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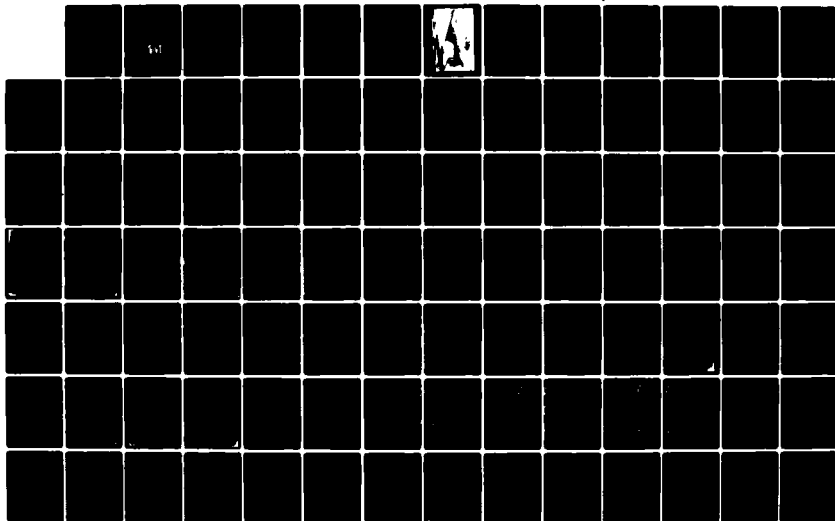
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EMBANKMENT CRITERIA AND PERFORMANCE REPORT(U) ARMY
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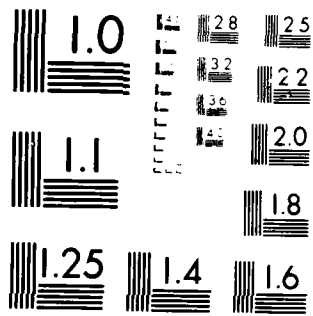
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CAESAR CREEK LAKE
LITTLE MIAMI RIVER BASIN
OHIO

EMBANKMENT CRITERIA AND
PERFORMANCE REPORT



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

SEPTEMBER 1982

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9 December 1982

SUBJECT: Embankment Criteria and Performance Report Caesar Creek Lake, Ohio

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Noah M. Whittle
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Site Geology Construction Notes Foundation-Abutment Treatment Slope Stability Diversion-Closure Compaction Test Results Shear Test Data Seepage Control Operational Notes Instrumentation		
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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CAESAR CREEK LAKE
OHIO RIVER BASIN
OHIO

EMBANKMENT CRITERIA
AND
PERFORMANCE REPORT

Prepared By
U. S. Army Engineer District, Louisville
Corps of Engineers
October 1982



Aerial View of Caesar Creek Lake

CAESAR CREEK LAKE, OHIO

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

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CAESAR CREEK LAKE
OHIO RIVER BASIN
EMBANKMENT CRITERIA AND PERFORMANCE REPORT

Pertinent Data

1. Authority for Project. Flood Control Act designated as Public Law 861, approved on 28 June 1938 as recommended by First Session, 75th Congress.
2. Purpose of Project. To furnish flood protection in the valley of Caesar Creek and Little Miami River Basin. The reservoir project is a unit in the general comprehensive plan for flood control and allied purposes in the Ohio River Basin. A secondary purpose of the project is to provide storage for water supply, land water quality control and a pool for recreation and fish and wildlife activities.
3. Location of Project. The dam is located on Caesar Creek about 3 miles above the junction with the Little Miami River and about 3.5 miles southeast of Waynesville, Ohio. It is located about 30 air miles northeast of Cincinnati, Ohio and 35 miles southeast of Dayton, Ohio.
4. Drainage Area at Damsite. 237 square miles.

5. Reservoir.

<u>Item</u>	<u>Elevation</u>	<u>Area</u>	<u>Storage</u>	
	<u>(feet msl)</u>	<u>(Acres)</u>	<u>Acft feet</u>	<u>Inches Runoff</u>
Siltation Reserve	800	700	13,300	1.05
Water Supply and				
Water Quality Control	846	2,720	93,700	7.41
Seasonal Pool	849	2,830	102,000	8.07
Flood Pool	883	6,110	242,200	19.16
Allocated to				
Flood Storage	846-883	-	148,500	11.75
Allocated to				
Water Supply and				
Water Quality Control	800-846	-	80,400	6.36
Allocated to				
Seasonal Storage	846-849	-	8,300	0.66
Allocated to				
Seasonal Flood				
Storage	849-883	-	140,200	11.09

6. Dam.

a. Embankment.

Type	Earth & Rockfill
Top Elevation (msl)	903
Maximum Height, feet	166
Length, feet	2,748
Top width, feet	42
Side Slopes - Upstream	IV on 3.5H
- Downstream	IV on 3H

b. Dikes.

Number	4
Type	Earth Fill
Top Elevation (msl)	903
Maximum Height, feet	'A'67, 'B'26, 'C'7, 'F'13
Length, feet	'A'5873, 'B'4054, 'C'605, 'F'977
Top Width, feet	12
Side Slopes - Upstream	IV on 3H upper 14 ft IV on 4H remainder
- Downstream	IV on 3H upper 14 ft IV on 4H remainder

c. Spillway.

Type	Open Cut through left abutment ridge
Crest Elevation (msl)	883
Bottom Width, feet	500
Protection for Spillway Cut	22' Concrete sill at crest
Length, feet	2,660
Side Slopes	1 on 3 overburden (10 foot berms) 2 on 1 rock
Bottom Slope	0.5% upstream 1.5% downstream

d. Outlet Works.

Conduit Type	oblong, concrete
Conduit diameter, feet	12' high x 8' wide
Control gates, number	2 service, 2 emergency
Size of gates, feet	4.00' x 12.00'
Invert Elevation to outlet works (msl)	739
Discharge Capacity at Minimum Pool(cfs)	3,360
Discharge Capacity at Seasonal Pool(cfs)	4,480
Discharge Capacity at Flood Pool(cfs)	5,130

7. Land Acquisition.

Fee, Acres

11,100

8. Relocations.

a. State Highways.

Ohio 380	2.38 miles
Ohio 73	1.40 miles

b. County Roads.

Greene County, 2 locations	1.5 miles
Clinton County, 2 locations	0.8 miles
Warren County, miscellaneous work	

c. Public Utilities.

High Voltage electric power transmission lines
Medium Voltage electric power distribution lines
Telephone facilities and lines
Gas transmission pipe lines

9. Public Access.

Number of sites

10. Reservoir Clearing.

Area, acres 400

11. Hydroelectric Power.

None

12. Annual Charges.

\$1,414,000

13. Annual Benefits.

a. Flood Control

\$1,244,000

b. Recreation

1,724,000

c. Water Quality Control

and Water Supply

424,000

Total

\$3,392,000

14. Ratio, Benefits to Cost.

2.4 to 1

15. Construction Time.

3-1/2 years

CAESAR CREEK LAKE
OHIO RIVER BASIN
EMBANKMENT CRITERIA AND PERFORMANCE REPORT

1. General.

a. Authority. Authority for preparation of the Embankment Criteria and Performance Report for Caesar Creek Dam is contained in ER-119-2-1901, dated 1 August 1972.

b. Project Purposes. To furnish flood protection in the valley of Caesar Creek and Little Miami River Basin. The reservoir project is a unit in the general comprehensive plan for flood control and allied purposes in the Ohio River Basin. A secondary purpose of the project is to provide storage for water quality control and a pool for recreation and fish and wildlife activities.

c. Project Location. The project is located on Caesar Creek about 3 miles above the junction with the Little Miami River and about 3.5 miles southeast of Waynesville, Ohio. It is located about 30 air miles northwest of Cincinnati, Ohio and 35 miles southeast of Dayton, Ohio. A reservoir area map and general plan are presented on Plates 1 and 2.

d. History of Construction. Contract DACW27-72-C-0086, Construction of Outlet Works, Dam, and Spillway, Caesar Creek Lake, Ohio, was awarded on 1 March 1972 to Butt and Head, Inc., Dayton, Ohio. The contract involved construction of the earth and rockfill dam, outlet works at the base of the right abutment, uncontrolled spillway on the left abutment, and all appurtenant work.

On 19 July 1973, the Attorney General of Ohio filed a complaint in the Federal District Court. As a result of this litigation, all significant work at the project was stopped by Court's Order on 24 July 1973 pending the filing of a complete and adequate Environmental Impact Statement. The restraining order was partially lifted to allow work to continue on the

permanent cofferdam and operating tower. The court injunction was vacated in May 1974.

The following is a compilation of significant contract dates:

04 April 1972	First clearing begins.
17 August 1972	First concrete placed.
23 March 1973	Completed concrete work on conduit.
25 May 1973	Began stripping for permanent cofferdam.
14 July 1973	Stream diverted through conduit.
21 July 1973	Diversion cofferdam overtopped.
24 July 1973	Diversion cofferdam overtopped.
25 July 1973	Contractor informed of injunction against earth work.
10 September 1973	Work suspended by court--all work after 1100 hours directed towards preventing damage during winter
11 September 1973	Work suspension lifted--work limited to permanent cofferdam and spillway.
02 November 1973	Completed Stage I cofferdam.
06 November 1973	Began excavating cutoff trench.
14 November 1973	Completed Stage II cofferdam.
07 December 1973	Began grout operations through valley.
27 December 1973	Completed grout in valley.
23 May 1974	Contractor informed that injunction had been totally lifted.
20 August 1974	Began cleaning cutoff trench.
07 September 1974	Core trench cleaned, inspected and impervious placement begun.
17 September 1974	Began placing rock.
25 October 1974	Began excavating right abutment cutoff trench.
06 November 1974	Began grouting right abutment.
14 November 1974	Grouting complete.
19 November 1974	Excavation for toe drain.
06 December 1974	Toe drain complete.
16 December 1974	Winter shutdown for major embankment with fill at elevation 783+.
03 April 1975	Began embankment.
06 May 1975	Start placing riprap on US slope.
09 August 1975	Dam topped out.
25 August 1975	Began piezometer installation.
11 October 1975	Piezometers complete.
13 October 1975	Spillway control structure finished.
12 December 1975	Installed surface reference marks.

2. Geology.

a. Project Area. The Caesar Creek Reservoir site is located in the glaciated area of Ohio. Glacial deposits are Illinoian and Wisconsinian in age. The damsite marks the southern limit of Wisconsinian deposits. Glacial deposits on the right bank are Wisconsinian and on the left bank are Illinoian. Caesar Creek is embedded in bedrock at the damsite with a valley width of about 300 feet. Bedrock in the valley is about elevation 724 and bedrock extends above spillway crest elevation 883 in both abutments. Bedrock is the Richmond Formation of interbedded limestone and shale, Ordovician in age. Approximately 2.5 miles above the dam, Caesar Creek flows in a broad meandering valley of glacial deposits. Maximum relief is 300 feet. A dendritic drainage pattern has developed. Prior to the Illinoian glaciation, the drainage pattern was quite different than that of today. A southward flowing river, referred to as the "Hamilton River" cut a deep bedrock channel through Green, Warren and Clinton Counties. This preglacial river split between New Burlington and Harveysburg. The west arm of the river flowed in the present Little Miami River valley and the east arm flowed in a southeast direction until it reached the present Todd Fork Valley where it turned southwest following the present Todd Fork Valley. Both arms of the river are now buried valleys. The west area of the valley is not in the reservoir whereas the east arm does cross the reservoir about 5 miles upstream from the dam. Approximate top of bedrock in the buried valley is elevation 750. The drainage divide between Caesar Creek and the Little Miami River is located in the old Hamilton River bedrock channel. The drainage divide is a Wisconsinian end moraine that was deposited as hills and ridges at the edges of the glacier. The ridges are not truly connected, but rather irregularly grouped together into more or less well defined belts. The drainage divide is composed of clay till with interbedded sand and gravel. The end moraine deposits lack the compactness characteristics of ground moraines which have been over-ridden by the heavy ice sheets. Formation at the damsite is a calcareous shale with 10-15 percent interbedded limestone which has 0.1 foot to 1.0 foot thick beds. The dominant joint pattern is N60W and N40E. The site is considered quiescent and no earthquake shocks

are known to have occurred which have caused an intensity greater than II on the Modified Mercalli Scale. The nearest and greatest disturbance of record was reported in the Cincinnati area on 17 October 1937.

b. Damsite. The topography along Caesar Creek in the damsite area is characterized by a broad, flat upland which has a steep-sided rock cut gorge running throughout. Rock outcrops in the tributary streams immediately upstream and downstream from the dam centerline. The drainage pattern is dendritic. Tributary streams are fed from springs high on the drainage divide and flow along gentle gradients in the glacial till and finally along bedrock near the mouth. Residual lean to fat clay is found on both abutment side slopes and in the spillway area. On the left abutment it is 2 to 5 feet thick whereas on the right abutment side slopes it is as thick as 10 feet. The clay is moderately firm with limestone fragments scattered throughout. In the spillway area the clay is 2 to 12 feet thick. Along the toe of the right abutment is 16 to 26 feet of colluvium. The colluvium varies from a fat clay to a gravelly clay. Colluvium is also found on top of the drainage divide in both abutments. Wisconsinian till is found on the right bank and Illinoian till is found on the left. On the right abutment the till thickness varies from 10 to 30 feet. The top 10 to 15 feet is a brown leached clay till which overlies 10 feet of gray clay till. The lower 3 to 8 feet is a gray brown clay till, Illinoian in age. On the left abutment the maximum thickness of overburden is found, just at the top of the hill where a topographic high is evident. The till has a maximum thickness of 28 feet and thins out toward the spillway where overburden is 2 to 7 feet thick and is primarily a residual lean clay with rock fragments. Alluvial sandy clay and gravel is found in the narrow valley bottom. Immediately overlying bedrock is a sandy gravel with some silt, clay and organic clay. The gravel has a maximum thickness of 20 feet at the downstream left bank toe. Overlying the gravel is some 10 to 15 feet of sandy silty clay which is soft to moderate soft. The geologic profiles and sections for the dam are shown on plates 4 through 10. For reference, a boring location plan is presented on plate 3.

3. Foundation and Abutment Treatment. The general abutment stripping varied from 1 to 3 feet in depth to residual soil. Stripping in the valley to much greater depths was necessary to remove wet and weak materials that contained organic materials in and adjacent to the stream-bed. The valley was excavated to sand and gravel or bedrock. The greatest depths of excavation were along the left side of the valley and at the downstream central portion where brown silty clays and scattered pockets of peat were removed to bedrock at elevation 725. The elevations of the stripped valley foundations are shown on Plates 13 and 14.

The cutoff was excavated 5 feet into rock (shale and limestone) with a bottom width of 50 feet below elevation 760 which extended between stations 19+50 and 23+50. The cutoff width was transitioned to 20 feet wide at the ends of the trench, stations 15+20 and 27+50.

The side slopes were 1H on 1V in rock and 1.5H on 1V in sand and gravel or residual soil. The foundation in the valley bottom cutoff trench was founded on a layer of limestone except for the quarter near the left abutment. At that location, the limestone layer had been broken through and the shale beneath it required more careful cleaning. Problems of cleaning the shale were also compounded by seepage from the left abutment through the overburden and also through the surrounding sands and gravels. Two sumps were dug at the downstream edge of the trench. One at the toe of the left abutment was cut 4 feet into rock and sandbagged. The other, 20 feet up station, acted as a drain for the sand and gravel. The upstream edge of the trench was benched at the interface between sand and gravel and sloped toward the sump located at the axis of the dam. These sumps were filled with 2 feet of impervious fill and hand-tamped with power tampers. The cutoff on the valley sides presented no difficulties except for seepage through the sand and gravel from approximately stations 25+40 to 27+00 which was controlled by the construction of the gravel packed sump at station 26+96. A 6-foot deep inspection trench was excavated from the ends of the cutoff trench (stations 15+20 and 27+50) to the ends of the dam embankment (stations 2+51 and 30+00). The trench side slopes were 1.5H to 1V and had a 6-foot wide bottom. Where sandy deposits

occurred at the bottom of the trench, it was excavated to the bottom of the sand. A 3-foot over excavation was made at station 28+00. No serious leakage problems were anticipated in the foundation under the dam fill, so a minor grouting program was undertaken. A single line grout curtain along the dam axis was placed to a depth of 30 feet below the top of rock, excepting the upper portion of the left abutment. From stations 15+20 to 16+67, the grout curtain was extended to elevation 812. The contract called for split spacing, stage grouting method with the primary grout holes on 20-foot centers. All holes were angled 20 degrees into the slope to intercept the maximum number of vertical fractures. All holes were drilled in this manner, but only 2 holes required more than 1 stage. During the grouting, several holes developed surface leaks 5 to 10 feet down the slope from the hole being grouted. The leakage occurred along shale-limestone contacts which were probably disrupted during excavation. When excessive leakage occurred, a 10-foot packer was used to grout the lower portion of the hole. The packer was then removed and the grout was thickened to stop the leaks in the upper portion of the hole. Grout take was minimal with most of the grout being used to stop surface leaks. Only four secondary holes were drilled to insure adequate grouting in cases where lower portion grouting of the primary holes were questionable.

Rock surfaces were exposed prior to embankment placement throughout the cutoff trench, on either side of the outlet works and in certain areas of the valley. Vertical faces in rock existed in the abutment areas at the termination of limestone seams. These faces were 1 foot or less in thickness and required no special excavation technique prior to placement of embankment material. When an overhang was produced by excavation operations, the overhang was removed by hand methods. The steepest slope face to receive embankment was 4V to 1H as excavated along the right abutment for outlet works construction. Cracks or fissures within the cutoff trench and foundation area were not found with openings large enough to be filled with grout. Loose rock and coating was removed from the rock surface by use of picks, shovels and brooms ahead of embankment placement.

4. Embankment.

a. General. The embankment section consists of compacted random fill and a compacted impervious core. The random fill zones are rock except the upper portion of the downstream zone which is clay. The embankment is 2,748 feet long with an upstream slope of 3.5H on 1V and downstream slope of 3H on 1V. The top of dam is elevation 903 with a crest width of 42 feet to provide for a county road. The core has symmetrical side slopes of 1H on 4V. Internal drainage is controlled by a 5-foot wide sloping filter drain on the downstream side of the core from elevation 883 down to where it ties into either a 3-foot thick horizontal filter blanket on the stripped foundation or extends 5 feet into the sand and gravel left in place in the valley bottom. A 5-foot wide transition zone was placed between the inclined drain and the downstream random fill zone from the horizontal drain up to the top of the random rock zone. The upstream face of the dam is blanketed with a 20-inch thickness of 150 pound maximum size stone on a 9-inch layer of bedding from the top of the dam to elevation 795. The downstream slope of the dam was covered with a 12-inch layer of topsoil from the spillway stripping. The site plan and typical dam sections are shown on plates 11 and 12.

b. Materials Sources. Approximately 2,296,000 cubic yards of earth and random fill, drainage and transition material, and protection stone was required in the dam section. The material used to construct the primary embankment zones was first obtained from required excavation and then from designated borrow areas. The granular borrow area is shown on Plate 16. Materials for the impervious core came from spillway overburden, borrow area 2 and the outlet works excavation. (See Plate 15.) A small portion of the impervious material came from the cutoff trench excavation. Random rock was obtained from the spillway excavation, borrow area 1 and the cutoff trench excavation. The random earth zone material was obtained from stockpiles of dam foundation excavation, the valley portion of the cutoff trench and the inlet and outlet channel excavation. All materials excavated were used in the embankment except surplus topsoil that was stockpiled left of the spillway and upstream of the left

abutment access road, the material from the foundation excavation, unsuitable for embankment, that was wasted and material used in haul roads. The Materials Usage Chart is shown on Plate 17.

c. Compaction Equipment. The following rollers were used in compacting the embankment materials:

Sheepsfoot Rollers:

- a. Ferguson Model 120F
- b. Self-propelled
- c. 2 drums, side-by-side, 5.5' long x 5.5'diameter.
- d. 3,040 lb/ft empty
- e. Oscillating frame and spring cleaner
- f. Specified 5 mph maximum speed
- g. 1,073 psi foot pressure-ballasted

Vibratory Rollers:

- a. Rago Rascal Model 400A
- b. Self-propelled
- c. 1 drum, 4.92' diameter
- d. Static weight 23,500 pounds
- e. Frequency of vibration 1100-1500 vibrations per minute
- f. Specified 3.5 mph maximum speed
- g. Dynamic force 27,000 pounds

Pneumatic-Tired Rollers:

- a. Tambo Model 50
- b. 4 tires, 24 ply, 18.00x25, 8 in apart
- c. Specified 5 mph maximum speed
- d. Roller width 9'4" overall
- e. Weight 19,000 pounds empty
- f. Weight 100,000 pounds w/85 psi
- g. Contact pressure 75 psi loose material

150 psi compacted material

d. Earth Placement. Impervious fill was placed in the impervious zone, cutoff and inspection trenches and adjacent to the sides of the operating tower. Material was spread in layers of not more than 6 inch thickness before compaction. Each layer was disked until clods were broken down and desired moisture content was obtained. Moisture content after compaction was required to be within the limits of 1 percentage point above optimum and 1 percentage point below optimum as determined in the field. In-place moistures of excavated material averaged 3 to 4 percentage points above optimum, making drying necessary both at the source and on the embankment. The layers were compacted by six passes of a sheepsfoot roller. Additional rolling was not necessary to attain the desired compaction.

In the compaction of the impervious and random earth embankment materials, the design requirements for density were considered met if the field density tests indicated densities of the compacted materials were 95 percent or greater of the maximum densities as determined from EM 1110-2-1906 Appendix VI (Standard Compaction Test). A nest of moisture-density curves covering the range of soil used was developed. (See plates 24 through 26.) Soils with 100 percent passing the No. 4 sieve were

compacted in a 4-inch mold. Soils with fractions retained on the No. 4 sieve and passing the 3/4-inch sieve were compacted in a 6-inch mold. A 1 point standard compaction test at 1 to 2 percentage points below optimum was made from each in-place density test material for identifying the applicable maximum density and optimum moisture from the best of curves. Tests were performed by Contractor quality control technicians in a field laboratory at the Resident Office under the supervision of a Government technician who also performed check tests for comparison with the Contractor tests. The total number of tests performed were as follows.

	<u>Dam</u>	<u>Dike</u>
Total Contractor Tests	247	597
Total Government Tests	102	52

The distribution of density tests performed on the impervious material, the random material and the drain material are shown on plates 18 through 21. A summary of field compaction control test data and design placement requirements for the dam is shown on plate 22. A summary of field compaction control test data and design placement requirements for the dike is shown on plate 23.

e. Rock Placement. Random rock from required excavations and borrow area No. 1 was placed upstream of the impervious core zone from the foundation to the top of the dam and downstream of the impervious core from the foundation to elevation 860. The material was dumped and spread in layers not more than 8 inches thick before compaction. Each layer was compacted by 4 passes of a sheepsfoot roller and 2 passes of a 50-ton pneumatic tired roller.

Density tests were performed by using a template placed on the compacted rock. A hole approximately 2'x2'x2' was carefully excavated by using a pick, shovel, and small hand tools. The weight of excavated material was obtained. The hole was lined with plastic and filled with water to the

calibration mark. The water used to fill the excavation to the calibration mark determined the volume of material excavated, thus weight per cubic foot was obtained.

Listed below are locations and results of the random rock tests:

Table 1

<u>Test No.</u>	<u>Station</u>	<u>Offset</u>	<u>Elevation</u>	<u>Density (#/Ft³)</u>
1	22+00	450 FT US	749	141.2
2	21+00	147 FT US	736	145.4
3	20+00	450 FT US	772	151.4
4	20+70	265 FT DS	810	123.3
5	20+80	180 FT DS	845	131.0
6	17+80	48 FT DS	890	139.9

A percolation test was also performed in the excavated holes. The results of these tests showed that the absorption rate of the random rock varied substantially, from .0006 ft/min to .0433 ft/min.

f. Seepage Control. The seepage control consisted of a five foot wide vertical drain inclined four vertical to one horizontal and a three foot wide blanket of filter sand on both abutments extending horizontally from the incline drain to within five feet of the outer slope and vertically to elevation 883. The drain is constructed between the downstream rock zone and the impervious core.

There is also a 5-foot wide transition zone between the filter and random rock zone. The following is a specified grading of the two materials:

<u>Filter Sand</u>		<u>Transition Stone</u>	
<u>Sieve</u>	<u>Percent Passing</u>	<u>Sieve</u>	<u>Percent Passing</u>
3/8"	100	2"	100
No. 4	95-100	1-1/2"	95-100

No. 16	45-80	3.4"	35-70
No. 50	10-30	3.8"	10-30
No. 100	0-5	No. 1	0-5

To assure a good interface between filter and clay, clay was overlapped on the top of the filter and then cut back to provide a smooth compacted vertical face. With adequate water and uniform grading of material, desired compaction was generally achieved with 4 passes on the roller.

A toe drainage system was constructed across the valley and discharges into the stilling basin. The drain extended down into the pervious foundation. The toe drainage system is shown on plate 27.

g. Shear Strengths. Because of the low shear strength and organic content of the alluvial foundation of the dam, it was determined that these materials would be removed. The alluvial foundation materials in the dam were stripped. The residual material on the upper portion of the abutments was left in place. The adopted ϕ strengths were obtained from a plot of cohesive strength versus moisture content and were adopted from test results to represent materials 2 percent wet of optimum. The R and S strength values for the impervious fill were adopted from a composite of test value envelopes. The shear strengths for the rolled random rock were based on shear tests for weathered materials from the spillway. The Adopted Shear Test values are presented below.

Table 2

Adopted Soil Design Values

Embankment Materials	γ_d PCF	γ_m PCF	γ_s PCF	γ_b PCF	Shear Values		
					Type Test	Tan ϕ	C TSF
Impervious (Lt. Abutment Borrow)	105.6	132.5	134.6	72.2	O	0.071	1.13
					R	0.287	0.19
					S	0.454	0.00
Impervious (Rt. Abutment Borrow)	105.6	127.0	129.0	66.6	O	0.130	1.00
					R	0.375	0.30
					S	0.547	0.00

Random Fill	109.0	135.0	140.0	77.6	Q	0.368	1.45
(Rock)					R	0.330	0.50
					S	0.650	0.00

The random rock materials were obtained from the weathered portion of the spillway. It was felt that they did not represent the bulk of the materials that were to be used in the fill. Therefore, during construction, unweathered materials were obtained and sent to South Atlantic Division laboratory for testing. Cube samples were also taken from the embankment core and tested by Ohio River Division laboratory. Below are the results of the additional testing.

Table 3
Testing After Feature Design Memorandum

Materials	γ_d PCF	γ_m PCF	Type Test	Shear Values	
				Tan ϕ	C TSF
Impervious (Lt. Abutment Borrow)	108.6	128.3	Q	0.000	1.25
			R	0.296	0.20
			S	0.520	0.00
Random Fill (Rock)	109.0	135.0	Q	0.727	1.40
			R	0.325	0.25
			R	0.767	0.30

h. Stability Analyses. The dam embankment sections were subject to analyses by the circular arc and sliding block and wedge methods. Slope stability computations for the circular arc analysis were made with an IBM 360 computer using Program No. 41-K2-H2-03. Slope stability computations for the block and wedge analysis were made with an IBM 360 computer using Program No. 41-K2-H2-02. The stability of the critical condition was checked by manual computations. The methods used in determining the factor of safety follows the procedures outlined in EM 1110-2-1902. The slopes were analyzed for the end of construction, sudden drawdown, partial pool and steady seepage cases. The circle analysis proved critical in every case. Since the damsite is not in an area of seismic activity, no earthquake analysis was considered. Cases studied along with values obtained are presented below in Table 4.

Table 4

Case Studied	Minimum Safety Factor		Required
	Circular Arc	Block & Wedge	
<u>Dam</u>			
End of Construction			
Upstream	2.37	--	1.3
End of Construction			
Downstream	2.23	2.34	1.3
Sudden Drawdown	1.20	1.29	1.2
Partial Pool	1.53	--	1.5
Steady Seepage	1.77	1.69	1.5

End of Construction.

O shear strengths are applicable for this case. A minimum factor of safety of 2.37 was obtained for the upstream section. A minimum factor of safety of 2.23 was obtained for the downstream section.

Sudden Drawdown.

R shear strengths are applicable for this case. The upstream slope was analyzed for drawdown from spillway crest to a minimum pool for a maximum drawdown of 83 feet. Full uplift was assumed with saturated weights utilized below the saturation line. A minimum factor of safety of 1.20 was obtained.

Partial Pool.

R shear strengths are applicable for this case. The pool elevations considered were spillway crest elevation, minimum pool elevation and no pool. Full uplift was utilized with horizontal saturation lines. A minimum factor of safety of 1.53 was obtained.

Steady Seepage.

R and S strengths are applicable for this case. The internal drainage system was considered operative. The embankment was considered to be

saturated to spillway crest upstream of the inclined drain. No tailwater was considered. A minimum average factor of safety of 1.77 was obtained.

The stability analyses are shown on plates 23 through 32.

5. Diversion and Closure.

a. Diversion. The dam diversion plan is presented on plate 33. Diversion of the stream occurred on 14 July 1973 and stripping across the entire valley started on 19 July 1973. Diversion was accomplished by temporary cofferdams immediately upstream and downstream of the respective toes of slope. The centerline of cofferdam "B" was 700 feet upstream of centerline of dam. The cofferdams were taken to rock except for a small section of "B" which was founded on sand and gravel with a 4-foot wide trench to rock. The cofferdams had side slopes of 2H on 1V with a 10-foot top width at elevation 745 and were composed of material from cofferdam "A" (around outlet works) which was outlet works excavation.

One week after diversion, the runoff from a severe storm caused overtopping of the diversion cofferdam. The cofferdams were overtopped again on 24 July 1973, a few hours after being restored. On the same day, a restraining order was issued in Federal Court which stopped all project work. Several times during construction the outlet channel became partially blocked by outwash from a small stream which empties into the channel from the right bank. The streambed has a gradient of 7.5 percent which produces a high velocity flow that carries limestone fragments to the outlet channel during heavy runoff. Although one gabion structure was built just above the outlet channel, the outwash problem may reoccur during future heavy stream flows.

b. Stage I, Permanent Cofferdam. The foundation of Stage I was excavated and the embankment placed from 19 July 1973 to 2 November 1973 with the major embankment effort occurring between 11 October and 2 November 1973. Three wells were sunk just upstream of the upstream toe on 40-foot centers and three wells were just upstream of the centerline of

the dam to control seepage. The wells were screened with 24-inch diamond slotted pipe and pumped with 3-inch electric pumps. Results were generally poor to fair, depending on the amount of effort put forth by the Contractor to develop this system. Part of Stage I had been placed earlier (before diversion) on the left side of the tower to facilitate the sequence of operations after diversion.

Stage I was built to elevation 895 with an upstream slope of 3.5H on 1V and a downstream slope of 2H on 1V with a 20-foot top width. A cutoff trench was excavated to rock through sand and gravel with a centerline 90 feet downstream from the upstream toe with 2H to 1V side slopes and a 10-foot bottom width. The embankment material was compacted random rock mainly from the spillway. Stage I and subsequently Stage II are the upstream portions of the permanent fill and were initially constructed to protect the rest of the foundation from flooding and allow it to be excavated in the dry.

c. Stage II, Permanent Cofferdam. Stage II was completed 14 November 1973. This extended the embankment to 820.0 with 3.5H to 1V upstream slope and 2H to 1V downstream slope with a 5-foot top width. Compacted random rockfill from the spillway was used.

6. Construction Notes. The prime Contractor was Butt and Head, Inc., 3858 New Germany Road, Dayton, Ohio 45431. The contract, DACW27-72-C-0086, Construction of Outlet Works, Dam, and Spillway, Caesar Creek Lake, was awarded on 1 March 1972 and involved construction of the earth and rockfill dam, the excavation and construction of the gate controlled outlet works at the base of the right abutment and the uncontrolled spillway on the left abutment, excavations of the inlet and outlet channels of the outlet works, and construction of the service bridge, access roads, parking areas and trash boom. It also included clearing and grubbing, site grading, placing of stone protection and seeding. Following grubbing of the construction site, excavation was performed for the outlet works along the toe of the

right abutment. Concrete placement started in August 1972 on the stilling basin and continued on the outlet works through the following winter. The stilling basin and conduit concrete were completed during the spring of 1973. The outlet works conduit was constructed in an open cut of reinforced concrete in 20-foot monoliths with the exception of monoliths 1 and 44 which are 15' long. Lean concrete fill was used under the entire length of the conduit in order to found on firm rock. The lean concrete also had two other purposes: (1) to provide a working pad for placing formwork for the conduit proper, and (2) to protect the rock surface from deteriorating until the invert was placed. In the impervious zone of the dam, lean concrete fill was placed to the top of the conduit on the landward side, over the full width of the excavation and three seep rings were placed around the conduit. Beyond the impervious zone on the landward side, granular fill was used to top of conduit over the full width of excavation. In order to insure that the backfill will maintain contact with the vertical sides of the conduit, the sides were given a batter of 1 horizontal to 10 vertical. Cut slopes are 4 on 1 in rock and 1 on 1.5 in earth. The surface between the lean concrete cradle and the conduit was given a coat of bituminous paint to break the bond. The inlet and outlet diversion channels were excavated in June and July 1973 and the stream diverted through the conduit on 14 July 1973. At that time, the tower concrete was placed to elevation 787, the service and emergency gates, frames, liners, bonnets and cylinders were in place and the left abutment cutoff trench was excavated and grouted. On 19 July 1973, the Attorney General of Ohio filed a complaint in the Federal District Court: State of Ohio, Ex rel William J. Brown, Attorney General of Ohio vs. Howard H. Calloway, Secretary of the Army, et al, Civil Action Nos. 8892 and 8893. It contended that the construction work at Caesar Creek Lake should be halted until the United States complied with certain laws. There were several allegations of noncompliance by the Attorney General, but his main contention related to noncompliance with the National Environmental Policy Act in that, he alleged, the environmental impact statements were inadequate and did not satisfy the requirements of Section 102 of NEPA. As a result of this litigation, all significant work at the project was stopped by the Court's Order of 24 July 1973 pending the filing of a

complete and adequate Environmental Impact Statement. The restraining order was partially lifted on 11 September 1973, allowing work to continue on the permanent cofferdam and operating tower. On 11 October 1973, the major embankment effort started on the permanent cofferdam. Stages I and II of the cofferdam were completed on 2 November 1973 and 14 November 1973, respectively. The valley portion of the cutoff trench was excavated and grouted later, then all work was discontinued until the court injunction was vacated and suspension claims were settled. The court injunction was vacated in June 1974. However, because of the unavailability of construction equipment in the late spring and early summer of 1974 and due to the indefinite nature of the court-imposed suspension, the prime Contractor decided to subcontract the earthwork to a firm with the necessary personnel and equipment. The low bid and work went to the Geupel Construction Company, Inc., of 1661 W. Henderson Road, Columbus, Ohio 45220. Remobilizing began in August 1974 for construction of the dam and other site work. Geupel placed the dam embankment to elevation 737 by November 1974 when the weather prevented further work. The embankment work was resumed again the first week in April 1975 and the dam was topped out in August 1975. The roads, spillway control structure and other site work were substantially completed in November 1975, but the prime Contractor did not complete the control tower until June 1976 at which time the final inspection was held. After a revised Impact Statement was compiled, an agreement was reached with the Ohio Attorney General's Office in early 1975 and further court action was not expected. Contract supervision was provided by the Government in the form of a resident office, administered by a resident engineer acting as a representative of the District Engineer. Personnel requirements for supervision of inspection of the work varied from time-to-time. The inspection force was sufficient to maintain effective control of the work during construction.

7. Modifications. There were 37 modifications for the construction of the Outlet Works, Dam and Spillway. Significant modifications are listed below:

Modification 3 deleted instrumentation around the conduit in three locations which were to have been installed by the Government.

Modification 7 gave the Contractor the option to use on-site granular material for placement behind the conduit, under riprap at the stilling basin wingwalls and in back of the stilling basin wingwalls. The original contract only specified selected streambed sand and gravel material excavated from the cutoff trenches for the cofferdams and dam to be used as a granular backfill.

Modification 13 provided construction of a 3-foot wide minimum collar of impervious fill material around the tower to meet plan impervious plugs for seepage control.

Modification 15 provided settlement for suspension of the contract and includes settlement of several outstanding cases which existed before and during suspension. Two of the cases affected the embankment and/or abutment design. Case 8 deleted a portion of the cribwall on the downstream right abutment and represented a 75 percent reduction in the original plan quantity. The rock slopes where the cribwall was to have been built, were excavated steeper than original contract plans as a result of Case 8 and seeded with crown vetch. The reasons for deletion of the cribwall were principally due to concern over the potential for deterioration and erosion of the exposed shale below the bench on which the wall would be built. Case 103 was for change of datum elevations from 1912 to 1929 to be consistent with the datum used throughout the rest of the lake project area. Order to change to 1929 datum was given to the Contractor on 22 June 1972. The adjustment was accomplished by adding 1.10 to the benchmark elevations on the plans.

Modification 20 allowed the Contractor to place random rock embankment to elevation 842.0 in the portion of the dam upstream of the impervious core in advance of the impervious fill. The upstream slope was built 3.5H to 1V to match the previously constructed Stage II cofferdam. The top was an average of 35 feet wide. The downstream slope was built 2H to 1V with a 28-foot wide haul road built on the face of the slope starting at the top on the right abutment and ending at the toe of the left abutment. This

allowed random rock placement during the early spring of 1975 while clay for impervious fill was too wet to work.

Modification 25 allowed use of borrow area No. 2 clay for impervious fill. Actual quantity used was 34,340 cubic yards.

Modification 36 added a 3-inch and a 4-inch PVC conduit underground across the upstream top of the dam for future electric and telephone cables.

Other changes which were not contract modifications include:

Initial stripping of the abutment was generally 1 foot instead of 4 feet as required as residual soil was found at the shallower depth. During the 1975 construction season, silty, sandy material was encountered in the upper portion of the right abutment, downstream from the cutoff trench and this material was removed with the greatest depth of 12 feet at Station 25+50. Natural granular material did not extend along the base of the abutments; therefore, unsuitable material was excavated down to rock along each side of the streambed granular material. The excavated material was replaced with random rock for leveling and topped with the horizontal dam filter. This resulted in overruns beyond the plan estimated quantities for dam foundation excavation and for the horizontal dam filter. All other modifications and changes applied to features of the contract other than the embankment.

8. Initial Filling.

a. General. Operations personnel at the damsite reported daily to the Regulation Section in Hydrology and Hydraulics Branch. Routine data reported consisted of pool elevation, damsite and observer rainfall, and pertinent stream stages. When rainfall conditions merited, collection of intermediate data from the damsite and from the NWS observer rain gages at Xenia, Wilmington, and Sedalia provided additional information needed to determine the most advantageous operating procedure. Regulation Section developed a reservoir inflow model for the area contributing to Caesar

Creek Lake; results from daily application to the model served as a basis for estimating project inflows. Based on these forecasted conditions, the Regulation Section disseminated operating instructions to assure maintenance of the desired filling schedule.

b. Filling Schedule. The filling of Caesar Creek Lake was done in three steps with a pool holding level of 5 days in between steps so that instrument reading and other observations could stabilize. The proposed and actual filling curves are shown on Plate 34.

The filling schedule, showing filling rates, rate of rise, and inspection or stabilization periods, is shown as Table 5.

Filling rates below elevation 800 were in excess of 1 foot/day however, since during construction the pool had been as high as elevation 800 and since elevation 780 had been exceeded several times during construction with no apparent problems, pool increases in excess of 1 foot/day in the lower lake levels were acceptable.

Table 5
Proposed Filling Schedule

Date (1978)	Average Filling Rate	Elevation	Capacity (Day-Second-Feet)	No. of Days	Average Rate of Rise
03 Jan		736	0		
	231 cfs			29	2.2 ft/day
31 Jan	--	800	6,703	5	--
05 Feb		800	6,703		
	645 cfs			25	1.0 ft/day
02 Mar	--	825	22,823	5	--
07 Mar		825	22,823		
	530 cfs			54	0.44 ft/day
01 May		849	51,441		

Flow in excess of the desired filling rate passed through the conduit.

If at any time during the winter project inflows were higher than the release capability, the gates remained fully open until the pool

stabilized. As inflows receded, the release was reduced commensurately in an effort to maintain the pool. After sufficient period for project inspection and instrument stabilization and after Geotechnical Branch had deemed conditions acceptable, filling continued at the prescribed rate.

During periods when the pool level was below the scheduled elevation and inflows were in excess of the prescribed filling rate, additional water was stored provided the rate of change of pool level did not exceed 1.0 foot/day.

c. Monitoring Procedures.

(1) General. During the initial filling of the reservoir, the dam and abutments were monitored for seepage by piezometers and surveillance of the downstream dam face and abutments. During the entire period the manholes of the toe drain of the dam were monitored as observation wells. Horizontal and vertical movements of the dam embankment were monitored by movement markers.

(2) Location of Instruments. Casagrande type piezometers are installed along stations 22+00 and 26+55 of the dam. Wellpoint piezometers are placed along the downstream toe of the dam embankment and on the right abutment. A single line of movement markers is located along the downstream crest of the dam. Three manholes associated with the toe drainage system are installed approximately 520 feet downstream.

(3) Observation Frequency. Piezometers and manholes were read daily until the all-season pool elevation 849 was reached and readings stabilized. Stabilization readings were taken on a weekly basis for the first year and on a monthly basis thereafter except during a rise in pool. Movement monuments were read monthly during the initial filling and quarterly thereafter. Surveillance of the dam and abutments was on a 24-hour basis during the initial filling.

(4) Reporting and Evaluation of Data. An engineer from the Geotechnical Branch was located at the project site during filling. The engineer kept data plots current, evaluated the results, and kept the District Office informed per daily telephone reports.

d. Emergency Plan. An emergency plan is being developed for all lakes in the Louisville District that will provide for orderly notification and evacuation of downstream residents in case of possible dam failure. Such plans will include, but not be limited to, inundation maps, points of contact, notification procedures, lake drawdown, and other pertinent items.

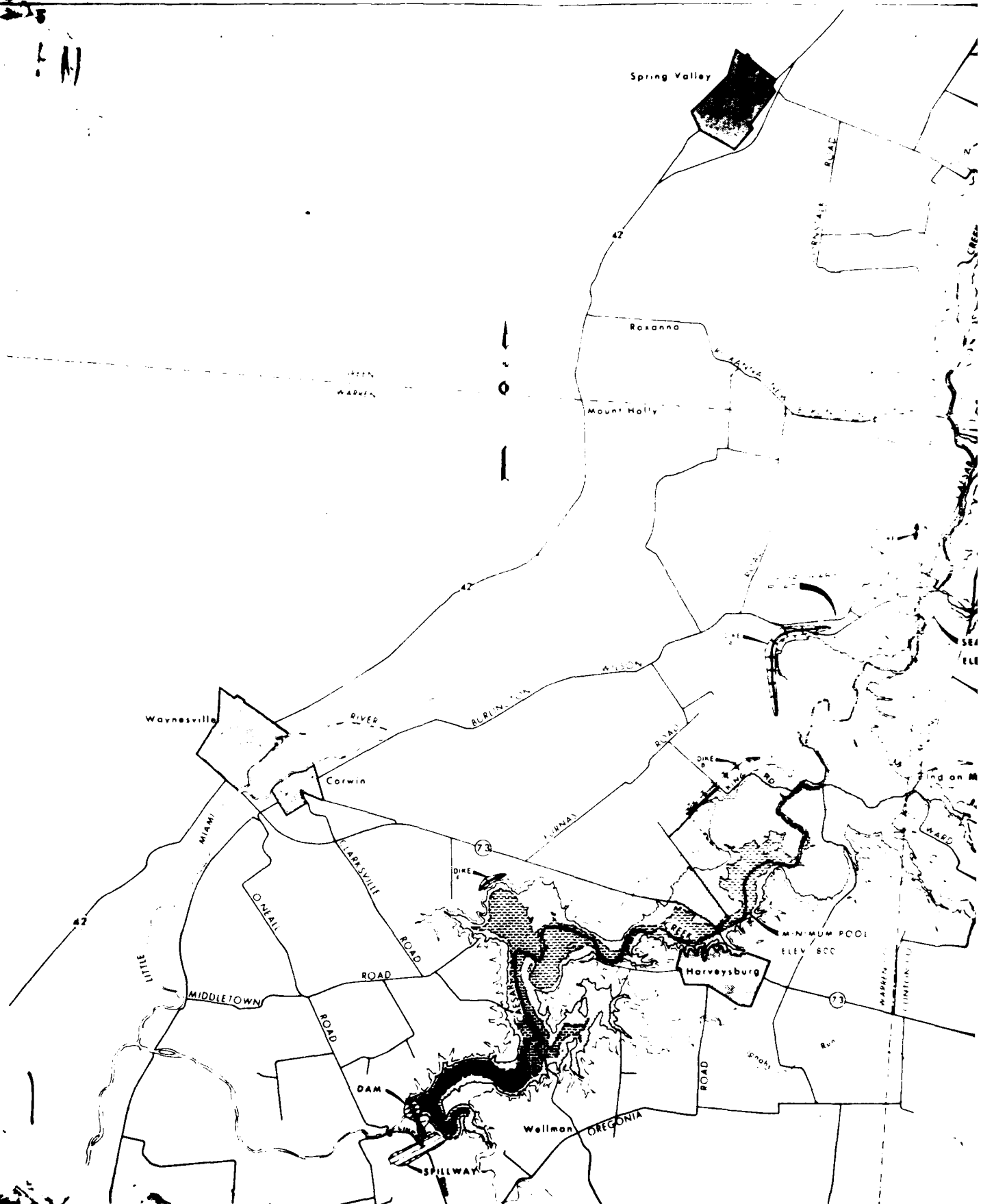
9. Instrumentation.

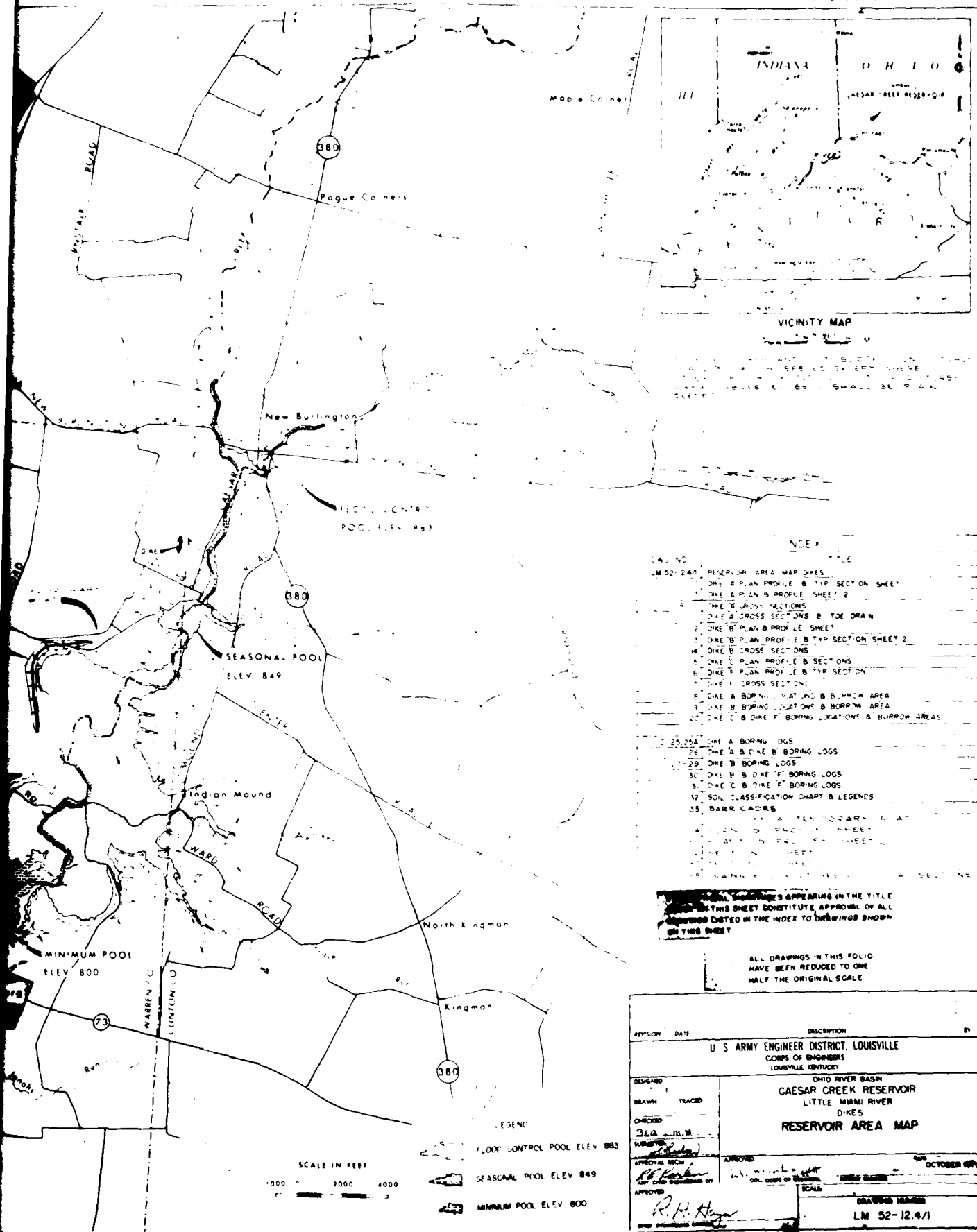
a. General. The instrumentation consists of piezometers, observation wells and movement monuments. The main dam has 10 piezometers in the embankment, 8 observation wells on the abutments, and a single line of movement monuments. Instrumentation plans, details and sections are shown on plates 35, 36 and 37.

b. Piezometers. Piezometers 6, 7 and 8 on the upstream side of the core reflect the pool indicating that the random rock zone is becoming saturated. The other upstream piezometer, number 9, is dry since its tip is at 846 which is above the present pool. Piezometers 3 and 4 on the downstream side of the core are both dry and along with piezometers 1 and 5 with low readings indicate that the core is effectively reducing the head. Piezometer 10 on the downstream side of the core is apparently influenced by ground water. The piezometer plots are shown on plates 38 through 41.

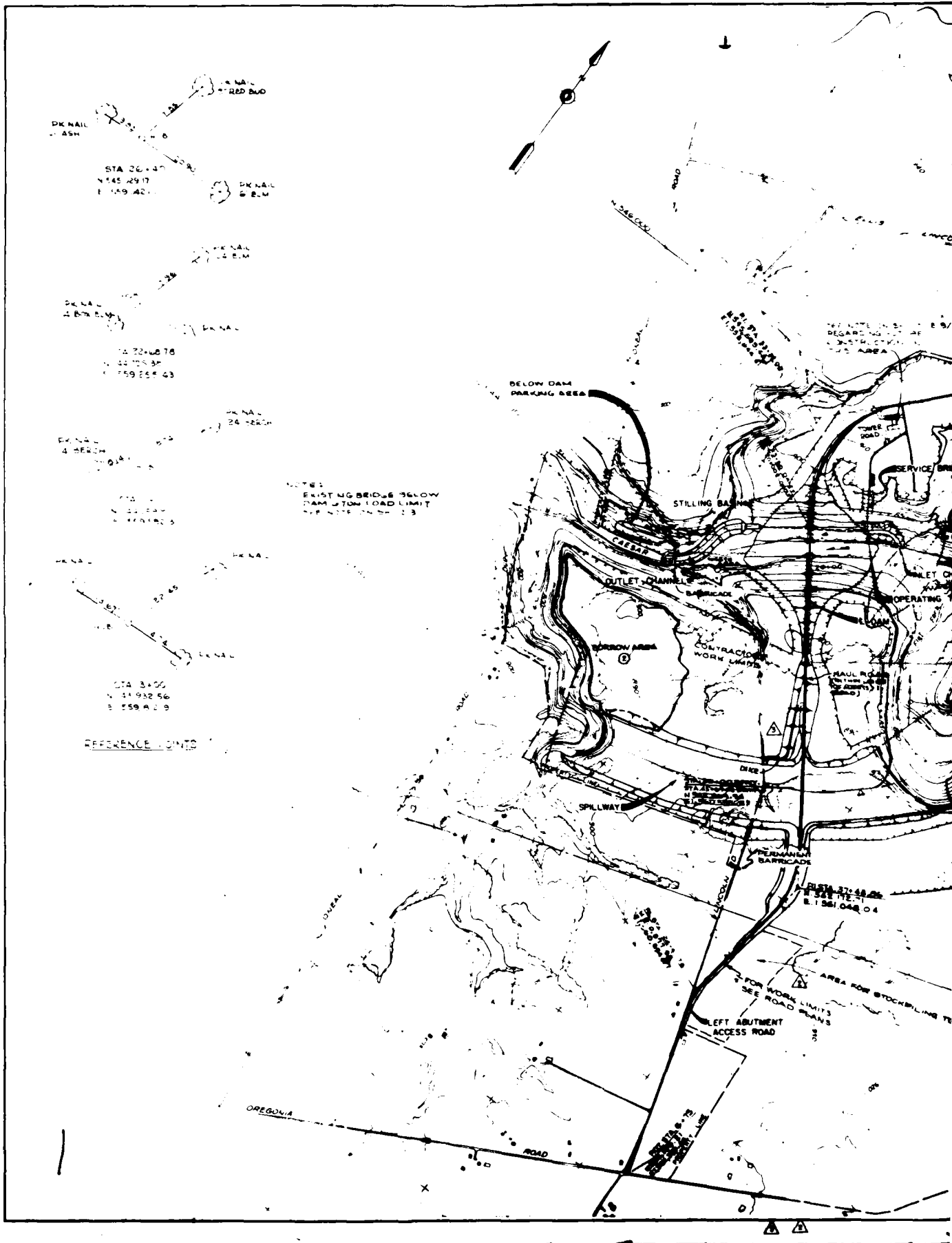
c. Observation Wells. Observation wells 11, 12, 13 and 14 on the right abutment are also apparently influenced by ground water. Observation wells 15 and 16 on the downstream side of the core fluctuate just above the tailwater. Observation wells 18 and 19 on the left downstream abutment react to the pool indicating slight seepage coming through the left abutment.

d. Movement Markers. The maximum vertical settlement of 0.18 foot occurred at the maximum embankment section. The maximum horizontal movement of 0.18 foot occurred at the maximum embankment section. The horizontal and vertical movement plots are shown on plates 4 and 5.





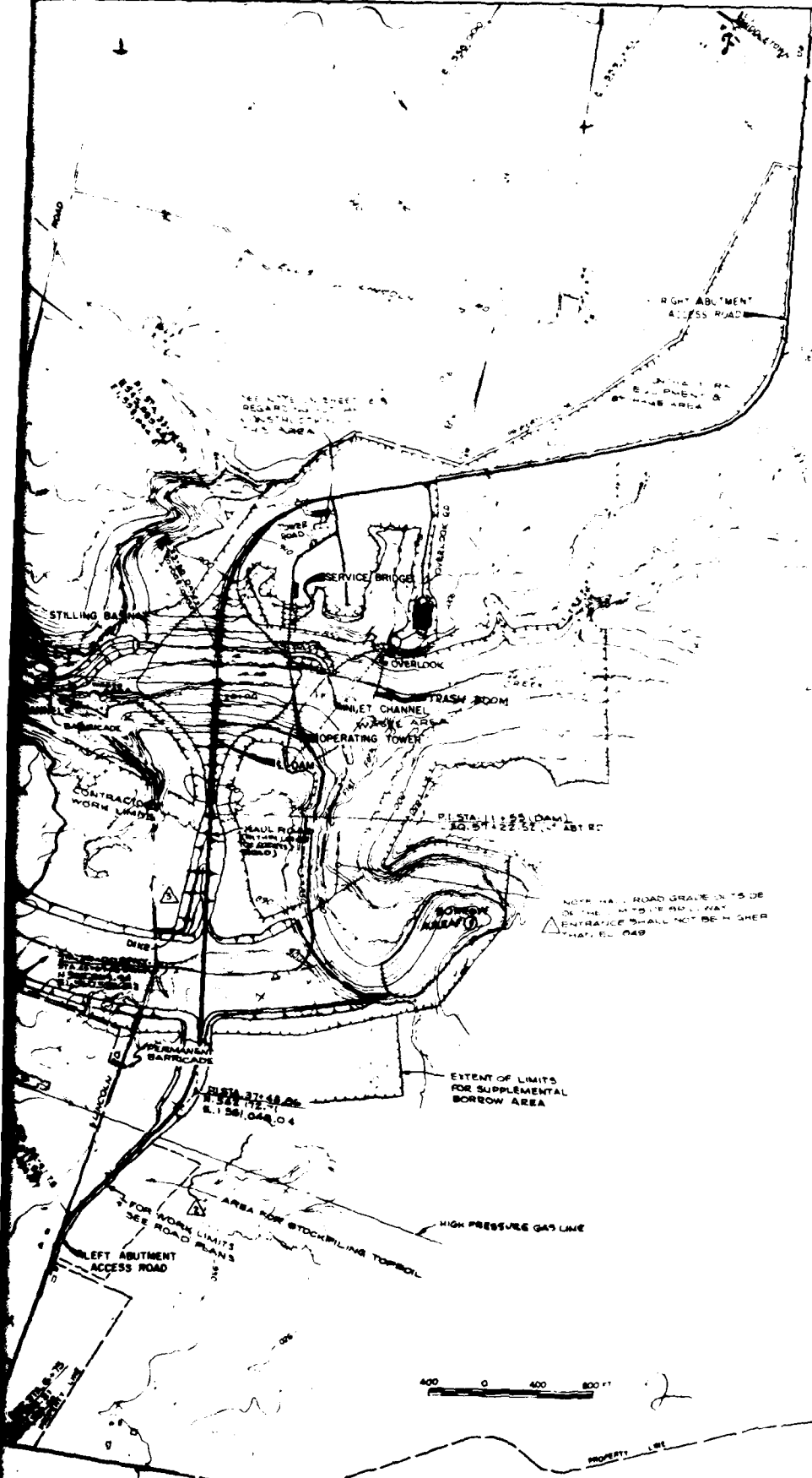
CORPS OF ENGINEERS



U. S. ARMY

SEQUENCE OF CONSTRUCTION

FOR THE NEW CAESAR CREEK LAKE DAM
SEE CHIT 12-1-1A 4-1-18
AND SPEC



1. EXCAVATED TOPSOIL FROM ACCESS ROADS AND SPILLWAY SHALL BE STOCKPILED IN ONE OR MORE OF THE FOLLOWING AREAS AS DIRECTED AND LEFT IN A NEAT AND PROPERLY DRAINED CONDITION
 - (1) AREA SHOWN TO RIGHT OF LEFT ABUTMENT ACCESS ROAD
 - (2) SUPPLEMENTAL BORROW AREA
 - (3) EQUIPMENT & STORAGE AREA TO LEFT OF RIGHT ABUTMENT ACCESS ROAD
- TEMPORARY STOCKPILES MAY BE PLACED IN ANY WORK OR STORAGE AREA EXCAVATED TOPSOIL FROM DAM FOUNDATION SHALL BE PLACED IN WASTE AREA IF NOT USED ON DOWNSTREAM FACE OF DAM OR OVER GRANULAR FILL

EXISTING BUILDING REMOVAL
THE EXISTING BUILDINGS REMAINING WITHIN THE CONSTRUCTION AREA, CONSISTING OF 5 CABINS, 12 TONNERS, AND OTHER MISCELLANEOUS BUILDINGS, SHALL BE REMOVED BY THE CONTRACTOR. SEE SPEC

LEGEND

PROPERTY LINE
CONTRACTOR'S WORK LIMITS

NOTE
THE PROPERTY LINE & LOCATION OF BORROW AREAS SEE CHIT 12-1-1B

1. MAY 1958 SERVICE ROAD (EXCLUDED FROM MOD) 2. JUNE 1958 NOTE & STOCKPILING TOPSOIL ADDED (AMDT NO 3) 3. JUNE 1958 STORAGE AREA ADDED NOTE CHANGED (AMDT NO 3)		JES JAB JCB
REVISION DATE DESCRIPTION	U. S. ARMY ENGINEER DISTRICT, LOUISVILLE CORPS OF ENGINEERS LOUISVILLE DISTRICT	
DESIGNED EUM DRAWN MDR CHECKED CLO INCHES SCALE AS SHOWN	CAESAR CREEK LAKE LITTLE MIAMI RIVER GENERAL PLAN	
DRAWING NUMBER LM52-121/3		DATE

PLATE 2

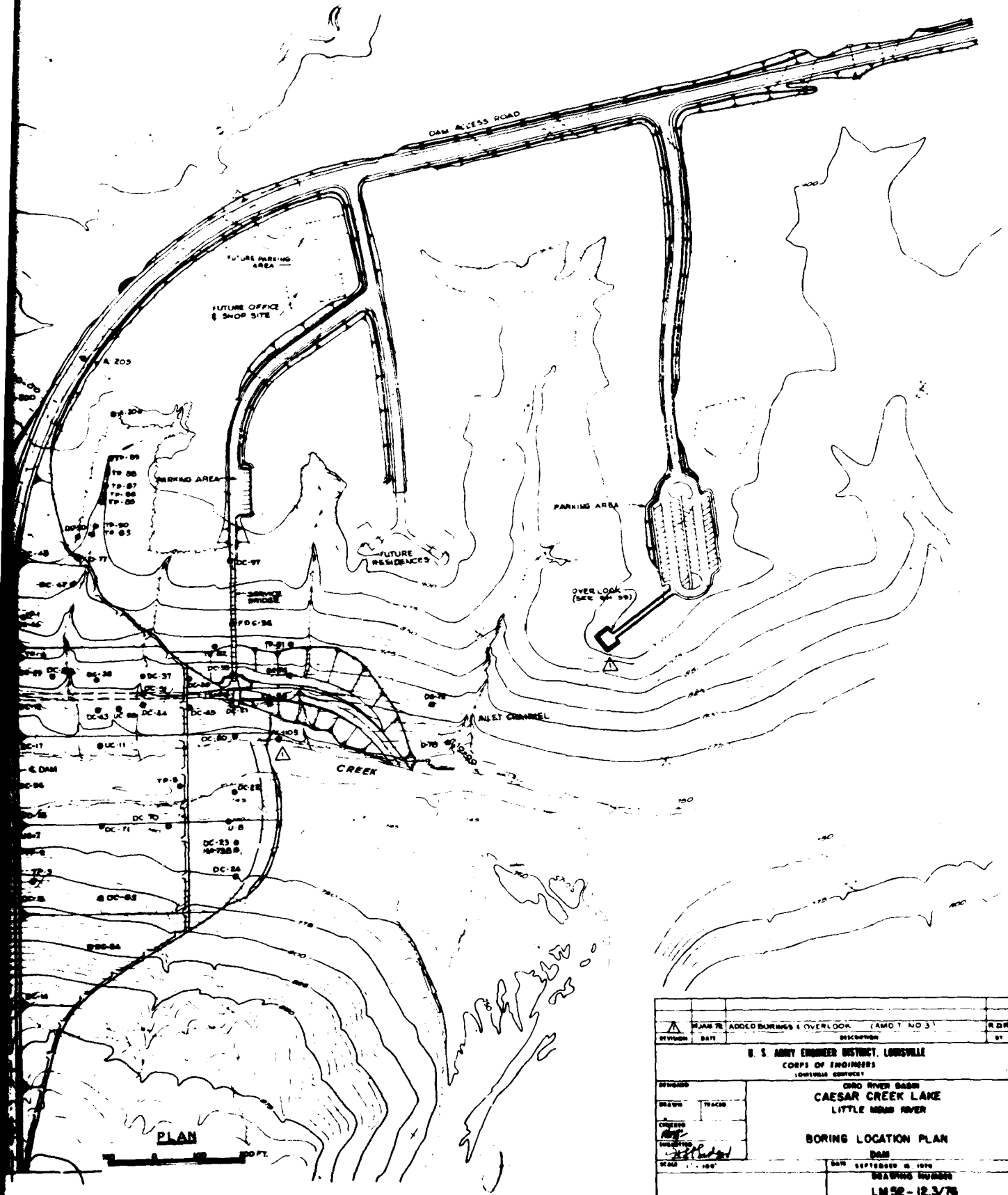
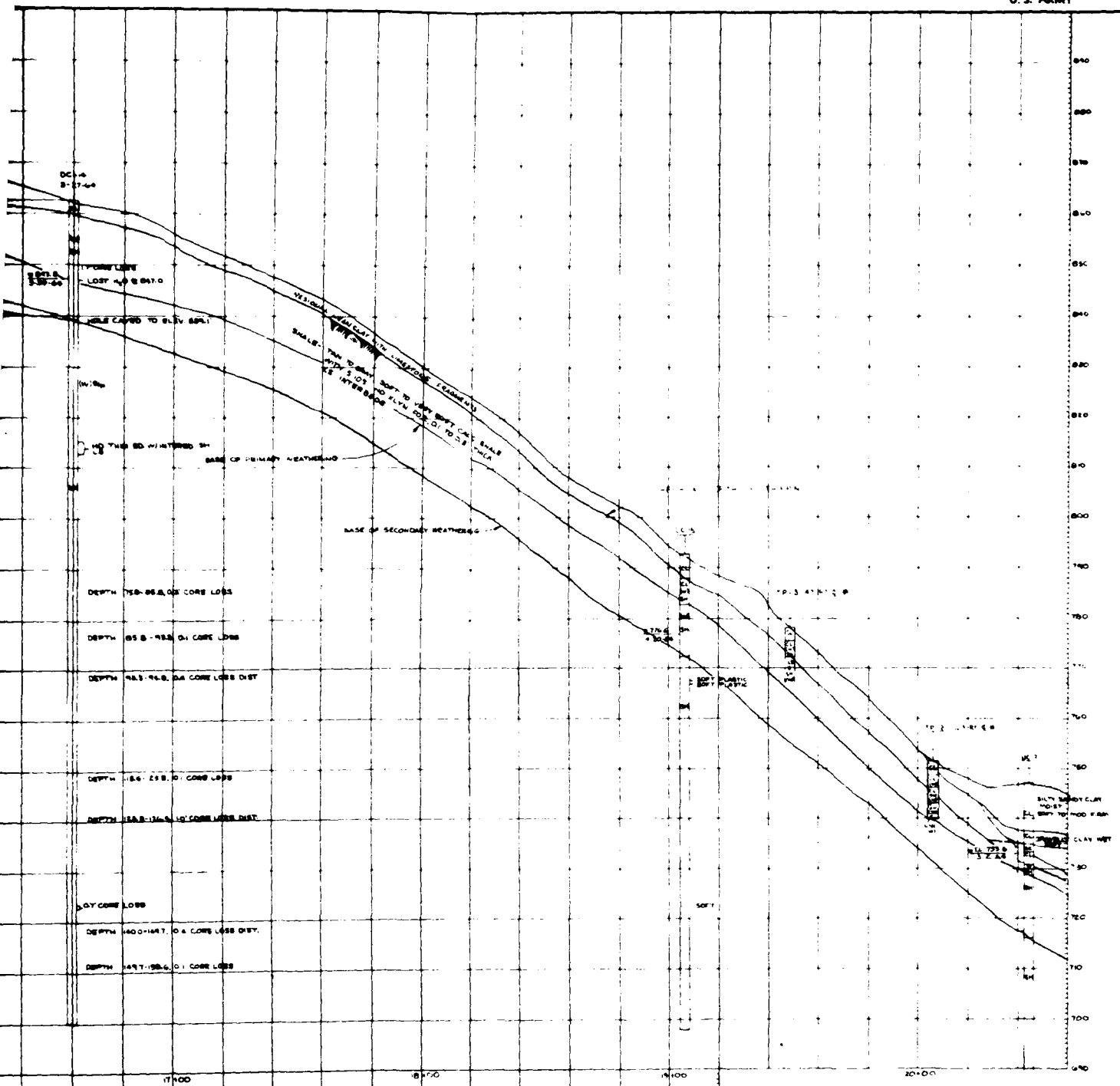


PLATE 3

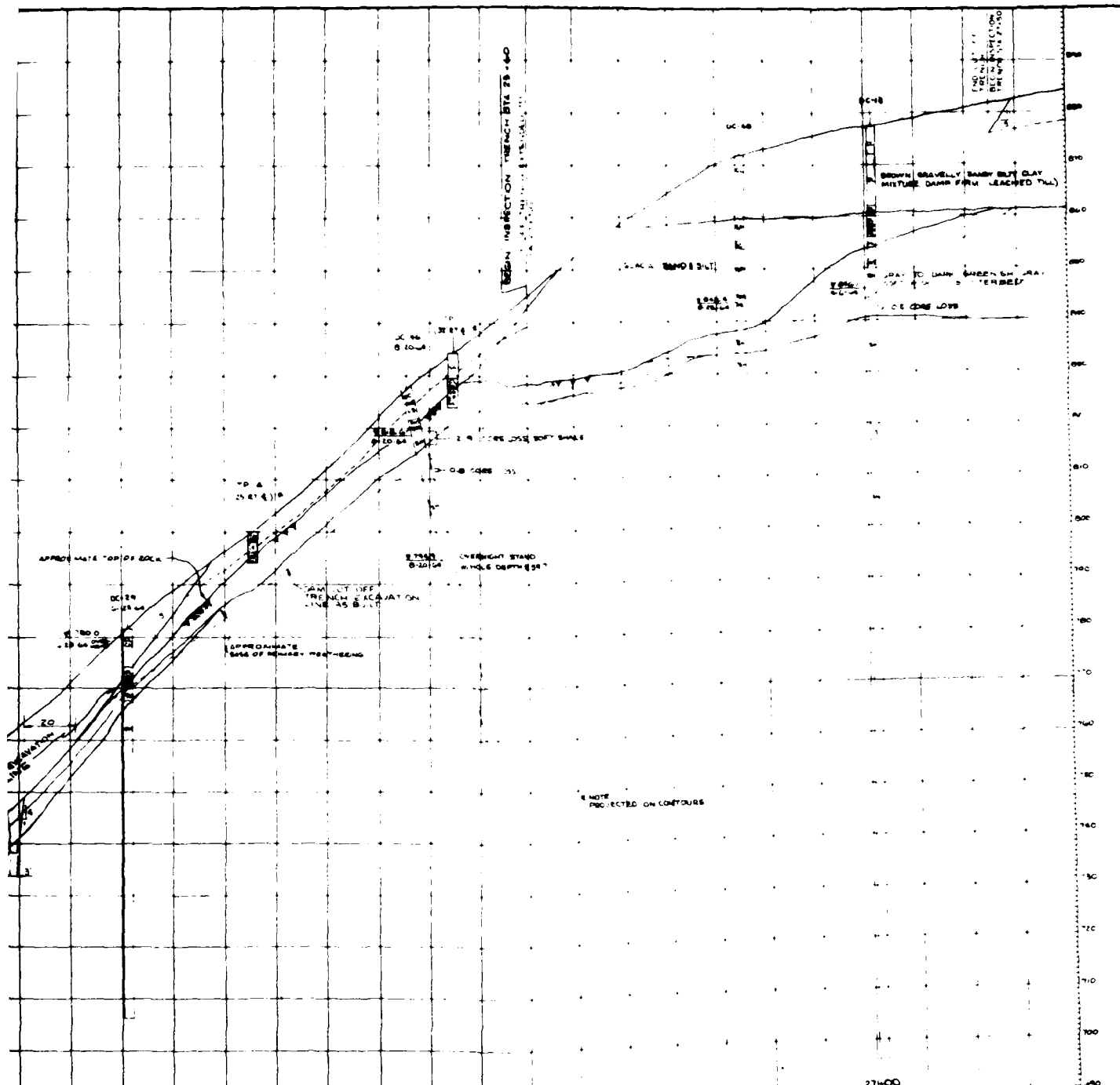
This geological cross-section diagram illustrates the subsurface conditions along a profile. The vertical axis represents elevation in feet, ranging from 680 to 970. The horizontal axis represents distance in feet, with markers at 4000, 5000, 6000, 7000, 8000, 9000, 10000, 11000, 12000, 13000, 14000, 15000, and 16000.

Key Features and Labels:

- Topography:** The ground surface is shown as a dashed line. Key points include "APPROX TOP OF GROUND" and "TOP OF DAM EL 903.0".
- Soil and Rock Profiles:**
 - Gravelly, Sandy, Silty Clay:** Labeled in the upper left and middle sections.
 - Gray Dam, Hard Compact Till:** Labeled in the upper left section.
 - Glacial Clay Till:** Labeled in the upper middle section.
 - Shale:** Labeled in the lower middle and right sections, with descriptions like "GRAY, SOFT TO MOD SOFT CALC SHALE WITH 10-15% NO ELYN" and "GRAY, GRAVELLY SANDY SILTY CLAY GLACIAL TILL".
 - Leached Till:** Labeled in the middle section.
 - Interbeds:** Labeled in the middle section.
 - 2-APPROX OF ROCK:** Labeled in the lower middle section.
- Core Losses:** Several locations are marked with "CORE LOSS" and specific depths:
 - DEPTH 11 CORE LOSS
 - DEPTH 12 CORE LOSS
 - DEPTH 13 CORE LOSS
 - DEPTH 14 CORE LOSS
 - DEPTH 15 CORE LOSS
 - DEPTH 16 CORE LOSS
 - DEPTH 17 CORE LOSS
 - DEPTH 18 CORE LOSS
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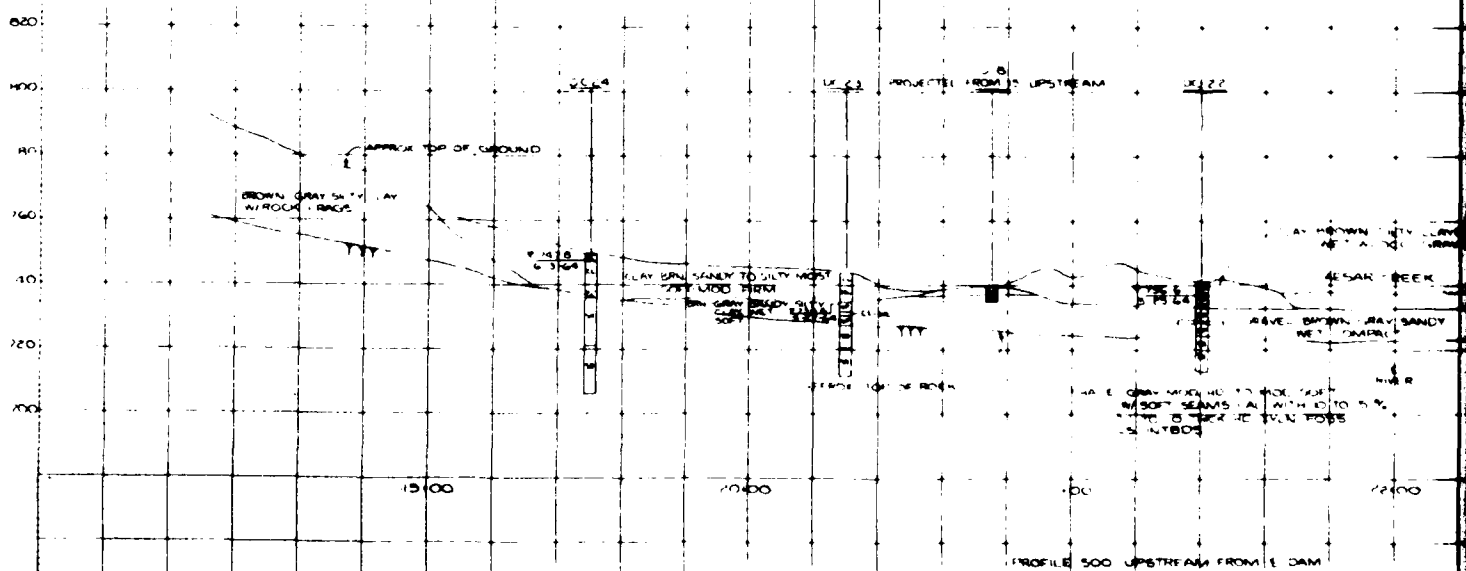
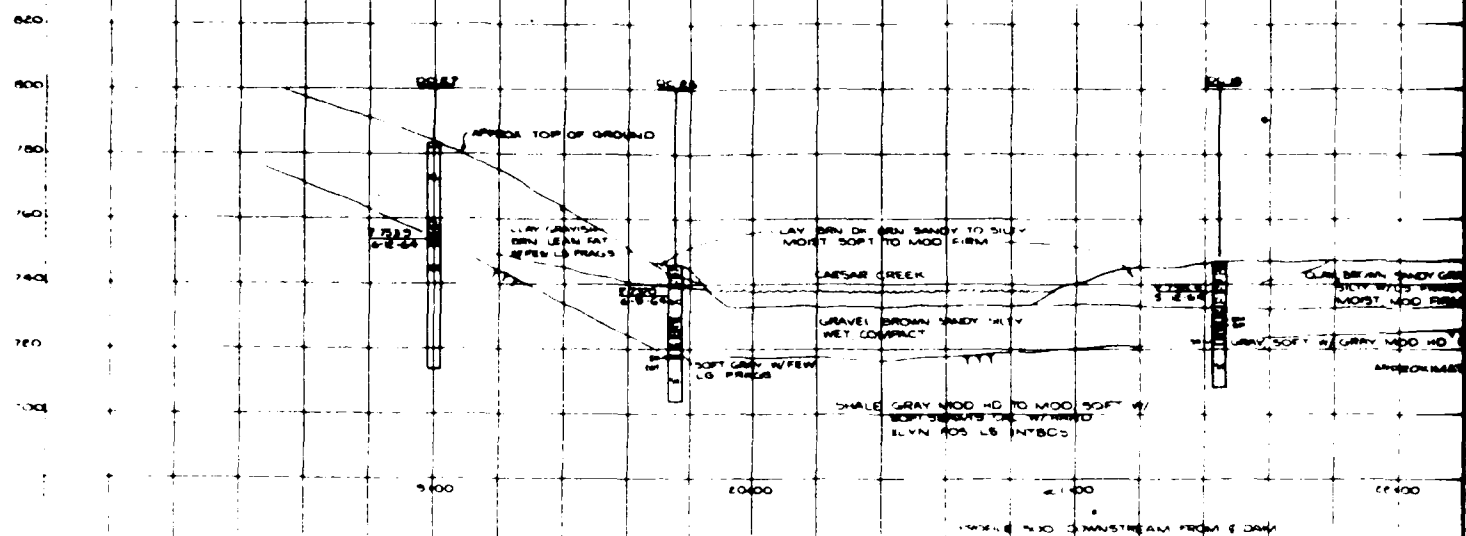
PROFILE EXTENDED U. S. ARMY ENGINEER DISTRICT, LOUISVILLE CORPS OF ENGINEERS LOUISVILLE, KENTUCKY	
DESIGNED DRAWN CHECKED APPROVED DATE	OHIO RIVER BASIN CAESAR CREEK RESERVOIR LITTLE MIAMI RIVER GEOLOGIC PROFILE DAM SHEET 1
APPROVED DATE SCALE DRAWING NUMBER	APPROVED DATE SCALE DRAWING NUMBER

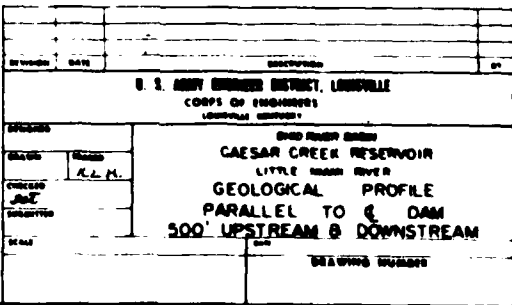


THIS DRAWING REFLECTS
"AS CONSTRUCTED" CONDITIONS

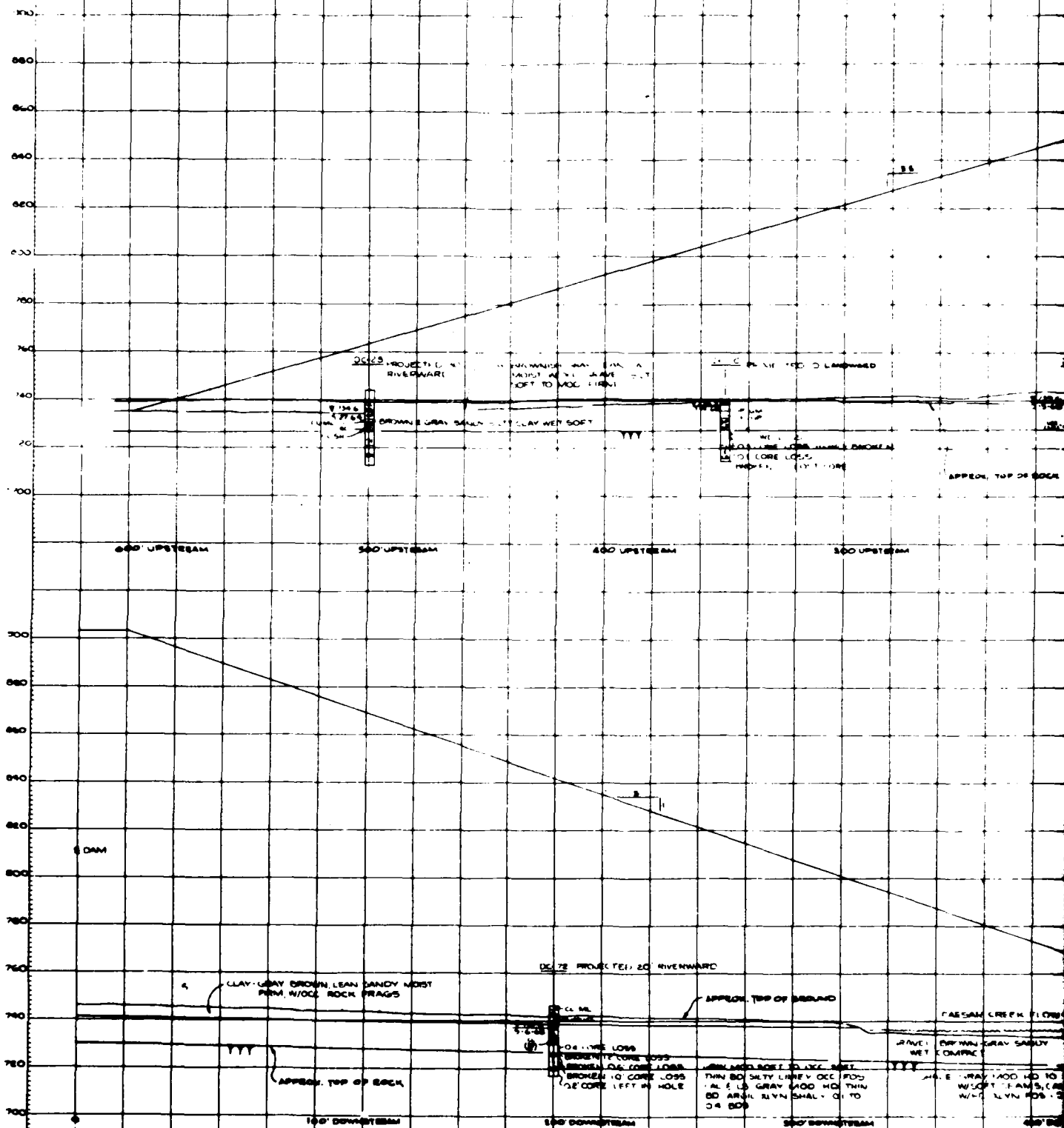
DIVISION DATE U. S. ARMY ENGINEER DISTRICT, LOUISVILLE CORPS OF ENGINEERS LOUISVILLE DISTRICT		SHEET 2
DRAWN CHECKED SUBMITTED APPROVAL R. M. Meyer		DESCRIPTION OHIO RIVER BASIN CAESAR CREEK RESERVOIR LITTLE MIAMI RIVER GEOLOGIC PROFILE DAM SHEET 2 SCALE DRAWING NUMBER

CORPS OF ENGINEERS





CORPS OF ENGINEERS



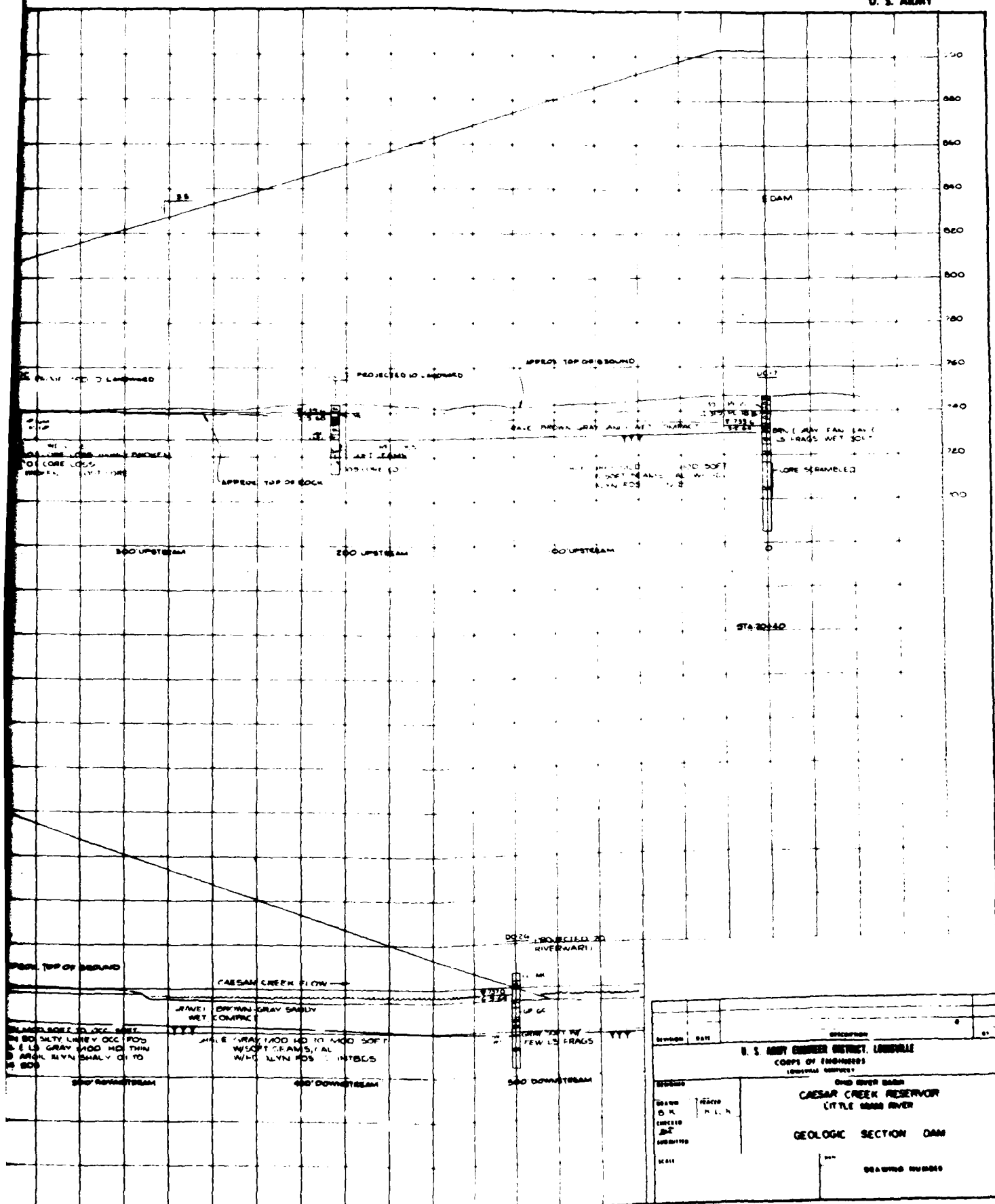
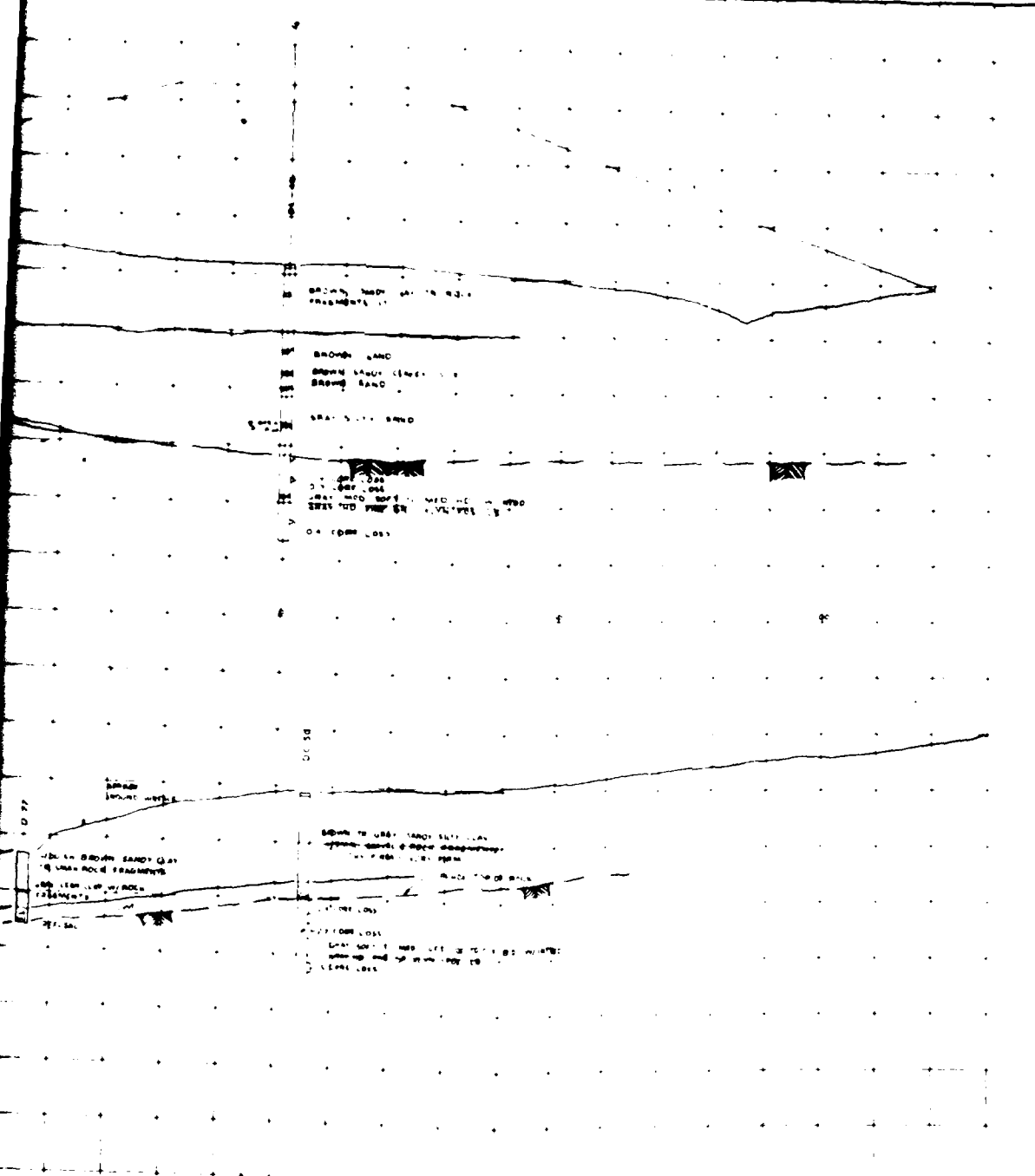


PLATE 7

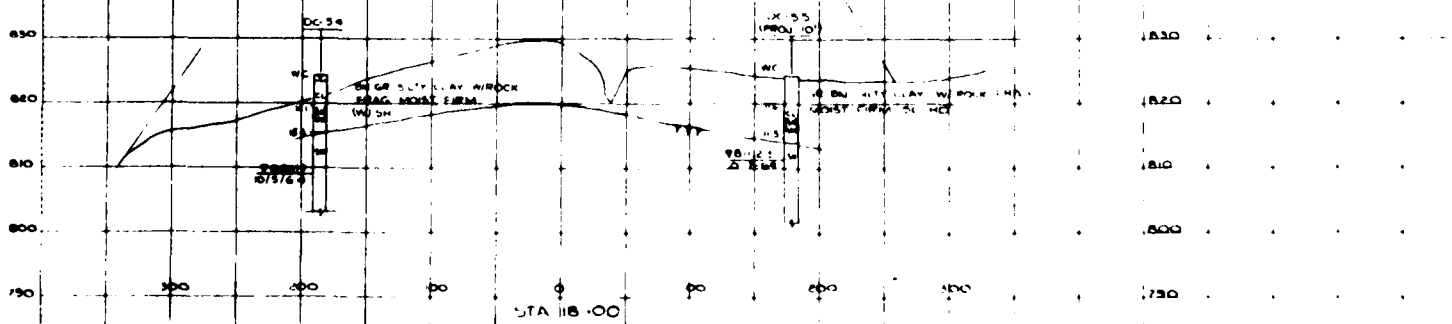
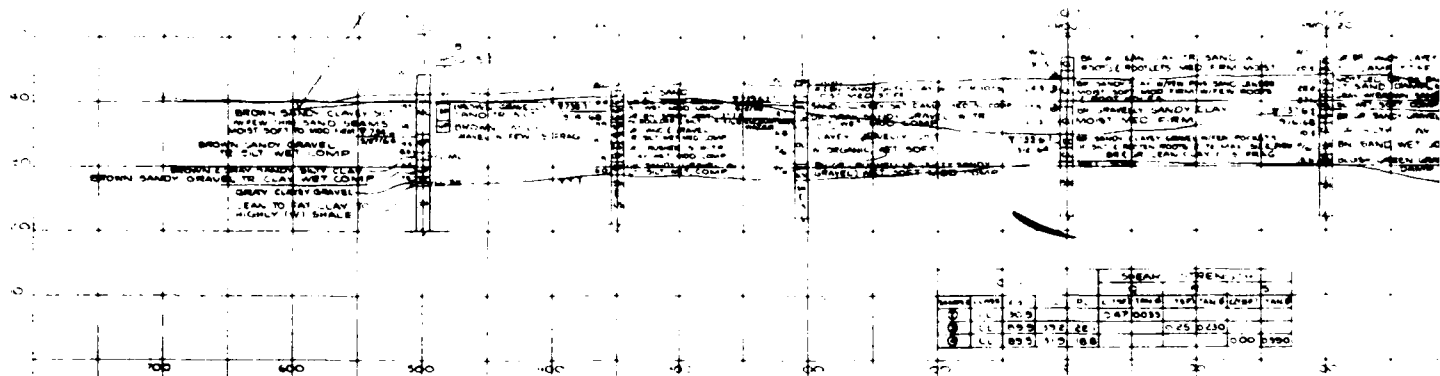
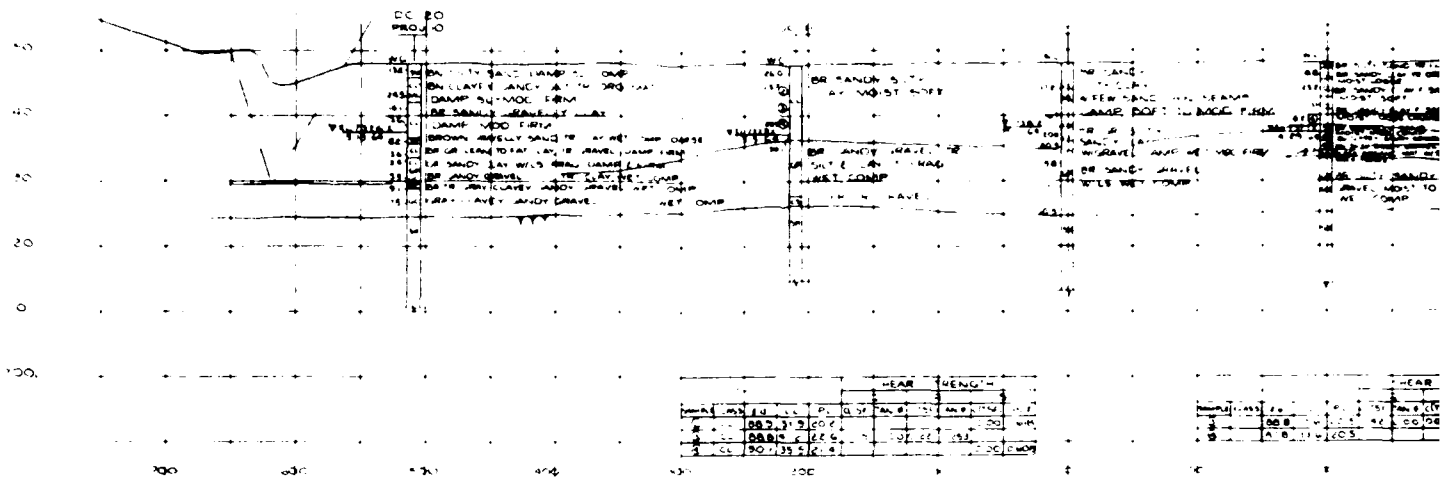


PROFILE 155 UPSTREAM

11100

DIVISION		DATE		DESCRIPTION	
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE					
CORPS OF ENGINEERS					
LOUISVILLE DISTRICT					
DESIGNED		OLD RIVER BRIDGE			
DRAWN		CAESAR CREEK RESERVOIR			
CHECKED		LITTLE MAINE RIVER			
SUBMITTED		RIGHT ABUTMENT			
SCALE		GEOLOGIC PROFILE & SECTION			
		DRAWING NUMBER			

CORPS OF ENGINEERS



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STATION	DEPTH	SOIL	REMARKS
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102	0.00	SAND	
103	0.00	SAND	
104	0.00	SAND	
105	0.00	SAND	
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109	0.00	SAND	
110	0.00	SAND	

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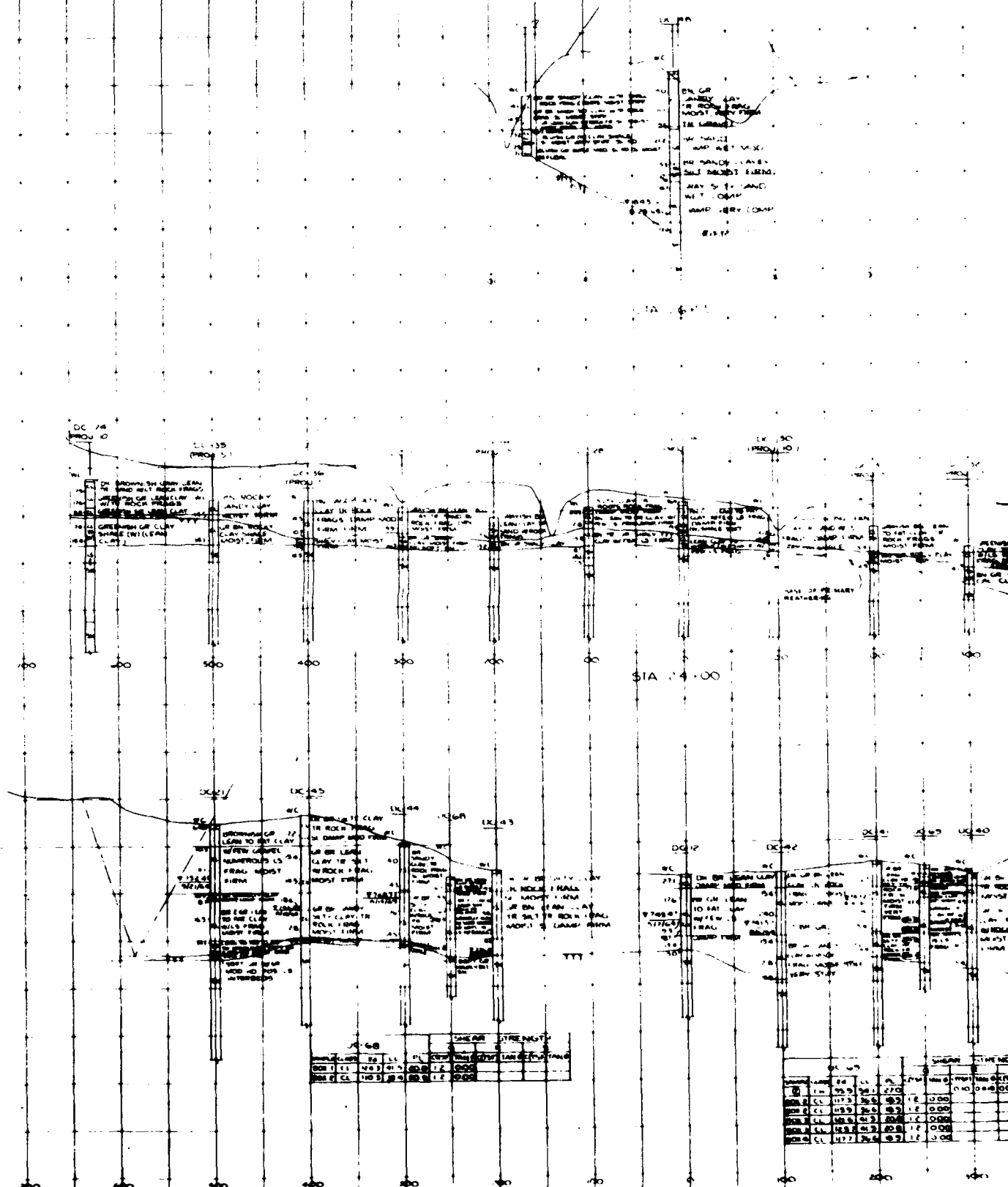
STATION	DEPTH	SOIL	REMARKS
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101	0.00	SAND	
102	0.00	SAND	
103	0.00	SAND	
104	0.00	SAND	
105	0.00	SAND	
106	0.00	SAND	
107	0.00	SAND	
108	0.00	SAND	
109	0.00	SAND	
110	0.00	SAND	

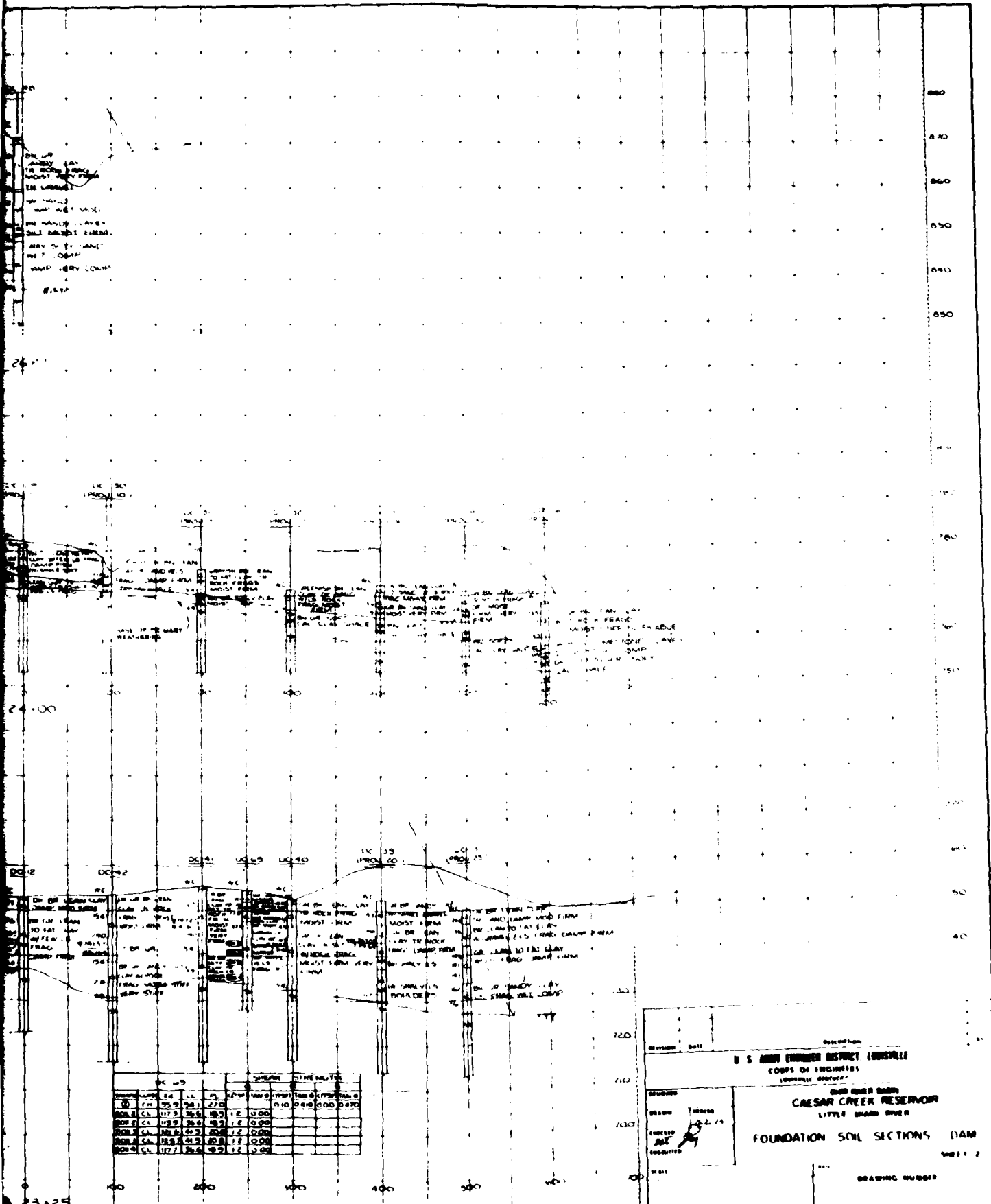
STA 40+50

830
 820
 810
 800
 790

DIVISION		DATE		DESCRIPTION		BY
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE CORPS OF ENGINEERS LOUISVILLE DISTRICT						
DESIGNED		CHECKED		SUBMITTED		SCALE
DRAWN		TESTED		APPROVED		DATE
ONE RIVER DAM CAESAR CREEK RESERVOIR LITTLE WASH RIVER FOUNDATION SOIL SECTIONS - DAM						
						SHEET 1
						DRAWING NUMBER

580
570
560
550
540
530
520
510
500
490
480
470
460
450
440
430
420
410
400

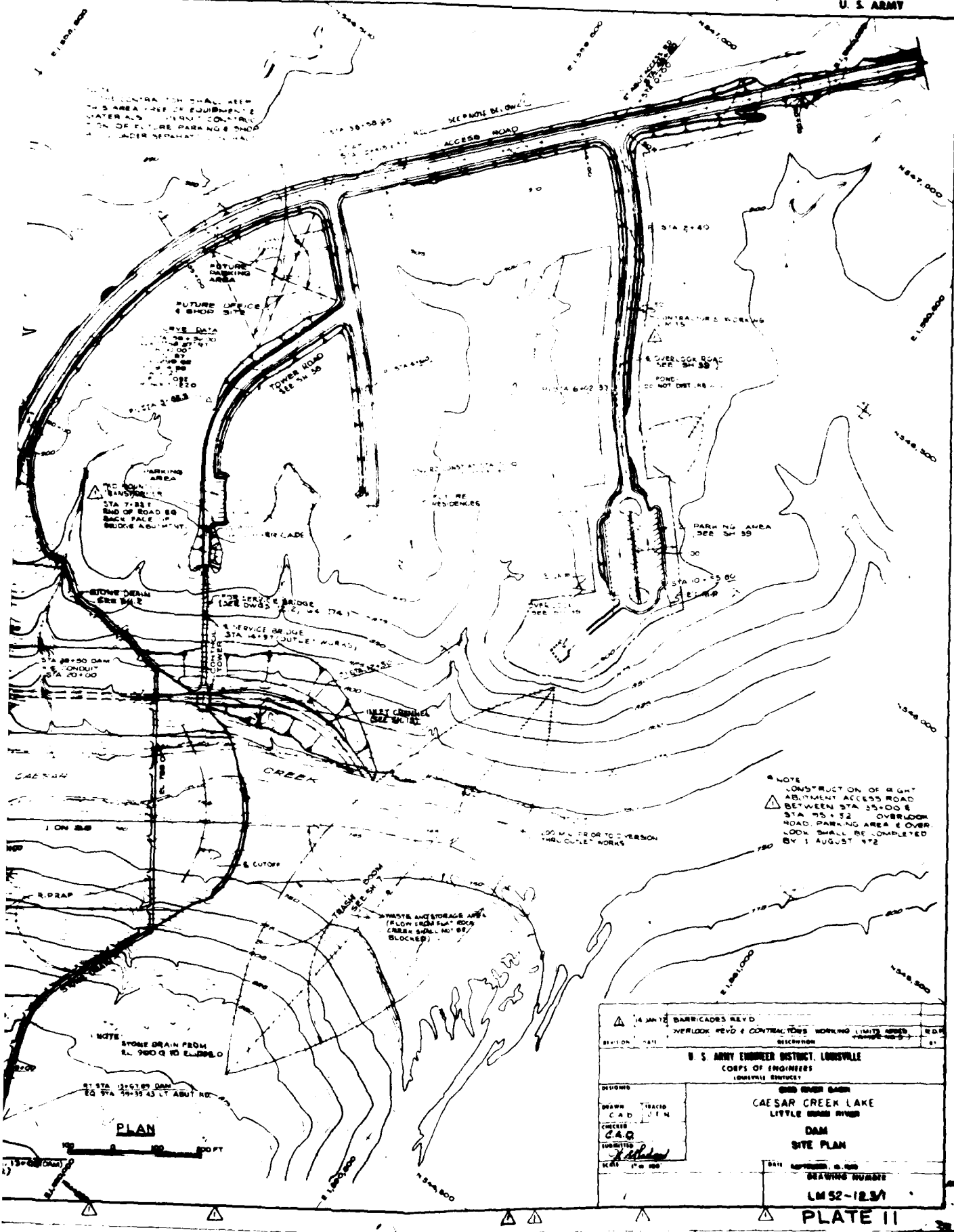




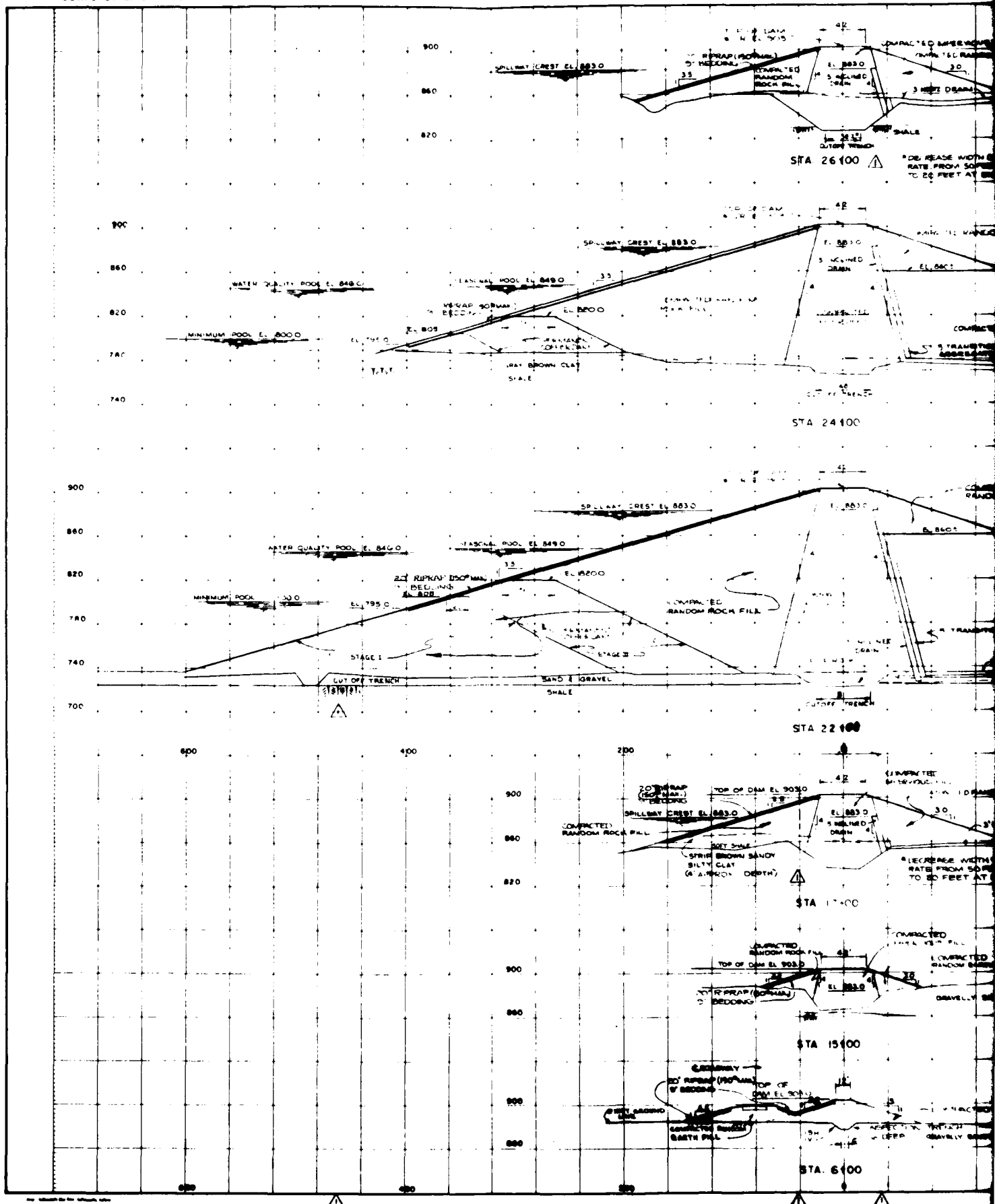
U. S. ARMY ENGINEER DISTRICT LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE DISTRICT

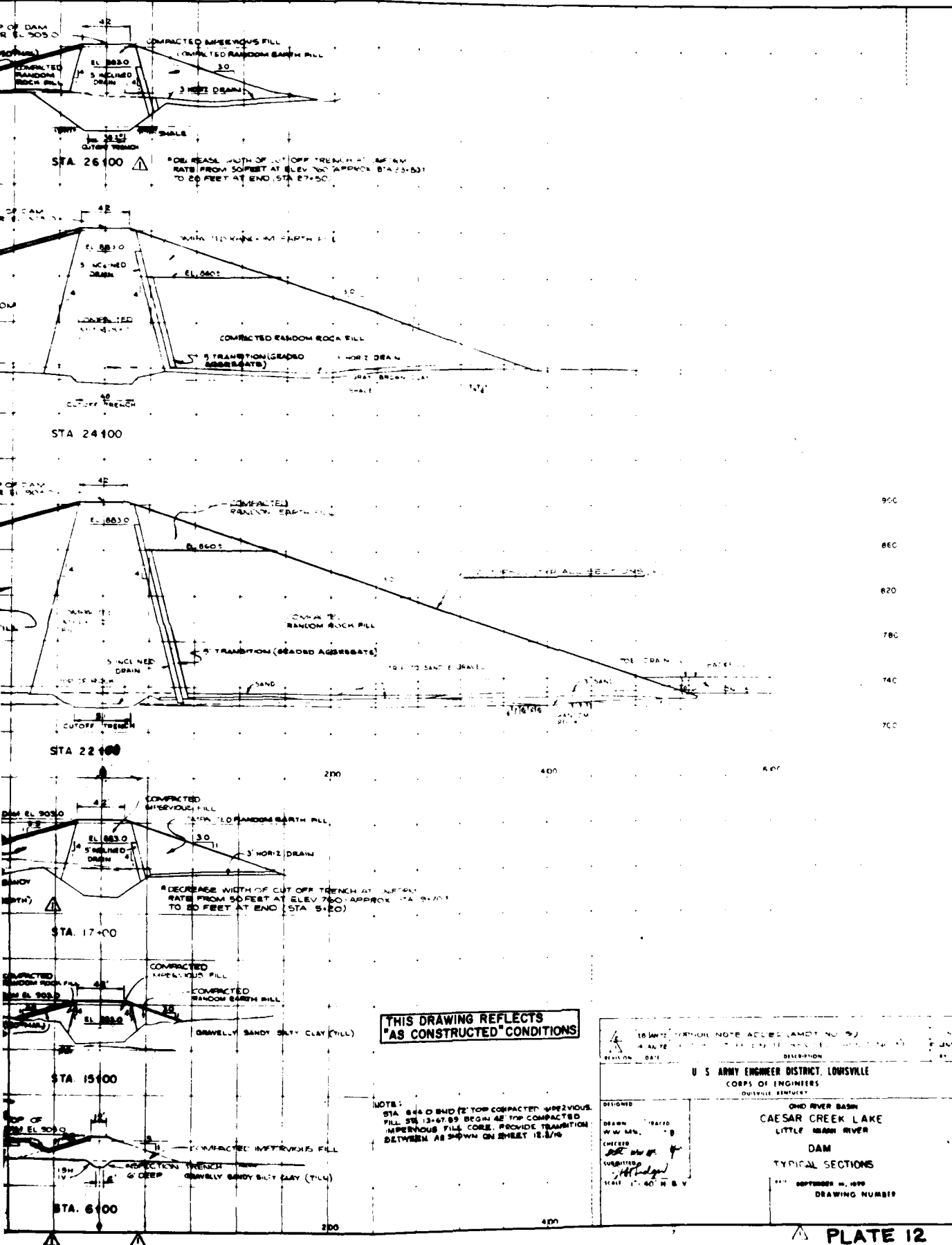
CAESAR CREEK RESERVOIR
FOUNDATION SOIL SECTIONS DAM

DRILLING NUMBER



CORPS OF ENGINEERS





100
T

200
T

300
T

400
T

Distance up from E. Dam (feet)

MATCH LINE - SUBSET 2

(735)

(737)

(785)

ROCK

(780)

ROCK FOUNDATION

(729)

N/S

N/S

N/S

(726)

N/S

(736)

(735)

SAND & GRAVEL

(731)

SAND & GRAVEL FOUNDATION

(531)

(535)

(731)

N/S

N/S

N/S

(728)

(727)

(725)

(720)

ROCK FOUNDATION

(780)

(780)

CLAY

(760)

CLAY

(770)

(780)

(770)

SPRINT

SPRINT

SPRINT

SPRINT

SPRINT

300
T
DANCE UP FROM E. DAM (POST)

400
T

500
T

600
T

S. Counter

-123+50

(785)

(781)

-123+00

(780)

ROCK FOUNDATION

(729)

(725)

(731)

SAND & GRAVEL FOUNDATION

(733)

SAND & GRAVEL

(725)

-122+00

UPSTREAM
7th or 8th

-121+00

(729)

(725)

ROCK FOUNDATION

(726)

(725)

-120+00

250000

CLAY

(779)

(780)

(780)

(780)

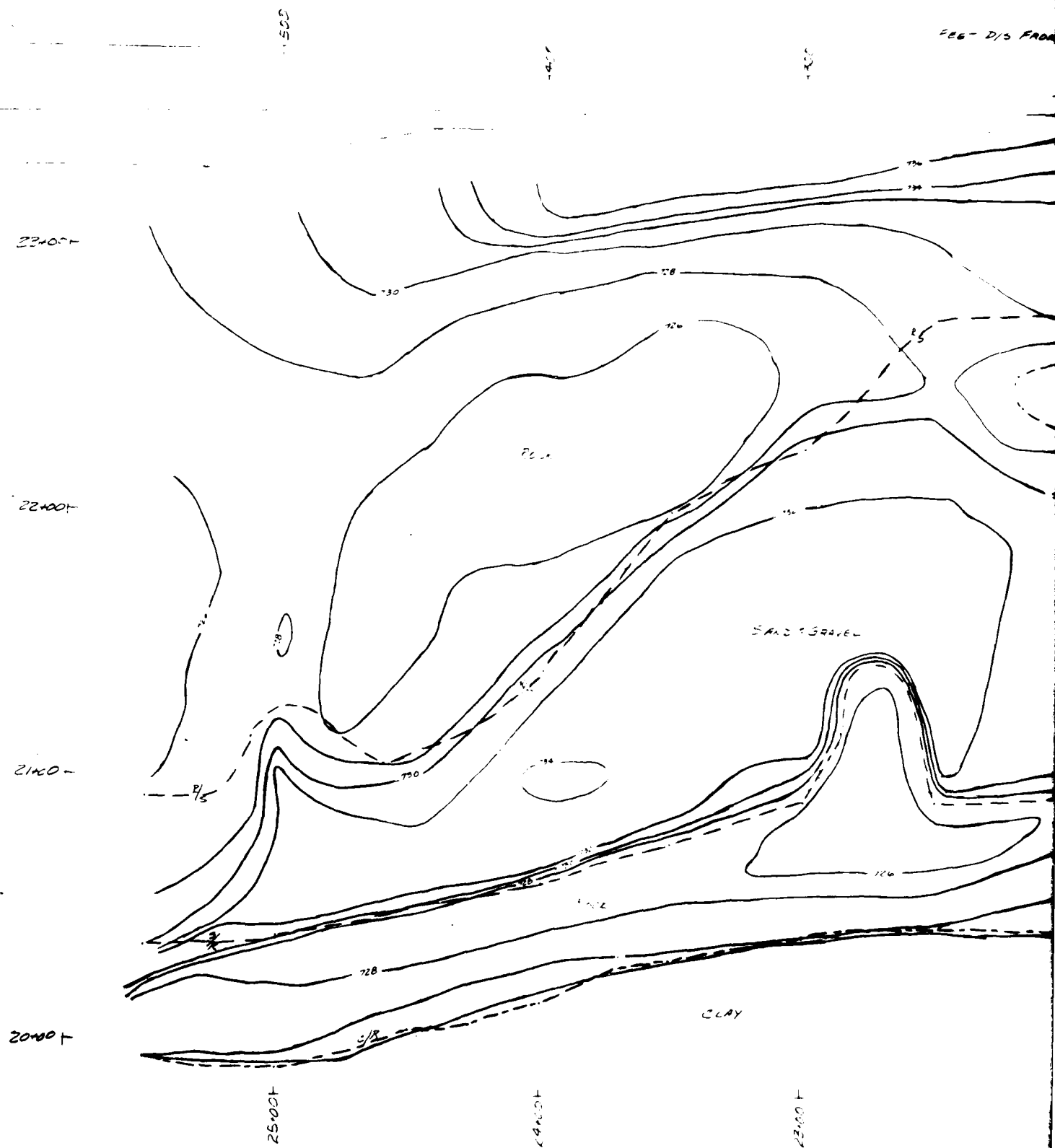
CASAR CREEK LAKE
UP VALLEY FOUNDATION
LEGEND
R/R Rock Sand Interface
C/R Clay Rock Interface
B/L Bottom of Lake or River Bed
(77) Ave. Elevation
Scale 1" = 100'

-119+00

150000

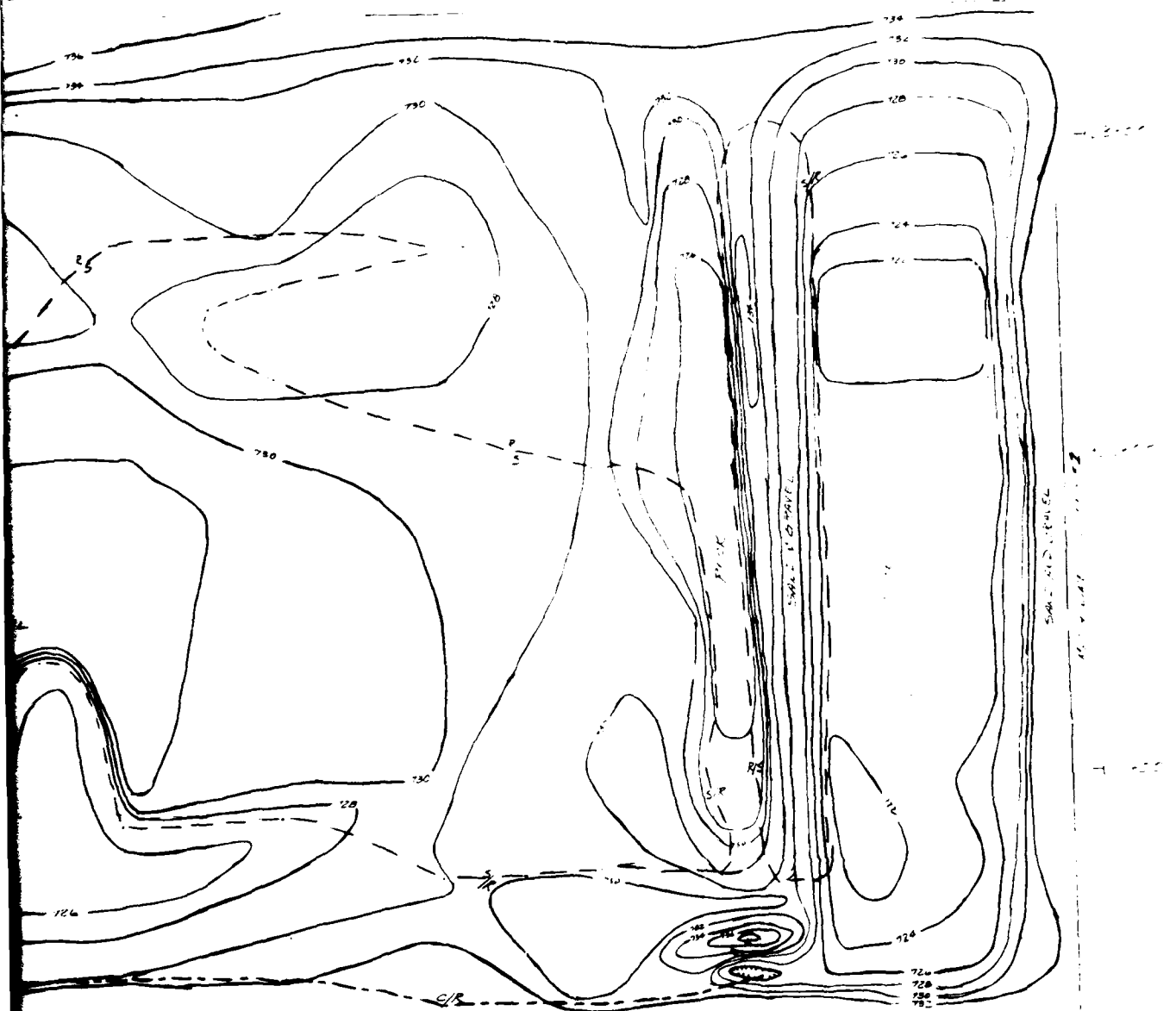
PLATE II

SEE D/S FROM



CONDUIT

285' D.D. FROM E. OF DAM

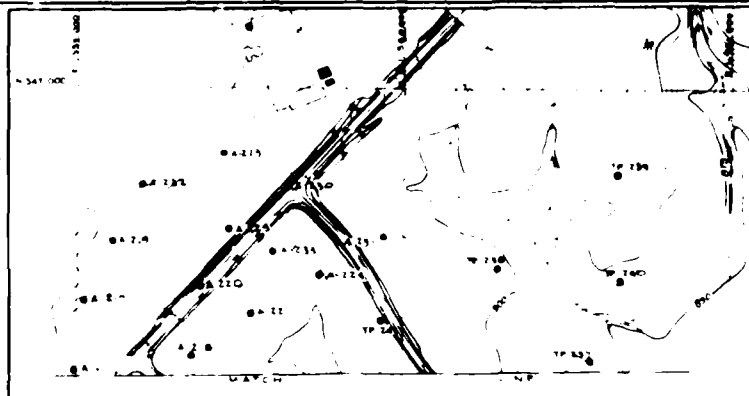


CONDUIT STATIONING

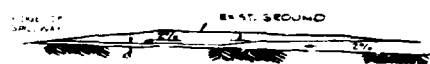
CASSADUN VALLEY
VALLEY FORMATION
LEGEND
P/S ROCK-SAND INTERFACE
C/P CLAY-ROCK CONTACT
0 10 20 30 40 50 60 70 80 90 100
SHEET 2
PLATE 13

PLATE 14





INSERT A



TYPICAL SECTION
BORROW AREA 2
NO SCALE

NOTE: BORROW AREA BORROWED FROM EDDY W. SLOPEWAY IN
TO OVERBURDEN WITH BAYS, USE REMAINS IN 1
3 OF OVERBURDEN WITH 100% OF DRAINAGE AND A
MIN. FREEBOARD AT THE SLOPEWAY WAS MAINTAINED
WHEAT TOPSOIL AT THE SLOPEWAY WAS MAINTAINED
WHEAT TOPSOIL AT THE SLOPEWAY WAS MAINTAINED
WHEAT TOPSOIL AT THE SLOPEWAY WAS MAINTAINED



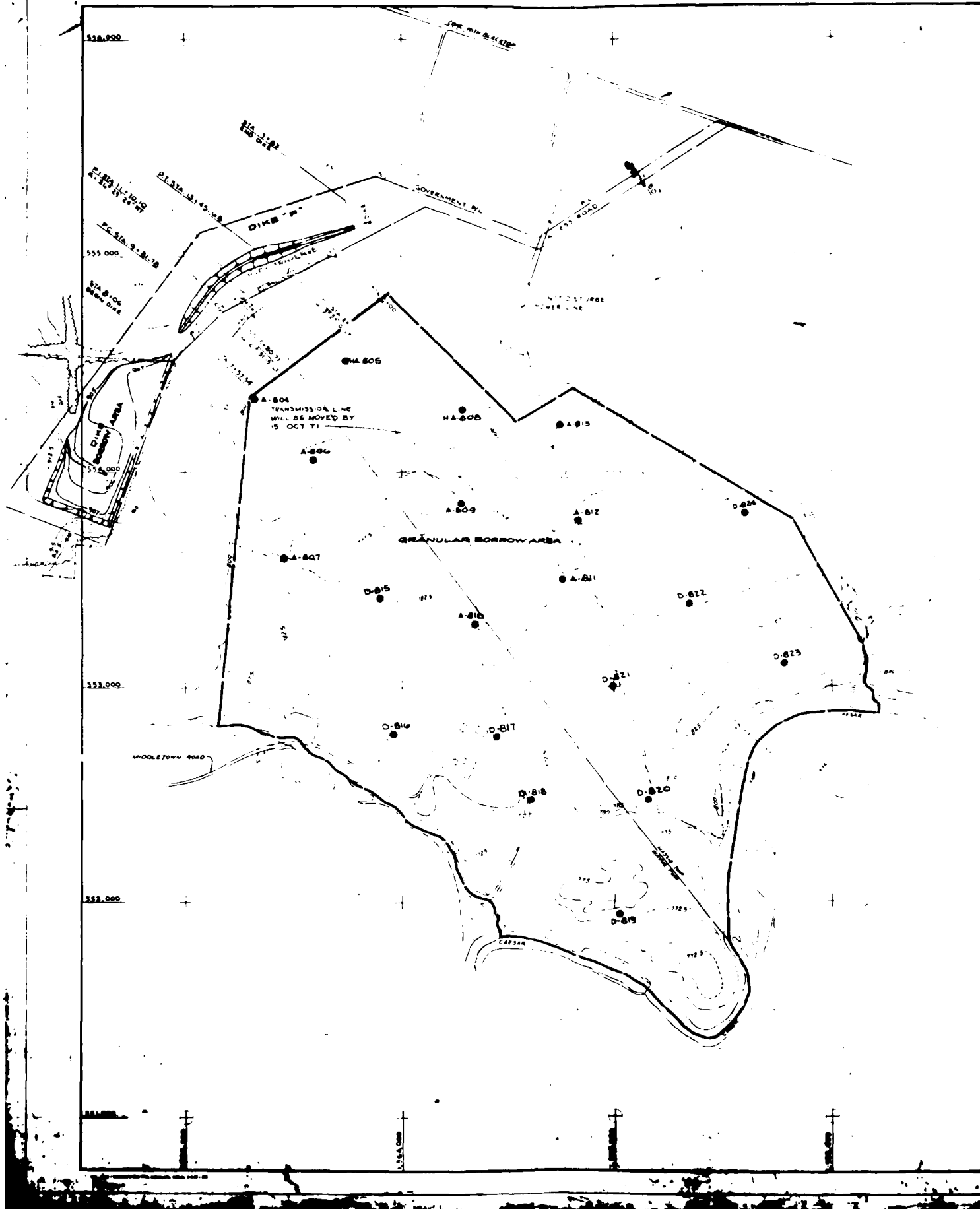
TYPICAL SECTION
BORROW AREA 1
NO SCALE

NOTE: BORROWED TO EDDY W. SLOPEWAY IN 1
TO OVERBURDEN WITH BAYS, USE REMAINS IN 1
3 OF OVERBURDEN WITH 100% OF DRAINAGE AND A
MIN. FREEBOARD AT THE SLOPEWAY WAS MAINTAINED
WHEAT TOPSOIL AT THE SLOPEWAY WAS MAINTAINED
WHEAT TOPSOIL AT THE SLOPEWAY WAS MAINTAINED

THIS DRAWING REFLECTS
"AS CONSTRUCTED" CONDITIONS

REVISION DATE DESCRIPTION	
U S ARMY ENGINEER DISTRICT LOUISVILLE CORPS OF ENGINEERS LOUISVILLE KENTUCKY	
DESIGNED W. W. M. E. DRAWN J. H. M. E. CHECKED J. H. M. E. APPROVED J. H. M. E.	OHIO RIVER BASIN CAESAR CREEK LAKE LITTLE MIAMI RIVER BORING LOCATION PLAN & BORROW AREAS
APPROVAL SIGNATURE	APPROVED DATE
APPROVED	APPROVED
SCALE	SCALE
DATE	DATE
LM 82-12.3/75	

CORPS OF ENGINEERS



NOTES

- 1 EXCAVATION BELOW EL 800 SHALL BE LEFT IN CONDITION TO BE SAFE FOR PEOPLE AND ANIMALS
- 2 EXCAVATION BETWEEN EL 800 AND EL 849 SHALL BE GRADED TO PRESENT A NEAT APPEARANCE AND DRAIN PROPERLY, WITH FINAL SLOPE NOT STEEPER THAN FOUR HORIZONTAL TO ONE VERTICAL (4:1)
- 3 HAUL ROAD BETWEEN EL 849 AND ACCESS SHOWN SHALL BE LOCATED TO AVOID TREES AND SHALL BE OBLITERATED UPON COMPLETION OF USE

DESIGNED	SHEET ADDED (AMDT NO 4)		E M
DRAWN	DATE	DESCRIPTION	BY
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE CORPS OF ENGINEERS LOUISVILLE, KENTUCKY			
DESIGNED	OHIO RIVER BASIN		
DRAWN	CAESAR CREEK RESERVOIR		
CHECKED	LITTLE MIAMI RIVER		
BY	DAM		
DATE	GRANULAR BORROW AREA		
APPROVAL	DATE	APPROVED	DATE
AND OTHER REVISIONS BY		FOR COPY OF REVISIONS	DATE
APPROVED		SCALE	DRAWING NUMBER
			LM 52-12 3/15

SCALE IN FEET

200 0 200 400

PLATE 16

EXCAVATION AND BORROW

	DAM	SPILLWAY	OUTLET WORKS	LFT. ABT ROAD	BORROW AREA 1
TOPSOIL	50,000	73,000	12,000	8,000	8,000
EARTH	170,900	398,800	39,000	31,000	—
WASTE	30,100	16,000	12,000	—	—
RANDOM ROCK	8,000	1,106,500	99,500	107,000	132,000
TOTAL	259,000	1,594,300	162,500	146,000	140,000

FILL QUANTITIES	2,295,915
RANDOM ROCK	1,598,000
IMPERVIOUS	450,000
RANDOM EARTH	112,000
GRANULAR BF	7,370
INC. DRAIN	19,500
HOR. DRAIN	37,750
GRADED AGG.	13,300
BEDDING	12,780
RIP-RAP	28,400
TOPSOIL	14,680
ROADWAY	2,135

* TOPSOIL ALSO USED TO RECLAIM BOR.

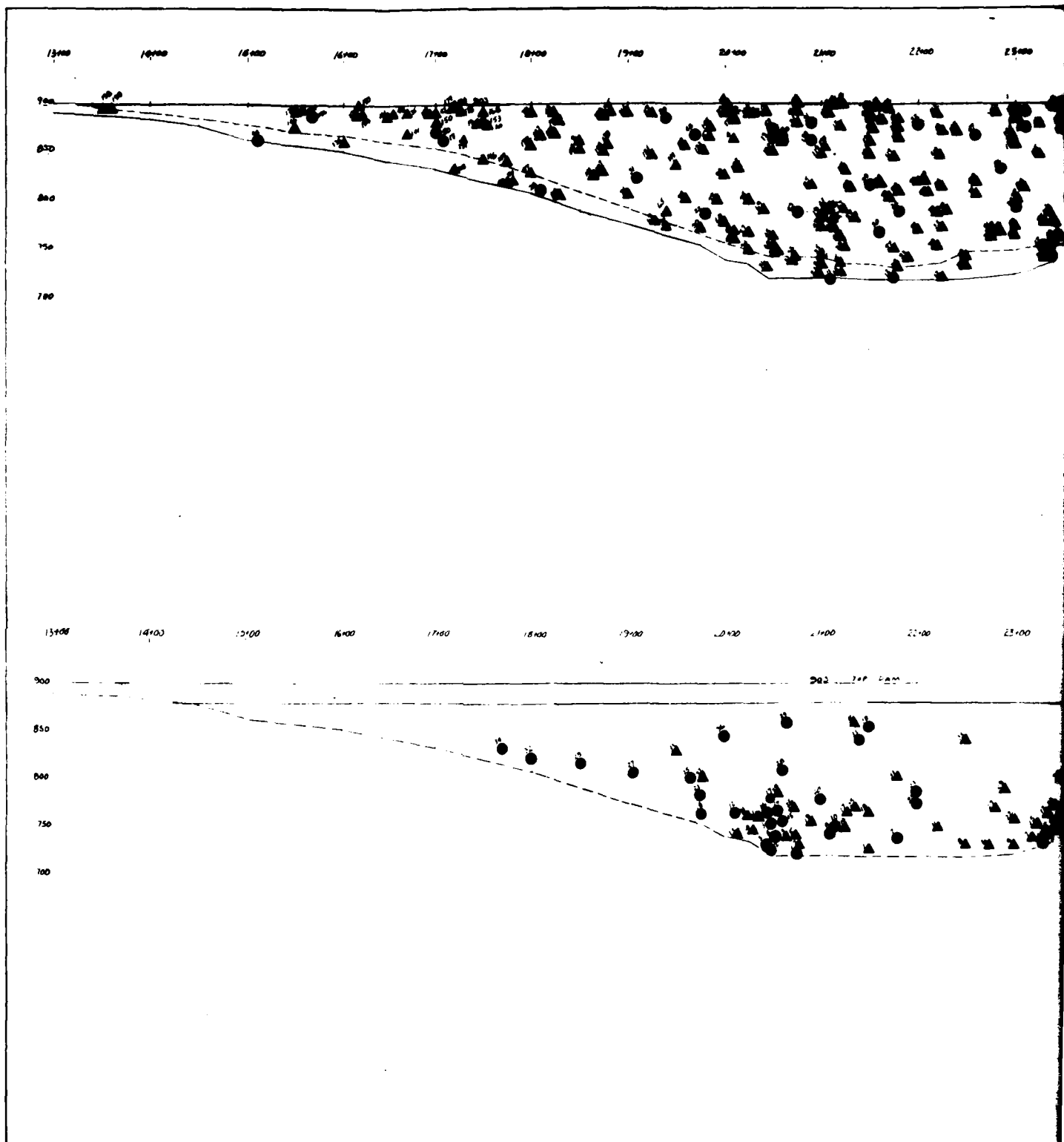
* WASTE INCLUDES MATERIAL USED IN AND UNSUITABLE MATERIAL DISPOSE DESIGNATED WASTE AREAS

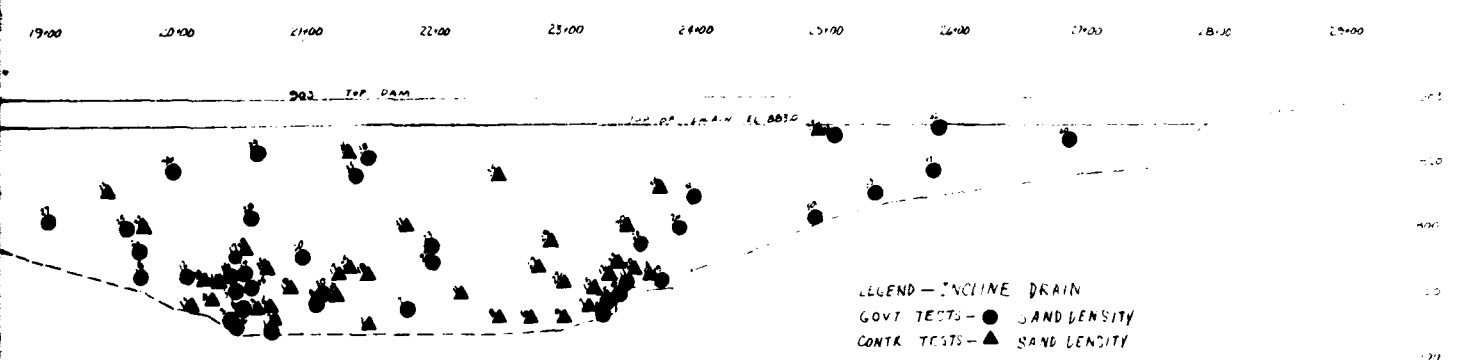
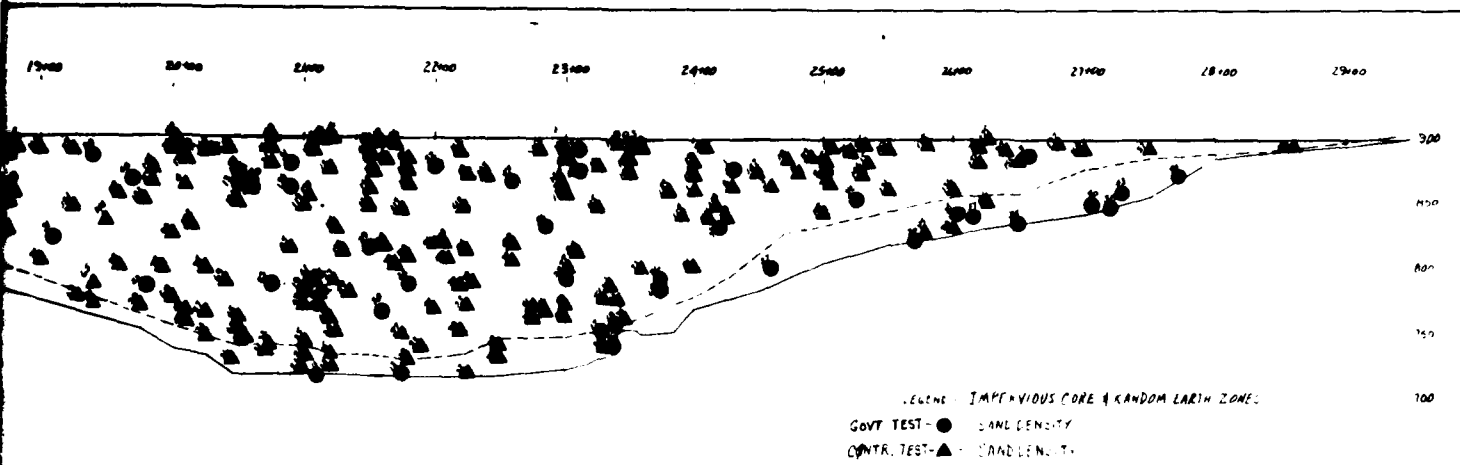
RROW

LFT. ABT ROAD	BORROW AREA 1	BORROW AREA 2	TOTAL	BALANCE FACTOR	ADJUSTED TOTAL
8,000	8,000	4,000	155,000 *	1.00	155,000
31,000	—	30,300	670,000	0.85	570,000
—	—	—	58,100 *	1.00	58,100
107,000	132,000	—	1,453,000	1.10	1,598,000
146,000	140,000	34,300			

USED TO RECLAIM BORROW AREAS
IDES MATERIAL USED IN HAUL ROADS
ABLE MATERIAL DISPOSED OF IN
WASTE AREAS

CAESAR CREEK LAKE
MATERIALS CHART
PLATE # 6





REVISION	DATE	DESCRIPTION	BY
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE CORPS OF ENGINEERS LOUISVILLE DISTRICT			
DESIGNED		CAESAR CREEK LAKE DENSITY TESTS IMPERVIOUS-RANDOM EARTH INCLINED DRAIN	
DRAWN	TRACED		
CHECKED			
SUBMITTED			
SCALE	DATE	DRAWING NUMBER	
		1 2	

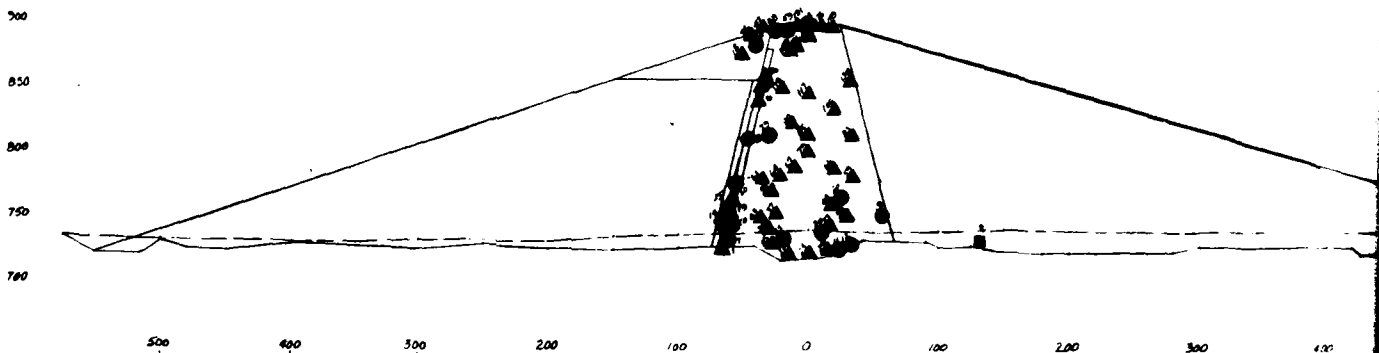
2



SAMPLE NUMBER AT
STATION 19+75 20+15 20+50 20+75

20+00

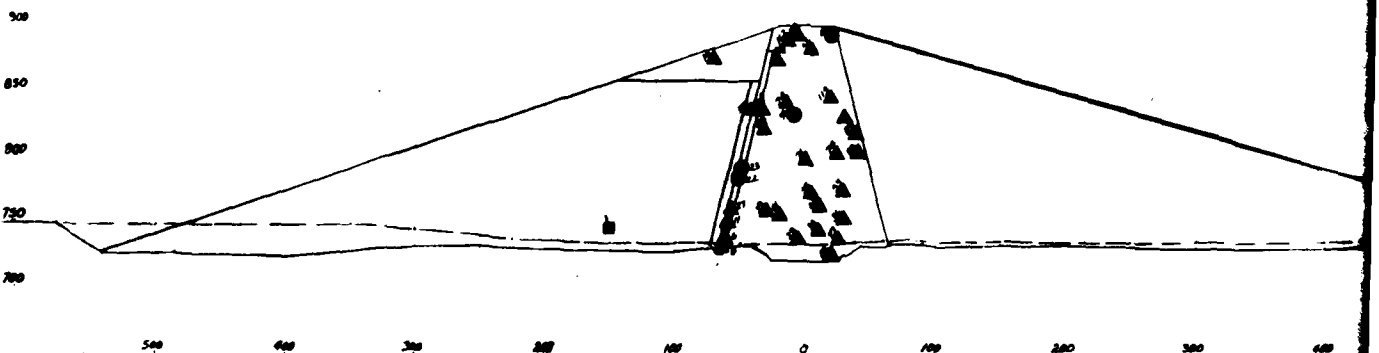
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22	44	5	23
48	57	13	31
50	78	26	32
122	160	40	46
145	15	42	51
18	21	49	159
27		67	150
32		81	121
		13	14
		13	14
		20	



SAMPLE NUMBER AT
STATION 20+25 21+50 21+75

21+00

11	8	15
15	20	24
15	28	24
15	48	28
18	45	35
44	55	37
35	85	47
64	90	75
106	67	83
130	185	77
109	191	149
152	1	186
15	18	
15	55	81
25	36	38



SAMPLE NUMBER AT
STATION 22+25 22+50 22+75

22+00

22	51	51
39	77	46
53	77	36
14	77	6
78	77	13
115	77	13
162	77	13
11	77	13



0 100 200 300 400 500

SAMPLE NUMBER AT

STATION	1917	2045	1970	2075
22	44	5	23	
48	57	13	31	
50	75	24	32	
122	140	40	51	
145	13	45	139	
18	21	49	190	
47		2, 8, 9	2, 120	
52		5, 40, 6	57	
		15, 8, 7		

20+00



0 100 200 300 400 500

SAMPLE NUMBER AT

STATION	2125	2150	2175
11	8	12	
15	20	24	
15	29	24	
25	48	26	
38	45	33	
44	53	37	
55	49	41	
64	50	79	
106	67	83	
126	195	117	
140	191	149	
152	1	186	
16	18	7	
19	33	37	
25	36		
	38		

21+00



0 100 200 300 400 500

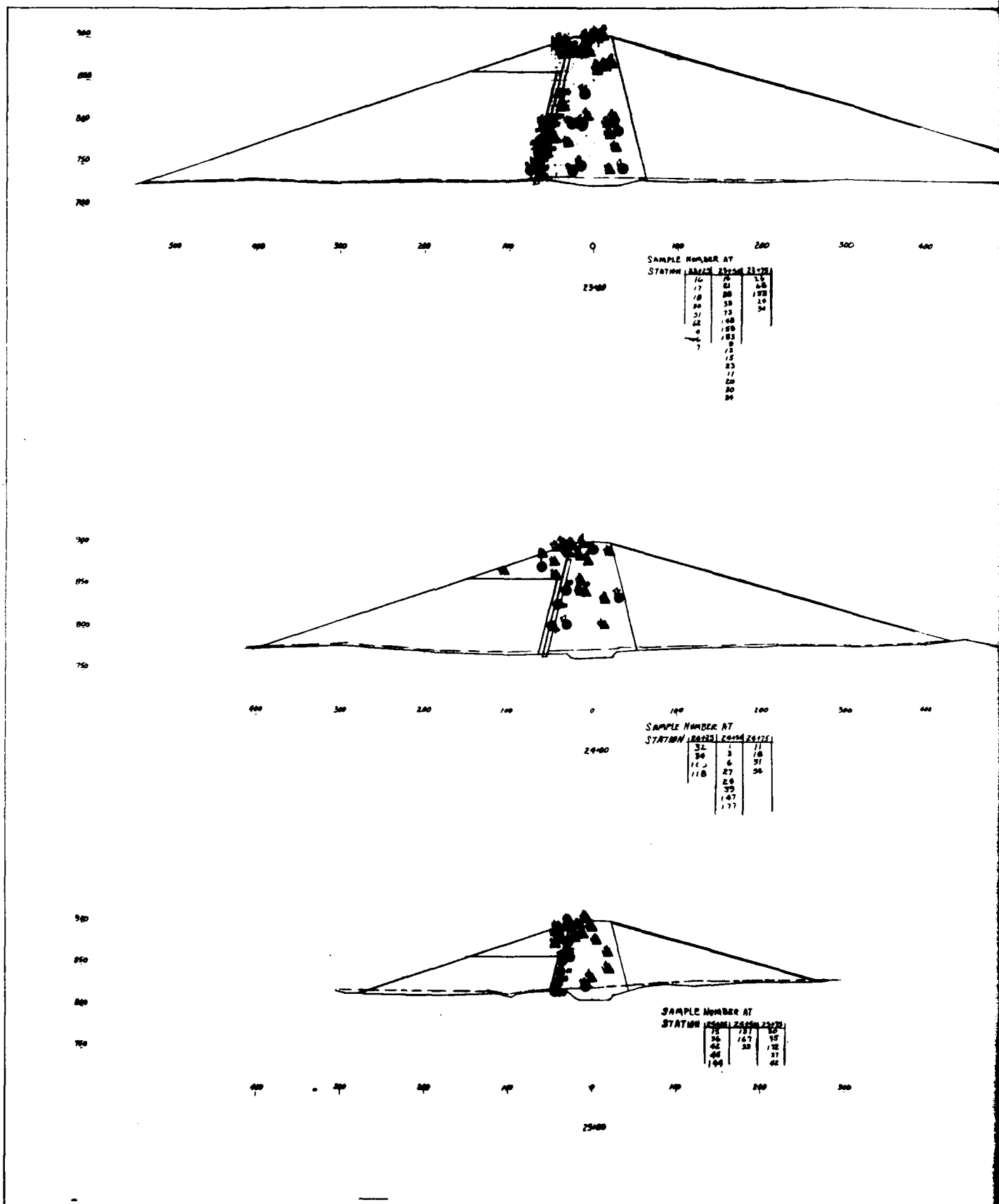
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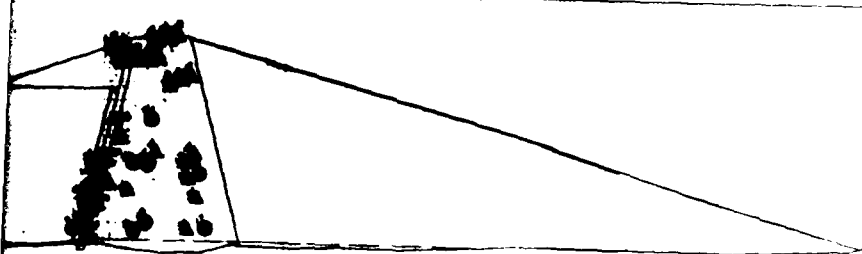
STATION	2275	2290	2275
22	21	37	
39	29	46	
53	77	56	
14	38	36	
74	40	63	
175	40	6	
162	190	47	
17	33		

22+00

REVISION	DATE	DESCRIPTION	BY
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE CORPS OF ENGINEERS LOUISVILLE OFFICE			
CAESAR CREEK LAKE DENSITY TESTS STA 20+00 - 22+75			
DRAWING NUMBER PLATE 9		DATE	

PLATE 19





9

SAMPLE NUMBER AT
STATION (80+25) 23+75

16	21	15
17	21	15
18	21	15
20	21	15
21	21	15
22	21	15
23	21	15
24	21	15
25	21	15
26	21	15
27	21	15
28	21	15
29	21	15
30	21	15
31	21	15
32	21	15
33	21	15
34	21	15
35	21	15
36	21	15
37	21	15
38	21	15
39	21	15
40	21	15
41	21	15
42	21	15
43	21	15
44	21	15
45	21	15
46	21	15
47	21	15
48	21	15
49	21	15
50	21	15
51	21	15
52	21	15
53	21	15
54	21	15
55	21	15
56	21	15
57	21	15
58	21	15
59	21	15
60	21	15
61	21	15
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68	21	15
69	21	15
70	21	15
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72	21	15
73	21	15
74	21	15
75	21	15
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77	21	15
78	21	15
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83	21	15
84	21	15
85	21	15
86	21	15
87	21	15
88	21	15
89	21	15
90	21	15
91	21	15
92	21	15
93	21	15
94	21	15
95	21	15
96	21	15
97	21	15
98	21	15
99	21	15
100	21	15

23+00



24+00

SAMPLE NUMBER AT
STATION (80+25) 24+75

32	1	11
34	3	10
100	6	31
110	27	26
	28	
	29	
	107	
	177	

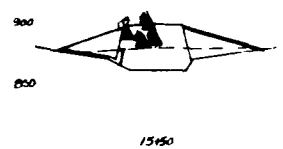
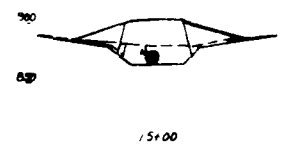
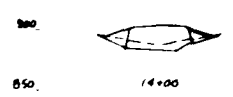
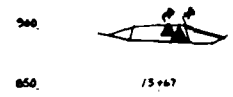
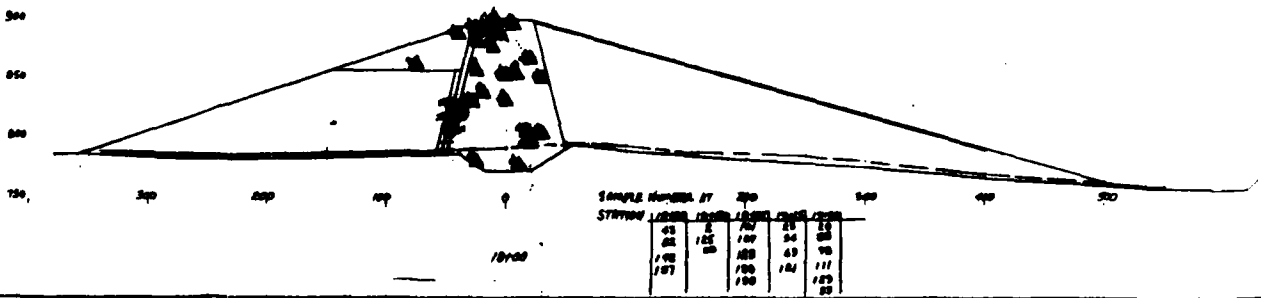
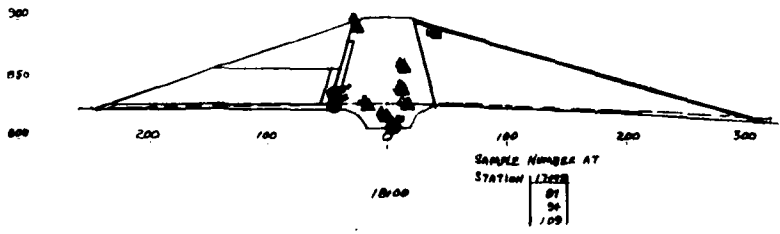
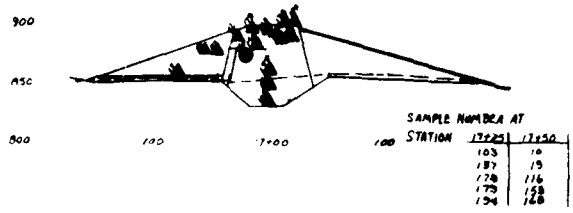
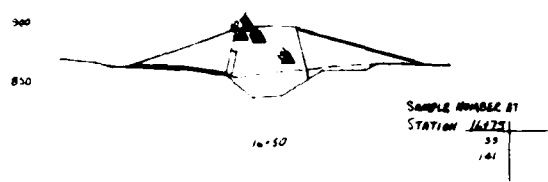
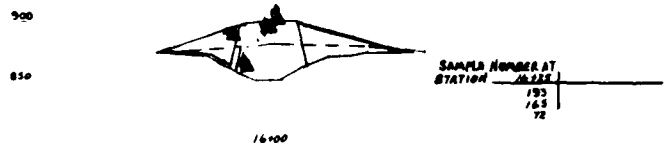


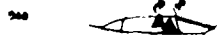
25+00

SAMPLE NUMBER AT
STATION (80+25) 25+75

15	167	15
26	30	12
42	30	12
46	30	12
100	30	12

STATION		DATE	DESCRIPTION	BY
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE				
CORPS OF ENGINEERS				
LOUISVILLE DISTRICT				
PROJECT		CAESAR CREEK LAKE		
SUBJECT		DENSITY TESTS		
STATION		STA 23+00-25+75		
SCALE		DRAWN BY		
		PLATE 10		





13+67



14+00



14+50



15+00



15+50



SAMPLE NUMBER AT

STATION 16+00

STATION	16+00	16+50	17+00
1	1	2	3
2	4	5	6
3	7	8	9
4	10	11	12



SAMPLE NUMBER AT

STATION 17+00

STATION	17+00	17+50	18+00
1	1	2	3
2	4	5	6
3	7	8	9
4	10	11	12



18+00



STATION AT

13+67

SAMPLE NUMBER AT	STATION	13+67	14+00	14+50	15+00	15+50
1	1	1	2	3	4	5
2	2	2	3	4	5	6
3	3	3	4	5	6	7
4	4	4	5	6	7	8

DESCRIPTION		ST
U. S. ARMY DISTRICT, LOUISVILLE		
CORPS OF ENGINEERS		
LOUISVILLE DISTRICT		
CAESAR CREEK LAKE		
DENSITY TEST		
STA 13+67-19+50		
STA 26+00-28+00		
SCALE	DATE	DRAWING NUMBER
		PLATE 11

PLATE 21

CONTRACTOR FIELD C

MATERIAL (ZONE)	NUMBER OF TESTS	DRY DENSITY				PERCENT COMP		
		HIGH	LOW	AVERAGE	DESIGN	HIGH	LOW	AVERAGE
IMPERVIOUS	199 *	128.5	90.3	108.6	105.6	111.3	92.4	101.6
RANDOM	11 **	133.1	93.7	110.3	108.7	108.7	87.9	98.5
PERVIOUS	37 ***	126.3	106.2	116.9	100.0	100.0	79.0	81.3

* OF THE 199 TESTS RUN ON THE IMPERVIOUS MATERIAL 73 TESTS FAILED. TESTS INDICATED THE MATERIAL WAS TOO DRY OF OPTIMUM, 4 TESTS AND 3 TESTS INDICATED THE MATERIAL WAS BOTH TOO WET OF OPTIMUM. THAT FAILED WERE REWORKED. THERE WERE 6 AREAS THAT WERE

THE 11 TESTS RUN ON THE RANDOM MATERIALS 3 TESTS FAILED. TEST INDICATED THE MATERIAL WAS BOTH TOO WET OF OPTIMUM. THAT FAILED WERE REWORKED; HOWEVER, NONE OF THE AREAS

*** OF THE 37 TESTS RUN ON THE PERVIOUS MATERIAL 22 TESTS FAILED (THE COMPACTION DESIRED). 10 OF THE TEST SECTIONS THAT FAILED AND ALL THESE TESTS WERE ACCEPTABLE.

CORPS OF ENGINEERS

MATERIAL (ZONE)	NUMBER OF TESTS	DRY DENSITY				PERCENT COMP		
		HIGH	LOW	AVERAGE	DESIGN	HIGH	LOW	AVERAGE
IMPERVIOUS	55 *	130.3	98.1	110.2	105.6	108.9	95.4	102.4
RANDOM	5 **	120.0	107.4	117.9	108.7	105.0	100.0	102.9
PERVIOUS	42 ***	126.8	111.5	118.4	100.0	100.0	78.0	85.2

* OF THE 55 TESTS RUN ON THE IMPERVIOUS MATERIAL 2 TESTS FAILED. BOTH OF THE TEST SECTIONS THAT FAILED WERE REWORKED. BOTH

** OF THE 5 TESTS RUN ON THE RANDOM MATERIALS 0 TESTS FAILED.

*** OF THE 42 TESTS RUN ON THE PERVIOUS MATERIAL 11 TESTS FAILED (THE COMPACTION DESIRED). ALL OF THE TEST SECTIONS THAT FAILED THE TESTS WERE ACCEPTABLE.

FIELD COMPACTION CONTROL - DAM

COMPACTION ① ③		WATER CONTENT ③				DEVIATION FROM OPTIMUM ③			
AVERAGE	DESIGN	HIGH	LOW	AVERAGE	DESIGN	HIGH	LOW	AVERAGE	SPECIFIED
91.6	95.0	25.2	11.4	18.1	20.2	+2.4	-2.7	-.06	-1.0 +1.0
98.5	95.0	24.3	12.1	15.4	20.2	+1.3	-1.0	-.13	-1.0 +1.0
81.3	80.0	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

FAILED (39 TESTS INDICATED THE MATERIAL WAS TOO WET OF OPTIMUM, 32 TESTS INDICATED THE MATERIAL WAS BELOW THE COMPACTION DESIRED OPTIMUM AND BELOW THE COMPACTION DESIRED). ALL OF THE TEST SECTIONS WERE RETESTED AND ALL THESE TESTS WERE ACCEPTABLE.

FAILED (2 TESTS INDICATED THE MATERIAL WAS TOO WET OF OPTIMUM AND OPTIMUM AND BELOW THE COMPACTION DESIRED). ALL OF THE TEST SECTIONS AREAS WERE RETESTED.

ITS FAILED (ALL OF THE TESTS INDICATED THE MATERIAL WAS BELOW OPTIMUM AND BELOW THE COMPACTION DESIRED). THERE WERE 7 AREAS THAT WERE RETESTED.

FIELD ACCEPTANCE TESTS - DAM

COMPACTION ① ③		WATER CONTENT ③				DEVIATION FROM OPTIMUM ③			
AVERAGE	DESIGN	HIGH	LOW	AVERAGE	DESIGN	HIGH	LOW	AVERAGE	SPECIFIED
92.4	95.0	24.3	11.0	17.9	20.2	+1.5	-1.0	-.25	-1.0 +1.0
92.9	95.0	17.7	13.5	15.4	20.2	+1.0	-0.7	+1.52	-1.0 +1.0
85.2	80.0	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ② N/A

FAILED (2 TESTS INDICATED THE MATERIAL WAS TOO WET OF OPTIMUM). BOTH AREAS WERE RETESTED AND THE TESTS WERE ACCEPTABLE.

FAILED.

IS FAILED (ALL OF THE TESTS INDICATED THE MATERIAL WAS BELOW OPTIMUM AND BELOW THE COMPACTION DESIRED). ALL AREAS WERE RETESTED AND

7

CONTRACTOR FIELD COM

MATERIAL (ZONE)	NUMBER OF TESTS	DRY DENSITY				PERCENT COMPAC		
		HIGH	LOW	AVERAGE	DESIGN	HIGH	LOW	AVERAGE
IMPERVIOUS AND RANDOM	581 *	149.7	96.2	118.4	105.6	110.7	91.4	100.6
PERVIOUS	16 **	121.0	107.9	112.9	109.0	100.1	78.0	98.8

* OF THE 581 TESTS RUN ON THE IMPERVIOUS AND RANDOM MAT WAS TOO WET OF OPTIMUM, 2 TESTS INDICATED THE MATERIAL WAS BELOW THE COMPACTION DESIRED AND 4 TESTS INDICATE BELOW THE COMPACTION DESIRED). ALL OF THE TEST SECTIONS THAT WERE RETESTED AND ALL THESE TESTS WERE ACCEPTABLE

** OF THE 16 TESTS RUN ON THE PERVIOUS MATERIAL 4 TESTS FAIL THE COMPACTION DESIRED). ALL OF THE TEST SECTIONS THAT THE TESTS WERE ACCEPTABLE.

CORPS OF ENGINEERS ACC

MATERIAL (ZONE)	NUMBER OF TESTS	DRY DENSITY				PERCENT COMPAC		
		HIGH	LOW	AVERAGE	DESIGN	HIGH	LOW	AVERAGE
IMPERVIOUS AND RANDOM	34 *	129.0	98.8	112.3	105.6	102.4	95.0	97.8
PERVIOUS	18 **	126.0	108.1	113.1	109.0	100.0	84.0	95.1

* OF THE 34 TESTS RUN ON THE IMPERVIOUS AND RANDOM MATERIAL

** OF THE 18 TESTS RUN ON THE PERVIOUS MATERIAL 0 TESTS FAIL

- ① STANDARD PROCTOR TEST USED ON THE IMPERVIOUS AND RANDOM MA
- ② NOT APPLKABLE - NO MOISTURE CONTROL SPECIFIED
- ③ INDICATE RESULTS OF ALL TESTS FOR HIGH AND LOW VALUES AND IN

COMPACTION CONTROL - DIKES

IMPACTION ① ③		WATER CONTENT ③				DEVIATION FROM OPTIMUM ③			
AVERAGE	DESIGN	HIGH	LOW	AVERAGE	DESIGN	HIGH	LOW	AVERAGE	SPECIFIED
100.6	95.0	24.0	4.5	13.1	20.2	+2.2	-2.3	-0.3	-2.0 +2.0
108.8	80.0	N/A ^②	N/A ^③	N/A ^③	N/A ^②	N/A ^③	N/A ^②	N/A ^②	N/A ^② N/A

MATERIAL 22 TESTS FAILED (12 TESTS INDICATED THE MATERIAL WAS TOO DRY OF OPTIMUM, 4 TESTS INDICATED THE MATERIAL WAS BOTH TOO WET OF OPTIMUM AND 6 TESTS THAT FAILED WERE REWORKED. THERE WERE 16 AREAS REWORKED.

5 FAILED (ALL OF THE TESTS INDICATED THE MATERIAL WAS BELOW
THAT FAILED WERE REWORKED. ALL AREAS WERE RETESTED AND

5 ACCEPTANCE TESTS - DIKES

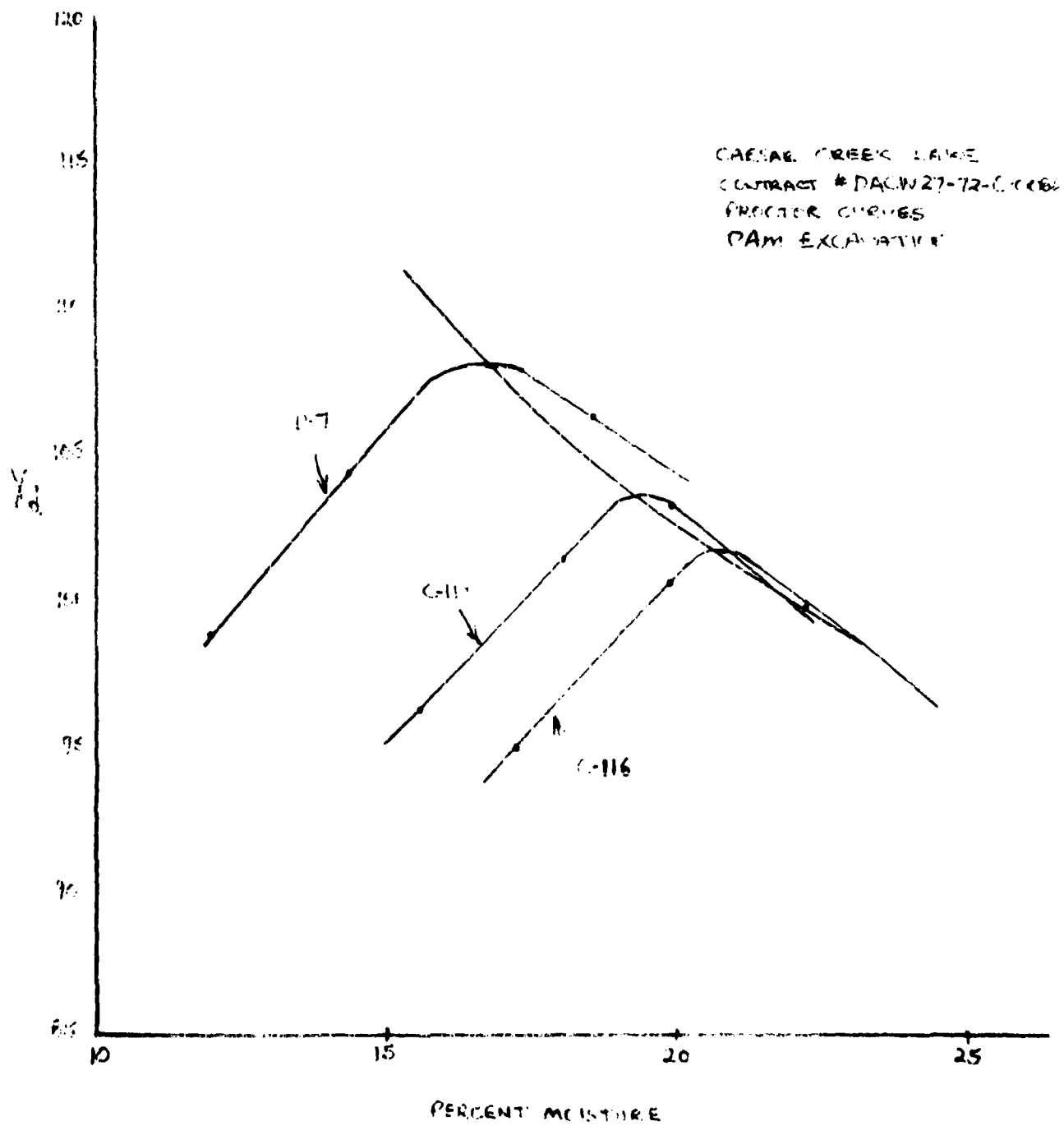
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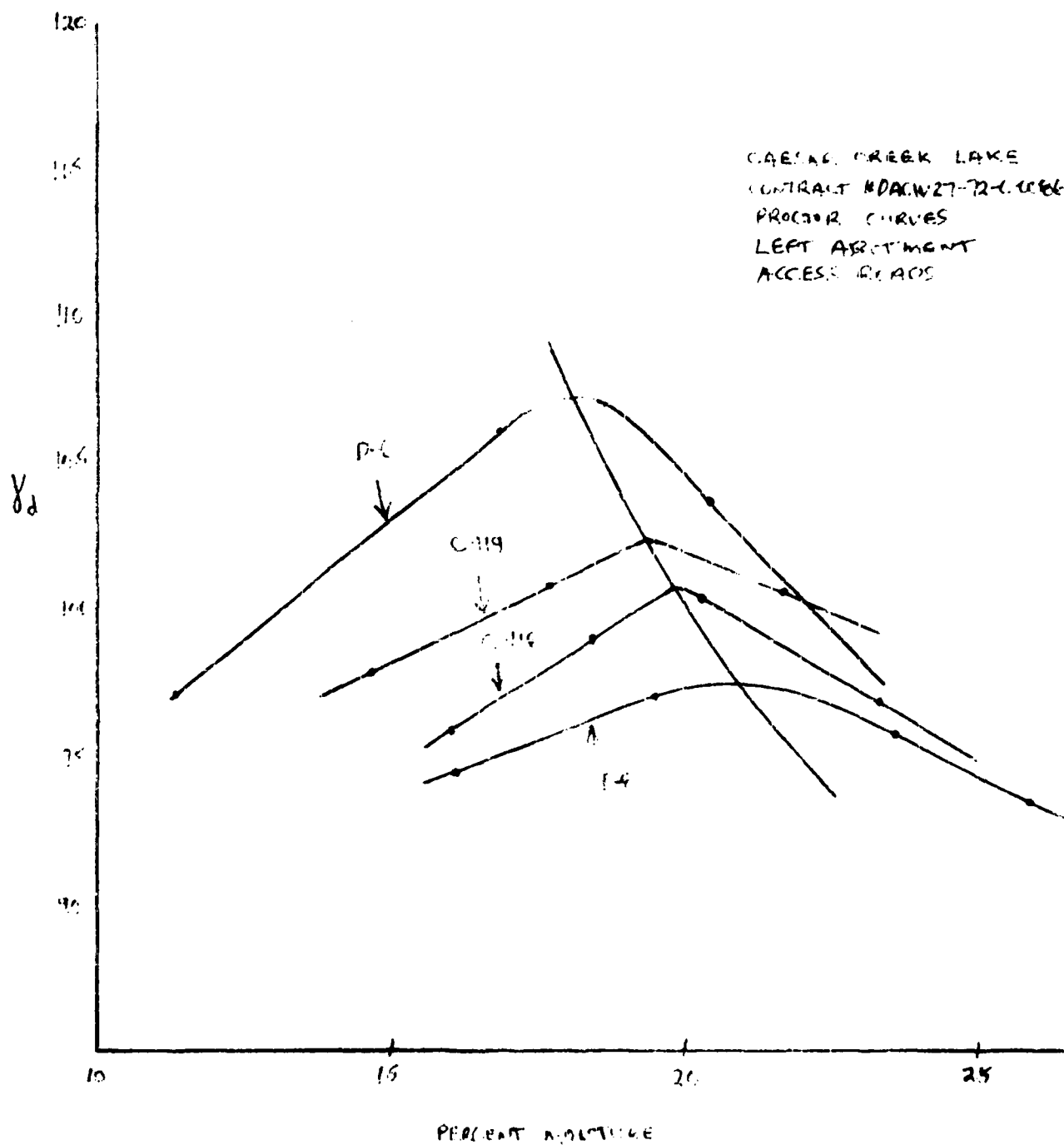
SERIAL 0 TESTS FAILED.

FAILED.

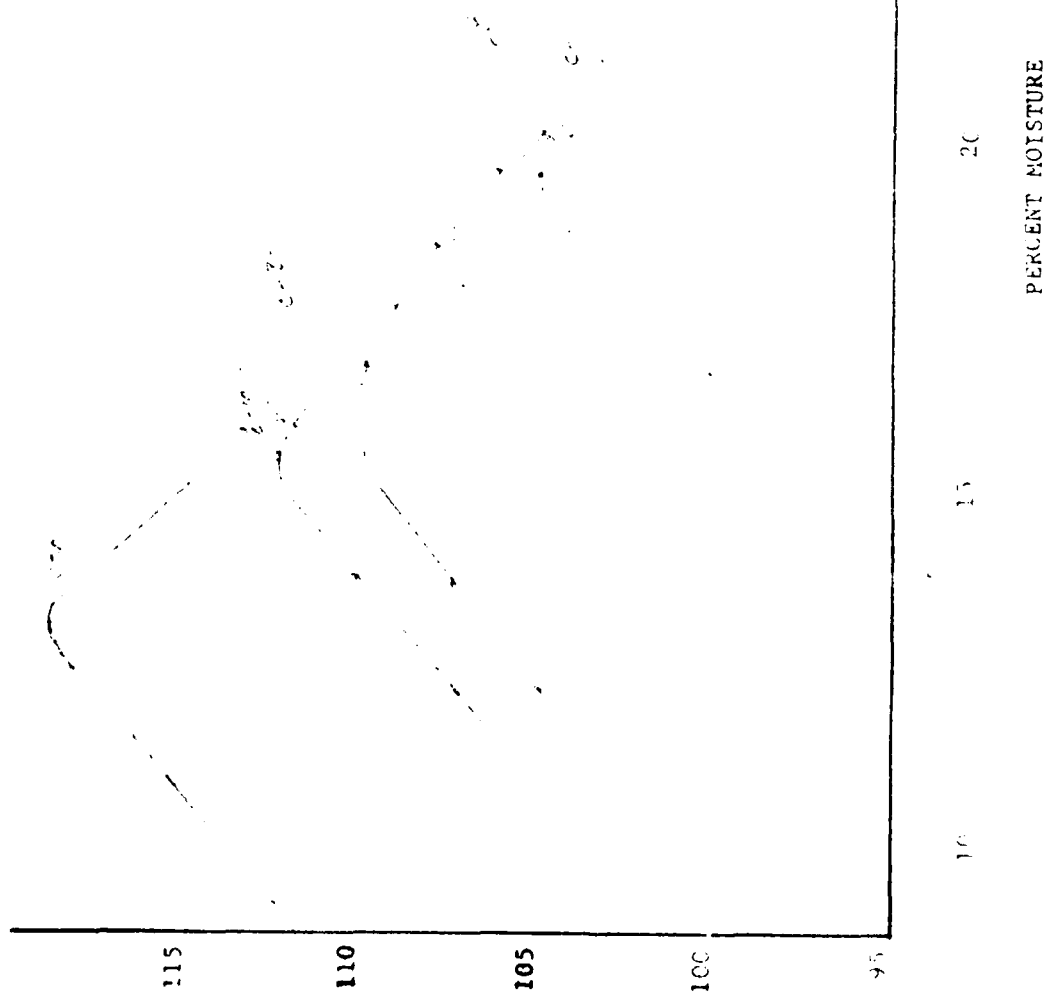
IN MATERIAL, RELATIVE DENSITY TEST USED ON THE PERVIOUS MATERIAL.

10 INDICATE RESULTS OF ACCEPTABLE TESTS AND RETESTS FOR AVERAGE VALUES

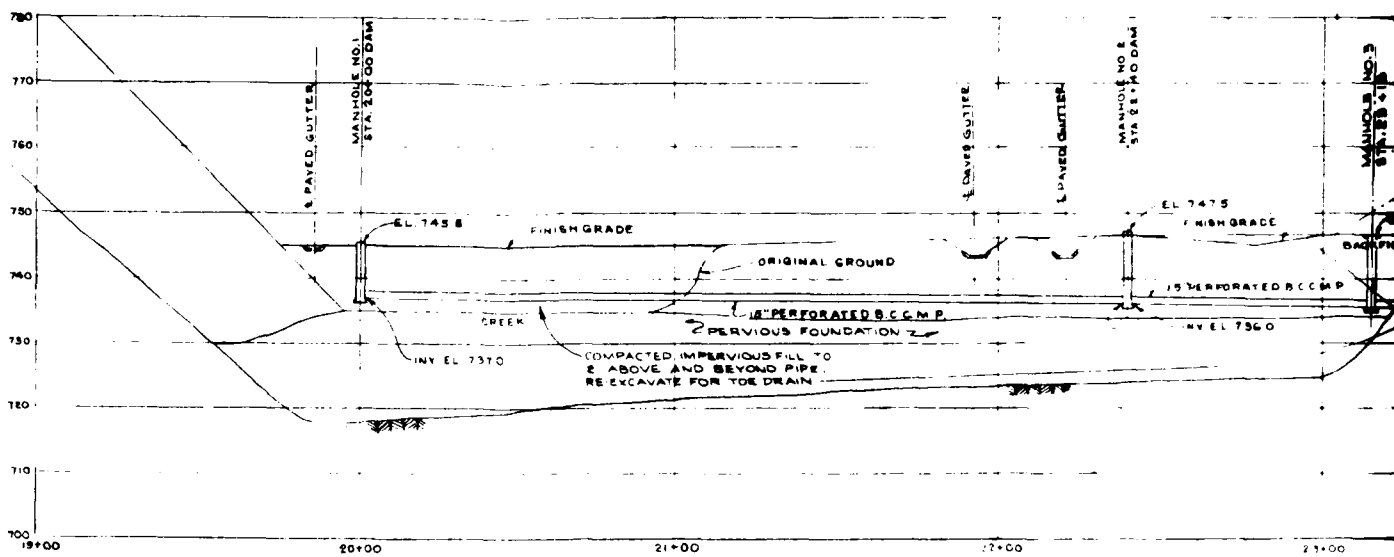




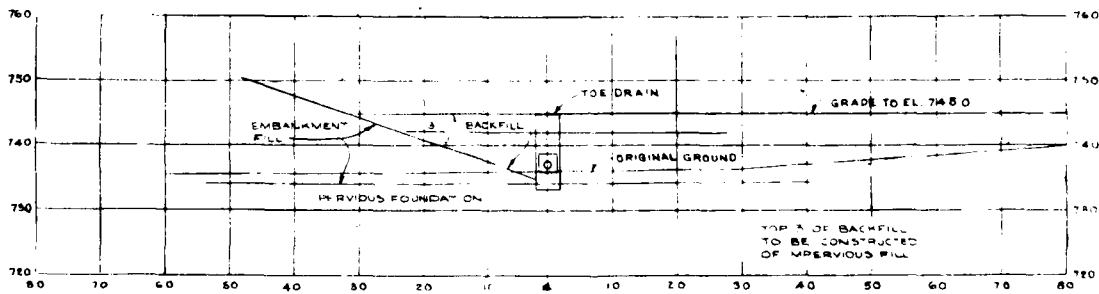
CAESAR CREEK LAKE
 CONTRACT #DACW27-72-C-0086
 PROCTOR CURVES
 SPILLWAY EXCAV.



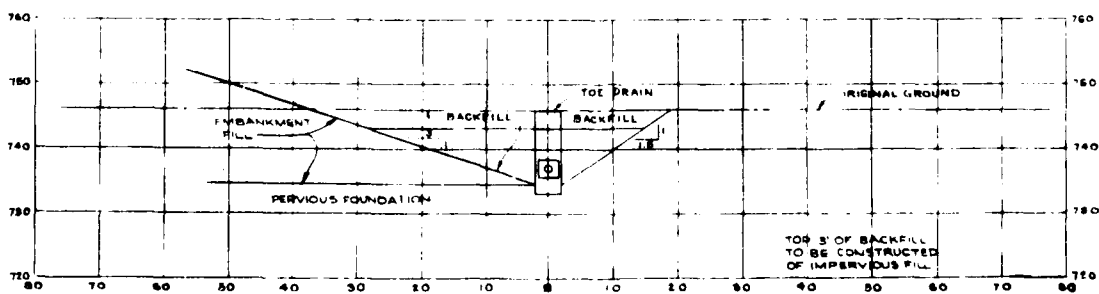
CORPS OF ENGINEERS



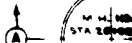
PROFILE TOE DRAIN 520' DOWNSTREAM



STA 21+00
520' DOWNSTREAM
SECTION ALONG TOE DRAIN



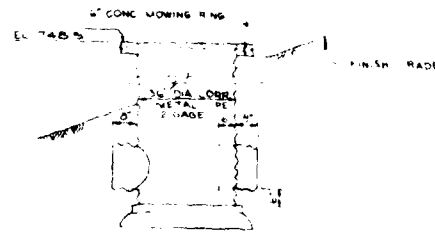
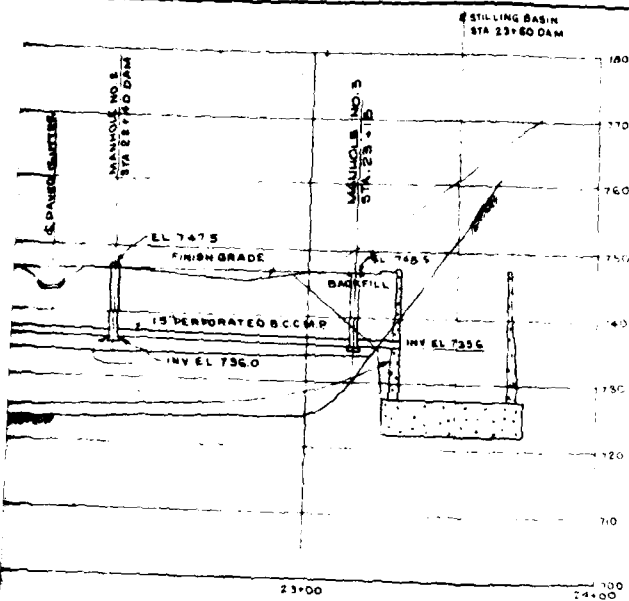
STA 21+75
520' DOWNSTREAM
SECTION ALONG TOE DRAIN



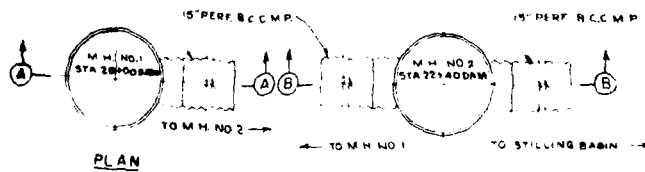
PLAN

SECTION

MANHOLE NO. 1
SCALE: 1" = 20'

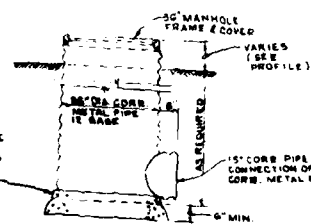


MANHOLE NO. 3
SAME AS M.H. NO. 1
EXCEPT AS SHOWN



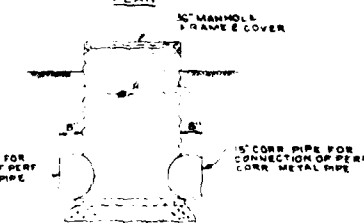
PLAN

PLAN



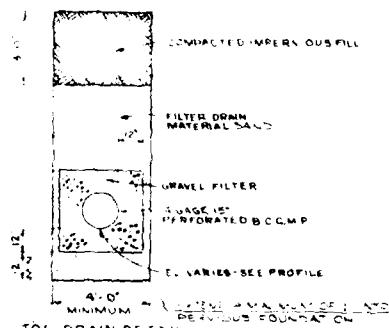
SECTION A-A

MANHOLE NO. 1 - 36" PIPE
SCALE: 1/4" = 1'-0"



SECTION B-B

MANHOLE NO. 2 - 36" PIPE
SCALE: 1/4" = 1'-0"



TOE DRAIN DETAIL
STA 20+00 TO 23+00
NOT TO SCALE

NOTE: THE DRAIN MAY BE CON-
STRUCTED EITHER BY SHEET
PIPING OR OPEN CUT, HOWEVER
IT MUST HAVE THE MINIMUM
SECTION AS SHOWN.

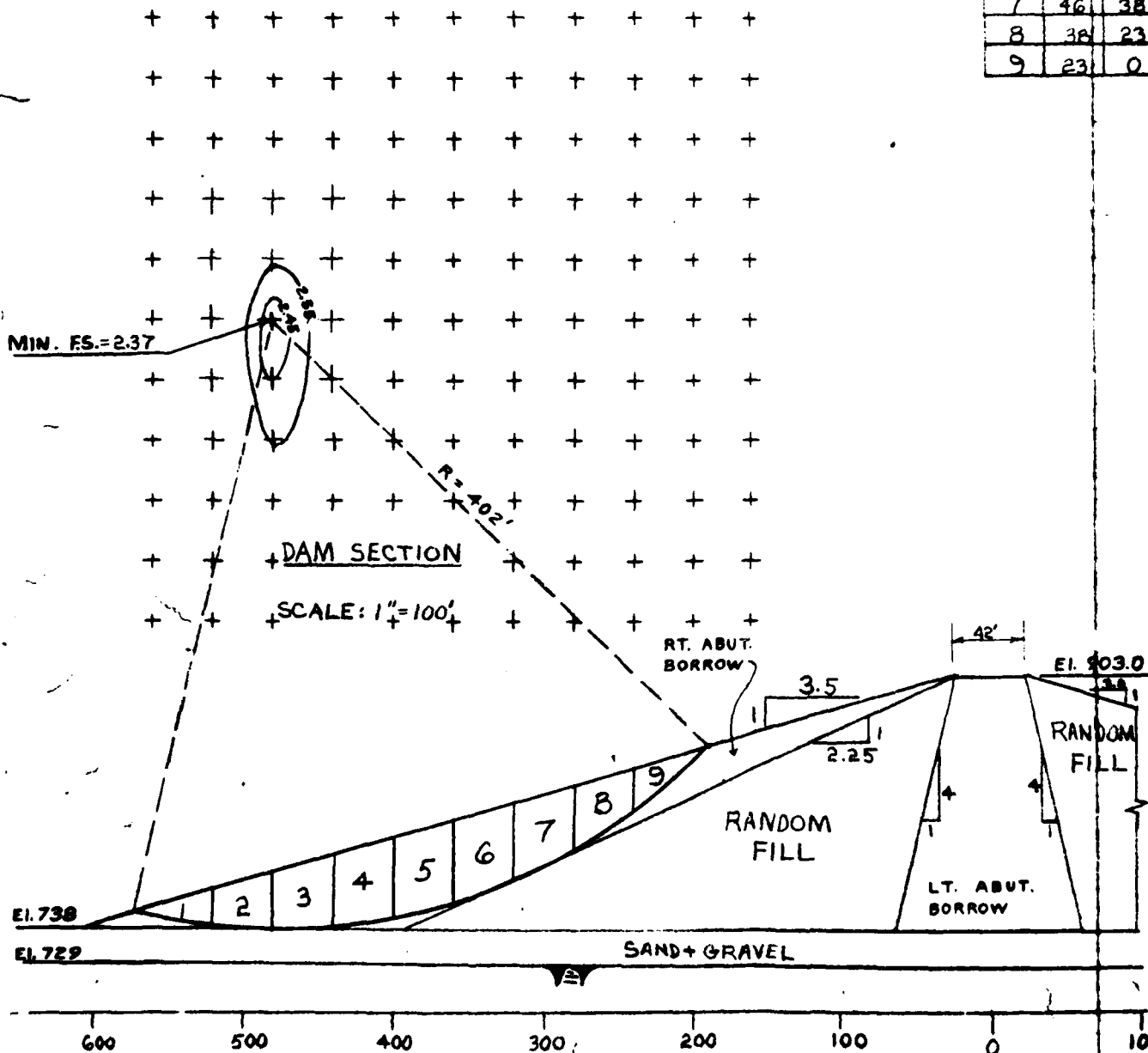
REVISION	DATE	DESCRIPTION	BY
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE CORPS OF ENGINEERS (LOUISVILLE DISTRICT)			
DESIGNED W. W. MC E. P. S. CHECKED SUBMITTED SCALE	TRACED E. P. S. DATE	OHIO RIVER BASIN CAESAR CREEK LAKE LITTLE MIAMI RIVER DAM DOWNSTREAM TOE DRAINAGE SYSTEM	
DRAWING NUMBER LM 92-1224		DATE	

CHKD. BY _____ DATE _____

JOB NO. _____

ADOPTED DESIGN VALUES						
MATERIAL	Y (PCF)			*Q* STRENGTH		
	MOIST	SAT	SUB	TAN ϕ	ϕ °	C" (TSF)
RT. ABUT. BORROW	132.5	134.6	72.2	0.130	7.4	1.00
LT. ABUT. BORROW	127.0	129.0	66.6	0.071	4.0	1.13
RANDOM FILL	135.0	140.0	77.6	0.368	20.2	1.05

SLICE NO.	HT. LT. SIDE (FT)	HT. RT. SIDE (FT)
1	0	20
2	20	34
3	34	43
4	43	48
5	48	50
6	50	46
7	46	38
8	38	23
9	23	0



MANUAL COMPUTATION FOR CRITICAL CIRCLE

MT. RT. SIDE (FT)	AVG. HT. (FT)	WIDTH (FT)	AREA (FT ²)	$\bar{X}$ (FT)	$\sin \theta$ $\bar{X}/R$	$\cos \theta$	NORMAL FORCE					COHESION			TANGENTIAL FORCE		
							γ_{EFF} (PCF)	W_{EFF} (KIPS)	N_{EFF} (KIPS)	$\tan \phi$	$N_{EFF} \tan \phi$ (KIPS)	ARC LENGTH (FT)	C (KSF)	CL (KIPS)	γ_T (PCF)	W_T (KIPS)	T (KIPS)
20	10.0	43.0	430.0	-54.3	-.135	.991	132.5	57.0	56.5	.130	7.3	44.0	2.00	88.0	132.5	57.0	-7.7
34	27.0	40.0	1080.0	-18.2	-.045	.999		143.1	143.0		18.6	40.0		80.0		143.1	-6.4
43	38.5		1540.0	20.8	.052	.999		204.1	203.9		26.5	40.5		81.0		204.1	10.6
48	45.5		1820.0	60.4	.150	.989		241.2	238.5		31.0	41.0		82.0		241.2	36.2
50	49.0		1960.0	100.0	.249	.969		259.7	251.6		32.7	41.5		83.0		259.7	64.7
46	48.0		1920.0	139.8	.348	.937		254.4	238.4		31.0	43.0		86.0		254.4	88.5
38	42.0		1680.0	179.3	.446	.895		222.6	199.2		25.9	45.0		90.0		222.6	99.3
23	30.5	40.0	1220.0	218.1	.543	.840		161.7	135.8		17.7	48.0		96.0		161.7	87.8
0	11.5	39.0	448.5	253.0	.629	.777	132.5	59.4	46.1	.130	6.0	52.0	2.00	104.0	132.5	59.4	37.4
$\Sigma N_{EFF} \tan \phi = 196.7$											$\Sigma CL = 790.0$	$\Sigma T = 410.4$					

$$F.S. = \frac{\Sigma N_{EFF} \tan \phi + \Sigma CL}{\Sigma T} = \frac{196.7 + 790.0}{410.4} = \frac{986.7}{410.4} = 2.40 \sim 2.37$$

NOTES:

1. Slope stability computations made with I.B.M. 360 electronic computer using program No.41-K2-H203. The stability of the critical circle was checked with the manual computation shown.
2. A search by the computer showed the most critical type of failure to be an embankment failure tangent to the sand and gravel at elevation 738.
3. Centers of all base circles are shown along with "Factor of Safety Contours." The critical circle is shown on the embankment cross section.

CAESAR CREEK RES.

STABILITY ANALYSIS
FINITE SLICE METHOD
END OF CONSTRUCTION

P.L.N.

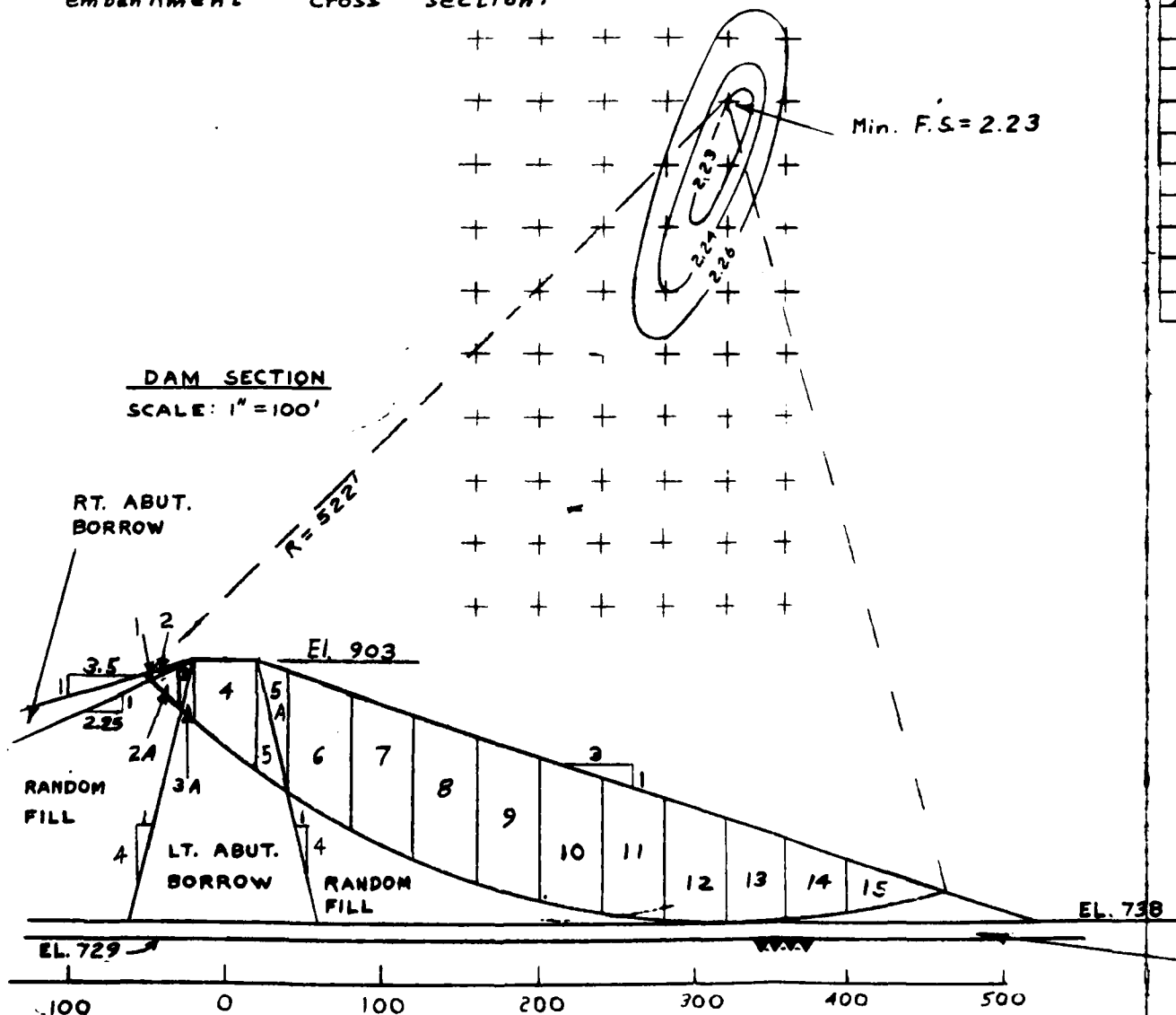
OCT. 1969

D.M. NO. 5

PLATE 28

NOTES:

1. Slope stability computations were made with an IBM 360 electronic computer using program No. 41-K2-H203. The stability of the critical circle was checked with the manual computation shown.
2. A search by the computer showed the most critical type of failure to be an embankment failure tangent to the sand and gravel at elevation 738.
3. Centers of base circles are shown along with "Factor of Safety Contours". The critical circle is shown on the embankment cross section.



MANUAL COMPUTATION FOR CRITICAL CIRCLE

SLICE NO.	HT. LT. SIDE (FT.)	HT. RT. SIDE (FT.)	AVG HT. (FT.)	WIDTH (FT.)	AREA (FT ²)	$\bar{X}$ (FT.)	SIN ϕ	COS ϕ	NORMAL FORCE				COHESION			TANGENTIAL FORCE			
									γ_{eff} (PCF)	W_{eff} (KIPS)	$W_{eff} \cos \phi$ (KIPS)	$TAN \phi$ (KIPS)	$N_{eff} TAN \phi$ (KIPS)	ARC LENGTH (FT.)	C (KSF)	CL (KIPS)	γT (PCF)	$W \sin \phi$ (KIPS)	$W \cos \phi$ (KIPS)
1	0	4	2.0	3.0	6.0	372.0	0.713	0.701	132.5	0.8	0.6	0.130	0.1	4.5	2.00	9.0	132.5	0.8	0.6
2	4	0	2.0	21.0	42.0	363.0	0.695	0.719	132.5	5.6	4.0						132.5	5.6	3.7
3A	0	28	14.0	21.0	294.0	356.0	0.682	0.731	135.0	39.7	27.0						135.0	39.7	27.1
3B											33.0	0.368	2.1	27.5	2.10	57.8			
4	28	0	14.0	8.0	112.0	346.7	0.663	0.749	135.0	12.1	11.3						135.0	15.1	10.2
5A	0	38	19.0	8.0	152.0	343.7	0.658	0.753	127.0	19.7	14.5						127.0	3.3	12.7
5B											25.8	0.071	1.8	120.2	2.26	22.6			
6	38	70	54.0	41.0	2214.0	318.5	0.610	0.792	127.0	281.2	222.7	0.071	15.3	53.0	2.26	119.9	127.0	281.2	17.5
7	70	0	35.0	22.0	770.0	292.7	0.561	0.828	127.0	97.3	91.0						127.0	97.3	54.9
8A	0	78	39.0	22.0	858.0	285.3	0.547	0.837	135.0	115.8	96.9						135.0	115.3	63.3
8B											177.9	0.071	12.6	26.0	2.26	59.5			
9	78	87	82.5	38.0	3135.0	258.7	0.496	0.868	135.0	423.2	367.3	0.368	135.2	44.0	2.10	92.4	135.0	423.2	209.2
10	87	92	89.5	40.0	3580.0	219.9	0.421	0.907	135.0	483.3	433.4	0.368	161.3	45.0	2.10	94.5	135.0	483.3	203.5
11	92	93	92.5	40.0	3700.0	180.0	0.345	0.939	135.0	499.5	469.0	0.368	172.6	43.0	2.10	90.2	135.0	499.5	172.3
12	93	91	92.0	40.0	3680.0	140.1	0.268	0.963	135.0	496.8	478.4	0.368	176.1	42.0	2.10	88.4	135.0	496.8	123.1
13	91	86	88.5	40.0	3540.0	100.2	0.192	0.981	135.0	477.9	468.0	0.368	172.5	41.0	2.10	86.1	135.0	477.9	91.8
14	86	77	81.5	40.0	3260.0	60.4	0.116	0.993	135.0	440.1	437.0	0.368	160.8	40.0	2.10	84.0	135.0	440.1	51.1
15	77	66	71.5	40.0	2860.0	20.5	0.039	0.999	135.0	386.1	385.7	0.368	141.9	40.0	2.10	84.0	135.0	386.1	15.1
16	66	50	58.0	40.0	2320.0	-19.1	-0.037	0.999	135.0	313.2	312.9	0.368	115.1	40.0	2.10	84.0	135.0	313.2	-11.6
17	50	33	41.5	40.0	1660.0	-58.6	-0.112	0.994	135.0	224.1	222.8	0.368	83.0	40.0	2.10	84.0	135.0	224.1	-25.5
18	33	0	16.5	60.0	990.0	-71.0	-0.136	0.991	135.0	133.7	132.5	0.368	48.8	60.0	2.10	125.0	135.0	133.7	-14.2
									Σ	1408.7				Σ	1181.5		Σ	1165.9	

$$F.S. = \frac{\Sigma N_{eff} TAN \phi + CL}{\Sigma T} = \frac{1408.7 + 1181.5}{1165.9} = 2.22$$

ADOPTED DESIGN VALUES					
MATERIAL	γ (PCF)			Q" STRENGTH	
	MOIST	SAT.	SUBM.	TAN ϕ	C (TSE)
RT. ABUT. BORROW	132.5	134.6	72.2	0.130	1.00
LT. ABUT. BORROW	127.0	129.0	66.6	0.071	1.13
RANDOM FILL	135.0	142.0	77.6	0.368	1.05

Sand & Gravel

2

CAESAR CREEK RESERVOIR
STABILITY ANALYSIS
FINITE SLICE METHOD
END OF CONSTRUCTION

GVF

OCT. 1969

D.M. NO. 5

PLATE 28

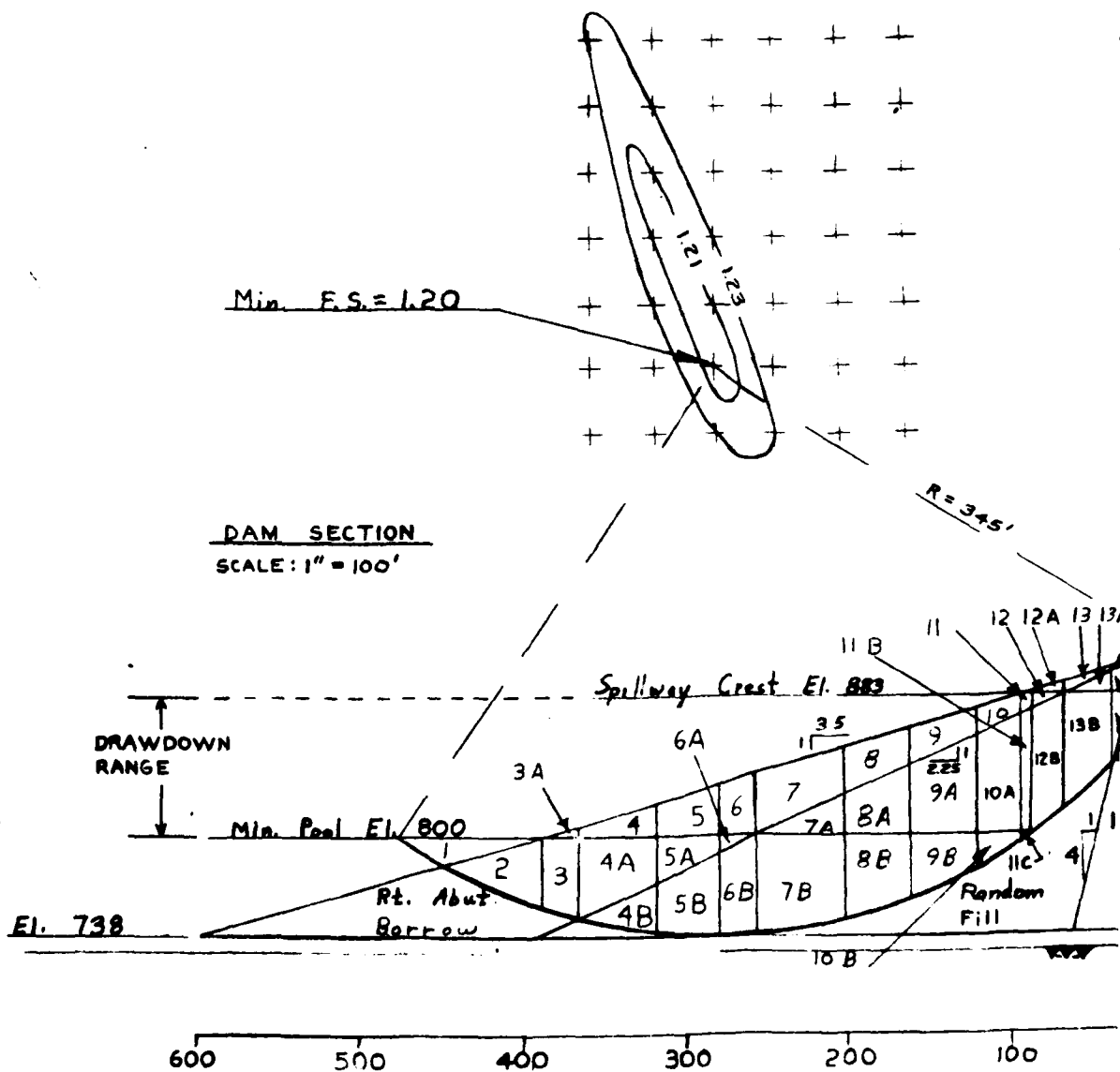
CHKD. BY _____ DATE _____

JOB NO. _____

ADOPTED DESIGN VALUES						
MATERIALS	γ (PCF)			STRENGTH		
	MOIST	SAT	SUBM	TEST	TAN ϕ	C (TSF)
RT. ABUT. BORROW	132.5	134.6	72.2	R	0.375	0.30
LT. ABUT. BORROW	127.0	129.0	66.6	R	0.287	0.19
RANDOM FILL	135.0	140.0	77.6	R	0.330	0.50

Min. F.S. = 1.20

DAM SECTION
SCALE: 1" = 100'



AD-A122 733

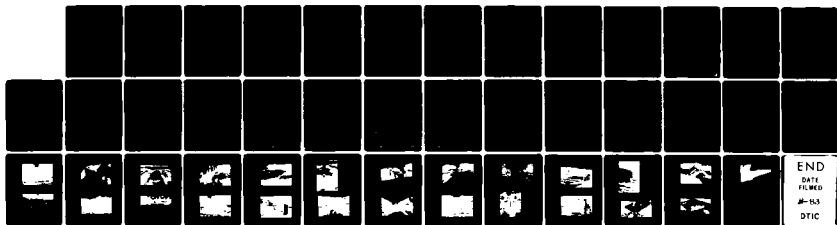
CAESAR CREEK LAKE LITTLE MIAMI RIVER BASIN OHIO
EMBANKMENT CRITERIA AND PERFORMANCE REPORT(U) ARMY
ENGINEER DISTRICT LOUISVILLE KY SEP 82

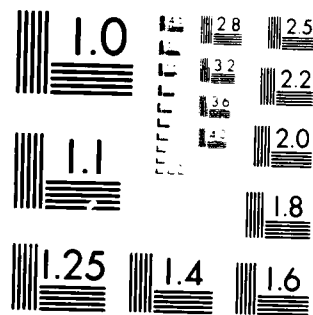
2/2

UNCLASSIFIED

F/G 13/2

NL

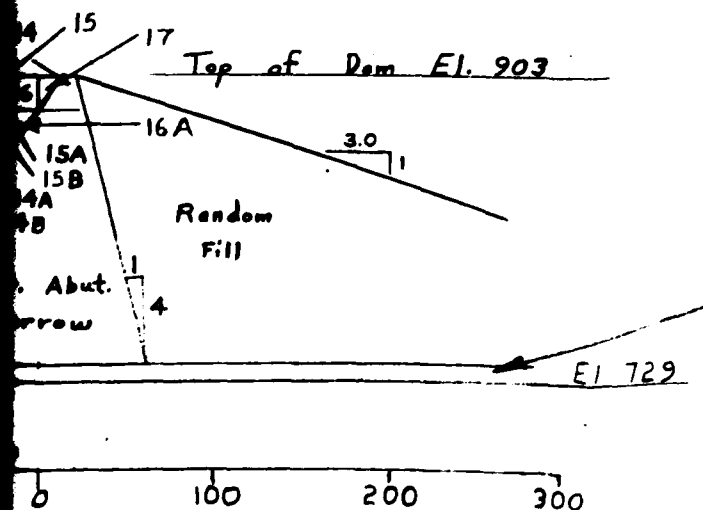




MICROCOPY RESOLUTION TEST CHART
 NATIONAL BUREAU OF STANDARDS-1963-A

NOTES:

1. Slope stability computations were made with an IBM 360 electronic computer using program No. 41-K2-H203. The stability of the critical circle was checked with the manual computation shown.
2. A search by the computer showed the most critical type of failure for sudden drawdown to be an embankment failure tangent to the sand and gravel at elevation 738.
3. Centers of all base circle are shown along with "Factor of Safety Contours." The critical circle is shown on the embankment cross section.



CAESAR CREEK RESERVOIR
STABILITY ANALYSIS
FINITE SLICE METHOD
SUDDEN DRAWDOWN

G.V.F. SHEET 1 OF 2

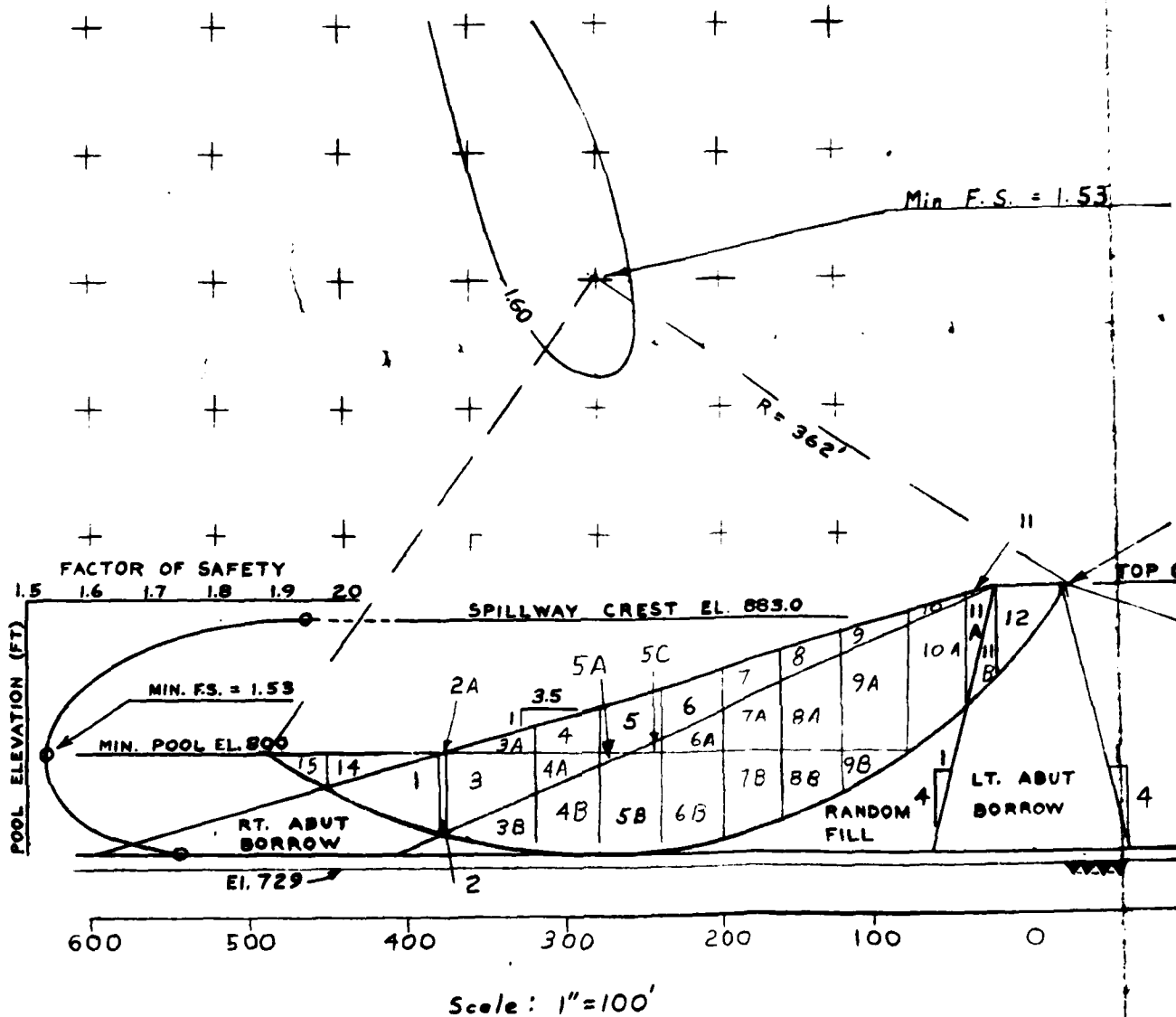
NOV. 1969

D.M. NO. 5

PLATE 30

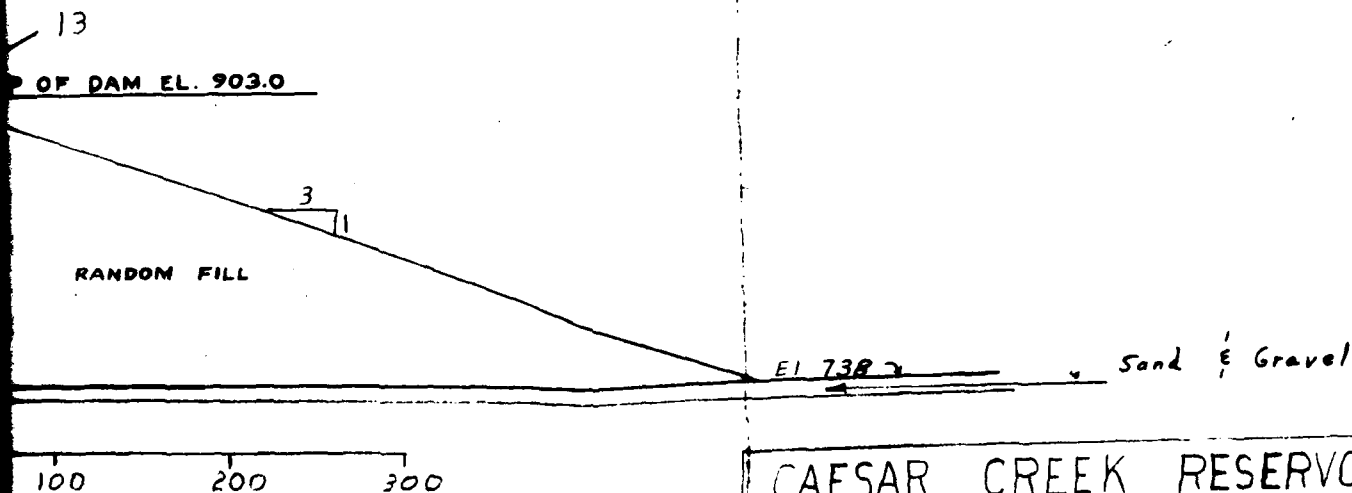
2

ADOPTED DESIGN VALUES					
MATERIALS	γ (PCF)		"R" STRENGTH		
	MOIST	SAT	TEST	TAN ϕ	C (TSF)
RT. ABUT. BORROW	132.5	134.6	R	0.375	0.30
LT. ABUT. BORROW	127.0	129.0	R	0.287	0.19
RANDOM FILL	135.0	140.0	R	0.330	0.50



NOTES:

1. Slope stability computations were made with an IBM 360 electronic computer using program No. 41-K2-H203. The stability of the critical circle was checked with the manual computation shown.
2. A search by the computer showed the most critical type of failure to be an embankment failure tangent to the sand and gravel at elevation 738.
3. Centers of all base circles are shown along with "Factor of Safety Contours". The critical circle is shown on the embankment cross section.



CAESAR CREEK RESERVOIR
STABILITY ANALYSIS
FINITE SLICE METHOD
PARTIAL POOL

G.V.F. SHEET 1 OF 2 OCT., 1969

D.M. NO. 5

PLATE 38

2

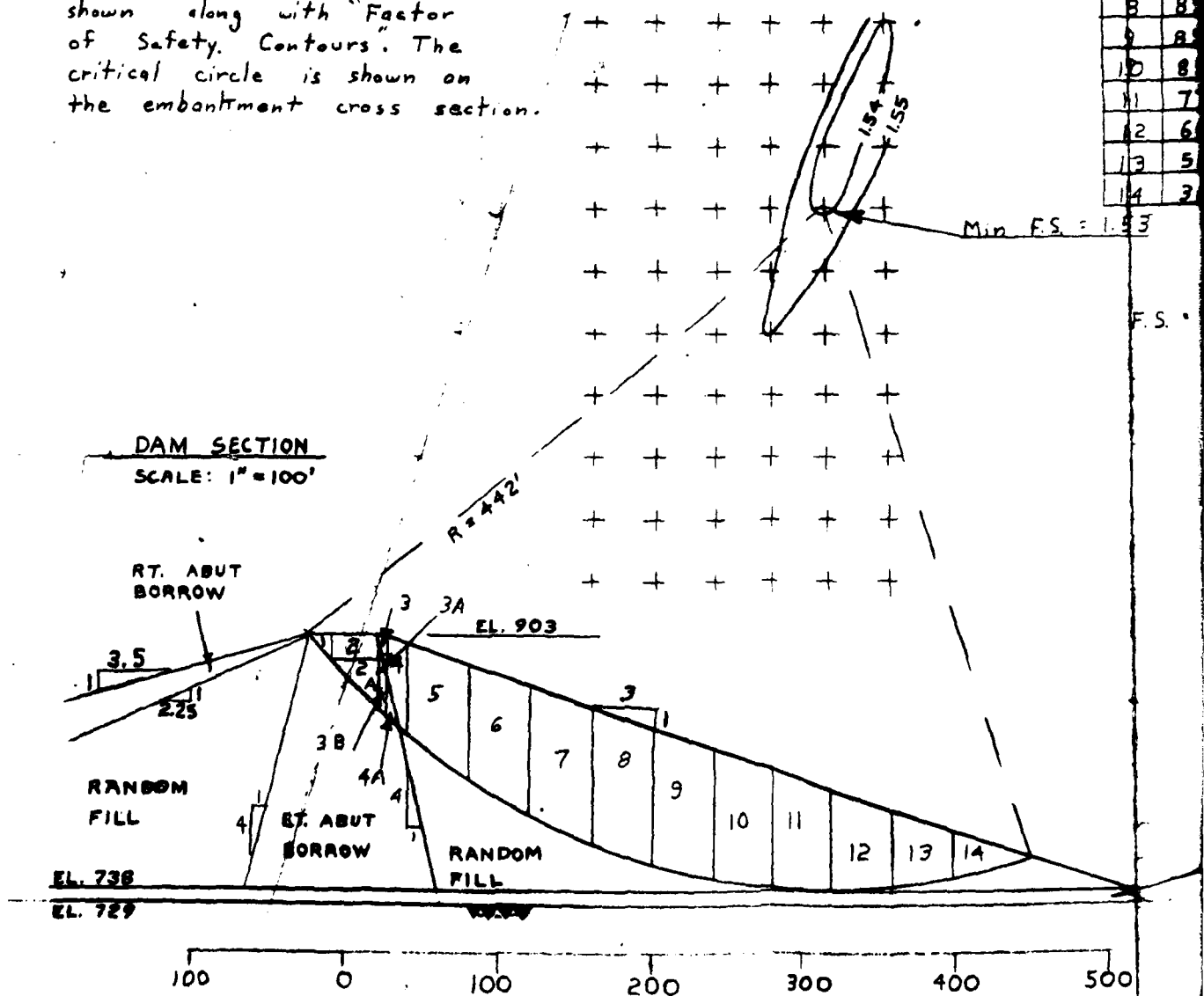
CHKD. BY _____ DATE _____

JOB NO. _____

NOTES:

1. Slope stability computations were made with an IBM 360 electronic computer using program No. 41-K2-H203. The stability of the critical circle was checked with the manual computations shown.
2. A search by the computer showed the most critical type of failure for Steady Seepage to be an embankment failure tangent to the Sand and Gravel at elev. 738. The "R" case yielded a F.S. = 1.53 and the "S" case 2.01. Since the "S" case is greater than the "R" case, the average F.S. = $(1.53 + 2.01) / 2 = 1.77$.
- 3 Centers of all base circles shown along with "Factor of Safety, Contours". The critical circle is shown on the embankment cross section.

SLICE NO.	HT. SH. F.
1	0
2	2
3A	0
3	0
3A	2
3B	2
4	2
4A	3
5	5
6	7
7	8
8	8
9	8
10	8
11	7
12	6
13	5
14	3



SIDE	HT. LT.	HT RT.	AVG WIDTH		AREA	$\bar{X}$	$\sin \alpha$	$\cos \alpha$	NORMAL FORCES		COHESION		TANGENTIAL FORCES	
	FT.	FT.	FT.	FT.	FT ²	FT.	$\frac{\bar{X}}{R}$		γ_{eff}	W_{eff}	N_{eff}	T_{eff}	γ	W
									PCF	KIPS	KIPS	KIPS	PCF	KIPS
0	21	10.5	16	168	331	.749	.663	127.0	21.3	14.1	.287	4.0	26	38
21	21	21	27	567	313	.708	.706	127.0	72.0	50.8	.287	14.6	0	35
0	27	13.5	27	3645	309	.699	.715	66.6	24.3	17.3	.287	5.0	38	14.4
0	21	10.5	6	63	296	.670	.742	135.0	8.5	6.3	.287	1.8	0	35
21	0	10.5	6	63	297	.672	.741	127.0	8.0	5.9	.287	1.7	0	38
26	31	28.5	6	171	296	.670	.742	66.6	11.4	8.5	.287	2.4	8	38
21	56	38.5	10	385	287	.649	.761	135.0	51.9	39.5	.287	11.3	0	38
31	0	15.5	10	155	290	.656	.755	66.6	10.3	7.8	.287	2.2	13	38
56	75	65.5	44	2882	261	.590	.807	135.0	389.0	313.9	.330	103.6	55	1.0
75	84	79.5	40	3180	220	.498	.867	135.0	429.3	372.2	.330	122.8	46	1.0
84	89	86.5	40	3460	180	.407	.913	135.0	467.1	426.5	.330	140.7	44	1.0
89	89	89	40	3560	140	.317	.948	135.0	480.6	455.6	.330	150.3	42	1.0
89	85	87	40	3480	100	.226	.974	135.0	469.8	457.6	.330	151.0	42	1.0
85	77	81	40	3240	60	.136	.991	135.0	437.4	433.5	.330	143.1	41	1.0
77	66	71.5	40	2860	20	.045	.999	135.0	386.1	385.7	.330	127.3	40	1.0
66	51	58.5	40	2340	-20	-.045	.999	135.0	315.9	315.6	.330	104.1	40	1.0
51	31	41	40	1640	-60	-.136	.991	135.0	221.4	219.4	.330	72.4	40	1.0
31	0	15.5	53	8215	-98	-.222	.975	135.0	110.9	108.1	.330	35.7	54	1.0
										$\Sigma = 1194.0$	$\Sigma = 4762$	$\Sigma = 10726$		

5.
$$\frac{\Sigma N_{eff} \tan \phi + \Sigma CL}{\Sigma T} = \frac{1194.0 + 476.2}{1072.6} = 1.56$$

ADOPTED		DESIGN VALUES			
MATERIALS	γ (PCF)			STRENGTH	
	MOIST	SAT	SUBM	TEST	$\tan \phi$ (TSF)
LT. ABUT. BORROW	132.5	134.6	72.2	R	.375
				S	.547
RT. ABUT. BORROW	127.0	129.0	66.6	R	.287
				S	.454
RANDOM FILL	135.0	140.0	77.6	R	.330
				S	.650

Sand & Gravel

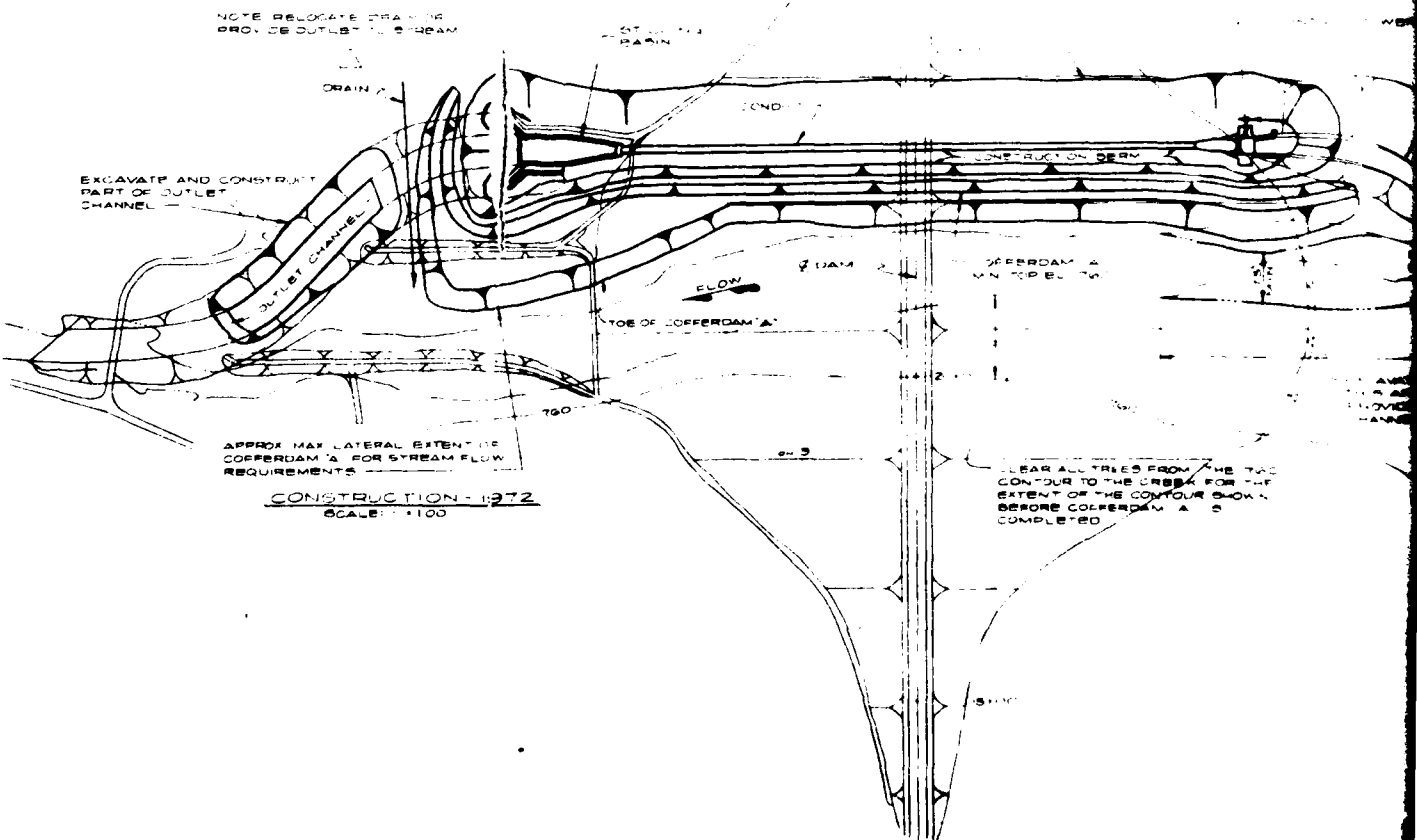
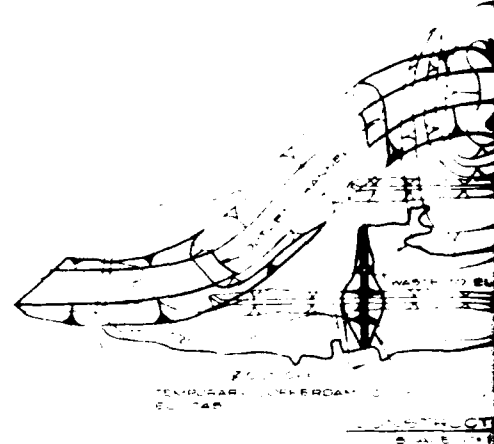
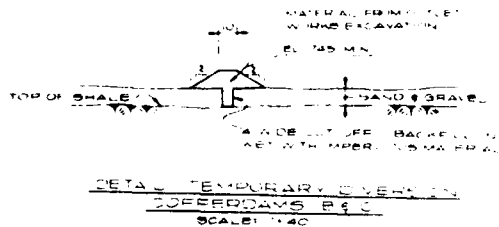
CAESAR CREEK RESERVOIR
STABILITY ANALYSIS
FINITE SLICE METHOD
STEADY SEEPAGE

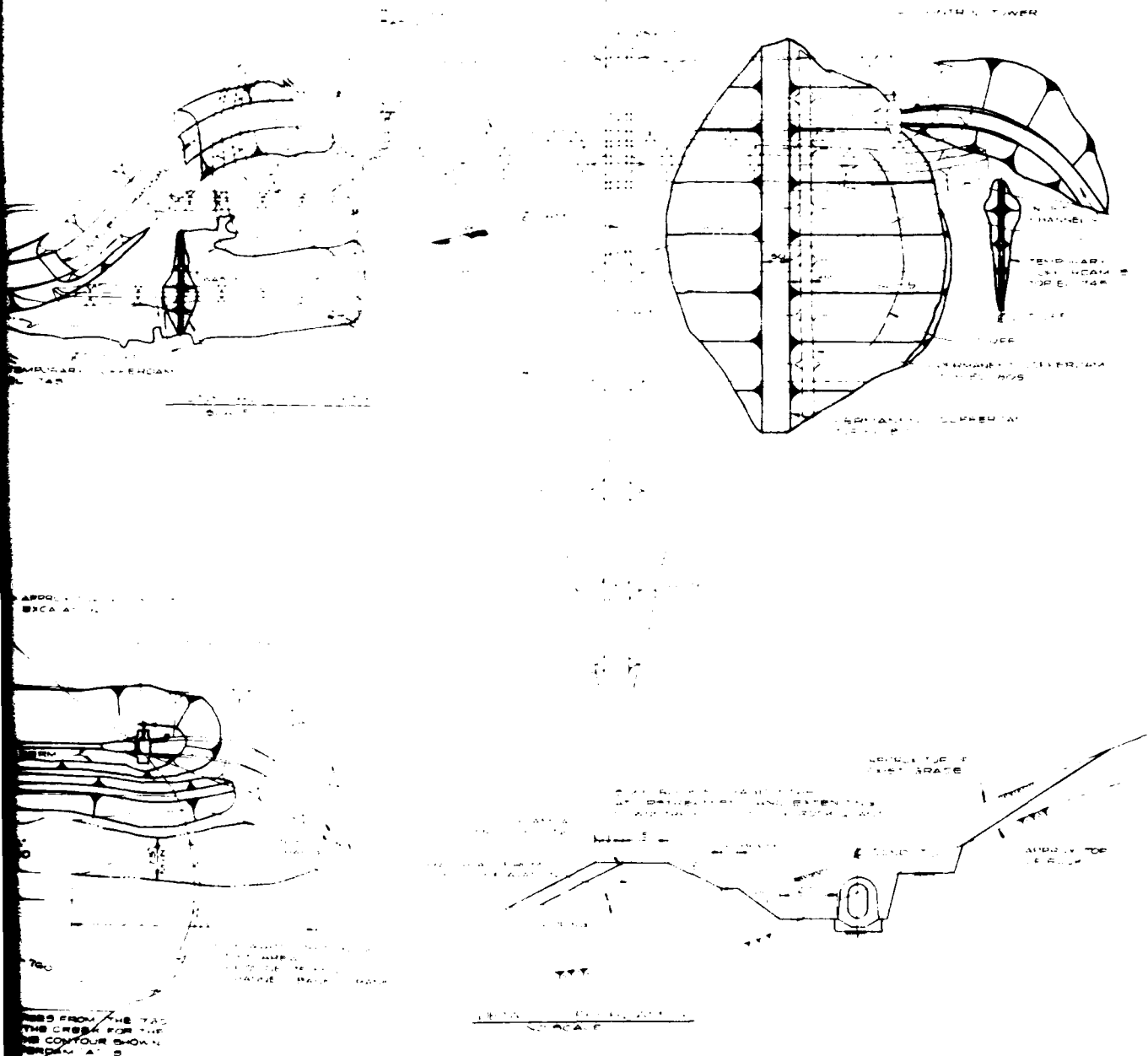
G.V.F.

OCT, 1960

D.M. NO. 5

PLATE 22

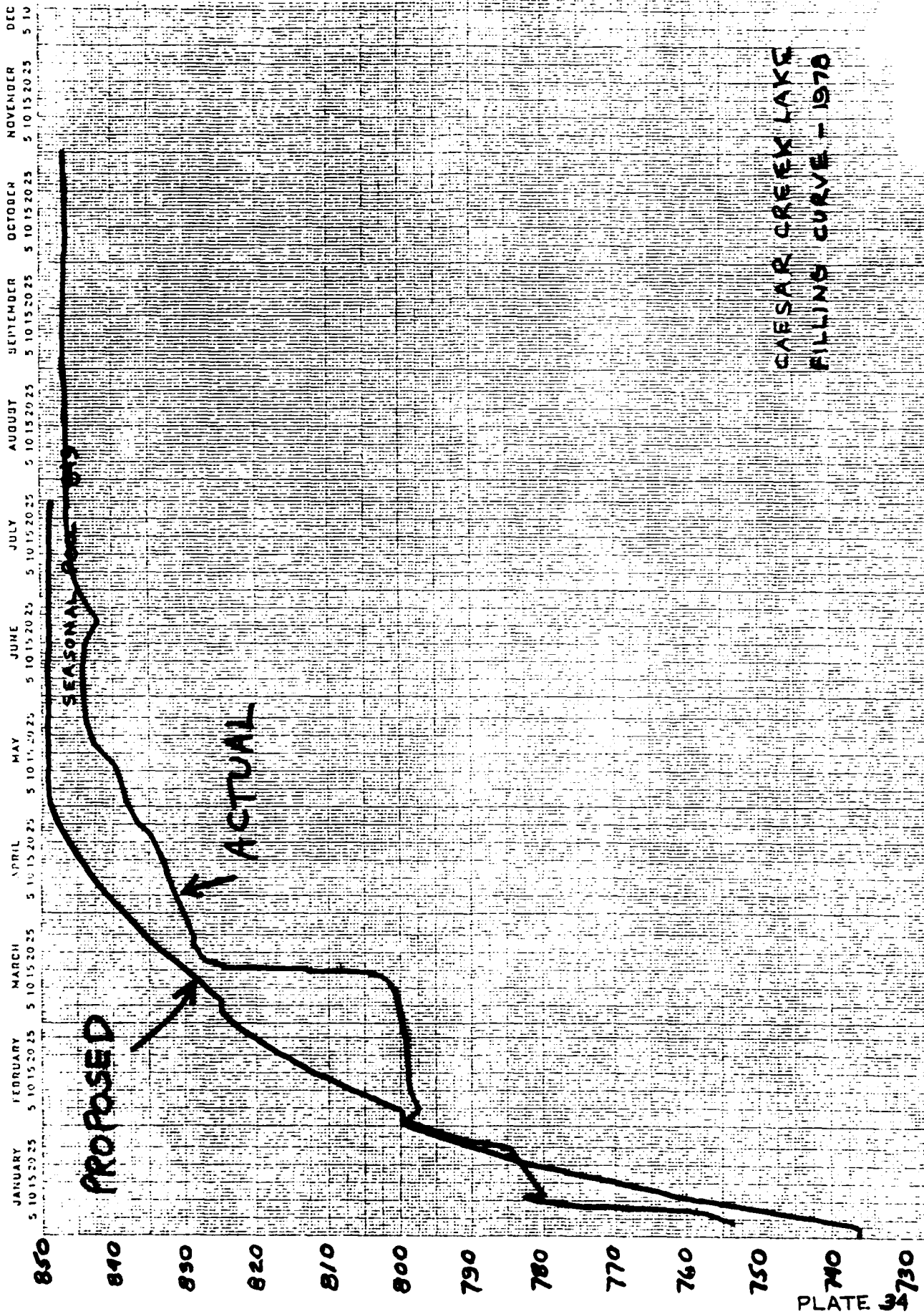


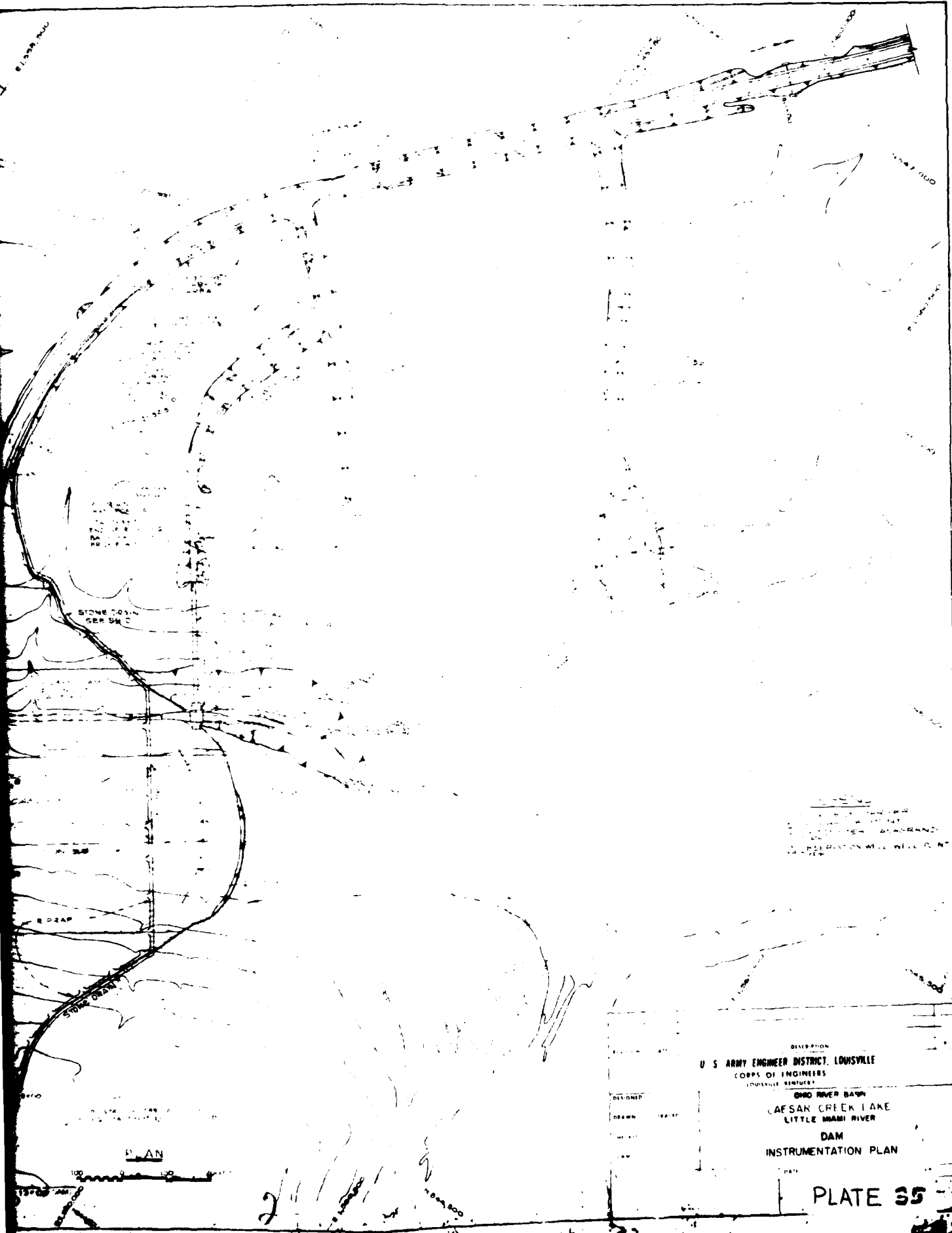


CHANGE PROVIDED FOR (AMDT NO. 1) SHEET ADDED (AMDT NO. 3)		JCS EOP
DIVISION DATE	DESCRIPTION BY	
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE CORPS OF ENGINEERS LOUISVILLE DISTRICT		
DESIGNED P. R. G. M. DRAWN TRACED G. H. H. CHECKED R. L. R. SUBMITTED J. H. H.	OHIO RIVER BASIN CAESAR CREEK LAKE LITTLE MAHON RIVER DAM DIVERSION PLAN	
SCALE	DATE	DRAWING NUMBER LM 52-12 3/1 A

LUJINE DIETZGEN CO.
MADE IN U. S. A.

FOR THE YEAR 1970
ONE YEAR BY DATE OF PAPER
1960 DATE X 250 (1970 X 100) DIVIDE





ALL DIMENSIONS
SHOWN ON THIS
DRAWING ARE
BASED ON THE
SURVEY DATA
AND SHALL BE
CONSIDERED
FINAL.

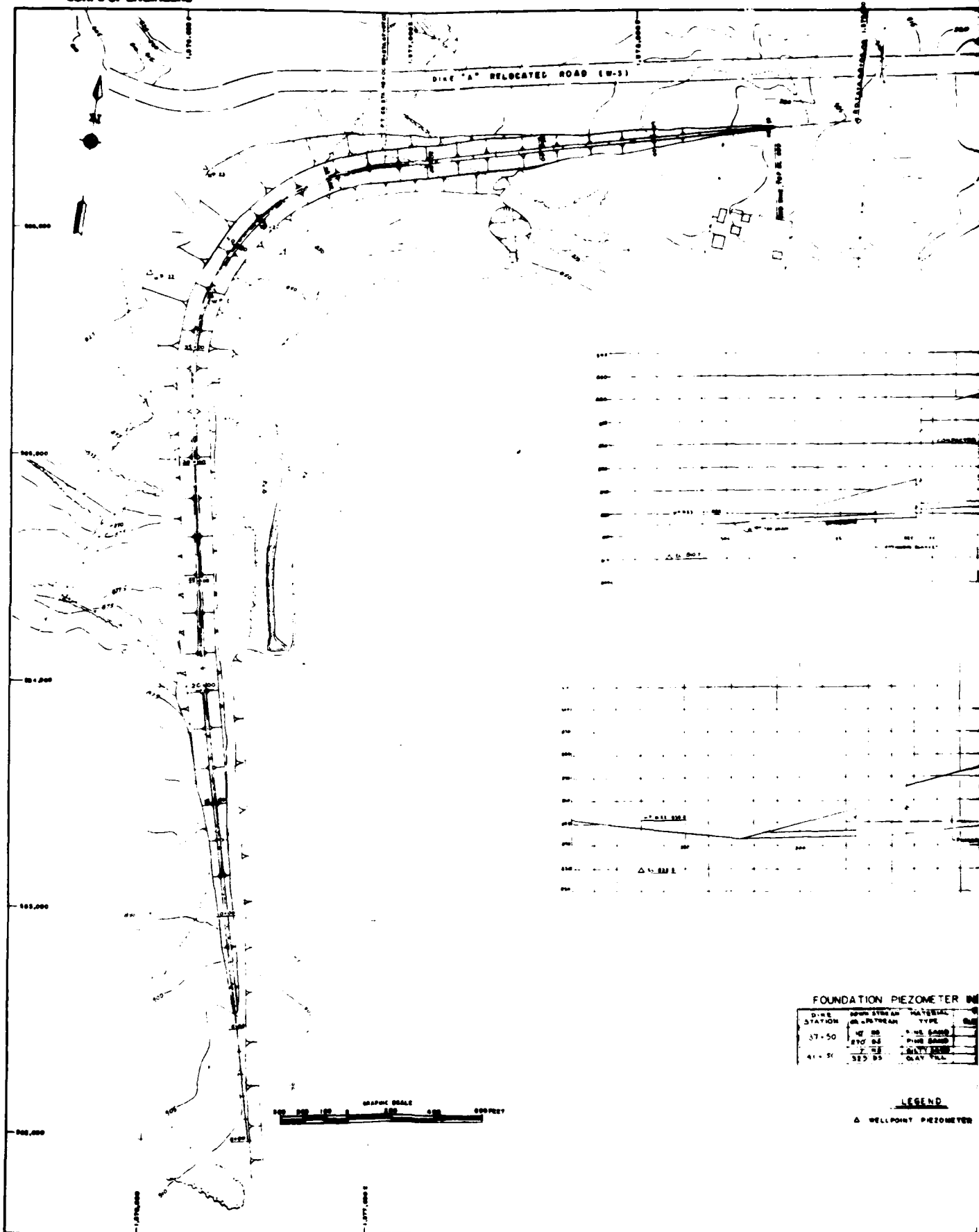
DESIGNED BY
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE DISTRICT

ONTO RIVER BASIN
LAKE CREEK LAKE
LITTLE MIAMI RIVER

DAM
INSTRUMENTATION PLAN

PLATE 35

CORPS OF ENGINEERS

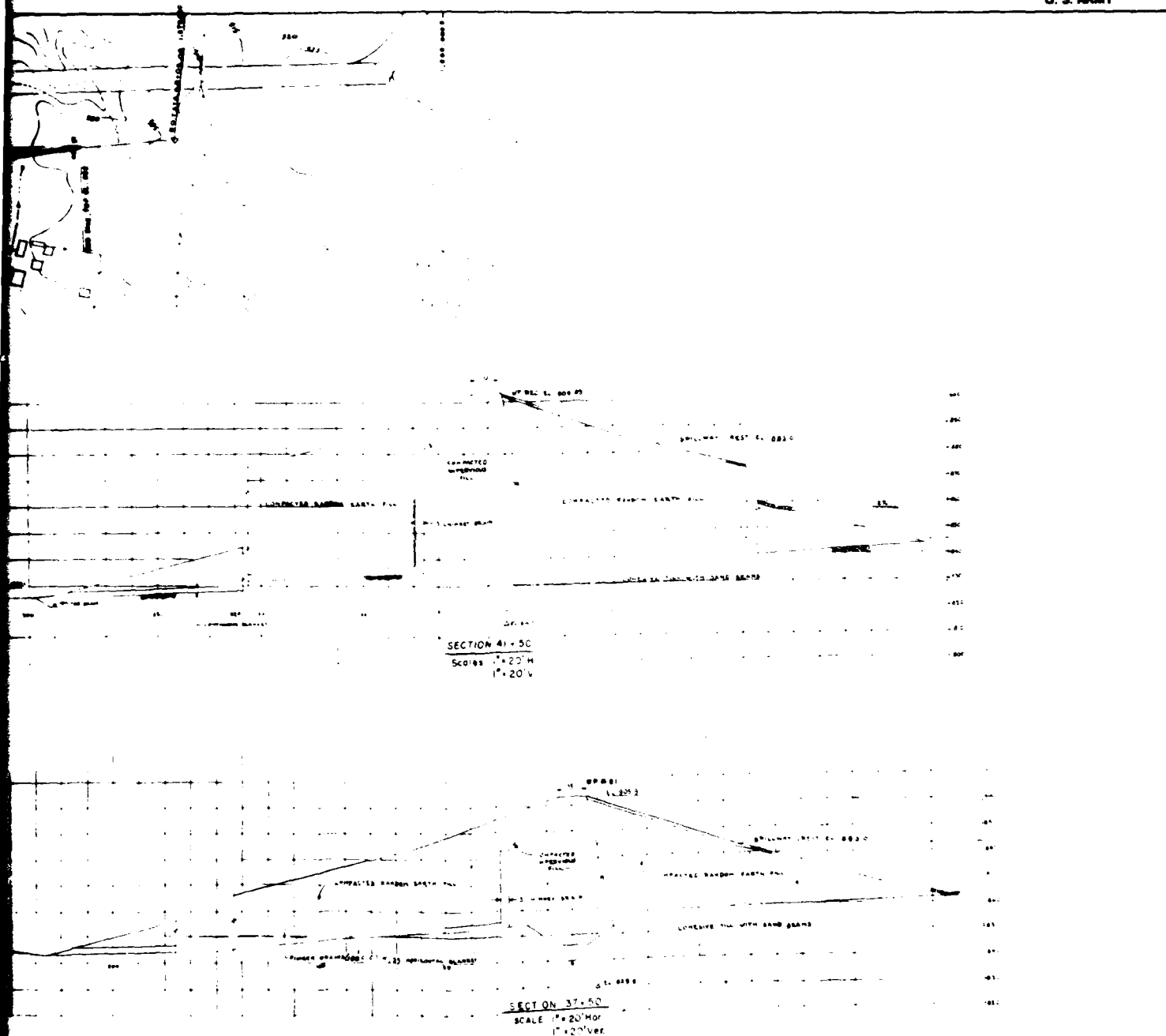


FOUNDATION PIEZOMETER

D.I.E. STATION	DOWN STREAM OR UPSTREAM	MATERIAL TYPE
37+50	47 00	CLAY SAND
	47 00	CLAY SAND
41+50	47 00	CLAY SAND
	47 00	CLAY SAND

LEGEND

Δ WELLPOINT PIEZOMETER



FOUNDATION PIEZOMETER INFORMATION

DIKE STATION	POINT STRIKE IN OR OUTSTREAM	MATERIAL TYPE	ELEVATION	NUMBER
37+50	45 00	PINE SAND	800.0	UP-31
	870 04	PINE SAND	800.0	UP-32
	7 08	SILTY SAND	815.7	UP-33
41+50	315 05	CLAY FILL	810.7	UP-34

LEGEND

A WELLPOINT PIEZOMETER

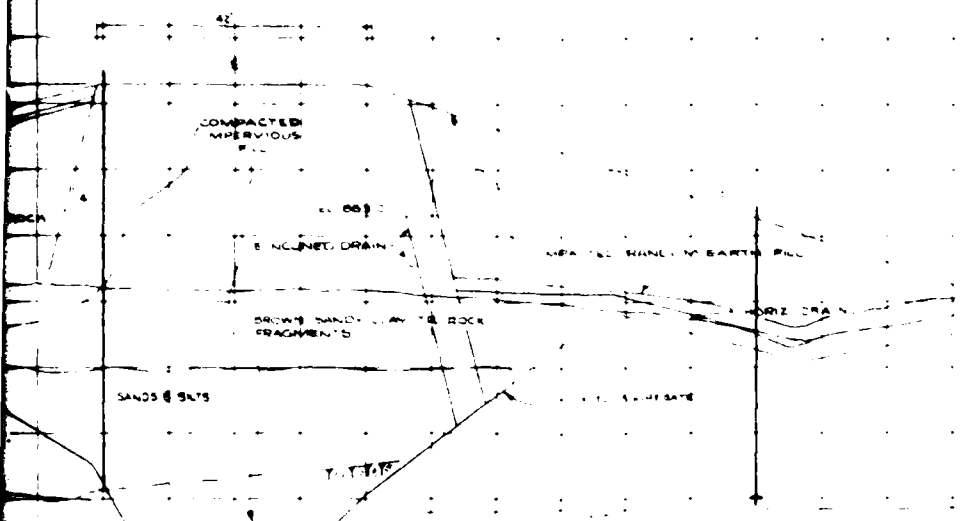
H&TWO 12 12 77		NAME OF NEW ROAD RECTIFICATION OF THE COORD. SYSTEM	
DESIGNER	DATE	DESCRIPTION	
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE			
CORPS OF ENGINEERS			
LOUISVILLE, KENTUCKY			
DRAWN BY: FRANCES		DATE: 12 12 77	
CHECKED BY: ENGINEER & SURVEY		SUBMITTER	
SCALE: 1"=20' H & V		DATE	
DRAWING NUMBER		DRAWING NUMBER	

The image contains two cross-section diagrams of a road project, labeled "SECTION 30+55" and "STA 22+00". Both diagrams show a road profile with various layers and features.

SECTION 30+55: This diagram shows a road profile with a "SPILLWAY" and "COMPACTED SANDY ROCK" layers. The elevation scale ranges from 830 to 900. The road is shown with a "REBAR & BEDDING" layer. The "SPILLWAY" is labeled with "E. 860". The "COMPACTED SANDY ROCK" is labeled with "E. 850". The road is shown with a "REBAR & BEDDING" layer. The "SPILLWAY" is labeled with "E. 860". The "COMPACTED SANDY ROCK" is labeled with "E. 850".

STA 22+00: This diagram shows a road profile with a "MINIMUM POOL" and "PERMANENT COTTERDAM" layers. The elevation scale ranges from 700 to 920. The road is shown with a "MINIMUM POOL" layer. The "PERMANENT COTTERDAM" is labeled with "E. 800". The road is shown with a "MINIMUM POOL" layer. The "PERMANENT COTTERDAM" is labeled with "E. 800".

STA 22 00



SECTION 26.59

MOVEMENT MONUMENT INFORMATION

DATE	DOWNSTREAM LOCATION	DETERMINATION OF FLOOD
11-00	10 08	M-3
12-00	13 08	M-2
13-00	16 08	M-1
14-00	19 08	M-
15-00	22 08	M-
16-00	25 08	M-3
17-00	28 08	M-4
18-00	31 08	M-5
19-00	34 08	M-6
20-00	37 08	M-7
21-00	40 08	M-8
22-00	43 08	M-9
23-00	46 08	M-10
24-00	49 08	M-11
25-00	52 08	M-12
26-00	55 08	M-13
27-00	58 08	M-14
28-00	61 08	M-15
29-00	64 08	M-16
30-00	67 08	M-17
31-00	70 08	M-18
32-00	73 08	M-19
33-00	76 08	M-20
34-00	79 08	M-21
35-00	82 08	M-22
36-00	85 08	M-23
37-00	88 08	M-24
38-00	91 08	M-25
39-00	94 08	M-26
40-00	97 08	M-27
41-00	100 08	M-28
42-00	103 08	M-29
43-00	106 08	M-30
44-00	109 08	M-31
45-00	112 08	M-32
46-00	115 08	M-33
47-00	118 08	M-34
48-00	121 08	M-35
49-00	124 08	M-36
50-00	127 08	M-37
51-00	130 08	M-38
52-00	133 08	M-39
53-00	136 08	M-40
54-00	139 08	M-41
55-00	142 08	M-42
56-00	145 08	M-43
57-00	148 08	M-44
58-00	151 08	M-45
59-00	154 08	M-46
60-00	157 08	M-47
61-00	160 08	M-48
62-00	163 08	M-49
63-00	166 08	M-50
64-00	169 08	M-51
65-00	172 08	M-52
66-00	175 08	M-53
67-00	178 08	M-54
68-00	181 08	M-55
69-00	184 08	M-56
70-00	187 08	M-57
71-00	190 08	M-58
72-00	193 08	M-59
73-00	196 08	M-60
74-00	199 08	M-61
75-00	202 08	M-62
76-00	205 08	M-63
77-00	208 08	M-64
78-00	211 08	M-65
79-00	214 08	M-66
80-00	217 08	M-67
81-00	220 08	M-68
82-00	223 08	M-69
83-00	226 08	M-70
84-00	229 08	M-71
85-00	232 08	M-72
86-00	235 08	M-73
87-00	238 08	M-74
88-00	241 08	M-75
89-00	244 08	M-76
90-00	247 08	M-77
91-00	250 08	M-78
92-00	253 08	M-79
93-00	256 08	M-80
94-00	259 08	M-81
95-00	262 08	M-82
96-00	265 08	M-83
97-00	268 08	M-84
98-00	271 08	M-85
99-00	274 08	M-86
100-00	277 08	M-87
101-00	280 08	M-88
102-00	283 08	M-89
103-00	286 08	M-90
104-00	289 08	M-91
105-00	292 08	M-92
106-00	295 08	M-93
107-00	298 08	M-94
108-00	301 08	M-95
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111-00	310 08	M-98
112-00	313 08	M-99
113-00		

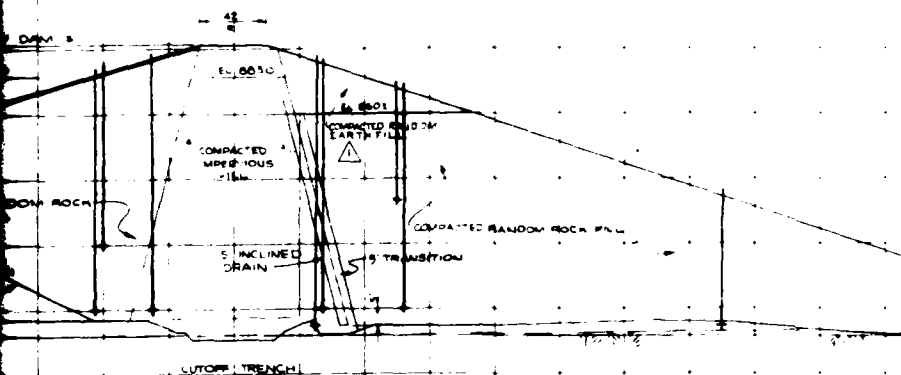
R = REFERENCE MONUMENT
M = MOVEMENT MONUMENT

FOUNDATION PIEZOMETER INFORMATION

DAM STATION	DOWSTREAM OR UPSTREAM	MATERIAL TYPE	PERCENT
22.00	50' DS	SAND & GRAVEL	12.0
22.95	500' DS	SAND & GRAVEL	12.0
26.55	50' DS	SAND & GRAVEL	12.0
	30' DS	SAND & GRAVEL	12.0

EMBANKMENT PIEZOMETER INFORMATION

DAM STATION	DOWNSTREAM OR UPSTREAM	T.P. ELEVATION
22+00	00 DS	7400
	00 DS	8070
	05 DS	7400
	50 DS	7800
	80 US	7800
	80 US	7400



STA 2200

LEGEND

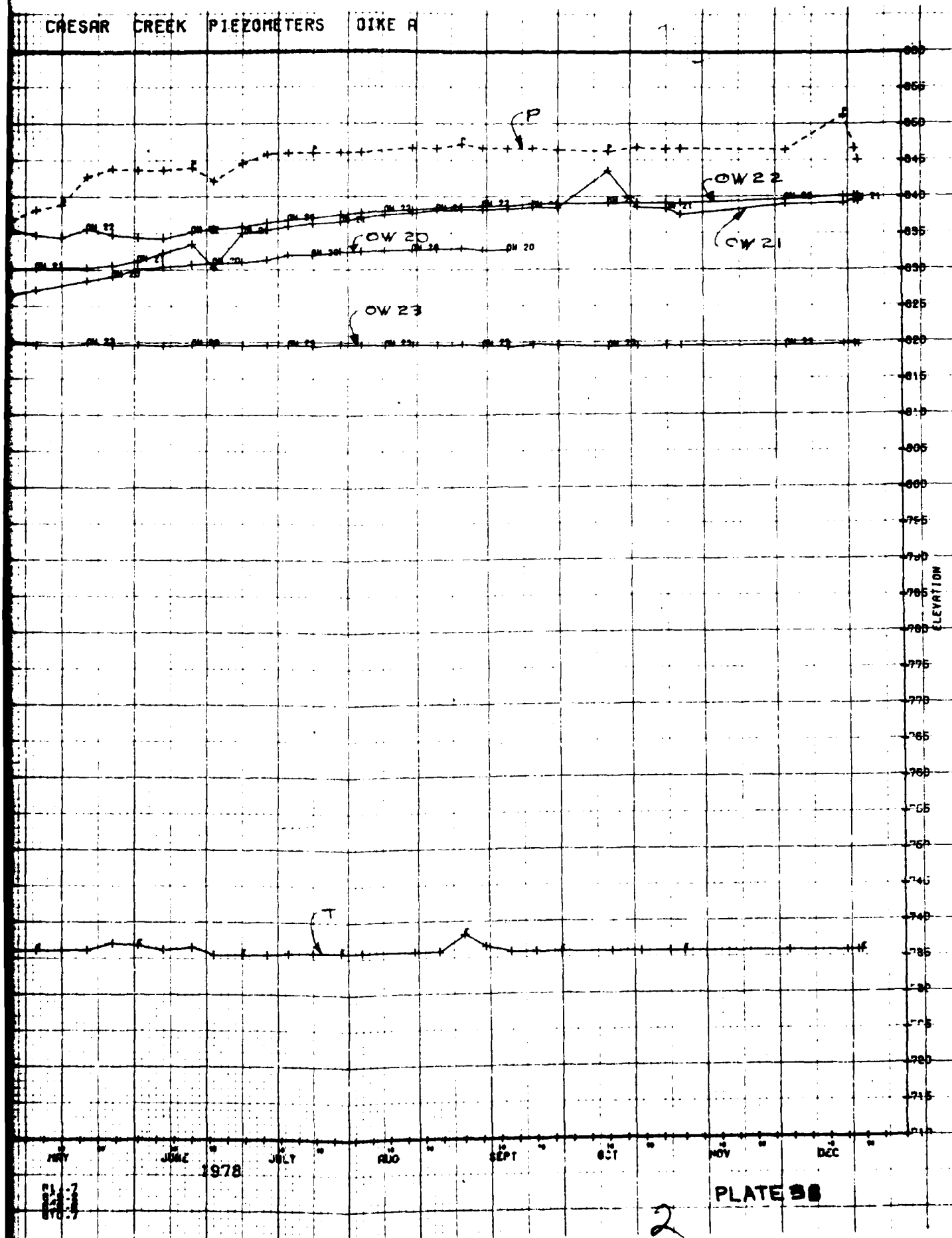
† PYEZOMETER (LASAGRADE TYPE)

**THIS DRAWING REFLECTS
"AS CONSTRUCTED" CONDITIONS**

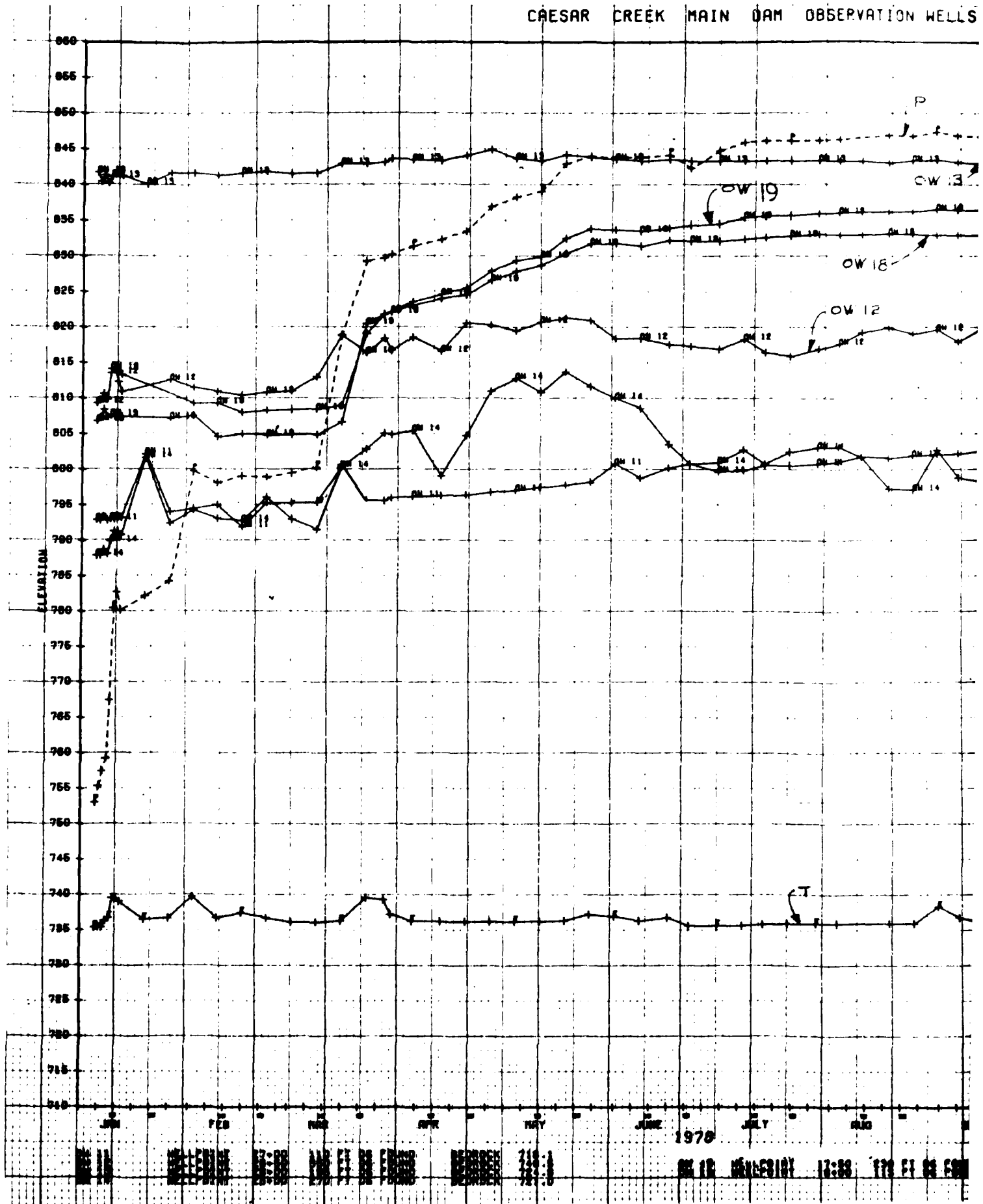
DATE		SECTION (NOTE REVISED)	AMEND NO.	BY
REVISION	DATE	DESCRIPTION		
U S ARMY ENGINEER DISTRICT, LOUISVILLE CORPS OF ENGINEERS LOUISVILLE DISTRICT*				
DESIGNED		OHIO RIVER BASIN CAESAR CREEK LAKE LITTLE MAJOR RIVER		
DRAWN BY W. M. MGS CHECKED BY [Signature] APPROVED BY [Signature] SUBMITTED BY [Signature] SCALE		DAM INSTRUMENTATION - SECTIONS		
		DATE		
		DRAWING NUMBER		

 PLATE 37

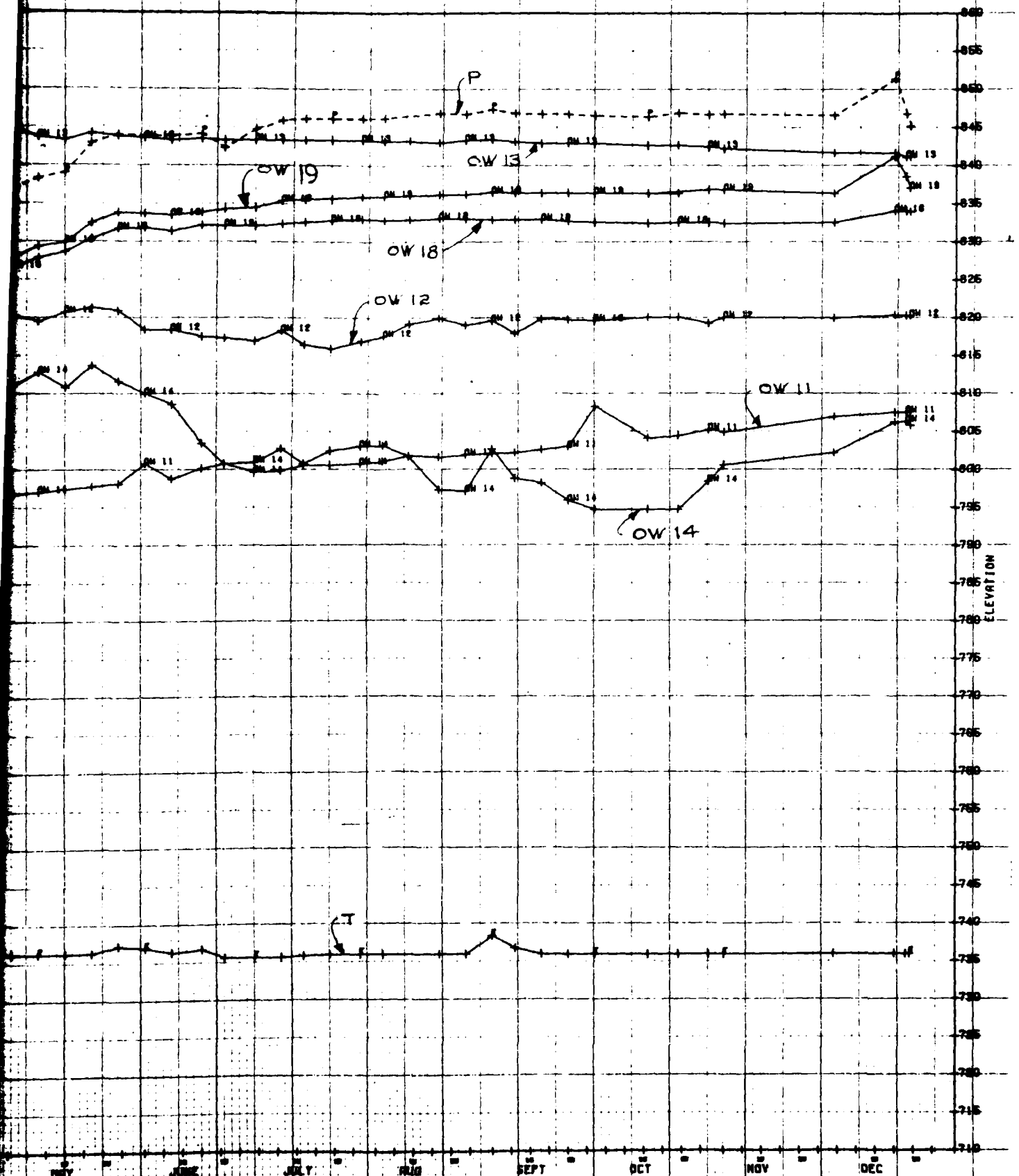
CAESAR CREEK PIEZOMETERS DIKE A



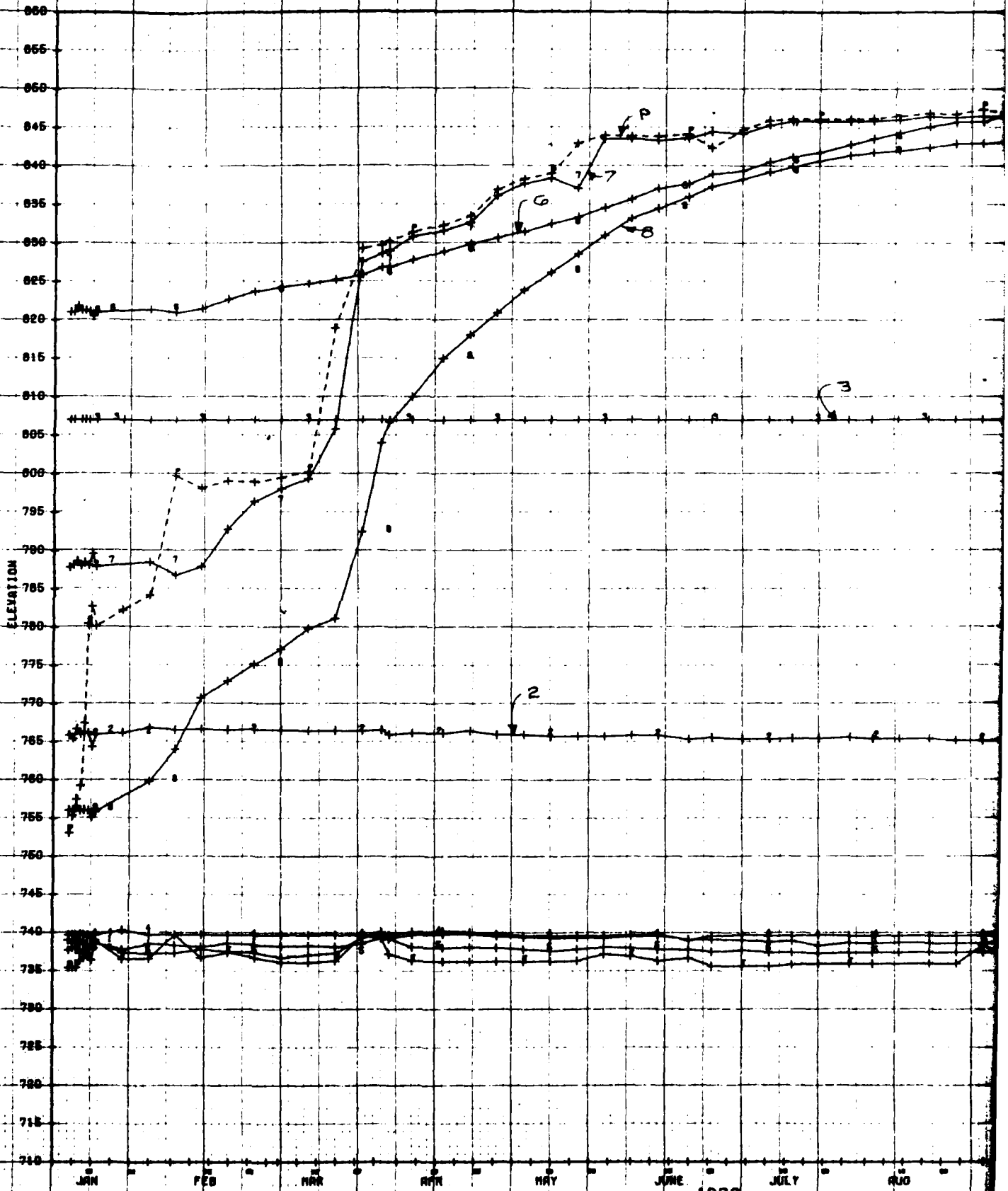
CAESAR CREEK MAIN DAM OBSERVATION WELLS



CAESAR CREEK MAIN DAM OBSERVATION WELLS

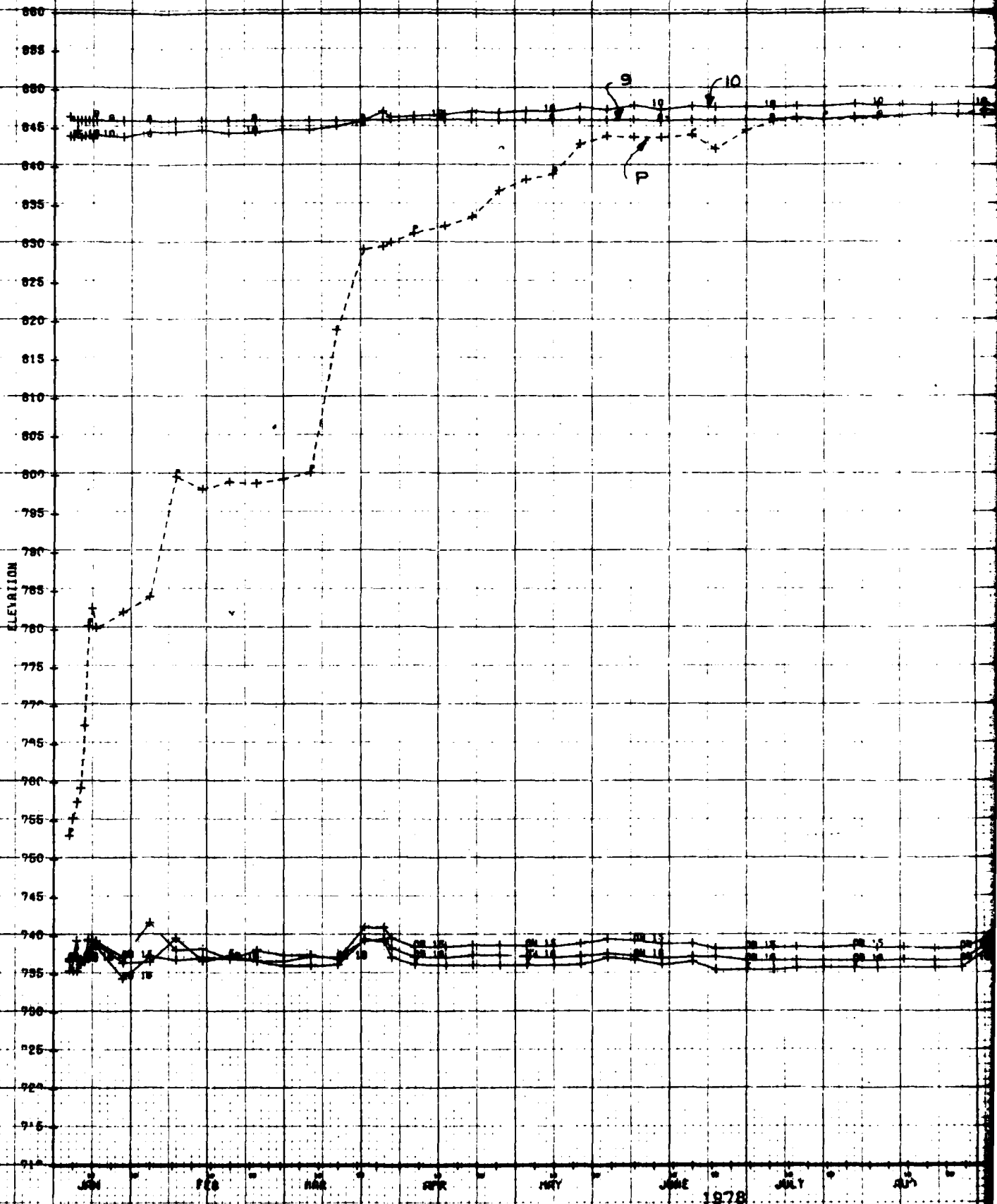


CAESAR CREEK PIEZOMETERS DAM STA 28



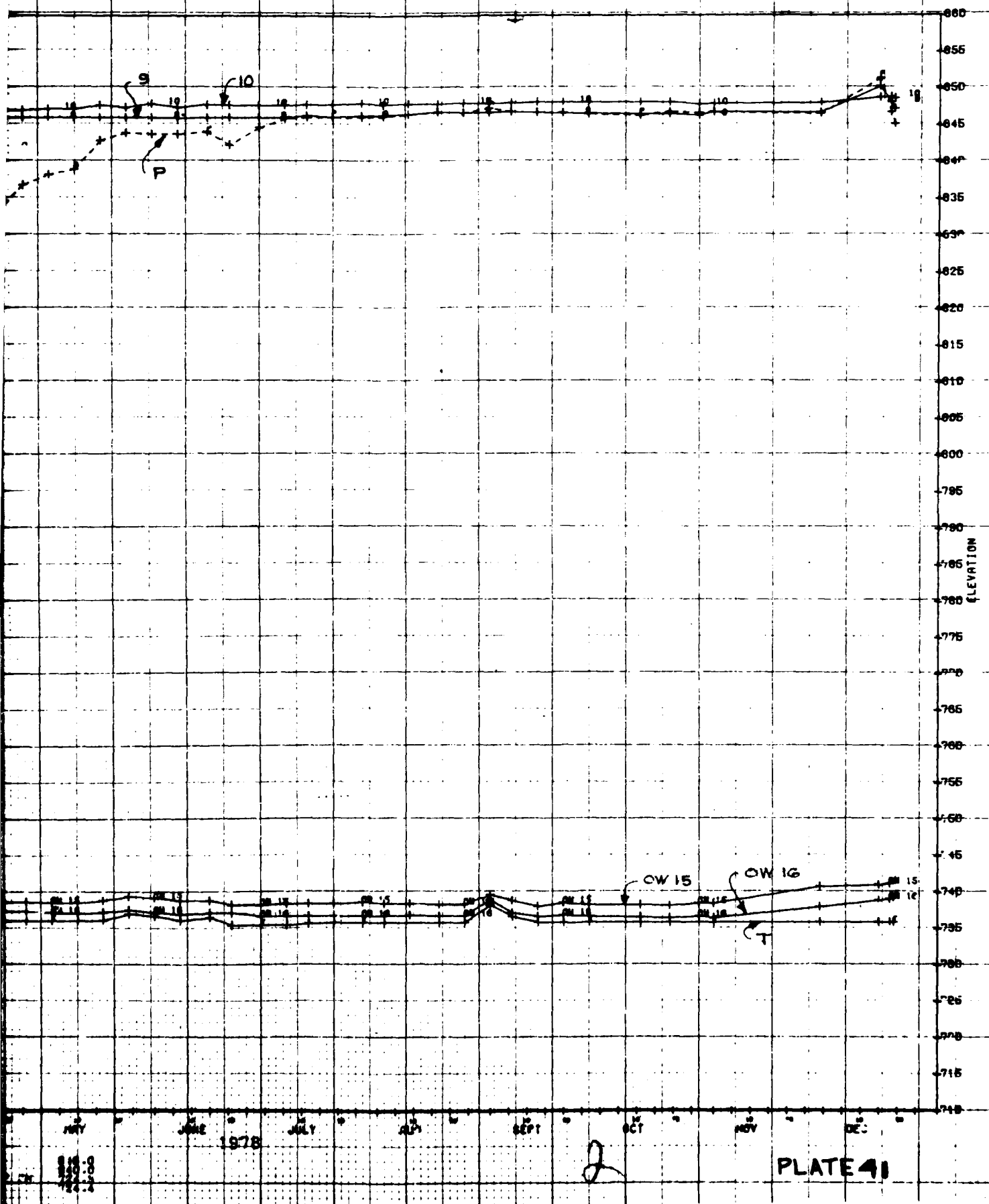
CONFERENCE 11:00 100 FT 05 FOUND 5 2 0 728.1
 CONFERENCE 11:00 100 FT 05 FOUND 5 2 0 728.0
 CONFERENCE 11:00 100 FT 05 FOUND 5 2 0 728.0
 CONFERENCE 11:00 100 FT 05 FOUND 5 2 0 728.0

CAESAR CREEK PIEZOMETERS DAM STA 26+5

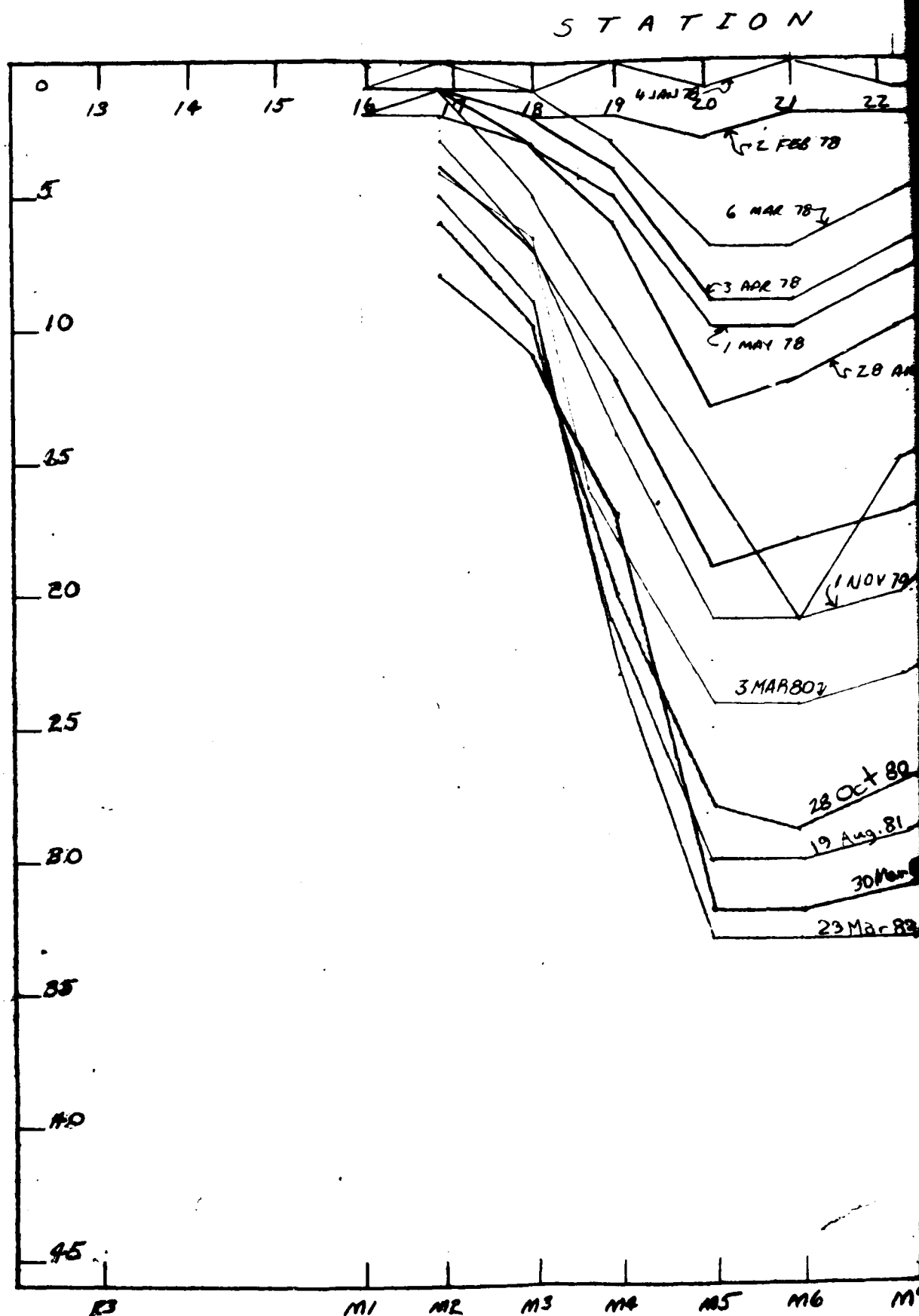


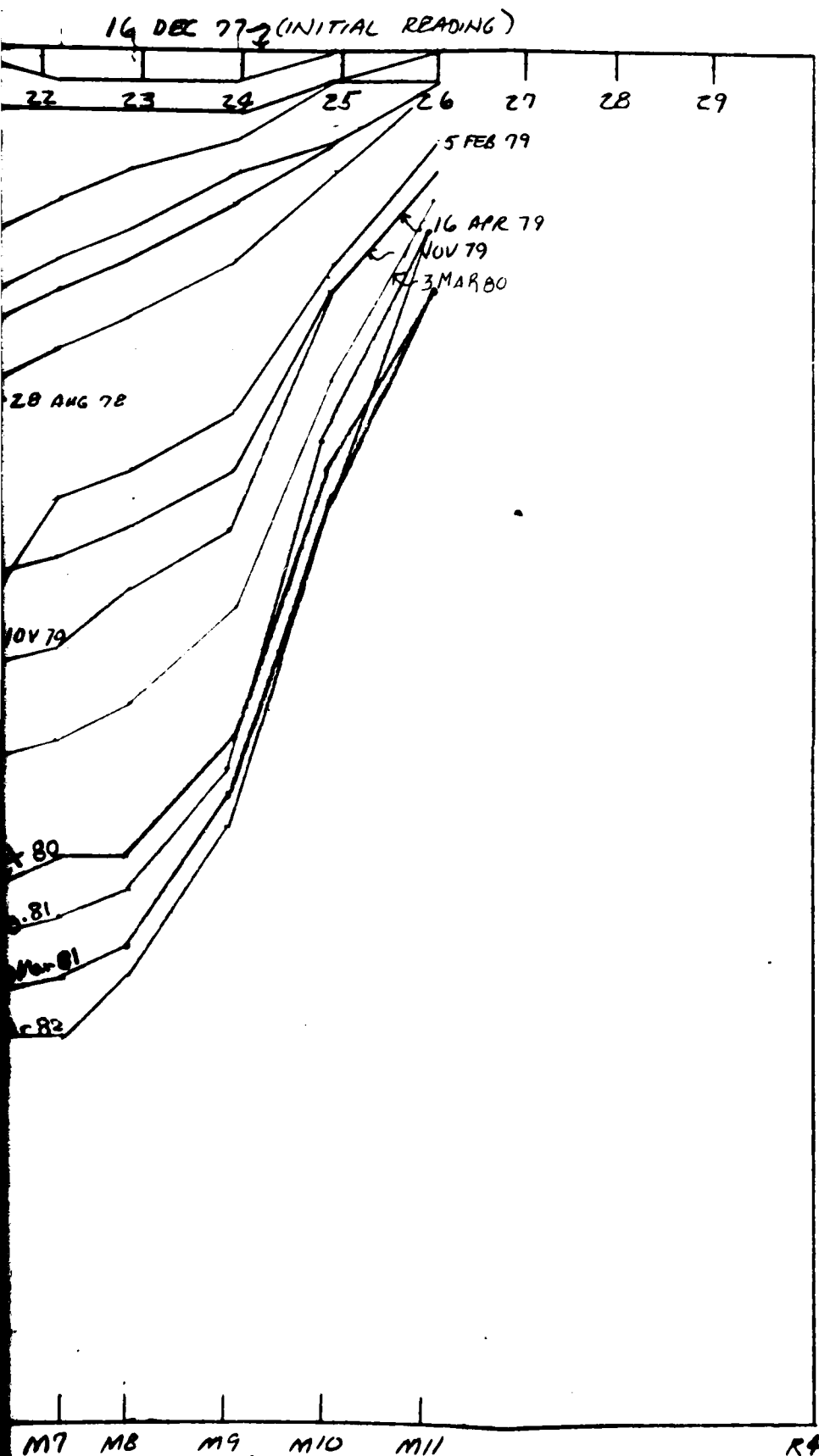
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CAESAR CREEK PIEZOMETERS DAM STA 26+55 ? OBS WELLS AT 21+00 +22+50



CUMULATIVE VERTICAL MOVEMENT
(HUNDRETHS OF A FOOT) ↓ DOWN



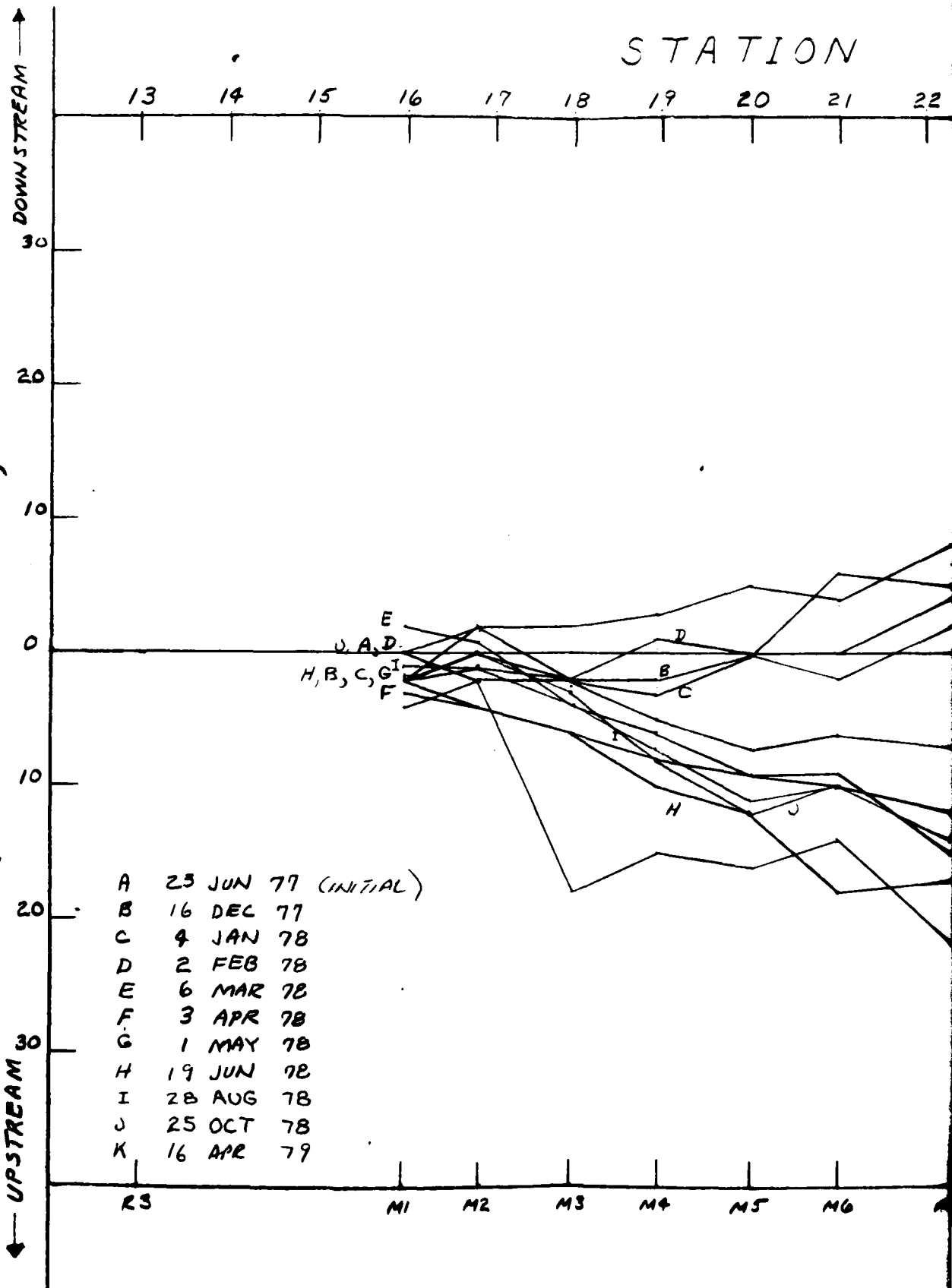


CAESAR CREEK
MOVEMENT MARKERS
20' D.S. &
VERTICAL MOVEMENT

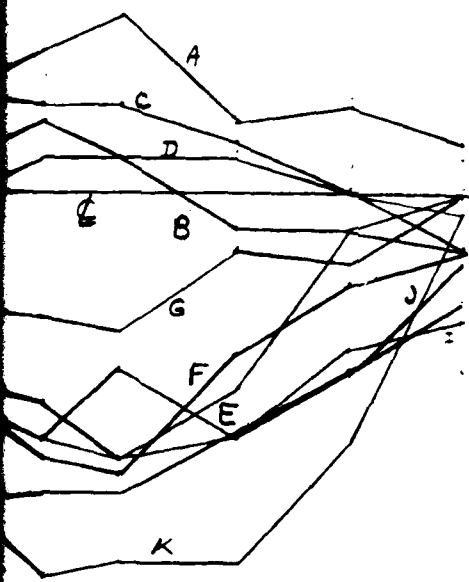
MOVEMENT MARKERS	INITIAL READINGS
M-1	902.74
M-2	902.48
M-3	902.53
M-4	902.37
M-5	901.98
M-6	901.90
M-7	901.91
M-8	902.04
M-9	902.59
M-10	903.25
M-11	903.84

PLATE 42

HORIZONTAL CUMULATIVE MOVEMENT (HUNDRETHS OF A FOOT)



2 23 24 25 26 27 28 29



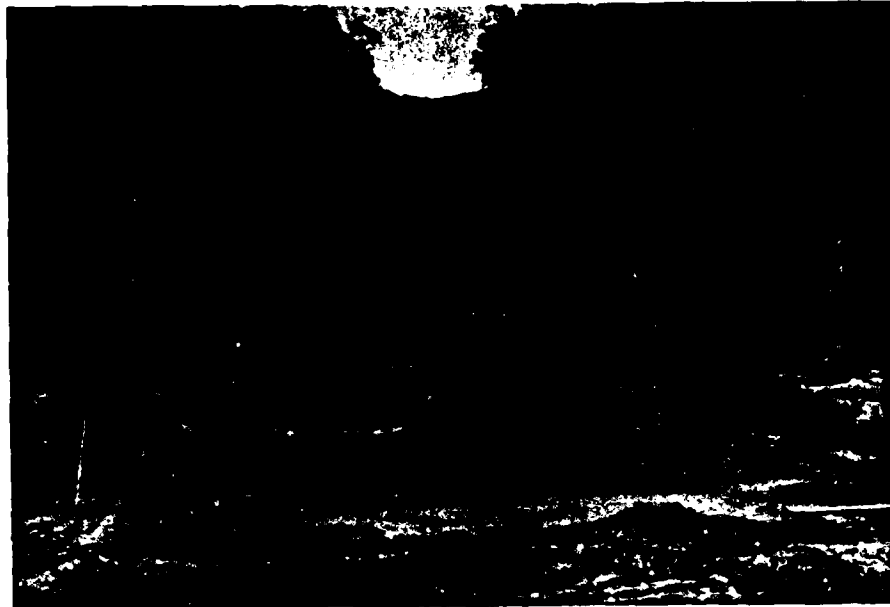
CAESAR CREEK
MOVEMENT MARKERS
20' D.S. &
HORIZONTAL MOVEMENT

M7 M8 M9 M10 M11

R4

PLATE 43

APPENDIX 1
COFFERDAM CONSTRUCTION

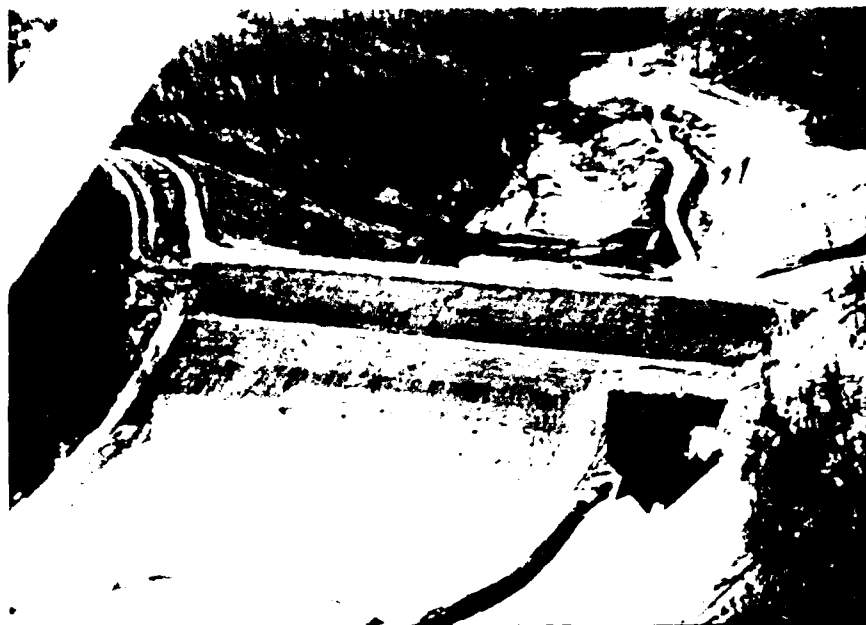


(1) View of left abutment of dam after stripping and prior to diversion 26 September 1973.



(2) View from left abutment showing cofferdam construction with more weather rock being placed in center of embankment Oct 1973.

COFFERDAM CONSTRUCTION

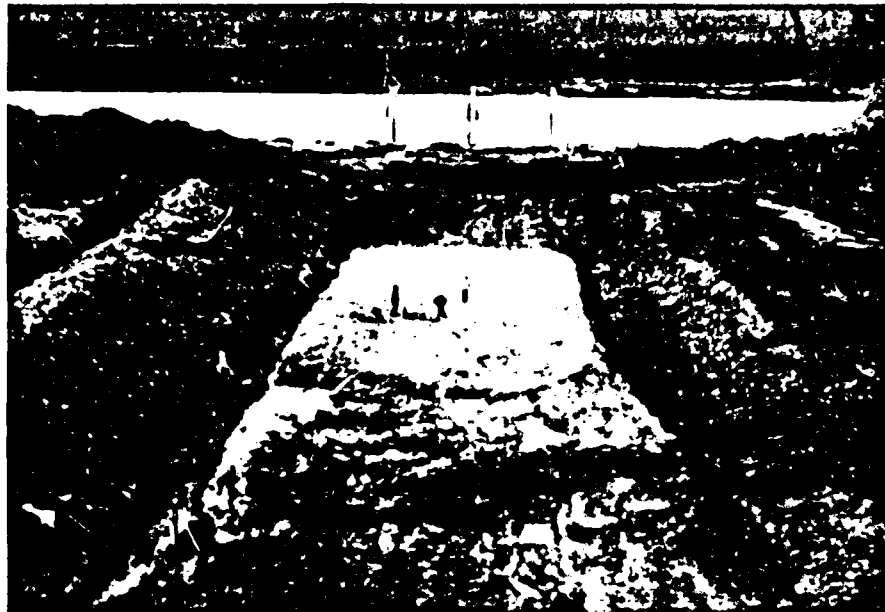


(3) View looking downstream at completed cofferdam Dec 1973.



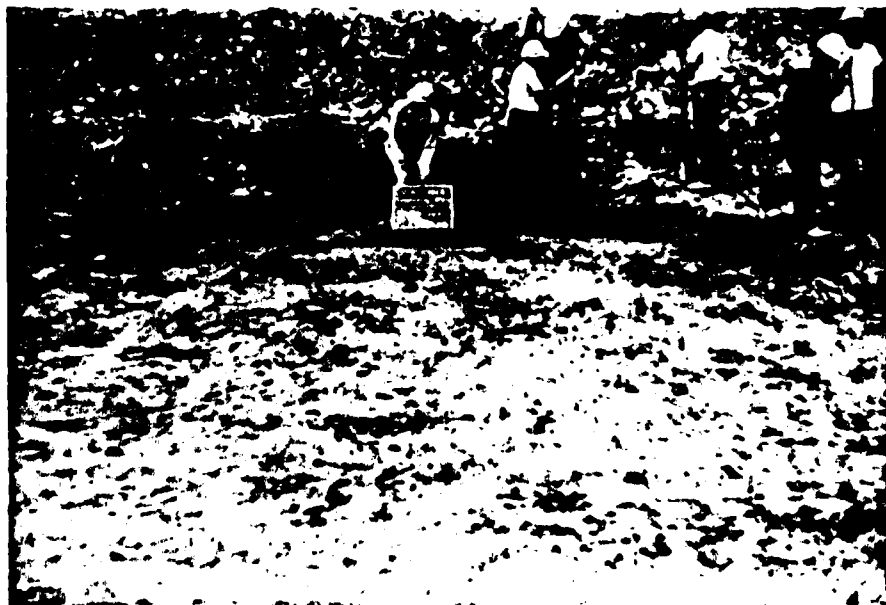
(4) View showing D.S. toe of cofferdam embankment and cleanup of core trench Dec 1973.

DAM FOUNDATION



(5) View showing shale foundation of valley cutoff trench from left abutment Dec 1973.

Impervious Core Embankment Placement - Dam



(6) First lift of impervious material being placed in core area of dam Sep 1974.

Impervious Core Embankment



(7) Impervious embankment being placed along left side of conduit, and right abutment toe of dam 17 Sep 1974.



(8) View of impervious placement at left abutment toe of dam 17 Sep 1974.

TRANSITION AND INCLINED DRAIN



- (9) View looking at left abutment toe of dam showing beginning of 5 foot wide transition zone and 5 foot wide inclined drain. Material right-hand lower corner of photo is top of original sand and gravel which remained in place. 19 Sep 1974.



- (10) Horizontal sand drain being placed at downstream toe of dam. Nov 1974.



(11) 3 foot thick horizontal sand drain being placed downstream of cutoff trench 1 Oct 1974.

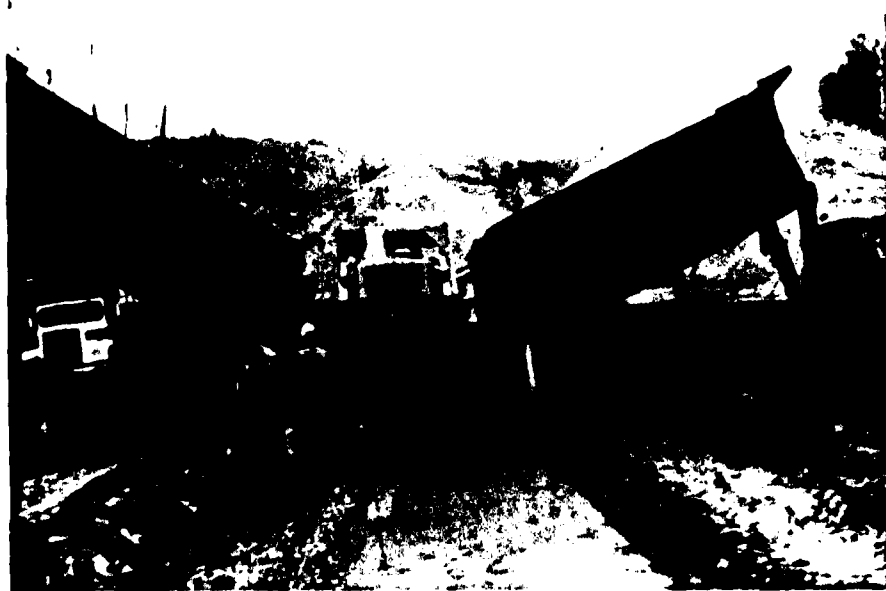
PLACEMENT OF VERTICAL TRANSITION AND INCLINED DRAIN ZONES
Each zone was 5 feet wide



(12) Spreader box built to place two 5 foot zones simultaneously.
17 Apr 1975.



(13) Spray bar and water supply wagon used to add moisture to transition material. June 1975.

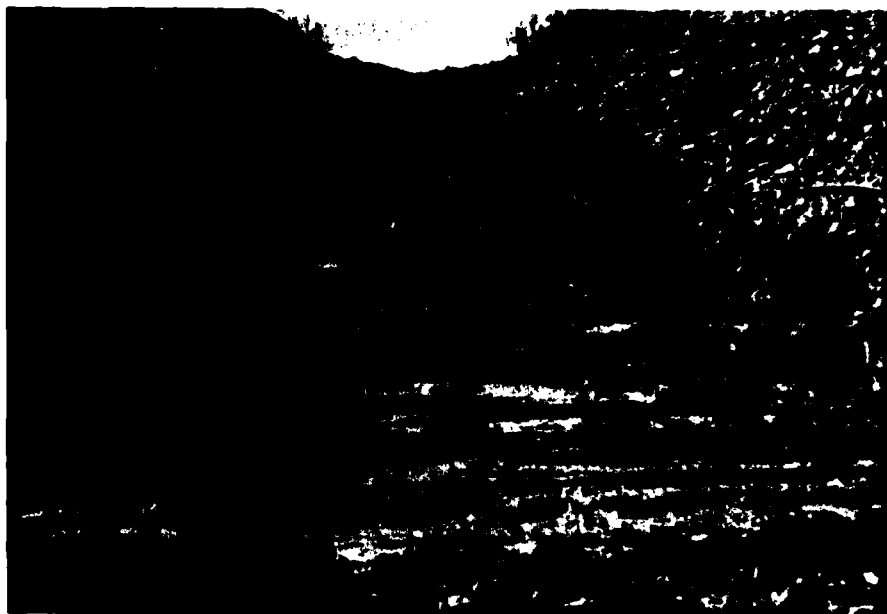


(14) Transition and inclined drain materials being dumped into spreader box. April 1975.



(15) View showing overbuilt width of core zone after being cut back to designed edge of zone by a grader. June 1975.

FOUNDATION CLEANUP AND DEWATERING



(16) View showing cleaned foundation prior to impervious placement in left abutment cutoff trench station 17+50, elev. 820. May 1975.



(17) View showing foundation cleanup in right abutment cutoff trench prior to impervious placement. Note dewatering casing upper left of photo. May 1975.



(18) Close view of over-burden collection dewatering casing and pump used to keep core area dry. May 1975.

GENERAL VIEWS OF CONSTRUCTION



(19) Overview of embankment progress from overlook area Oct 1973.



(20) View looking downstream along right abutment of dam showing impervious core placement. Sep 1974.



(21) View showing lay-out for excavation of D.S. toe drain of dam embankment. Nov 1974.



(22) View looking from left abutment to right abutment showing height of embankment at end of 1974 construction season. Dec 1974.



(23) Aerial view showing construction progress. 1 Feb 1975.



(24) General view of construction operations looking from right abutment. June 1975.



(25) View from right abutment to left abutment across upstream face of dam showing placed riprap. 4 Oct 1975.

DA
FILM
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