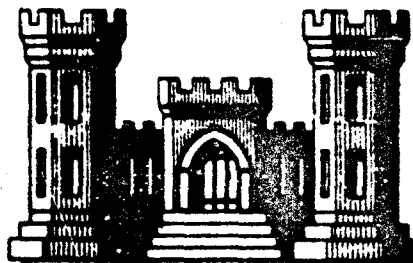


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**CARR FORK LAKE**  
**KENTUCKY RIVER BASIN**  
**KENTUCKY**

**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

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| 1. REPORT NUMBER                                                                                                                                                                                                                                                                                                                                                                                                 | 2. GOVT ACCESSION NO.<br>AD-A122 400 | 3. RECIPIENT'S CATALOG NUMBER                                                                         |
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| 19. KEY WORDS (Continue on reverse side if necessary and identify by block number)                                                                                                                                                                                                                                                                                                                               |                                      |                                                                                                       |
| Site Geology<br>Construction Notes<br>Foundation-Abutment Treatment<br>Slope Stability<br>Diversion-Closure                                                                                                                                                                                                                                                                                                      |                                      | Compaction Test Results<br>Shear Test Data<br>Seepage Control<br>Operational Notes<br>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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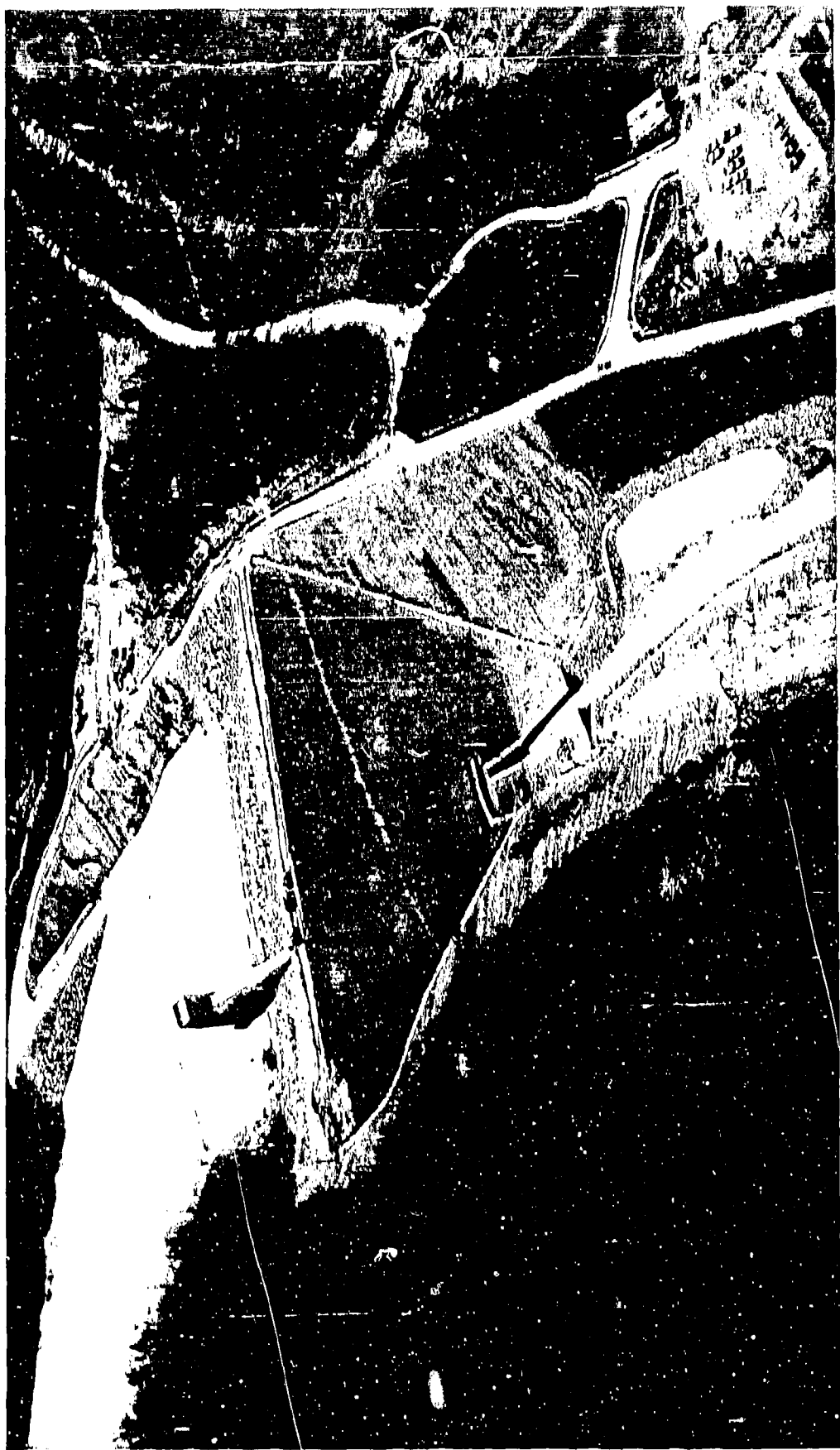
EMBANKMENT CRITERIA  
AND  
PERFORMANCE REPORT

Prepared By  
U. S. Army Engineer District, Louisville  
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September 1982

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Aerial View of Carr Fork lake

CARR FORK LAKE, KENTUCKY  
EMBANKMENT CRITERIA AND PERFORMANCE REPORT

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Carr Fork Lake  
Kentucky River Basin  
Embankment Criteria and Performance Report

Pertinent Data

1. Authority for project. Flood Control Act designated as Public Law 87-874, approved on 23 October 1962, as recommended in House Document 423, 87th Congress.
2. Purpose of Project. To furnish flood protection in the valley of the North Fork of Kentucky River and the lower Kentucky 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 Carr Fork, a branch of North Fork of Kentucky River about 8.8 miles above their confluence, near Vicco, Kentucky. It is located about 160 air miles southeast of Louisville, Kentucky and 150 miles south of Cincinnati, Ohio, in Knott County, Kentucky.
4. Drainage Area at Dam Site. 58 square miles.
5. Reservoir.

| <u>Item</u>        | <u>Elevation</u>  | <u>Area</u>    | <u>Storage</u>   |                      |
|--------------------|-------------------|----------------|------------------|----------------------|
|                    | <u>(feet msl)</u> | <u>(Acres)</u> | <u>Acre Feet</u> | <u>Inches Runoff</u> |
| Minimum Pool       | 1,009             | 530            | 11,830           | 3.81                 |
| Water Quality Pool | 1,017             | 590            | 16,160           | 5.21                 |
| Seasonal Pool      | 1,027             | 710            | 22,640           | 7.29                 |

| <u>Item</u>                           | <u>Elevation</u>  | <u>Area</u>    | <u>Storage</u>   |                      |
|---------------------------------------|-------------------|----------------|------------------|----------------------|
|                                       | <u>(feet msl)</u> | <u>(Acres)</u> | <u>Acre Feet</u> | <u>Inches Runoff</u> |
| Flood Pool                            | 1,055             | 1,120          | 47,700           | 15.38                |
| Allocated to<br>Flood Storage         | 1,017-1,055       | -              | 31,540           | 10.17                |
| Allocated to<br>Seasonal Recreation   | 1,017-1,027       | -              | 6,480            | 2.08                 |
| Allocated to<br>Water Quality Control | 1,009-1,017       | -              | 4,330            | 1.40                 |

6. Dam.

a. Embankment.

|                        |                                                                                                          |
|------------------------|----------------------------------------------------------------------------------------------------------|
| Type                   | Rock and Earth Fill                                                                                      |
| Top Elevation (msl)    | 1,083                                                                                                    |
| Maximum Height, feet   | 132                                                                                                      |
| Length, feet           | 753                                                                                                      |
| Top Width, feet        | 30                                                                                                       |
| Side Slopes - Upstream | 1 on 2.5, down to elevation 1061<br>1 on 3, down to elevation 992<br>25.3-foot berm<br>1 on 3, remainder |
| - Downstream           | 1 on 2.5                                                                                                 |

b. Spillway.

|                       |                                         |
|-----------------------|-----------------------------------------|
| Type                  | Open Cut Through Left<br>Abutment Ridge |
| Crest Elevation (msl) | 1,055                                   |
| Bottom Width, feet    | 265                                     |

Protection for Spillway Cut

Concrete sill at crest

Length, feet

574

Side Slopes

1 on 1.5 overburden

(10-foot berms)

2 on 1 in rock

c. Outlet Works.

Conduit type

Circular, concrete

Conduit diameter, feet

8

Control gates, number

2 service, 2 emergency

Size of gates, feet

3.5 x 8

Invert elevation to outlet works

955

Discharge capacity with

Seasonal Pool elev. 1,027, c.f.s.

2,060

Flood Pool elev. 1,055, c.f.s.

2,530

7. Land Acquisition

Fee, Acres

1,775

8. Relocations.

a. State Highways

Kentucky 15 6.3 miles

Kentucky 160 3.7 miles

Kentucky 582 0.2 miles

Kentucky 1410 0.2 miles

b. County Roads

|                        |           |
|------------------------|-----------|
| Irishman Creek         | 3.3 miles |
| Defeated Creek - Kodak | 5.5 miles |
| Smith Branch           | 0.6 mile  |
| Trace Fork             | 0.2 mile  |

c. Public Utilities.

|                                    |             |          |
|------------------------------------|-------------|----------|
| Electric, (Kentucky Power Co.)     | Re location | 10 miles |
|                                    | Abandonment | 6 miles  |
| Telephone, (Thacker & Grigsby Co.) | Relocation  | 21 miles |
|                                    | Abandonment | 5 miles  |

9. Public Access.

Number of Sites 4

10. Reservoir Clearing.

Area, acres 175

11. Hydroelectric Power. None

12. Annual Charges. \$870,000

13. Annual Benefits.

|                          |               |
|--------------------------|---------------|
| a. Flood Control         | \$ 567,300    |
| b. Water Quality Control | 63,000        |
| c. Recreation            | 316,000       |
| d. Development           | <u>60,000</u> |
| TOTAL                    | \$1,006,300   |

14. Ratio, Benefits to Cost. 1.16 to 1

15. Construction Time. 3 1/2 years

## Carr Fork Lake

### Kentucky River Basin

#### Embankment Criteria and Performance Report

##### 1. General.

a. Authority. Authority for preparation of the Embankment Criteria and Performance Report for Carr Fork Dam is contained in ER 1110-2-1901, dated 1 August 1972.

b. Project Purpose. To furnish flood protection in the valley of the North Fork of Kentucky River and the lower Kentucky 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 a pool for recreation and fish and wildlife activities.

c. Project Location. The project is located on Carr Fork, a branch of North Fork of Kentucky River about 8.8 miles above their confluence, near Vicco, Kentucky. It is located about 160 miles southeast of Louisville, Kentucky and 150 miles south of Cincinnati, Ohio, in Knott County, Kentucky. The project location and vicinity map is shown on Plate 1. The general plans are shown on Plates 2 and 3.

d. History of Construction. The Outlet Works Contract DACW27-66-C-0050 for the construction of the operating tower, conduit, and stilling basin was awarded on 12 January 1966 to Markwell and Hartz, Inc. of Memphis, Tennessee and completed 31 January 1968. Contract DACW27-73-C-0009 for the construction of the dam and spillway was awarded to G.B. & Y.,

Inc. of London, Kentucky, on 23 July 1972 and completed on 30 November 1976.

SIGNIFICANT CONTRACT DATES

|                |                                                                                                                                                                       |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9 October 1972 | Started clearing outlet channel and damsite.                                                                                                                          |
| 16 April 1973  | Grouting program initiated.                                                                                                                                           |
| 23 May 1973    | Representatives of CD and ED visited site and decided insufficient weathered rock had been removed from the right abutment prior to grouting.                         |
|                | Grouting on this abutment was stopped. Six exploratory core holes were drilled and some additional rock removed by presplitting. Some dental work was also performed. |
| 19 June 1973   | Began placing material in cofferdam "C".                                                                                                                              |
| 12 July 1973   | Stream diverted through the conduit.                                                                                                                                  |
| 13 July 1973   | Grouting commenced again.                                                                                                                                             |
| 14 July 1973   | Began fill for temporary U.S. channel cofferdam "A".                                                                                                                  |
| 18 July 1973   | Cofferdam "A" completed. Cofferdam "B" started.                                                                                                                       |
| 21 July 1973   | Temporary cofferdam "B" completed.                                                                                                                                    |
| 23 July 1973   | Began excavating for permanent cofferdam.                                                                                                                             |
| 29 July 1973   | Temporary cofferdam "C" overtopped.                                                                                                                                   |
| 4 August 1973  | Repairing flood damage to cofferdam "C".                                                                                                                              |
| 14 August 1973 | Started material placement for permanent cofferdam main embankment.                                                                                                   |

|                  |                                                                                             |
|------------------|---------------------------------------------------------------------------------------------|
| 1 September 1973 | Permanent cofferdam completed to elevation 992.                                             |
| 4 October 1973   | Permanent cofferdam completed to elevation 1010.                                            |
| 11 October 1973  | Began cleaning dam foundation D.S. of permanent cofferdam for main embankment.              |
| 22 October 1973  | Began placing impervious core, transition stone, shale, and random fill in main embankment. |
| 21 November 1973 | Grouting at dam foundation completed.                                                       |
| 5 December 1973  | Placed 15 yards of bentonite concrete over coal seam, Station 16+38 Centerline of dam.      |
| 10 January 1974  | All work stopped for the winter.                                                            |
| 1 April 1974     | Contractor started placing fill in dam embankment again.                                    |
| 22 June 1974     | Pool at elevation 988.2                                                                     |
| 14 March 1975    | Pool at elevation 992.5.                                                                    |
| 11 April 1975    | Impervious core topped out at elevation 1080.                                               |
| 23 April 1975    | Dam embankment completed.                                                                   |
| 5 January 1976   | Outlet works gates put into operation.                                                      |
| 7 August 1976    | Dedication of lake.                                                                         |
| 17 October 1976  | Final Inspection of dam contract.                                                           |

## 2. Geology.

a. Project Area. The Carr Fork Reservoir site is located in the Pottsville series of the Eastern Kentucky Geosyncline coal measures. The area is characterized by deep, steep-sided, narrow V-shaped valleys, with pockets or areas of clayey colluvium from old landsides that are usually found on the concave side of the valley wall. The sharp crested divides vary from elevation 1450 to 1950 and the valley bottom is about elevation 950. The formations encountered in the core drillings are typical of the Pottsville series, and the coal measures area, being composed of recurring strata of hard, fine grain sandstone, carbonaceous to silty to sandy shale, shaly sandstone, and thin to thick coal seams with variable thickness of sandy indurated underclays and silty, carbonaceous roof shales. The No. 4 or Fire Clay coal is about 5 feet thick and is the marker strata for this section. This coal is extensively mined throughout the reservoir area. The top of dam is elevation 1083 and the Fire Clay coal is at a minimum elevation of 1115. The Elkhorn coal seam, about 42 inches thick, lies about 50 feet below creek bottom at elevation 905 at the damsite. Structurally, the formations generally dip about 35 feet per mile west to northwest. The dominant joint patterns are N 10 E and S 83 W. Producing gas wells are present throughout the reservoir area. Some wells are in the flood plain of the main stream; others are in tributary drainage channels and on valley walls.

b. Damsite. There is considerable lithologic variation in the bedrock strata at the damsite. The bedrock from about elevation 1260 varies from a hard, gray, fine to medium grain, medium to massively bedded sandstone capping the narrow ridge at the spillway site, downward through some five or six hard, variably silty to sandy shale strata, and fine, massively bedded, occasionally shaly sandstone strata, to elevation 905. Scattered fairly uniformly throughout this approximately 350-foot bedrock section are some 12 to 14 thin mineable seams of bituminous coal. The Fire Clay coal marker strata is about elevation 1115<sup>+</sup>, and is mined commercially. Mining the 42-inch Elkhorn coal seam at the lower elevation is limited because excessive quantities of water are frequently encountered. The right valley bank at the damsite, elevation 955-965 is about 200 feet wide, and overburden thickness varies from 6 feet in the streambed to about 18 feet on the high right bank flood plain. Laboratory tests made on comparable material from correlative strata at Buckhorn Dam gave an unconfined compressive strength of 3,580 psi for silty, carbonaceous shale and 1,100 psi for clay shales, and the sandstone strata are much stronger than the carbonaceous shale. The deeper portions of the Carr Fork Reservoir embankment were founded on sandstone overlying silty, carbonaceous shale. The strength of the founding strata at this project is considered satisfactory for the imposed load. The geologic profile of the dam axis is shown on Plate 6. For reference, boring location plans are presented on Plates 4 and 5.

c. Abutments. The abutments below the top of dam encompass two massive sandstone strata separated by a 60-foot thick silty to sandy shale stratum containing three thin coal seams. This coal is not mined commercially. The right abutment has a slope of about 2.25 horizontal to 1 vertical. Few bedrock outcrops are present. The thin Little Fire Clay coal seam, about 1.9 feet thick, occurs at about elevation 1092, some 9 feet above top of dam. Overburden thickness varies from zero at the sandstone outcrops to about 18 feet near the toe of the slope. The overburden soil is a sandy to silty clay with rock fragments. Primary weathering of bedrock is deeper in the thin bedded shale and shaly sandstone strata than in the more massive sandstone. It varies from 1 to 7 feet and averages about 2 feet in thickness in the sandstone and about 4 foot in the other strata. Bedrock is relatively watertight below elevation 985. Groundwater surface in the right abutment holes varies from a low elevation of 965 to a high elevation of 1055. The left abutment slope is steeper than that of the right abutment, being about 1.5 horizontal to 1 vertical. The slope has numerous sandstone outcrops. The thin Little Fire Clay coal outcrops at about elevation 1084 on this abutment. Overburden thickness varies from zero at the bedrock outcrops to about 15 feet in the area of old landslides and between Kentucky Highway 15 and the toe of the slope. The thin veneer of rocky, silty clay cover in the dam foundation and uphill from the road cut at station 1+20 varies from zero in thickness to 5 feet in the clay shale and coal zones. The material from the road excavation, spoiled downslope, averaged 8 to 12 feet in thickness. This spoil contained large size rock pieces. Primary weathering in bedrock averages

about 2 feet. Groundwater varies from a low elevation of 952 to a high elevation of 1063.

d. Spillway. The spillway is located on the narrow left abutment ridge some 200 feet upstream from station 0+00 of the dam. It has a width of 265 feet at crest elevation 1055, and a top width of about 460 feet. The spillway cut at the center is about 574 feet long. Ground surface at the left bank is elevation 1266 and at the right bank it is elevation 1174. The formations encountered in excavation of the spillway are typical of the area. Beginning in a sandstone at top, there are 7 medium thick to thick sandstone strata, 5 medium thick shale strata, and 6 coal seams. The commercially mineable Fire Clay coal is about elevation 1120. An abandoned opening into this coal is nearby upstream from the spillway site. The extent of mine operations in the area is not known; however, 5 mine rooms were encountered on the left side of the spillway. The sandstones and silty shale strata are well cemented. As evidenced by nearby highway excavation, the sandstone broke out in rather large pieces unless shot rather heavily. Pre-splitting was required. A concrete control structure was used. The strength and weathering characteristics of the series are satisfactory for the construction of the 200-foot deep cut. Side cuts of 4 vertical on 1 horizontal were used except for the predominantly shale sections on the left side of the spillway between elevations 1055 and 1120 and 1222-1262. These were cut to 2 vertical on 1 horizontal. Ten-foot wide berms were located at the base of the sandstone stratas below this elevation.

3. Foundation and Abutment Treatment. The core trench was stripped to solid rock first on both abutments so that the foundation grouting could be started. The foundation grouting program started on the right abutment. A double line grout curtain was initiated between stations 14+25 and 18+20; however, it was determined that the abutments within the core trench were not adequately stripped to unweathered rock or clean enough for grouting. All grouting efforts were ceased until the core area was cleaned. All grout holes were drilled with CP-65 air rotary collar or air track drills using EX diameter diamond plug bits. No sand or fly ash was used in the grouting on this project. A double line grout curtain was placed from station 10+35 to station 18+20. The split-space method was used when a hole took over 5 sacks of cement per zone or stage. In these cases, holes were split to a spacing of 2.5 feet to assure a tight foundation. Grout holes were drilled on 20° angles, into the abutments, except the angle was changed to get better coverage under the conduit. A normal, tight hole was drilled and grouted in two zones. The first zone drilling on the abutments was 20 feet deep and in the valley bottom 10 feet deep. The first zone grouting was done to cap off the upper layers of the foundation so that the second zone could be grouted at higher pressures to assure a tight foundation. Staging was done to the grout holes in two cases. If there was an appreciable amount of drill water loss, the hole was staged (stopped early), pressure tested and grouted before drilling to further depths. The other condition was when artesian flow was encountered. The drilling was stopped, artesian pressure measured, pressure tested, then grouted before drilling to further depths.

There were very few problems encountered during grouting. There were various joints encountered within the core trench in the embankment foundation and on the left abutment. These joints were cleaned out to a depth 3 times their width. They were then filled with a special non-shrinking, quick setting grout. There were seven coal beds exposed in the core trench. All of these received dental treatment, either concrete or mortar. On the left abutment, there were four coal beds; one at elevation 980.0 to 980.3, cleaned out 1 foot in depth and filled with mortar the width of the core trench; two at elevation 1025.3 to 1026.3 and 1027.5 to 1028.0 with a shale layer between them. These two coal beds were cleaned out altogether, along with the shale layer, the width of the core trench, 1-foot deep, and filled with concrete. One coal seam at elevation 1056.7 to 1056.9 along with 0.7 foot of underclay was cleaned out 1 foot in depth and filled with concrete. On the right abutment there were three coal seams; one at elevation 988.5 to 988.7 cleaned out, 1-foot deep, the width of the core trench, and filled with mortar; two beds from elevation 1048.1 to 1049.6 with a shale layer between them from 1048.5 to 1049.2 were cleaned out the width of the core trench, 1-foot deep and filled with concrete. During an optional 50-foot widening of the left wall of the spillway to obtain more rock for the embankment construction, 5 mine rooms were encountered during presplitting operations. These rooms are in the Hazard #4 coal seam from elevation 1120 to 1124. These openings were sealed with concrete to prevent any further deterioration, and to prevent entry by visitors. 1415 cubic yards of concrete was used. The foundation treatment is shown on Plate 8.

#### 4. Embankment.

a. General. The embankment section utilized the suitable required excavation from construction and borrow from the designated areas in the upstream valley and the left abutment. The embankment was constructed to elevation 1083 for a maximum height of 132 feet above bedrock. Crest width is 30 feet. The length of the dam is 753 feet at the crown. The structure is arched upstream on about a one degree curve. The upstream slopes are 1 on 2.5 down to elevation 1061 then 1 on 3 down to elevation 992, a 25.3 foot berm and then 1 on 3 down to the toe. The downstream slopes are 2.5 to 1. The dam is constructed on bedrock with a central impervious core and random earth and rock fill shells. The core is symmetrical with slopes of 1 horizontal to 8 vertical. The random material was obtained from the spillway excavation. A 10-foot horizontal thickness of graded transition material was placed between the shale and impervious fills on the upstream section and between the impervious and shale fills and impervious and random earth fills on the downstream section. The area under the impervious core required special foundation treatment consisting of removal of any soft and weathered rock to be accomplished before grouting began. Select material from the spillway excavation was placed to a minimum normal thickness of 10 feet on the upstream slope to provide protection against wavewash. This protection is provided from top of embankment to elevation 1004 (5 feet below minimum pool). Shale fill a minimum normal thickness of 10 feet was provided on the downstream slope down to elevation 1012. The random rock fill was placed in lifts not to exceed 2 feet in thickness and was compacted by 4 passes of a 50-ton rubber tired roller. The coarse

material was bladed toward the outer slope and the fines were bladed against the shale fill. The impervious fill was compacted by 6 passes over each 6-inch lift with a sheeps foot roller. At least 95 percent standard density was obtained by this method. The coal seams in the left abutment under the embankment required special treatment. This consisted of cleaning the coal and soft shale out of the abutment face for a distance of about a foot and refilling with concrete or mortar. A 12-foot horizontal thickness of shale was placed between the transition zones and the random earth and rock fills. This material was obtained from the spillway excavation and compacted with a self propelled Caterpillar 825B. The lifts did not exceed 12 inches in thickness and the number of passes was two. The site plans and typical dam sections are shown on Plates 9 through 11.

b. Material Sources. Approximately 946,000 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 is presented below.

#### Impervious

| <u>Designation</u> | <u>Source</u>                               |
|--------------------|---------------------------------------------|
| Storage "A"        | Stockpile from relocation<br>at Highway 15. |
| D.S. Storage       | Stockpile from stripping of<br>dam area.    |
| Borrow "A"         | Upstream right descending<br>valley.        |

Area "OA"

Upstream left descending  
valley.

Rock

Spillway Excavation

Upstream Rock Borrow

Upstream right descending  
valley.

The Materials Usage Charts are shown on Plates 12 and 13.

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

Sheepsfoot Rollers.

- a. Ferguson Model #22-MOD
- b. Towed
- c. Drums: Number - 2, diameter - 5 ft., length - 6 ft.
- d. Tamping foot
  1. Base area - 7.5 in.<sup>2</sup>
  2. Shape - Trapezoidal with rectangular cross section.
  3. Length - 9.5 in.
  4. Number/drum - 144
  5. Number/row - 18
  6. Number rows - 8
- e. Roller weight
  1. Empty - 26,850 lbs.
  2. As used - 50,000 lbs.
- f. Foot pressure - 417 psi

- g. Cleaners and frame
  - 1. Teeth on frame between feet
  - 2. Rigid frame
- h. Speed of travel during compaction
  - 1. Specified - 5 mph max.
  - 2. Actual - 4 mph

Vibratory Rollers.

- a. Raygo Rascals Dynamic 400
- b. Self propelled
- c. Drum
  - 1. Number - 1
  - 2. Diameter - 59 in.
  - 3. Length - 84 in.
- d. Static roller weight - 17,900 lbs.
- e. Dynamic pressure - 27,000 lbs.
- f. Vibrating frequency - 1100 to 1500 VPM

Pneumatic - Tired Rollers.

- a. W. E. Grace Mfg. Co. Model Y-18
- b. Tires
  - 1. Number - 4
  - 2. Size - 18.00X25
  - 3. Ply rating - 32
  - 4. Spacing - 10.5 in.

c. Roller width, weight, and tire pressure

1. Width - 93"
2. Weight: As used - 70 tons.
3. Tire pressure - 90 to 100 psi

d. Contact pressure - 100 psi

e. Speed of travel

1. Specified - 5 mph; max.
2. Actual 4 - 5 mph

Tamping Rollers.

a. Caterpillar 825B

b. Self propelled

c. Drum

1. Number - 4
2. Diameter - 51 in.
3. Length - 44.5 in.

d. Tamping foot

1. Base Area - 29.75 in.<sup>2</sup>
2. Length - 7.5 in.
3. Number/wheel - 65
4. Number : w - 13
5. Number : ows - 5

e. Roller weight

1. As used - 67,760 lbs.

f. Foot Pressure - 114 psi

d. Materials Placement.

(1) Impervious Zone. The impervious fill consisted of SC and SC-SM materials. The material was spread in 8-inch loose lifts where the sheepsfoot roller was used and 4-inch loose lifts in areas inaccessible to the towed sheepsfoot roller and compacted by a mechanical hand tamper. Six passes of the sheepsfoot roller and 3 with the hand compactor were used to obtain compaction. The moisture content permitted by the specifications was between plus or minus 2 percentage points of optimum. However, it was found that some material could not be placed without deformation with moisture content approaching plus 2 percentage points of optimum. Some material placed with a moisture content of between plus one and two percentage points of optimum had to be removed, aerated, and placed again.

(2) Transition Zone. The material for this zone consisted of crushed limestone obtained from a commercial quarry. This material was spread in 12-inch loose lifts and compacted by four complete passes with a Raygo Rascal Dynamic 400 vibratory roller. No moisture control was required on the graded aggregate zones.

(3) Shale Fill. The shale was spread in 12-inch loose lifts. These zones were compacted by two passes with a 825B Caterpillar tamping roller. The shale was placed at the natural moisture content.

(4) Random Fill. This material consisted of sandstone and shale spread in 24-inch lifts. The random fill zone was compacted by 4 complete passes of a pneumatic-tired roller.

(5) Random Earth Fill. The specifications called for this material to be spread in 12-inch lifts and compacted by 4 complete passes of a rubber tired roller. However, the Contractor requested to place this material in 8-inch lifts and roll with a sheepsfoot roller and this method was permitted. The upper limit of moisture control was 3 percentage points above optimum.

The distribution of density tests performed on the impervious material, transition material, shale fill, random fill and random earth fill are shown on Plates 14 through 18. A summary of field compaction control test data and design placement requirements for the dam is shown on Plate 19. The laboratory compaction proctor curves are shown on Plates 20 and 21.

e. Seepage Control. To insure water tightness at the foundation, a double line grout curtain was constructed along the centerline of the dam. Design seepage computations through the impervious zone were based upon a permeability coefficient of  $0.015 \times 10^{-4}$  feet per minute based upon test of composite samples from the borrow areas. Seepage was computed for the seasonal pool at elevation 1027 for an extended length of time. Based on the design and the low permeability of the soil, seepage through the dam is not considered a problem.

To prevent migration of the impervious materials from the core zone, a 10-foot wide transition zone was constructed on both upstream and downstream sides of the core. The material was reasonably well graded between the following limits.

| <u>Sieve Size</u> | <u>%Passing</u>           | <u>%Passing</u>        |
|-------------------|---------------------------|------------------------|
|                   | <u>Prior to July 1974</u> | <u>After July 1974</u> |
| 2-1/2"            | 100                       | 100                    |
| 2"                | 90-100                    | 90-100                 |
| 1"                | 65-85                     | 65-100                 |
| 3/8"              | 35-65                     | 35-75                  |
| #4                | 25-55                     | 20-60                  |

| <u>Sieve Size</u> | <u>% Passing<br/>Prior to July 1974</u> | <u>% Passing<br/>After July 1974</u> |
|-------------------|-----------------------------------------|--------------------------------------|
| #40               | 10-25                                   | 5-25                                 |
| #200              | 0-10                                    | 0-10                                 |

f. Shear Strengths. Because of the low "Q" shear strength and high organic content of the foundation overburden materials, it was determined that these materials were to be removed. The "R" strengths for the impervious borrow material was adopted on a weakest material concept. The "S" strengths for the impervious materials were all essentially the same; therefore, the adopted value is based on a numerical average of the shear test values. Optimum plus 2 percent is considered a realistic design moisture content. A plot of shear strength versus percent wet of optimum was made to determine "Q" shear strength. The shear strengths of the random material were based on a limited number of tests. The adequacy of these shear strengths was confirmed with subsequent testing at other projects.

TABLE 1

| Material   | $\gamma_d$         | $\gamma_m$         | $\gamma_s$         | $\gamma_b$         | Shear | Values |                              |
|------------|--------------------|--------------------|--------------------|--------------------|-------|--------|------------------------------|
|            | lb/ft <sup>3</sup> | lb/ft <sup>3</sup> | lb/ft <sup>3</sup> | lb/ft <sup>3</sup> |       | C      |                              |
|            |                    |                    |                    |                    |       | Test   | Tan $\phi$ T/FT <sup>2</sup> |
| Impervious | 110.2              | 125.0              | 131.0              | 65.0               | Q     | 0.00   | 0.70                         |
|            |                    |                    |                    |                    | R     | 0.43   | 0.20                         |
|            |                    |                    |                    |                    | S     | 0.60   | 0.00                         |
| Random     | 110.2              | 135.0              | 140.0              | 77.5               | Q     | 0.65   | 0.00                         |
|            |                    |                    |                    |                    | R     | 0.29   | 1.20                         |
|            |                    |                    |                    |                    | S     | 0.65   | 0.00                         |

The composites used to determine the adopted soil design values are shown on Plates 37 through 41.

g. Stability Analyses. The embankment section has been subjected to analysis by the sliding wedge and block method. The adopted shear test values were used in analysis. The methods used in the analysis follow the procedures outlined in Appendix IV, EM 1110-2-1902. The slopes were analyzed for end of construction, steady seepage, partial pool and sudden drawdown. Since the damsite is not located in an area of seismic activity, no earthquake analysis was considered. Cases studied along with values obtained are presented below:

Table 2

| <u>Case</u>                         | <u>Slope</u> | <u>Minimum<br/>Safety Factor</u> | <u>Required<br/>Safety Factor</u> |
|-------------------------------------|--------------|----------------------------------|-----------------------------------|
| End of Construction                 | U.S.         | 2.27                             | 1.30                              |
| End of Construction                 | D.S.         | 1.81                             | 1.30                              |
| Sudden Drawdown<br>(Maximum Pool)   | U.S.         | 1.92                             | 1.00                              |
| Sudden Drawdown<br>(Spillway Crest) | U.S.         | 1.80                             | 1.20                              |
| Partial Pool                        | U.S.         | 2.24                             | 1.50                              |
| Steady Seepage                      | D.S.         | 1.87                             | 1.50                              |

It was not considered necessary to reanalyze the cases studied under the original analysis because of the type of changes made during preparation of the contract plans. The embankment was rezoned slightly and the top of dam was raised 2 feet. The stability analyses are shown on Plates 22 through 27.

5. Diversion and Closure.

a. Diversion. The sequence of construction is shown on Plate 7. Due to the late contract award of 25 July 1972, only clearing of the outlet channel and damsite was accomplished during the 1972 season. Cofferdam construction was initiated with cofferdam "C" around the control tower excavation which later became a part of the permanent embankment. Diversion through the outlet works was accomplished on 12 July 1973 by constructing a small dike across the upstream channel. The outlet works conduit was constructed, in an open cut, of reinforced concrete in 20-foot monoliths. In the impervious zone of the dam, lean concrete fill was placed on each side of the conduit to the top of the extrados. Three seep rings were placed around the conduit in this area. Beyond the impervious zones, compacted earth fill was placed to the top of the conduit or to the top of rock. Cut slopes are 4 on 1 in rock and 1 on 1.5 in earth. Then temporary cofferdams "A" in the upstream channel area and "B" in the downstream channel area were constructed by dragline excavation of a minimum 4-foot wide cut-off trench to the gray shale bedrock and backfilled to original ground by placing impervious fill. Design top elevation at temporary cofferdam "A" was 970 and temporary cofferdam "B" was 960. The temporary cofferdams were completed by 21 July 1973. On 23 July 1973 the excavation for the main embankment in the area of the permanent cofferdam was initiated. On 29 July 1973, cofferdam "C" was overtopped and cofferdam "B" was breached to prevent possible failure and a wall of water being released downstream. The cofferdams were repaired after the water subsided.

b. Permanent Cofferdam. The excavation for the permanent cofferdam was initiated on 23 July 1973, and permanent cofferdam embankment placement was initiated on 14 August 1973. By 1 September 1973, the permanent cofferdam was completed to the designed elevation of 992. Placement continued in the permanent cofferdam to elevation 1010 by 15 September 1973. On 11 October 1973, the cleanup of the dam foundation downstream of the permanent cofferdam was initiated and impervious core placement was initiated on 22 October 1973.

6. Changes in Design and Modifications.

a. Revised Spillway Width. Subsequent to award of the contract, a recomputation of quantiles was made and it was determined that construction of the dam embankment with excavation of the spillway as indicated by the contract drawings would result in a rock shortage of approximately 37,000 cubic yards. In addition, weather conditions delayed planned construction progress to the point where it was deemed necessary to utilize some of the fill (shale and sandstone from the spillway) in the random earth zone. This utilized rock from the spillway resulted in a further shortage of 13,000 cubic yards.

The top area of the embankment above elevation 1030 and downstream of the random fill was to be constructed of Random Earth or Random Fill. The Random Earth was to be obtained from designated areas upstream of dam if suitable at the time of need. However, the areas were subject to inundation and the suitability of the material could not be determined until

the time of need. Therefore, it was determined that 30,000 cubic yards of additional rock should be provided in the planned spillway widening as an alternate source for this zone if found to be required. Therefore, the spillway was widened 50 feet along the left side from the beginning of the cut to provide a total of 80,000 additional yards of rock from the spillway.

b. Revised Gradation of Graded Aggregate. Subsequent to the award of the contract and after placing 19,270 cubic yards of transition material, it became evident that the sole supplier of Graded Aggregate for use in the transition zone could not consistently meet the gradation requirements of the contract. Review of the gradation requirements showed that the gradation could be liberalized and still retain its function. Therefore, it was deemed necessary and in the best interest of the Government to modify the contract specifications with a revised gradation for graded aggregate to prevent delays with the embankment and future impoundment. The revised gradation is shown under Seepage Control.

c. Rezoning of Dam Embankment. As the dam neared completion it was determined that sufficient rock was not available from the contract sources and the Contractor was directed as a change order to use random earth fill in lieu of the option of using random earth or random fill (rock). This revision made the following changes:

1. Eliminated shale and transition zones on upstream side at elevation 1038.

2. Continued graded aggregate transition zone to elevation 1055 on downstream side.
3. Eliminated shale zone on downstream side at approximate elevation 1030.
4. Use random earth to bring the downstream side up in the area of the existing bench at elevation 1012.
5. Use a 10-foot wide shale zone on downstream edge of fill slope.
6. Use a 10-foot wide shale layer back of the sandstone facies on the upstream face.

After proceeding with the random earth fill to elevation 1046 the embankment placement was stopped due to pumping and heaving, as a result of excessive moisture, on 20 September 1974. Investigation resulted in cancelling the previous change order to use random earth fill because the random earth fill was found to be unsatisfactory. About 5 feet of the random earth embankment was removed from the upstream side down to stable material. The specifications allowed for the placement of this material with up to plus 3 percent moisture of optimum and there was an abnormal amount of rain for this time of the year. At this time, it was decided to investigate an additional rock borrow area.

On 24 September, it was decided to go back to the original design with the shale zones, graded aggregate zones, with random rock on the upstream side and random earth on the downstream side with a 12-foot wide zone of shale on outside face of the downstream slope. The necessary rock to complete the embankment was obtained from a rock borrow upstream of the dam on the right descending side of the valley.

## 7. Instrumentation.

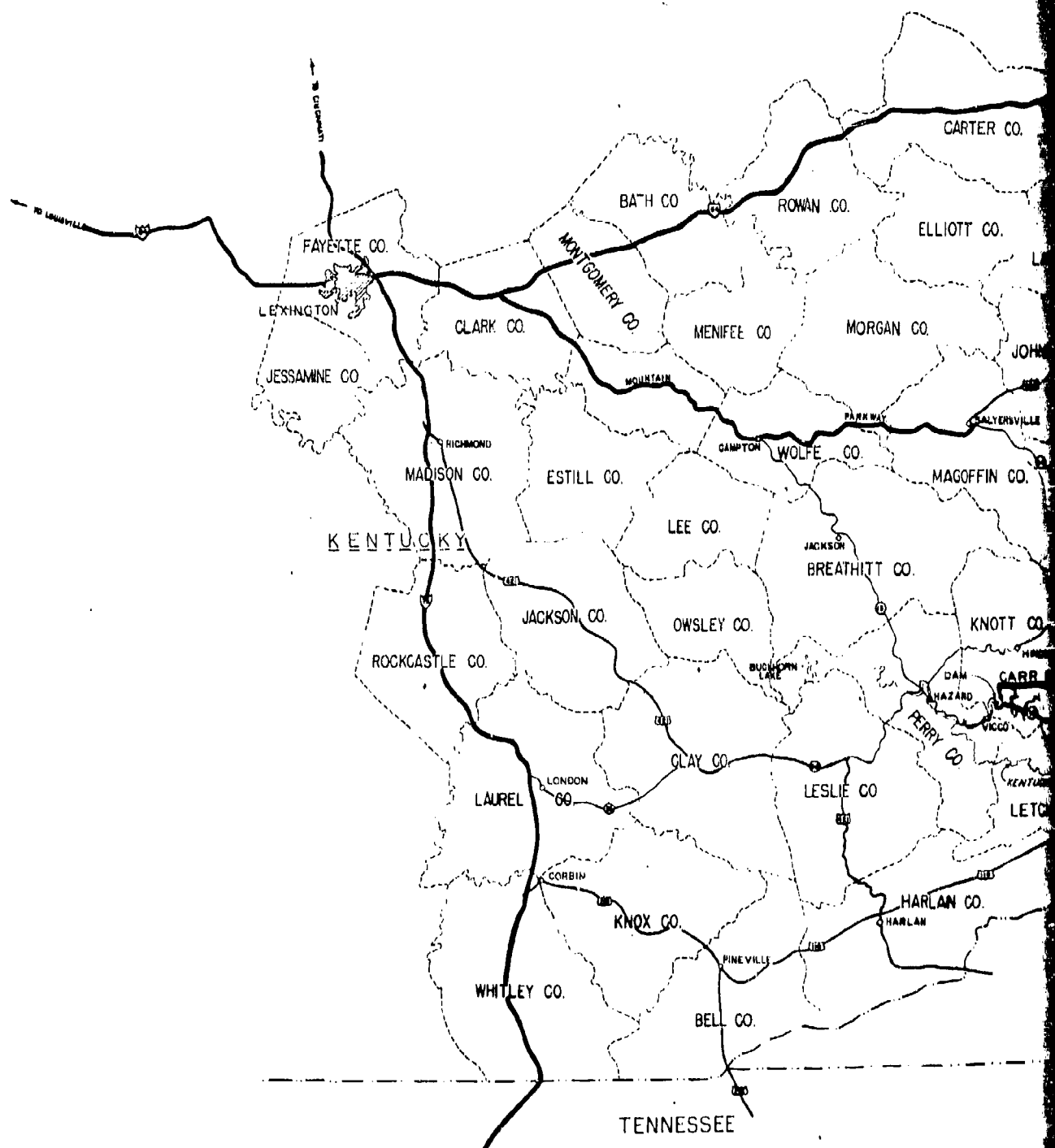
a. General. No instrumentation was installed or monitored during construction of the embankment. After the embankment was topped out four Casagrande type piezometers were installed in the impervious core with lines of movement monuments installed on the crest and midway on the upstream and downstream slopes. As a result of the periodic inspections, two wellpoint piezometers were installed near the downstream toe of the embankment prior to impoundment. Instrumentation plans, details and sections are shown on Plates 28 and 29.

b. Piezometers. The piezometers located near the upstream face of the impervious core react almost directly with the pool while the piezometers located near the downstream face show a significant drop. These piezometers indicate the expected seepage line through the impervious core and confirm the effectiveness of the core. The wellpoint piezometers located near the downstream toe of the embankment indicate that the random rock fill is free draining with no pore pressure buildup at the downstream toe. Instrumentation readings taken to date do not indicate any excessive piezometric conditions. The piezometer plot is shown on Plate 30.

c. Movement Markers. Movement monuments on the slope were installed prior to impoundment while the line across the crest was installed during the initial filling of the lake. Instrumentation readings taken to date do not indicate any significant movement of the embankment.

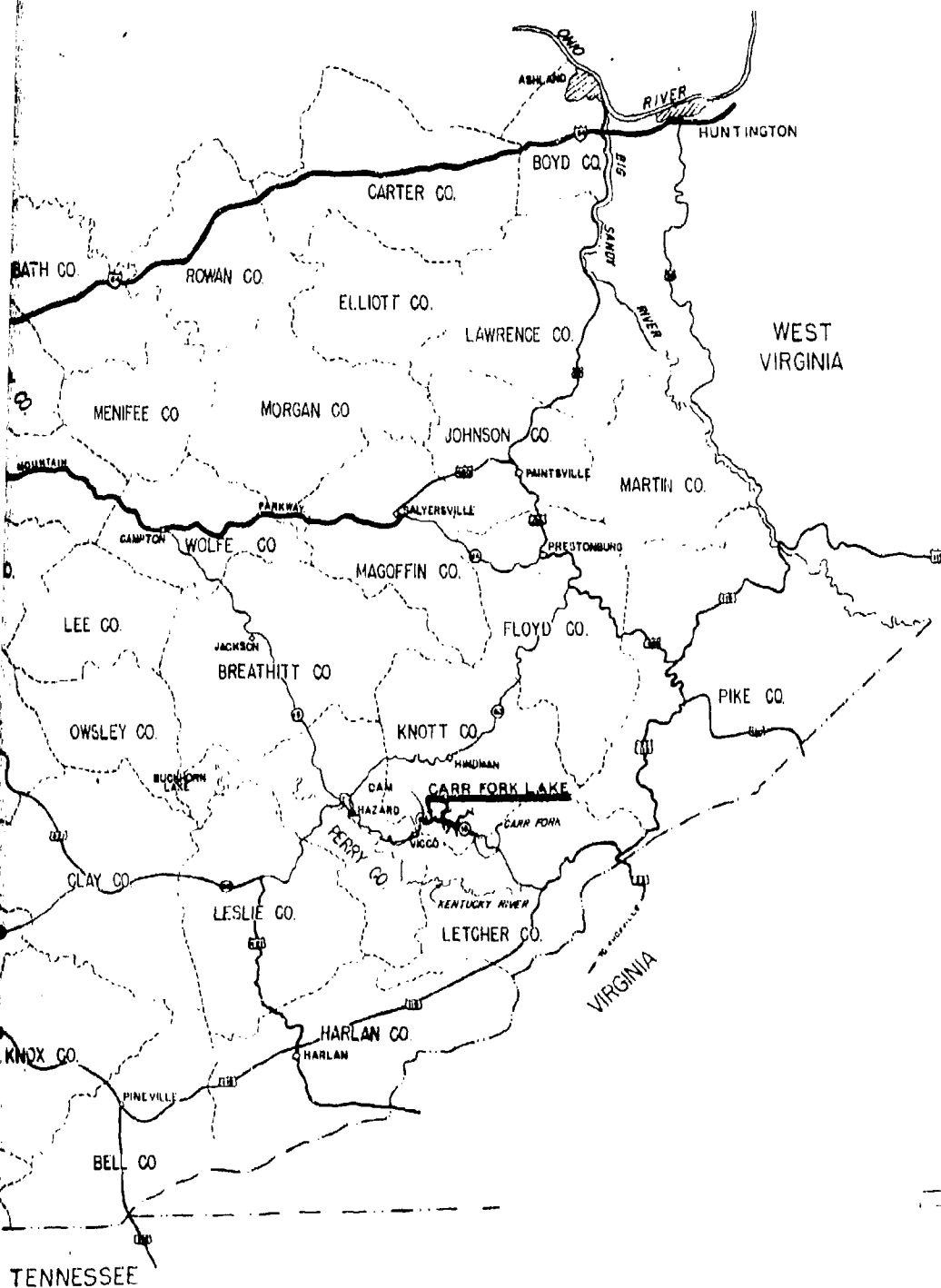
The horizontal and vertical movement plots are shown on Plates 31 through 36.

d. Service Bridge Monumentation The movement markers installed on the service bridge have been monitored and do not indicate any significant movement.





VICINITY MAP  
SCALE IN MILES  
0 10 20 30 40 50 60 70 80 90 100



DRAWING SCALE:  
1" = 5 MILES

| DATE | DESCRIPTION | BY |
|------|-------------|----|
|      |             |    |
|      |             |    |
|      |             |    |

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

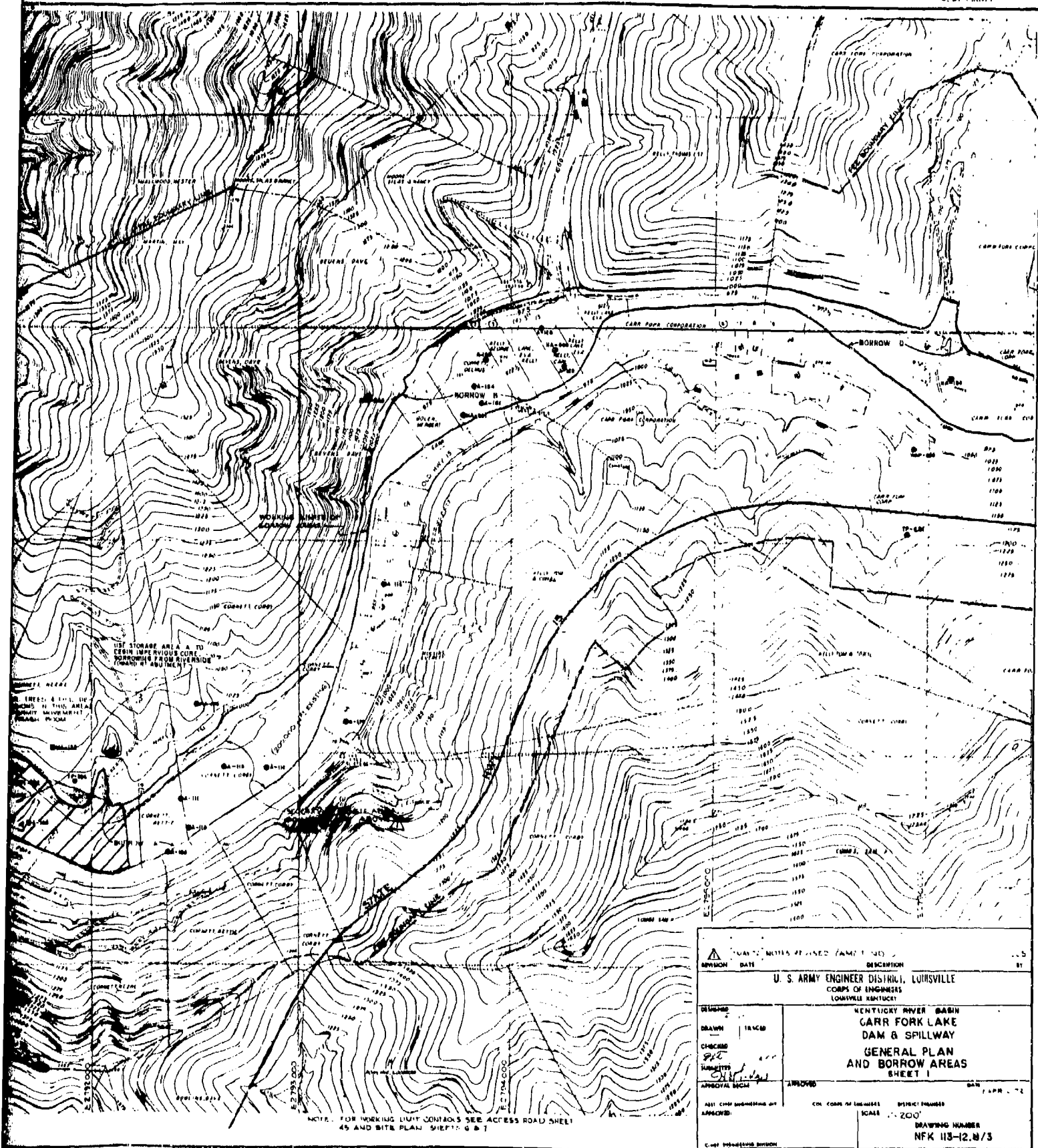
DESIGNED BY  
CHECKED BY  
APPROVED BY  
SCALE

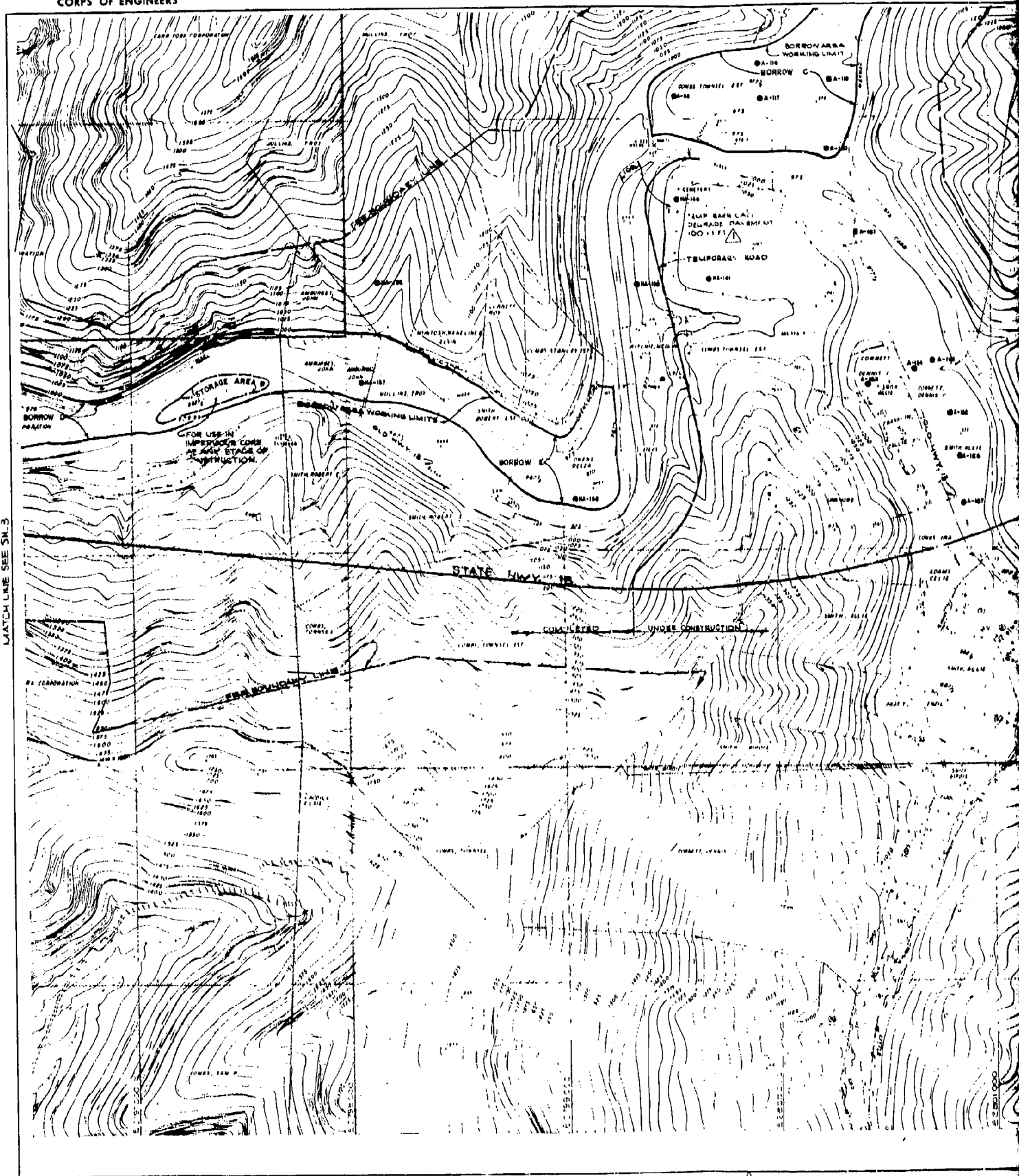
KENTUCKY RIVER BASIN  
CARR FORK LAKE  
DAM & SPILLWAY  
PROJECT LOCATION  
AND VICINITY MAP

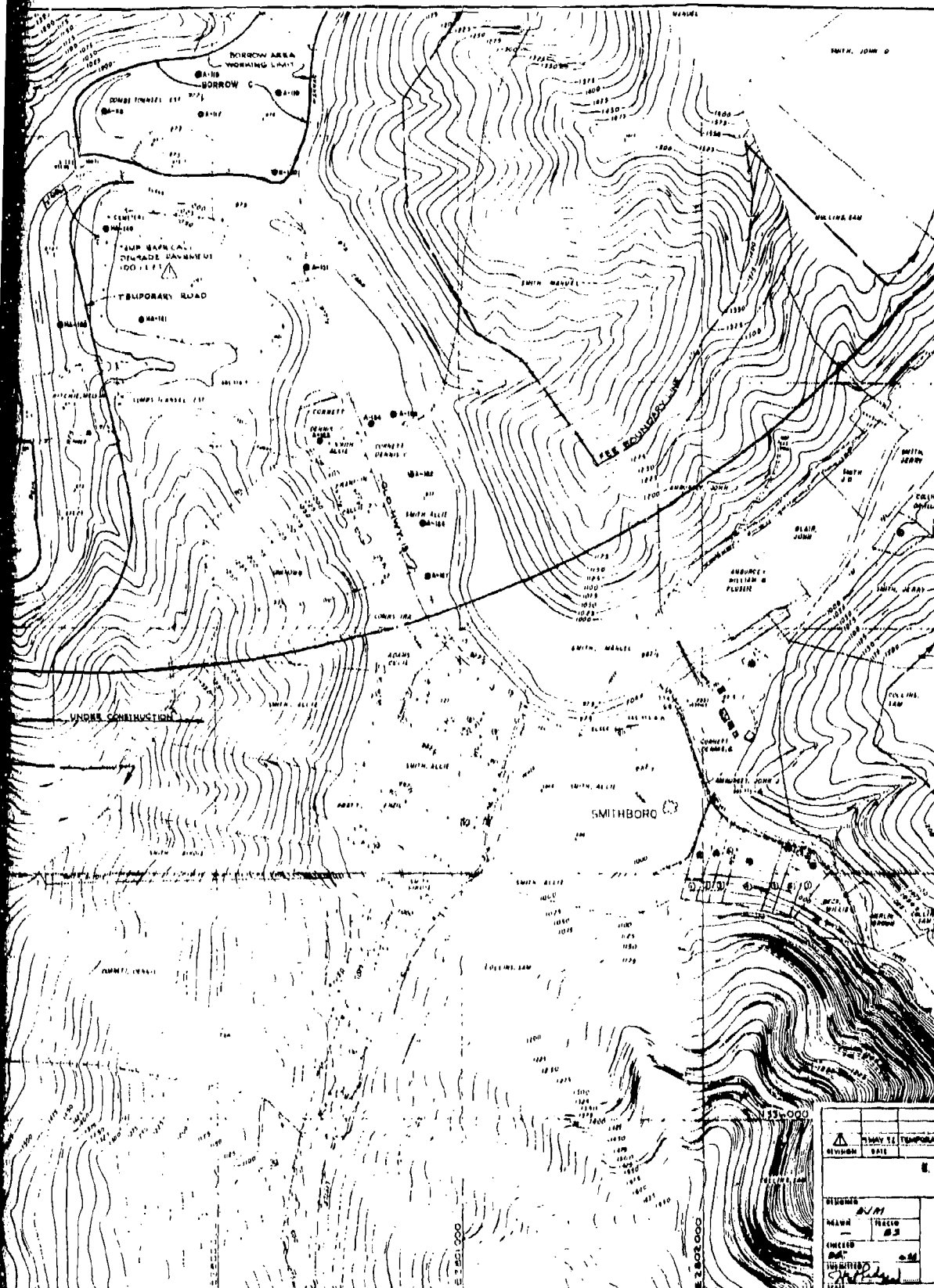
DATE APRIL 1, 1978  
DRAWING NUMBER  
DPM 43-12.5/8

PLATE 3

NOTE. FOR WOMEN  
45 AND 1







N 340000

N 339 000

N 338 000

FEE BOUNDARY LINE

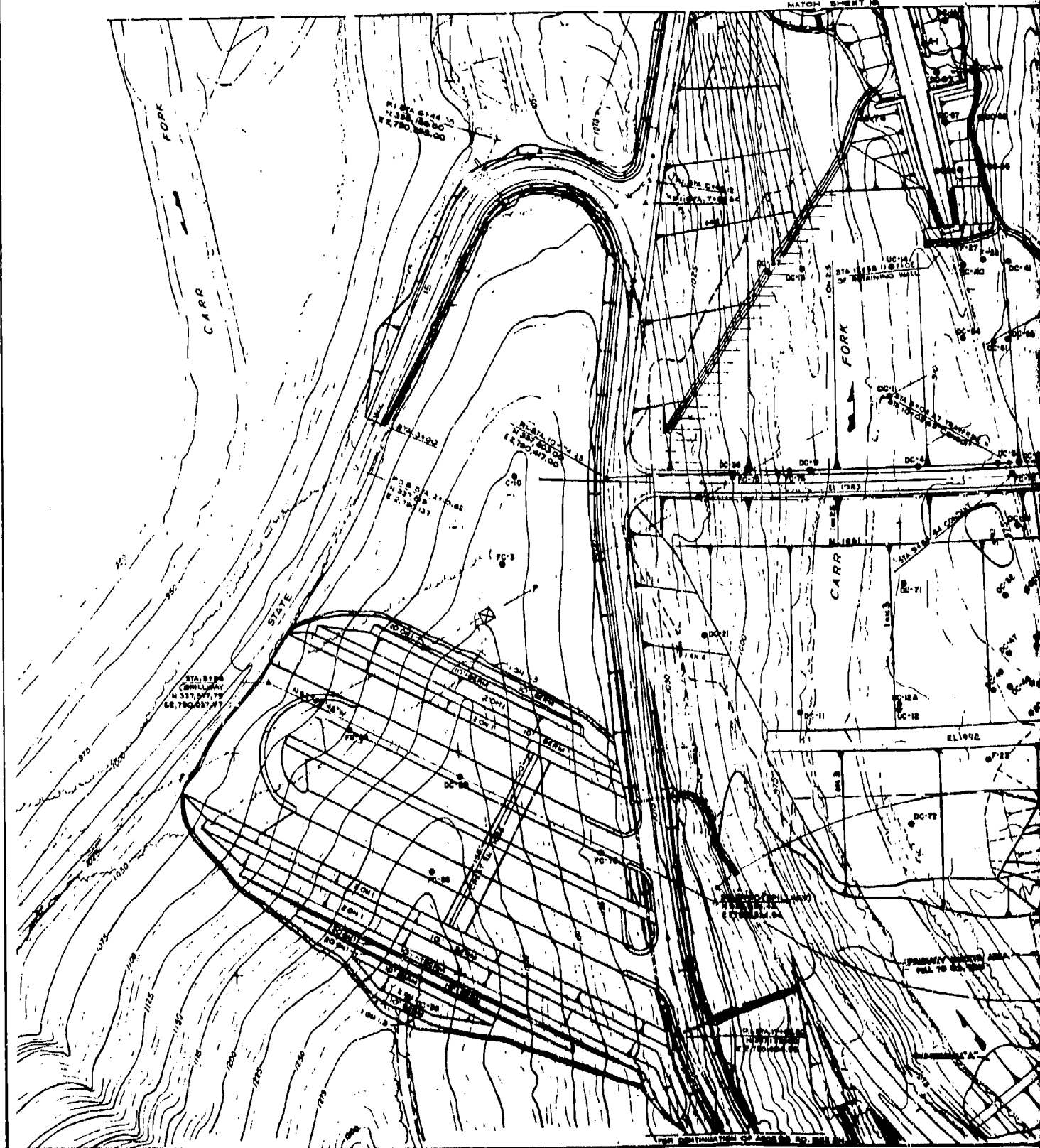
NOTE:  
ANY BUILDINGS SHOWN INSIDE BORROW  
AREA LIMITS THAT INTERFERE WITH  
CONTRACTORS OPERATIONS MAY BE  
REMOVED BY THE CONTRACTOR.  
(SOME OF THE BUILDINGS SHOWN HAVE  
ALREADY BEEN REMOVED.)

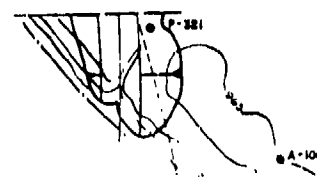
N 337 000

0 100 200  
SCALE IN FEET

|                                                          |        |
|----------------------------------------------------------|--------|
| THAT IS TEMPORARY BARRICADE (MAY BE ADDED) (ALERT 100-1) |        |
| REVISION                                                 | DATE   |
| U. S. ARMY ENGINEER DISTRICT, MEMPHIS                    |        |
| COPIES OF DRAWINGS                                       |        |
| LITHOGRAPH, REPRODUCED                                   |        |
| DRAWN                                                    | BY     |
| NEARBY                                                   | TRACED |
| CHECKED                                                  | BY     |
| APPROVED                                                 | BY     |
| MEMPHIS FOR THE                                          |        |
| GARRISON L.                                              |        |
| GARRISON L.                                              |        |
| GENERAL PLAN                                             |        |
| AND BORROW AREAS                                         |        |
| SHEET 2                                                  |        |
| DATE APRIL 9, 1978                                       |        |
| DRAWING NUMBER                                           |        |
| NPK 13-12.8/4                                            |        |

114713 B





INSERT

DC-2

DC-8 - STA. 9+40 TRANSVERSE

N 137, 250

N 137, 250

N 137, 250

NOTE:  
FOR GRAPHIC LOGS OF BORINGS  
WITHIN CONDUIT AREA SEE  
REFERENCE DRAWINGS.

SCALE: 1" = 50'

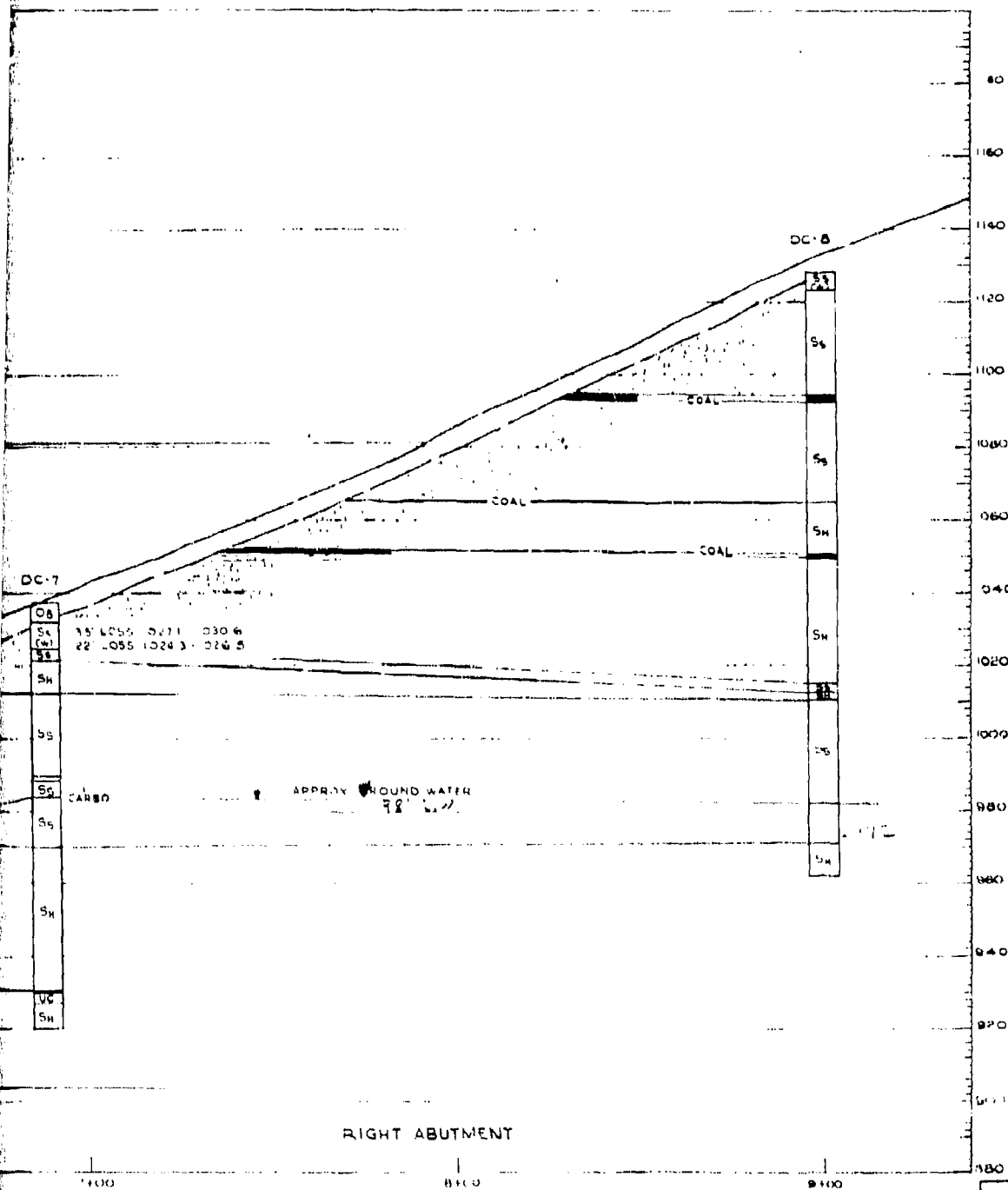
|                                                                                                                       |  |          |  |                                  |  |             |  |
|-----------------------------------------------------------------------------------------------------------------------|--|----------|--|----------------------------------|--|-------------|--|
| DIVISION                                                                                                              |  | DATE     |  | DESCRIPTION                      |  | BY          |  |
| U. S. ARMY ENGINEER DISTRICT, LOUISVILLE<br>CORPS OF ENGINEERS<br>LOUISVILLE DISTRICT                                 |  |          |  |                                  |  |             |  |
| ENGINEER                                                                                                              |  | DESIGNER |  | CHECKED                          |  | DATE        |  |
| EIN                                                                                                                   |  | RHO      |  | G.T.S.                           |  | 7 APRIL '78 |  |
| KENTUCKY RIVER - BASIN<br>CARR FORK LAKE<br>DAM & SPILLWAY<br>BORING LOCATION PLAN -<br>DAM AND SPILLWAY<br>SHEET - I |  |          |  | DRAWING NUMBER<br>NFM 83-12.8/17 |  |             |  |

PLATE 1



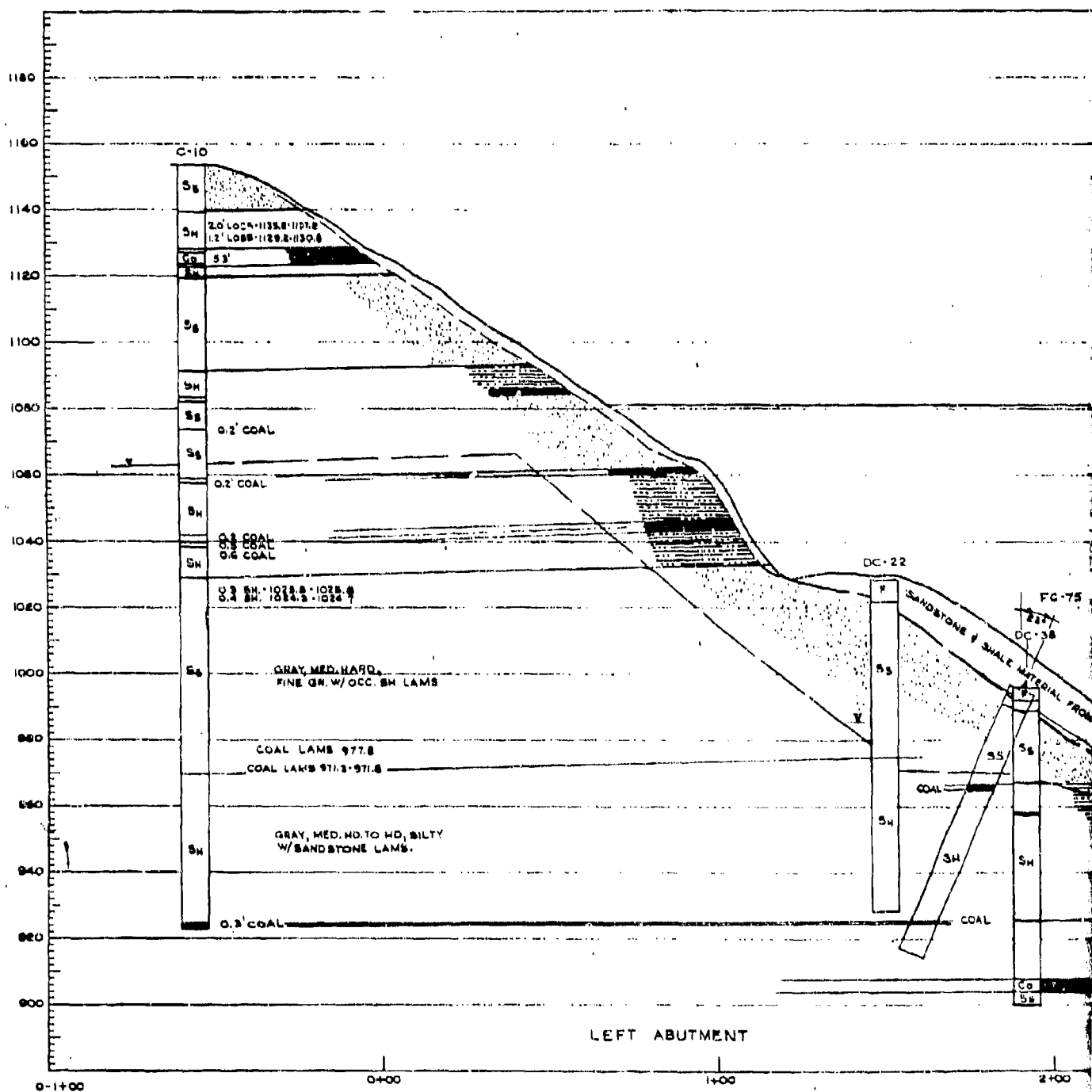




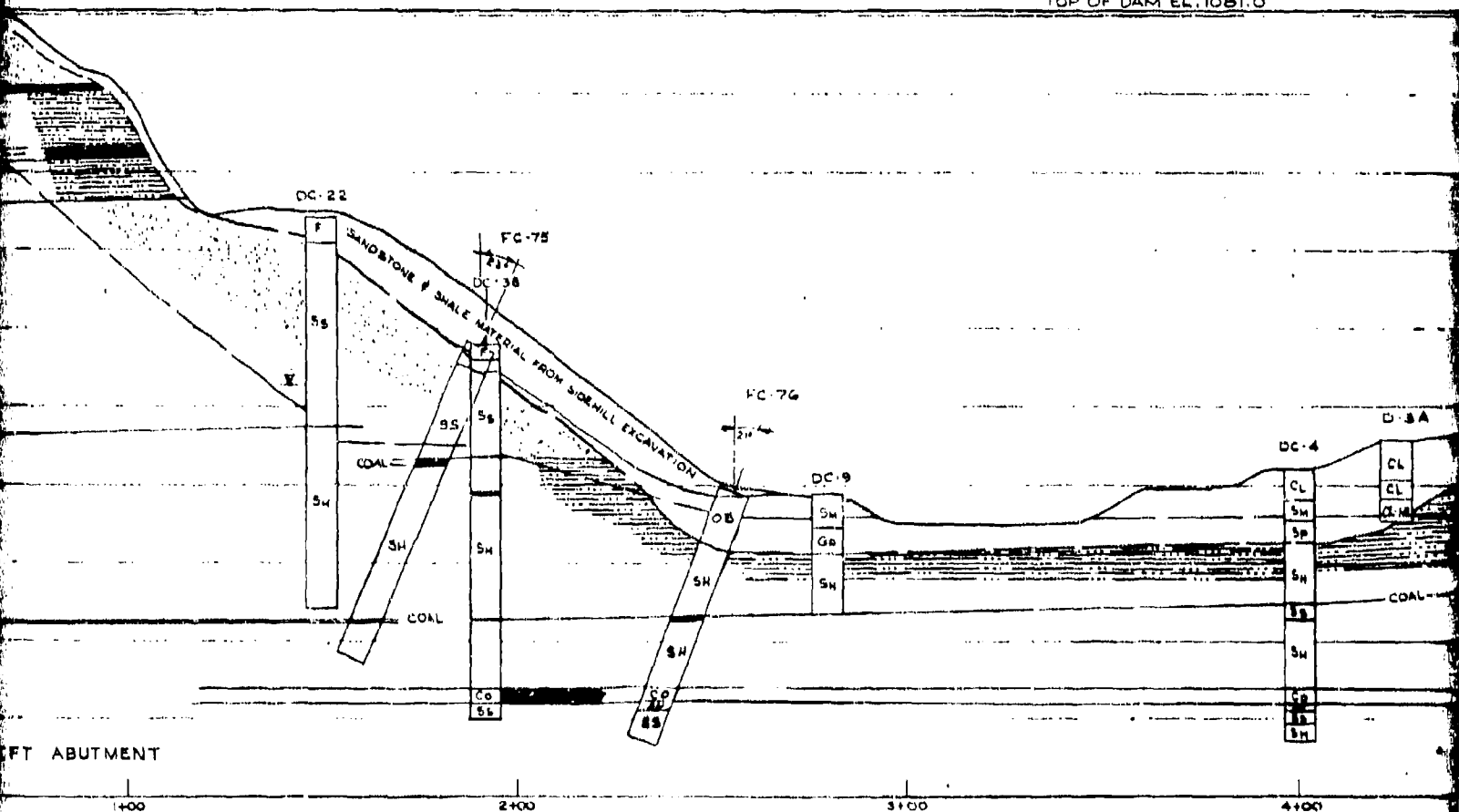


KENTUCKY RIVER BASIN, KY.  
CARR FORK RESERVOIR

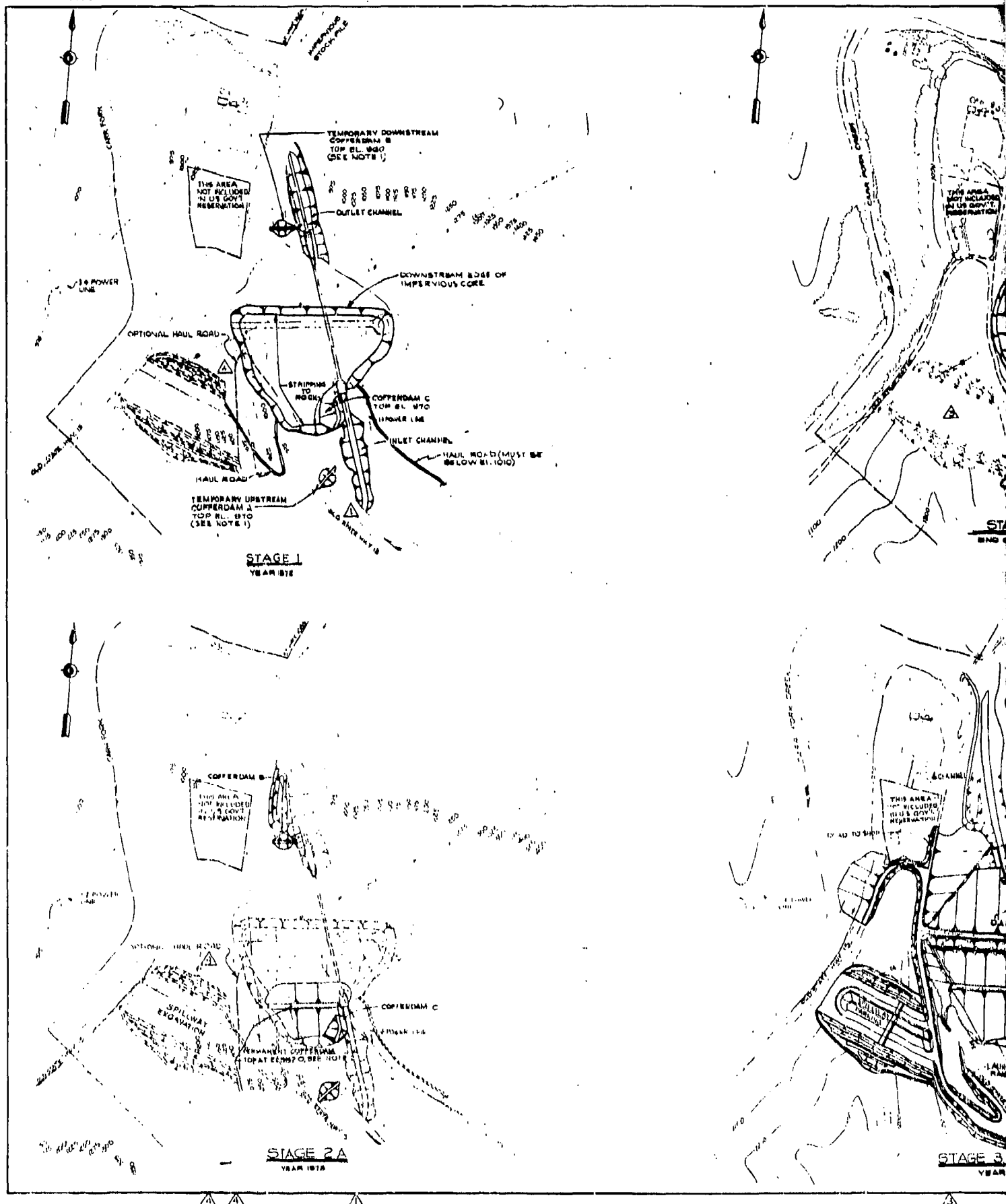
GEOLOGIC PROFILE  
ON DAM AXIS

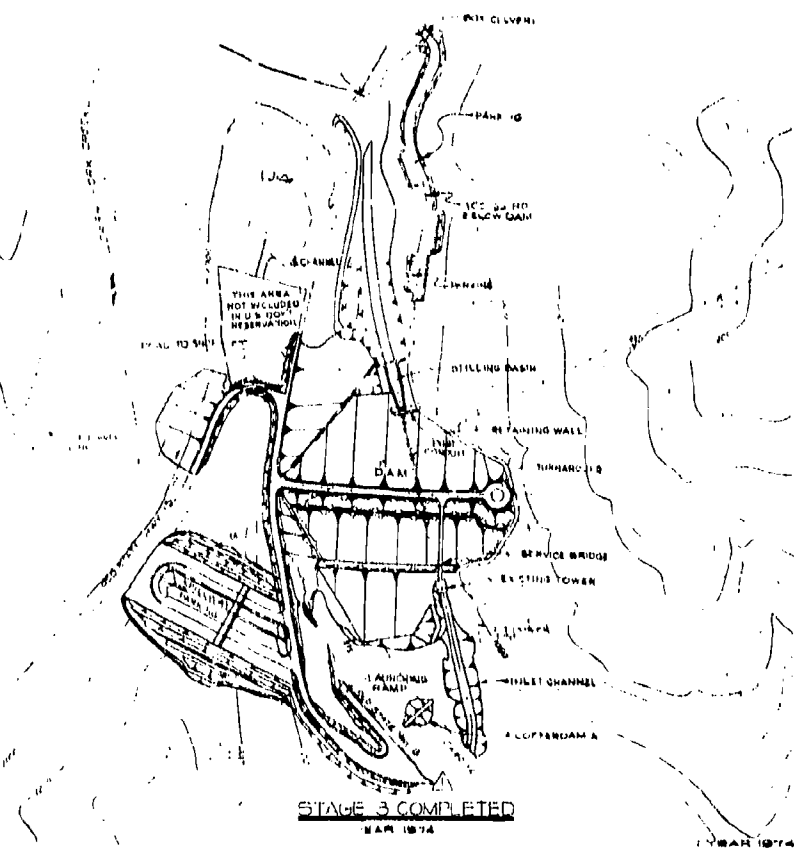
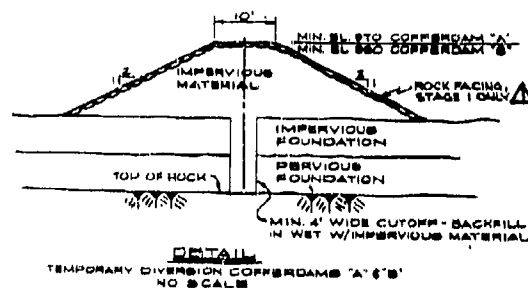
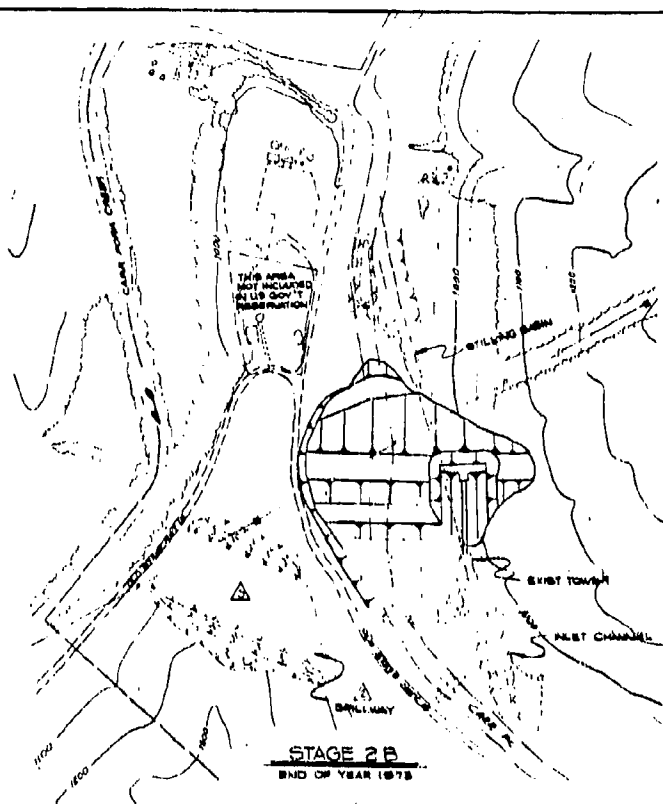


TOP OF DAM EL. 1081.0



GEOLOGIC PROFILE OF DAM  
VIEW DOWNSTREAM





## NOTES

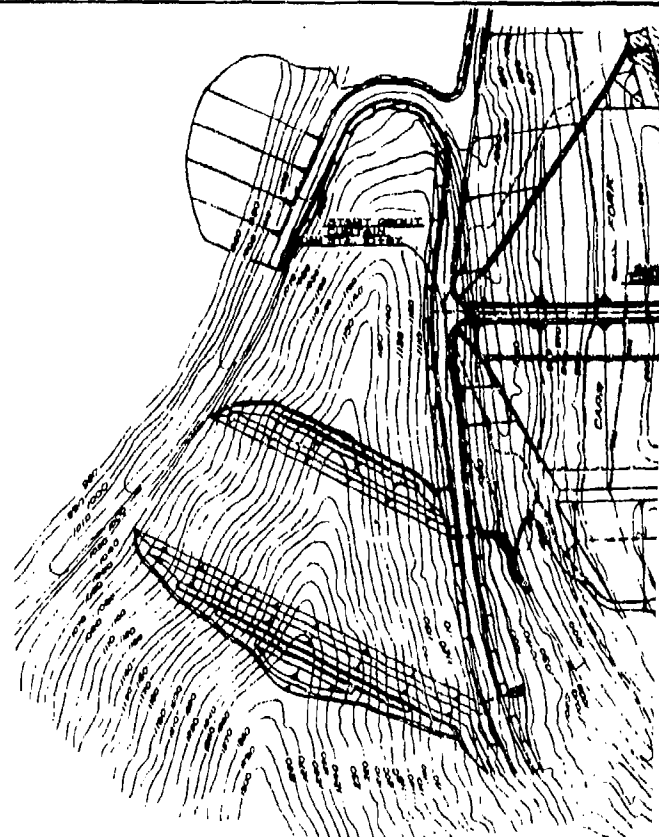
1. COFFERDAMS A & B ARE TO BE CONSTRUCTED AT START OF CONTRACT (1972) AND STREAM DIVERTED THRU OUTLET WORKS AND COFFERDAMS REMOVED BY 1 NOV. 1973. AFTER 1 MAY 1973 COFFERDAMS A & B ARE TO BE RECONSTRUCTED AND STREAM DIVERTED THROUGH OUTLET WORKS.
2. THE PERMANENT COFFERDAM SHALL BE RECONSTRUCTED TO EL. 885 UNDER A 1:1.5 SLOPE IN DATE OF PLACEMENT AND WITH A CRATER TIME LIMIT FOR DETAILS, SEE SPEC. A INITIAL SECTION OF DAM SHALL BE COMPLETED BY 1 NOV 1973.

|          |          |                                                |        |
|----------|----------|------------------------------------------------|--------|
| REVISION | DATE     | DESCRIPTION                                    | BY     |
| 1        | 1 JUN 71 | ADDITIONAL HAUL ROAD (AMDT NO 1)               | J.S.L. |
| 2        | 1 JUN 72 | SPILLWAY DIM DELETED (AMDT NO 2)               | J.S.B. |
| 3        | 1 MAY 73 | WORD "EXISTING" DELETED (AMDT NO 3)            | J.S.B. |
| 4        | 1 MAY 72 | ROCK FACING FILL, GAS LINE REMOVED (AMDT NO 4) | J.S.B. |

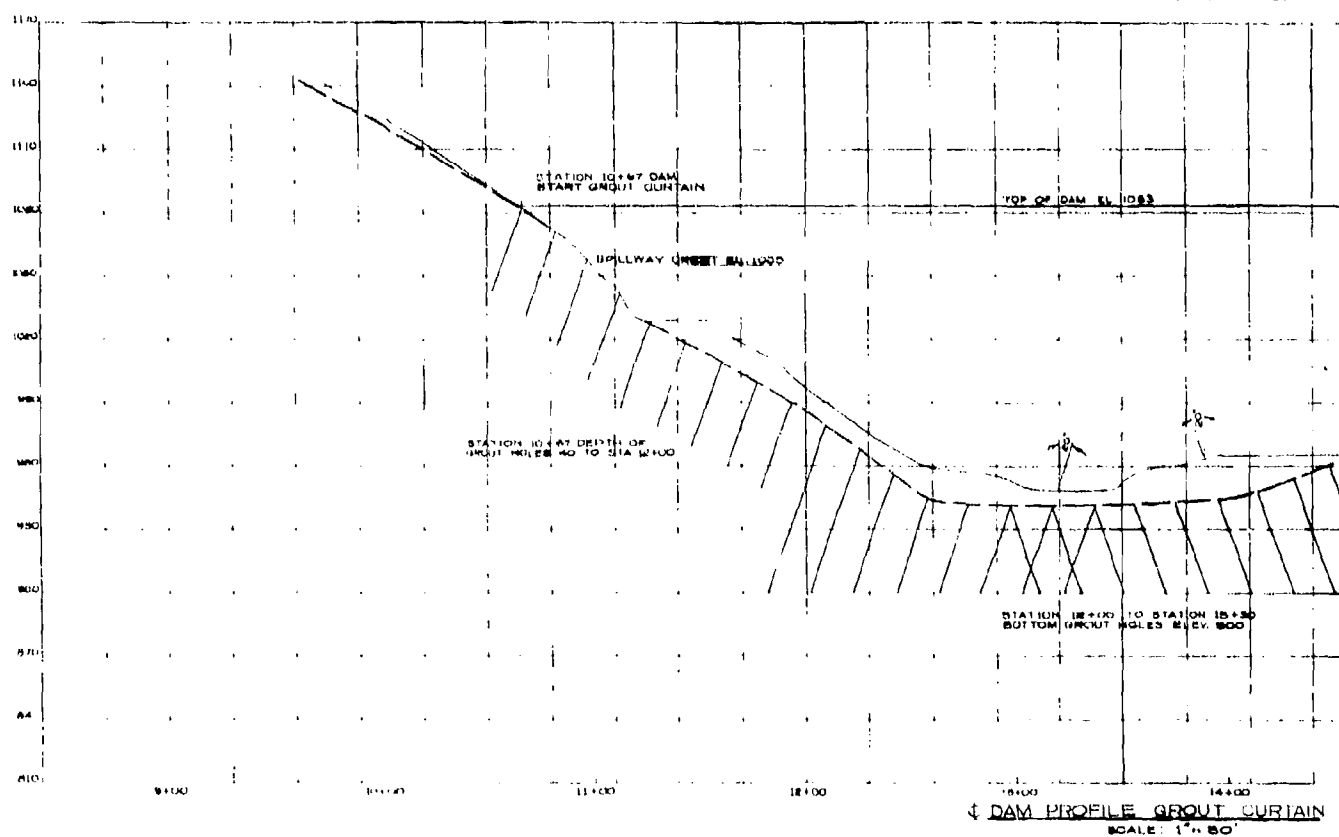
  

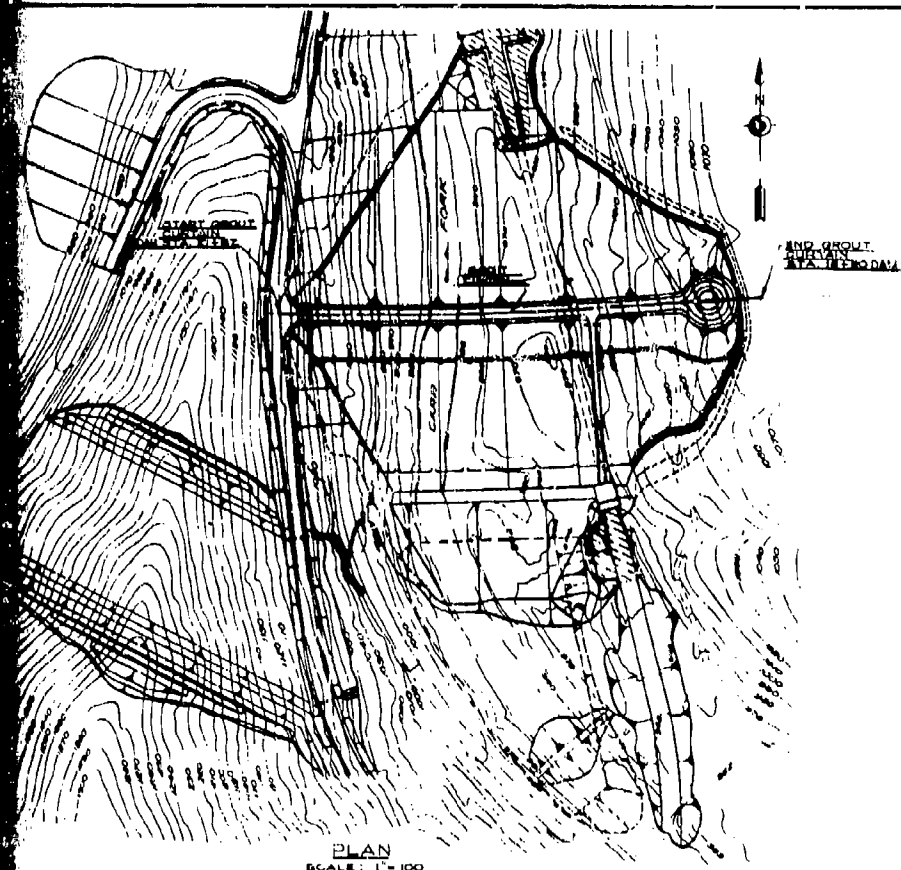
|                                          |                |
|------------------------------------------|----------------|
| U. S. ARMY ENGINEER DISTRICT, LOUISVILLE |                |
| CORPS OF ENGINEERS                       |                |
| LOUISVILLE, KENTUCKY                     |                |
| KENTUCKY RIVER BASIN                     |                |
| CARR FORK LAKE                           |                |
| DAM & SPILLWAY                           |                |
| SEQUENCE OF CONSTRUCTION                 |                |
| DESIGNED                                 | V. J. A.       |
| DRAWN                                    | W. J. A.       |
| CHECKED                                  | W. J. A.       |
| APPROVED                                 | W. J. A.       |
| SCALE                                    | 1" = 50'       |
| DATE                                     | 1 MAY 1974     |
| DRAWING NUMBER                           | NFK 113-12.8/5 |

PLATE 7



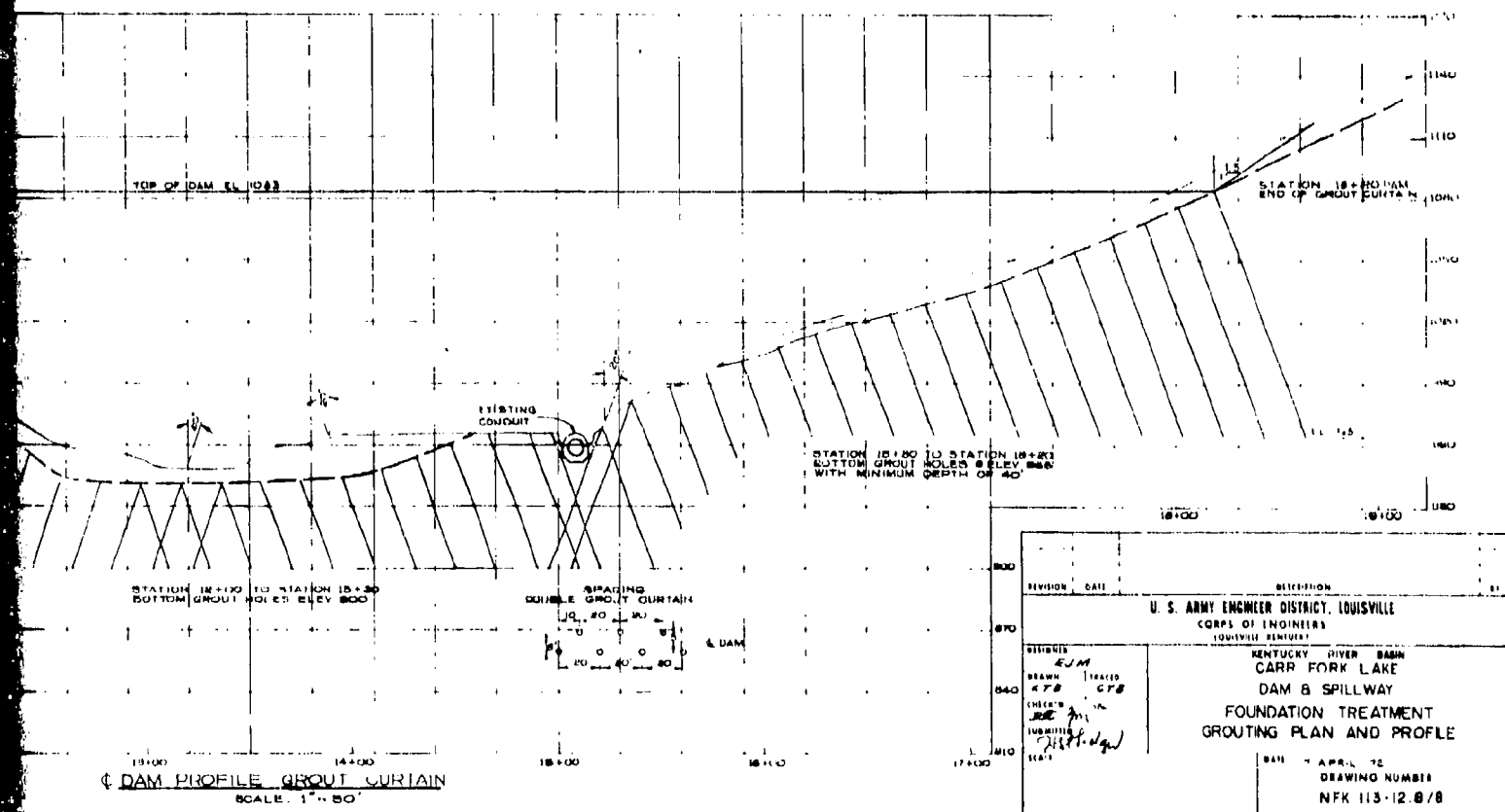
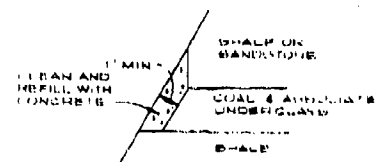
PLAN  
SCALE: 1" = 100'





## NOTES

1. ALL LOOSE WEATHERED ROCK ON FOUNDATION AND ABUTMENTS WITHIN LIMITS OF IMPERVIOUS EARTH CORE SHALL BE REMOVED PRIOR TO SLUSH GROUTING.
2. ALL VERTICAL ROCK EXPOSURES OVER 2' IN HEIGHT AND ALL ROCK OVER-HANGING LEDGES WITHIN LIMITS OF THE IMPERVIOUS CORE SHALL BE EXCAVATED TO A MAXIMUM SLOPE OF 4V ON 1H PRIOR TO SLUSH GROUTING.
3. ALL VERTICAL ROCK EXPOSURES OVER 2' IN HEIGHT AND ALL ROCK OVER-HANGING LEDGES WITHIN LIMITS OF THE RANDOM FILL SHALL BE EXCAVATED TO A MAXIMUM SLOPE OF 4V ON 1H PRIOR TO COMPACTION OF RANDOM FILL.
4. FILLING OF CRACKS OR FISSURES WITHIN THE SPECIAL TREATMENT AREA AND FOUNDATION AREA SHALL BE WITH SLUSH GROUT, BUT LIMITED TO THE OPENINGS IN THE ROCK SURFACE, AND THIN LAYERS OF SLUSH GROUT SHALL NOT COVER SURFACE AREAS OF SOUND ROCK WHERE IT MIGHT CRACK OFF UNDER ROLLING ACTION.
5. A FINAL CLEANUP IN THE SPECIAL TREATMENT AREA SHALL BE MADE JUST PRIOR TO RAISING FILL.
6. THE FOUNDATION SHALL BE STRIPPED IN ITS ENTIRETY UNDER THE DAM AND HIGHWAY FILL WITH STUDY ADJACENT TO THE DAM.
7. THE COAL AND ASSOCIATED UNDERGLAN BEARING THE ABUTMENTS UNDER THE IMPERVIOUS CURTAIN OF THE EMBANKMENT SHALL BE REMOVED TO A MINIMUM DEPTH OF ONE FOOT AND REFILLED WITH CONCRETE.



NOTES:  
 1. LITTLE DOVE CHURCH PROPERTY  
 SHALL BE KEPT ACCESSIBLE TO THE  
 PUBLIC AT ALL TIMES.  
 2. ALL HIGHWAY JOINS MUST BE KEPT  
 OPEN TO THE PUBLIC AT ALL TIMES.

WORKING  
LIMIT

WAS 1 ON 1.5 TO NATURAL  
 GRADE-40 AS SHOWN  
 1.500,000  
 1.500,000

FOR DETAIL  
SEE 1.500,000

INSERT

4334.530

4338.000

NOTES:

- 1 FOR WORKING LIMIT CONTROLS NOT SHOWN ON THIS SHEET SEE ACCESS ROAD SHEET 33
- 2 FOR DETAILS OF DAM ALIGNMENT SEE SM 37
- 3 FOR MAINT DITCH DETAILS SEE SM 38
- 4 FOR SECTIONS A-A, B-B, C-C, D-D, E-E, F-F, G-G, H-H, I-I, J-J, K-K, L-L, M-M, N-N, O-O, P-P, Q-Q, R-R, S-S, T-T, U-U, V-V, W-W, X-X, Y-Y, Z-Z SEE SM 39
- 5 FOR CROWN DETAIL AT TOP OF DAM SEE SM 40
- 6 FOR CROWN DETAIL AT BOTTOM OF DAM SEE SM 41
- 7 FOR LOCATION OF GUARD RAIL ON DAM SEE SM 42
- 8 FOR DETAILS OF EMBANKMENT FILL SHALL BE PLACED DIRECTLY ON STRIPPED SLICES OR ON THE RANDOM FILL OF THE DAM.
- 9 FILL OF THIS EMBANKMENT SHALL BE REMOVED AS REQUIRED UNDER THE ROAD FILL TO MEET THE ABOVE REQUIREMENT.
- 10 FOR ELEVATIONS ON CANAL FOR CHANNEL BOTTOM, SEE SM 43
- 11 FOR DETAILS OF EXISTING INTAKE WALLS SEE REFERENCE DRAWING H4-18-12/1/19
- 12 FOR DETAILS OF EXISTING UTILITY WALLS SEE REFERENCE DRAWING H4-18-12/1/19
- 13 FOR UTILITIES ALONG ACCESS ROAD AND IN SPILLWAY SEE SM 44
- 14 FOR DETAILS OF TRAILER CUM STATION, SEE SM 45

447,500

TRASH ROOM LHS  
ANCHORAGE  
2337 380  
E 2.14, 215

TO N 057, 200  
E 2, 10, 200

[illegible]

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

KENTUCKY RIVER BASIN  
CARR FORK LAKE  
DAM & SPILLWAY  
SITE PLAN

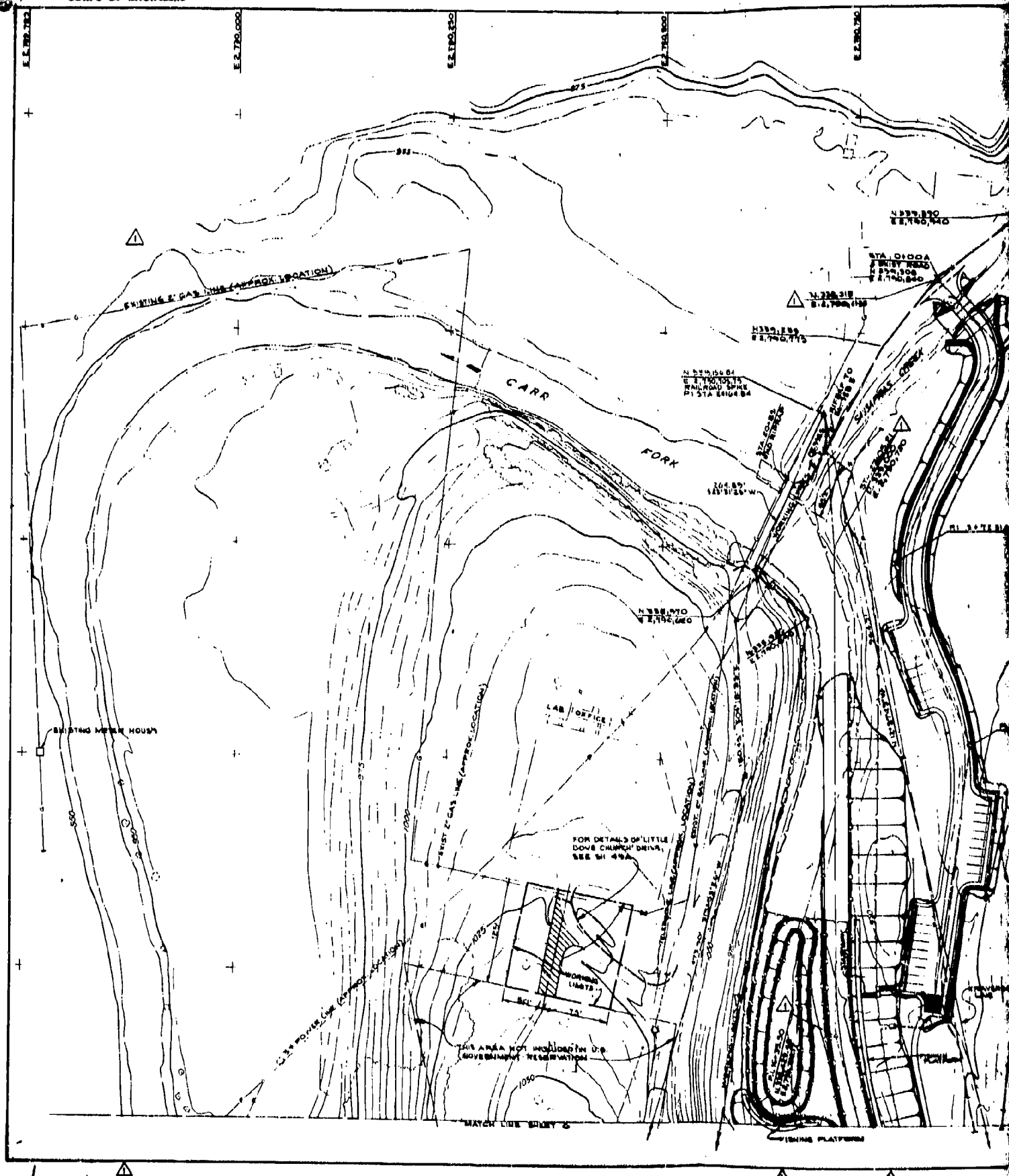
**附註**

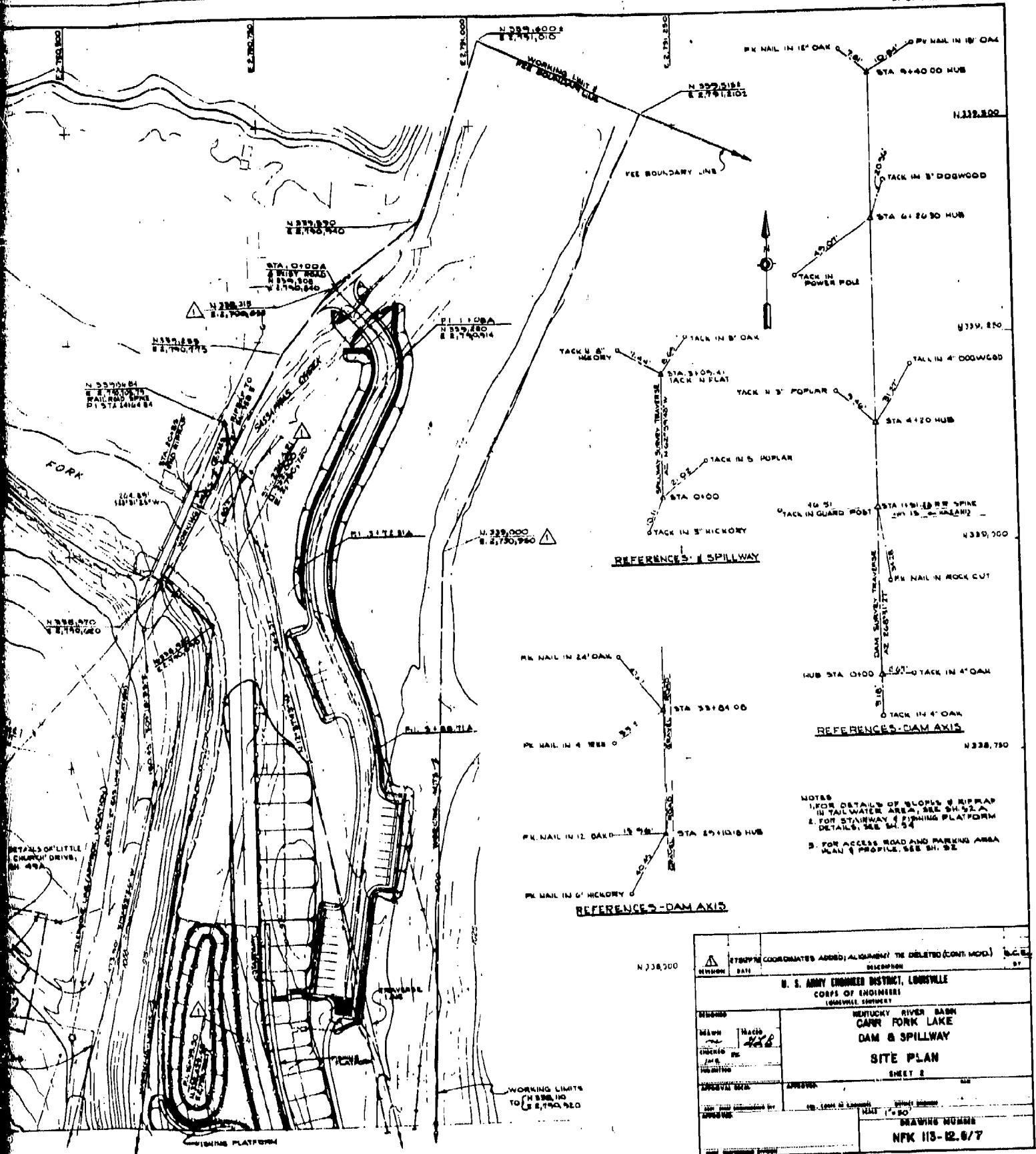
7 APR 1968

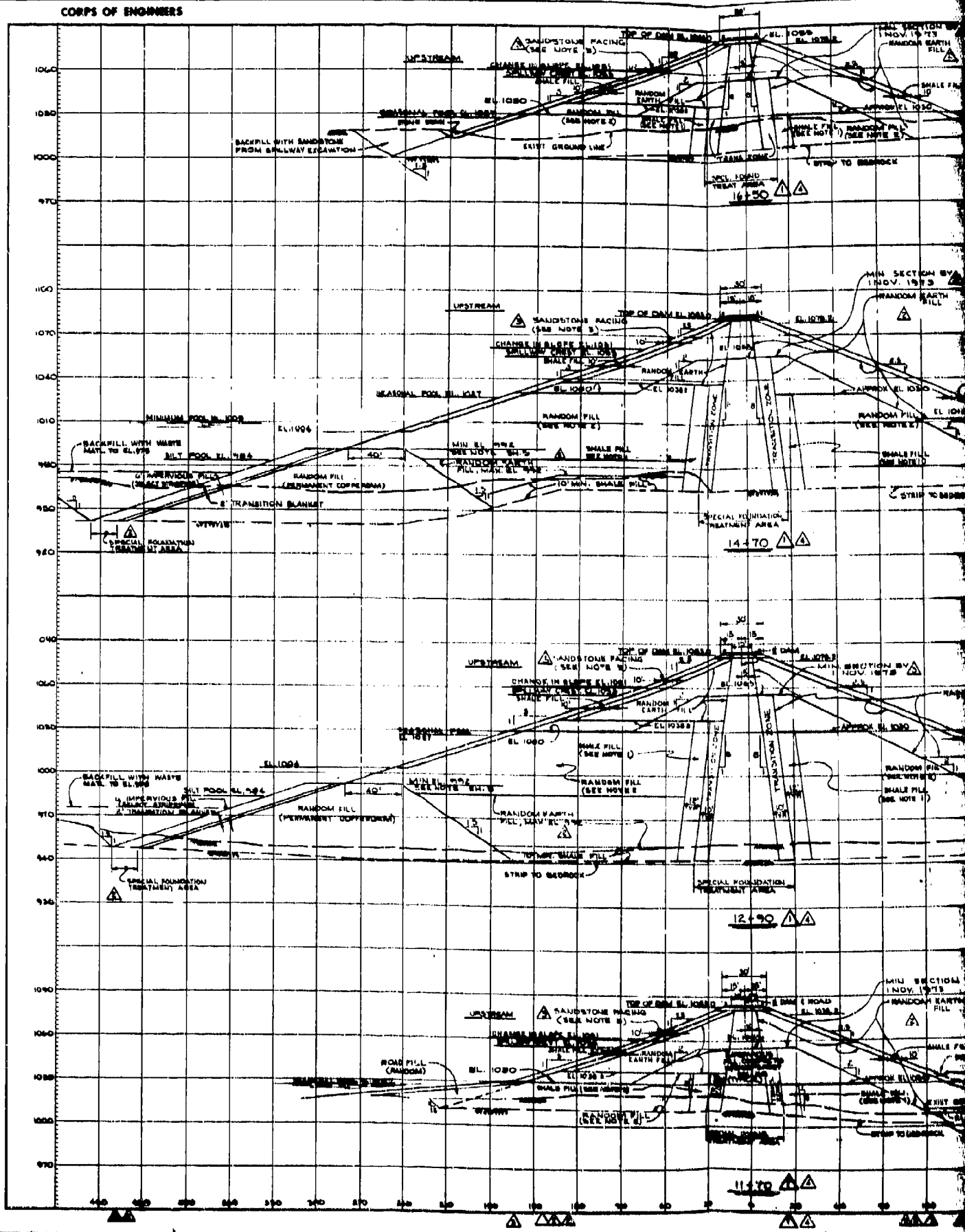
~~CONFIDENTIAL~~

NFK 103-12, 8/6

PLATE 9







1. SHALE FILL MATERIAL PLACED ON TOP OF THE COMPACTOR DURING PASSING OF THE COMPACTOR TO BE REMOVED BY THE COMPACTOR AND COMPACTOR OR EQUAL IN A NEW LOOSE LIFT.

2. RANDOM FILL PLACED IN 2<sup>ND</sup> LIFT COMPACTED WITH 80 TON RUBBER TYRED ROLLER. BLADE COVER MATERIAL TO OUTER SLOPE. BLADE PILES AGAINST SHALE FILL.

3. SANDSTONE FROM SPILLWAY EXCAVATION USED FOR FILL.

[illegible]

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

STANDARD  
DRAWN BY  
CHECKED  
APPROVED  
DATE

KENTUCKY RIVER BASIN  
CARR FORK LAKE  
DAM & SPILLWAY  
TYPICAL SECTIONS OF DAM

CALL APRIL 7, 1972  
DRAWING NO. 200  
NEK 113-12.87

ST. AUGUSTINE

**Carr Fork Lake  
Materials Usage Chart  
Excavation**

| <u>Item</u>             | <u>Excavated<br/>Quantity<br/>CY</u> | <u>Total<br/>Quantity<br/>CY</u> | <u>Disposition</u> | <u>Disposition<br/>Excavation<br/>Quantity<br/>CY</u> | <u>Balance<br/>Factor</u> | <u>Embankment<br/>Quantity<br/>CY</u> |
|-------------------------|--------------------------------------|----------------------------------|--------------------|-------------------------------------------------------|---------------------------|---------------------------------------|
| <u>Topsoil</u>          |                                      |                                  |                    |                                                       |                           |                                       |
| Dam                     | 23,900                               | 36,000                           | Waste Area         | 36,000                                                |                           |                                       |
| Spillway                | 12,100                               |                                  |                    |                                                       |                           |                                       |
| <u>Earth Excavation</u> |                                      |                                  |                    |                                                       |                           |                                       |
| Dam Foundation          | 180,500                              |                                  | Waste Area         | 123,500                                               |                           | 69,000                                |
| Spillway                | 12,400                               | 322,900                          | Impervious Fill    | 82,900                                                | 0.83                      | 96,700                                |
| Storage Area A          | 94,000                               |                                  | Random Fill        | 116,500                                               | 0.83                      |                                       |
| Storage Area B          | 36,000                               |                                  |                    |                                                       |                           |                                       |
| <u>Rock Excavation</u>  |                                      |                                  |                    |                                                       |                           |                                       |
| Dam Foundation          | 1,300                                |                                  |                    |                                                       |                           |                                       |
| Spillway Area           |                                      |                                  |                    |                                                       |                           |                                       |
| Shale                   | 172,600                              | 718,600                          | Shale Fill         | 49,300                                                | 1.15                      | 56,700                                |
| Sandstone               | 385,300                              |                                  | Transition Blanket | 3,100                                                 | 1.15                      | 3,600                                 |
| Coal                    | 40,700                               |                                  | Coal (Waste)       | 40,700                                                |                           |                                       |
| Underclay               | 40,000                               |                                  | Underclay (Waste)  | 40,000                                                |                           |                                       |
| Borrow                  | 78,190                               |                                  | Random Fill        | 584,900                                               | 1.15                      | 672,700                               |

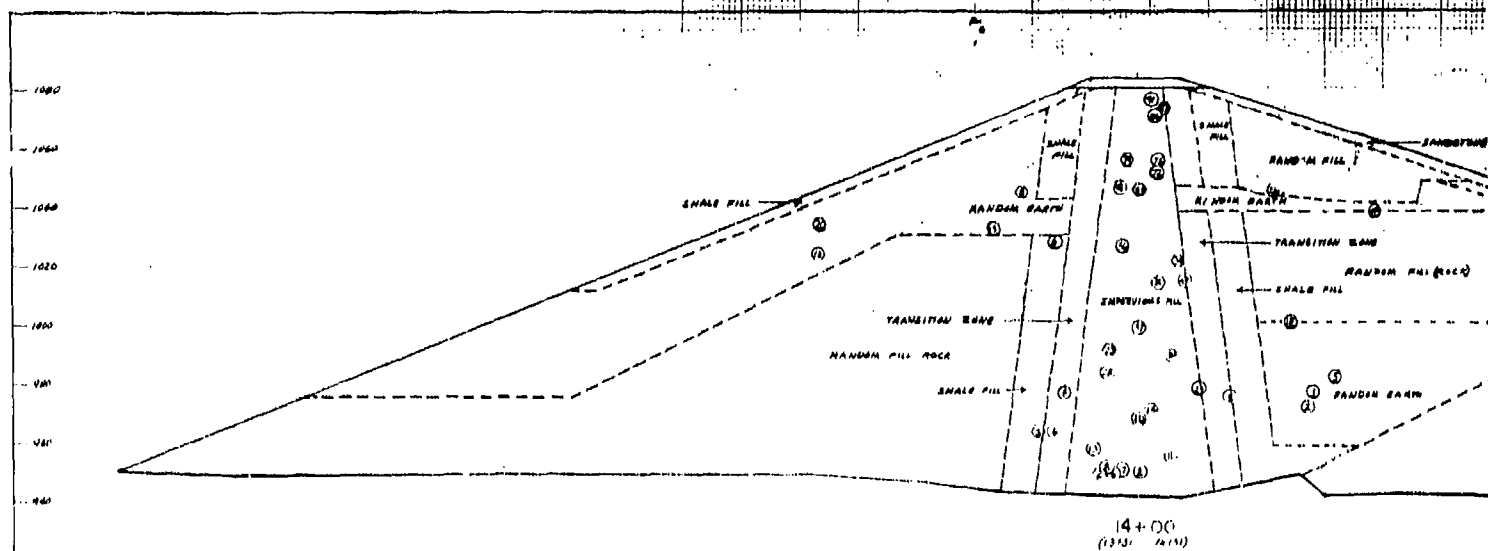
Carr Fork Lake  
Materials Usage Chart

Fill

| <u>Item</u>        | <u>Quantity</u> | <u>Source</u>  | <u>Total</u> |
|--------------------|-----------------|----------------|--------------|
| Impervious Fill    | 30,700          | Dam Area       | 69,000       |
|                    | 38,300          | Storage Area A |              |
| Shale Fill         | 56,700          | Spillway       | 56,700       |
| Random Rock Fill   | 581,300         | Spillway       | 672,700      |
|                    | 89,900          | Borrow         |              |
|                    | 1,500           | Dam Area       |              |
| Transition Blanket | 3,600           | Spillway       | 3,600        |
| Random Earth Fill  | 16,600          | Dam Area       | 96,700       |
|                    | 10,300          | Spillway       |              |
|                    | 39,900          | Storage Area A |              |
|                    | 29,900          | Storage Area B |              |
| Graded Aggregate   | 48,000          | Commercial     | 48,000       |

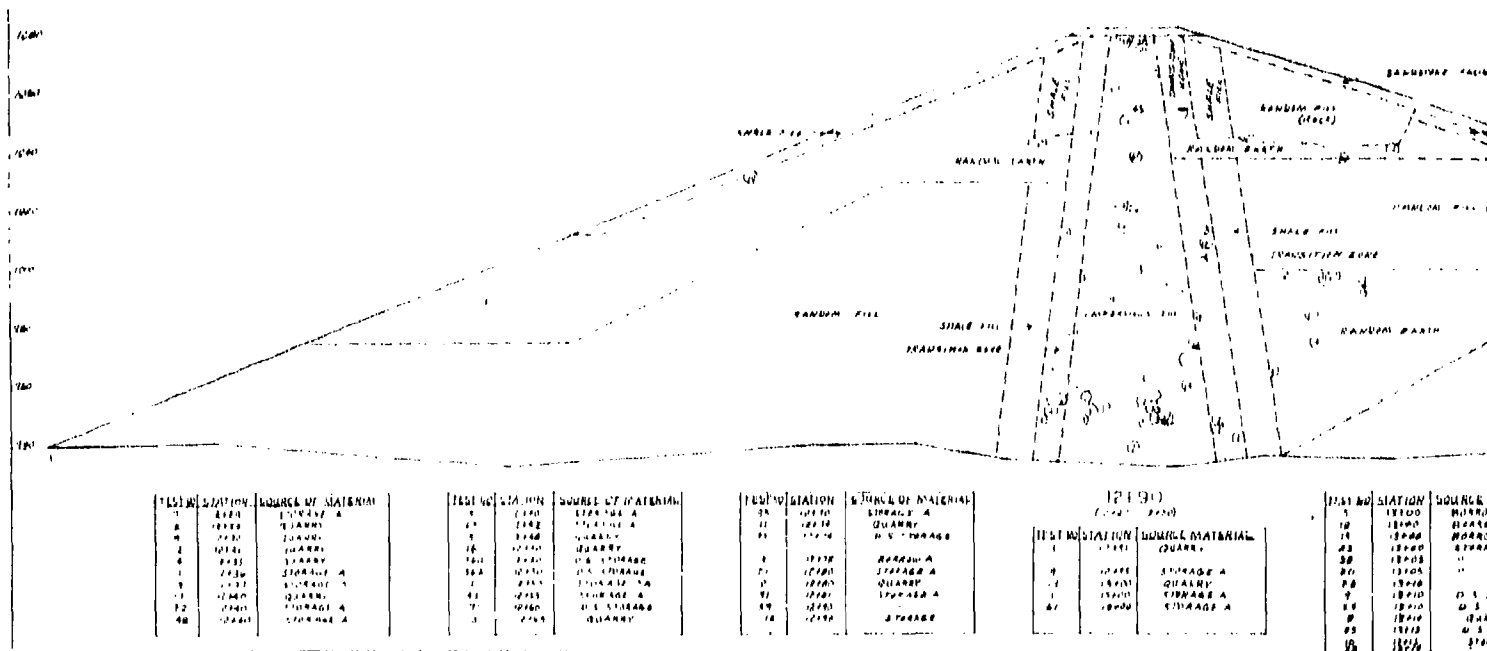






| TEST NO. | DATE     | SOURCE OF MATERIAL |
|----------|----------|--------------------|
| 1        | 1-1-1970 | QUARRY             |
| 2        | 1-1-1970 | STATION A          |
| 3        | 1-1-1970 | STATION A          |
| 4        | 1-1-1970 | STATION A          |
| 5        | 1-1-1970 | STATION A          |
| 6        | 1-1-1970 | STATION A          |
| 7        | 1-1-1970 | STATION A          |
| 8        | 1-1-1970 | STATION A          |
| 9        | 1-1-1970 | STATION A          |
| 10       | 1-1-1970 | STATION A          |
| 11       | 1-1-1970 | STATION A          |
| 12       | 1-1-1970 | STATION A          |
| 13       | 1-1-1970 | STATION A          |
| 14       | 1-1-1970 | STATION A          |
| 15       | 1-1-1970 | STATION A          |
| 16       | 1-1-1970 | STATION A          |
| 17       | 1-1-1970 | STATION A          |
| 18       | 1-1-1970 | STATION A          |
| 19       | 1-1-1970 | STATION A          |
| 20       | 1-1-1970 | STATION A          |

| STATION | STATION | SOURCE OF MATERIAL |
|---------|---------|--------------------|
| 1       | 100133  | 1. 100133 A        |
| 2       | 100134  | 2. 100134 A        |
| 3       | 100135  | 3. 100135 A        |
| 4       | 100136  | 4. 100136 A        |
| 5       | 100137  | 5. 100137 A        |
| 6       | 100138  | 6. 100138 A        |
| 7       | 100139  | 7. 100139 A        |
| 8       | 100140  | 8. 100140 A        |
| 9       | 100141  | 9. 100141 A        |
| 10      | 100142  | 10. 100142 A       |
| 11      | 100143  | 11. 100143 A       |
| 12      | 100144  | 12. 100144 A       |
| 13      | 100145  | 13. 100145 A       |
| 14      | 100146  | 14. 100146 A       |
| 15      | 100147  | 15. 100147 A       |
| 16      | 100148  | 16. 100148 A       |
| 17      | 100149  | 17. 100149 A       |
| 18      | 100150  | 18. 100150 A       |
| 19      | 100151  | 19. 100151 A       |
| 20      | 100152  | 20. 100152 A       |
| 21      | 100153  | 21. 100153 A       |
| 22      | 100154  | 22. 100154 A       |
| 23      | 100155  | 23. 100155 A       |
| 24      | 100156  | 24. 100156 A       |
| 25      | 100157  | 25. 100157 A       |
| 26      | 100158  | 26. 100158 A       |
| 27      | 100159  | 27. 100159 A       |
| 28      | 100160  | 28. 100160 A       |
| 29      | 100161  | 29. 100161 A       |
| 30      | 100162  | 30. 100162 A       |
| 31      | 100163  | 31. 100163 A       |
| 32      | 100164  | 32. 100164 A       |
| 33      | 100165  | 33. 100165 A       |
| 34      | 100166  | 34. 100166 A       |
| 35      | 100167  | 35. 100167 A       |
| 36      | 100168  | 36. 100168 A       |
| 37      | 100169  | 37. 100169 A       |
| 38      | 100170  | 38. 100170 A       |
| 39      | 100171  | 39. 100171 A       |
| 40      | 100172  | 40. 100172 A       |
| 41      | 100173  | 41. 100173 A       |
| 42      | 100174  | 42. 100174 A       |
| 43      | 100175  | 43. 100175 A       |
| 44      | 100176  | 44. 100176 A       |
| 45      | 100177  | 45. 100177 A       |
| 46      | 100178  | 46. 100178 A       |
| 47      | 100179  | 47. 100179 A       |
| 48      | 100180  | 48. 100180 A       |
| 49      | 100181  | 49. 100181 A       |
| 50      | 100182  | 50. 100182 A       |
| 51      | 100183  | 51. 100183 A       |
| 52      | 100184  | 52. 100184 A       |
| 53      | 100185  | 53. 100185 A       |
| 54      | 100186  | 54. 100186 A       |
| 55      | 100187  | 55. 100187 A       |
| 56      | 100188  | 56. 100188 A       |
| 57      | 100189  | 57. 100189 A       |
| 58      | 100190  | 58. 100190 A       |
| 59      | 100191  | 59. 100191 A       |
| 60      | 100192  | 60. 100192 A       |
| 61      | 100193  | 61. 100193 A       |
| 62      | 100194  | 62. 100194 A       |
| 63      | 100195  | 63. 100195 A       |
| 64      | 100196  | 64. 100196 A       |
| 65      | 100197  | 65. 100197 A       |
| 66      | 100198  | 66. 100198 A       |
| 67      | 100199  | 67. 100199 A       |
| 68      | 100200  | 68. 100200 A       |
| 69      | 100201  | 69. 100201 A       |
| 70      | 100202  | 70. 100202 A       |
| 71      | 100203  | 71. 100203 A       |
| 72      | 100204  | 72. 100204 A       |
| 73      | 100205  | 73. 100205 A       |
| 74      | 100206  | 74. 100206 A       |
| 75      | 100207  | 75. 100207 A       |
| 76      | 100208  | 76. 100208 A       |
| 77      | 100209  | 77. 100209 A       |
| 78      | 100210  | 78. 100210 A       |
| 79      | 100211  | 79. 100211 A       |
| 80      | 100212  | 80. 100212 A       |
| 81      | 100213  | 81. 100213 A       |
| 82      | 100214  | 82. 100214 A       |
| 83      | 100215  | 83. 100215 A       |
| 84      | 100216  | 84. 100216 A       |
| 85      | 100217  | 85. 100217 A       |
| 86      | 100218  | 86. 100218 A       |
| 87      | 100219  | 87. 100219 A       |
| 88      | 100220  | 88. 100220 A       |
| 89      | 100221  | 89. 100221 A       |
| 90      | 100222  | 90. 100222 A       |
| 91      | 100223  | 91. 100223 A       |
| 92      | 100224  | 92. 100224 A       |
| 93      | 100225  | 93. 100225 A       |
| 94      | 100226  | 94. 100226 A       |
| 95      | 100227  | 95. 100227 A       |
| 96      | 100228  | 96. 100228 A       |
| 97      | 100229  | 97. 100229 A       |
| 98      | 100230  | 98. 100230 A       |
| 99      | 100231  | 99. 100231 A       |
| 100     | 100232  | 100. 100232 A      |



| TESTER | DATE     | LOCATION | TYPE OF MATERIAL |
|--------|----------|----------|------------------|
| 1      | 10/10/54 | 10/10/54 | A                |
| 2      | 10/10/54 | 10/10/54 | A                |
| 3      | 10/10/54 | 10/10/54 | A                |
| 4      | 10/10/54 | 10/10/54 | A                |
| 5      | 10/10/54 | 10/10/54 | A                |
| 6      | 10/10/54 | 10/10/54 | A                |
| 7      | 10/10/54 | 10/10/54 | A                |
| 8      | 10/10/54 | 10/10/54 | A                |
| 9      | 10/10/54 | 10/10/54 | A                |
| 10     | 10/10/54 | 10/10/54 | A                |

| 1945 | 1946   | SOURCE OF MATERIAL |
|------|--------|--------------------|
| 9    | 12,000 | 1. 1945年12月        |
| 10   | 12,000 | 2. 1946年1月         |
| 11   | 12,000 | 3. 1946年2月         |
| 12   | 12,000 | 4. 1946年3月         |
| 13   | 12,000 | 5. 1946年4月         |
| 14   | 12,000 | 6. 1946年5月         |
| 15   | 12,000 | 7. 1946年6月         |
| 16   | 12,000 | 8. 1946年7月         |
| 17   | 12,000 | 9. 1946年8月         |
| 18   | 12,000 | 10. 1946年9月        |
| 19   | 12,000 | 11. 1946年10月       |
| 20   | 12,000 | 12. 1946年11月       |
| 21   | 12,000 | 13. 1946年12月       |
| 22   | 12,000 | 14. 1947年1月        |
| 23   | 12,000 | 15. 1947年2月        |
| 24   | 12,000 | 16. 1947年3月        |
| 25   | 12,000 | 17. 1947年4月        |
| 26   | 12,000 | 18. 1947年5月        |
| 27   | 12,000 | 19. 1947年6月        |
| 28   | 12,000 | 20. 1947年7月        |
| 29   | 12,000 | 21. 1947年8月        |
| 30   | 12,000 | 22. 1947年9月        |
| 31   | 12,000 | 23. 1947年10月       |
| 32   | 12,000 | 24. 1947年11月       |
| 33   | 12,000 | 25. 1947年12月       |
| 34   | 12,000 | 26. 1948年1月        |
| 35   | 12,000 | 27. 1948年2月        |
| 36   | 12,000 | 28. 1948年3月        |
| 37   | 12,000 | 29. 1948年4月        |
| 38   | 12,000 | 30. 1948年5月        |
| 39   | 12,000 | 31. 1948年6月        |
| 40   | 12,000 | 32. 1948年7月        |
| 41   | 12,000 | 33. 1948年8月        |
| 42   | 12,000 | 34. 1948年9月        |
| 43   | 12,000 | 35. 1948年10月       |
| 44   | 12,000 | 36. 1948年11月       |
| 45   | 12,000 | 37. 1948年12月       |
| 46   | 12,000 | 38. 1949年1月        |
| 47   | 12,000 | 39. 1949年2月        |
| 48   | 12,000 | 40. 1949年3月        |
| 49   | 12,000 | 41. 1949年4月        |
| 50   | 12,000 | 42. 1949年5月        |
| 51   | 12,000 | 43. 1949年6月        |
| 52   | 12,000 | 44. 1949年7月        |
| 53   | 12,000 | 45. 1949年8月        |
| 54   | 12,000 | 46. 1949年9月        |
| 55   | 12,000 | 47. 1949年10月       |
| 56   | 12,000 | 48. 1949年11月       |
| 57   | 12,000 | 49. 1949年12月       |
| 58   | 12,000 | 50. 1950年1月        |
| 59   | 12,000 | 51. 1950年2月        |
| 60   | 12,000 | 52. 1950年3月        |
| 61   | 12,000 | 53. 1950年4月        |
| 62   | 12,000 | 54. 1950年5月        |
| 63   | 12,000 | 55. 1950年6月        |
| 64   | 12,000 | 56. 1950年7月        |
| 65   | 12,000 | 57. 1950年8月        |
| 66   | 12,000 | 58. 1950年9月        |
| 67   | 12,000 | 59. 1950年10月       |
| 68   | 12,000 | 60. 1950年11月       |
| 69   | 12,000 | 61. 1950年12月       |
| 70   | 12,000 | 62. 1951年1月        |
| 71   | 12,000 | 63. 1951年2月        |
| 72   | 12,000 | 64. 1951年3月        |
| 73   | 12,000 | 65. 1951年4月        |
| 74   | 12,000 | 66. 1951年5月        |
| 75   | 12,000 | 67. 1951年6月        |
| 76   | 12,000 | 68. 1951年7月        |
| 77   | 12,000 | 69. 1951年8月        |
| 78   | 12,000 | 70. 1951年9月        |
| 79   | 12,000 | 71. 1951年10月       |
| 80   | 12,000 | 72. 1951年11月       |
| 81   | 12,000 | 73. 1951年12月       |
| 82   | 12,000 | 74. 1952年1月        |
| 83   | 12,000 | 75. 1952年2月        |
| 84   | 12,000 | 76. 1952年3月        |
| 85   | 12,000 | 77. 1952年4月        |
| 86   | 12,000 | 78. 1952年5月        |
| 87   | 12,000 | 79. 1952年6月        |
| 88   | 12,000 | 80. 1952年7月        |
| 89   | 12,000 | 81. 1952年8月        |
| 90   | 12,000 | 82. 1952年9月        |
| 91   | 12,000 | 83. 1952年10月       |
| 92   | 12,000 | 84. 1952年11月       |
| 93   | 12,000 | 85. 1952年12月       |
| 94   | 12,000 | 86. 1953年1月        |
| 95   | 12,000 | 87. 1953年2月        |
| 96   | 12,000 | 88. 1953年3月        |
| 97   | 12,000 | 89. 1953年4月        |
| 98   | 12,000 | 90. 1953年5月        |
| 99   | 12,000 | 91. 1953年6月        |
| 100  | 12,000 | 92                 |

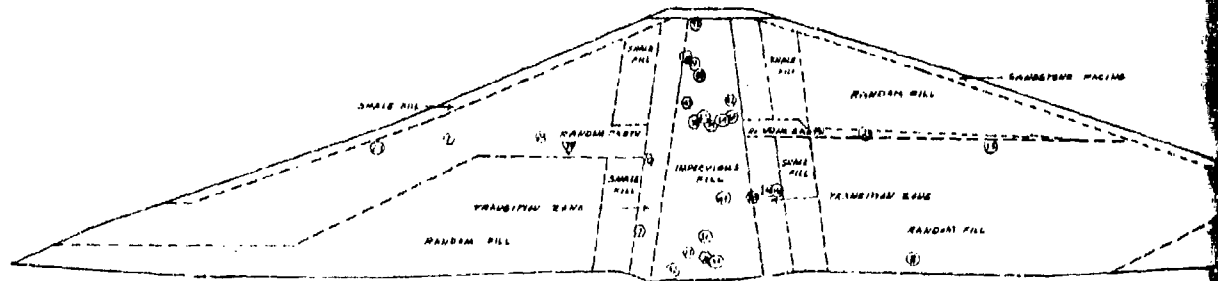
| FILE NO | LOCATION | NAME OF MAINT |
|---------|----------|---------------|
| 34      | 12110    | STRAUSS A     |
| 11      | 12010    | QUARRY        |
| 01      | 11110    | H. S. TUNNAGE |
| 8       | 12110    | REAR A        |
| 71      | 12110    | STRAUSS A     |
| 5       | 12110    | QUARRY        |
| 81      | 12110    | STRAUSS A     |
| 09      | 12110    | -             |
| 18      | 12110    | STRAUSS       |

| ITEM NO. | STATION | DESCRIPTION |
|----------|---------|-------------|
| 1        | 1000    | QUANTITY    |
| 2        | 1000    | QUANTITY    |
| 3        | 1000    | QUANTITY    |
| 4        | 1000    | QUANTITY    |

| TIME | STATION | SOURCE |
|------|---------|--------|
| 5    | 13100   | 13100  |
| 10   | 13100   | 13100  |
| 15   | 13100   | 13100  |
| 20   | 13100   | 13100  |
| 25   | 13100   | 13100  |
| 30   | 13100   | 13100  |
| 35   | 13100   | 13100  |
| 40   | 13100   | 13100  |
| 45   | 13100   | 13100  |
| 50   | 13100   | 13100  |
| 55   | 13100   | 13100  |
| 60   | 13100   | 13100  |



1000  
1000  
1000  
1000  
1000  
1000

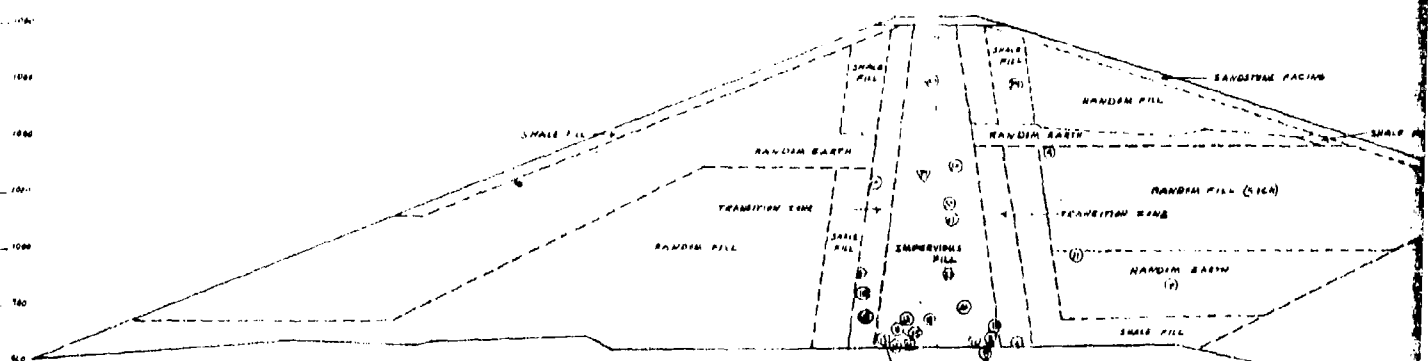


15+95  
(15+95 to 16+10)

| TEST NO. | STATION | SOURCE OF MATERIAL |
|----------|---------|--------------------|
| 34       | 15+85   | STORAGE "A"        |
| 35       | 15+85   | STORAGE "A"        |
| 36       | 15+85   | STORAGE "A"        |
| 37       | 15+85   | STORAGE "A"        |
| 38       | 15+85   | STORAGE "A"        |
| 39       | 15+85   | STORAGE "A"        |
| 40       | 15+85   | STORAGE "A"        |
| 41       | 15+85   | STORAGE "A"        |
| 42       | 15+85   | STORAGE "A"        |
| 43       | 15+85   | STORAGE "A"        |
| 44       | 15+85   | STORAGE "A"        |
| 45       | 15+85   | STORAGE "A"        |
| 46       | 15+85   | STORAGE "A"        |
| 47       | 15+85   | STORAGE "A"        |
| 48       | 15+85   | STORAGE "A"        |
| 49       | 15+85   | STORAGE "A"        |
| 50       | 15+85   | STORAGE "A"        |

| TEST NO. | STATION | SOURCE OF MATERIAL |
|----------|---------|--------------------|
| 51       | 15+85   | STORAGE "A"        |
| 52       | 15+85   | STORAGE "A"        |
| 53       | 15+85   | STORAGE "A"        |
| 54       | 15+85   | STORAGE "A"        |
| 55       | 15+85   | STORAGE "A"        |
| 56       | 15+85   | STORAGE "A"        |
| 57       | 15+85   | STORAGE "A"        |
| 58       | 15+85   | STORAGE "A"        |
| 59       | 15+85   | STORAGE "A"        |
| 60       | 15+85   | STORAGE "A"        |
| 61       | 15+85   | STORAGE "A"        |
| 62       | 15+85   | STORAGE "A"        |
| 63       | 15+85   | STORAGE "A"        |
| 64       | 15+85   | STORAGE "A"        |
| 65       | 15+85   | STORAGE "A"        |
| 66       | 15+85   | STORAGE "A"        |
| 67       | 15+85   | STORAGE "A"        |
| 68       | 15+85   | STORAGE "A"        |
| 69       | 15+85   | STORAGE "A"        |
| 70       | 15+85   | STORAGE "A"        |

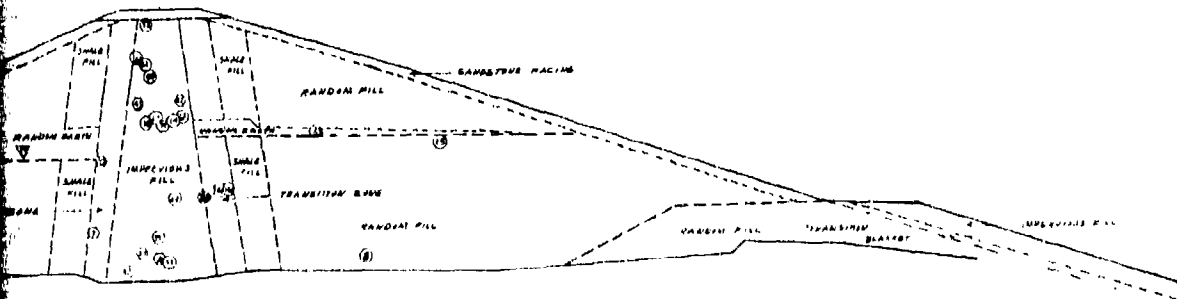
1000  
1000  
1000  
1000  
1000  
1000



14+95  
(14+95 to 15+10)

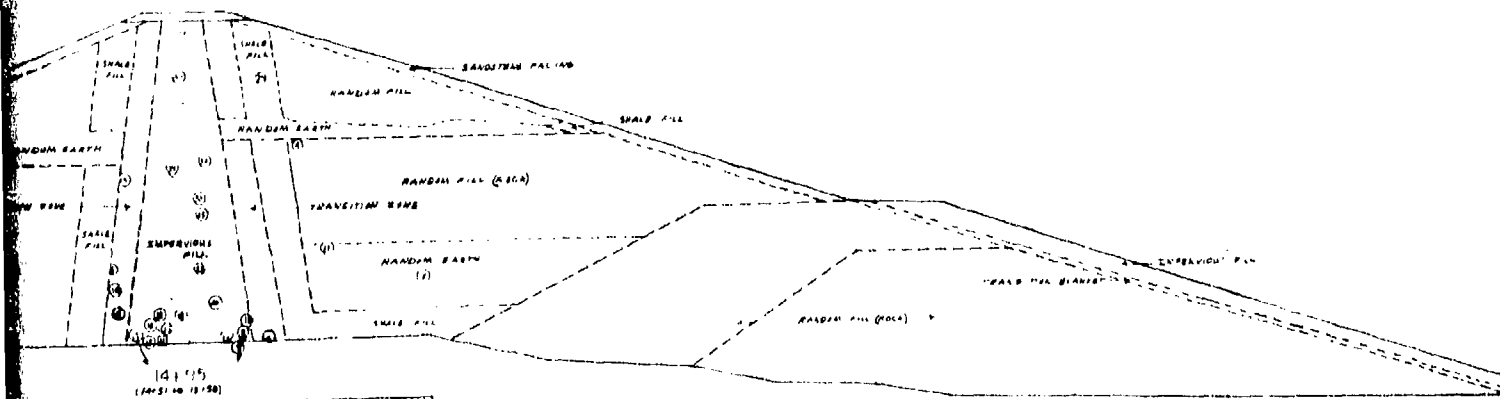
| TEST NO. | STATION | SOURCE OF MATERIAL |
|----------|---------|--------------------|
| 71       | 14+85   | STORAGE "A"        |
| 72       | 14+85   | STORAGE "A"        |
| 73       | 14+85   | STORAGE "A"        |
| 74       | 14+85   | STORAGE "A"        |
| 75       | 14+85   | STORAGE "A"        |
| 76       | 14+85   | STORAGE "A"        |
| 77       | 14+85   | STORAGE "A"        |
| 78       | 14+85   | STORAGE "A"        |
| 79       | 14+85   | STORAGE "A"        |
| 80       | 14+85   | STORAGE "A"        |
| 81       | 14+85   | STORAGE "A"        |
| 82       | 14+85   | STORAGE "A"        |
| 83       | 14+85   | STORAGE "A"        |
| 84       | 14+85   | STORAGE "A"        |
| 85       | 14+85   | STORAGE "A"        |
| 86       | 14+85   | STORAGE "A"        |
| 87       | 14+85   | STORAGE "A"        |
| 88       | 14+85   | STORAGE "A"        |
| 89       | 14+85   | STORAGE "A"        |
| 90       | 14+85   | STORAGE "A"        |

| TEST NO. | STATION | SOURCE OF MATERIAL |
|----------|---------|--------------------|
| 91       | 14+85   | STORAGE "A"        |
| 92       | 14+85   | STORAGE "A"        |
| 93       | 14+85   | STORAGE "A"        |
| 94       | 14+85   | STORAGE "A"        |
| 95       | 14+85   | STORAGE "A"        |
| 96       | 14+85   | STORAGE "A"        |
| 97       | 14+85   | STORAGE "A"        |
| 98       | 14+85   | STORAGE "A"        |
| 99       | 14+85   | STORAGE "A"        |
| 100      | 14+85   | STORAGE "A"        |
| 101      | 14+85   | STORAGE "A"        |
| 102      | 14+85   | STORAGE "A"        |
| 103      | 14+85   | STORAGE "A"        |
| 104      | 14+85   | STORAGE "A"        |
| 105      | 14+85   | STORAGE "A"        |
| 106      | 14+85   | STORAGE "A"        |
| 107      | 14+85   | STORAGE "A"        |
| 108      | 14+85   | STORAGE "A"        |
| 109      | 14+85   | STORAGE "A"        |
| 110      | 14+85   | STORAGE "A"        |



15+95  
(1515 to 16130)

| SOURCE OF MATERIAL | STATION | SOURCE OF MATERIAL |
|--------------------|---------|--------------------|
| STORAGE "A"        | 88      | D.S. STORAGE       |
| STORAGE "A"        | 8       | ACCESS RD          |
| STORAGE "A"        | 49      | D.S. STORAGE       |
| STORAGE "A"        | 83      | D.S. STORAGE       |
| STORAGE "A"        | 106     | QUARRY             |
| STORAGE "A"        | 34      | STORAGE "A"        |
| STORAGE "A"        | 33      | STORAGE "A"        |
| STORAGE "A"        | 7       | QUARRY             |
| STORAGE "A"        | 16      | STORAGE "A"        |
| STORAGE "A"        | 14      | ACCESS RD          |
| STORAGE "A"        | 27      | STORAGE "A"        |
| STORAGE "A"        | 16      | ACCESS RD          |
| STORAGE "A"        | 47      | D.S. STORAGE       |
| STORAGE "A"        | 43      | D.S. STORAGE       |
| STORAGE "A"        | 40      | QUARRY             |



141+55  
(14150 to 15150)

| SOURCE OF MATERIAL | STATION | SOURCE OF MATERIAL |
|--------------------|---------|--------------------|
| STORAGE "A"        | 11      | STORAGE "A"        |
| STORAGE "A"        | 30      | STORAGE "A"        |
| STORAGE "A"        | 78      | ACCESS RD          |
| STORAGE "A"        | 1       | ACCESS RD          |
| STORAGE "A"        | 6       | STORAGE "A"        |
| STORAGE "A"        | 13      | STORAGE "A"        |
| STORAGE "A"        | 43      | D.S. STORAGE       |
| STORAGE "A"        | 80      | STORAGE "A"        |
| STORAGE "A"        | 18      | STORAGE "A"        |
| STORAGE "A"        | 18      | QUARRY             |
| STORAGE "A"        | 27      | STORAGE "A"        |
| STORAGE "A"        | 41      | QUARRY             |

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

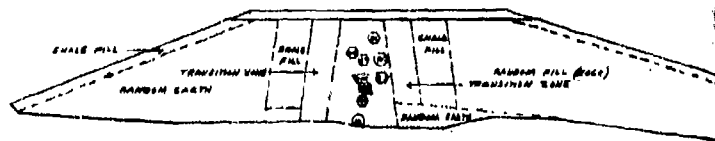
CARR FORK LAKE  
DAM & SPILLWAY

COMPACTION TEST LOCATIONS  
STA. 14+51 TO 16+50

DATE: 1-27-77  
BY: [Signature]  
JAN 1977  
[Signature]

PLATE 16

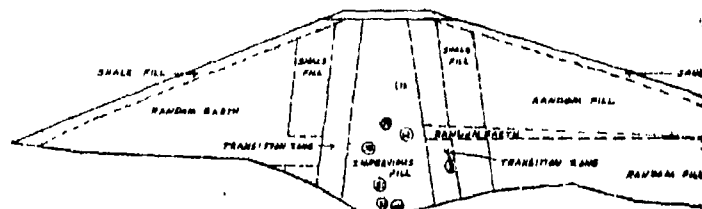
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1100



17+45  
(17+00 TO 18+00)

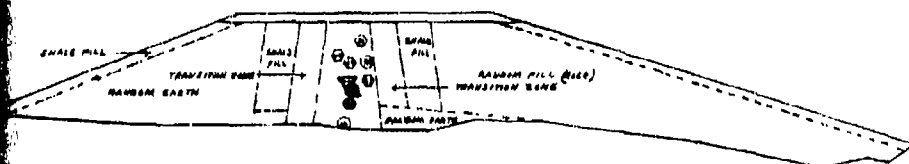
| STATION | STATION | SOURCE OF MATERIAL |
|---------|---------|--------------------|
| 65      | 17+00   | D. & S. STORAGE    |
| 66      | 17+00   | "                  |
| 67      | 17+00   | "                  |
| 68      | 17+00   | "                  |
| 69      | 17+00   | "                  |
| 70      | 17+00   | "                  |
| 71      | 17+00   | "                  |
| 72      | 17+00   | "                  |
| 73      | 17+00   | "                  |
| 74      | 17+00   | "                  |
| 75      | 17+00   | "                  |
| 76      | 17+00   | "                  |
| 77      | 17+00   | "                  |
| 78      | 17+00   | "                  |
| 79      | 17+00   | "                  |
| 80      | 17+00   | "                  |
| 81      | 17+00   | "                  |
| 82      | 17+00   | "                  |
| 83      | 17+00   | "                  |
| 84      | 17+00   | "                  |
| 85      | 17+00   | "                  |
| 86      | 17+00   | "                  |
| 87      | 17+00   | "                  |
| 88      | 17+00   | "                  |
| 89      | 17+00   | "                  |
| 90      | 17+00   | "                  |
| 91      | 17+00   | "                  |
| 92      | 17+00   | "                  |
| 93      | 17+00   | "                  |
| 94      | 17+00   | "                  |
| 95      | 17+00   | "                  |
| 96      | 17+00   | "                  |
| 97      | 17+00   | "                  |
| 98      | 17+00   | "                  |
| 99      | 17+00   | "                  |
| 100     | 17+00   | "                  |

1000  
1050  
1100  
1150  
1200  
1250  
1300



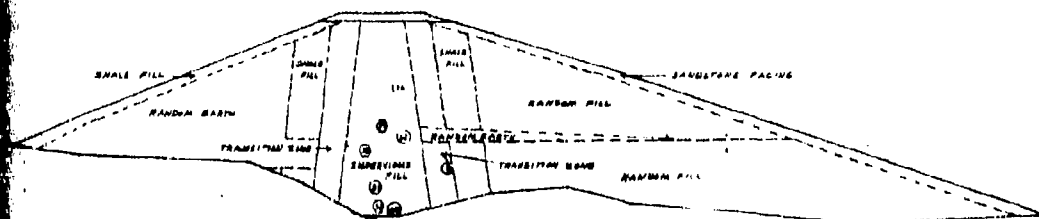
16+95  
(16+00 TO 17+00)

| STATION | STATION | SOURCE OF MATERIAL |
|---------|---------|--------------------|
| 25      | 16+00   | D. & S. STORAGE    |
| 26      | 16+00   | "                  |
| 27      | 16+00   | "                  |
| 28      | 16+00   | "                  |
| 29      | 16+00   | "                  |
| 30      | 16+00   | "                  |
| 31      | 16+00   | "                  |
| 32      | 16+00   | "                  |
| 33      | 16+00   | "                  |
| 34      | 16+00   | "                  |
| 35      | 16+00   | "                  |
| 36      | 16+00   | "                  |
| 37      | 16+00   | "                  |
| 38      | 16+00   | "                  |
| 39      | 16+00   | "                  |
| 40      | 16+00   | "                  |
| 41      | 16+00   | "                  |
| 42      | 16+00   | "                  |
| 43      | 16+00   | "                  |
| 44      | 16+00   | "                  |
| 45      | 16+00   | "                  |
| 46      | 16+00   | "                  |
| 47      | 16+00   | "                  |
| 48      | 16+00   | "                  |
| 49      | 16+00   | "                  |
| 50      | 16+00   | "                  |
| 51      | 16+00   | "                  |
| 52      | 16+00   | "                  |
| 53      | 16+00   | "                  |
| 54      | 16+00   | "                  |
| 55      | 16+00   | "                  |
| 56      | 16+00   | "                  |
| 57      | 16+00   | "                  |
| 58      | 16+00   | "                  |
| 59      | 16+00   | "                  |
| 60      | 16+00   | "                  |
| 61      | 16+00   | "                  |
| 62      | 16+00   | "                  |
| 63      | 16+00   | "                  |
| 64      | 16+00   | "                  |
| 65      | 16+00   | "                  |
| 66      | 16+00   | "                  |
| 67      | 16+00   | "                  |
| 68      | 16+00   | "                  |
| 69      | 16+00   | "                  |
| 70      | 16+00   | "                  |
| 71      | 16+00   | "                  |
| 72      | 16+00   | "                  |
| 73      | 16+00   | "                  |
| 74      | 16+00   | "                  |
| 75      | 16+00   | "                  |
| 76      | 16+00   | "                  |
| 77      | 16+00   | "                  |
| 78      | 16+00   | "                  |
| 79      | 16+00   | "                  |
| 80      | 16+00   | "                  |
| 81      | 16+00   | "                  |
| 82      | 16+00   | "                  |
| 83      | 16+00   | "                  |
| 84      | 16+00   | "                  |
| 85      | 16+00   | "                  |
| 86      | 16+00   | "                  |
| 87      | 16+00   | "                  |
| 88      | 16+00   | "                  |
| 89      | 16+00   | "                  |
| 90      | 16+00   | "                  |
| 91      | 16+00   | "                  |
| 92      | 16+00   | "                  |
| 93      | 16+00   | "                  |
| 94      | 16+00   | "                  |
| 95      | 16+00   | "                  |
| 96      | 16+00   | "                  |
| 97      | 16+00   | "                  |
| 98      | 16+00   | "                  |
| 99      | 16+00   | "                  |
| 100     | 16+00   | "                  |



17+45  
(17+50 TO 18+00)

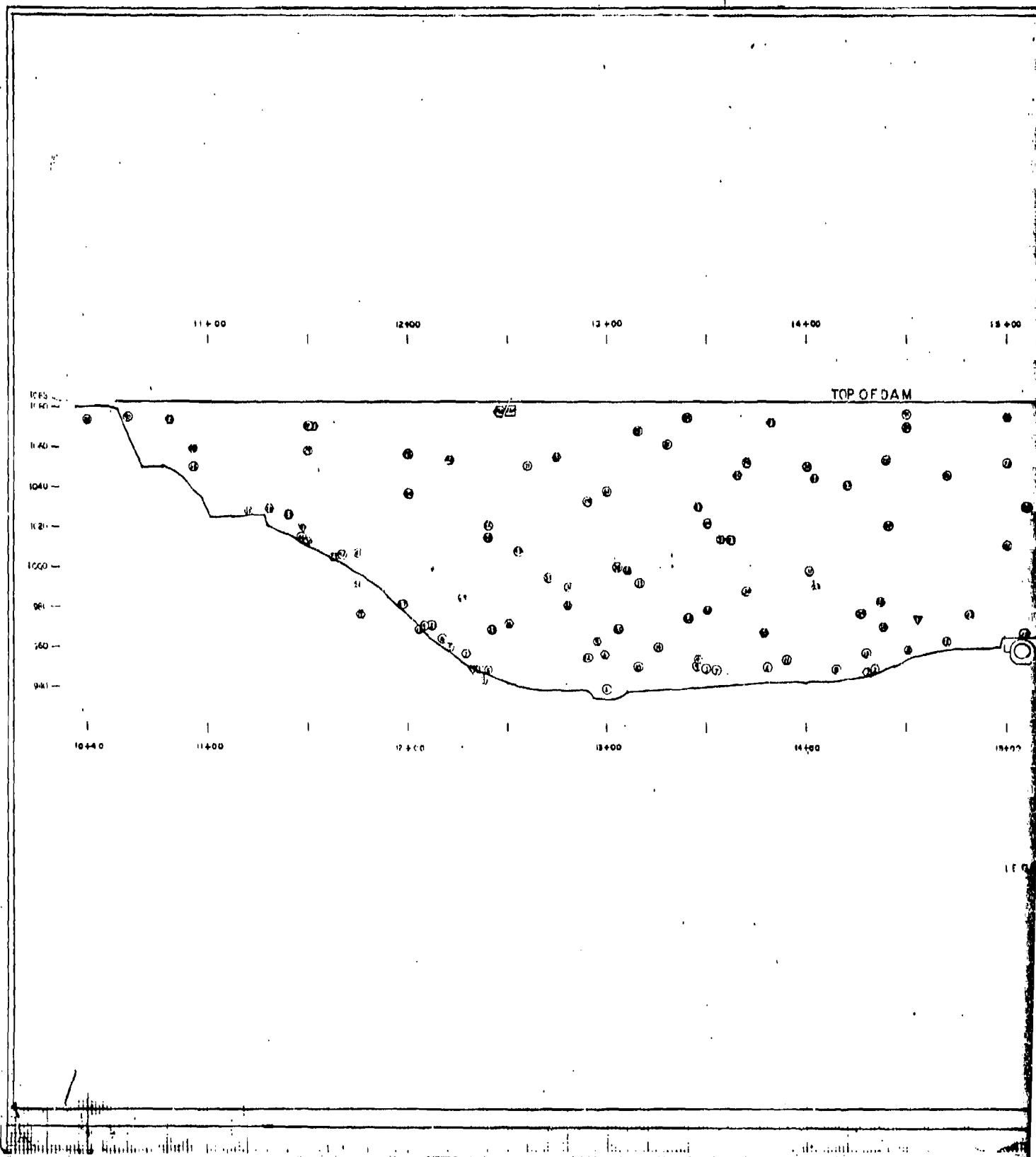
| TEST NO. | DATE | LOCATION   | DEPTH | REMARKS  |
|----------|------|------------|-------|----------|
| 10       | 1700 | SHALE FILL | 2.5   | STANDARD |
| 11       | 1700 | SHALE FILL | 2.5   | STANDARD |
| 12       | 1700 | SHALE FILL | 2.5   | STANDARD |
| 13       | 1700 | SHALE FILL | 2.5   | STANDARD |
| 14       | 1700 | SHALE FILL | 2.5   | STANDARD |
| 15       | 1700 | SHALE FILL | 2.5   | STANDARD |
| 16       | 1700 | SHALE FILL | 2.5   | STANDARD |
| 17       | 1700 | SHALE FILL | 2.5   | STANDARD |
| 18       | 1700 | SHALE FILL | 2.5   | STANDARD |
| 19       | 1700 | SHALE FILL | 2.5   | STANDARD |
| 20       | 1700 | SHALE FILL | 2.5   | STANDARD |

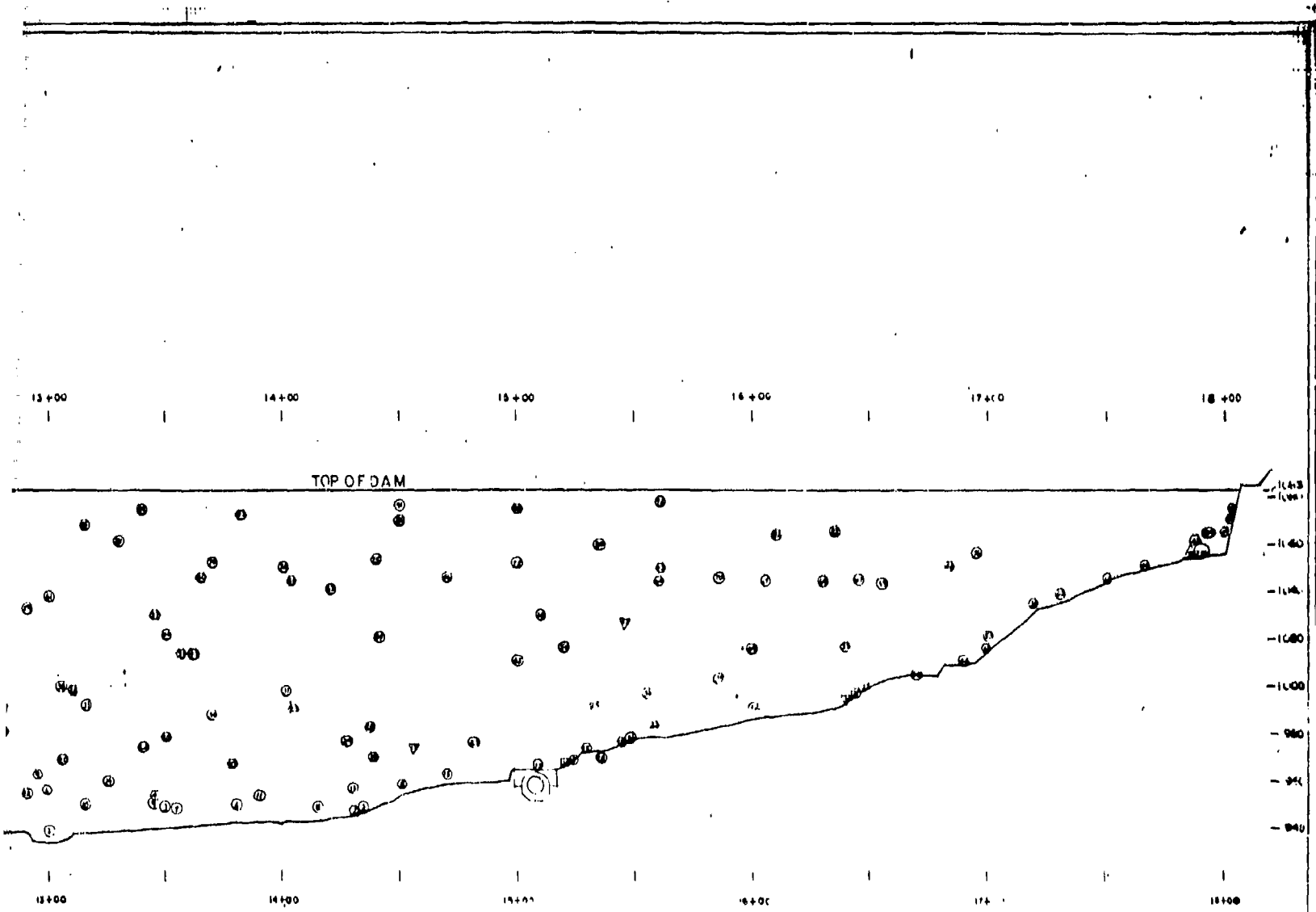


16+95  
(16+50 TO 17+00)

| TEST NO. | DATE | LOCATION   | DEPTH | REMARKS  |
|----------|------|------------|-------|----------|
| 21       | 1600 | SHALE FILL | 2.5   | STANDARD |
| 22       | 1600 | SHALE FILL | 2.5   | STANDARD |
| 23       | 1600 | SHALE FILL | 2.5   | STANDARD |
| 24       | 1600 | SHALE FILL | 2.5   | STANDARD |
| 25       | 1600 | SHALE FILL | 2.5   | STANDARD |
| 26       | 1600 | SHALE FILL | 2.5   | STANDARD |
| 27       | 1600 | SHALE FILL | 2.5   | STANDARD |
| 28       | 1600 | SHALE FILL | 2.5   | STANDARD |
| 29       | 1600 | SHALE FILL | 2.5   | STANDARD |
| 30       | 1600 | SHALE FILL | 2.5   | STANDARD |

|                                          |    |
|------------------------------------------|----|
| U. S. ARMY ENGINEER DISTRICT, LOUISVILLE |    |
| CORPS OF ENGINEERS                       |    |
| CARR FORK LAKE DAM & SPILLWAY            |    |
| COMPACTION TEST LOCATIONS                |    |
| STA. 16+51 TO 18+07                      |    |
| DATE                                     | BY |
| 17-20                                    |    |
| 17-20                                    |    |





LEGEND:

- GOVERNMENT TEST - PASSED
- GOVERNMENT TEST - FAILED
- CONTRACTOR TEST - PASSED
- ▽ CONTRACTOR TEST - FAILED

|                                              |                 |
|----------------------------------------------|-----------------|
| U. S. ARMY ENGINEER DISTRICT, LOUISVILLE     |                 |
| COMPT. OF ENGINEERS                          |                 |
| LOUISVILLE, KENTUCKY                         |                 |
| CARR FORK LAKE<br>DAM & SPILLWAY             |                 |
| E PROFILE OF DAM<br>IMPERVIOUS TESTS PLOTTED |                 |
| DATE: MAR 20 1977                            | BY: [Signature] |
| DRAWN BY: [Signature]                        |                 |
| CHECKED BY: [Signature]                      |                 |
| APPROVED BY: [Signature]                     |                 |
| SCALE: [Blank]                               |                 |
| SHEET: 19                                    |                 |

## CONTRACTOR FIELD

| MATERIAL<br>(ZONE) | NUMBER<br>OF<br>TESTS | DRY DENSITY |       |         |        | PERCENT COMPACTION |      |         |
|--------------------|-----------------------|-------------|-------|---------|--------|--------------------|------|---------|
|                    |                       | HIGH        | LOW   | AVERAGE | DESIGN | HIGH               | LOW  | AVERAGE |
| IMPERVIOUS         | 89 *                  | 127.0       | 107.4 | 117.8   | 110.2  | 110.4              | 94.8 | 101.2   |
| RANDOM             | 29 **                 | 128.2       | 109.4 | 119.6   | 110.2  | 109.0              | 94.6 | 102.2   |
| TRANSITION         | 20 ***                | 149.4       | 123.3 | 138.0   | 140.0  | 178.0              | 76.0 | 116.3   |

\* OF THE 89 TESTS RUN ON THE IMPERVIOUS MATERIAL 7 TESTS WERE AT OPTIMUM AND 4 TESTS INDICATED THE MATERIAL WAS BELOW THE OPTIMUM. 3 TESTS FAILED WERE REWORKED. ALL AREAS WERE RETESTED AND THE RESULTS WERE RECORDED.

\*\* OF THE 29 TESTS RUN ON THE RANDOM MATERIAL ONLY 1 TEST FAILED (BELOW THE COMPACTION DESIRED). THIS AREA WAS REWORKED AND RETESTED.

\*\*\* OF THE 20 TESTS RUN ON THE TRANSITION MATERIAL ONLY 1 TEST FAILED (BELOW THE COMPACTION DESIRED). THIS AREA WAS REWORKED AND RETESTED AND THE RESULTS WERE RECORDED.

## CORPS OF ENGINEER

| MATERIAL<br>(ZONE) | NUMBER<br>OF<br>TESTS | DRY DENSITY |       |         |        | PERCENT COMPACTION |      |         |
|--------------------|-----------------------|-------------|-------|---------|--------|--------------------|------|---------|
|                    |                       | HIGH        | LOW   | AVERAGE | DESIGN | HIGH               | LOW  | AVERAGE |
| IMPERVIOUS         | 53 *                  | 123.3       | 104.5 | 116.3   | 110.2  | 105.5              | 90.8 | 99.4    |
| RANDOM             | 8 **                  | 126.8       | 115.5 | 120.0   | 110.2  | 102.7              | 96.6 | 100.1   |
| TRANSITION         | 11 ***                | 146.4       | 127.7 | 137.1   | 140.0  | 148.0              | 86.8 | 115.9   |

\* OF THE 53 TESTS RUN ON THE IMPERVIOUS MATERIAL 3 TESTS WERE AT OPTIMUM AND 2 TESTS INDICATED THE MATERIAL WAS BELOW THE OPTIMUM. 1 TEST FAILED WERE REWORKED. THERE WAS 1 AREA THAT WAS REWORKED AND RETESTED.

\*\* OF THE 8 TESTS RUN ON THE RANDOM MATERIAL 0 TESTS FAILED.

\*\*\* OF THE 11 TESTS RUN ON THE TRANSITION MATERIAL 0 TESTS FAILED.

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

# FIELD COMPACTION CONTROL - DAM

| COMPACTION ④ ③ |         | WATER CONTENT ③ |       |         |        | DEVIATION FROM OPTIMUM ③ |       |         |           |
|----------------|---------|-----------------|-------|---------|--------|--------------------------|-------|---------|-----------|
| AVERAGE        | DESIRED | HIGH            | LOW   | AVERAGE | DESIGN | HIGH                     | LOW   | AVERAGE | SPECIFIED |
| 101.2          | 95.0    | 17.4            | 11.0  | 14.3    | 13.4   | +2.5                     | -1.7  | -.58    | -2.0 +2.0 |
| 102.2          | 95.0    | 19.9            | 11.0  | 14.0    | 13.4   | +2.1                     | -2.8  | -.40    | -2.0 +3.0 |
| 116.3          | 85.0    | N/A ③           | N/A ③ | N/A ②   | N/A ②  | N/A ③                    | N/A ③ | N/A ②   | N/A ②     |

TESTS FAILED ( 3 TESTS INDICATED THE MATERIAL WAS TOO WET OF  
 BELOW THE COMPACTION DESIRED). ALL OF THE TEST SECTIONS THAT  
 AND THE TESTS WERE ACCEPTABLE.

TEST FAILED ( THE MATERIAL WAS BOTH TOO DRY OF OPTIMUM AND  
 REWORKED AND RETESTED AND THE TEST WAS ACCEPTABLE.

ONLY 1 TEST FAILED (THE MATERIAL WAS BELOW THE COMPACTION)  
 AND THE TEST WAS ACCEPTABLE.

## ENGINEERS ACCEPTANCE TESTS - DAM

| COMPACTION ④ ③ |         | WATER CONTENT ③ |       |         |        | DEVIATION FROM OPTIMUM ③ |       |         |           |
|----------------|---------|-----------------|-------|---------|--------|--------------------------|-------|---------|-----------|
| AVERAGE        | DESIRED | HIGH            | LOW   | AVERAGE | DESIGN | HIGH                     | LOW   | AVERAGE | SPECIFIED |
| 99.4           | 95.0    | 17.6            | 11.6  | 14.1    | 13.4   | +2.0                     | -2.1  | -.32    | -2.0 +2.0 |
| 100.1          | 95.0    | 14.9            | 10.4  | 13.9    | 13.4   | +0.7                     | -2.0  | -.46    | -2.0 +3.0 |
| 115.9          | 85.0    | N/A ③           | N/A ③ | N/A ②   | N/A ②  | N/A ③                    | N/A ③ | N/A ②   | N/A ②     |

TESTS FAILED ( 1 TEST INDICATED THE MATERIAL WAS TOO DRY OF  
 BELOW THE COMPACTION DESIRED). ALL OF THE TEST SECTIONS THAT  
 WAS RETESTED AND THIS TEST WAS ACCEPTABLE.

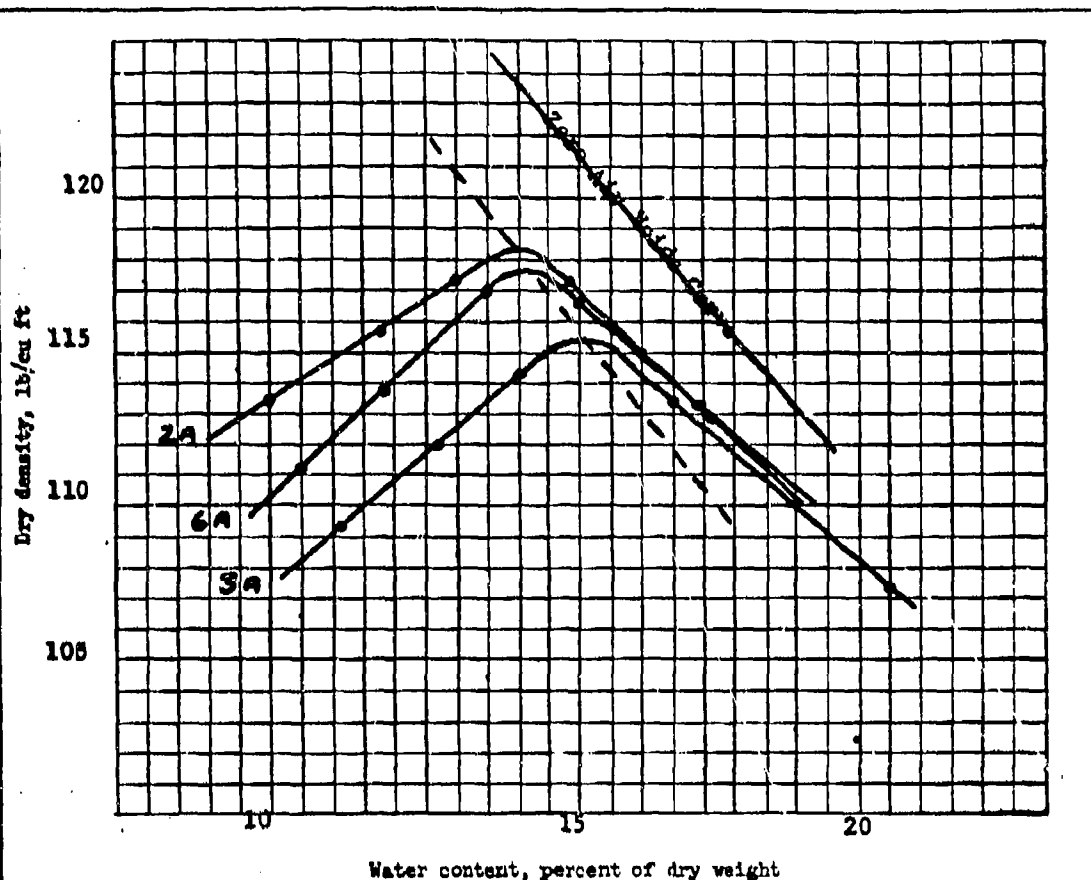
TESTS FAILED.

ALL TESTS FAILED.

MATERIAL , RELATIVE DENSITY TEST USED ON THE TRANSITION MATERIAL

RESULTS OF ACCEPTABLE TESTS AND RETESTS FOR AVERAGE VALUES.

PLATE 19 2



Standard \_\_\_\_\_ compaction test  
 56 blows per each of 3 layers, with 5.5 lb rammer and  
 12 inch drop. 6 inch diameter mold

| Sample No. | Elev or Depth | Classification            | G    | LL   | PL   | % > No. 4 | % > 3/4 in. |
|------------|---------------|---------------------------|------|------|------|-----------|-------------|
| 2A         | 18"           | Gravelly sandy clay SC-SM | 2.75 | 27.0 | 20.3 | 26.4      | 10.1        |
| 3A         | 970±          | Gravelly sandy clay SC    | 2.72 | 28.8 | 20.5 | 17.1      | 3.2         |
| 6A         | 3'            | Gravelly sandy clay SC-SM | 2.73 | 27.3 | 20.6 | 26.0      | 9.5         |

| Sample No.                     | 2A    | 3A    | 6A    |
|--------------------------------|-------|-------|-------|
| Natural water content, percent |       |       |       |
| Optimum water content, percent | 14.0  | 15.2  | 14.2  |
| Max dry density, lb/cu ft      | 118.3 | 115.5 | 117.7 |

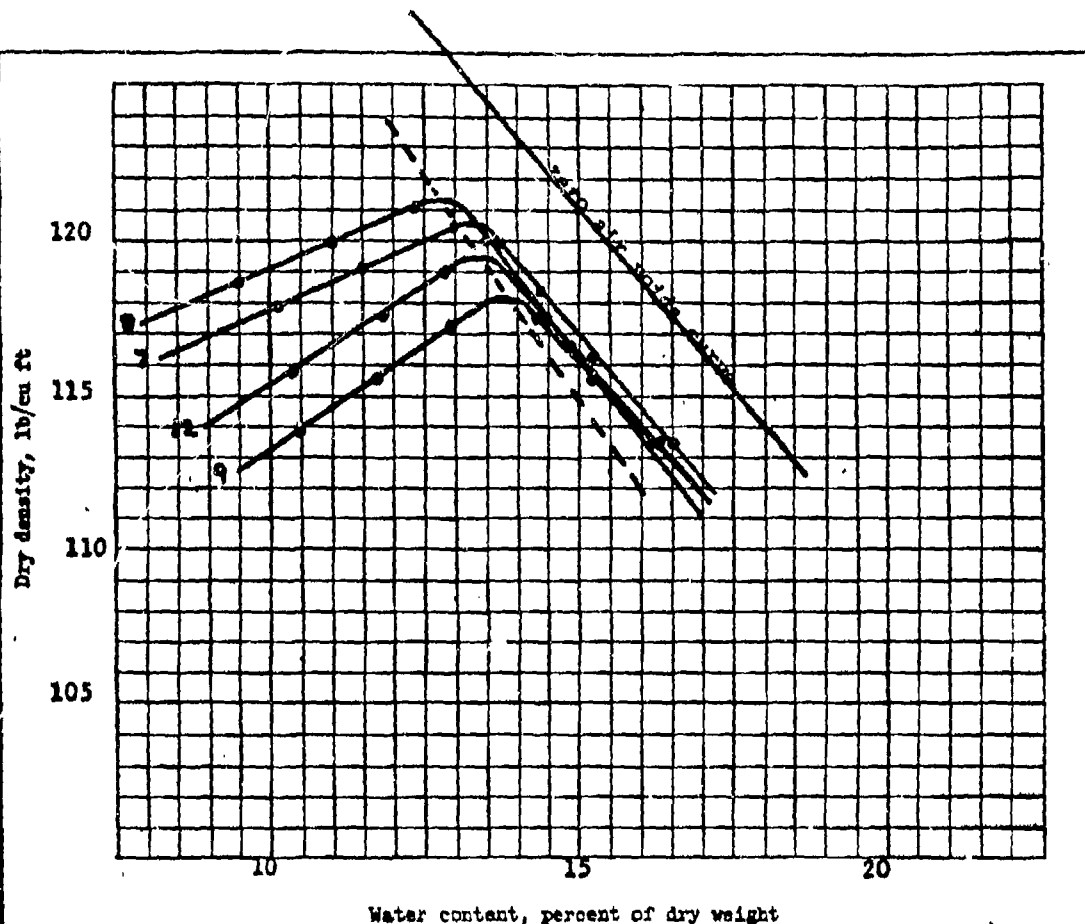
|                           |                        |                               |
|---------------------------|------------------------|-------------------------------|
| Remarks: Material for use | Project                | Carr Fork Lake Dam & Spillway |
| in impervious core        |                        | Vicco, Ky.                    |
|                           | Area                   | Storage Area "A"              |
|                           | Boring No.             | Date May 1971                 |
|                           | COMPACTION TEST REPORT |                               |

ENG FORM  
1 JUN 65

2091

PREVIOUS EDITIONS ARE OBSOLETE.

(TRANSLUCENT)



Standard \_\_\_\_\_ compaction test

56 blows per each of 3 layers, with 5.5 lb rammer and 12 inch drop. 6 inch diameter mold

| Sample No. | Elev or Depth | Classification              | G    | LL   | PL   | % > No. 4 | % > 3/4 in. |
|------------|---------------|-----------------------------|------|------|------|-----------|-------------|
| 7DS        |               | Gravelly sandy clay, SC-SM  | 2.73 | 24.2 | 19.0 | 24.4      | 14.4        |
| 8DS        |               | Sandy gravelly clay, GC-GM  | 2.72 | 26.4 | 19.7 | 33.4      | 16.5        |
| 9DS        |               | Gravelly clayey sand, SC-SM | 2.75 | 23.9 | 19.6 | 14.7      | 4.2         |
| 10DS       |               | Gravelly clayey sand, SC-SM | 2.70 | 23.2 | 18.4 | 21.9      | 5.9         |

| Sample No.                     | 10    | 9     | 8     | 7     |
|--------------------------------|-------|-------|-------|-------|
| Natural water content, percent |       |       |       |       |
| Optimum water content, percent | 13.3  | 13.8  | 12.8  | 13.3  |
| Max dry density, lb/cu ft      | 119.2 | 118.2 | 121.3 | 120.6 |

|                        |                                         |
|------------------------|-----------------------------------------|
| Remarks For use in im- | Project Carr Fork Lake Dam and Spillway |
| pervious core,         | Vicco, Ky.                              |
|                        | Area D.S. storage area                  |
|                        | Boring No. _____ Date 24 Aug 73         |
|                        | COMPACTION TEST REPORT                  |

ENG FORM  
1 JUN 68

2091

PREVIOUS EDITIONS ARE OBSOLETE.

(TRANSLUCENT)

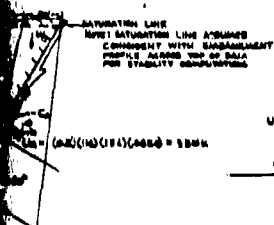
PLATE 21





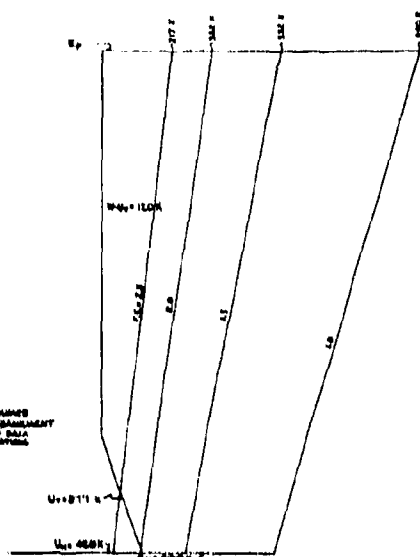
**WAG PRESSURE**

**LOCK**



## STATIC PRESSURE

**WEDGE**

341<sup>2</sup> = 99<sup>1</sup>

VECTOR DIAGRAM

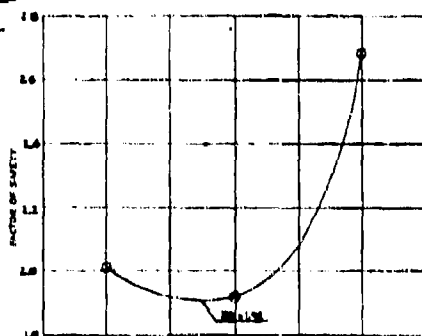
ACTIVE WEDGE

SCALE 1:100000  
A 4 42

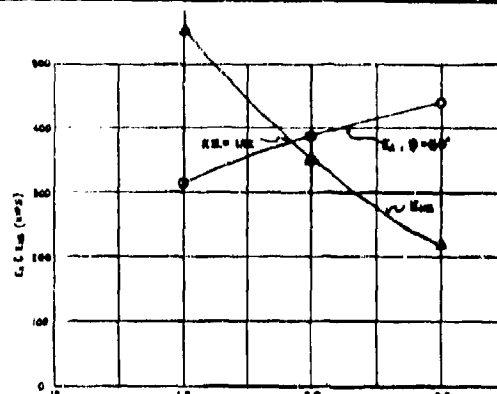


## NEUTRAL BLOCK

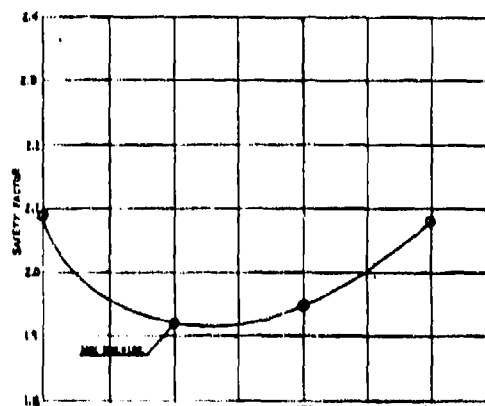
SCALE: 1' = 400'



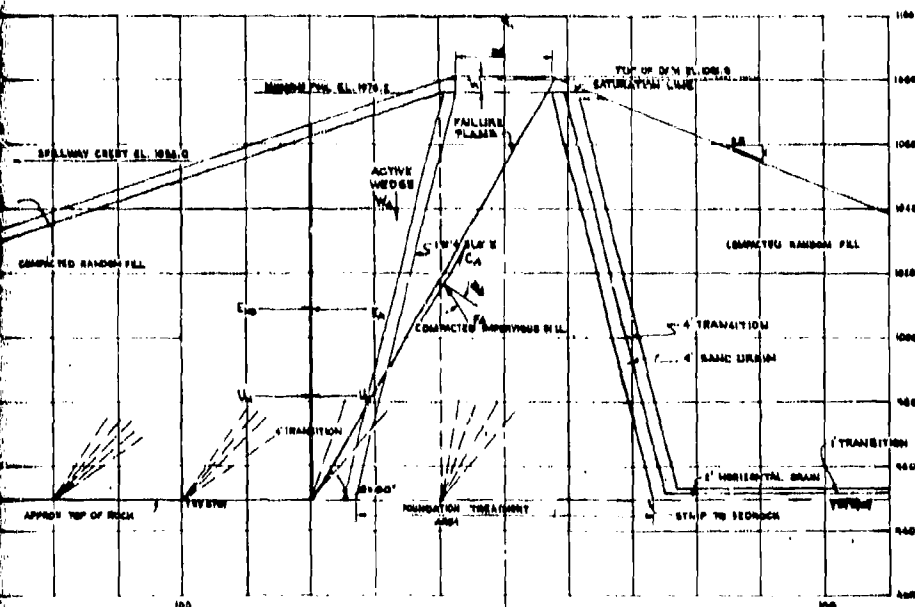
B ANGLE



### TRIAL FACTOR OF SAFETY



DISTANCE U/S OF CENTERLINE



|                                                                                                                            |      |                                                                                                                |  |                          |  |
|----------------------------------------------------------------------------------------------------------------------------|------|----------------------------------------------------------------------------------------------------------------|--|--------------------------|--|
|                                                                                                                            |      |                                                                                                                |  |                          |  |
|                                                                                                                            |      |                                                                                                                |  |                          |  |
| APPROVED                                                                                                                   | DATE | DISAPPROVED                                                                                                    |  | BY                       |  |
| <p align="center"><b>U. S. ARMY ENGINEER DISTRICT, LOUISVILLE</b><br/> <b>COOPS OF STADIUMS</b><br/> <b>LOUISVILLE</b></p> |      |                                                                                                                |  |                          |  |
| DESIGNER<br>MAJOR<br>CAPTAIN<br>MAJOR<br>MAJOR                                                                             |      | KENTUCKY RIVER GARRISON, KY<br>CARRIAGE POND RESERVOIR<br><b>STABILITY ANALYSIS</b><br><b>SUDDEN DRAINDOWN</b> |  |                          |  |
| APPROVED<br><br>R. H. HAYS<br>MAJOR   |      | APPROVED<br>SHEET 1                                                                                            |  | DATE<br>JULY 1968        |  |
| APPROVED<br><br>R. H. HAYS<br>MAJOR   |      | MAJOR, COOPS OF STADIUMS<br>SCALE AS SHOWN                                                                     |  | MAJOR, COOPS OF STADIUMS |  |

| ADOPTED DESIGN VALUES |                |             |         |                     |      |
|-----------------------|----------------|-------------|---------|---------------------|------|
| MATERIALS             | $\gamma$ (pcf) | SAT. WEIGHT | $\phi$  | TAN $\delta$ C 1/T1 |      |
| EMB-IMP               | 131.0          | 135.0       | 23° 18' | 0.43                | 0.20 |
| RANDOM ROCK           | 145.0          | 155.5       | 10°     | 0.23                | 1.20 |

- NOTES:
1. "H" SHEAR STRENGTHS USED FOR IMPERVIOUS MATERIAL.
  2. SATURATED WEIGHTS USED BELOW SPILLWAY CREST
  3. F.A. = TAN  $\delta$  | F.S. = 1.5
  4. COMPUTATIONS PRESENTED FOR PLANE WT 1/16 FROM  $\phi$ ,  $\delta$  20° AND TRIAL S.F. 1.5

**ACTIVE WEDGE**

$$W_1 = 884^k$$

$$\text{IMP: TAN } \delta_1 = \frac{0.43}{1.5} = 0.29$$

$$\text{RANDOM: TAN } \delta_2 = \frac{0.23}{1.5} = 0.15$$

$$\text{WEIGHTED TAN } \delta_1 = \frac{W_1}{W_1 + W_2} = \frac{884}{884 + 100} = 0.89$$

$$\text{RAN: } \frac{W_2}{W_1 + W_2} = \frac{100}{884 + 100} = 0.10$$

$$\text{TAN } \delta_1 = 0.814 \quad \delta_1 = 39^\circ$$

$$C_1 = \frac{2.0}{1.5} (100) = 133^k$$

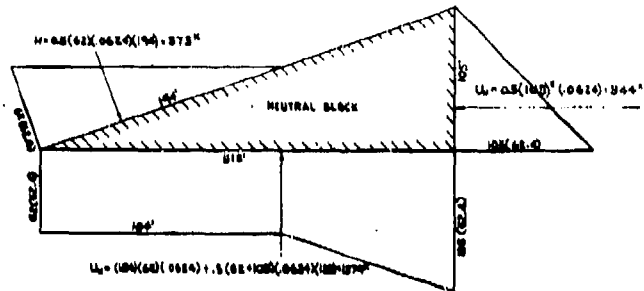
**NEUTRAL BLOCK**

$$W_2 = 0.5(100)(20)(1.5) = 1500^k$$

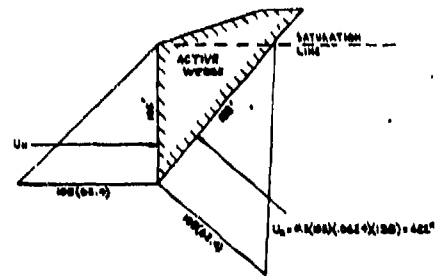
$$\text{TAN } \delta_2 = \frac{0.23}{1.5} = 0.15$$

$$\delta_2 = 10^\circ$$

$$C_{20} = \frac{2.0}{1.5} (10) = 133^k$$

**TYPICAL HYDROSTATIC PRESSURE****NEUTRAL BLOCK**

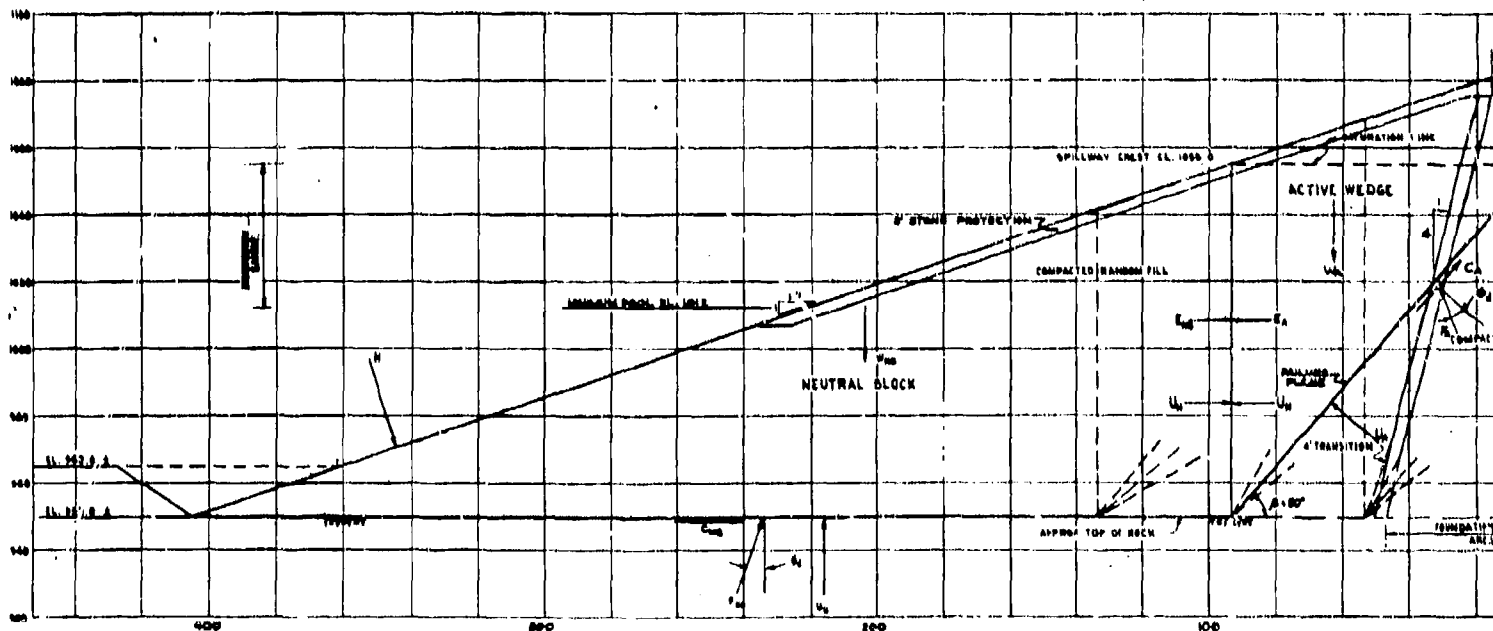
SCALE: 1" = 50'

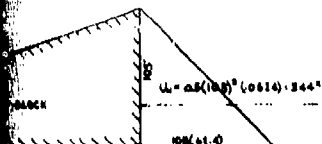
**TYPICAL HYDROSTATIC PRESSURE****ACTIVE WEDGE**

SCALE: 1" = 50'

**VECTOR DIAGRAM****NEUTRAL BLOCK**

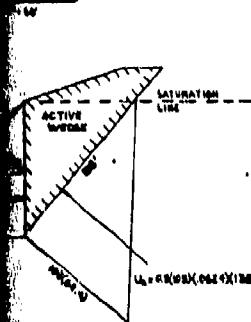
SCALE: 1" = 500'





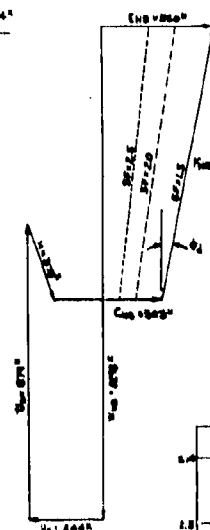
STATIC PRESSURE

BLOCK



STATIC PRESSURE

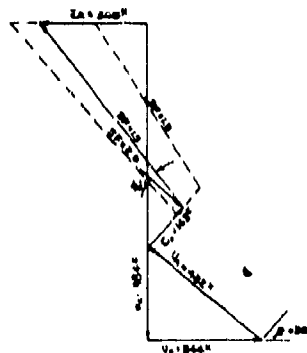
WEDGE



VECTOR DIAGRAM

NEUTRAL BLOCK

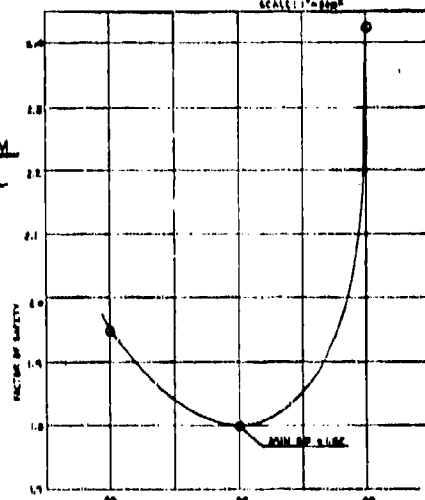
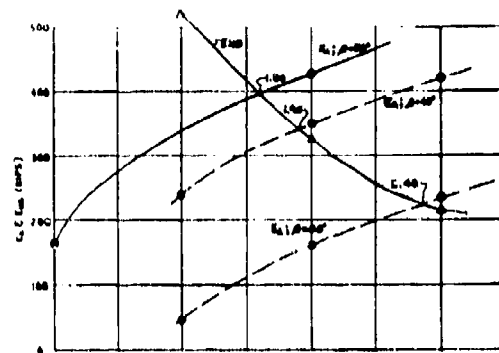
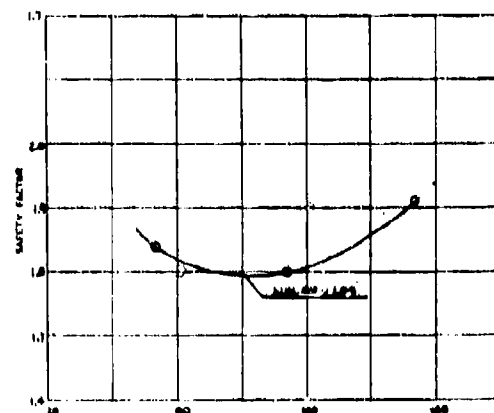
SCALE: 1"=1000'



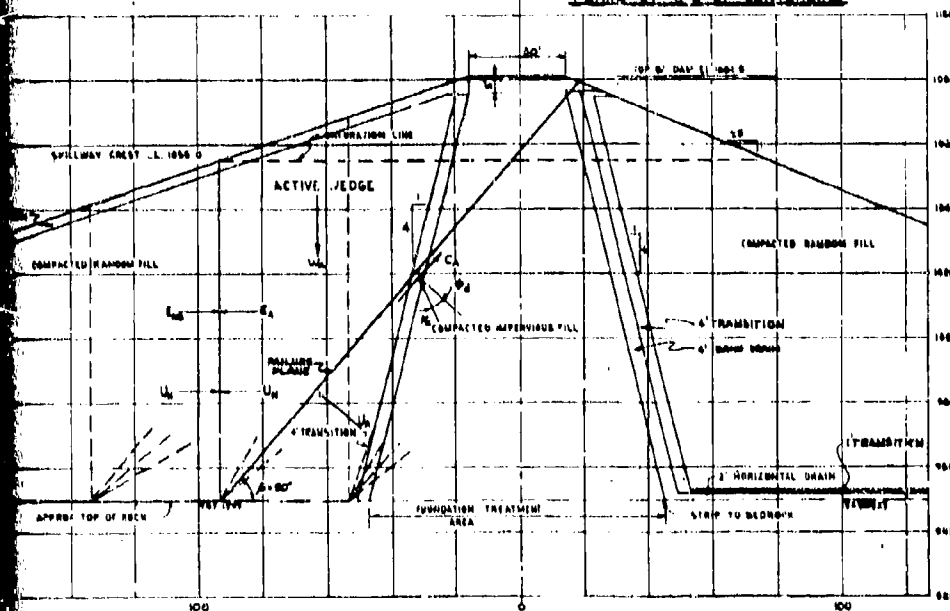
VECTOR DIAGRAM

ACTIVE WEDGE

SCALE: 1"=1000'

ANGLE  
PLANE 97' U/S OF CENTERLINETRIAL FACTOR OF SAFETY  
PLANE 97' U/S OF CENTERLINE

DISTANCE U/S OF CENTERLINE



|                                                                                        |                      |                   |                   |
|----------------------------------------------------------------------------------------|----------------------|-------------------|-------------------|
| REVISION                                                                               | DATE                 | DESCRIPTION       | BY                |
| U. S. ARMY ENGINEER DISTRICT, LOUISVILLE<br>CORPS OF ENGINEERS<br>LOUISVILLE, KENTUCKY |                      |                   |                   |
| KENTUCKY RIVER BASIN, KY<br>CARR FORD RESERVOIR                                        |                      |                   |                   |
| STABILITY ANALYSIS<br>SUDDEN DRAWDOWN<br>CASE 1                                        |                      |                   |                   |
| DESIGNED BY<br>CHECKED BY<br>APPROVED BY                                               | DATE<br>DATE<br>DATE | SCALE<br>AS SHOWN | DATE<br>JUNE 1964 |
| DRAWING NUMBER                                                                         |                      |                   |                   |





| ADOPTED DESIGN VALUE |                            |       |      |          |            |                     |
|----------------------|----------------------------|-------|------|----------|------------|---------------------|
| MATERIAL             | $\gamma$ #/ft <sup>3</sup> |       |      | STRENGTH |            |                     |
|                      | UNSAT                      | SAT   | 200  | TEST     | TAN $\phi$ | C #/ft <sup>2</sup> |
| REP. SAND            | 115.0                      | 131.0 | 65.0 | Q        | 0.00       | 0.70                |
| RANDOM FILL          | 115.0                      | 140.0 | 77.5 | Q        | 0.65       | 0.00                |

## NOTES:

1. "Q" SHEAR STRENGTH USED
2. F.S. =  $\frac{1000}{1.5} = 66.7$
3. COMPUTATIONS PRESENTED FOR PLANE 80' D.S. FROM S DAM, 51.25' AND TRAIL 7% +1.0

## ACTIVE WEDGE

$$W_A = 1500 \text{ k}$$

$$C_A = \frac{1}{2} (80) = 40 \text{ k}$$

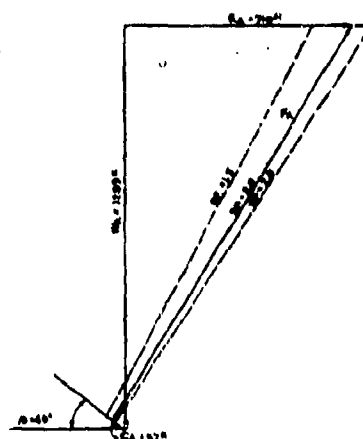
$$\text{HORIZONTAL TAN } \phi = \frac{1000}{66.7} (0.65) = 9.75$$

$$\text{TAN } \phi_A = \frac{9.75}{1.5} = 6.50 \quad \phi_A = 33^\circ$$

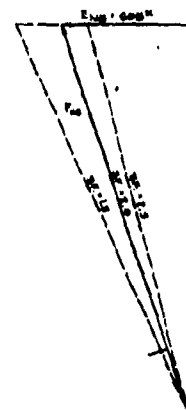
## NEUTRAL BLOCK

$$W_N = 1.5 (80) (100) = 12000 \text{ k}$$

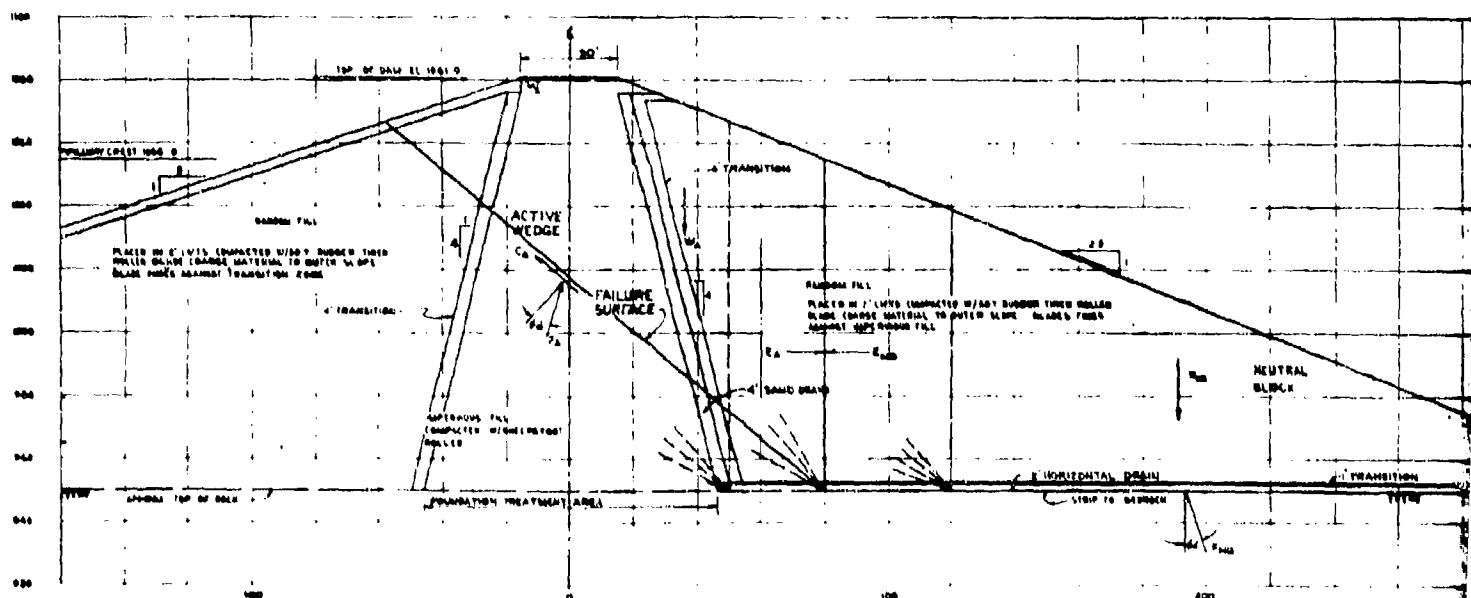
$$\text{TAN } \phi_N = \frac{1000}{66.7} = 15.0 \quad \phi_N = 86^\circ$$



VECTOR DIAGRAM  
ACTIVE WEDGE  
SCALE: 1" = 500 K

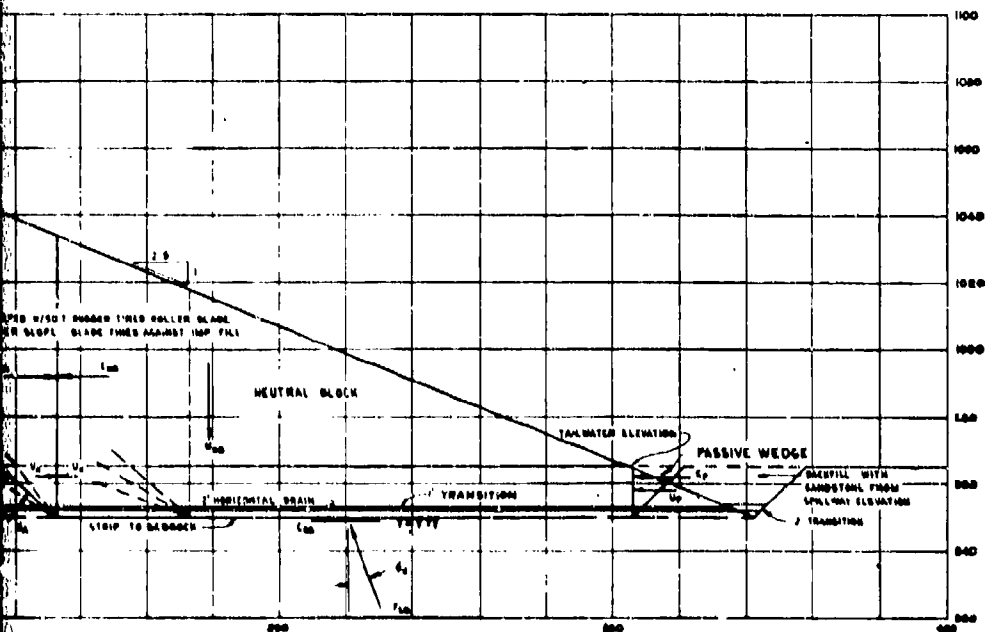
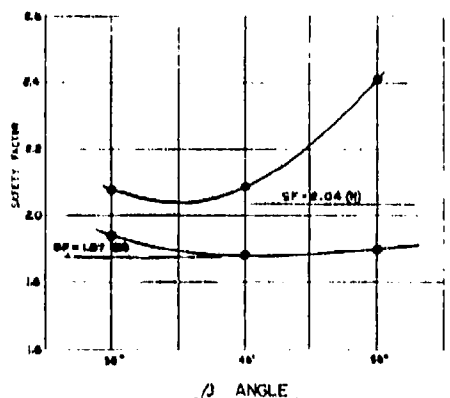
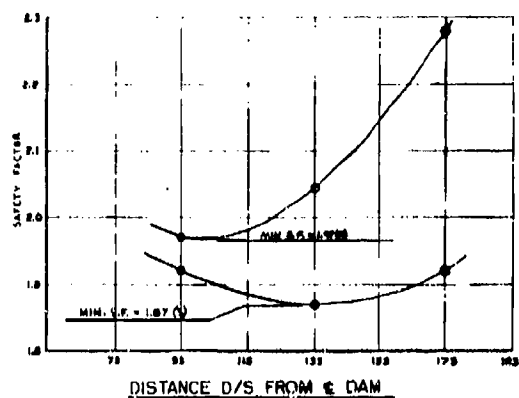
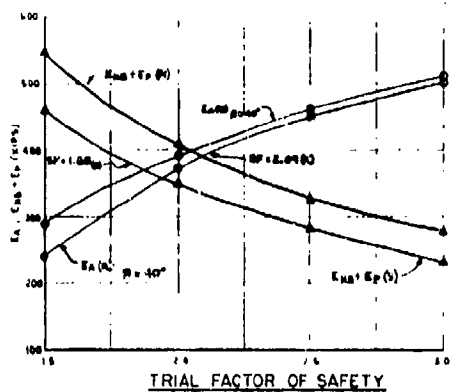
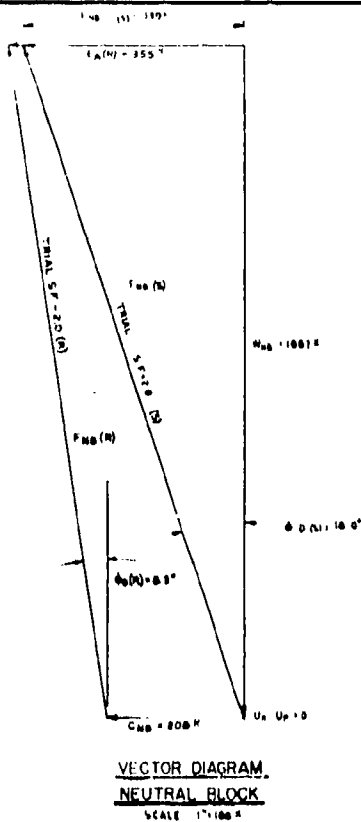


VECTOR DIAGRAM  
NEUTRAL BLOCK  
SCALE: 1" = 500 K









|                                          |             |
|------------------------------------------|-------------|
| U. S. ARMY ENGINEER DISTRICT, LOUISVILLE |             |
| CORPS OF ENGINEERS                       |             |
| MIDDLE DIVISION                          |             |
| KENTUCKY POWER DAM, IN                   |             |
| CAMP FORD RESERVOIR                      |             |
| DOWNSTREAM DAM SECTION                   |             |
| STABILITY ANALYSIS                       |             |
| STEADY SEEPAGE                           |             |
| DESIGNED BY                              | REVIEWED BY |
| CHECKED BY                               | APPROVED BY |
| DATE                                     | DATE        |

**NOTE:**

1. "N" BEAM STRENGTH USED
2. SUBMERGED WEIGHTS USED BELOW POOL ELEVATION
3.  $F.S. = \frac{TAN \theta}{TAN \theta_c}$  ;  $F.S. = \frac{C}{S}$
4. COMPUTATIONS PRESENTED FOR PLANE 10W W/S  
FROM E. DAM, A. 40°, TRIAL 4.F. 2.5 & POOL  
ELEVATION 904.0

ACTIVE WEDGE

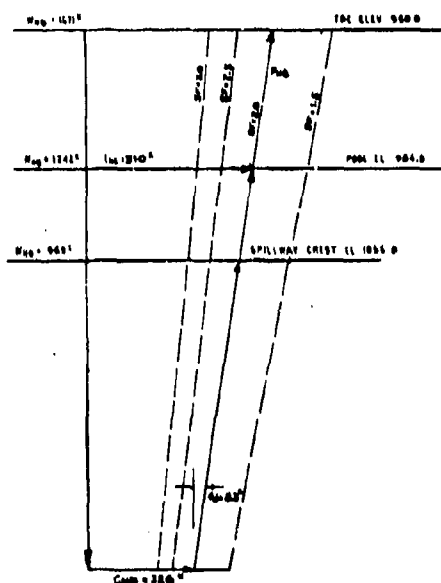
$$u_0 = \{(126)(.6)(56)(.194)\} + \{(109)(74)(.6)(.175)\} + \{220(177+204)(2)(.125)\} + \{2100 + 411/8)(67)(.150)\} + \{(41)(.6)(24)(.0775)\} + 1050^M$$

WEIGHTED VALUES  
 TAN (200/204) (.49) = .098  
 ROCK (200/204) (.51) = .102  
 WEIGHTED TAN 0 = .200  
 TAN 0 =  $\frac{.200}{2} = .100$   
 0.100

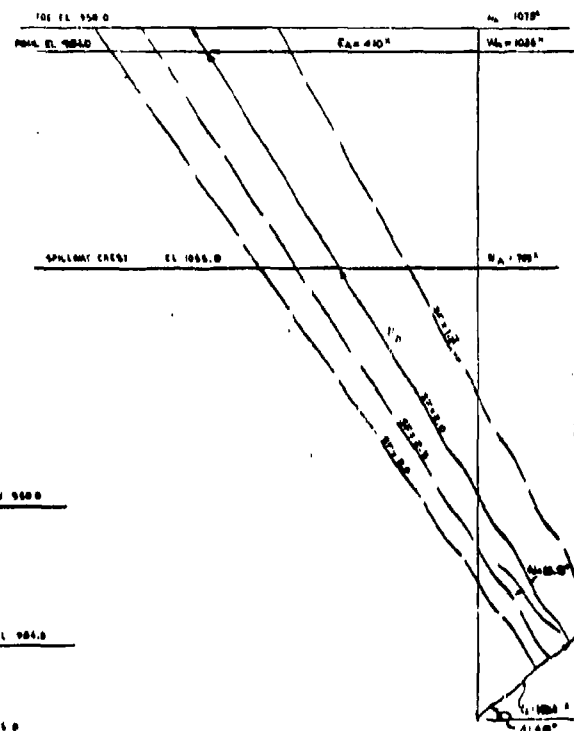
$$C_2 = 1 + \left(\frac{1}{1.05}\right) + 40\left(\frac{1.05}{1.05}\right) = 41.05$$

NEUTRAL BLOCK

$$W_{100} = (.6)(.97)(.171)(.136) + (.171)(.978)(.6)(.976) = 124.2 \text{ A}$$



VECTOR DIAGRAM  
NEUTRAL BLOCK  
GENE 1-1004



VECTOR DIAGRAM  
ACTIVE WEDGE  
SCALE 1"=100'

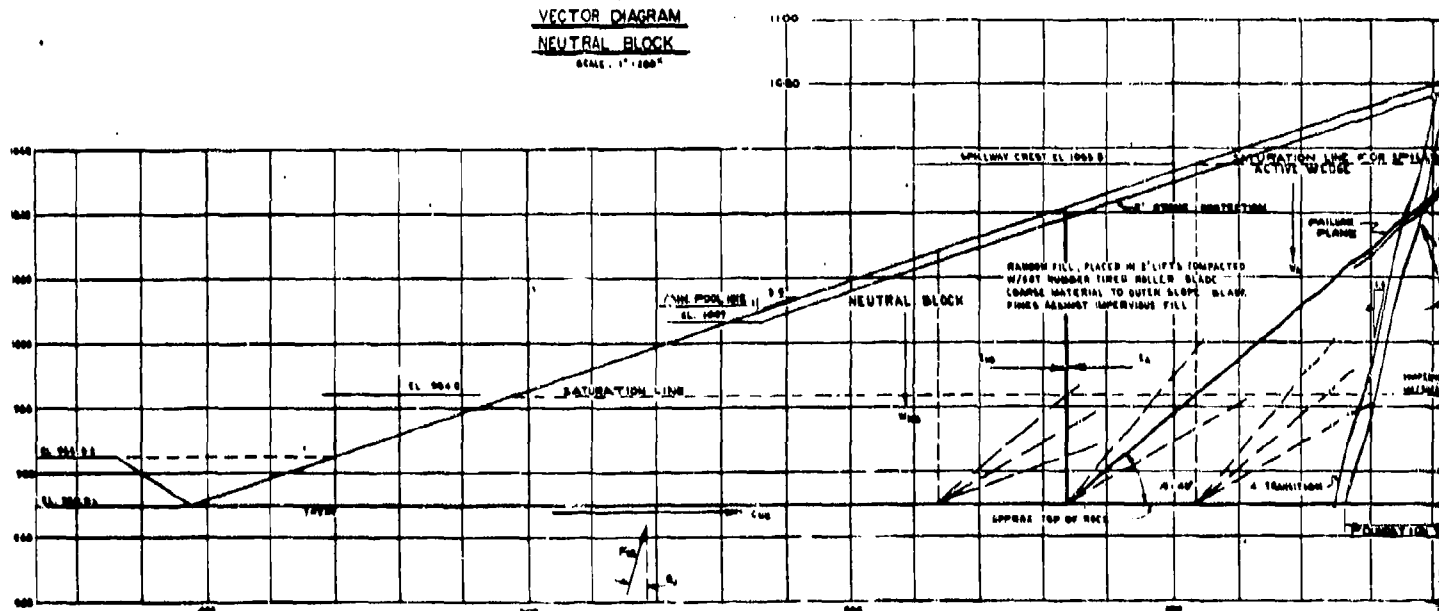
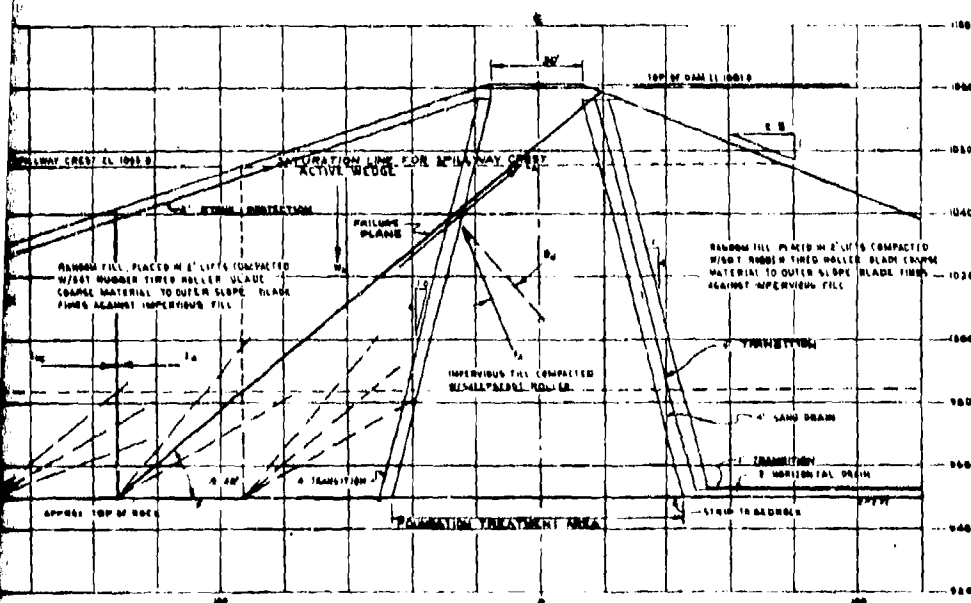
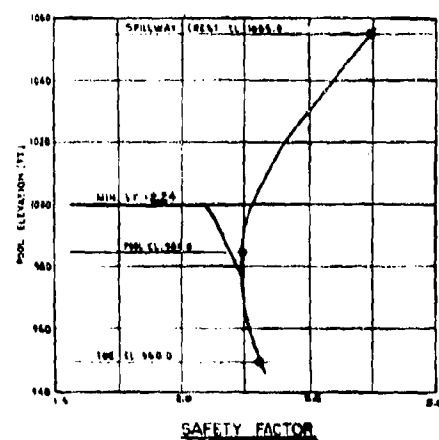


Figure 1 is a line graph showing the Safety Factor (Y-axis) versus Distance U/S from a Dam (X-axis). The Y-axis ranges from 1.2 to 1.4, and the X-axis ranges from 0 to 140. Three curves are plotted, representing different cases:

- Case 1 (top curve):  $SP = 1.200$  (SPRIMARY COMB)
- Case 2 (middle curve):  $SP = 1.100$  (SECONDARY COMB)
- Case 3 (bottom curve):  $SP = 1.000$  (TERTIARY COMB)

The curves show that the safety factor decreases as the distance from the dam increases, with the primary case (top curve) maintaining the highest safety factor throughout the range shown.



|                                                                                     |       |                                                                          |              |  |   |
|-------------------------------------------------------------------------------------|-------|--------------------------------------------------------------------------|--------------|--|---|
|                                                                                     |       |                                                                          |              |  |   |
|                                                                                     |       |                                                                          |              |  |   |
|                                                                                     |       |                                                                          |              |  |   |
| REGION                                                                              | DAYS  |                                                                          | SUBSCRIPTION |  | N |
| U. S. ARMY ENGINEER DISTRICT, LOUISVILLE<br>CORPS OF ENGINEERS<br>LOUISVILLE OFFICE |       |                                                                          |              |  |   |
| DRAWING                                                                             |       |                                                                          |              |  |   |
| SCALE                                                                               | TITLE | KENTUCKY RIVER BASIN, KY.<br>CARR FORK RESERVOIR<br>UPSTREAM DAM SECTION |              |  |   |
| CHECKED                                                                             |       | STABILITY ANALYSIS<br>PARTIAL POOL                                       |              |  |   |
| DATE                                                                                |       |                                                                          |              |  |   |
| BY                                                                                  |       |                                                                          |              |  |   |
| APPROVED                                                                            |       | JUNE 1968                                                                |              |  |   |
| REVISIONS                                                                           |       | MAINTAIN RECORD                                                          |              |  |   |

2



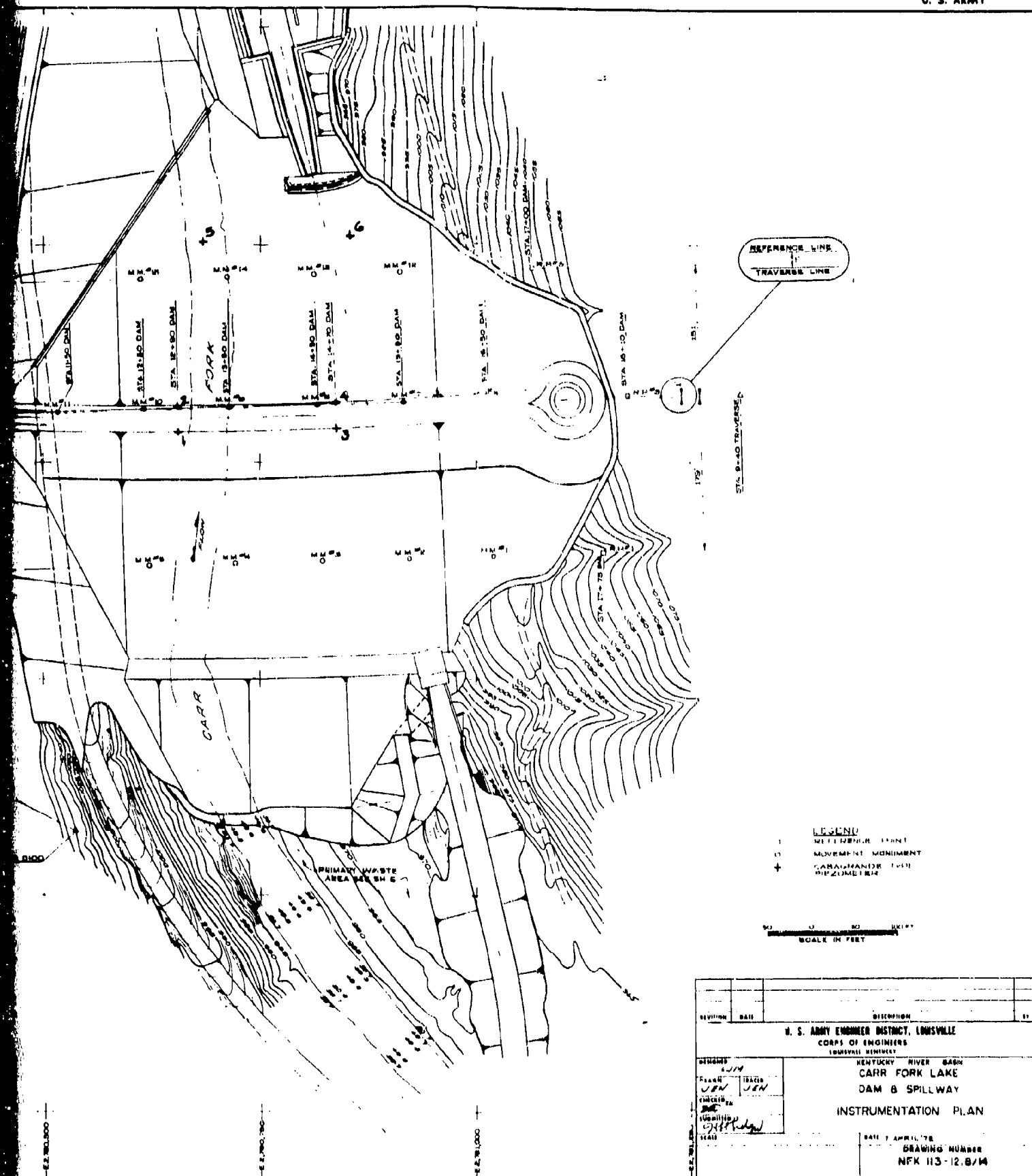
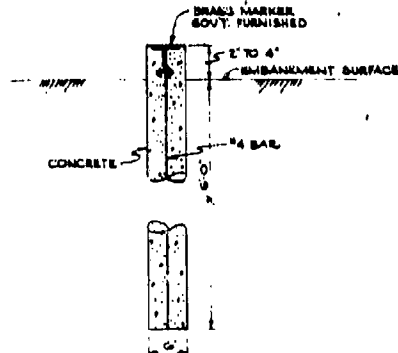


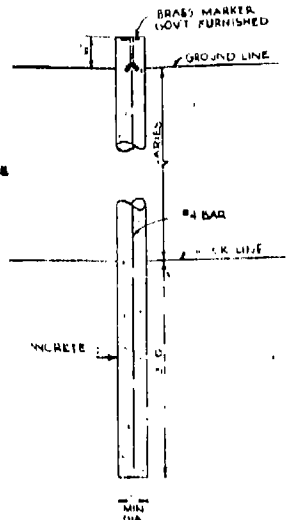
PLATE 26

2

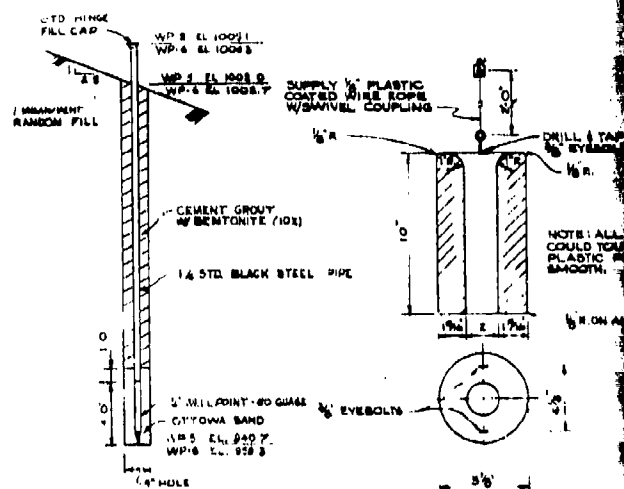
\*PUNCH MARKER TO  
MATCH LINE BETWEEN  
REFERENCE MONUMENTS



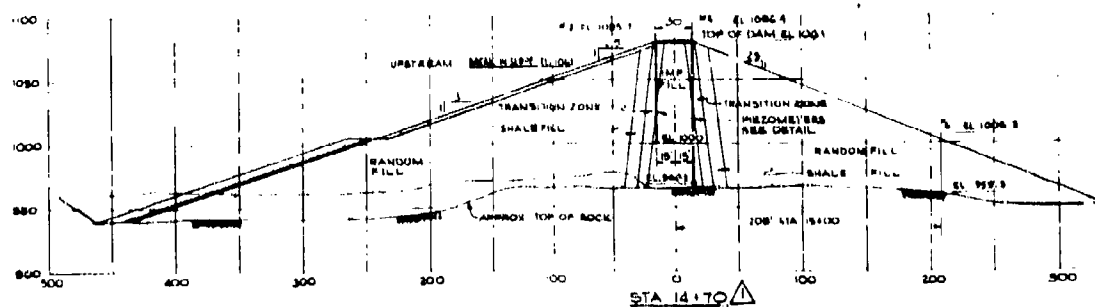
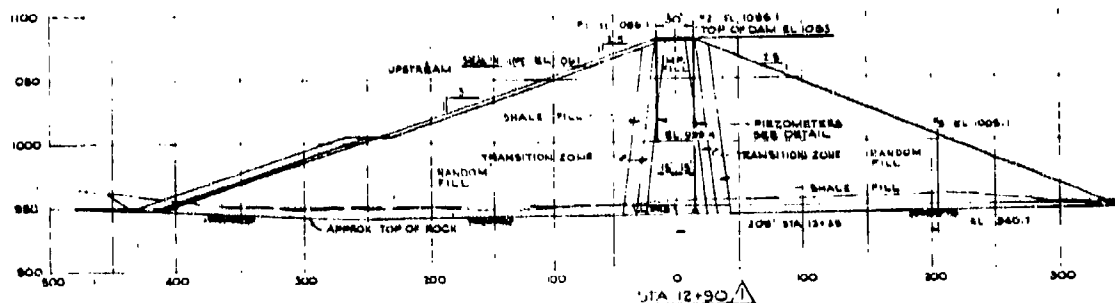
**MOVEMENT MONUMENT**  
TYPICAL FOR MONUMENTS 1' WIDE BY 5' 4" 2" THRU 11' 2"  
SCALE: 1"=1'-0"



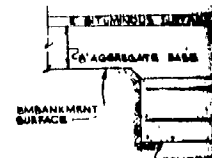
REFERENCE: QUINCY



STEEL TAMPING HAMMER  
SCALE: 3"=1'-0"  
NOTE: FOR USE IN COMPACTING  
SAND FILL & BENTONITE SEAL  
IN PIEZOMETERS

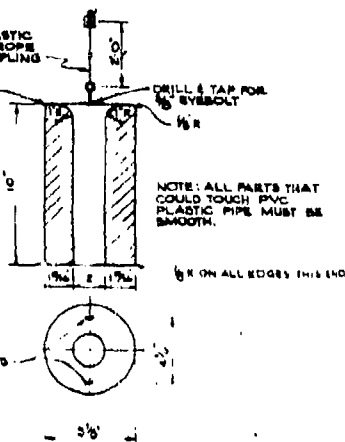


PIEZOMETER LOCATIONS  
SCALE: 1" = 50'



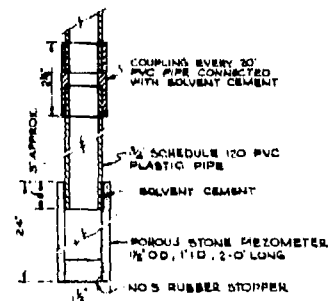
**MQV**  
**TYPICAL**

KLADINT - 80 GUAGE  
FOVA BAND  
1 EL. 9407.  
2 EL. 9183



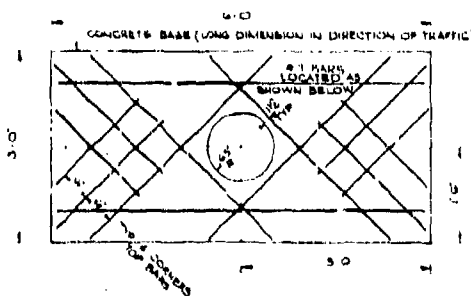
STEEL TAMPING HAMMER  
SCALE 3" = 1'-0"

NOTE: FOR USE IN COMPACTING  
SAND FILL & BENTONITE SEAL  
IN PIEZOMETERS



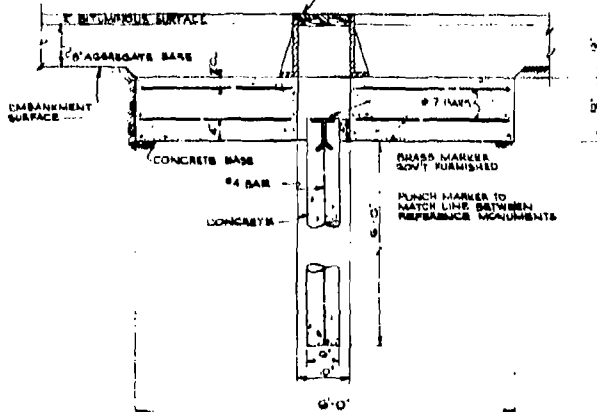
### PIEZOMETER ASSEMBLY

NOT TO SCALE.



### PLAN

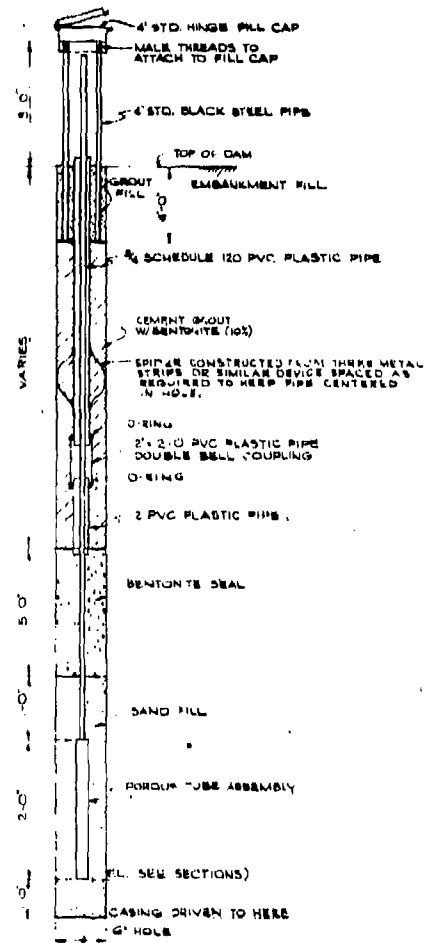
MONUMENT FRAME W/ID  
BOLTED TO FRAME (SIMILAR  
TO NEEAH CATALOG NO R 1977)



SECTION

MOVEMENT MONUMENT IN ROADWAY

TYPICAL FOR MONUMENTS, 66 THRU 69  
SCALE: 1"=1'-0"

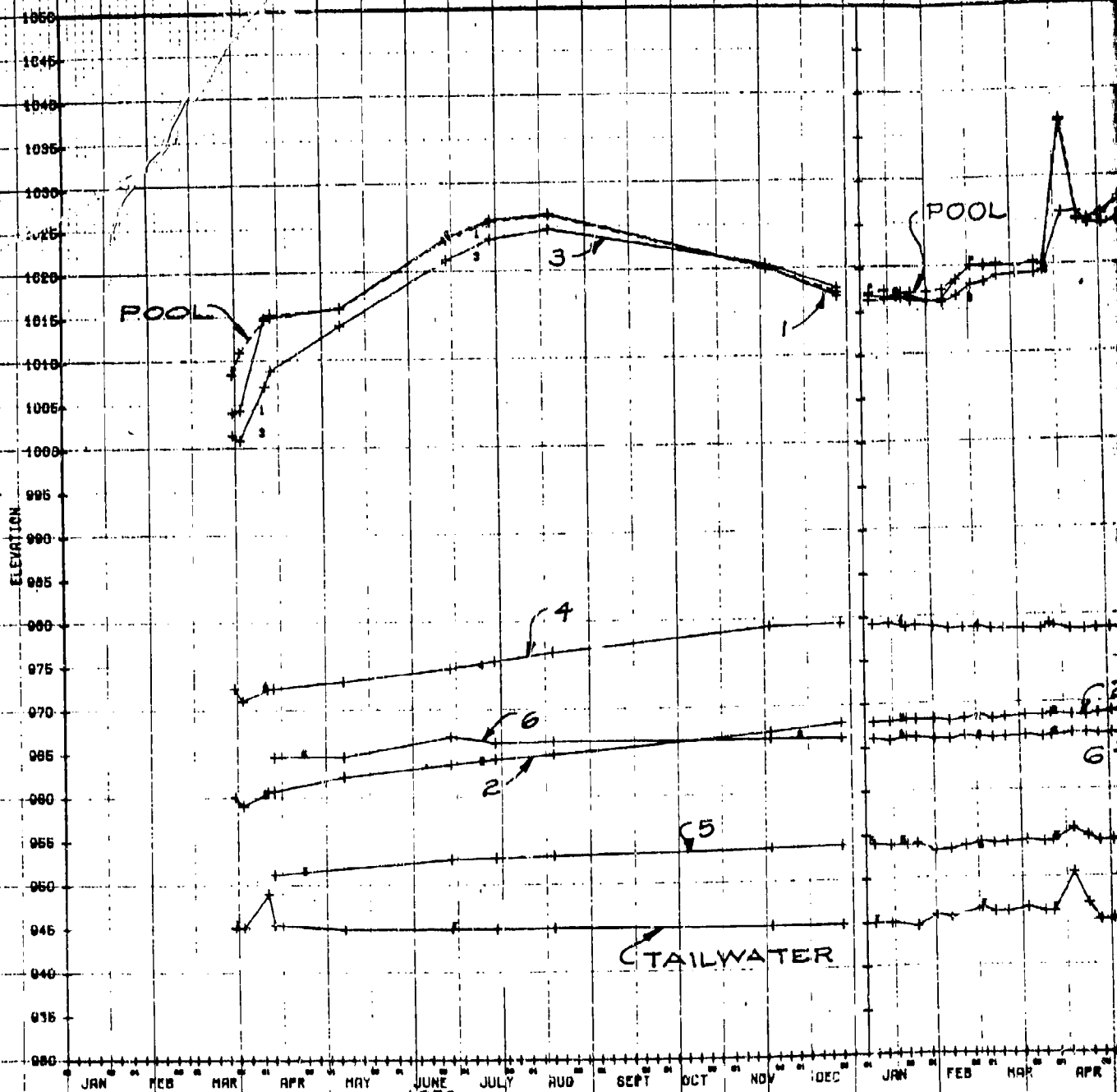


PIEZOMETER (CASAGRANDE TYPE)

TYPICAL COMPLETED INSTALLATION SCHEMATIC  
NOT TO SCALE

|                                                                                                |                                                                                                                  |             |
|------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-------------|
| REVISION                                                                                       | DATE                                                                                                             | DESCRIPTION |
| <p>U. S. ARMY ENGINEER DISTRICT, LOUISVILLE<br/>CORPS OF ENGINEERS<br/>LOUISVILLE DISTRICT</p> |                                                                                                                  |             |
| <p>REVISION<br/>BY<br/>CAN<br/>CHECKED<br/>DATE<br/>INSTRUMENTED<br/>DATE<br/>SCALE</p>        | <p>KENTUCKY RIVER DAM<br/>CARR FORK LAKE<br/>DAM &amp; SPILLWAY<br/>INSTRUMENTATION DETAILS<br/>AND SECTIONS</p> |             |
|                                                                                                | <p>DRAWING NUMBER<br/>NFK-113-12.0/10</p>                                                                        |             |

CARR FORK L



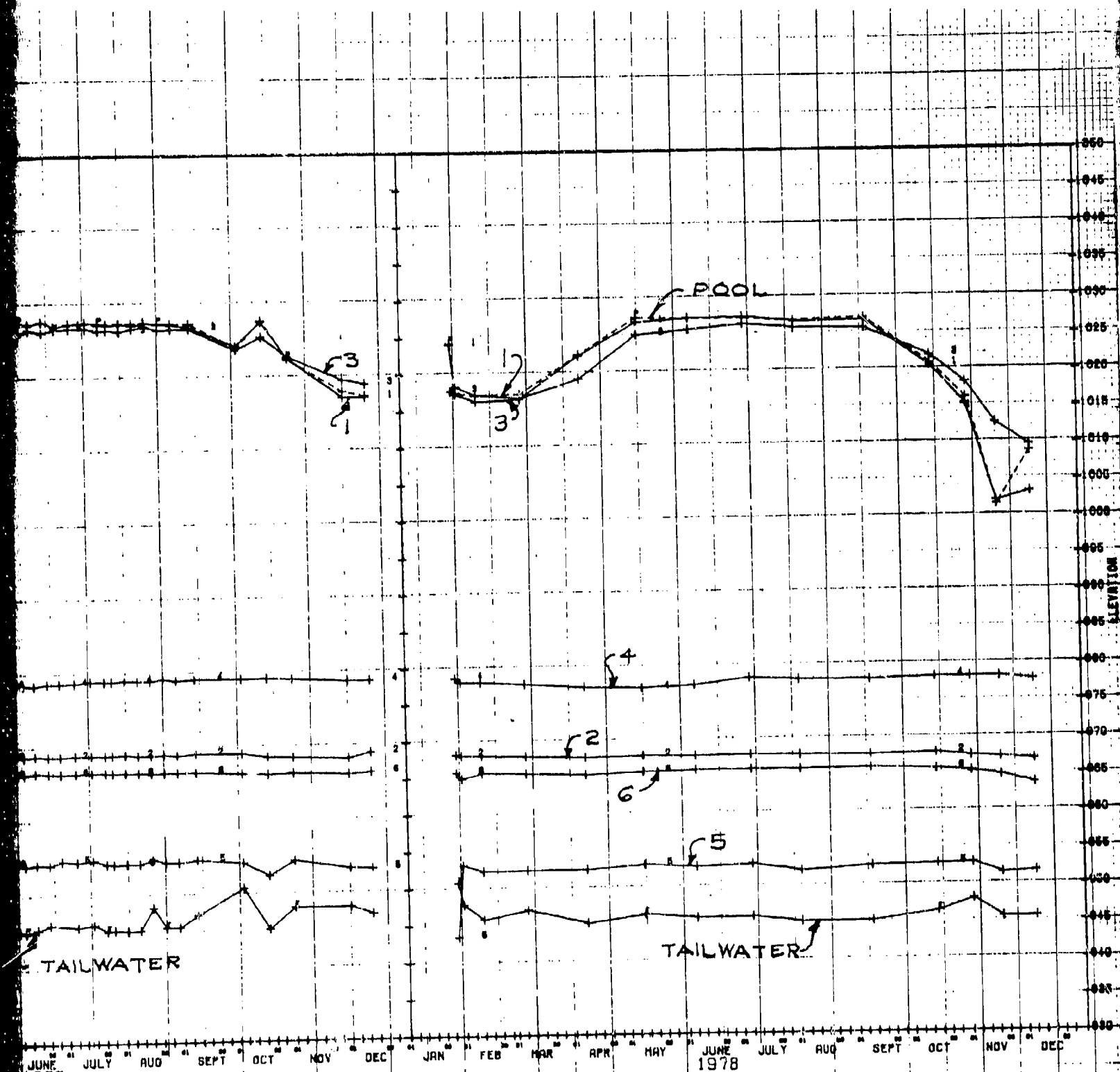
CASHBORNE 12:00  
CASHBORNE 12:00

15 FT 06 EMB  
15 FT 06 EMB

CL  
CL

820.0  
800.0

WELLPOINT 12:00 200 FT 00



JUNE 1977 JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE 1978 JULY AUG SEPT OCT NOV DEC

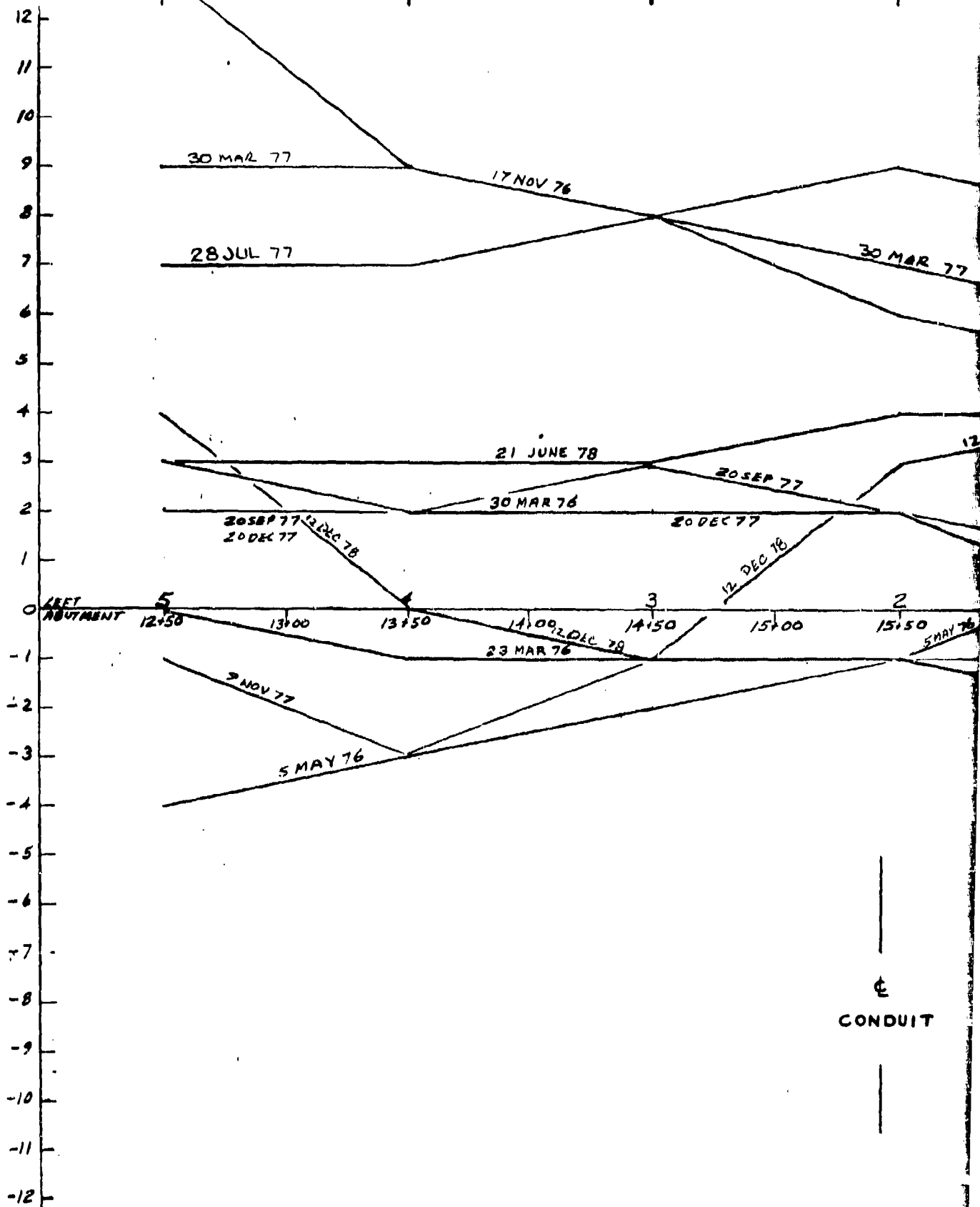
1977 888.3

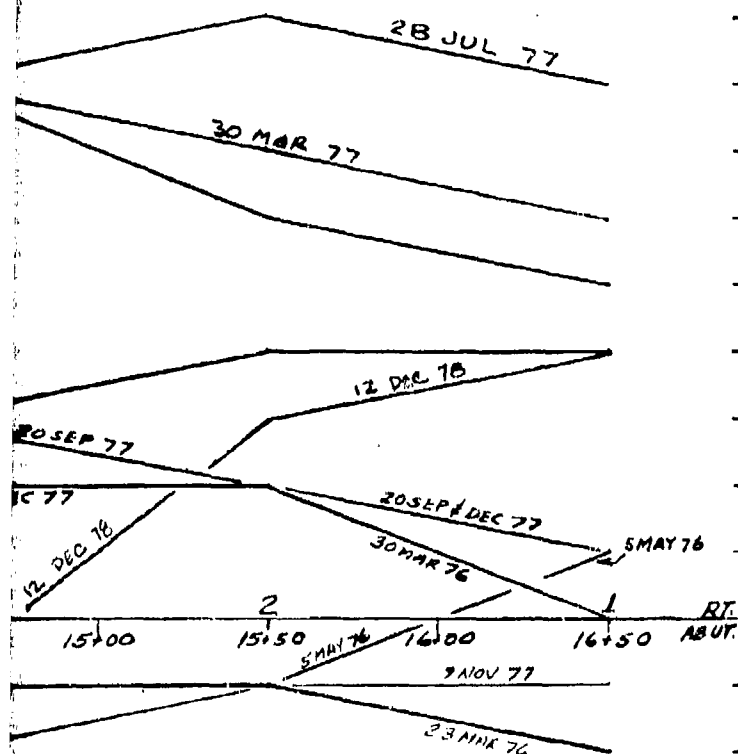
888.3

PLATE 88

2

VERTICAL CUMULATIVE MOVEMENT  
(HUNDREDS OF A FOOT)





17 DEC 75

| INITIAL READING |         |
|-----------------|---------|
| MON. NO.        | ELEV.   |
| 1               | 1028.60 |
| 2               | 1029.29 |
| 3               | 1030.72 |
| 4               | 1030.23 |
| 5               | 1028.96 |

RT. MONUMENT NUMBER  
STATION

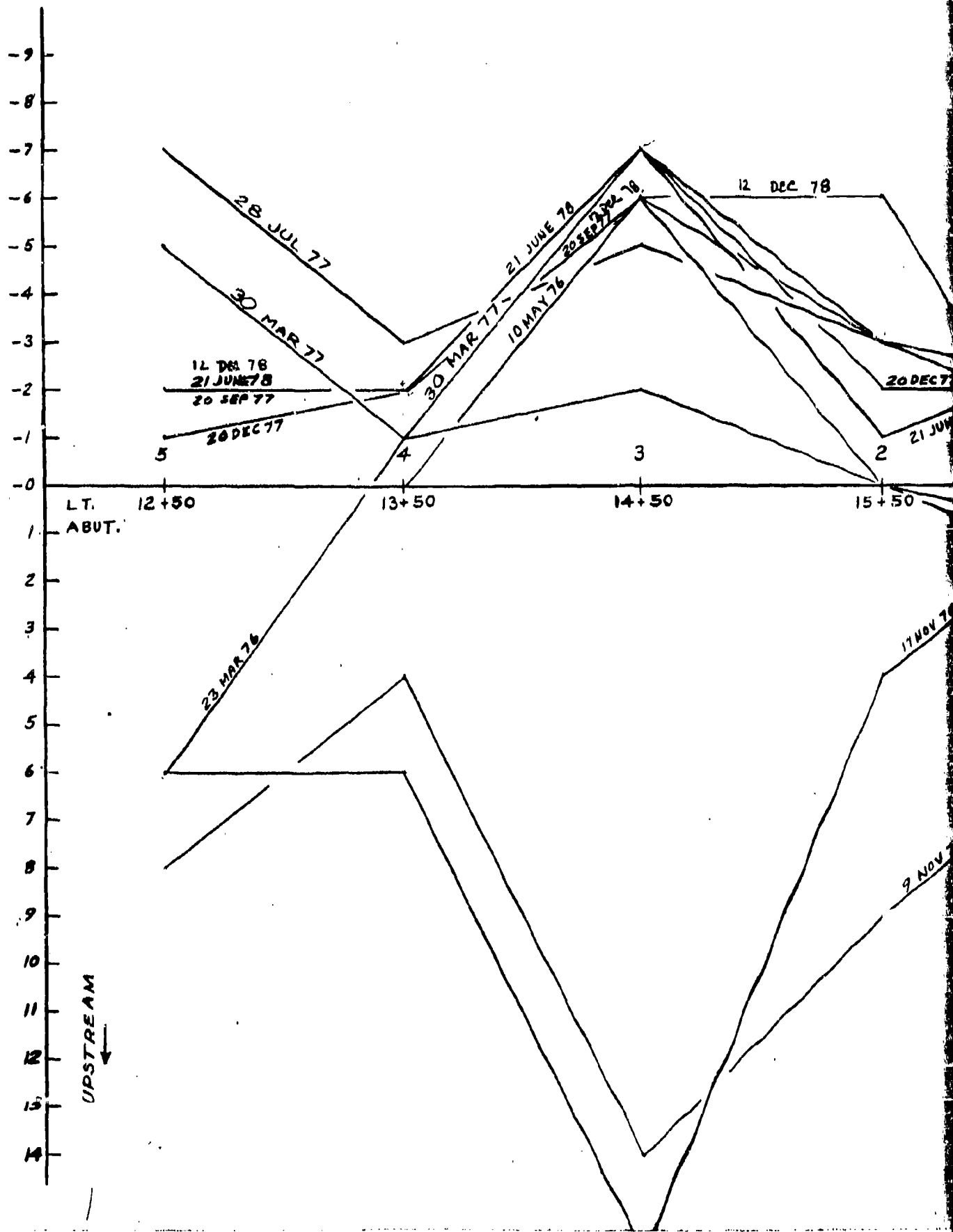
-6 CARR FORK LAKE  
MOVEMENT MONUMENTS  
-7 179' UPSTREAM &  
ROW 1  
-8 VERTICAL MOVEMENT

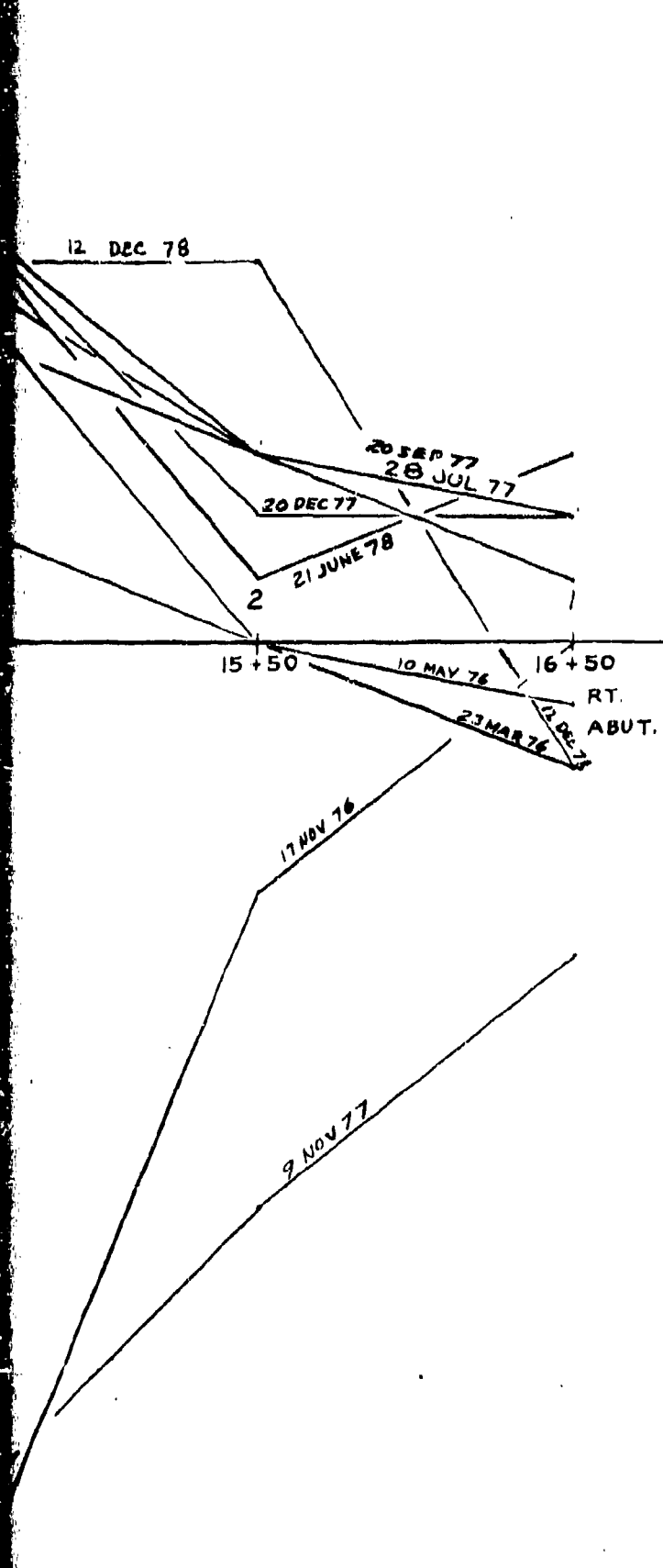
CONDUIT

PLP

2

# HORIZONTAL CUMULATIVE MOVEMENT (HUNDREDS OF A FOOT)





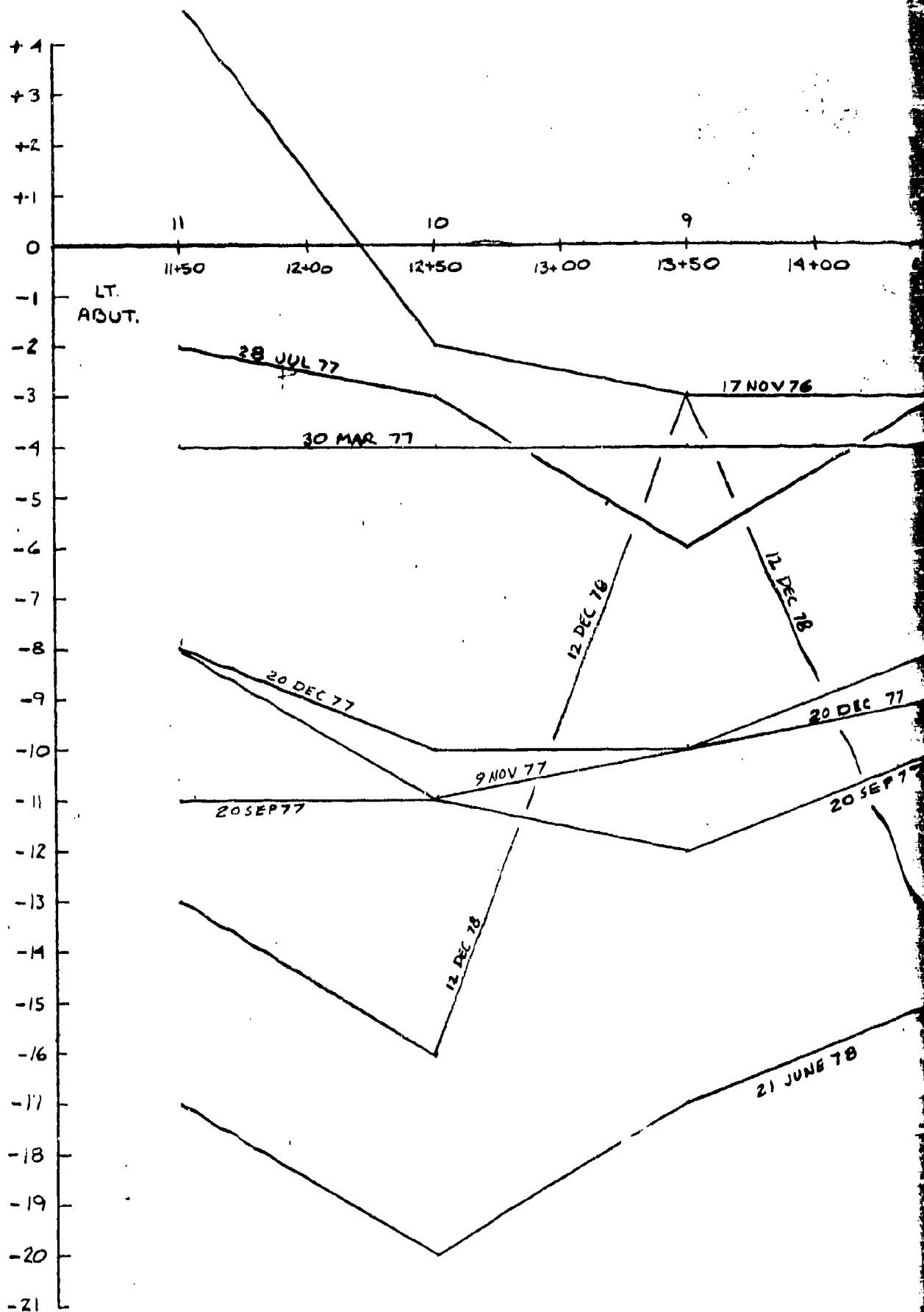
MONUMENTS INSTALLED 17 DEC 75

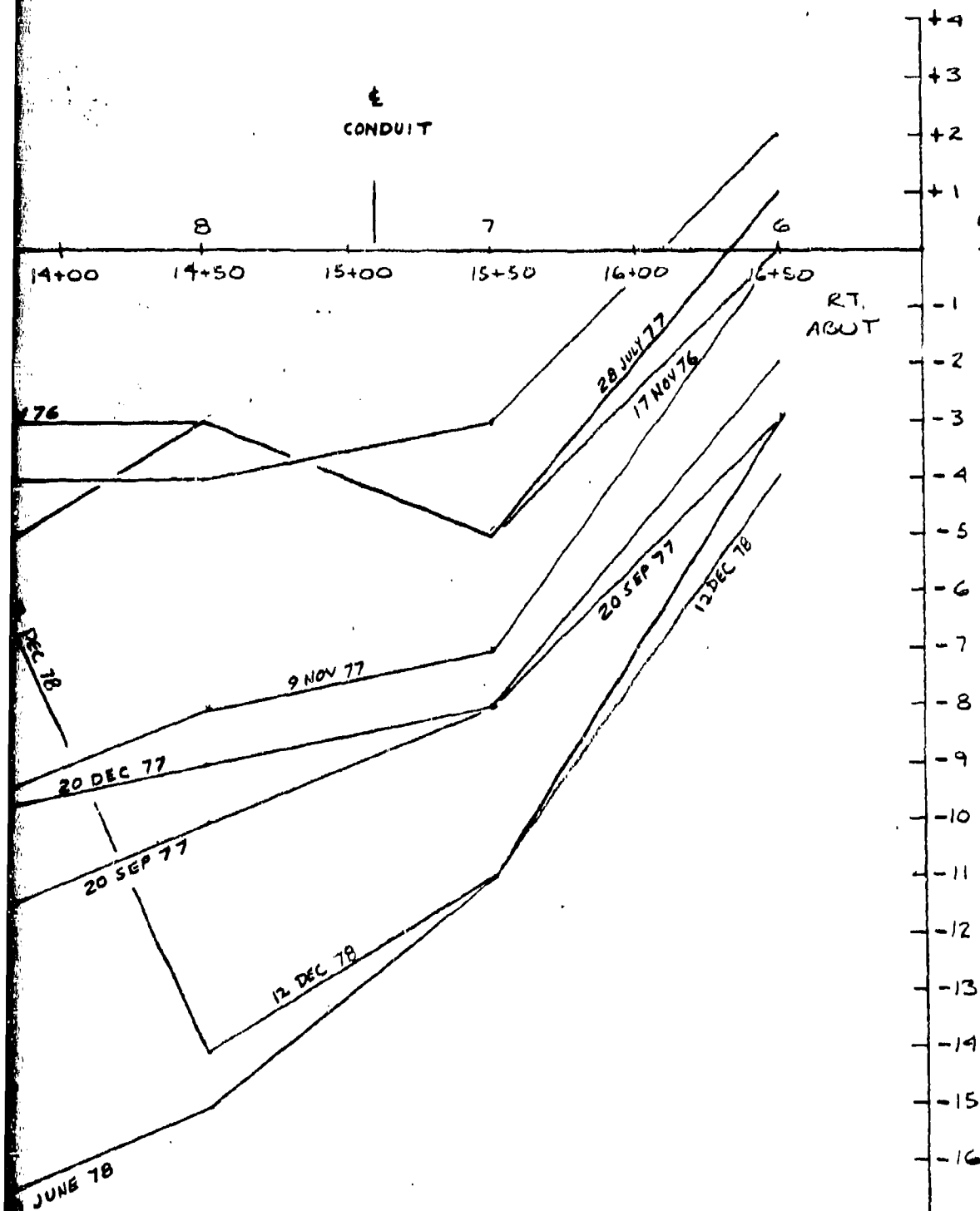
MONUMENT NUMBER

STATION

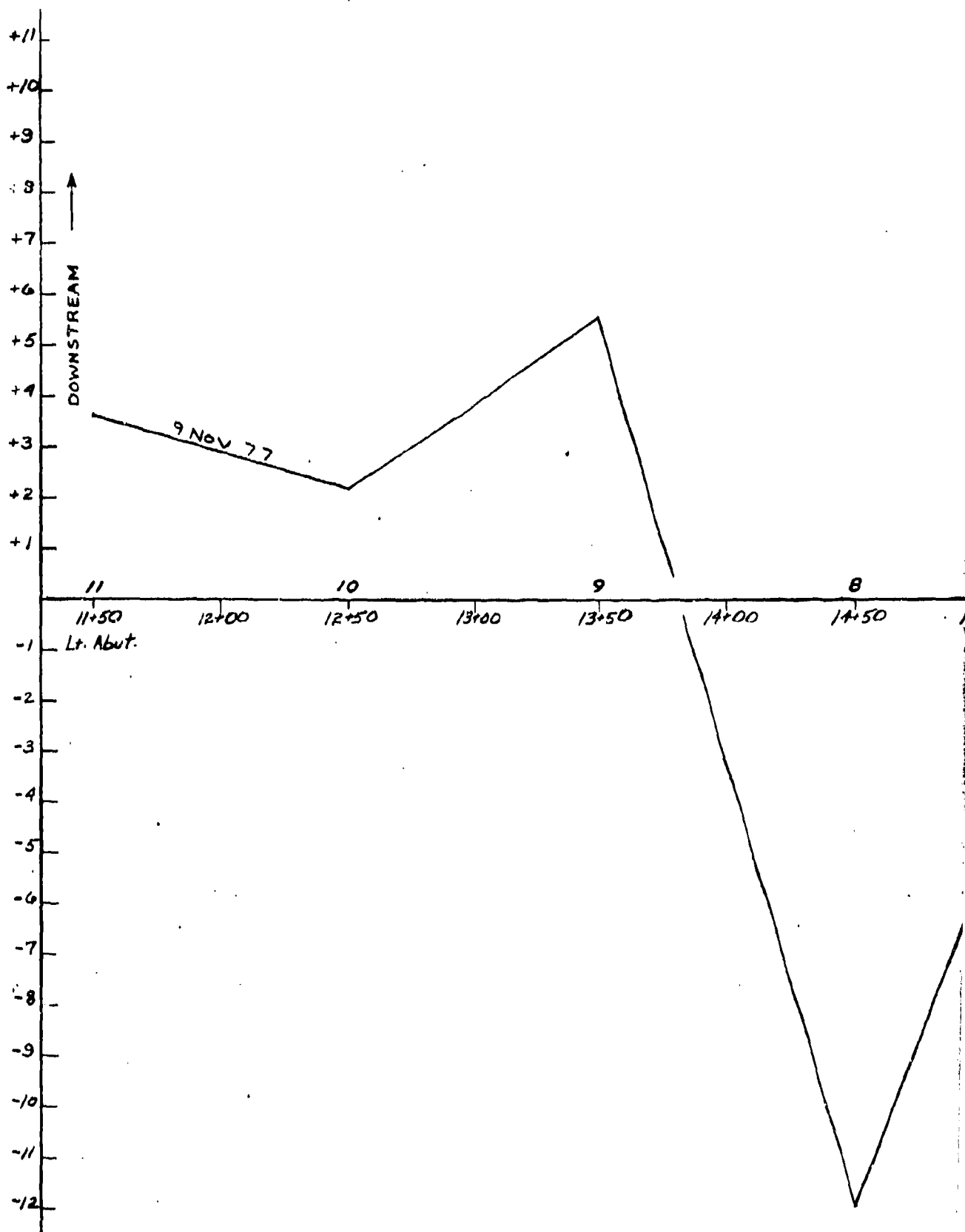
CARR FORK LAKE  
MOVEMENT MONUMENTS  
179' UPSTREAM &  
ROW 1  
HORIZONTAL MOVEMENT

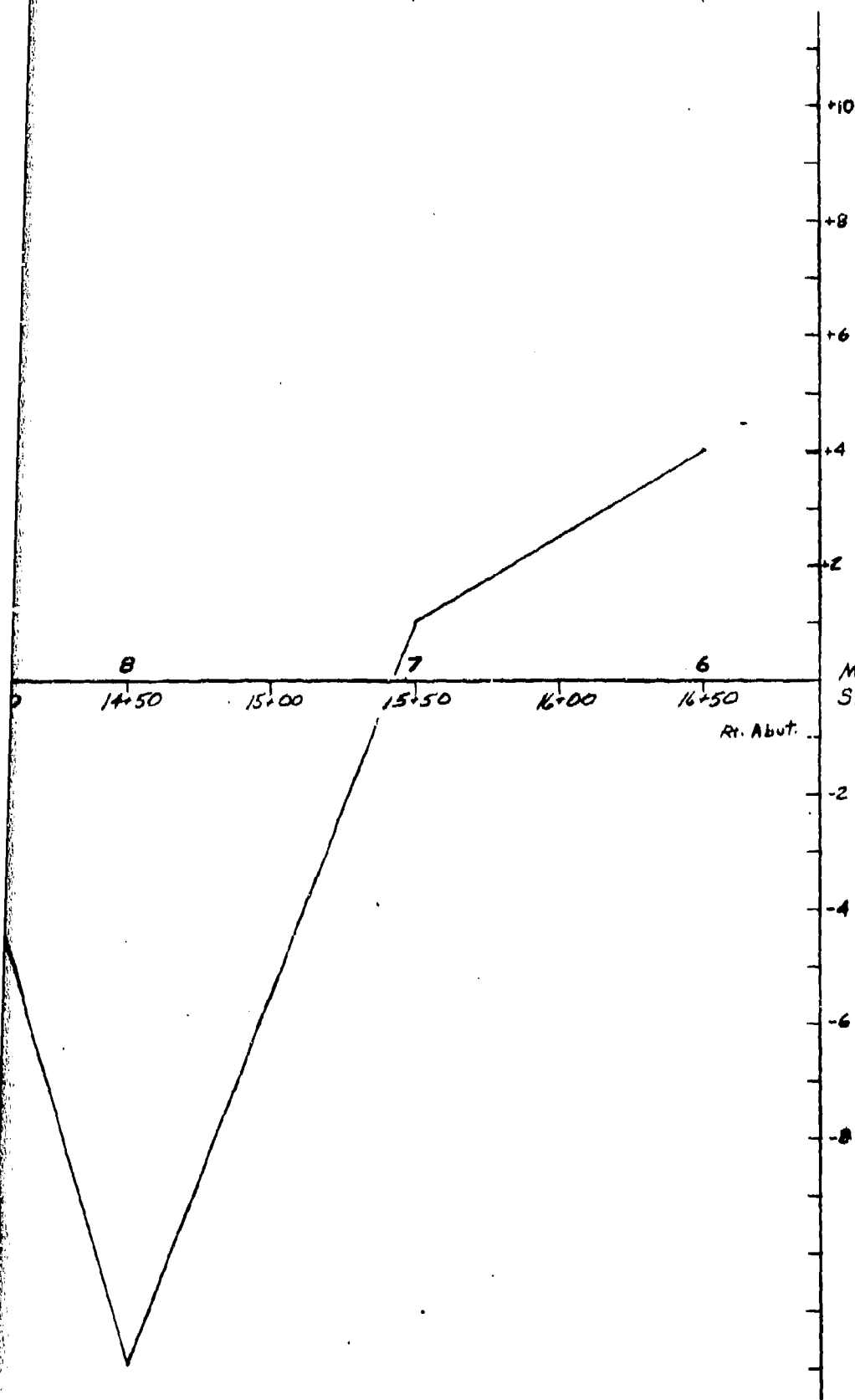
# VERTICAL CUMULATIVE MOVEMENT (HUNDRETHS OF A FOOT)





HORIZONTAL CUMULATIVE MOVEMENT  
(HUNDREDS OF A FOOT)





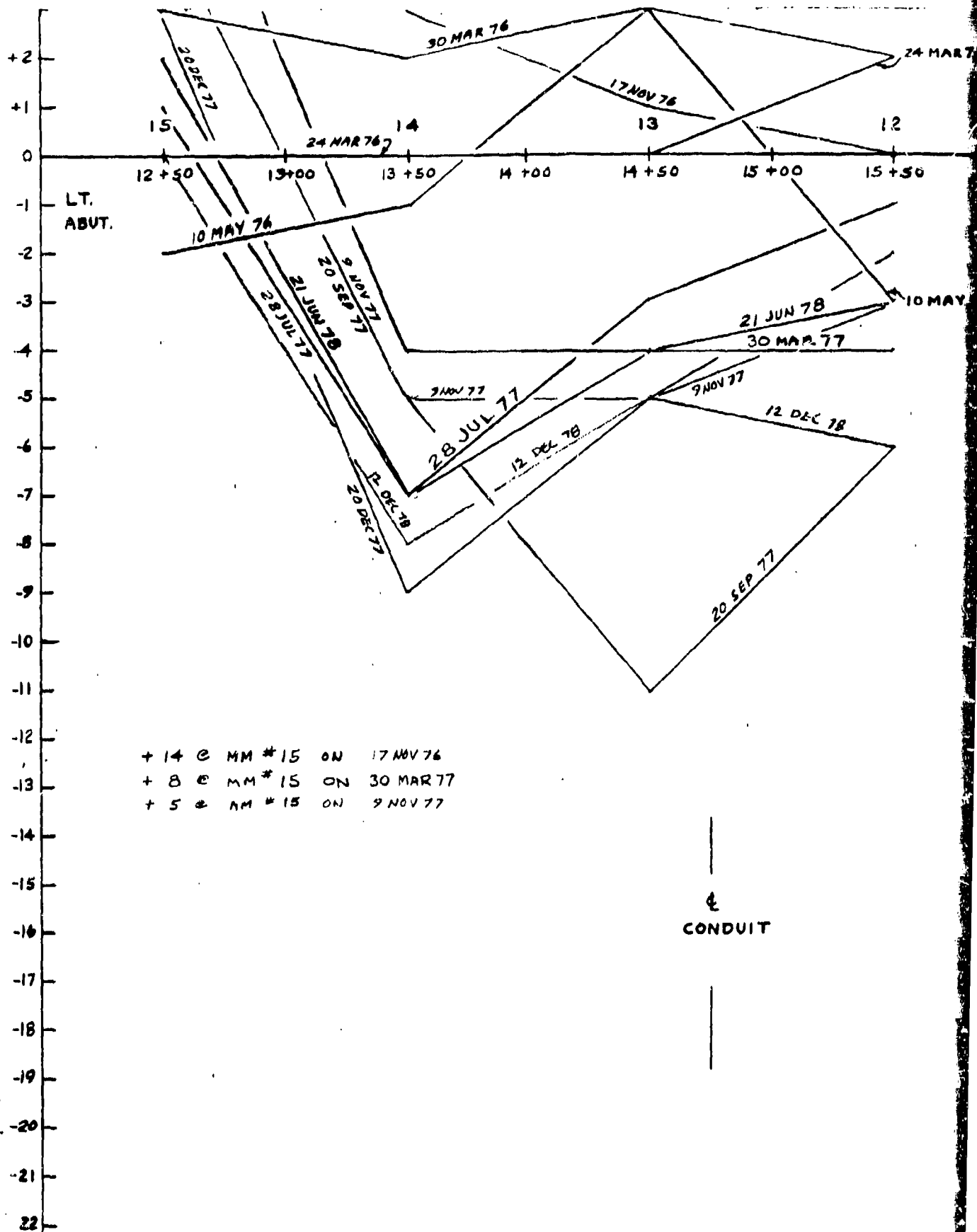
MONUMENTS INSTALLED 21 JAN 76

Mon. No.  
Station.

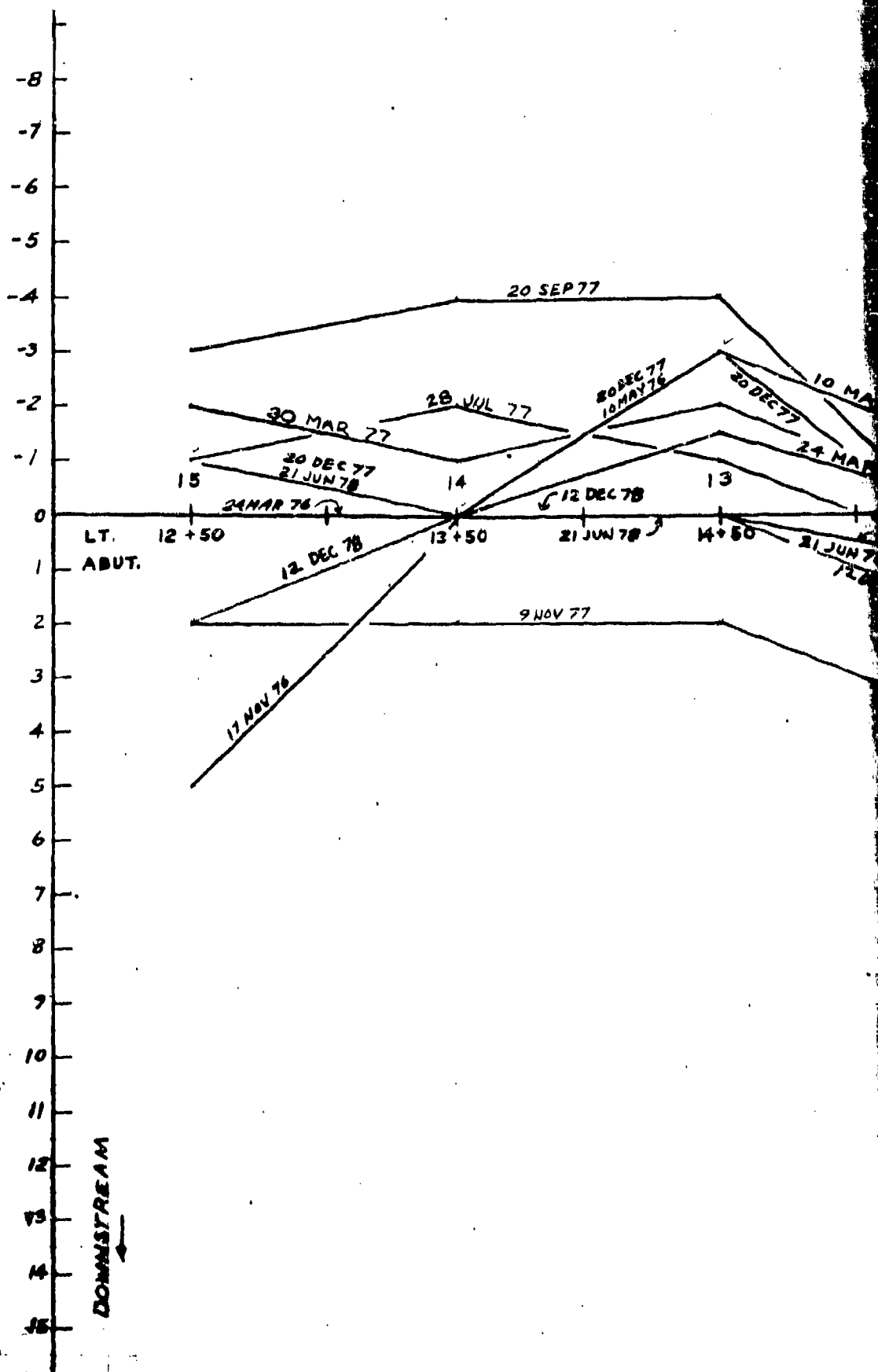
Rt. Abut.

CARR FORK LAKE  
MOVEMENT MONUMENTS  
15' DOWNSTREAM &  
ROW 2  
HORIZONTAL MOVEMENT

VERTICAL CUMULATIVE MOVEMENT  
(HUNDREDS OF A FOOT)







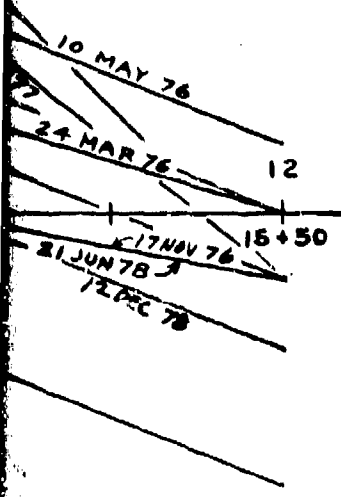
۱۰۰

-8  
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13  
14  
15

MONUMENTS INSTALLED 30 OCT 75

MONUMENT NUMBER

STATION



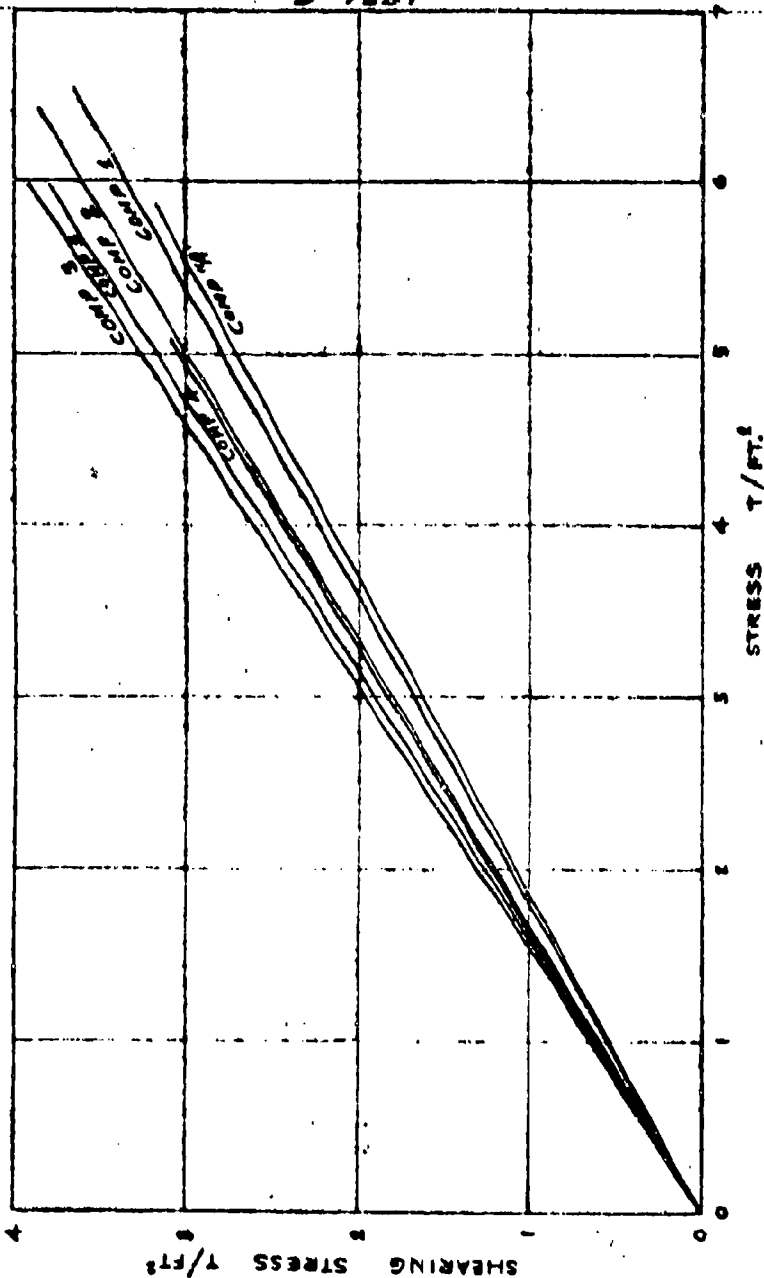
RT.  
ABUT.

10 GARR FORK LAKE  
MOVEMENT MONUMENTS  
11 151' DOWNSTREAM &  
ROW 3  
12 HORIZONTAL MOVEMENT

PLATE

2

DATE 10/2/54 SUBJECT CARR FERR RESERVOIR SHEET NO. OF  
 DATE 10/2/54 EMBANKMENT SHEAR TEST SUMMARY JOB NO.  
 57837



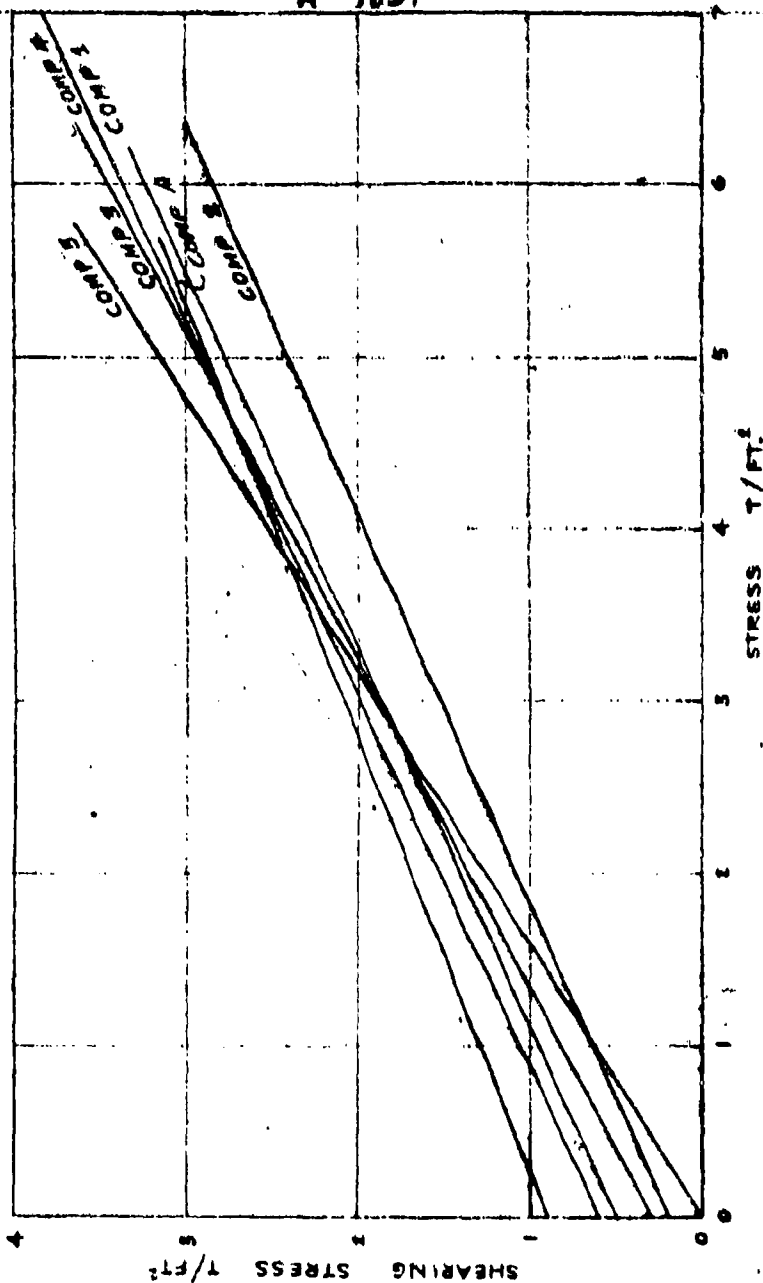
Avg Value  
 $\tan \phi = 0.598$   
 $c = 0.00 \text{ T/ft}^2$

| HOLE NO. | SAMPLE NO. | CLASS. | LL   | PL   | TAN $\phi$ | $\frac{C}{T/FT^2}$ | SATURATION |
|----------|------------|--------|------|------|------------|--------------------|------------|
| COMP #1  | 162        | CL     | 32.8 | 21.8 | 0.566      | 0.00               |            |
| COMP #2  | 162        | CL     | 29.0 | 18.8 | 0.593      | 0.00               |            |
| COMP #3  | 162        | SM     | N-P  |      | 0.640      | 0.00               |            |
| COMP #4  | 1          | CL     | 28.7 | 20.1 | 0.600      | 0.00               |            |
| COMP #5  | 1          | SM     | N-P  |      | 0.628      | 0.00               |            |
| COMP A   |            | CL     | 30.6 | 20.0 | 0.534      | 0.00               |            |

PLATE 37

DATE 10/19/66 SUBJECT CARR FORK RESERVOIR  
 DATE 1/19/67 EMBANKMENT TREATMENT TEST SUMMARY  
 TEST

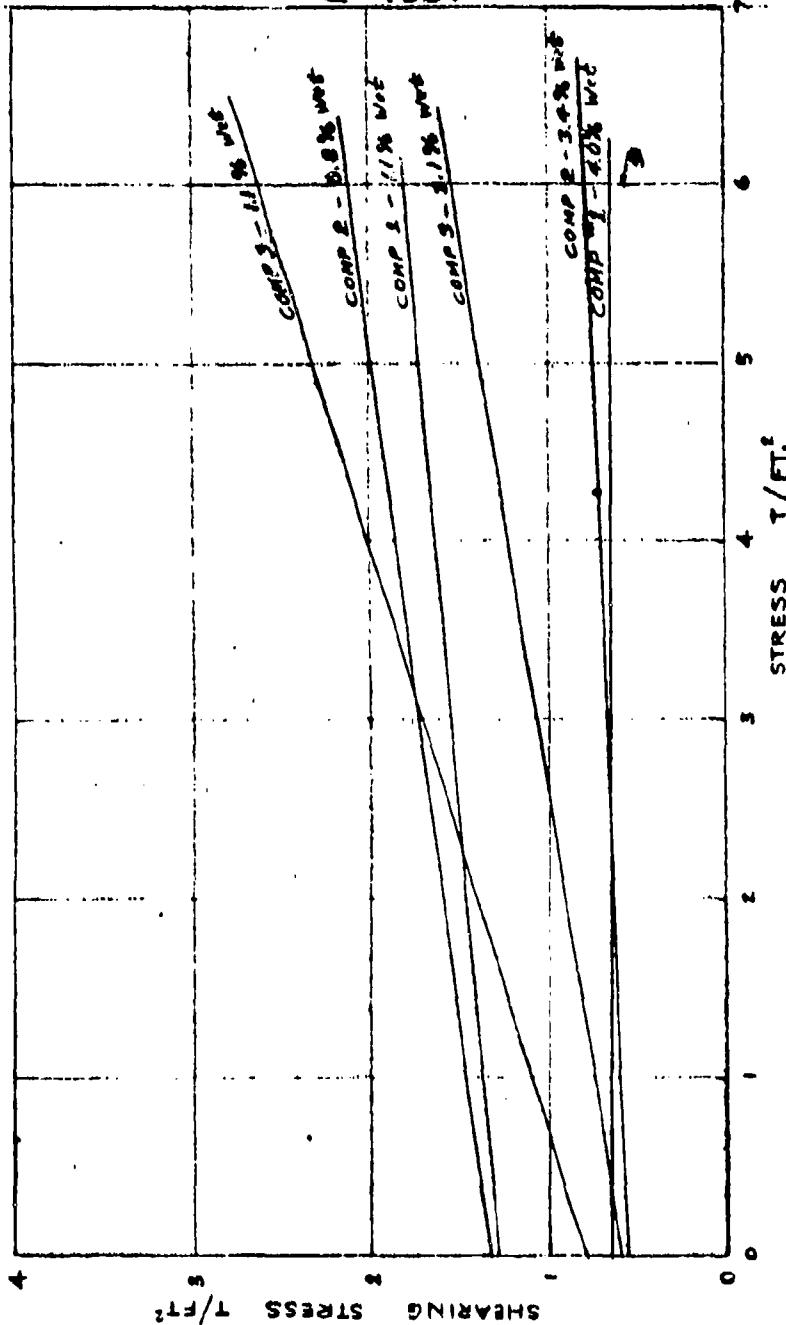
SHEET NO. \_\_\_\_\_ OF \_\_\_\_\_  
 JOB NO. \_\_\_\_\_



Avg Value  
 $\tan \phi = 0.477$   
 $C = 0.42 \text{ T/FT}^2$

| HOLE NO. | SAMPLE NO. | CLASS. | LL   | PL   | TAN $\phi$ | C<br>T/FT <sup>2</sup> | SATURATION |
|----------|------------|--------|------|------|------------|------------------------|------------|
| COMP #1  | 142        | CL     | 32.8 | 21.8 | 0.410      | 0.55                   | 106.3      |
| COMP #2  | 142        | CL     | 29.0 | 18.8 | 0.423      | 0.20                   | 111.3      |
| COMP #3  | 142        | SM     | N-P  |      | 0.518      | 0.30                   | 109.1      |
| COMP #4  | 1          | CL     | 28.7 | 20.1 | 0.463      | 0.60                   | 112.0      |
| COMP #5  | 1          | SM     | N-P  |      | 0.630      | 0.00                   | 115.8      |
| COMP 'A' |            | CL     | 30.6 | 20.0 | 0.410      | 0.90                   | 111.2      |
|          |            |        |      |      |            |                        | 118.4      |
|          |            |        |      |      |            |                        | 121.8      |
|          |            |        |      |      |            |                        | 121.7      |

PLATE 38

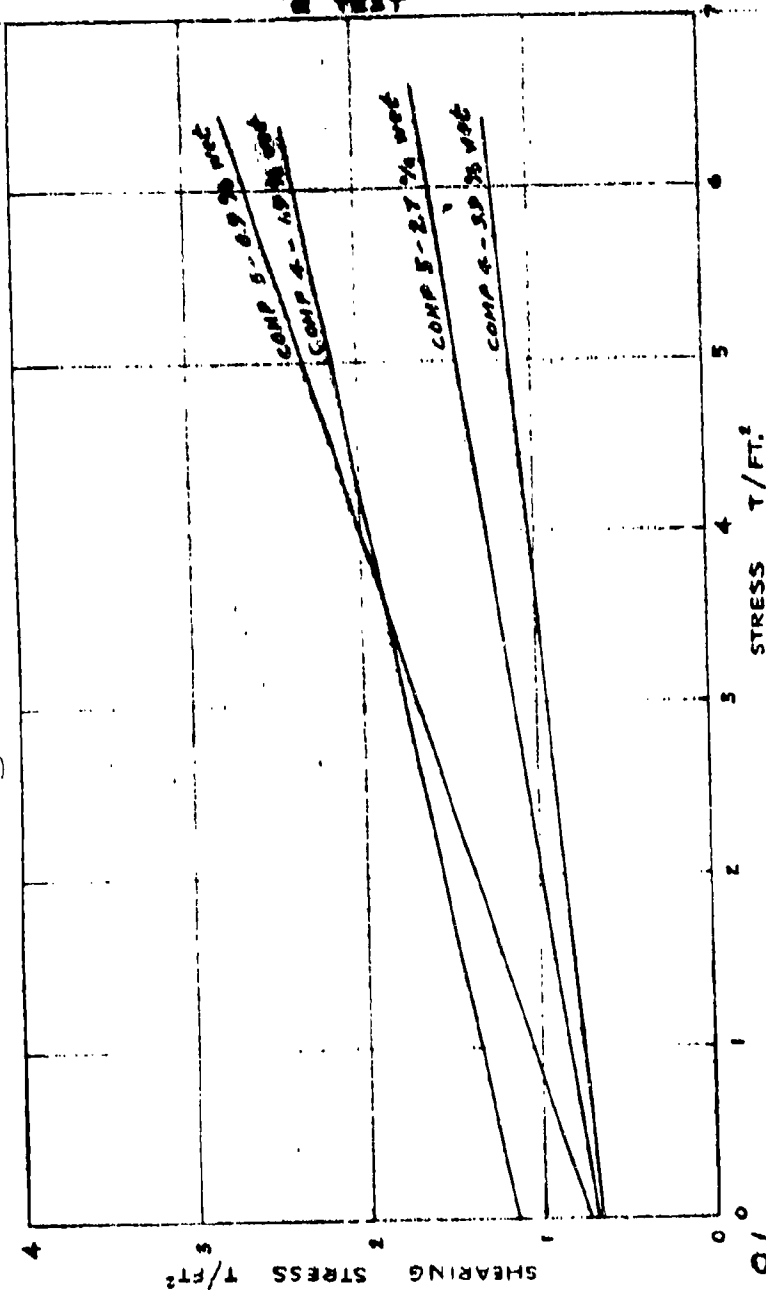


See Plate 91

| HOLE NO. | SAMPLE NO. | CLASS. | LL   | PL   | TAN $\phi$ | C<br>T/FT <sup>2</sup> | SATURATION          |
|----------|------------|--------|------|------|------------|------------------------|---------------------|
| COMP #1  | 142        | CL     | 32.8 | 21.8 | 0.088      | 1.30                   | 1.1% wet of optimum |
|          |            |        |      |      | 0.000      | 0.65                   | 0.0% wet            |
| COMP #2  | 142        | CL     | 29.0 | 18.8 | 0.143      | 1.33                   | 0.8% wet of optimum |
|          |            |        |      |      | 0.036      | 0.56                   | 3.4% wet            |
| COMP #3  | 142        | SM     | N-P  |      | 0.306      | 0.80                   | 1.1% wet of optimum |
|          |            |        |      |      | 0.156      | 0.60                   | 3.1% wet            |

DATE 10/2/67 SUBJECT CARR PARK RESERVOIR  
 DATE 1/14/68 EMBANKMENT SHEAR TEST DATA  
91° TEST

SHEET NO. 2 OF 2  
 JOB NO.         



See Plate 91°

| HOLE NO. | SAMPLE NO. | CLASS. | LL % | PL   | TAN $\phi$ | $\frac{C}{\gamma \cdot F \cdot z}$ | SATURATION          |
|----------|------------|--------|------|------|------------|------------------------------------|---------------------|
| COMP #4  | 1          | CL     | 28.7 | 20.1 | 0.185      | 1.16                               | 1.9% wet of optimum |
| COMP #5  | 1          | SM     | N-P  |      | 0.102      | 0.67                               | 3.9% wet            |
|          |            |        |      |      | 0.306      | 0.75                               | 0.9% wet of optimum |
|          |            |        |      |      | 0.140      | 0.70                               | 2.7% wet            |
| COMP A   |            | CL     | 30.6 | 20.0 | 0.160      | 1.50                               | 2.5% wet of optimum |
|          |            |        |      |      | 0.000      | 0.90                               | 4.5% wet            |

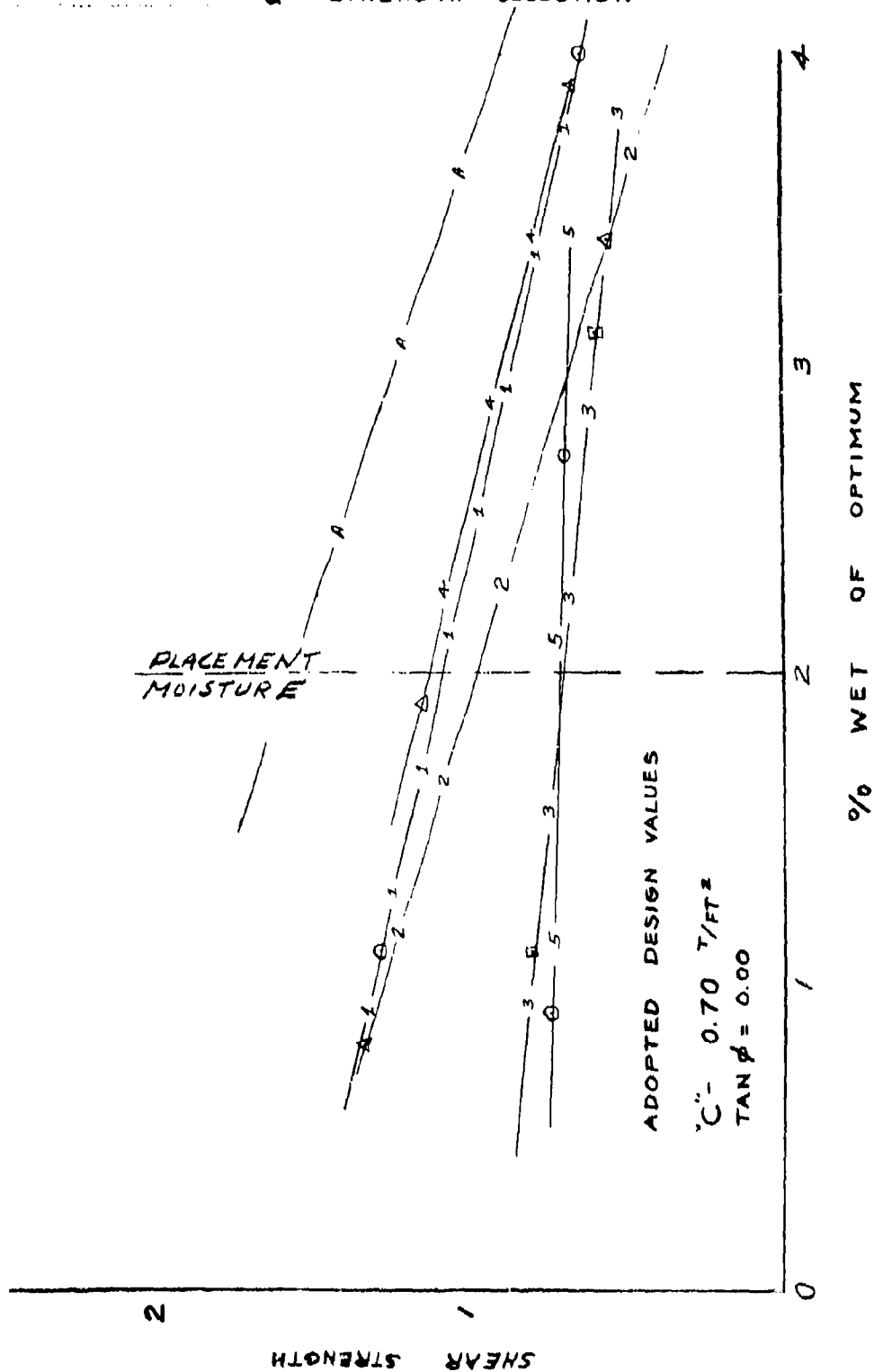
PLATE 40

DATE  
CHECKED BY

10/8/64

DATE

CARR FORK RESERVOIR  
EMBANKMENT SHEAR TEST DATA  
Q - STRENGTH SELECTION



Appendix I



(1)

21 October 1973

View from left abutment showing grouting on lower left abutment and cleaned core area across lowest area of dam.



(2)

22 October 1973

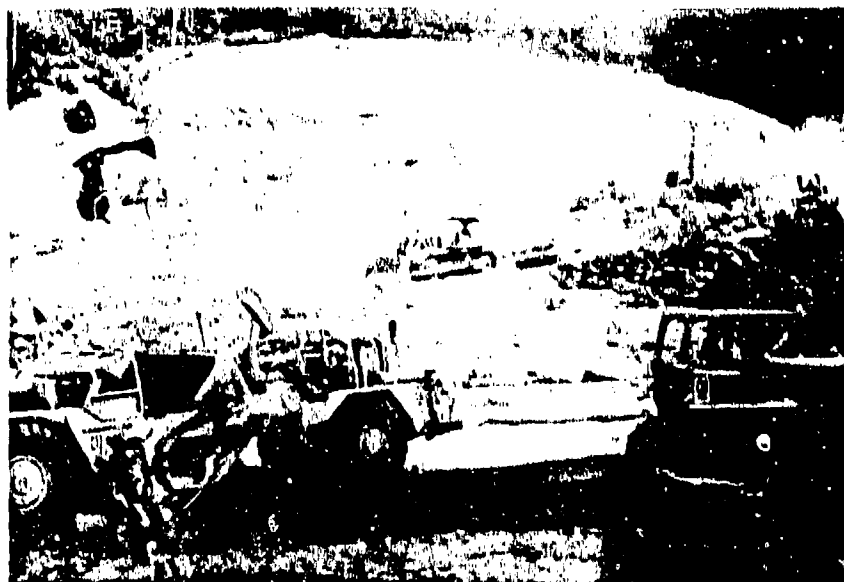
Hand packing impervious core at embankment Station 13+05.



(3)

22 October 1973

View from lower left abutment showing grouting and initial placement of core material.



(4)

October 1973

View showing hauling and compaction equipment in use during the initial placement of impervious core in lower part of dam.

(5)



25 October 1973

Dental treatment of joints within special treatment area along the centerline of the right abutment. Impervious core and transition zones shown in lower area of dam.

(6)



1 November 1973

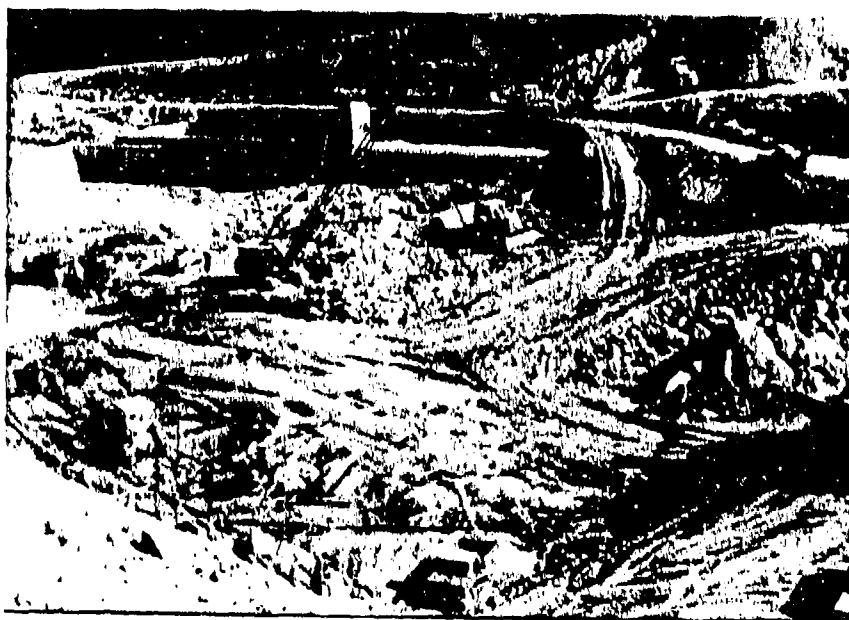
A joint 0.3 foot wide infilled with silt station 14+75 cleaned out 1 foot deep and filled with dental concrete. View looking north across core area.



(7)

2 November 1973

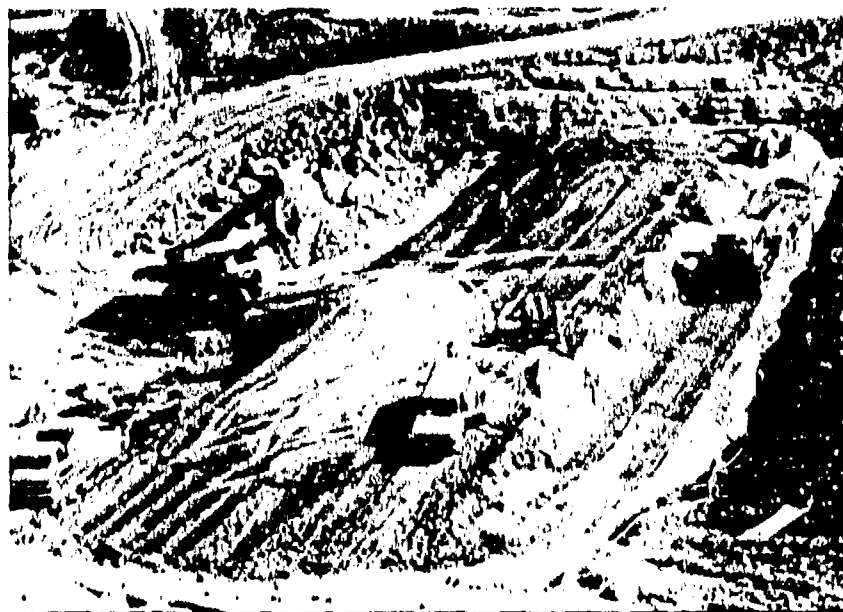
View showing core rock tie-in on right abutment. Workmen hand cleaning right abutment Station 15+30 to Station 18+20 along Centerline of dam.



(8)

November 1973

View showing equipment used for cleanup of the D.S. area of the dam embankment.



(9)

November 1973

View showing impervious zone and filter aggregate being placed during initial placement of main dam embankment.



(10)

22 March 1974

View looking at left abutment of dam special treatment area from center of dam embankment.



(11)

22 March 1974

View of right abutment of dam from west edge of spillway. No embankment placement this past winter. Bottom of picture shows graded aggregate stockpiled on top of permanent cofferdam, elev. 1010.



(12)

8 July 1974

Looking from left abutment toward to right abutment. Center of picture is dental treatment at Station 17+70, centerline of dam.



(13)

8 July 1974

View from right abutment toward left abutment. Impervious core, graded aggregate and shale zones shown. Spillway cut upper left of photo.



(14)

21 August 1974

View showing upstream face of dam, riprap and haul road ramps.  
Bench upstream is at elev. 1010.



(15)

21 August 1974

View from left abutment showing upstream face of dam and haul  
ramps onto embankment. Upstream bench is at elevation 1010.