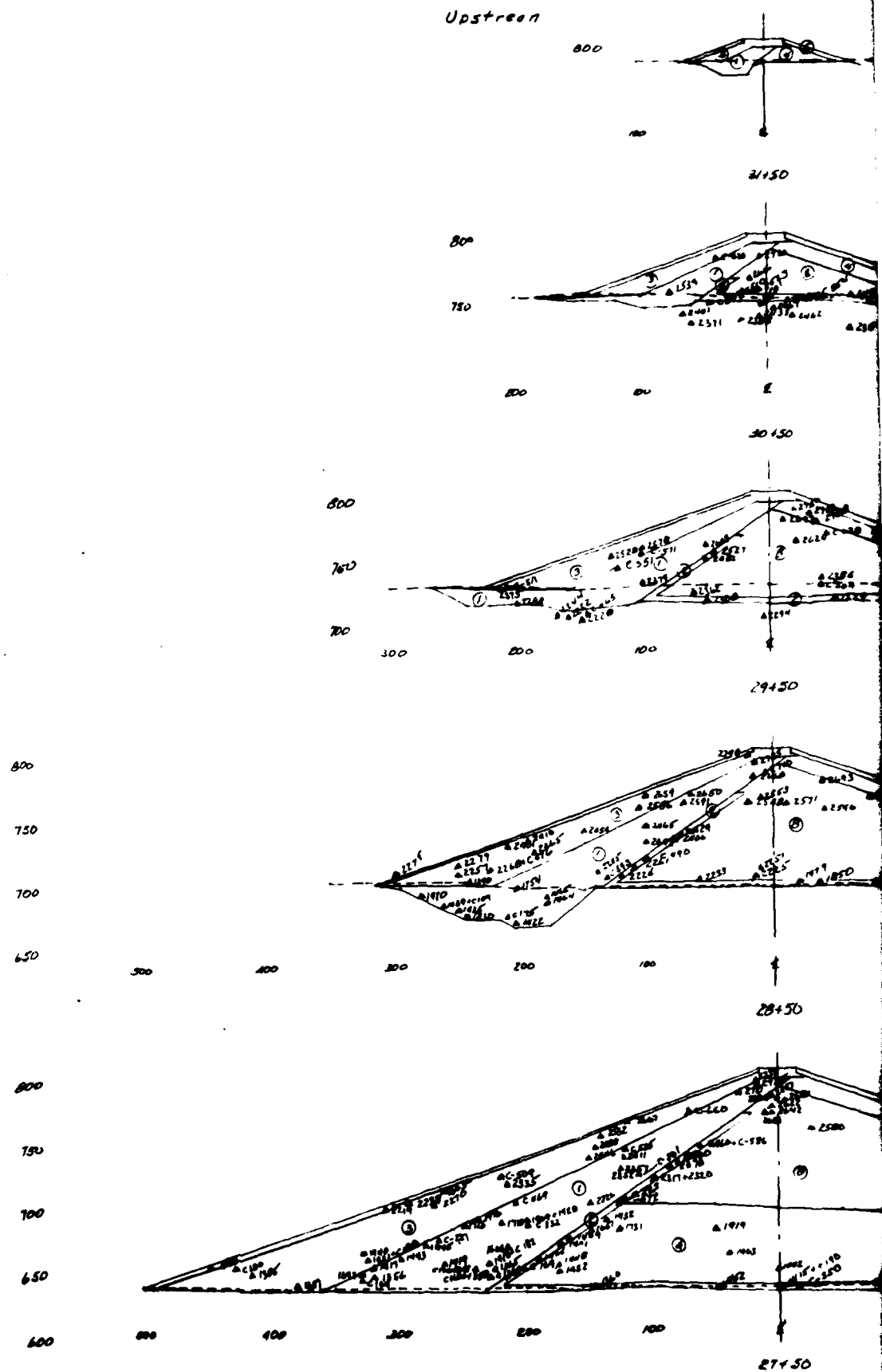
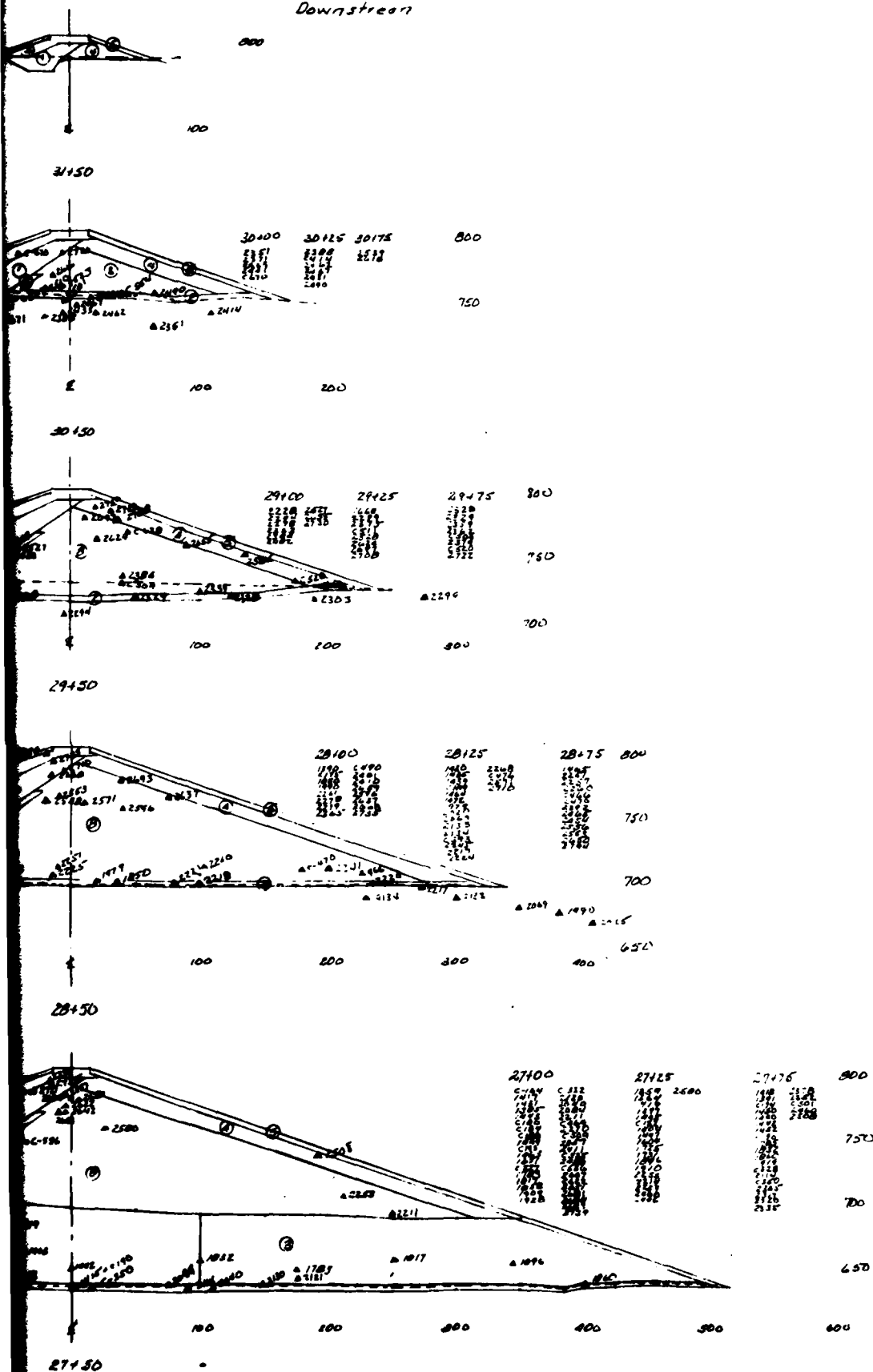


PLATE NO. 473



Downstream



US Army Engineer
Corps of Engineers
Louisville, Ky
Miami River
Brookville, Pa
Field Control T

Scale 1" = 50'

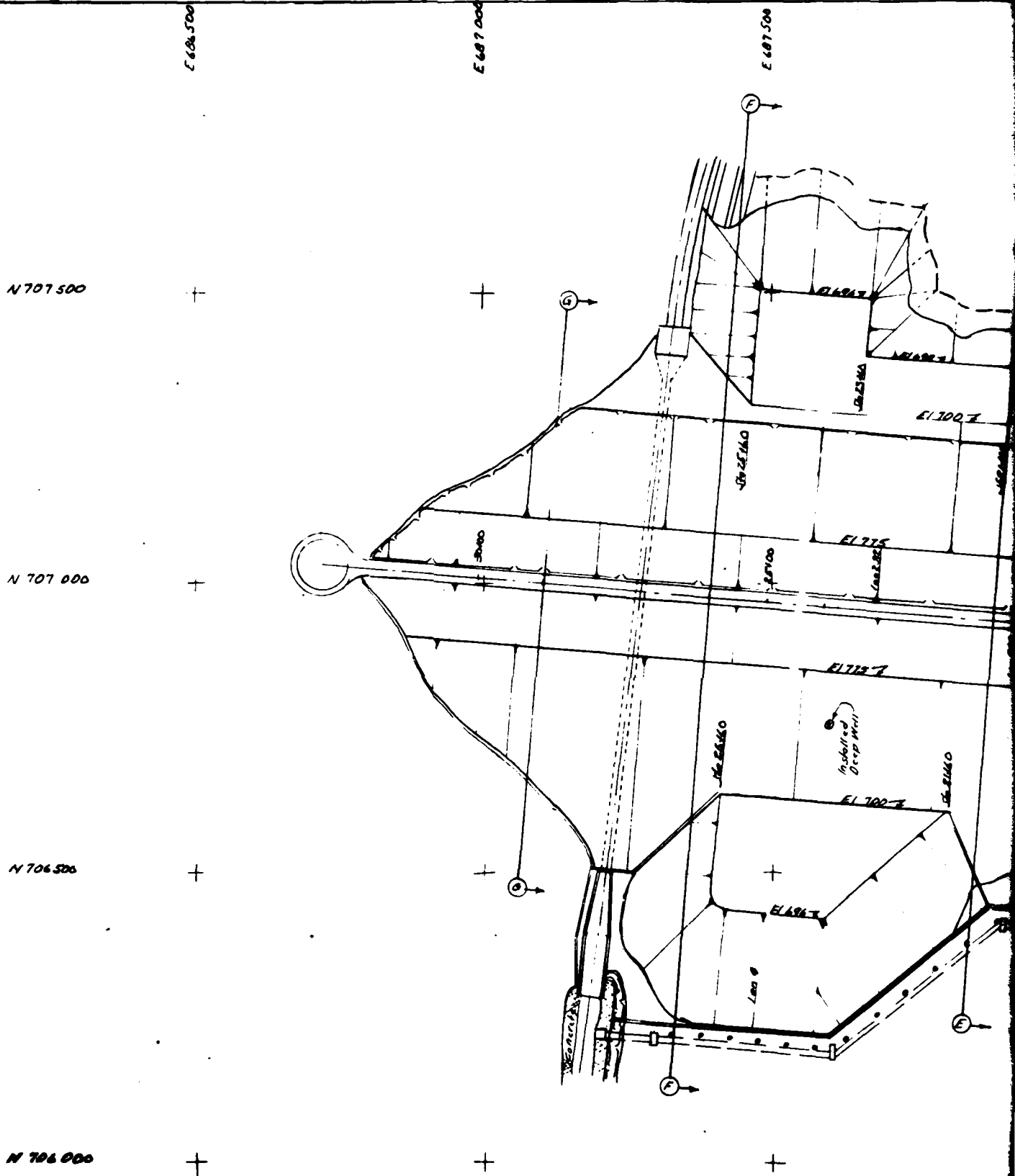
U.S. Army

Note
For more detail
see Plate No.

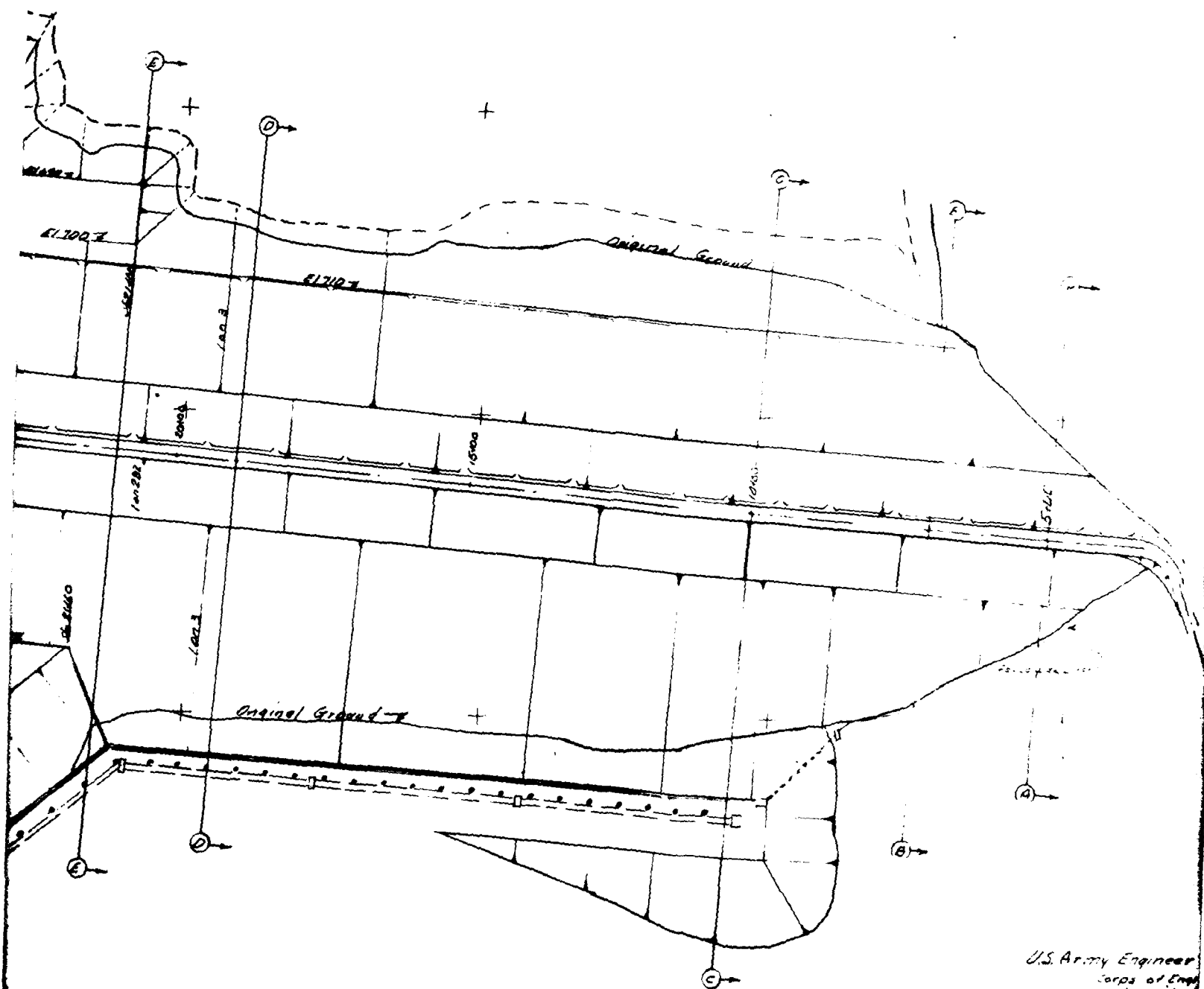
U.S. Army Engineer District, Louisville
Corps of Engineers
Louisville, Ky.
Miami River Basin
Brookville Lake Dam
Brookville, Ind.
Field Control Test Locations

Scale 1" = 50' Plate No.

PLATE NO. 48
3



05-697-500



U.S. Army Engineer
Corps of Engineers
Louisville, Ky.
Miami River
Brookville, La.
Brookville, La.
General Plan De

Scale 1"=100'

2

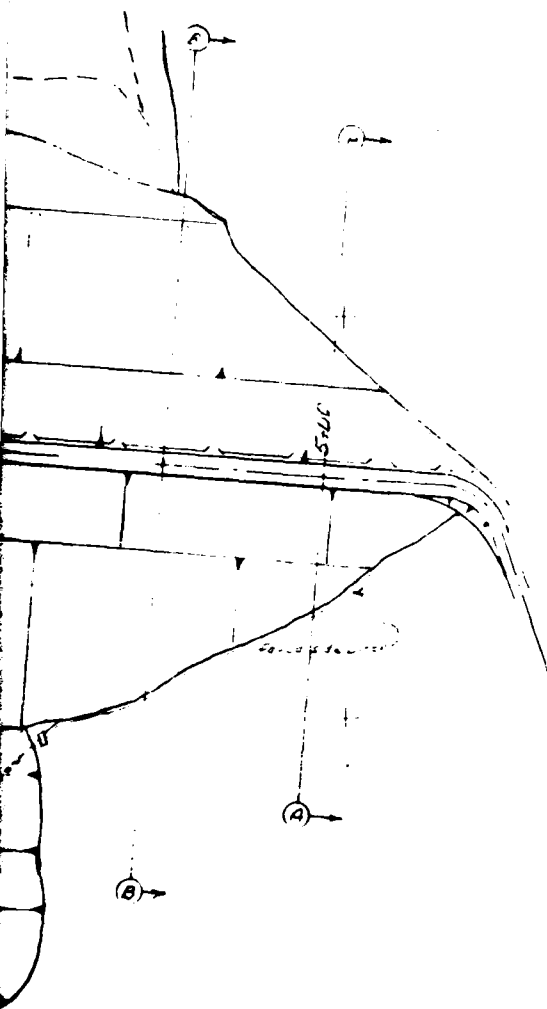
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PLAT

U.S. Army

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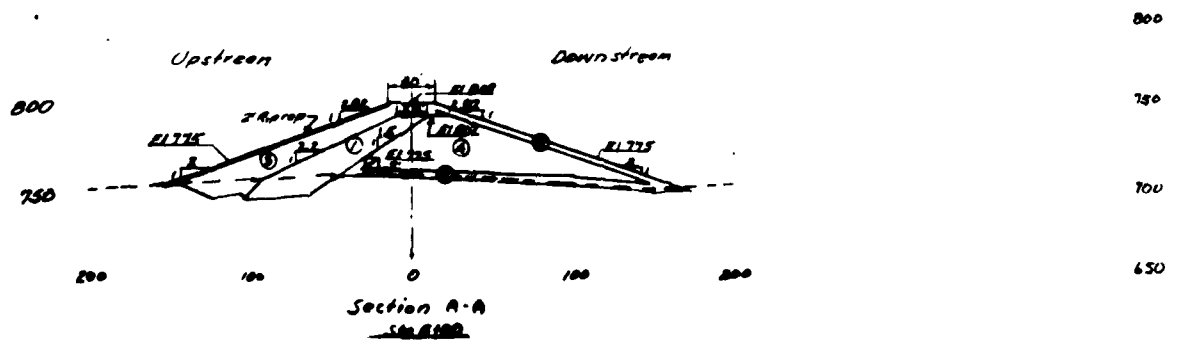
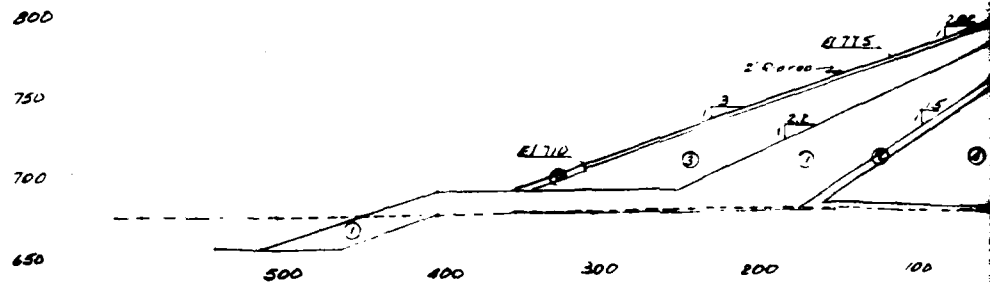
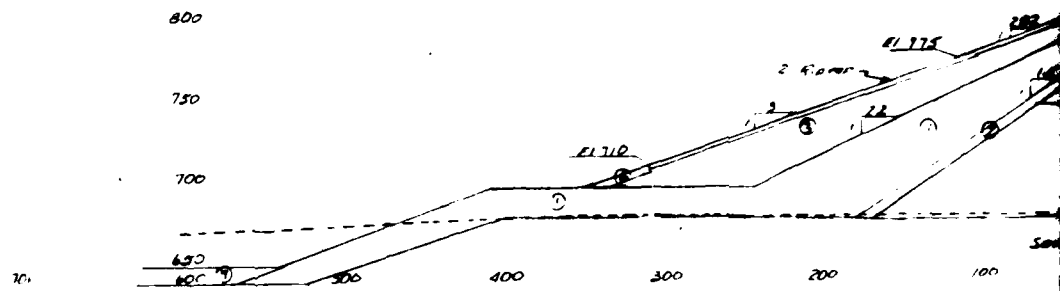
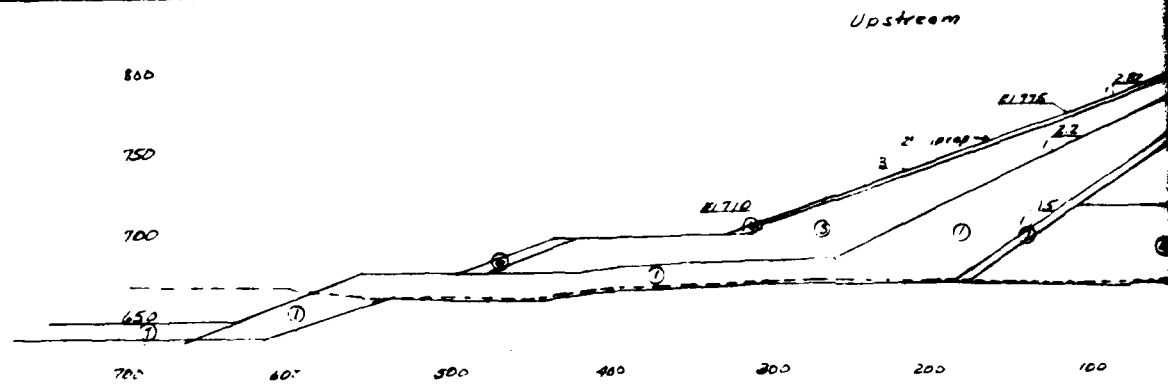


U.S. Army Engineer District, Louisville
Corps of Engineers
Louisville, Ky.
Miami River Basin
Brookville Lake Dam
Brookville, Ind.
General Plan Dam Embankment

Scale 1"=100'

Plate No.

1
PLATE NO. 49 3



US Army

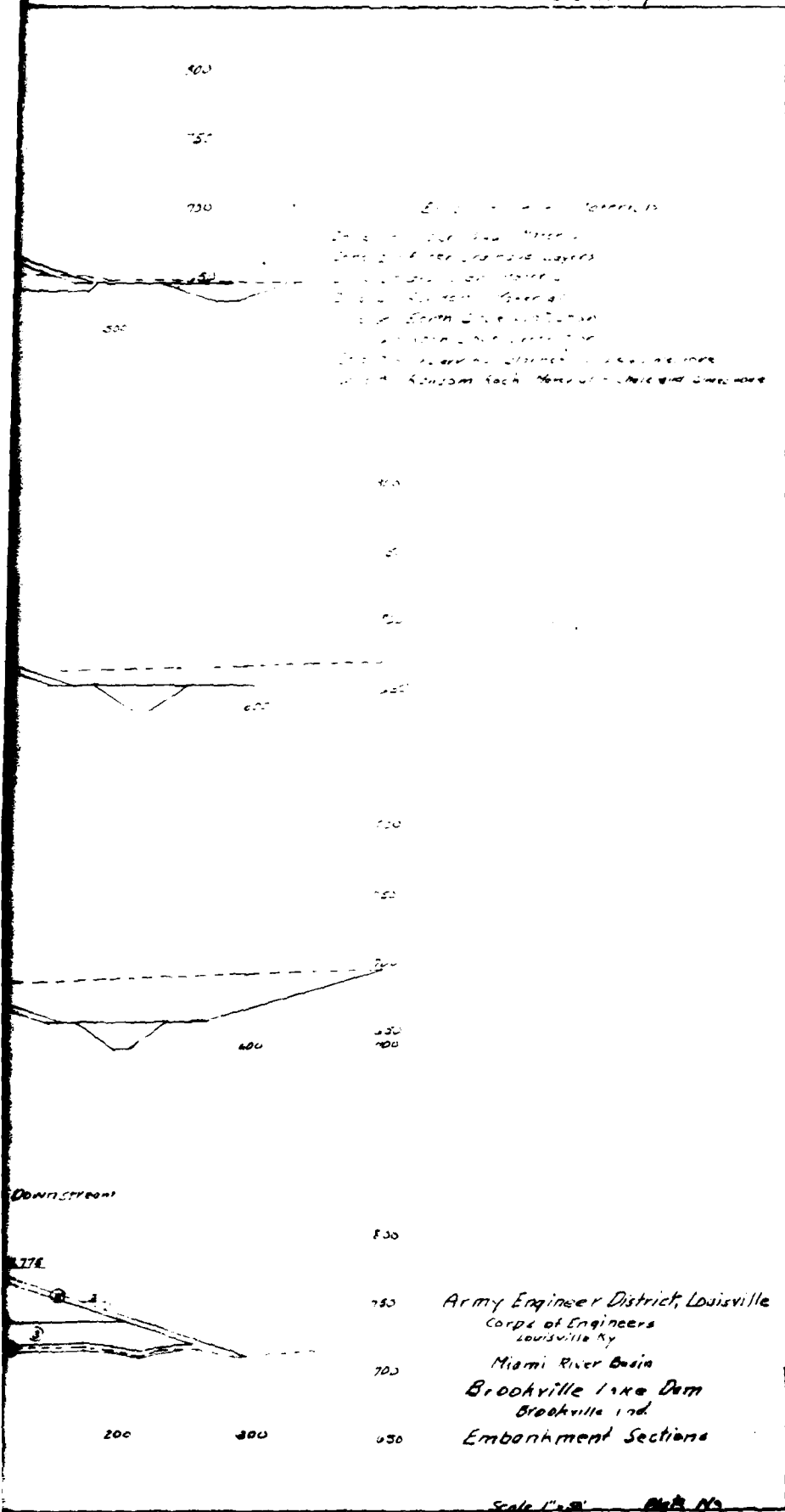
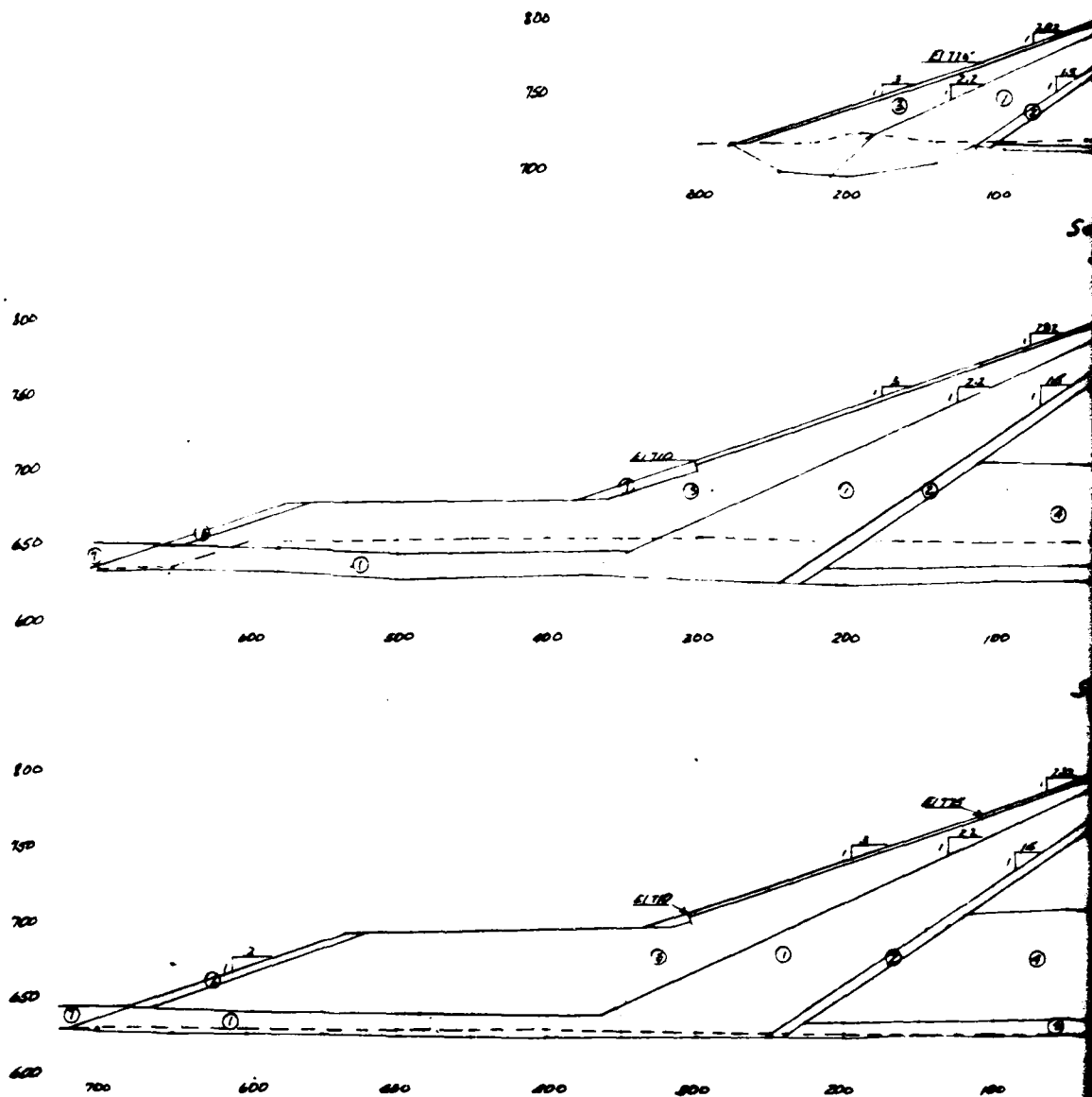
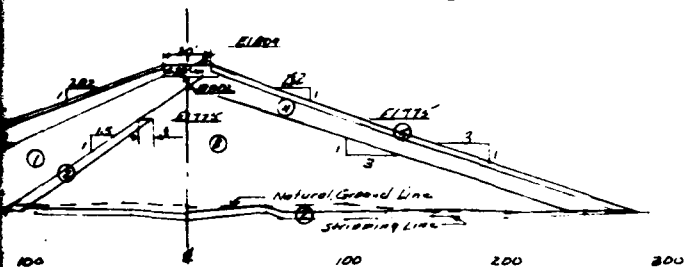


PLATE NO. 50

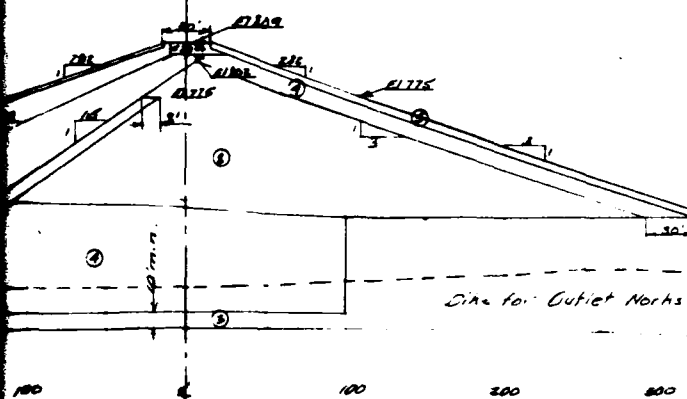
Upstream



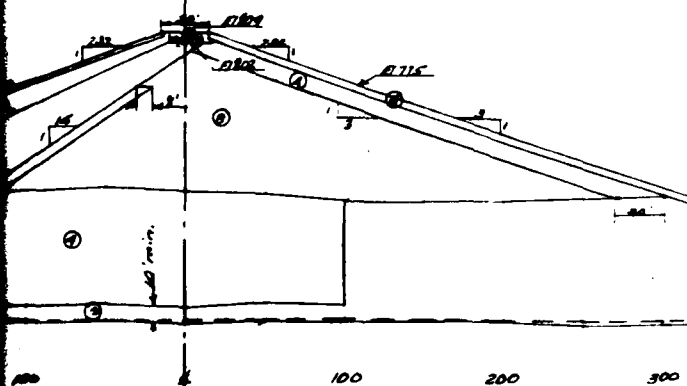
Downstream



Section H-N
Sta 29100



Section G-G
Sta 30100



Section F-F
Sta 31000

- Embankment Section
- Zone 1 - Natural Ground
 - Zone 2 - Embankment
 - Zone 3 - Natural Ground
 - Zone 4 - Embankment
 - Zone 5 - Natural Ground
 - Zone 6 - Embankment
 - Zone 7 - Natural Ground
 - Zone 8 - Embankment
 - Zone 9 - Natural Ground

U.S. Army Engineer District
Corps of Engineers
Columbia, Ky
Miami River Basin
Brookville Lake
Brookville, Ind
Embankment Section

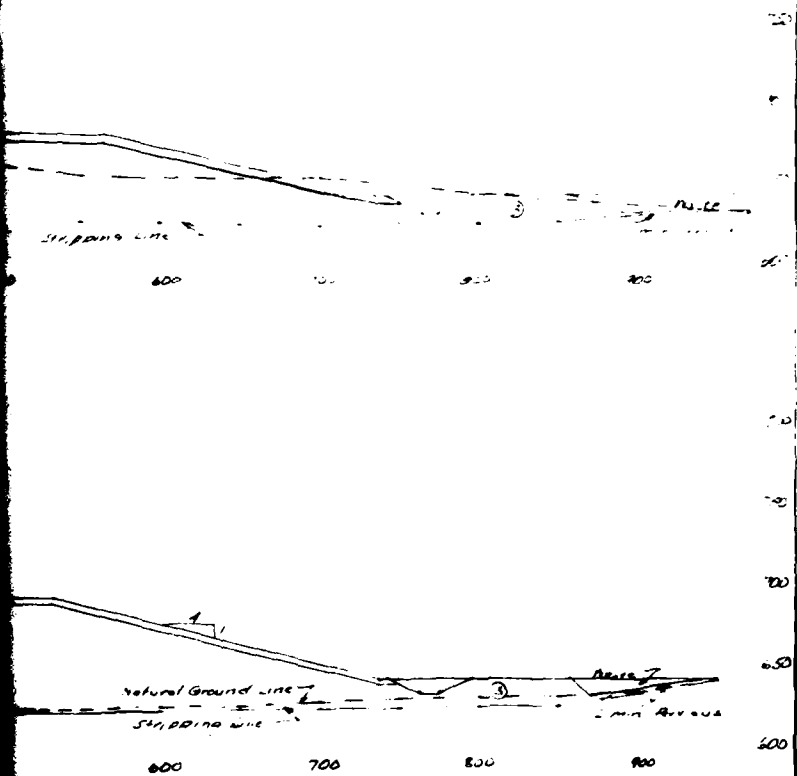
Scale 1"=50'

PLATE 1

U.S. Army

EMBANKMENT SECTIONS

- 2016 - 100' EMBANKMENT
- 2017 - 100' EMBANKMENT
- 2018 - 100' EMBANKMENT
- 2019 - 100' EMBANKMENT
- 2020 - 100' EMBANKMENT
- 2021 - 100' EMBANKMENT
- 2022 - 100' EMBANKMENT
- 2023 - 100' EMBANKMENT
- 2024 - 100' EMBANKMENT
- 2025 - 100' EMBANKMENT



U.S. Army Engineer District, Louisville
 Corps of Engineers
 Louisville Ky
 Miami River Basin
 Brookville Lake Dam
 Brookville, Ind
 Embankment Sections

Scale 1"=50'

Plate No.

CONTRACTOR FIELD COMPACTION

MATERIAL (ZONE)	NUMBER OF TESTS	DRY DENSITY				PERCENT C		
		HIGH	LOW	AVERAGE	DESIGN	HIGH	LOW	AV
IMPERVIOUS	158 *	139.9	91.0	108.7	110.0	112.4	85.1	
RANDOM	90 **	145.9	99.7	129.4	127.5	102.0	56.0	
PERVIOUS	464 ***	157.7	107.5	135.4	125.0	100.0	20.0	

* OF THE 158 TESTS RUN ON THE IMPERVIOUS MATERIAL 36 OPTIMUM, 9 TESTS INDICATED THE MATERIAL WAS TOO DRY (BELOW THE COMPACTION DESIRED). ALL OF THE TEST SECTIONS THAT WERE RETESTED AND ALL THESE TESTS WERE ACCEPTABLE.

** OF THE 90 TESTS RUN ON THE RANDOM MATERIAL 7 TESTS INDICATED THE MATERIAL WAS TOO DRY (BELOW THE COMPACTION DESIRED). ALL OF THE TEST SECTIONS THAT WERE RETESTED AND ALL THESE TESTS WERE ACCEPTABLE.

*** OF THE 464 TESTS RUN ON THE PERVIOUS MATERIAL 8 TESTS INDICATED THE MATERIAL WAS TOO DRY (BELOW THE COMPACTION DESIRED). ALL OF THE TEST SECTIONS THAT WERE RETESTED AND ALL THESE TESTS WERE ACCEPTABLE.

CORPS OF ENGINEERS ACCEPTANCE

MATERIAL (ZONE)	NUMBER OF TESTS	DRY DENSITY				PERCENT		
		HIGH	LOW	AVERAGE	DESIGN	HIGH	LOW	AV
IMPERVIOUS	7 *	114.9	99.8	110.3	110.0	102.0	99.0	
PERVIOUS	20 **	146.4	103.9	124.9	125.0	100.0	6.0	

* OF THE 7 TESTS RUN ON THE IMPERVIOUS MATERIAL 0 TESTS INDICATED THE MATERIAL WAS TOO DRY (BELOW THE COMPACTION DESIRED). ALL OF THE TEST SECTIONS THAT WERE RETESTED AND ALL THESE TESTS WERE ACCEPTABLE.

** OF THE 20 TESTS RUN ON THE PERVIOUS MATERIAL 8 TESTS INDICATED THE MATERIAL WAS TOO DRY (BELOW THE COMPACTION DESIRED). ALL OF THE TEST SECTIONS THAT WERE RETESTED AND ALL THESE TESTS WERE ACCEPTABLE.

- ① STANDARD PROCTOR TEST USED ON THE IMPERVIOUS MATERIAL
- ② NOT APPLICABLE - NO MOISTURE CONTROL SPECIFIED
- ③ INDICATE RESULTS OF ALL TESTS FOR HIGH AND LOW VALUES AND AVERAGE

Brookville

FOR FIELD COMPACTION CONTROL - DAM

	PERCENT COMPACTION ①③				WATER CONTENT ③				DEVIATION FROM		
	HIGH	LOW	AVERAGE	DESIRED	HIGH	LOW	AVERAGE	DESIGN	HIGH	LOW	AVERAGE
0	112.4	85.1	98.2	95.0	28.9	3.5	17.4	15.0	+8.9	-10.0	+
5	102.0	56.0	94.5	85.0	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A
0	100.0	20.0	94.7	85.0	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A

MATERIAL 36 TESTS FAILED (11 TESTS INDICATED THE MATERIAL WAS TOO DRY OF OPTIMUM AND 16 TESTS INDICATED THE MATERIAL WAS TOO WET OF OPTIMUM). THE MATERIAL WAS BELIEVED TO BE ACCEPTABLE. THE TEST SECTIONS THAT FAILED WERE REWORKED. THERE WERE 14 TESTS WERE ACCEPTABLE.

MATERIAL 7 TESTS FAILED (ALL TESTS INDICATED THE MATERIAL WAS BELIEVED TO BE ACCEPTABLE). THE TEST SECTIONS THAT FAILED WERE REWORKED. ALL AREAS WERE RETESTED.

PERVIOUS MATERIAL 27 TESTS FAILED (ALL TESTS INDICATED THE MATERIAL WAS BELIEVED TO BE ACCEPTABLE). THE TEST SECTIONS THAT FAILED WERE REWORKED. THERE WERE 2 TESTS WERE ACCEPTABLE.

ENGINEERS ACCEPTANCE TESTS - DAM

	PERCENT COMPACTION ①③				WATER CONTENT ③				DEVIATION FROM		
	HIGH	LOW	AVERAGE	DESIRED	HIGH	LOW	AVERAGE	DESIGN	HIGH	LOW	AVERAGE
0	102.0	99.0	100.6	95.0	23.0	13.6	17.0	15.0	+1.5	-2.9	-1.0
0	100.0	6.0	77.8	85.0	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A

MATERIAL 0 TESTS FAILED.

MATERIAL 8 TESTS FAILED (ALL TESTS INDICATED THE MATERIAL WAS BELIEVED TO BE ACCEPTABLE). THE TEST SECTIONS THAT FAILED WERE REWORKED. THERE WERE 6 AREAS THAT WERE REWORKED.

PERVIOUS MATERIAL, RELATIVE DENSITY TEST USED ON THE RANDOM AND PERVIOUS MATERIAL. THE TEST SECTIONS THAT FAILED WERE REWORKED. THERE WERE 6 AREAS THAT WERE REWORKED.

AND LOW VALUES AND INDICATE RESULTS OF ACCEPTABLE TESTS AND RETESTS FOR

③	DEVIATION FROM OPTIMUM ③				
SIGN	HIGH	LOW	AVERAGE	SPECIFIED	
5.0	+8.9	-10.0	+ .15	-2.0	+2.0
N/A ②	N/A ②	N/A ③	N/A ②	N/A ②	
N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	

THE MATERIAL WAS TOO WET OF
 LATED THE MATERIAL WAS
 D. THE WERE 14 AREAS

MATERIAL WAS BELOW THE
 AS WERE RETESTED AND

ED THE MATERIAL WAS BELOW
 D. THERE WERE 24 AREAS

③	DEVIATION FROM OPTIMUM ③				
SIGN	HIGH	LOW	AVERAGE	SPECIFIED	
5.0	+1.5	-2.9	-1.04	-2.0	+2.0
N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	

MATERIAL WAS BELOW THE
 6 AREAS THAT WERE RETESTED

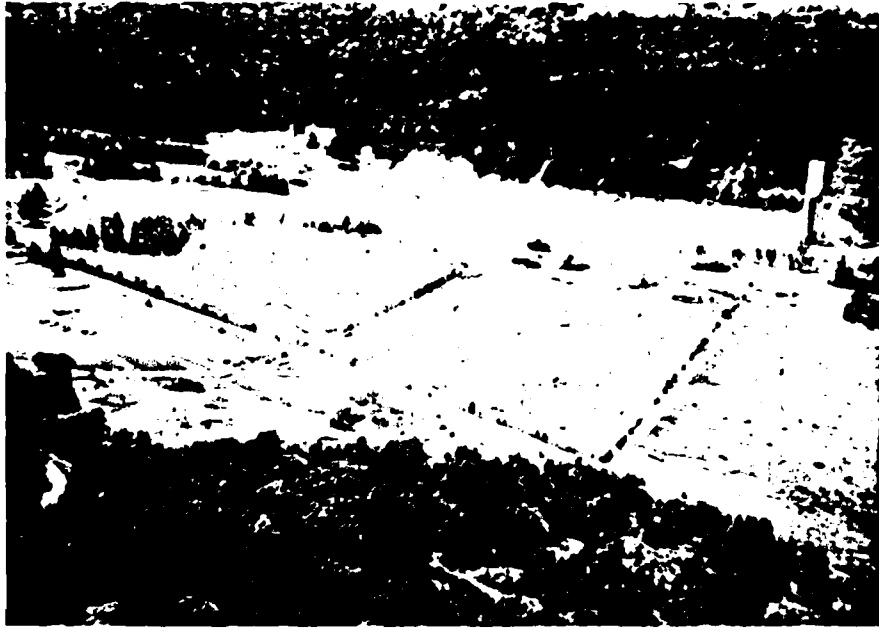
RANDOM AND PERVIOUS MATERIAL.

ESTS AND RETESTS FOR AVERAGE VALUES

PLATE 52

3

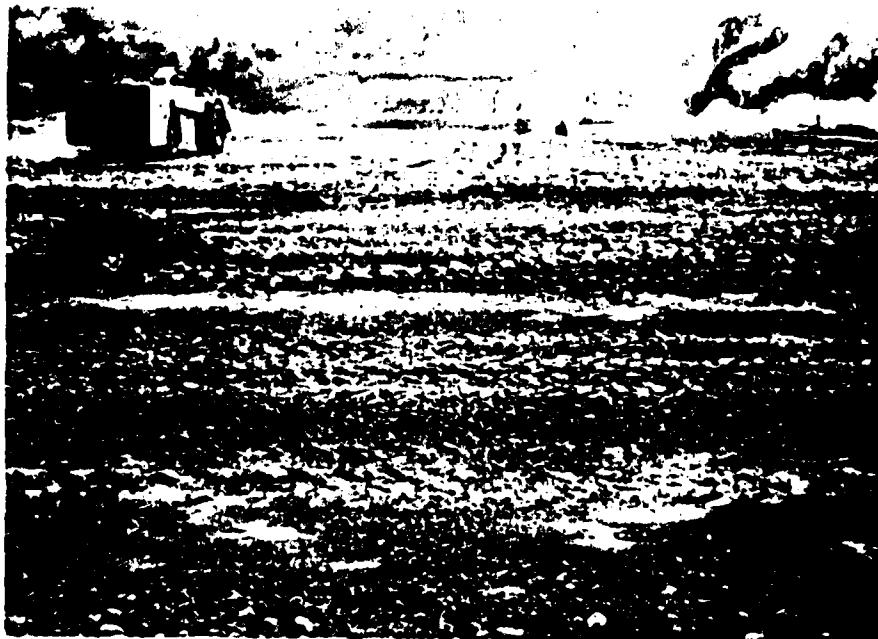
Foundation Photographs



1. Typical view of dam area from left abutment to prior stripping.



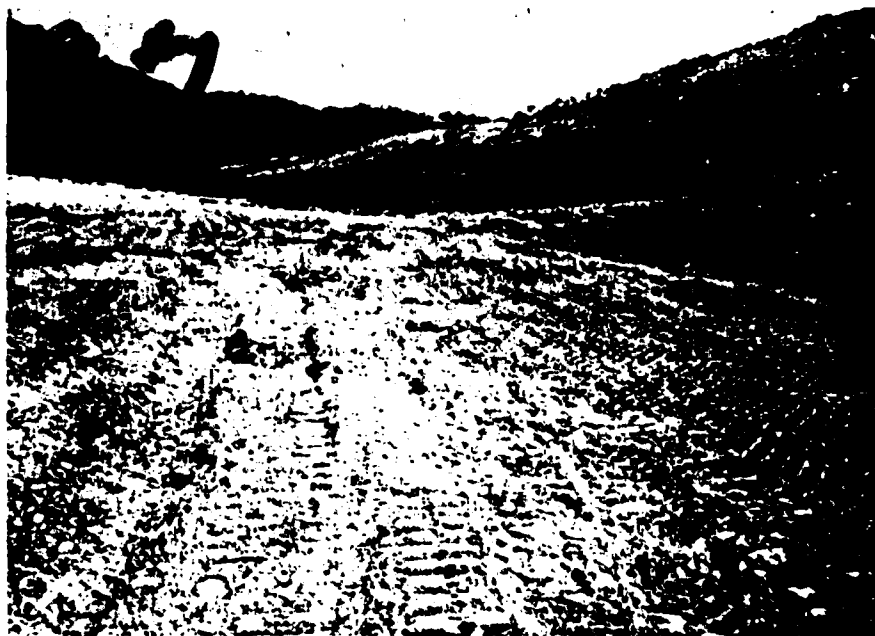
2. View of left abutment cutoff trench back station from 2+00 (9/15/70).



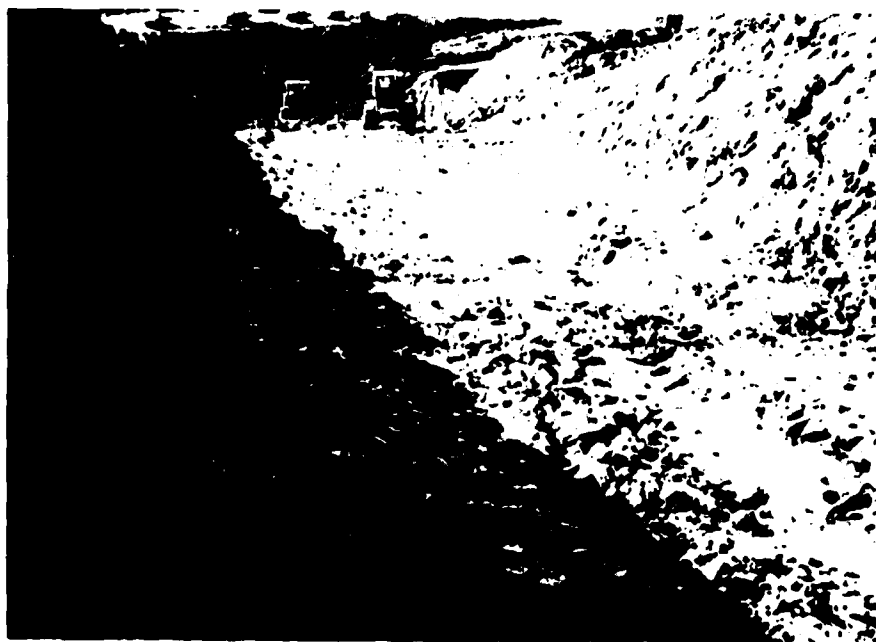
3. View looking back at embankment rolling from Station 20+75. Top of embankment is elevation 672 (8/14/70).



4. View looking U.S. from C dam Station 22+50 (8/14/70).



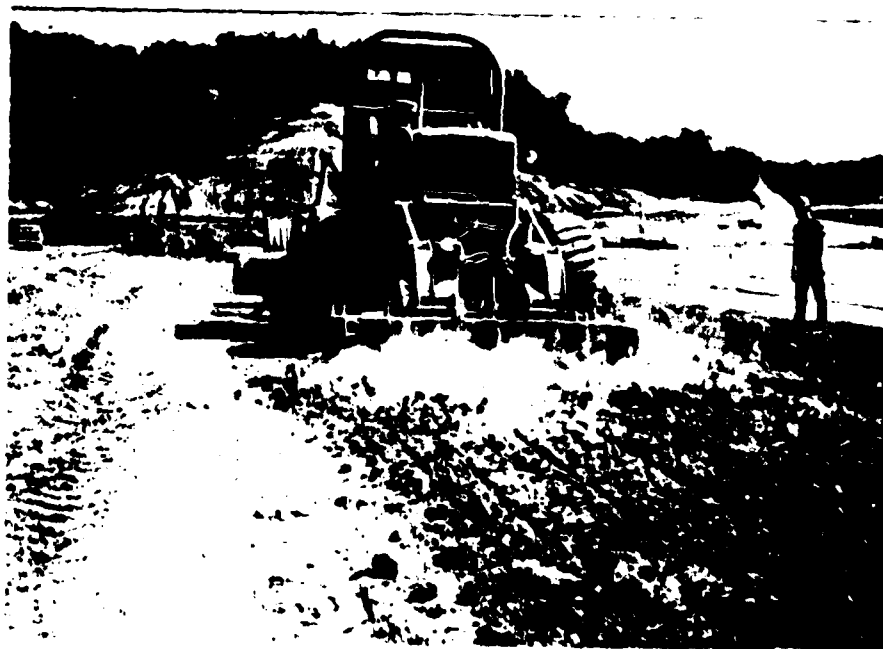
5. View looking upstream from E dam Station 22+50 at embankment tie to the abutment (8/14/70).



6. View of right abutment cutoff trench foundation from Station 30+00 ahead during excavation (10/6/70).



7. Typical right abutment cutoff trench foundation (5/27/72).



8. Disking dry impervious fill material (9/1/70).



9. Typical operation of placing incline drain material (9/1/70).



10. Rolling incline drain material @ Station 17+00 (9/1/70).



11. View of inclined drain zone after being rolled (9/1/70).



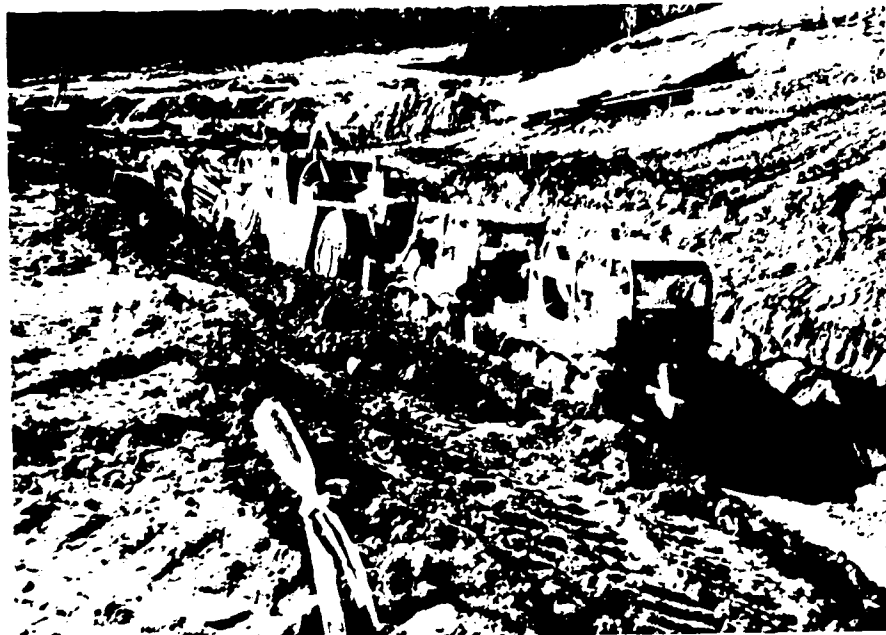
12. Adding moisture to dam foundation material prior to rolling @ 75 feet left of Station 200+00.



13. Adding moisture to dry impervious material (9/1/70).



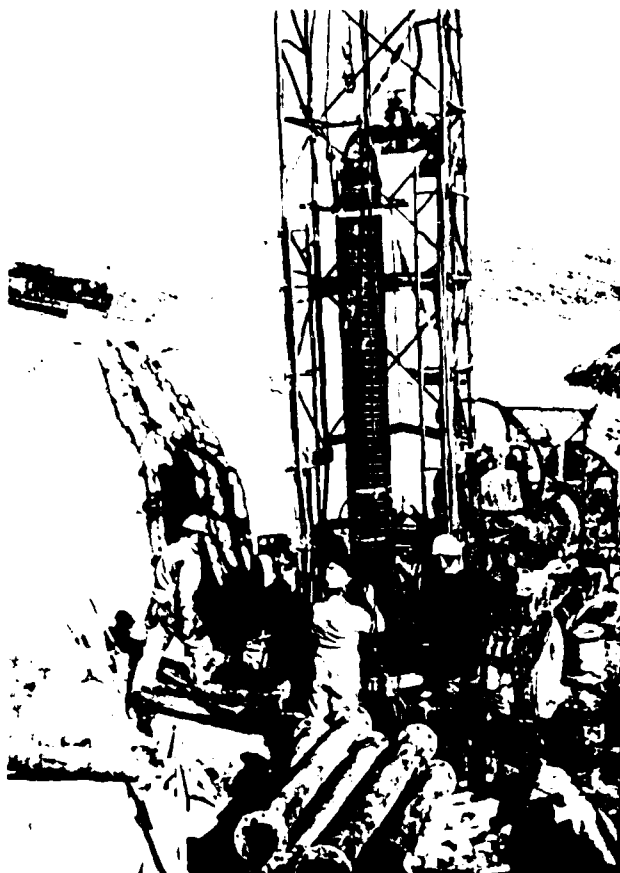
14. Ripping random shale material in spillway excavation (12/2/71).



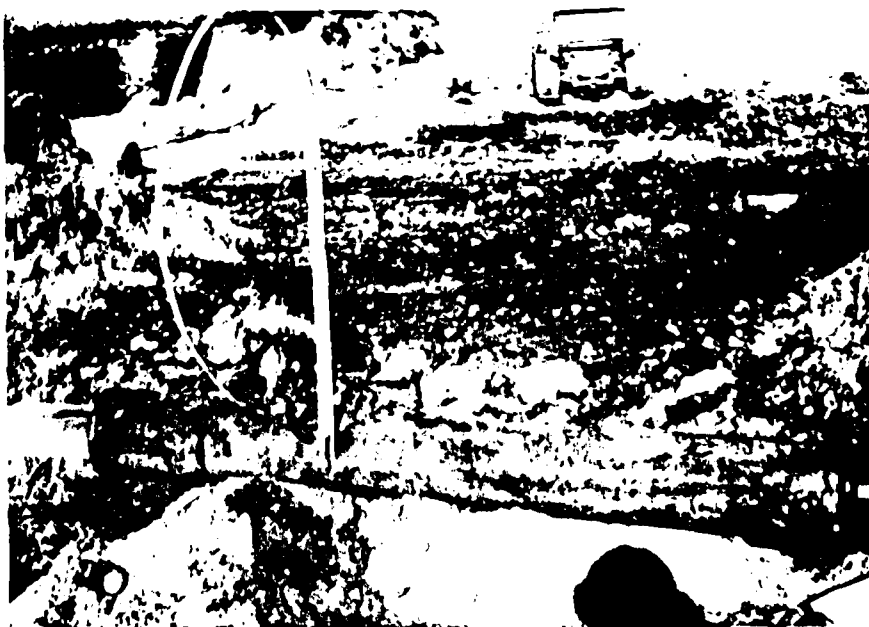
15. Typical operation of excavating relief well galley ditch at Station 14+00 along D.S. toe of dam (12/2/70).



16. View of in-place relief well collector gallery pipe (9/4/72).



17. View of installing
a relief well screen
(Feb. 71).

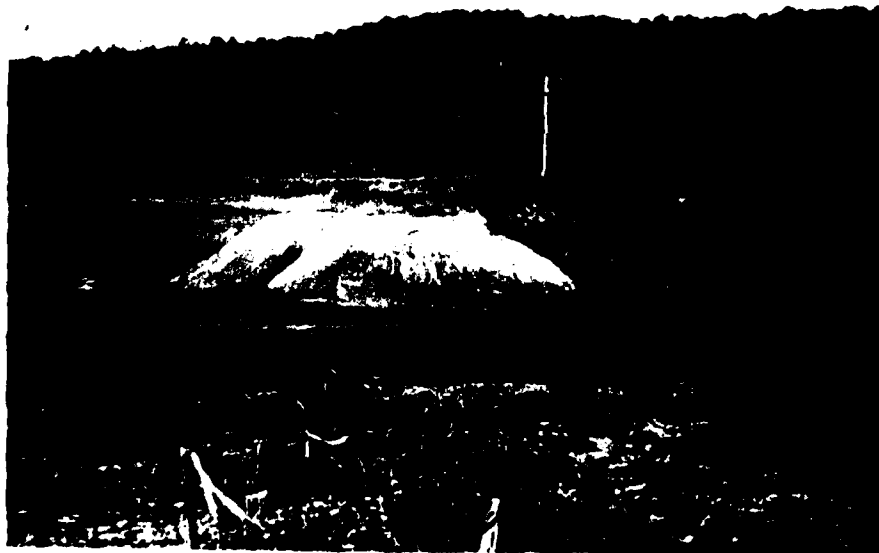


18. View of monitoring by gage flow from relief pump test.

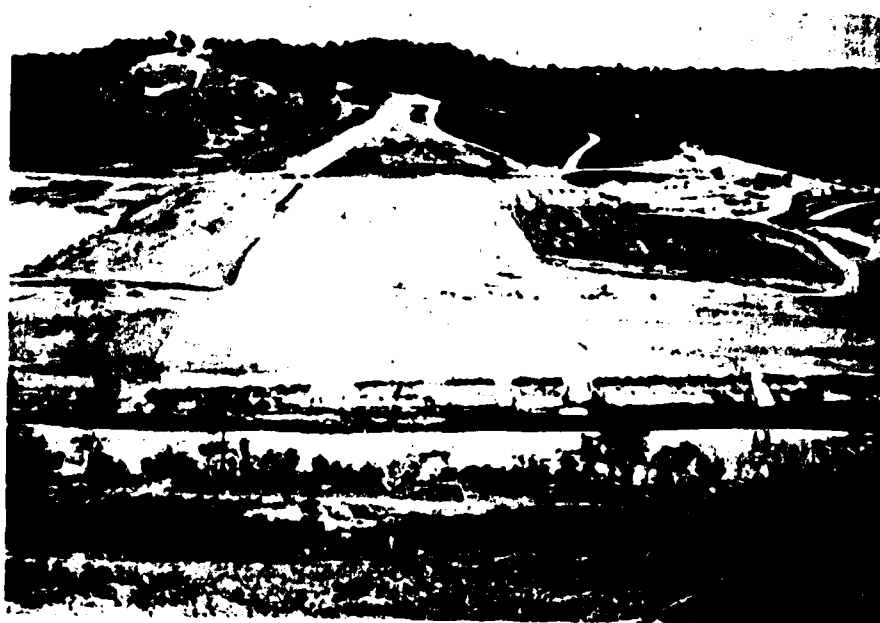


19. View of collector drain pipes for horizontal drains installed in abutment on right side of stilling basin. The bench is elevation 700 (10/1/75).

Progress Photographs



20. View looking ahead of E of dam from Station 2+50 (8/17/70).



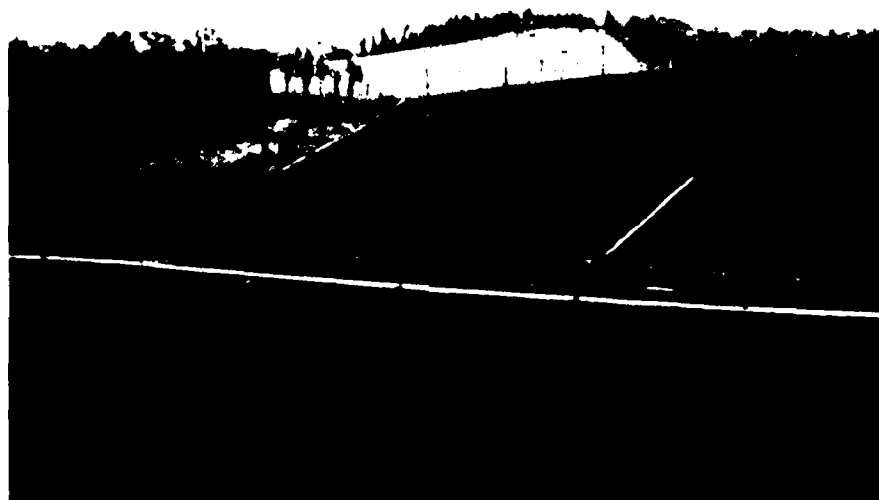
21. View from dam E Station 34+00 looking back station (9/11/70).



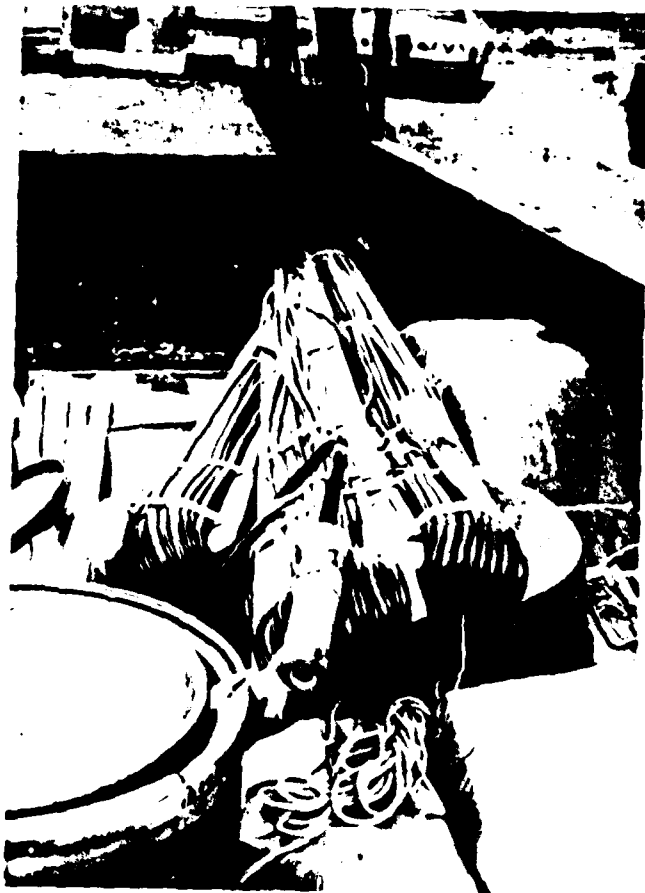
22. View from E dam Station 32+50 looking back station (6/17/72).



23. View of permanent cofferdam closure.



24. View from D.S. of embankment looking toward right abutment showing the downstream embankment berm in area of previous river channel (Oct 75).



25. Typical gas-actuated piezometer sensor and tube installed in embankment (8/13/70).



26. Typical 2-foot long porous stone piezometer installed in embankment (4/29/71).

DATE
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-83