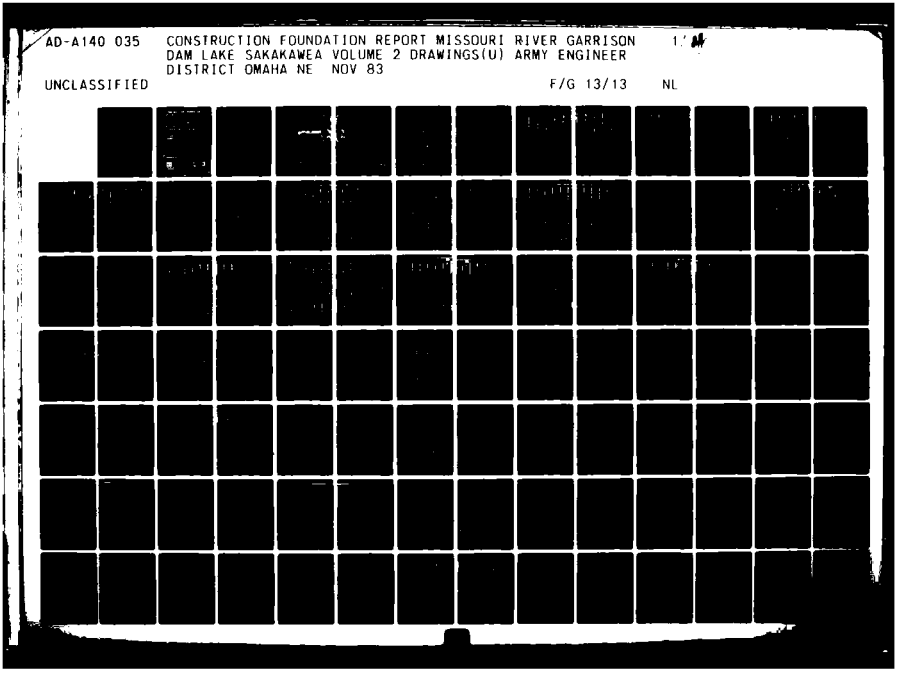
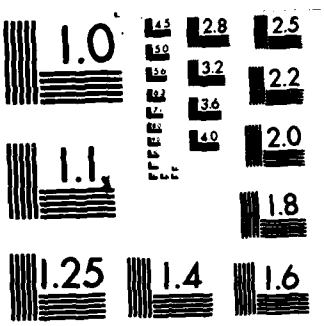
AD-A140 035 CONSTRUCTION FOUNDATION REPORT MISSOURI RIVER GARRISON 1/
DAM LAKE SAKAKAWEA VOLUME 2 DRAWINGS(U) ARMY ENGINEER
DISTRICT OMAHA NE NOV 83

UNCLASSIFIED F/G 13/13 NL





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

CONSTRUCTION FOUNDATION REPORT

AD A140035

(3)

MISSOURI RIVER
GARRISON DAM - LAKE SAKAKAWEA

VOLUME II
DRAWINGS

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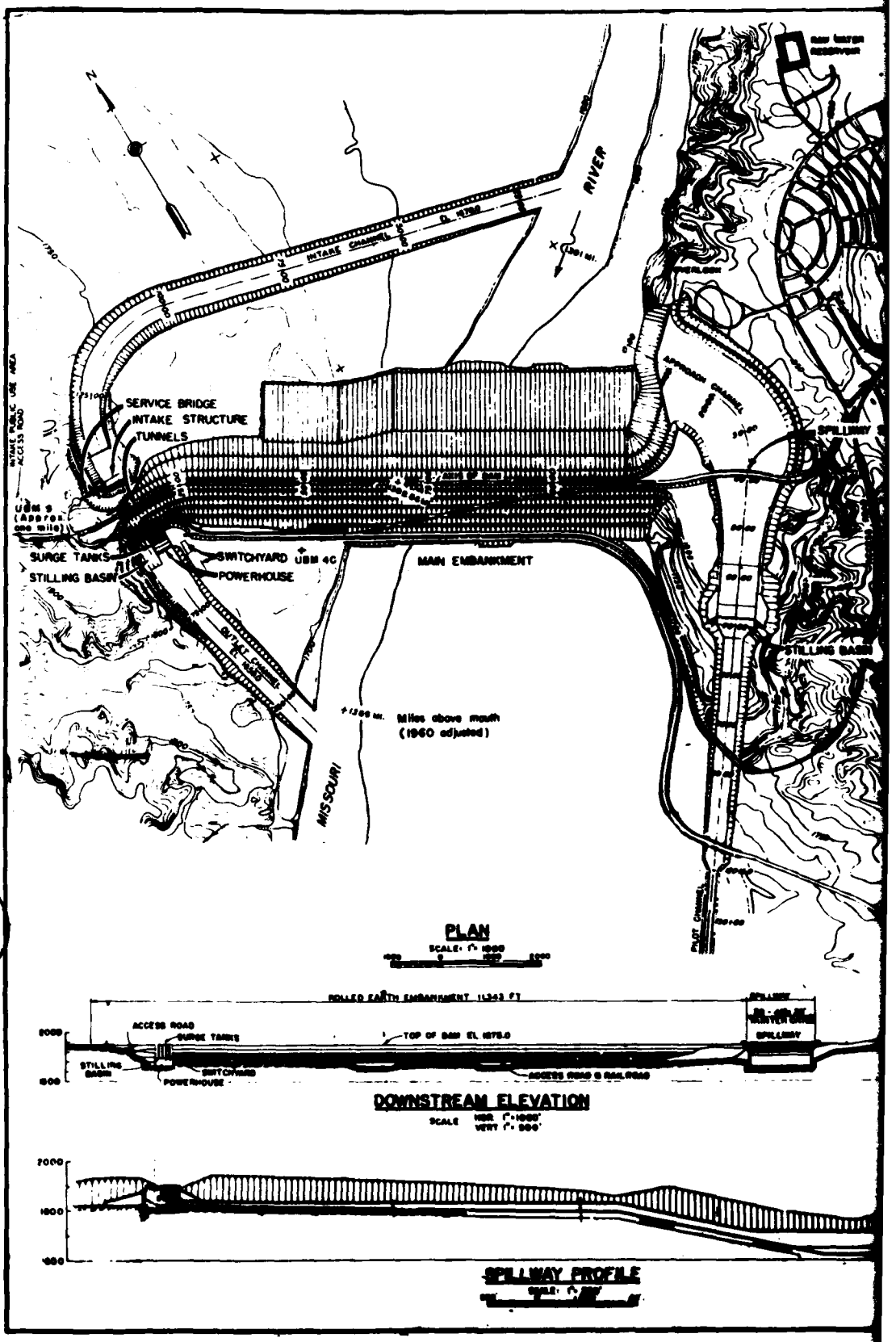




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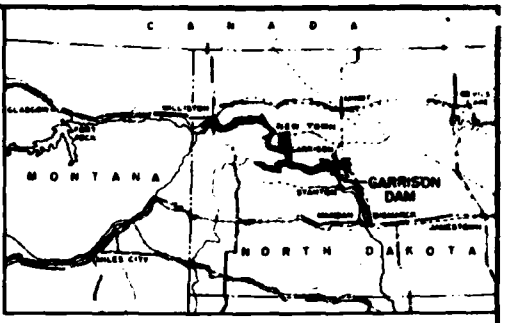
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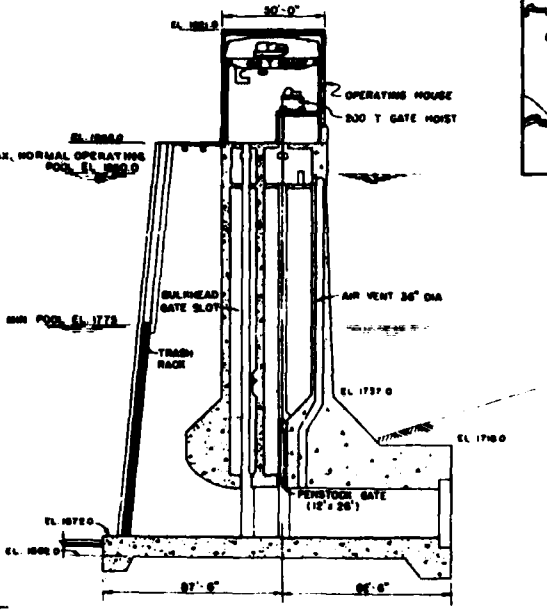
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A-1 | 23 cm





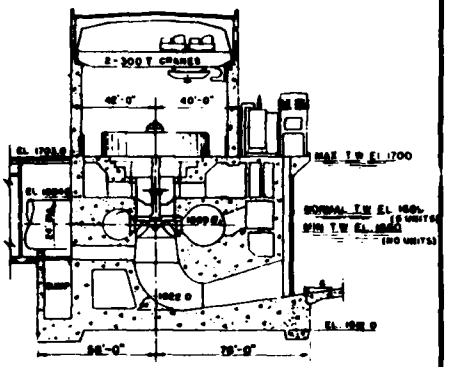
LOCATION MAP

SCALE IN MILES



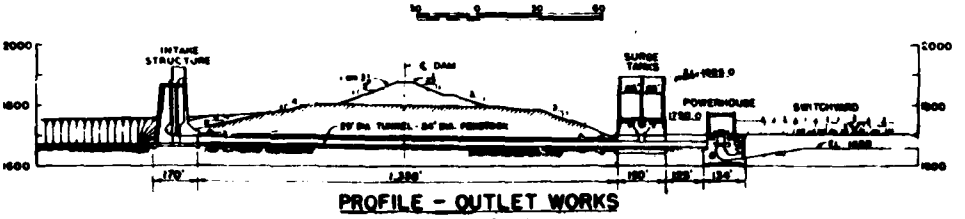
SECTION THRU INTAKE STRUCTURE

SCALE 1" = 30'



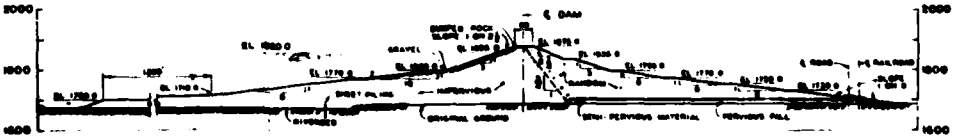
SECTION THRU POWERHOUSE

SCALE 1" = 30'



PROFILE - OUTLET WORKS

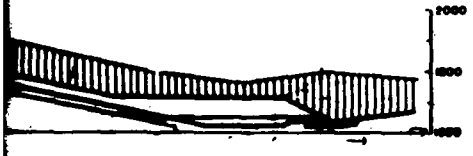
SCALE 1" = 200'

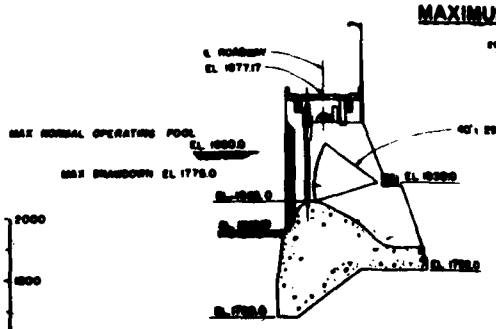


MAXIMUM EMBANKMENT SECTION

SCALE 1" = 200'







SPILLWAY SECTION

SCALE 1" = 30'

THIS DRAWING HAS BEEN REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE.

REV	DATE	REVISION (indicated by △)	BY

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEB

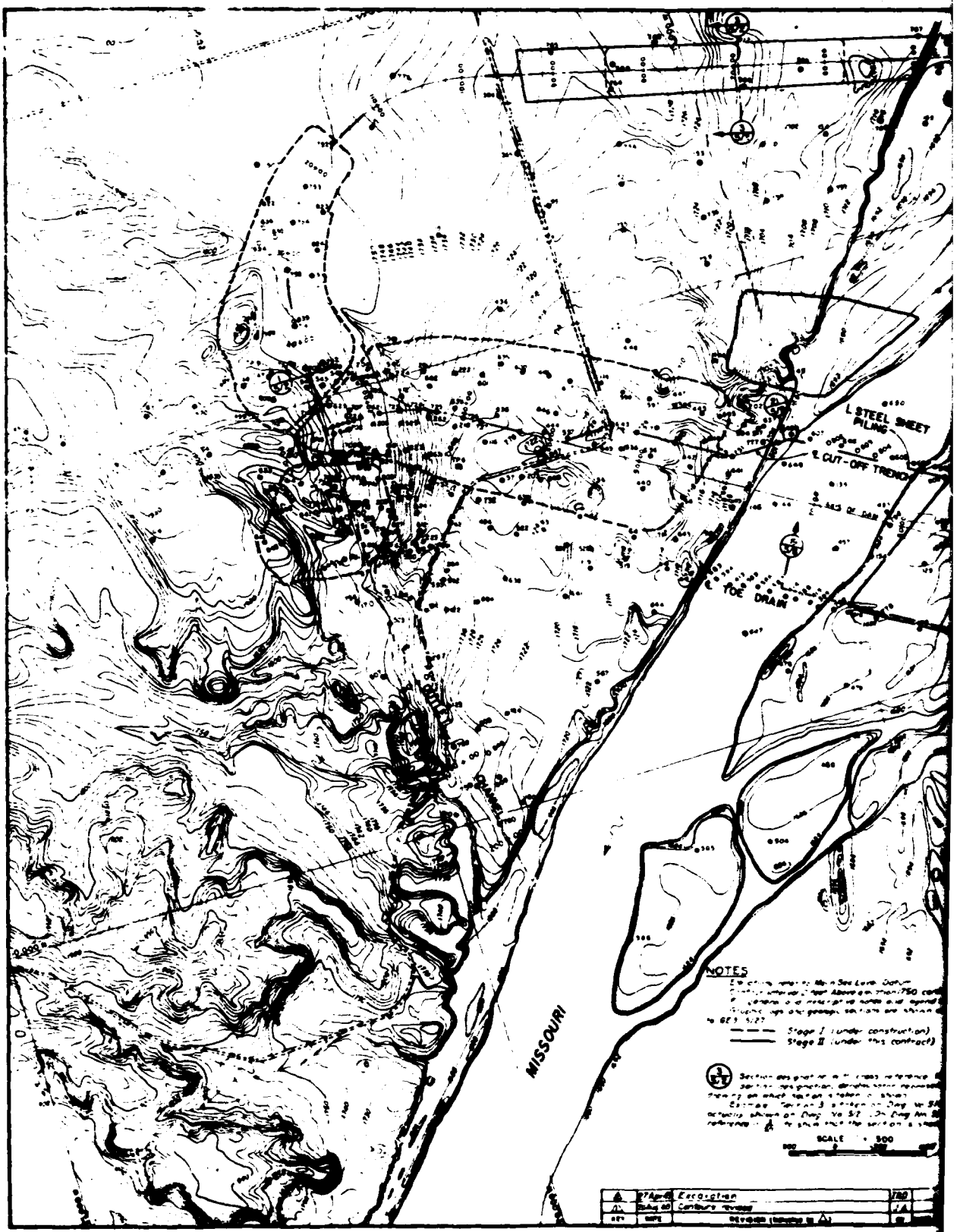
MISSOURI RIVER

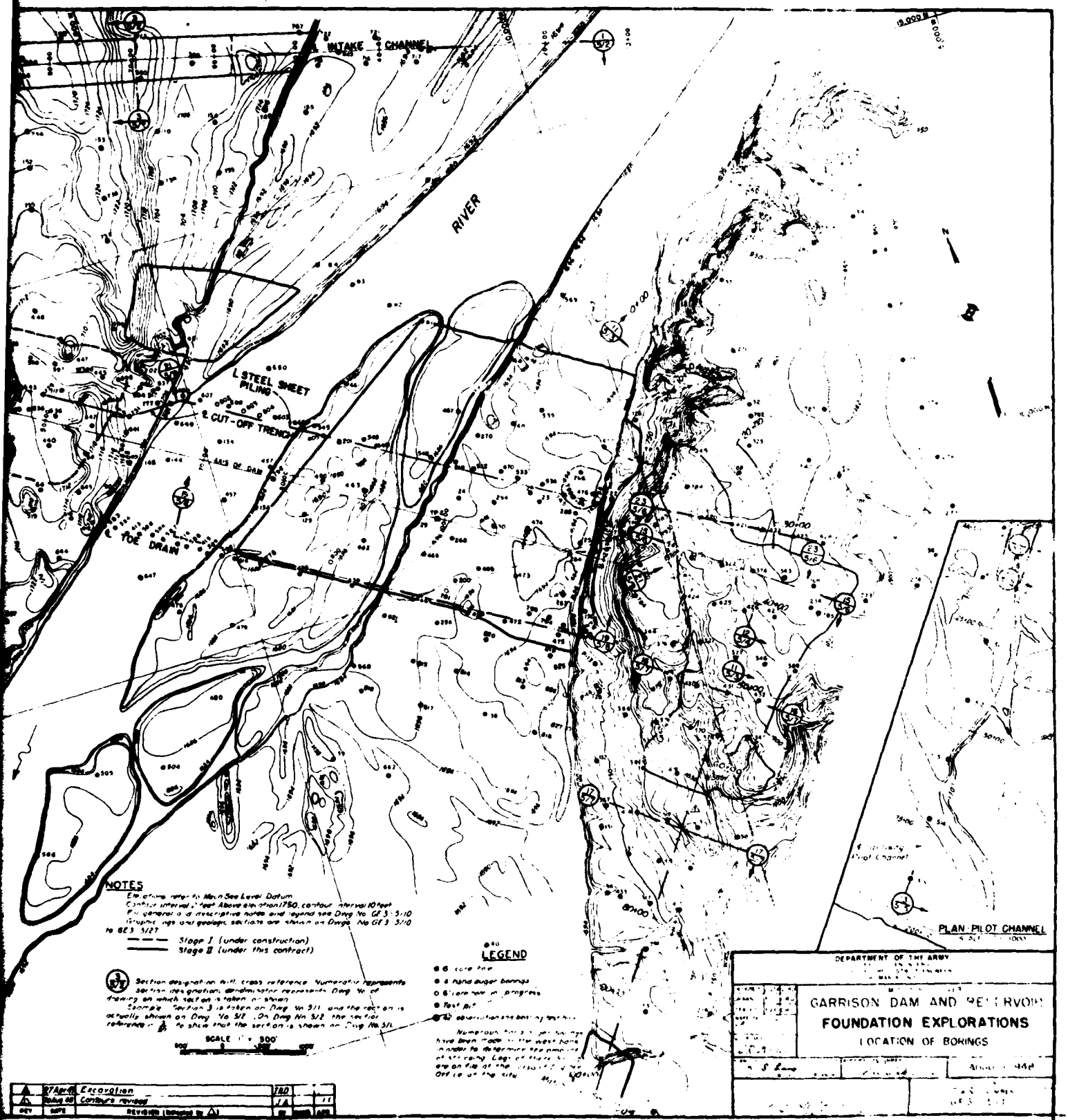
GARRISON DAM-LAKE SAKAKAWEA

GENERAL PLAN AND DETAILS

SEPTEMBER 1962

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 1


L-STEEL SHEET PILING
CUT-OFF TRENCH
TOE DRAIN
MISSOURI
NOTES
Stage I (under construction)
Stage II (under this contract)
SCALE



NOTES

Elevations refer to Mean Sea Level Datum.
Contour interval 2 feet Above elevation 1750, contour interval 10 feet.
For general and descriptive notes and legend see Dwg No GE 3-3/10.
Engineering and geologic sections are shown on Dwgs No GE 3-3/10 to GE 3-3/27.

Stage I (under construction)
Stage II (under this contract)

Section designation drill cross reference. Numerator represents section designation, denominator represents Dwg No of drawing on which section is taken or shown.
Example: Section 3 is taken on Dwg No 3/11 and the section is actually shown on Dwg No 3/2. On Dwg No 3/2 the section reference is to show that the section is shown on Dwg No 3/11.

SCALE 1" = 500'

LEGEND

- core hole
- 6" hand auger borings
- 6" core hole in progress
- Test pit
- observation well boring

Numerous borings not shown have been made in the west bank in order to determine the nature of the rock. Logs of these borings are on file at the District Office on the site.

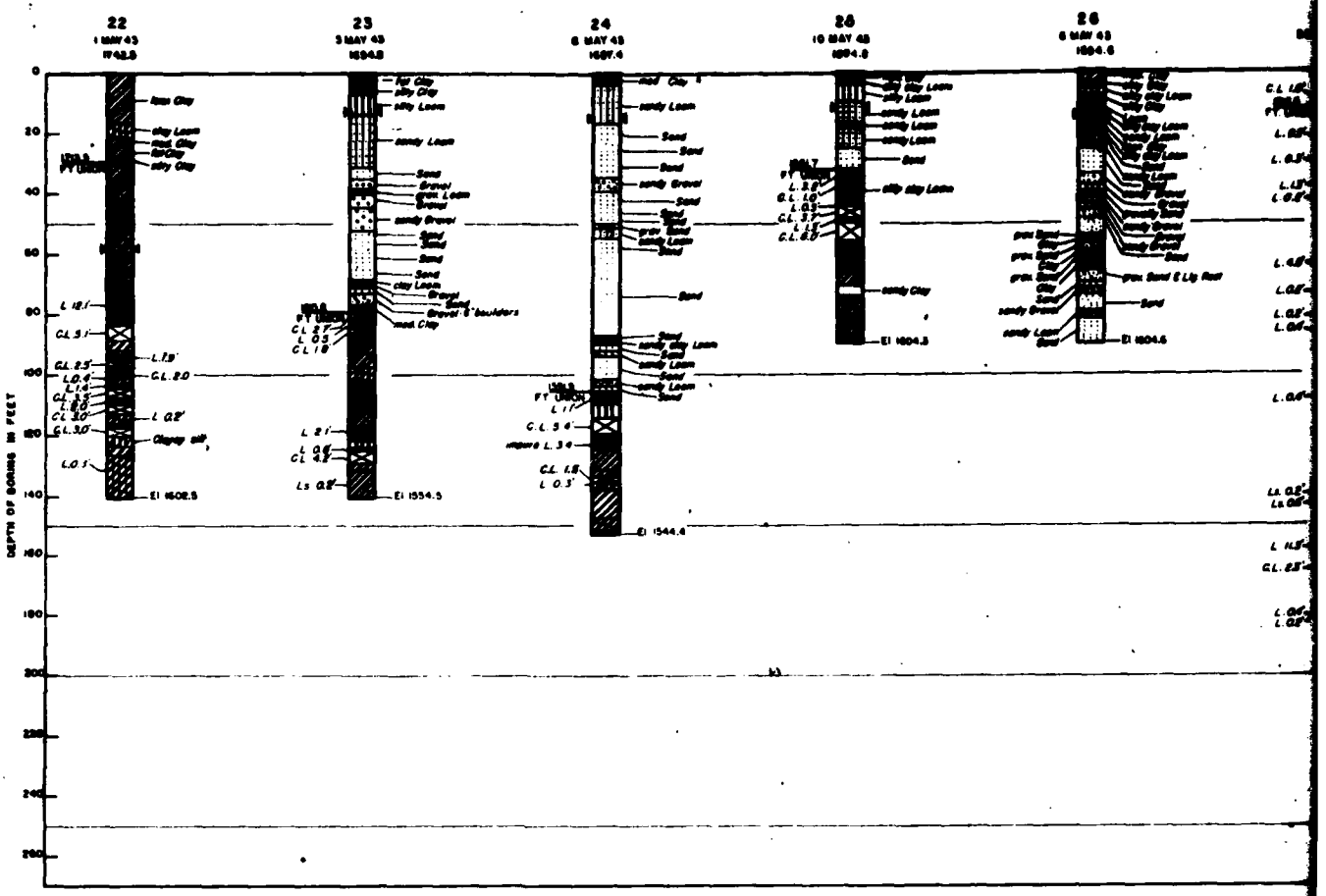
NO.	DATE	REVISION (Initiated by △)	BY	CHKD	APPD
1	27 April 48	Excavation	TAD		
2	Dwng 48	Contours revised	J.A.		

DEPARTMENT OF THE ARMY

GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
LOCATION OF BORINGS

CONSTRUCTION FOUNDATION REPORT (1950) PLATE 2

2



DESCRIPTIVE NOTES

Fort Union Formation is an immature shale consisting of a series of continentally deposited, consolidated, clayey to sandy materials, arranged in gently dipping beds (often cross bedded), which range from thin partings to 15' or more in thickness. Clayey phases are predominant.

There are also present within the formation, bands of *limestone* which may attain a thickness of 5' or more, and numerous beds of *lignite coal* varying in thickness from thin partings to over 10 feet.

Burning of lignite beds has in places colored and hardened adjacent materials. When exposed these have a pinkish color and are locally known as *scoria*.

The *alluvial fill* formation is an unsorted mixture, graded largely from sand sizes to clay sizes, glacially deposited in a compact state generally characterized by a small percentage of pebbles having a usual maximum size of one inch.

Lignite float indicates the presence of various sized pieces of lignite transported and mixed by stream action and found deposited in varying concentrations at irregular horizons throughalluvial valley fill materials.

The term *loam* is used to designate a mixture of sand, silt and clay sizes, the percentage of clay sizes ranging from 0 to 19 for loam and from 20 to 29 for clay loam, with the predominant remaining material indicated by a modifying adjective. The term loam does not imply the admixture of organic material.

GENERAL NOTES

For location of bore holes see Drawing No GE3 S/1

For method of designating sections and exclanation of cross reference system see Drawing No GE3 S/1

Indicated water table elevations, although derived from best available data, should be regarded as approximate only and subject to considerable variation.

Available samples may be inspected at the Corps of Engineers Office at the damsite.

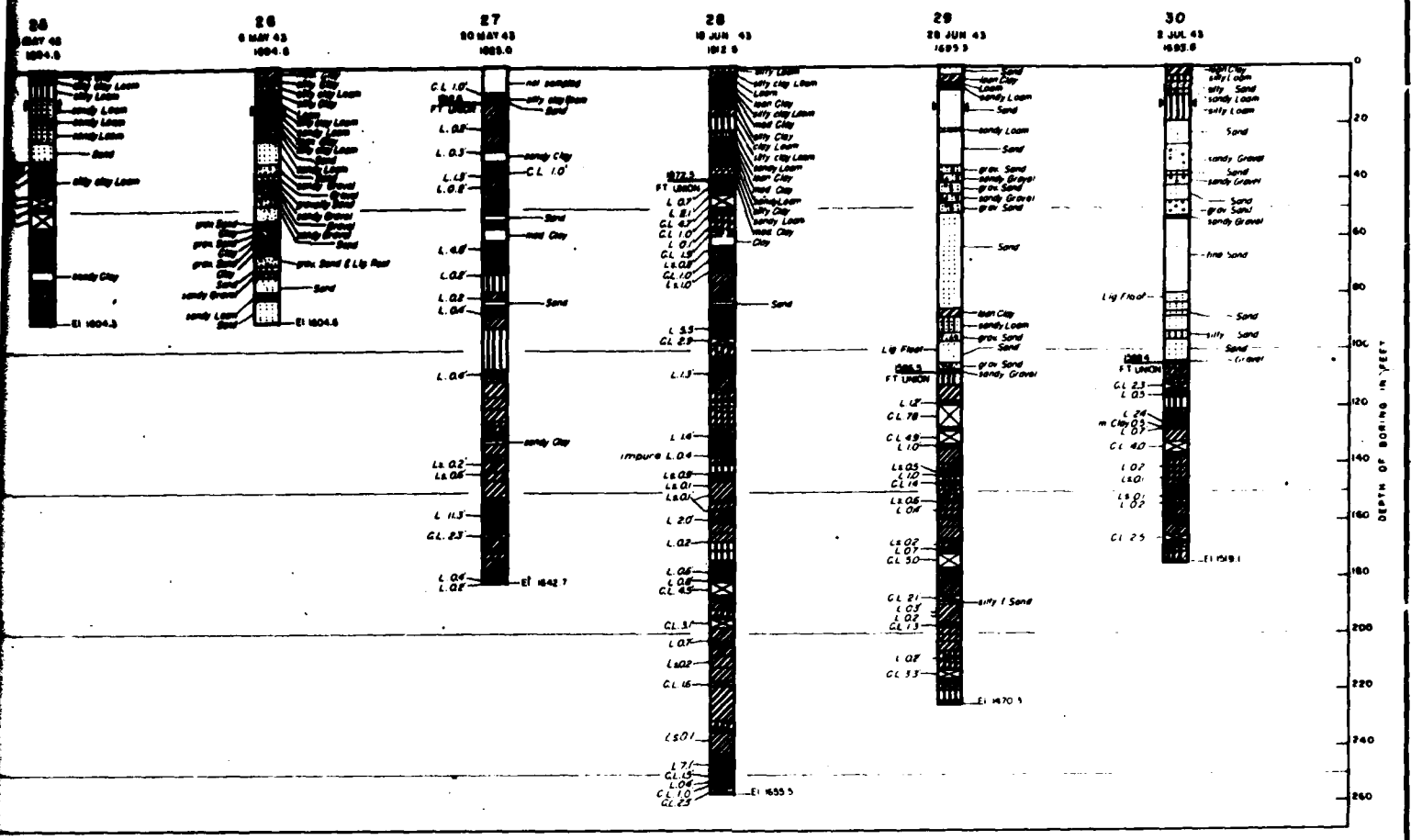
Graphic logs give boring information in condensed form. Further information is shown on the complete boring logs which may be inspected at the Corps of Engineers Office at the site.

All borings in overburden made by churn type rig using 6-inch inside diameter open end drive tube. Continuous samples recovered.

All borings in Fort Union made by rotary type rig using double tube core barrel. Continuous core 5 3/8 inches in diameter recovered.

Complete logs of borings not shown on Record of Borings sheets may be inspected at the Corps of Engineers Office at the site.

40'R — indicates a hole located 40' feet to right of profile, relative to direction of increase in stationing, similarly, L stands for left of profile. U, upstream, and D, downstream, are used in instances where R & L are not applicable.



NOTES

- ... of bore holes see Drawing No GE3 5/1
- ... of designating sections and explanation of ... system see Drawing No GE3 5/1
- ... water table elevations, although derived from ... data, should be regarded as approximate ... to considerable variation
- ... samples may be inspected at the Corps of ... of the damsite
- ... give boring information in condensed form ... these is shown on the complete boring logs ... inspected at the Corps of Engineers Office
- ... an overburden made by churn type rig ... inch diameter open end drive tube Con- ... recovered
- ... in Fort Union made by rotary type rig using ... barrel Continuous core 5 $\frac{7}{8}$ - inches ... barrel
- ... type of borings not shown on Record of Borings ... inspected at the Corps of Engineers Office

... a hole located 40' feet to right of pro- ... relative to direction of increase in stationing, ... R for left of profile U, upstream, and ... are used in instances where R & L are

LEGEND

87 ..... HOLE NUMBER
25 MAR 43 ..... DATE HOLE COMPLETED
1798.4 ..... ELEV TOP OF HOLE

FIELD CLASSIFICATION (Where no laboratory classification)
WATER TABLE (At time of exploration)
SPECIAL GEOLOGIC GROUPING
TOP OF FORT UNION FORMATION
WEATHERED ZONE
FIELD CLASSIFICATION (Where no laboratory classification)
LIGNITE BED
CORE LOST
LIMESTONE - shown graphically
CORE LOST - under 1.0'
EL 1649.7 — LIMESTONE - thin bed

gra - gravelly
sa - sandy
si - silty
cl - clayey
l - lean (clay)
m - medium (clay)
f - fat (clay)

Lean, medium & fat clays are not differentiated in Fort Union
Fine, medium & coarse sands are not differentiated in both overburden and Fort Union, strata less than 1.0' thick not shown, boring combined with the most similar material above or below except thicknesses of 0.1' are indicated for lignite, limestone, core loss, and foreign materials within a salvageable lignite bed

GRAIN SIZE SYMBOLS

SAND — SILT — GRAVEL — CLAY

Symbols represent grain size distribution, predominant type by heavy lines, modifying types by light lines

OTHER SYMBOLS

LIMESTONE — LIGNITE — SHALE — SCORIA — LIGNITE (Drainage coring omitted) — Hole drilled (Hole Boring not sampled)

SET	DATE	REVISION (Indicated by △)	BY	APP

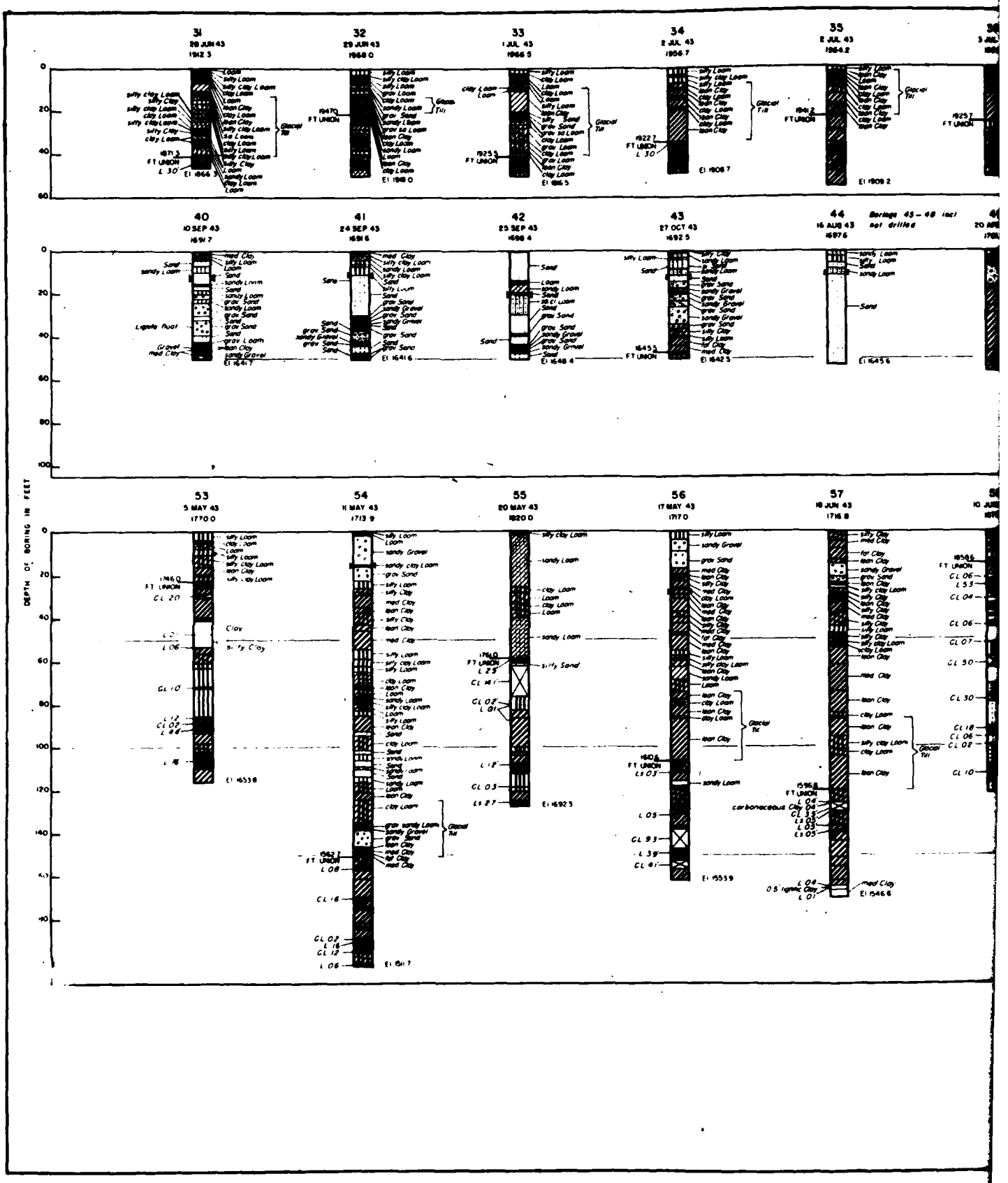
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OFFICE OF THE DISTRICT ENGINEER
BISMARCK, N.D.

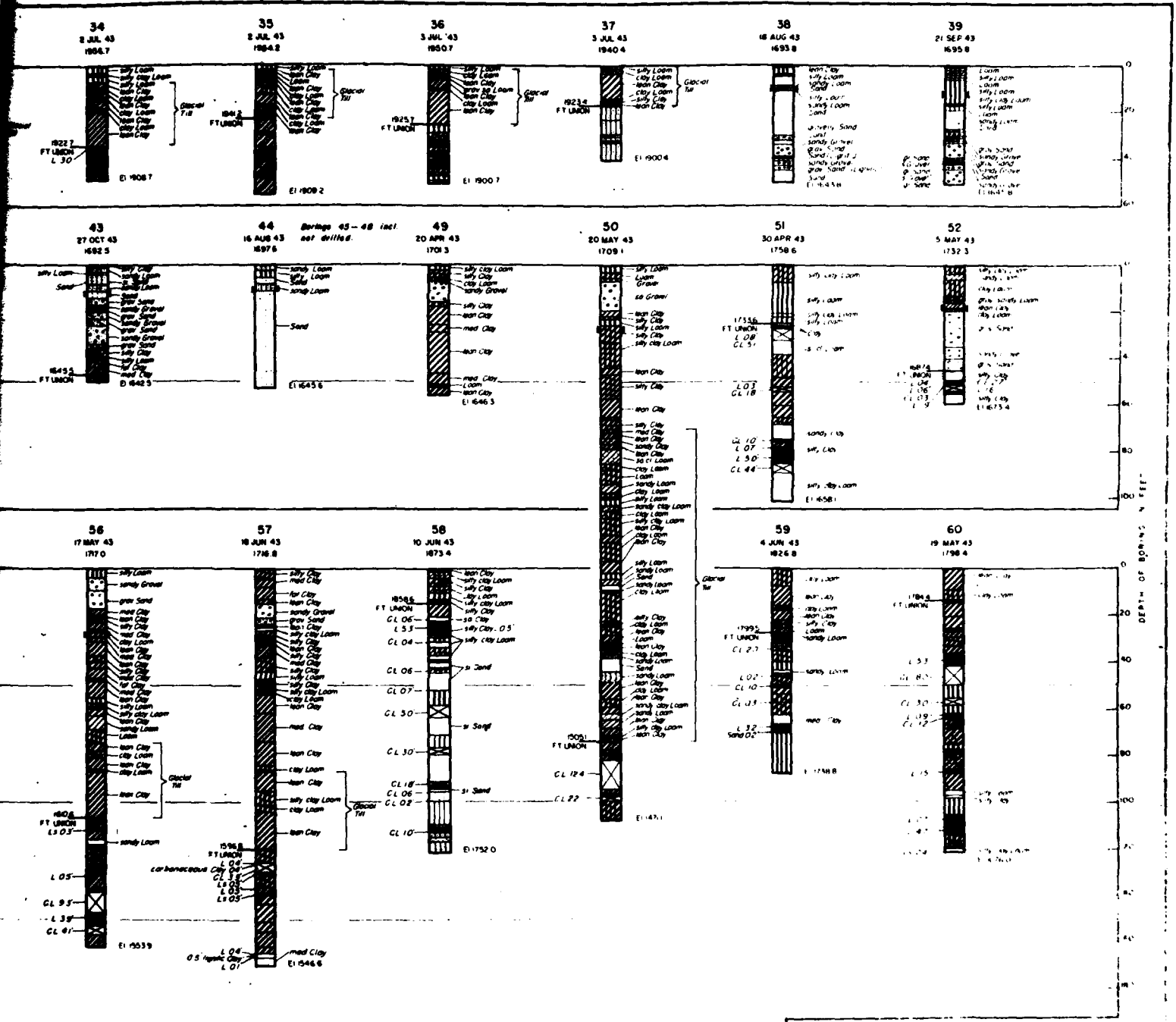
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
RECORD OF BORINGS — 22 TO 30

AUGUST 1948

DRAWING NUMBER
GE3 — 5/10

2


DEPTH OF BORING IN FEET
31
28 JUN 43
1912 3
32
29 JUN 43
1968 0
33
1 JUL 43
1966 5
34
2 JUL 43
1956 7
35
2 JUL 43
1964 2
40
10 SEP 43
1691 7
41
24 SEP 43
1691 6
42
25 SEP 43
1698 4
43
27 OCT 43
1692 5
44
16 AUG 43
1697 6
Borings 45 – 48 incl
not drilled
53
5 MAY 43
1770 0
54
11 MAY 43
1713 9
55
20 MAY 43
1820 0
56
17 MAY 43
1717 0
57
18 JUN 43
1716 8
Glacial Till
FT UNION
Clay
Silty Clay
sandy Gravel
carbonaceous Clay
lignitic Clay



REV	DATE	REVISIONS (indicated by △)	BY	CK	APP

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BISMARCK, N. D.

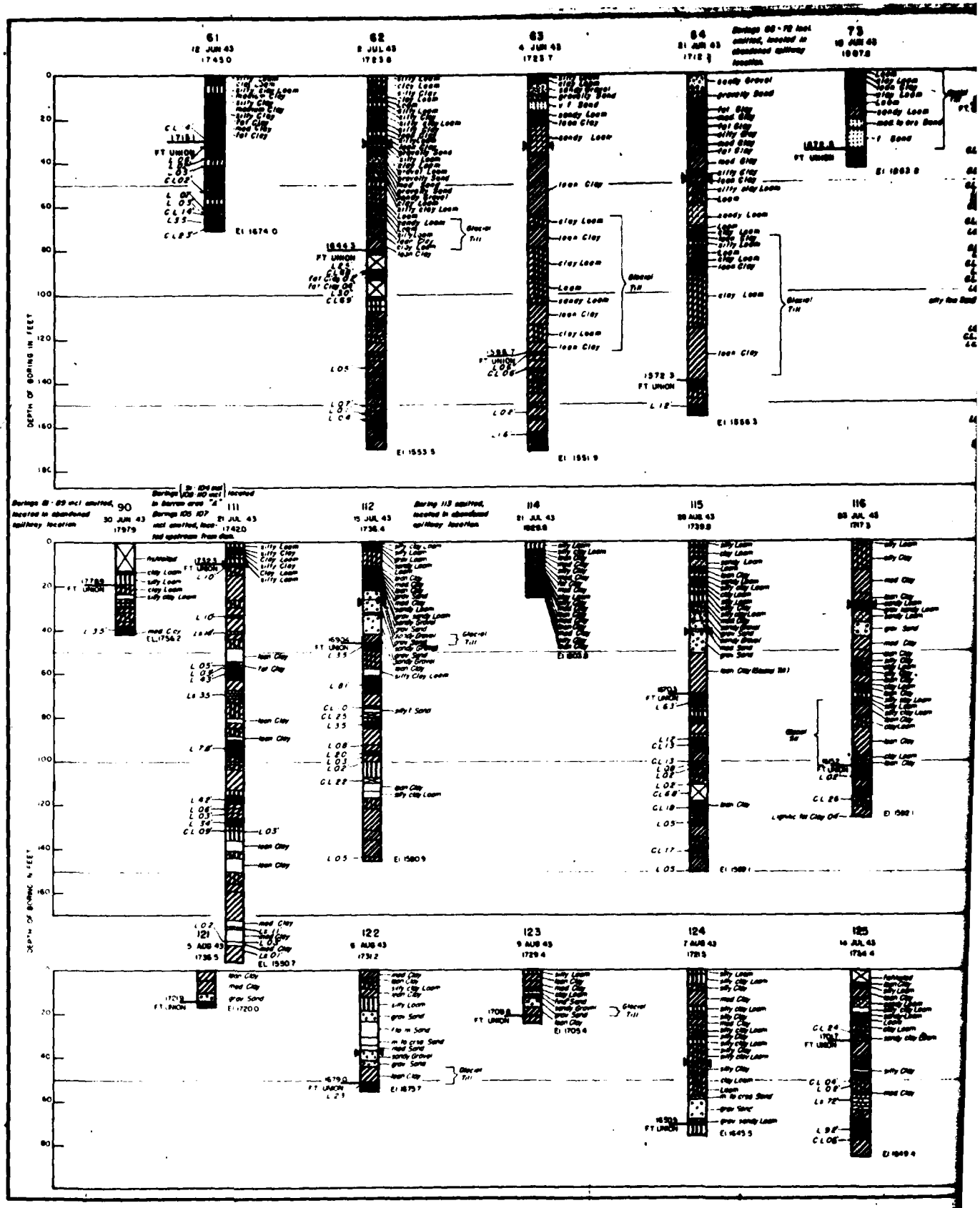
MISSOURI RIVER

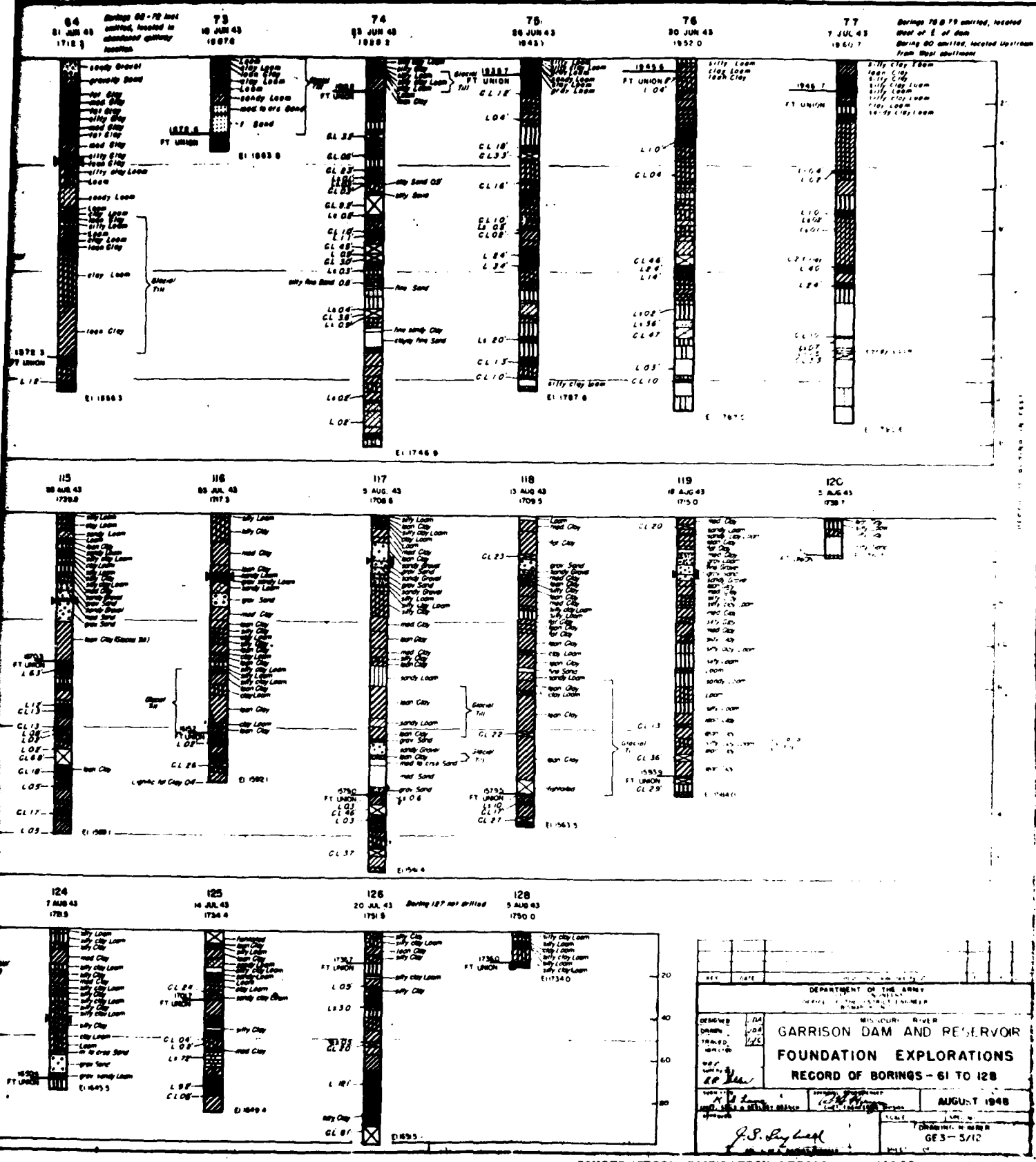
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
RECORD OF BORINGS - 34 TO 60

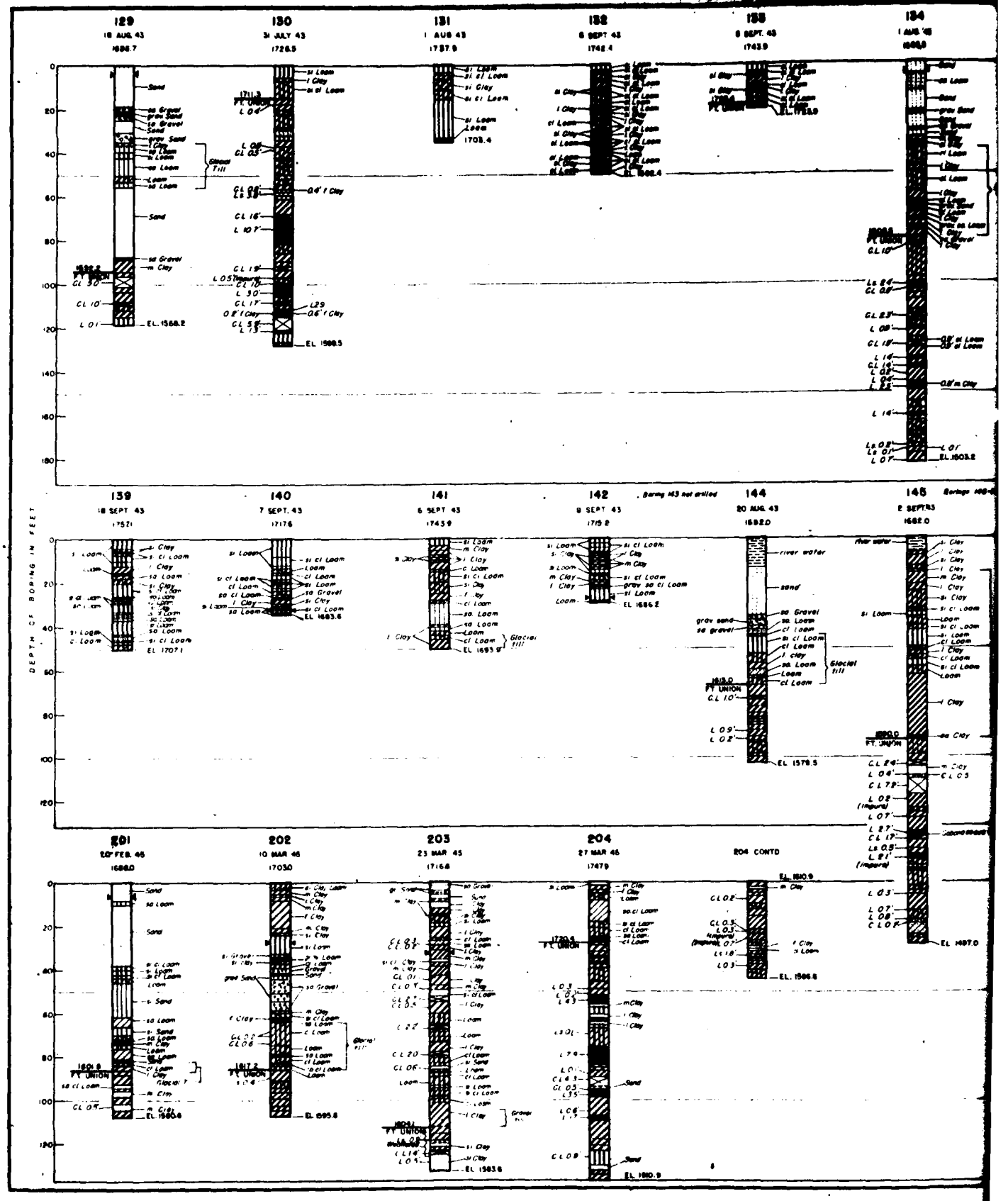
AUGUST 1948

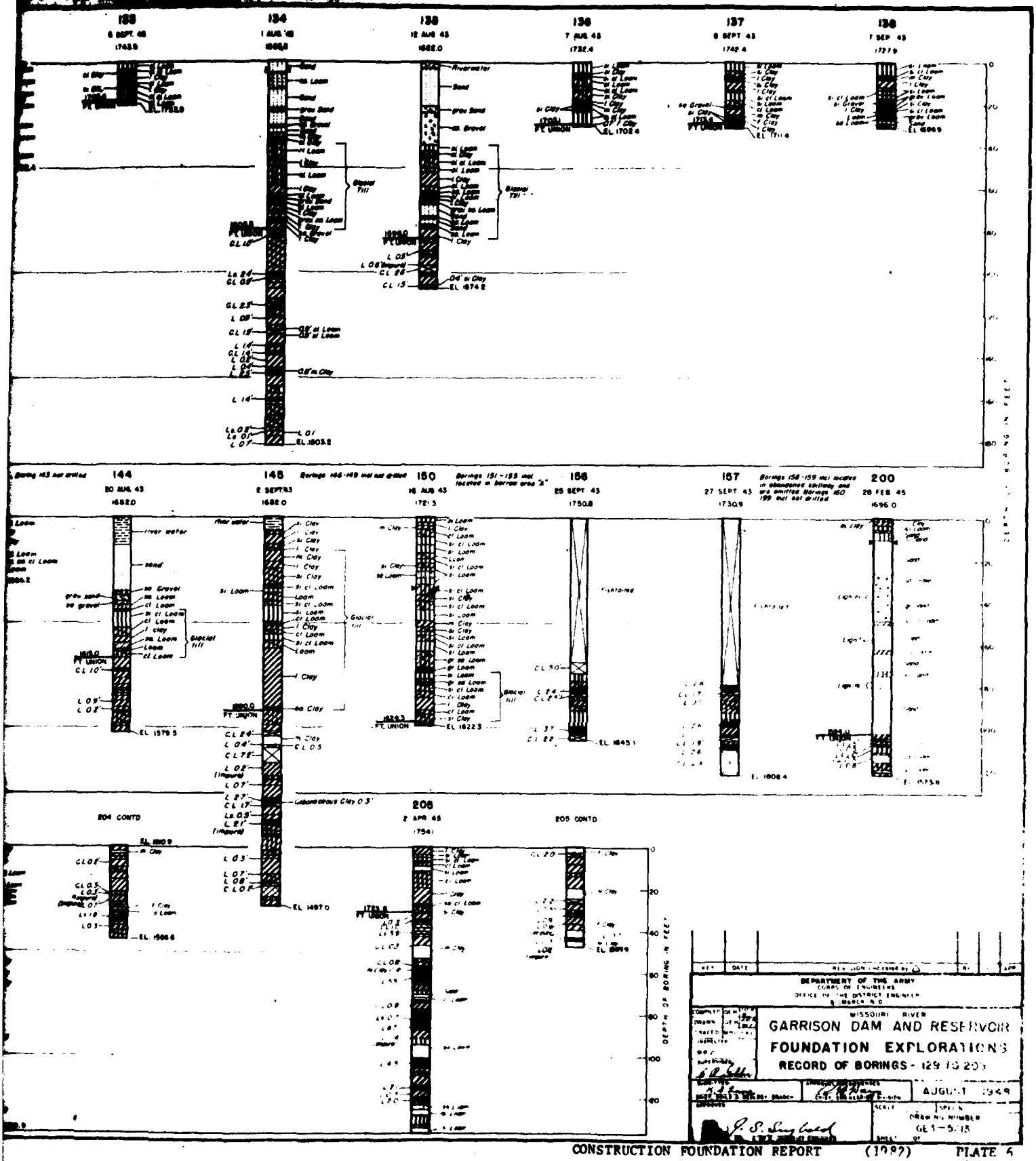
GE 3 -- 5/11

CONSTRUCTION FOUNDATION REPORT (1950) PLATE 4


61
62
63
64
73
DEPTH OF BORING IN FEET
90
111
112
114
115
116
121
122
123
124
125
DEPTH OF BORING IN FEET


64
73
74
75
76
77
115
116
117
118
119
120
124
125
126
128
DEPARTMENT OF THE ARMY
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
RECORD OF BORINGS - 61 TO 128
AUGUST 1948
GE 3 - 5/12


129
18 AUG 43
1686.7
130
31 JULY 43
1726.5
131
1 AUG 43
1737.9
132
8 SEPT 43
1748.4
133
8 SEPT. 43
1743.9
134
1 AUG '43
1696.8
139
18 SEPT 43
1757.1
140
7 SEPT. 43
1717.6
141
6 SEPT 43
1743.9
142
9 SEPT 43
1719.2
144
20 AUG 43
1682.0
145
2 SEPT 43
1682.0
201
20 FEB. 45
1686.0
202
10 MAR 45
1703.0
203
23 MAR 45
1716.8
204
27 MAR 45
1747.9
204 CONTD
DEPTH OF BORING IN FEET



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OMAHA, NEBR.

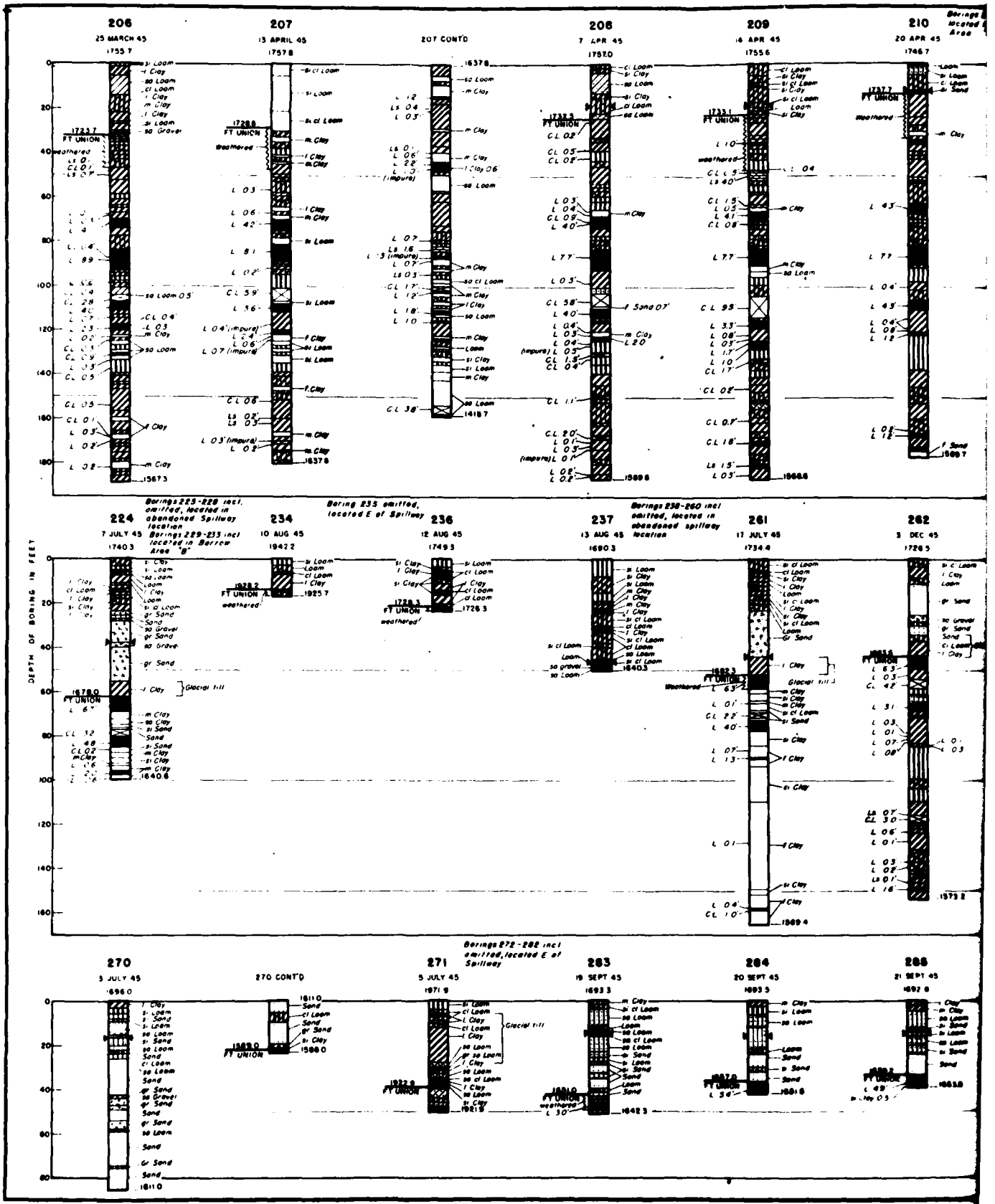
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
RECORD OF BORINGS - 129 TO 208

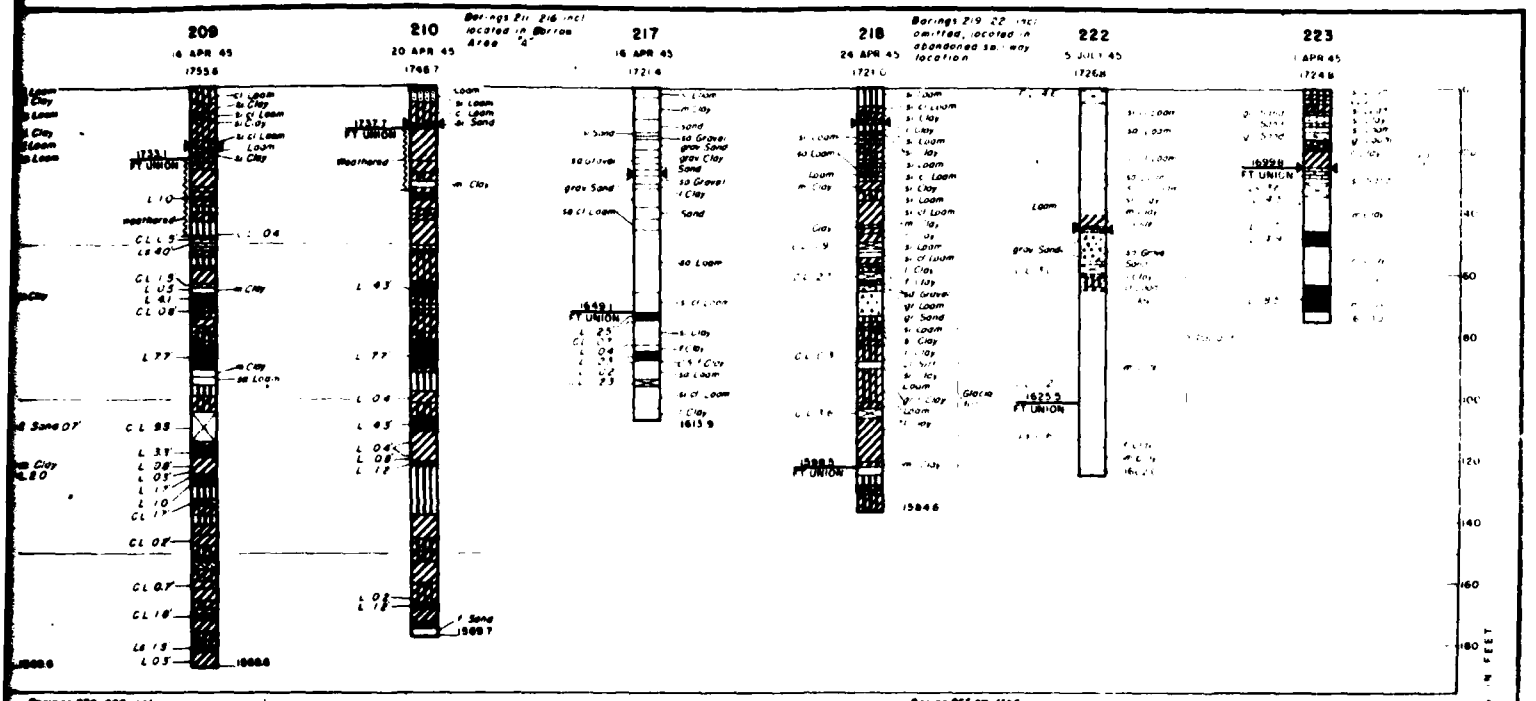
AUGUST 1949

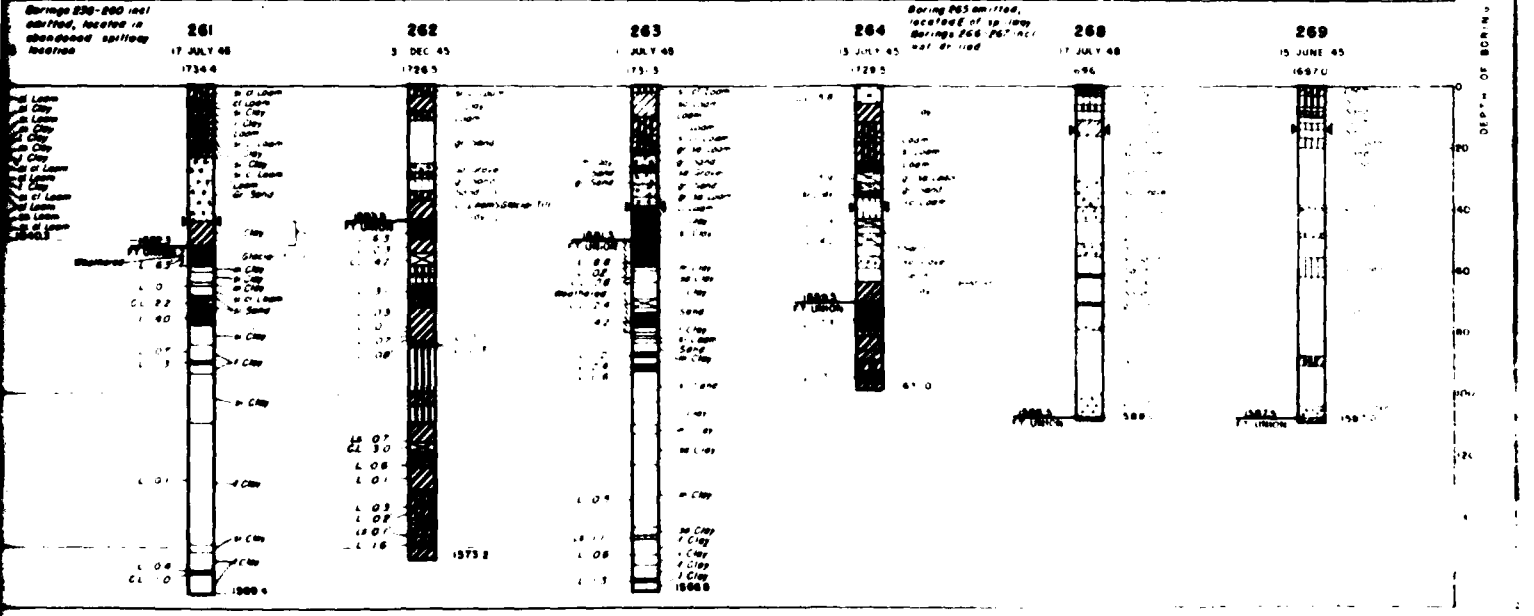
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GE 1-5.15

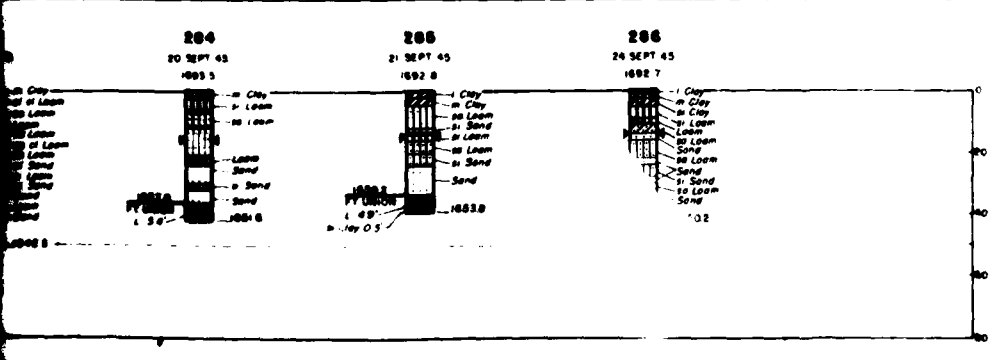
CONSTRUCTION FOUNDATION REPORT (1949) PLATE 6

2


206
25 MARCH 45
207
13 APRIL 45
207 CONT'D
208
7 APR 45
209
16 APR 45
210
20 APR 45
Borings located Area
Borings 225-228 incl. omitted, located in abandoned Spillway location
Boring 233 omitted, located E of Spillway
Borings 258-260 incl omitted, located in abandoned spillway location
224
7 JULY 45
Borings 229-233 incl located in Borrow Area "B"
234
10 AUG 45
236
12 AUG 45
237
13 AUG 45
261
17 JULY 45
262
3 DEC 45
DEPTH OF BORING IN FEET
Borings 272-282 incl omitted, located E of Spillway
270
5 JULY 45
270 CONT'D
271
5 JULY 45
283
19 SEPT 45
284
20 SEPT 45
285
21 SEPT 45







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OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEBRASKA

MISSOURI RIVER

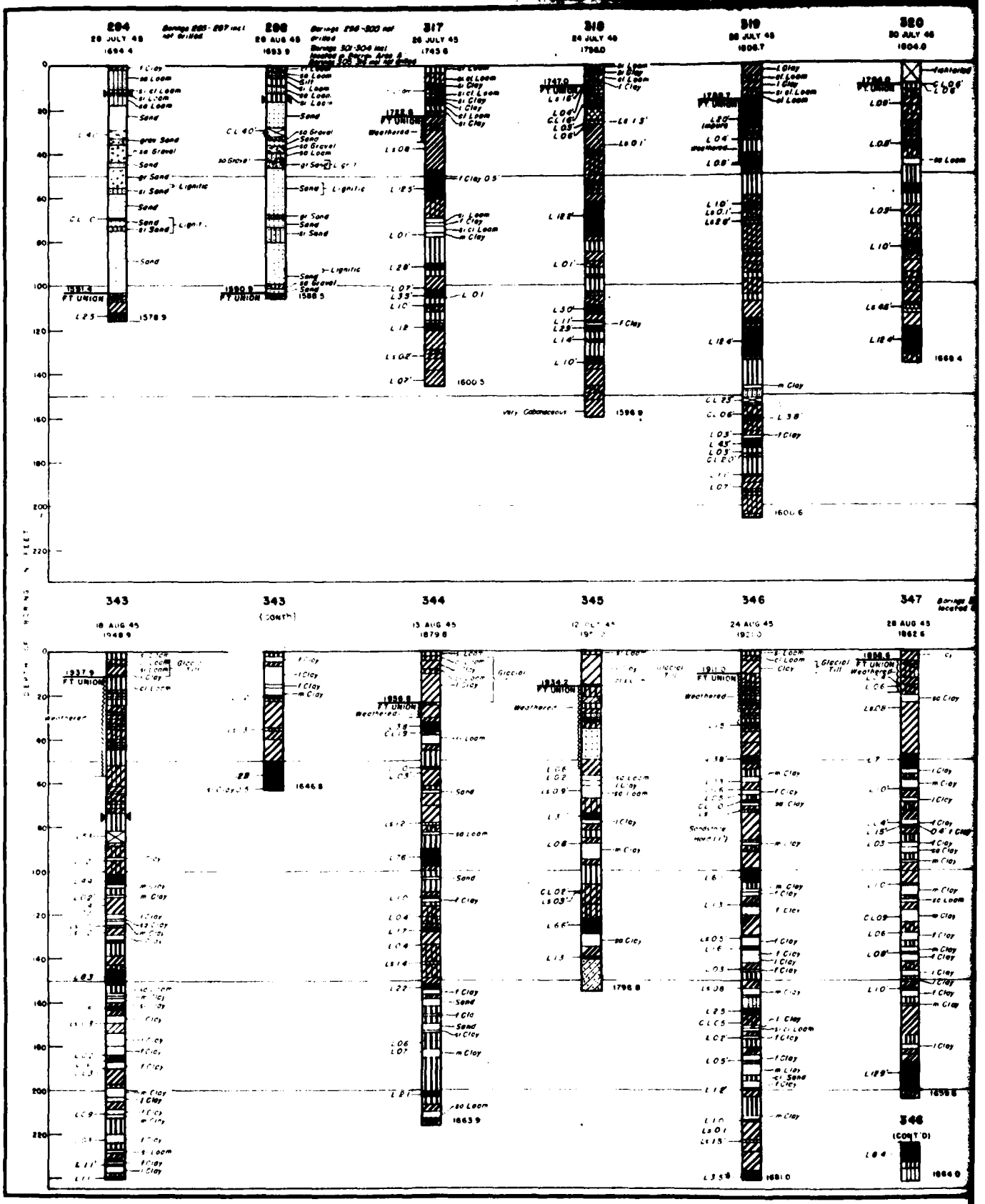
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
RECORD OF BORINGS - 206 TO 286

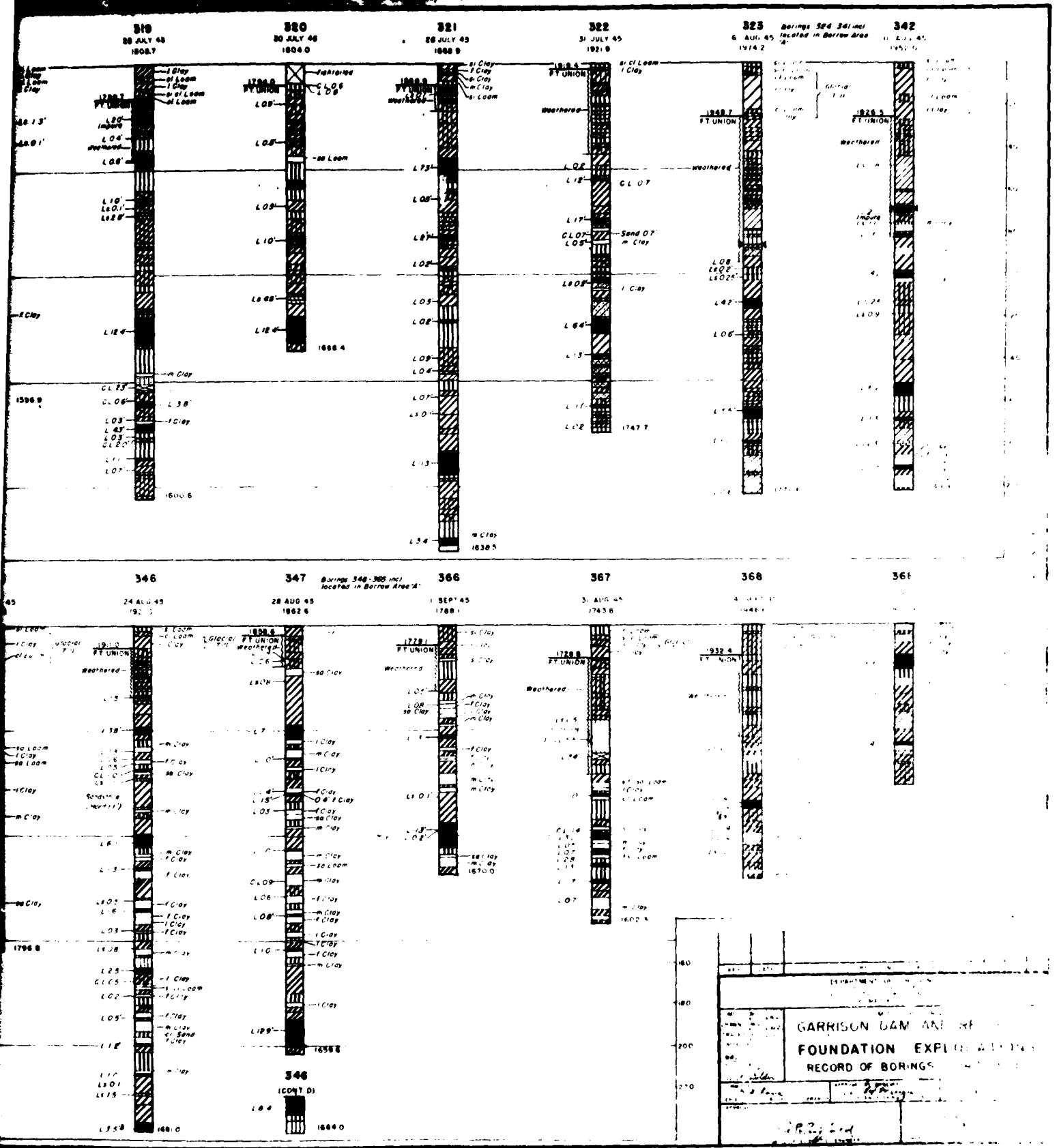
AUGUST 1946

DRAWING NUMBER
6E3-5/14

CONSTRUCTION FOUNDATION REPORT (1945) PLATE 7

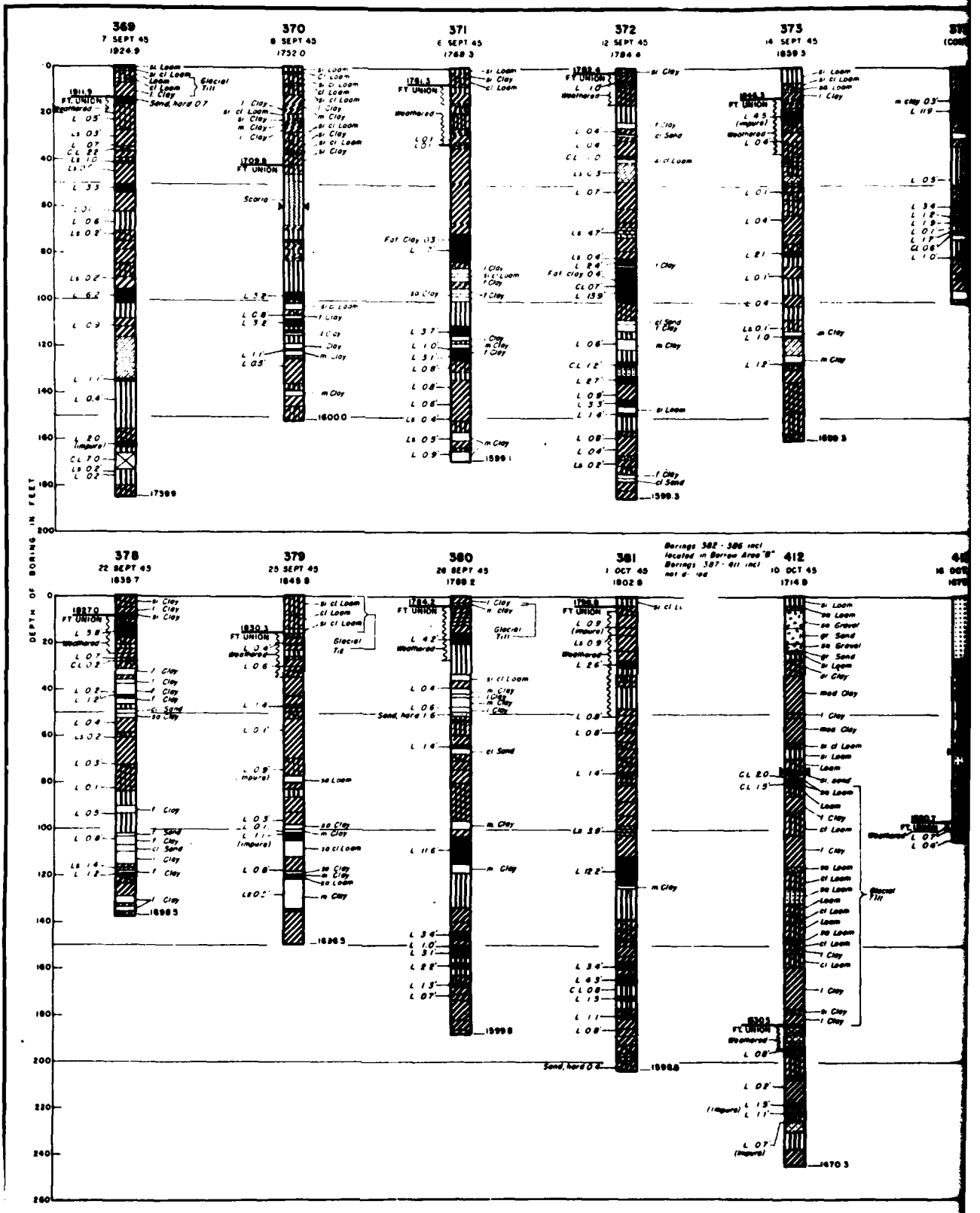
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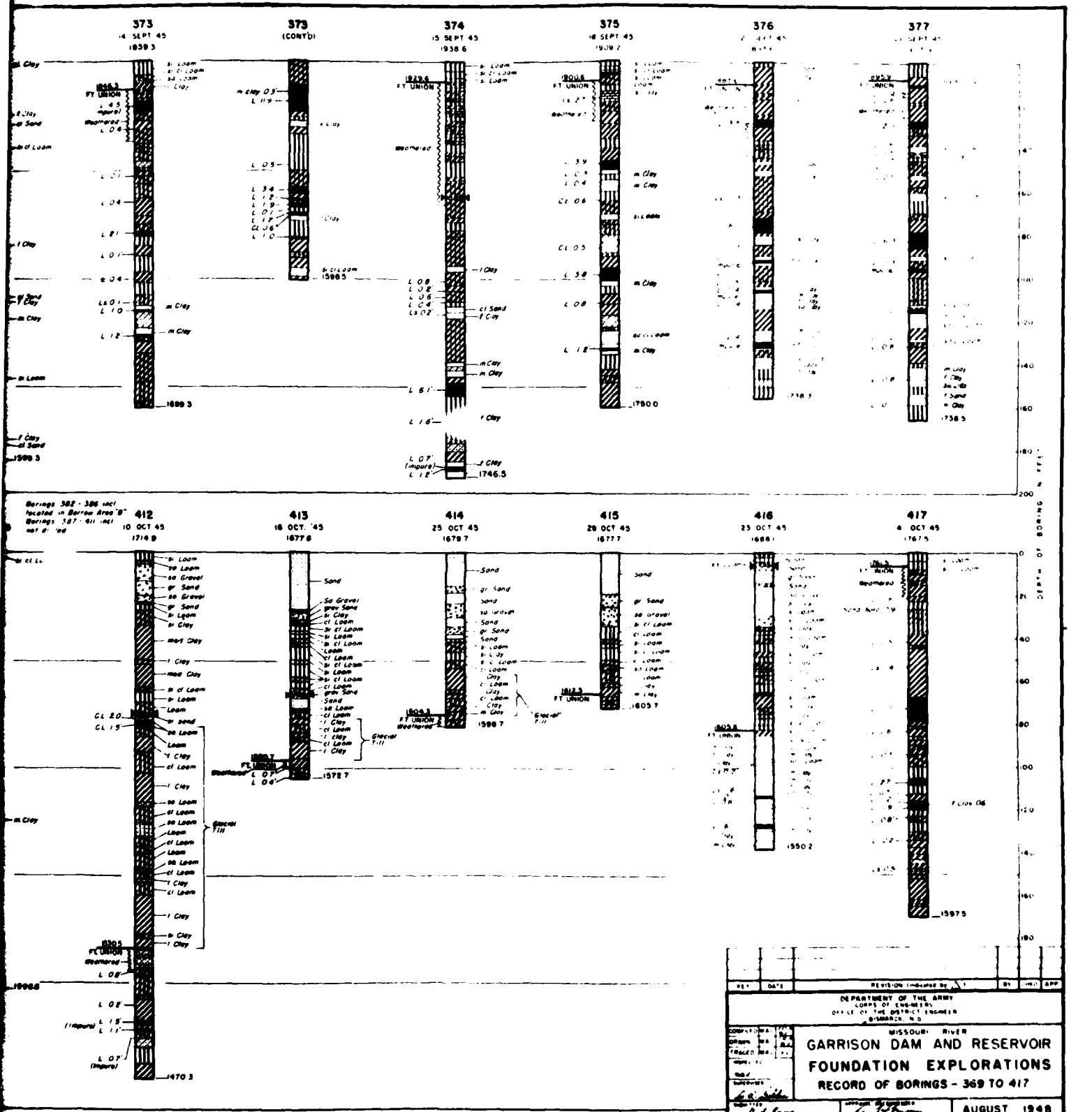

294
29 JULY 45
1694.4
296
29 AUG 45
1693.9
317
26 JULY 45
1745.6
318
24 JULY 45
1796.0
319
28 JULY 45
1808.7
320
30 JULY 46
1804.8
343
18 AUG 45
1948.9
343
(South)
344
13 AUG 45
1879.8
345
12 OCT 45
346
24 AUG 45
1923.0
347
28 AUG 45
1862.6
346
(CONT'D)
DEPTH IN FEET



CONSTRUCTION FOUNDATION REPORT (1982) PLATE 9

2


369
7 SEPT 45
1926.9
370
8 SEPT 45
1752.0
371
6 SEPT 45
1768.3
372
12 SEPT 45
1784.6
373
14 SEPT 45
1839.3
378
22 SEPT 45
1838.7
379
23 SEPT 45
1848.8
380
26 SEPT 45
1788.2
381
1 OCT 45
1802.8
412
10 OCT 45
1714.8
DEPTH OF BORING IN FEET
Borings 382 - 386 incl located in Borrow Area "B"
Borings 387 - 411 incl not drilled



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BISMARCK, N.D.

MISSOURI RIVER

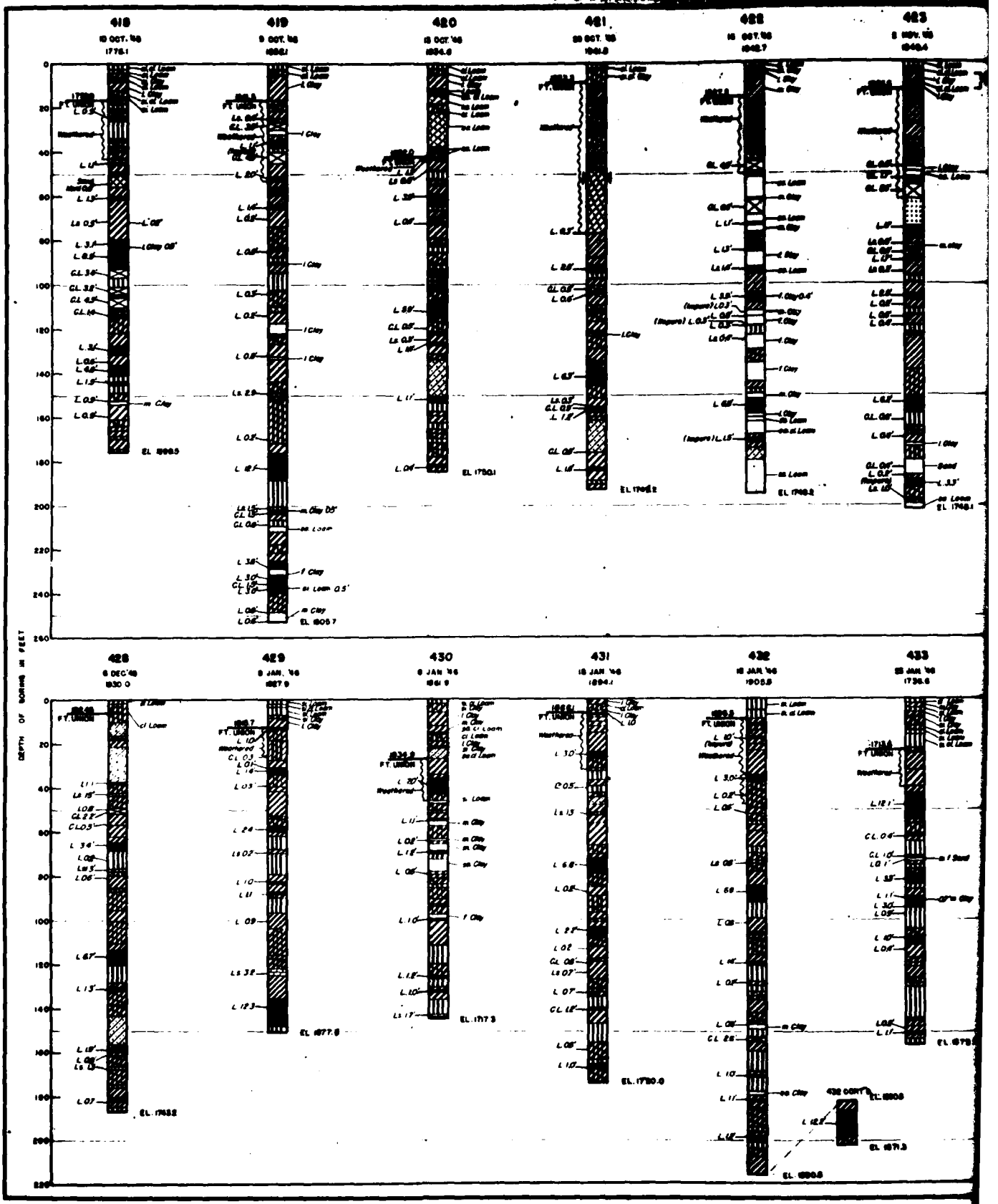
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
RECORD OF BORINGS - 369 TO 417

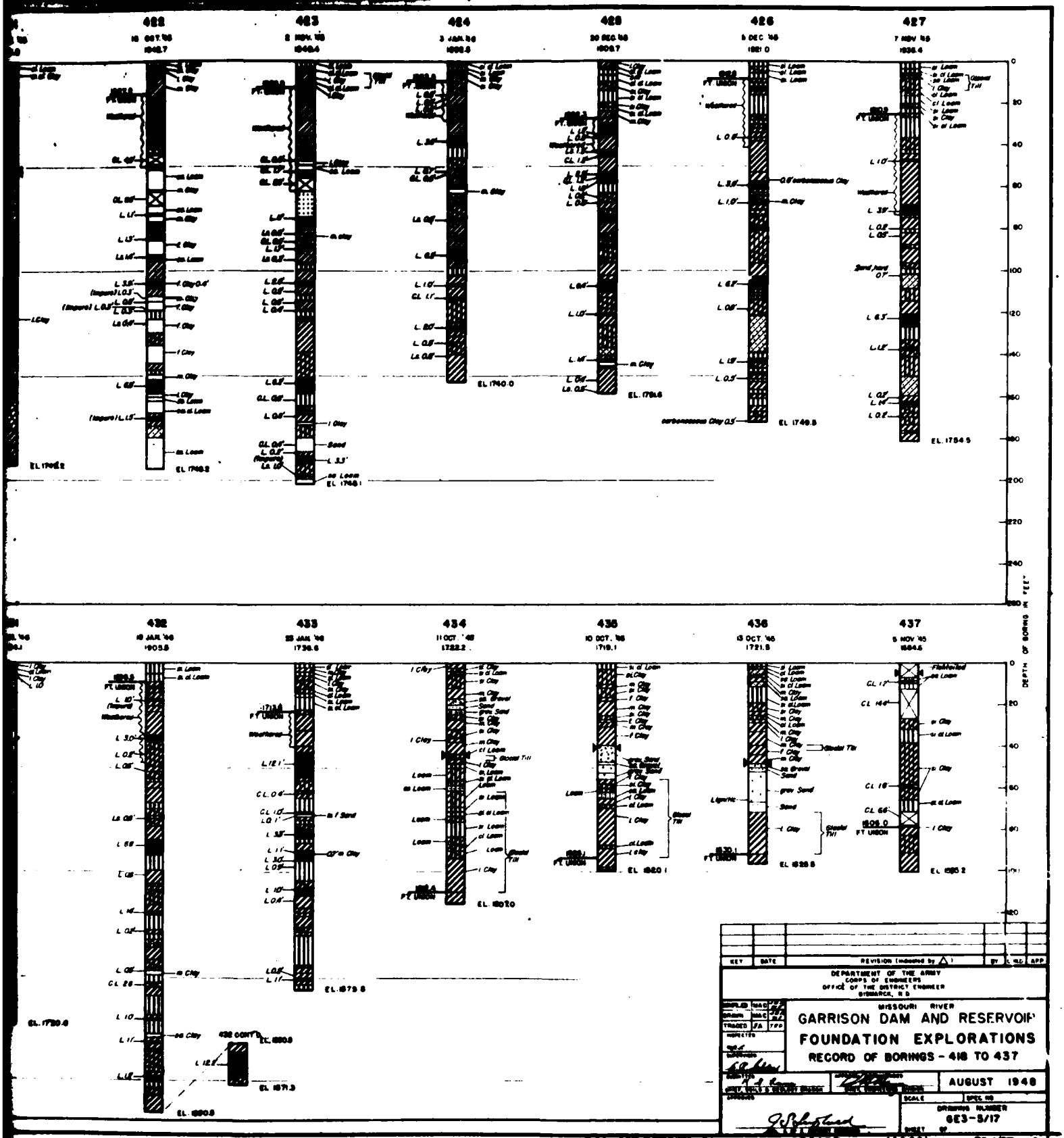
AUGUST 1948

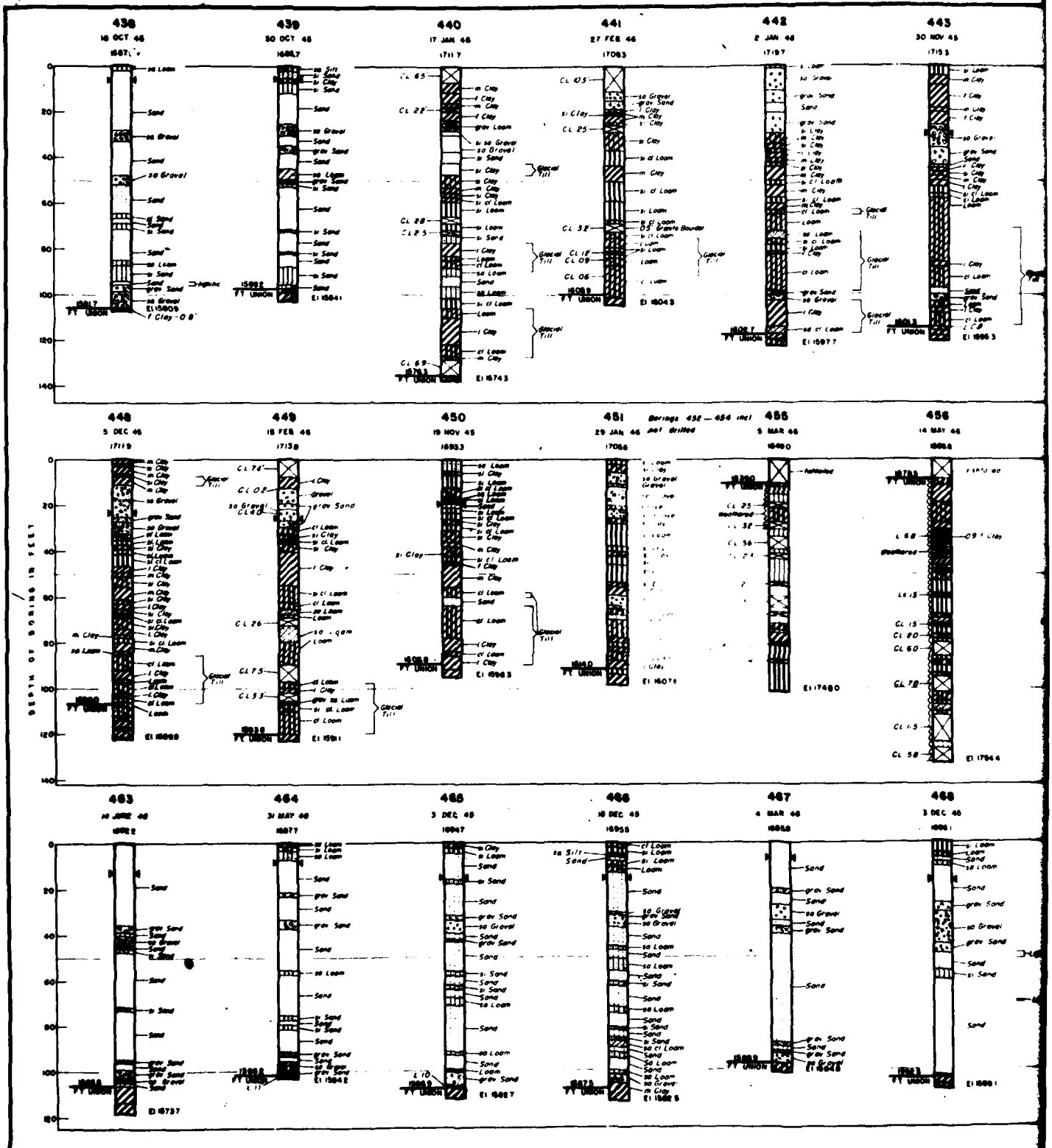
DRAWING NUMBER
GE 3 - 5/16

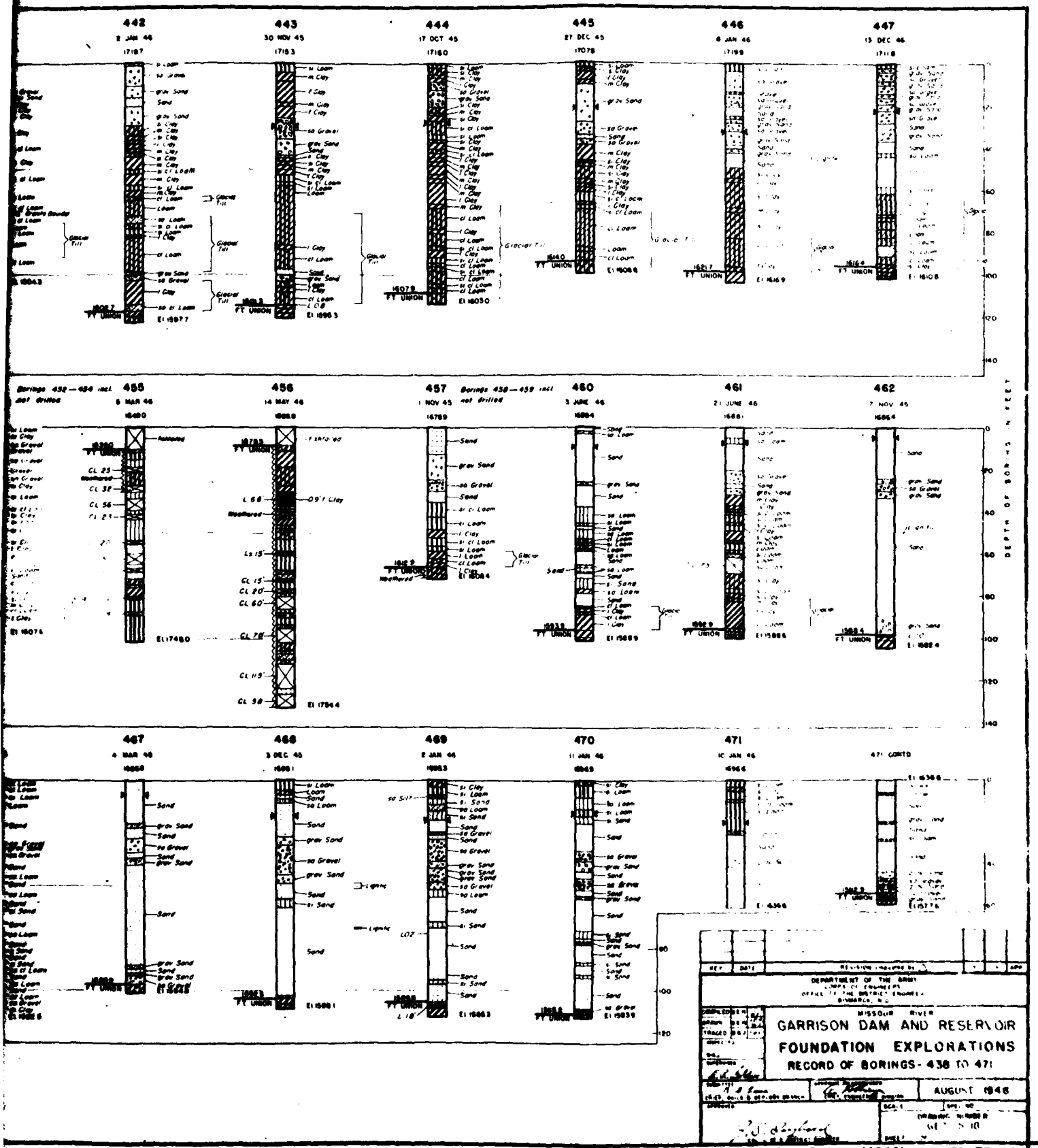
CONSTRUCTION FOUNDATION REPORT (1982) PLATE 9

2

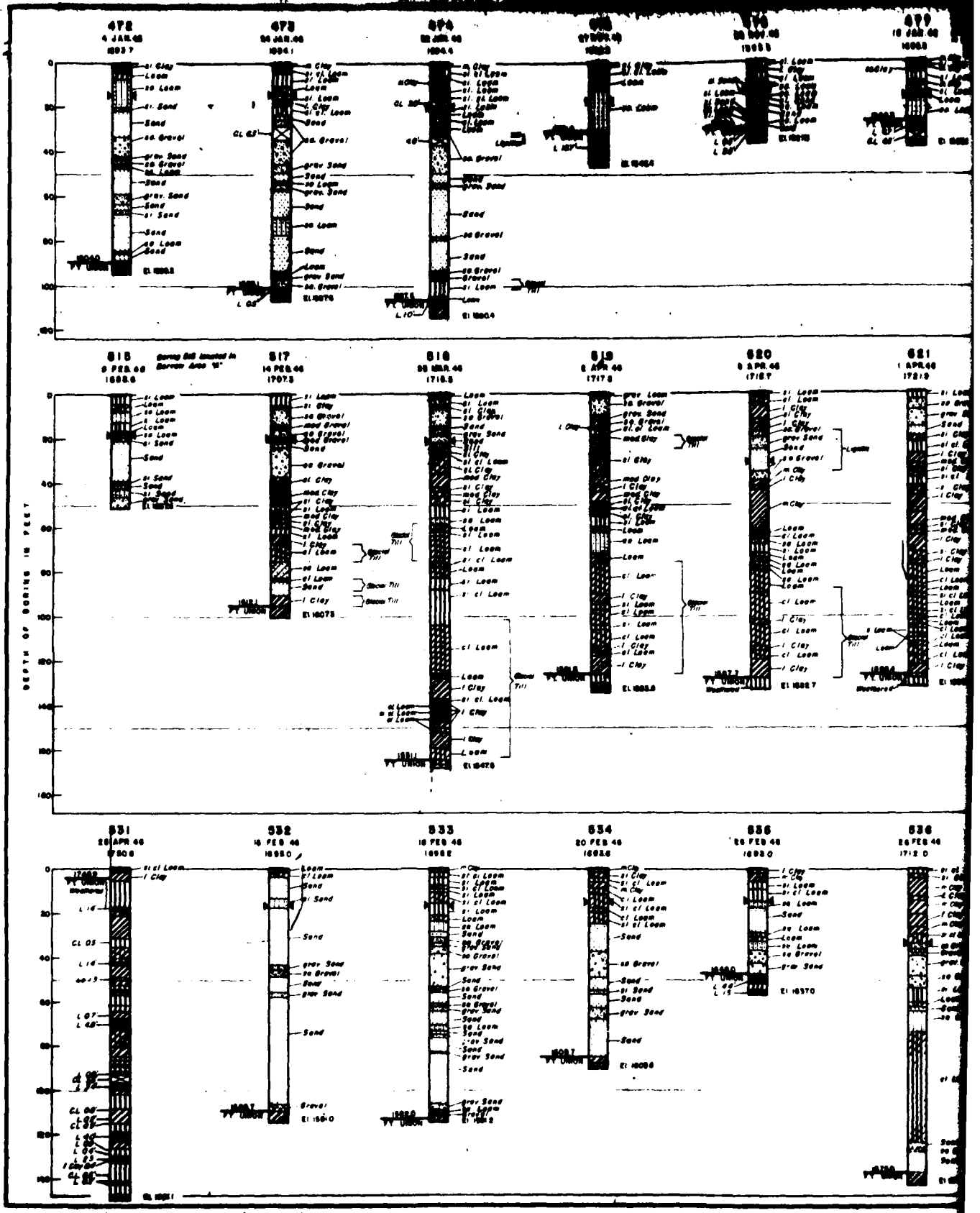

418
419
420
421
422
423
424
425
426
427
428
429
430
431
432
433
DEPTH OF BORING IN FEET

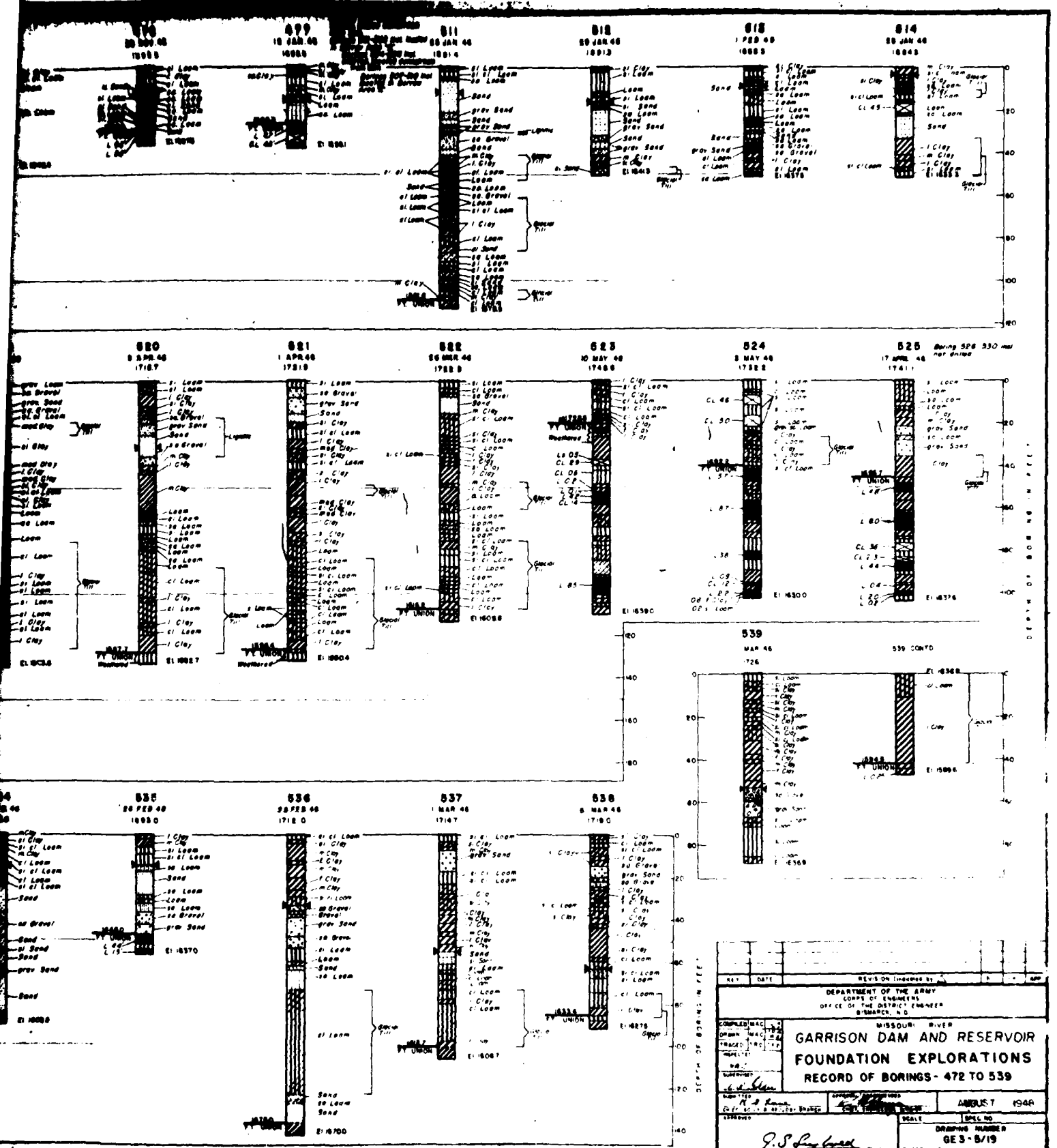

422
423
424
425
426
427
428
429
430
431
432
433
434
435
436
437
DEPTH IN FEET
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
BISMARCK, N.D.
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
RECORD OF BORINGS - 418 TO 437
AUGUST 1948
DRAWING NUMBER
6E3-5/17

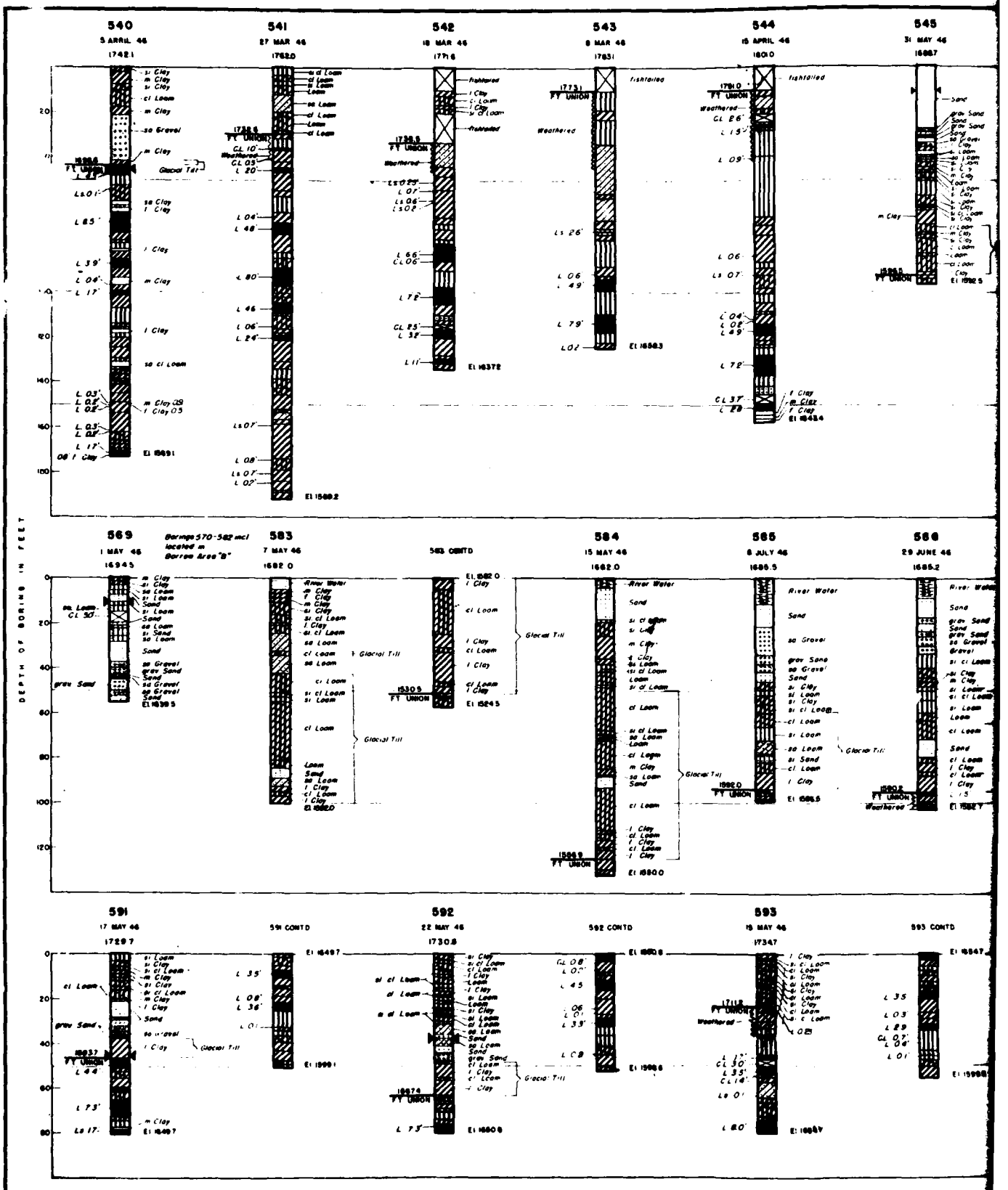

438
18 OCT 46
439
30 OCT 45
440
17 JAN 46
441
27 FEB 46
442
2 JAN 46
443
30 NOV 45
448
5 DEC 46
449
18 FEB 46
450
19 NOV 45
451
29 JAN 46
Borings 452 — 454 incl not drilled
455
5 MAR 46
456
16 MAY 46
463
10 JUNE 46
464
31 MAY 46
465
3 DEC 45
466
18 DEC 45
467
4 MAR 46
468
3 DEC 45
DEPTH OF BORING IN FEET

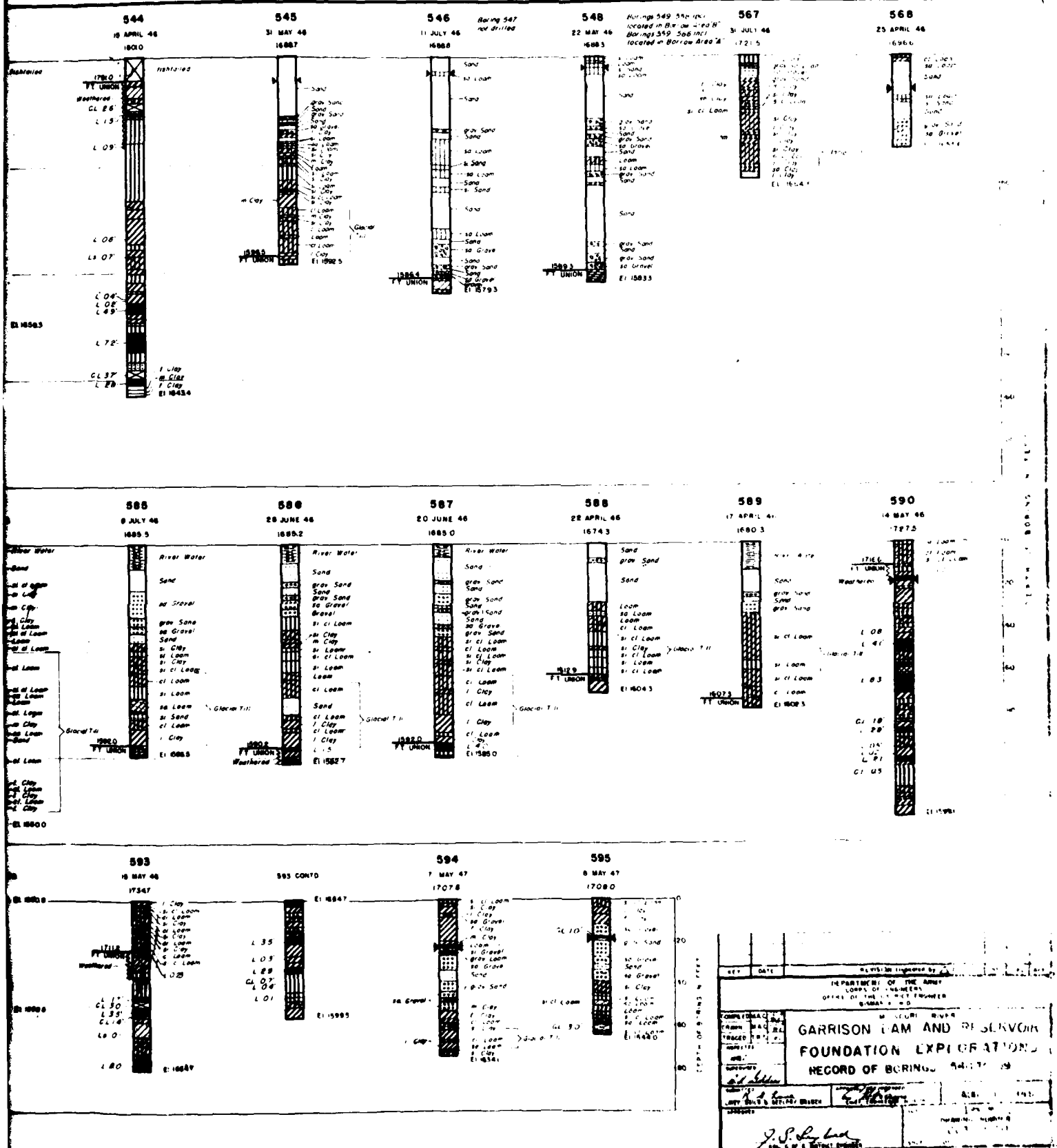

442
2 JAN 46
443
30 NOV 45
444
17 OCT 45
445
27 DEC 45
446
8 JAN 46
447
13 DEC 46
Borings 452—454 incl not drilled
455
5 MAR 46
456
14 MAY 46
457
1 NOV 45
Borings 458—459 incl not drilled
460
3 JUNE 46
461
21 JUNE 46
462
7 NOV 45
467
4 MAR 46
468
3 DEC 45
469
2 JAN 46
470
11 JAN 46
471
IC JAN 46
471 CONTD
DEPTH OF BORINGS IN FEET
DEPARTMENT OF THE ARMY
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
RECORD OF BORINGS - 438 TO 471
AUGUST 1946

2


DEPTH OF BORING IN FEET


610
611
618
614
620
621
622
623
624
625
539
539 CONTD
635
636
637
638
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
BISMARCK, N.D.
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
RECORD OF BORINGS - 472 TO 539
AUGUST 1948
DRAWING NUMBER
GE 3-5/19


DEPTH OF BORING IN FEET
540
5 APRIL 46
17421
541
27 MAR 46
17520
542
18 MAR 46
17716
543
8 MAR 46
17831
544
15 APRIL 46
18010
545
31 MAY 46
16887
569
1 MAY 46
16945
Borings 570-582 incl located in Borrow Area "B"
583
7 MAY 46
16820
583 CONTD
584
15 MAY 46
16820
585
8 JULY 46
16885
586
29 JUNE 46
16885.2
591
17 MAY 46
17297
591 CONTD
592
22 MAY 46
17308
592 CONTD
593
15 MAY 46
17347
593 CONTD



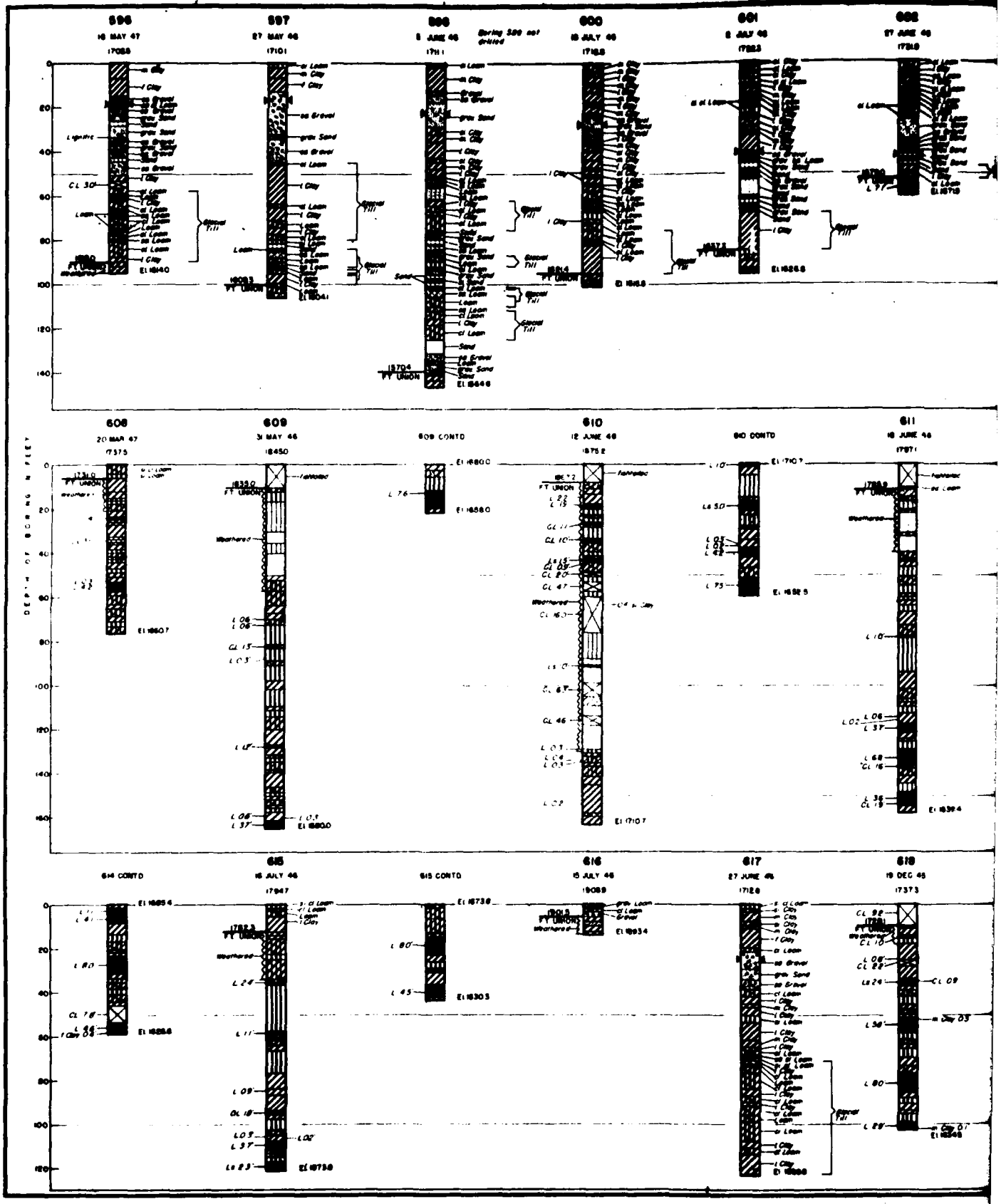
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEBRASKA

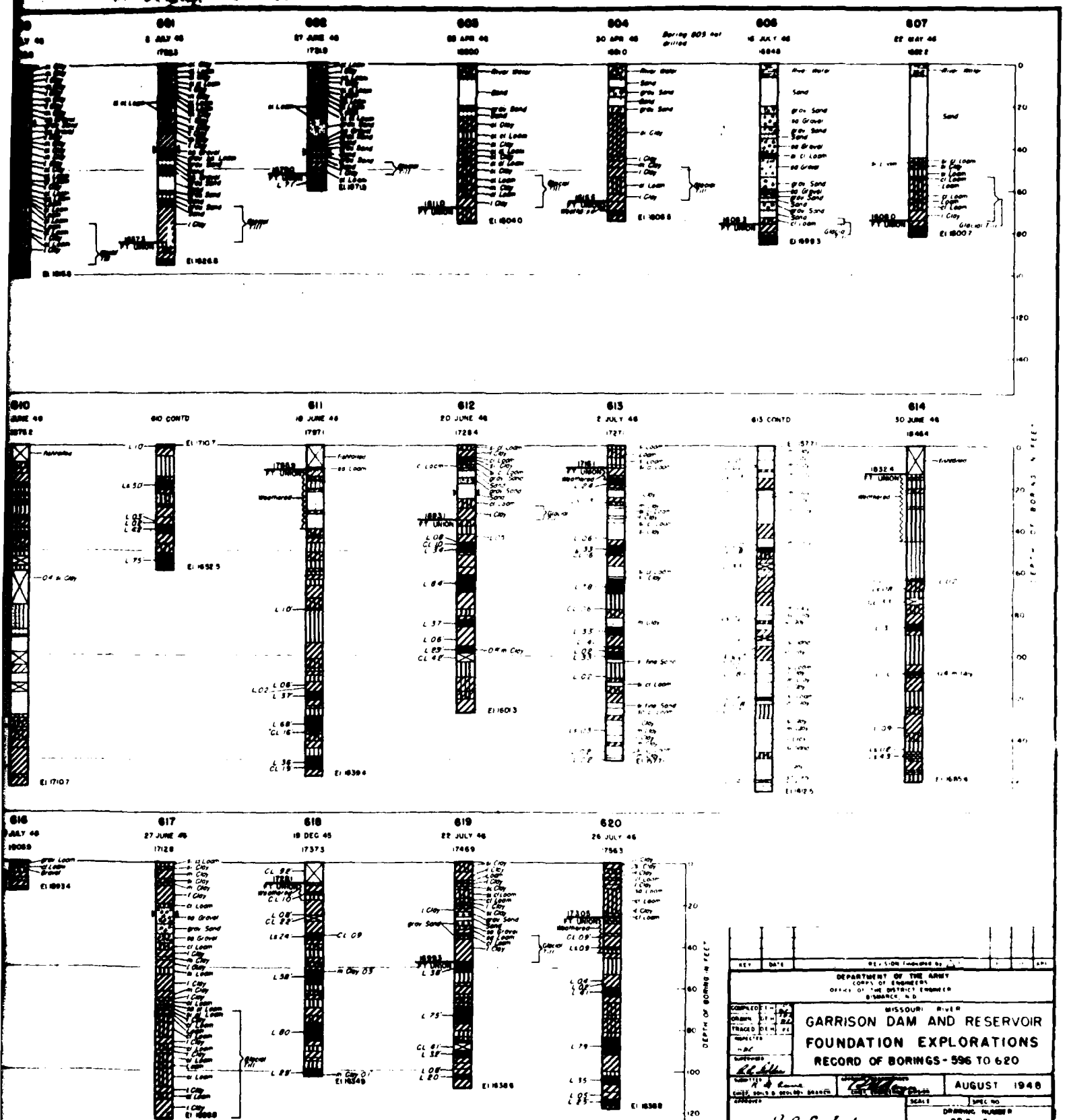
MISSOURI RIVER

GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
RECORD OF BORINGS

CONSTRUCTION FOUNDATION REPORT (1947) PLATE 13

2


596
16 MAY 47
17088
597
27 MAY 46
17101
598
5 JUNE 46
17111
Boring 598 not drilled
600
15 JULY 46
17158
601
5 JULY 46
17223
602
27 JUNE 46
17210
608
20 MAR 47
17375
609
31 MAY 46
18450
609 CONTD
610
12 JUNE 46
18752
610 CONTD
611
16 JUNE 46
17271
614 CONTD
615
15 JULY 46
17947
615 CONTD
616
15 JULY 46
19089
617
27 JUNE 46
17128
618
19 DEC 45
17373
DEPTH OF BORING IN FEET



DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
BISMARCK, N.D.

MISSOURI RIVER

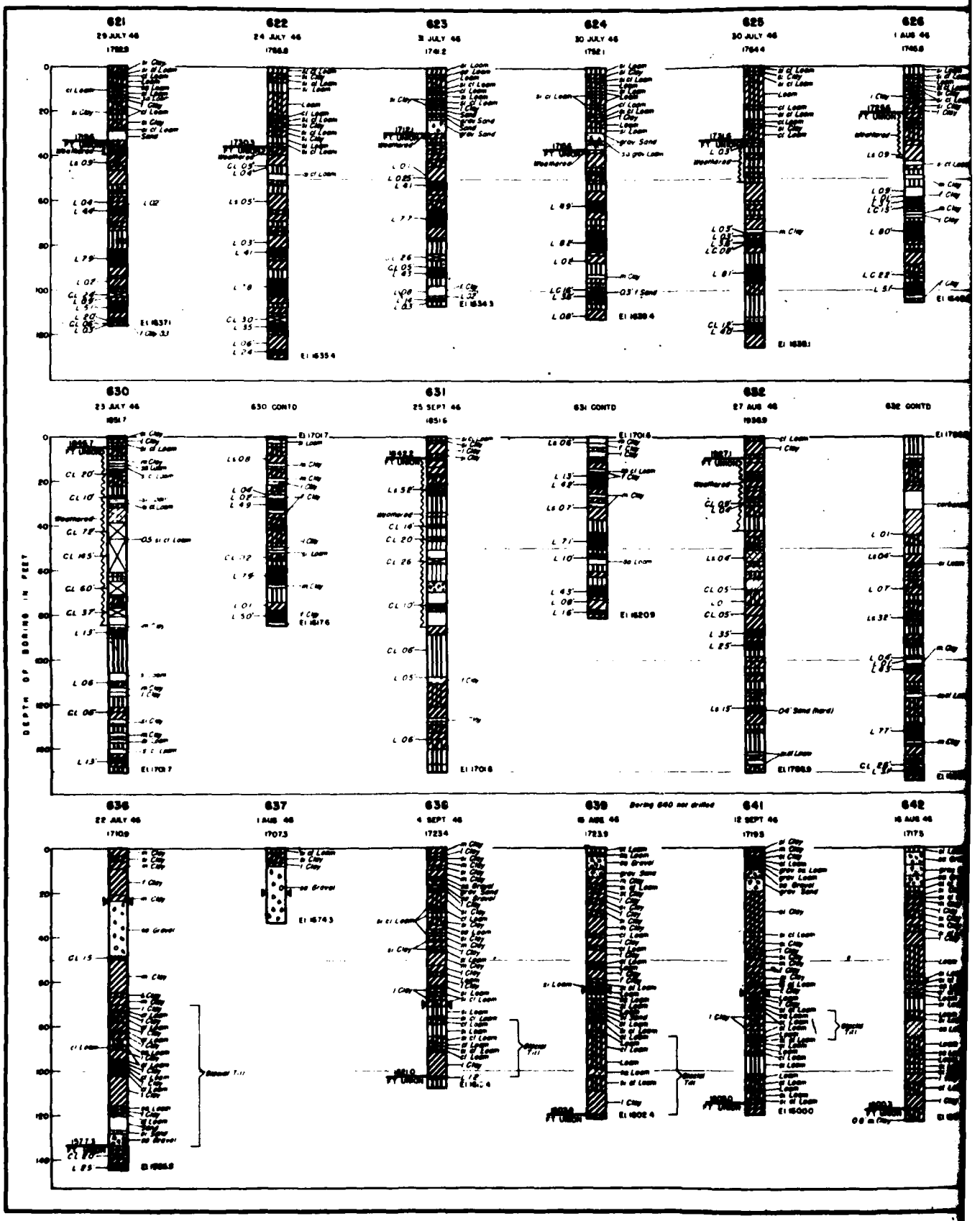
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
RECORD OF BORINGS - 596 TO 620

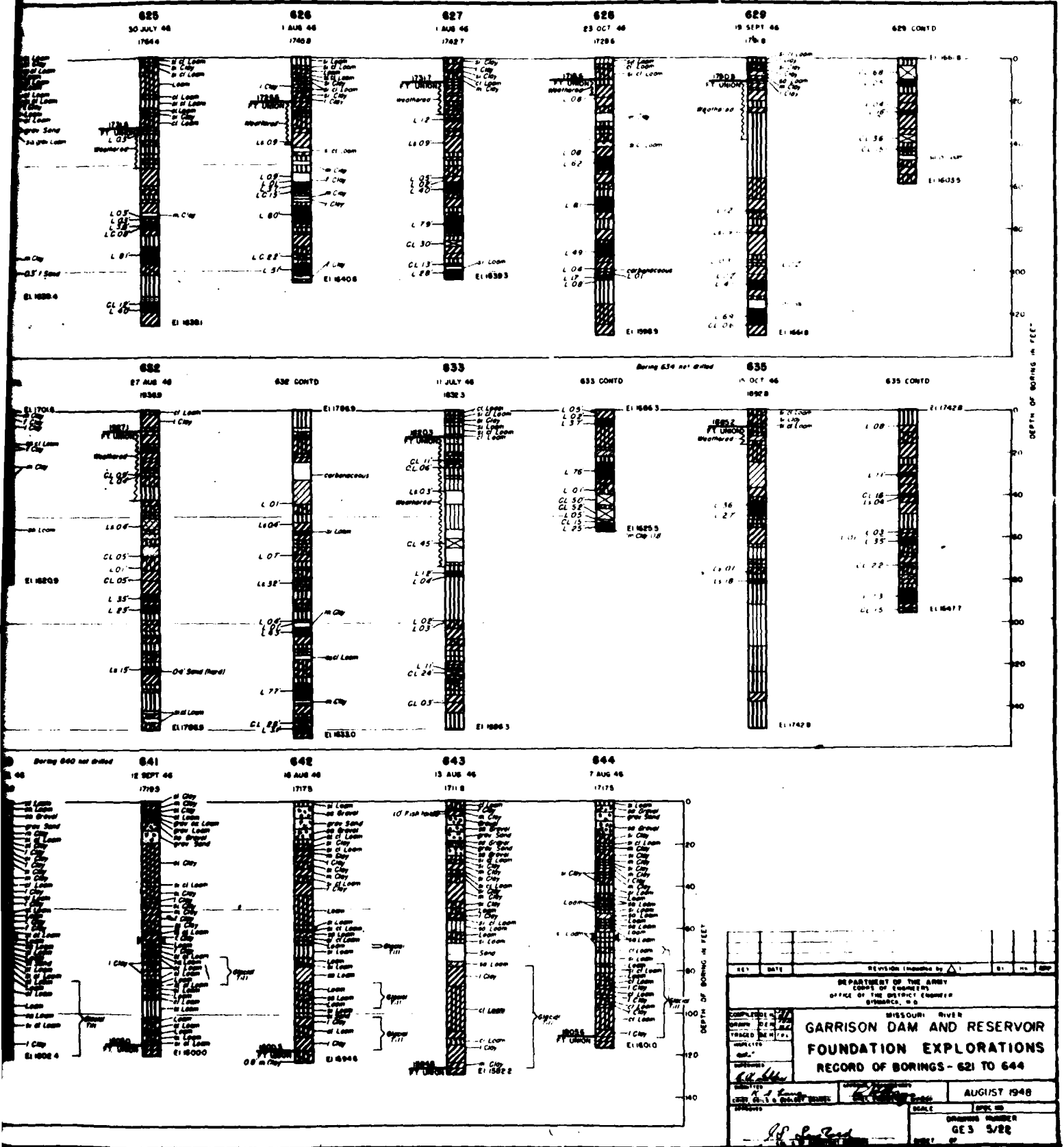
AUGUST 1948

SCALE

DRAWING NUMBER
GE 3 - 5121

2


621
29 JULY 46
622
24 JULY 46
623
3 JULY 46
624
30 JULY 46
625
30 JULY 46
626
1 AUG 46
630
23 JULY 46
630 CONTD
631
25 SEPT 46
631 CONTD
632
27 AUG 46
632 CONTD
636
22 JULY 46
637
1 AUG 46
638
4 SEPT 46
639
15 AUG 46
Boring 640 not drilled
641
12 SEPT 46
642
16 AUG 46
DEPTH OF BORING IN FEET



DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEBR.

MISSOURI RIVER

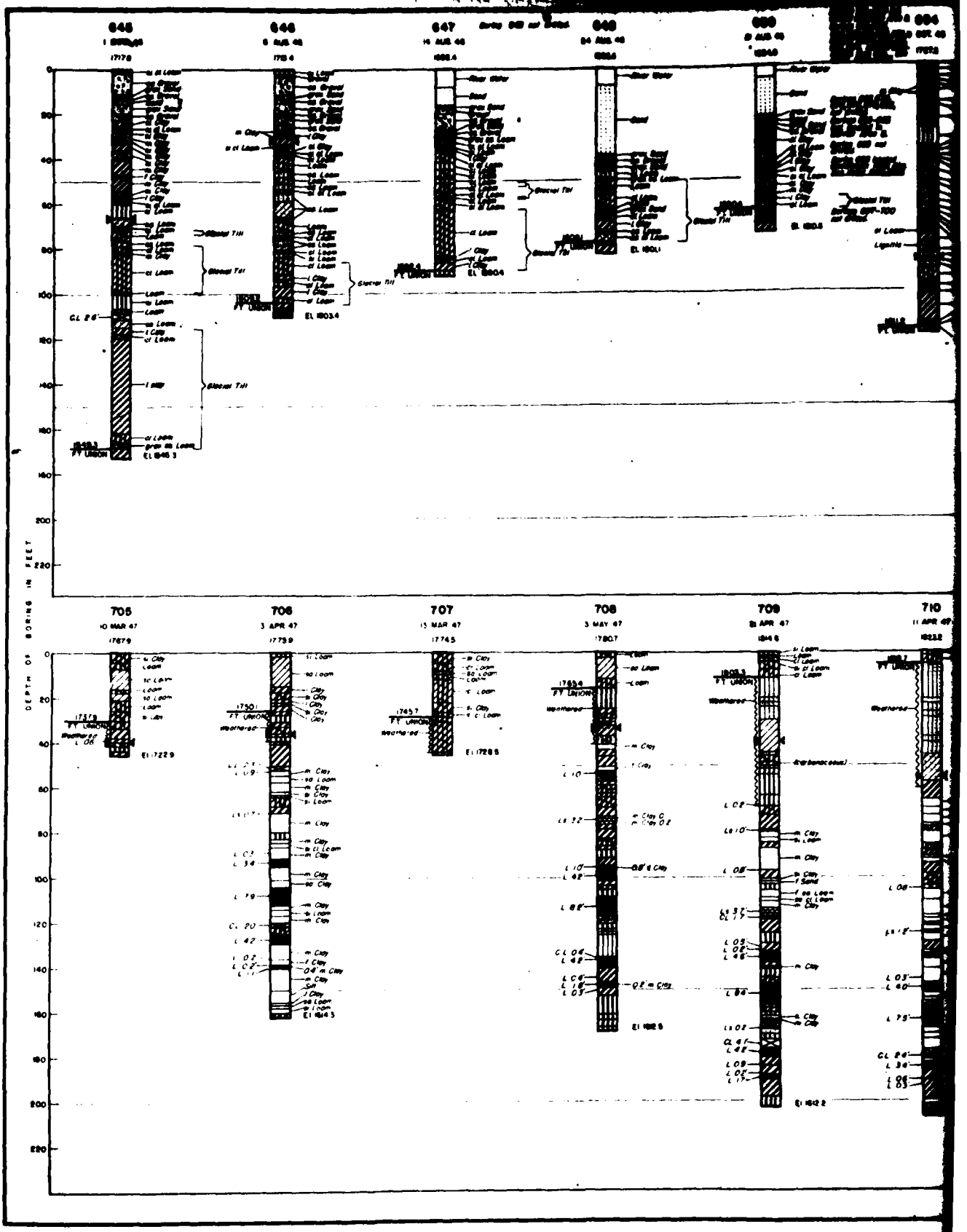
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
RECORD OF BORINGS - 621 TO 644

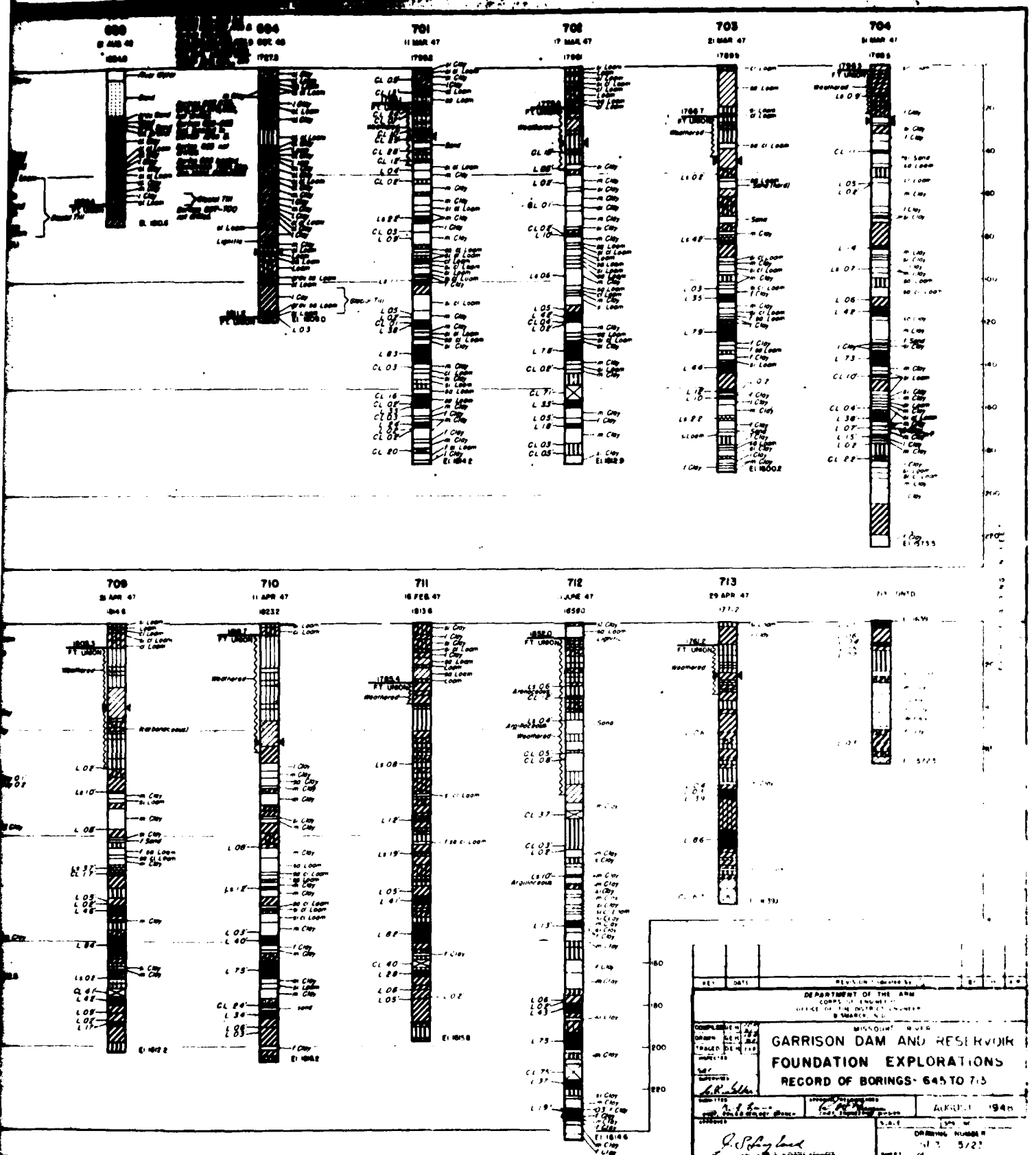
AUGUST 1948

DRAWING NUMBER GE 3 5/22

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 15

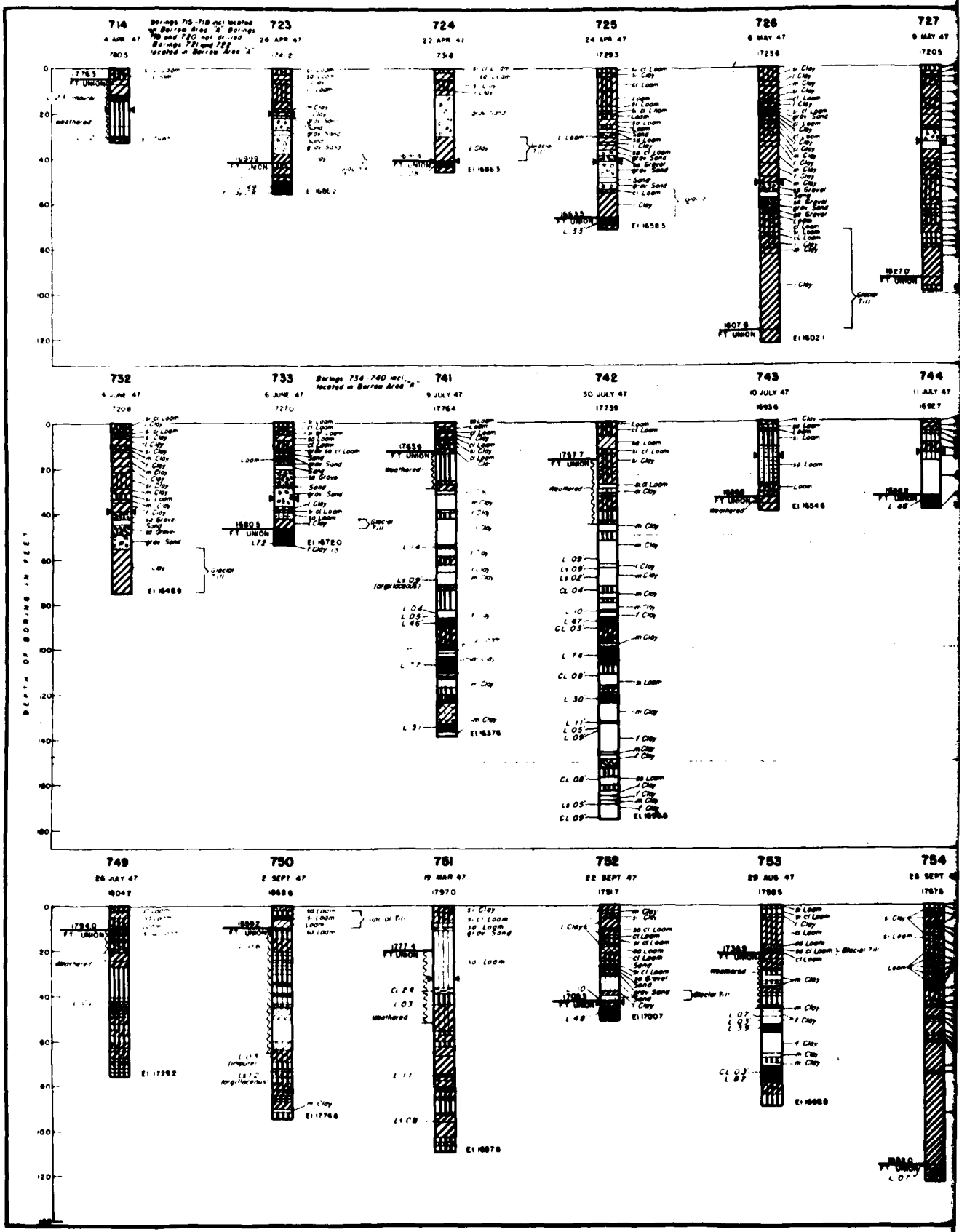
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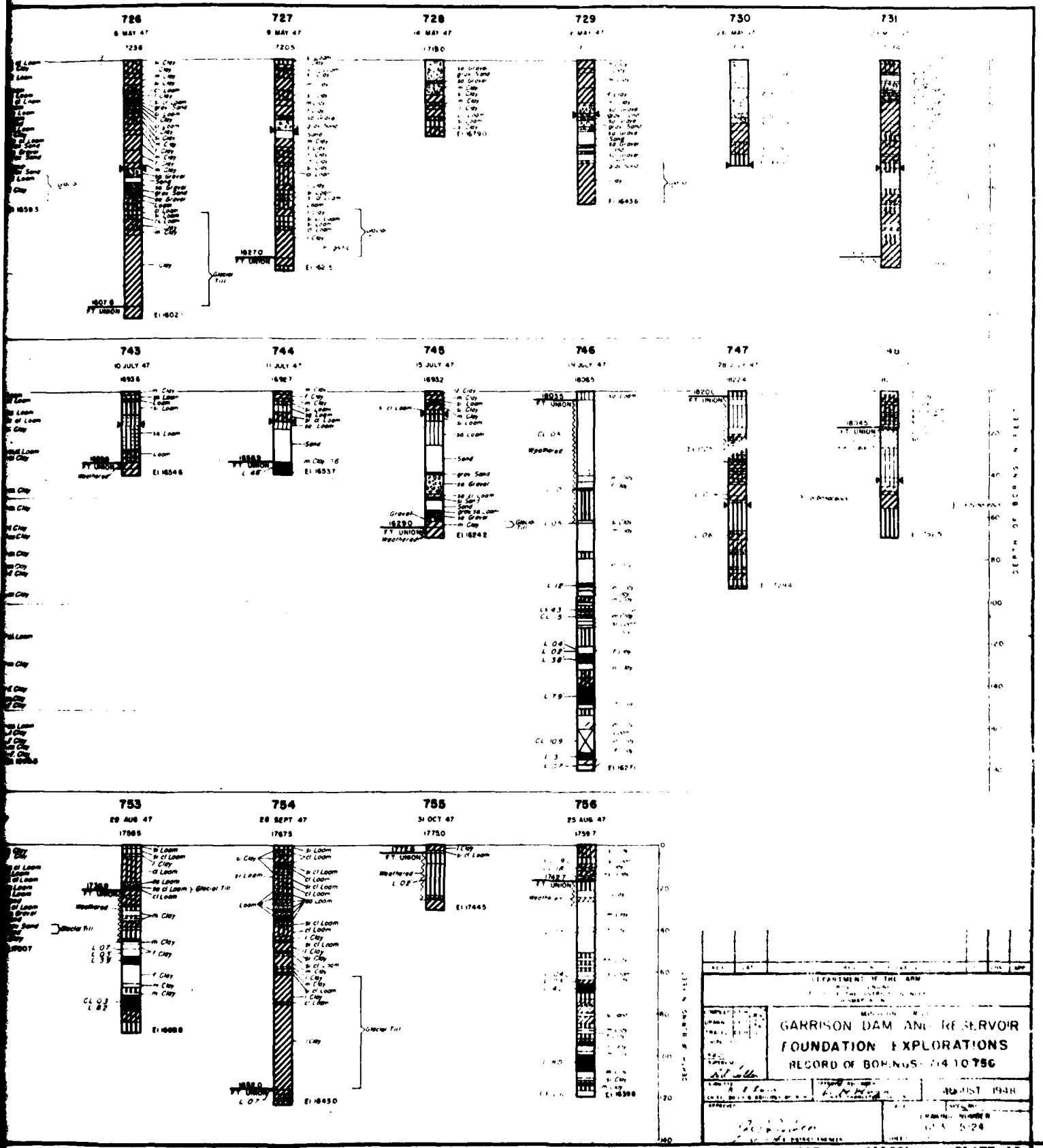

DEPTH OF BORING IN FEET
0
20
40
60
80
100
120
140
160
180
200
220
705
10 MAR 47
706
3 APR 47
707
15 MAR 47
708
3 MAY 47
709
710
Glacial Till
Weathered
Ft Union



CONSTRUCTION FOUNDATION REPORT (1982) PLATE 15

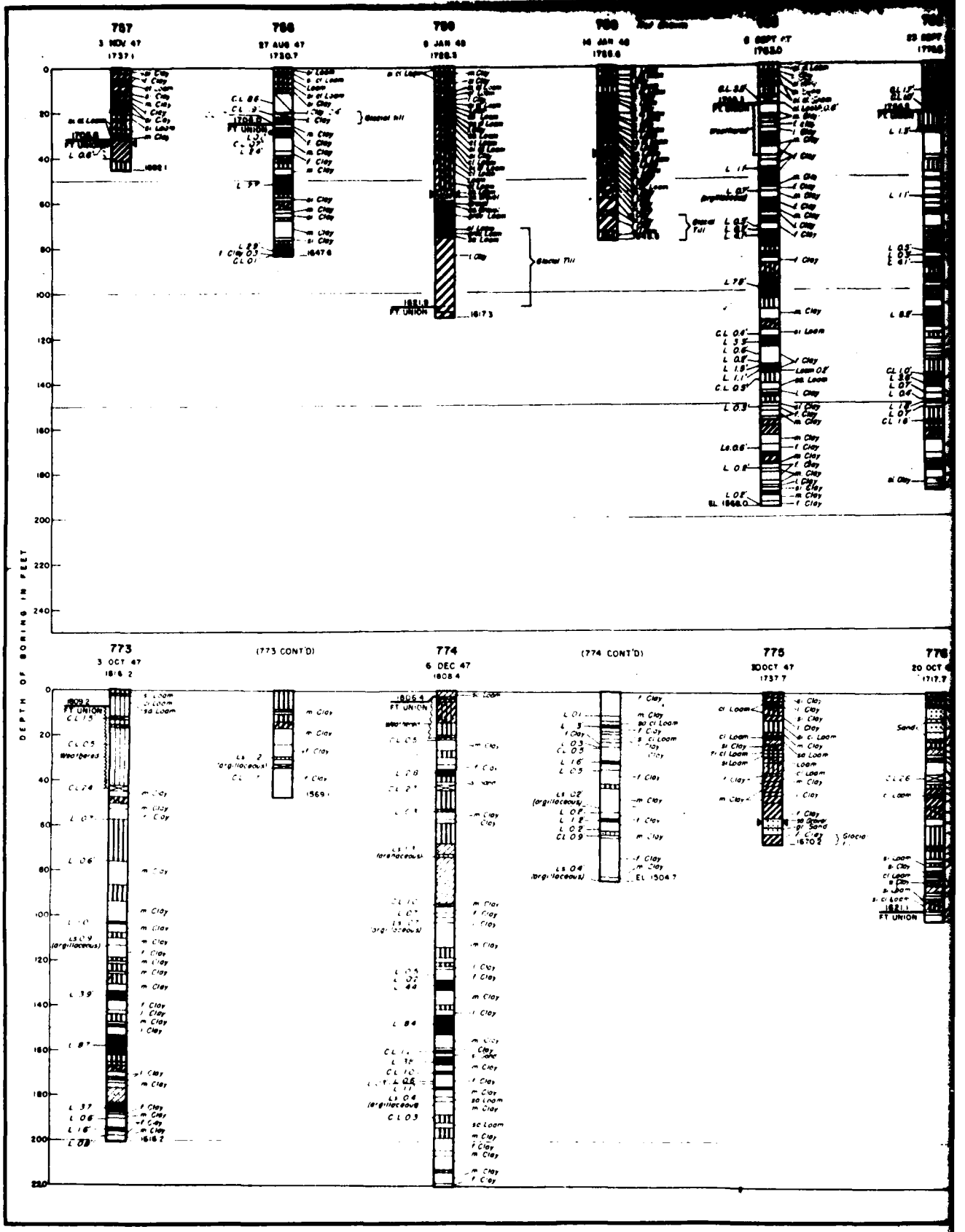
2

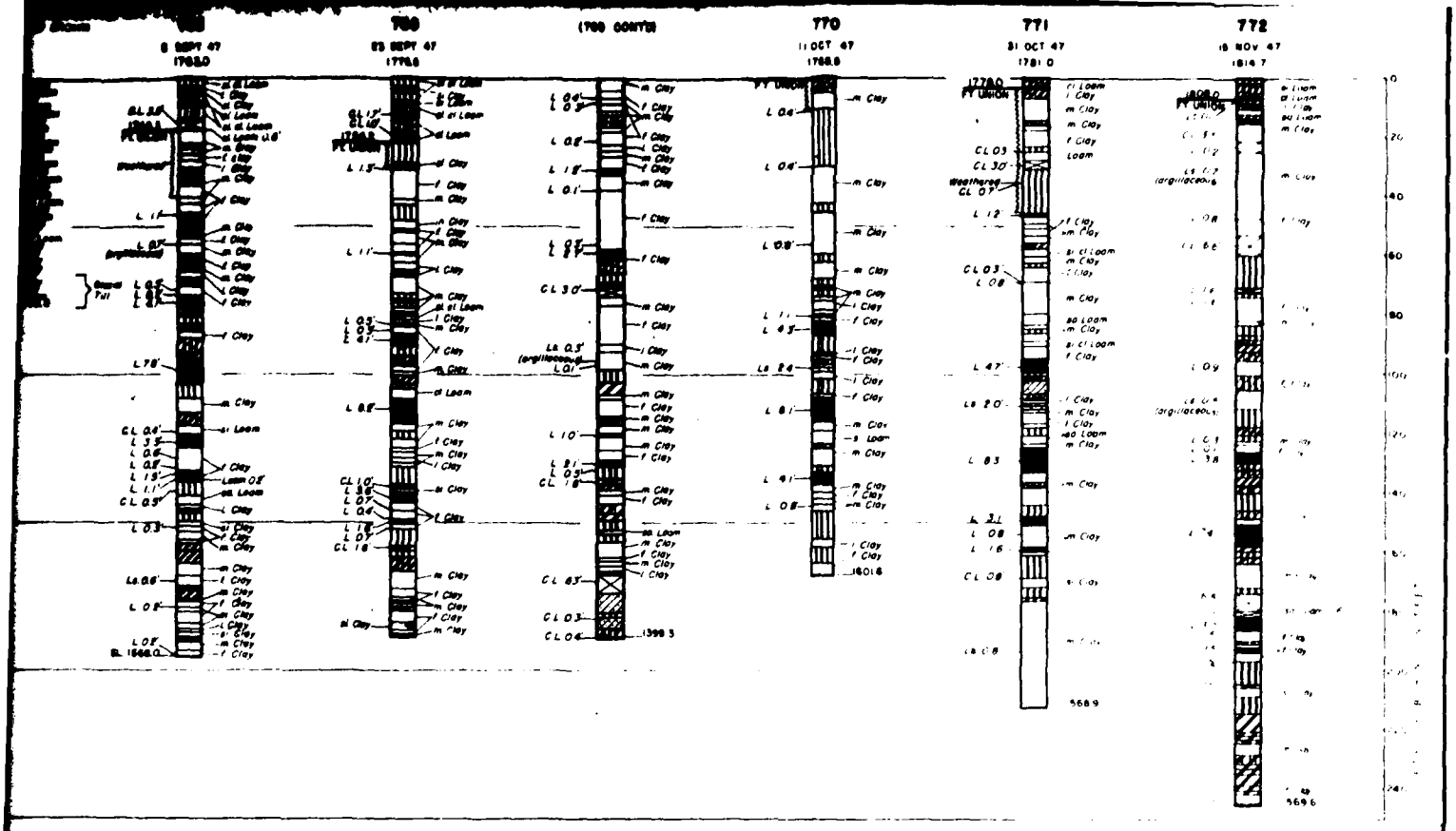

714
723
724
725
726
727
732
733
741
742
743
744
749
750
751
752
753
754
DEPTH OF BORING IN FEET

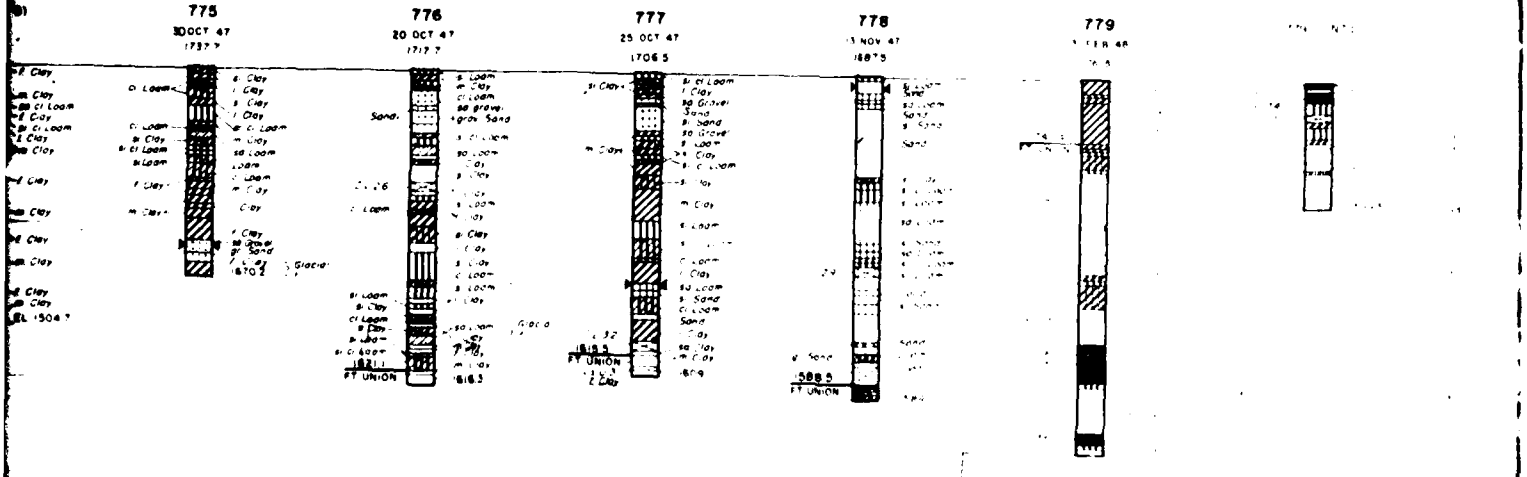


CONSTRUCTION FOUNDATION REPORT (1982) PLATE 17

2

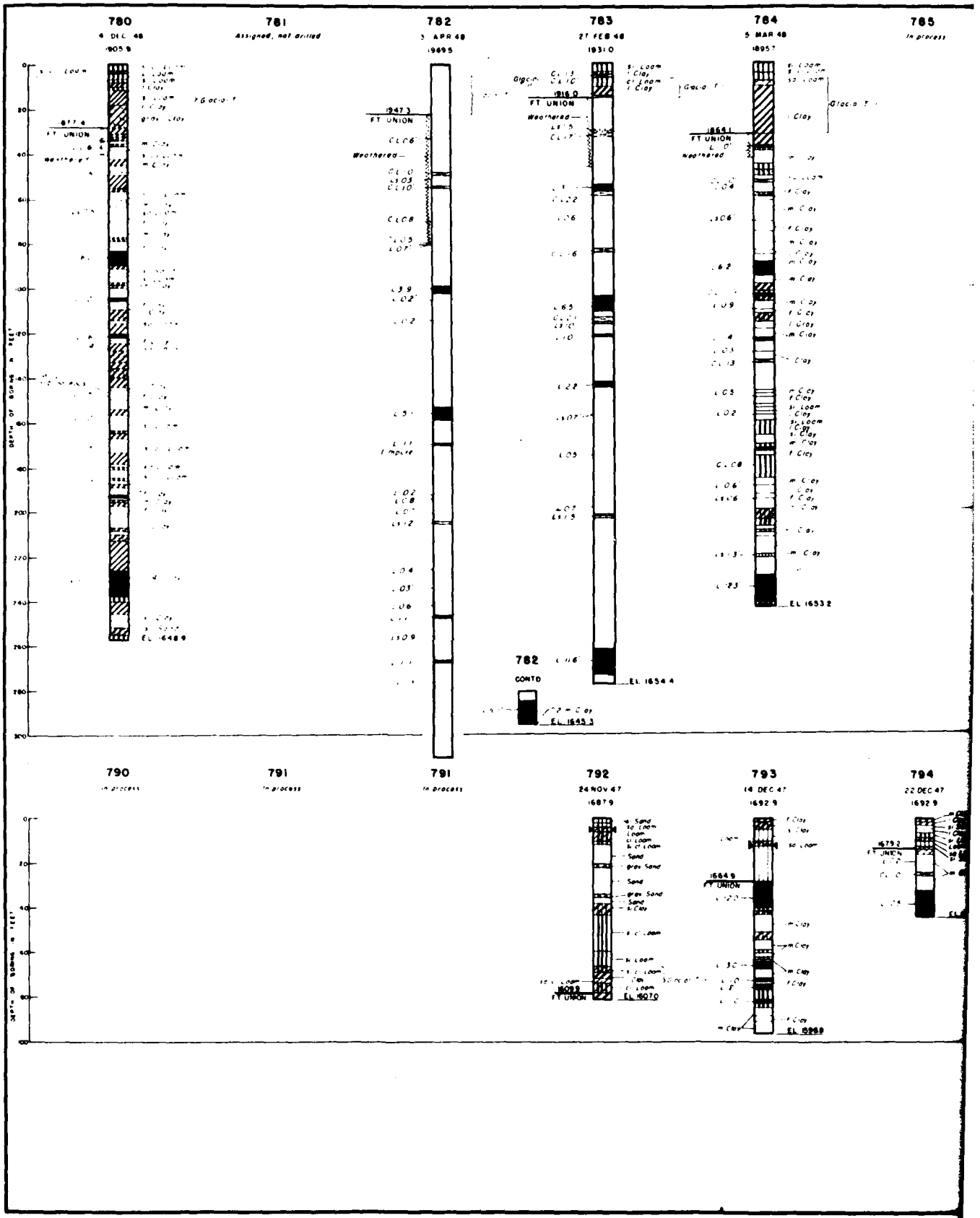

DEPTH OF BORING IN FEET
0
20
40
60
80
100
120
140
160
180
200
220
240
787
3 NOV 47
1737.1
788
27 AUG 47
1730.7
789
9 JAN 48
1788.3
790
16 JAN 48
1788.6
8 SEPT 47
1783.0
773
3 OCT 47
1816.2
(773 CONT'D)
774
6 DEC 47
1808.4
(774 CONT'D)
775
30 OCT 47
1737.7
776
20 OCT 47
1717.7

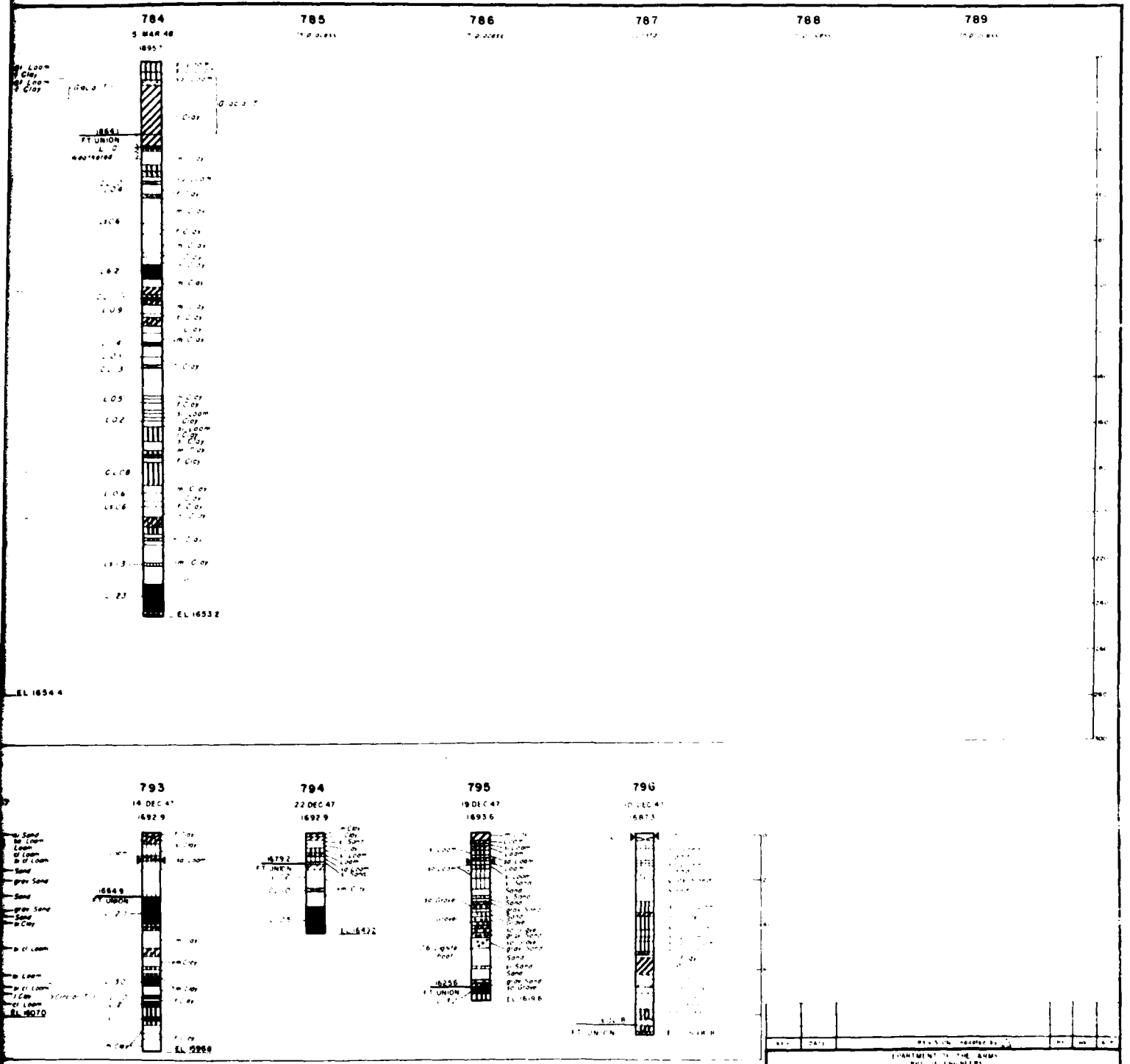




GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
RECORD OF BORINGS 757 TO 779

AUGUST


780
4 DEC 48
1905.9
781
Assigned, not drilled
782
3 APR 48
1969.5
783
27 FEB 48
1931.0
784
5 MAR 48
1895.7
785
In process
DEPTH OF BORING IN FEET
FT. UNION
EL. 1648.9
EL. 1653.2
EL. 1654.4
EL. 1645.3
790
In process
791
In process
791
In process
792
24 NOV 47
1687.9
793
14 DEC 47
1692.9
794
22 DEC 47
1692.9
EL. 1607.0
EL. 1598.9

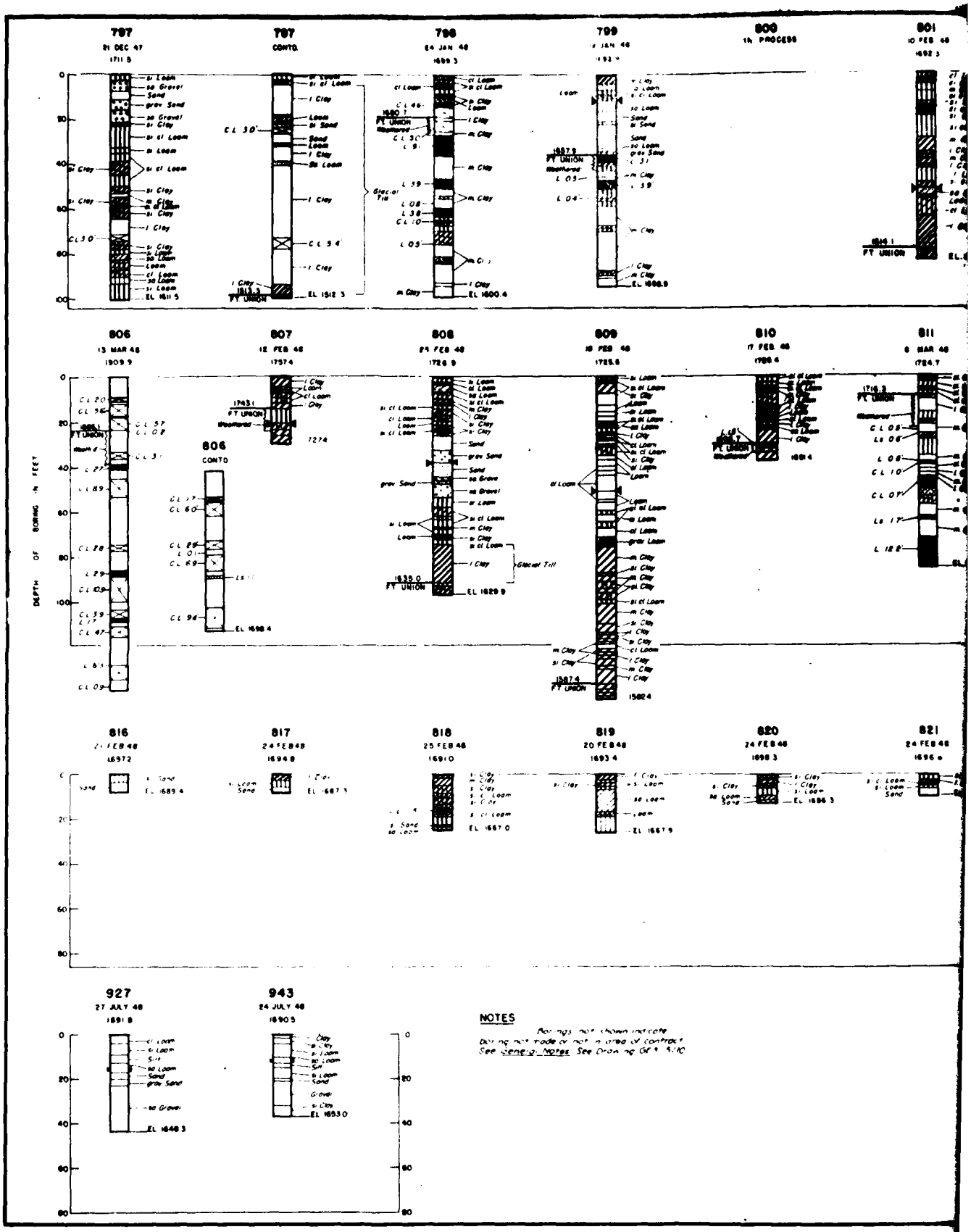


GARRISON DAM AND RESERVOIR

FOUNDATION EXPLORATIONS

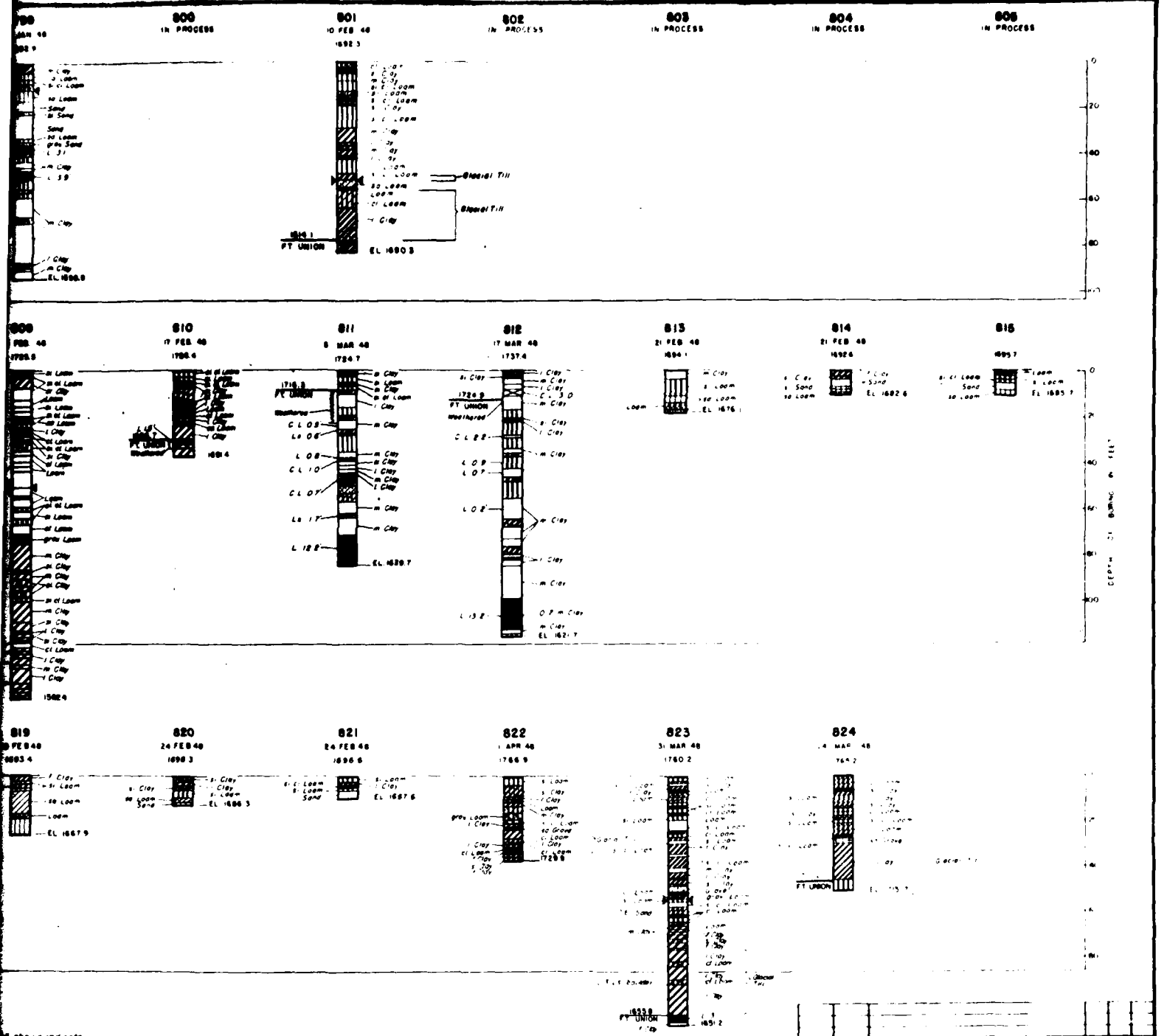
RECORD OF BORINGS 780 TO 796

AUGUST 1948



NOTES

Borings not shown not complete
Boring not made or not a part of contract
See General Notes See Drawing GE 9 5/10



shown indicate
m area of contract
Drawing GE3-5/10

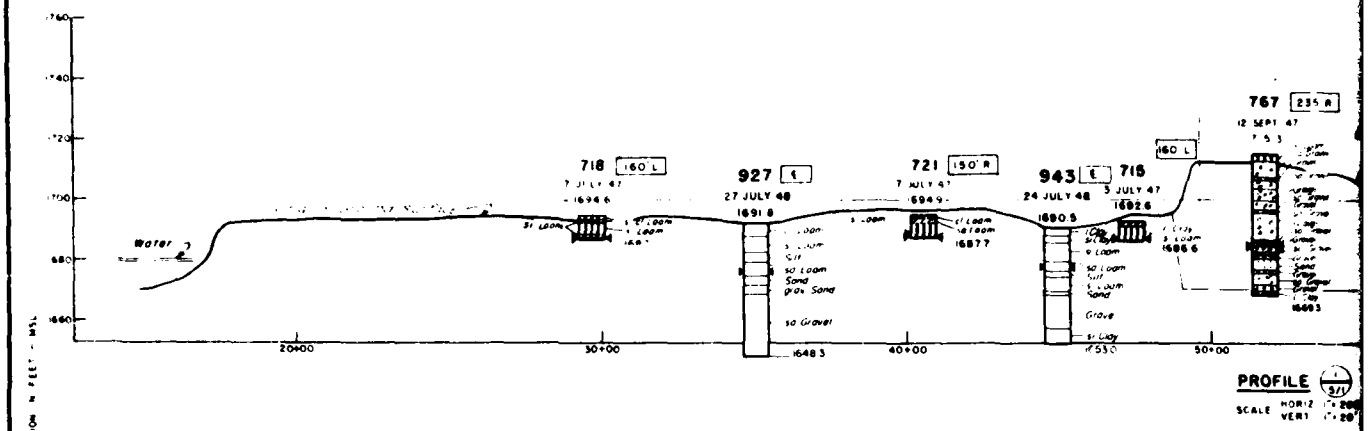
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
BISMARCK, N.D.

MISSOURI RIVER

GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
RECORD OF BORINGS — 797 TO 824 827 AND 943

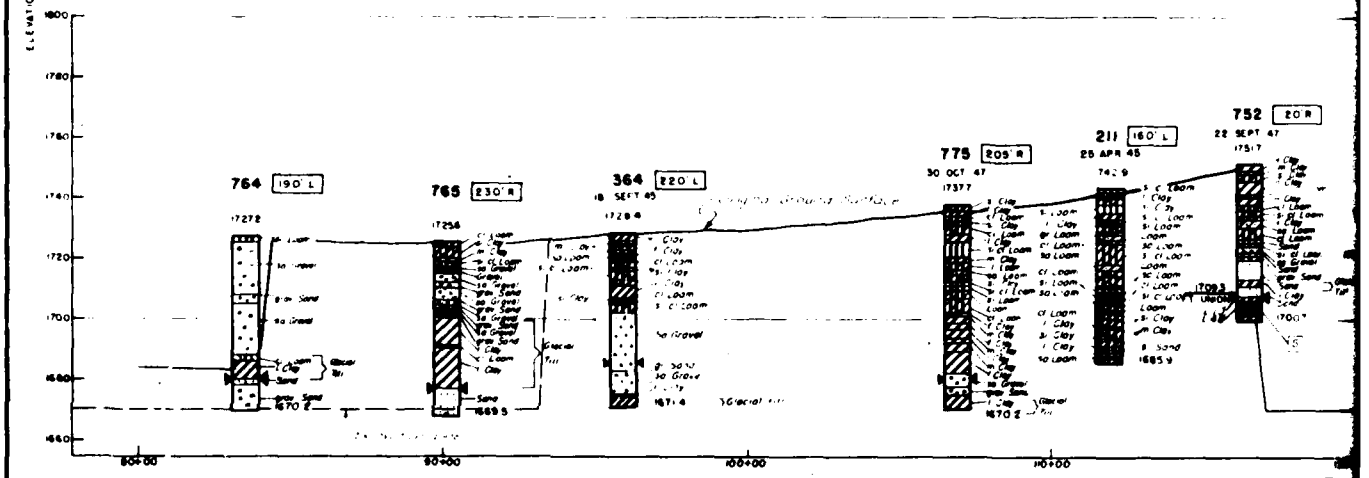
AUGUST 1948

DRAWING NUMBER
GE3 - 5/27



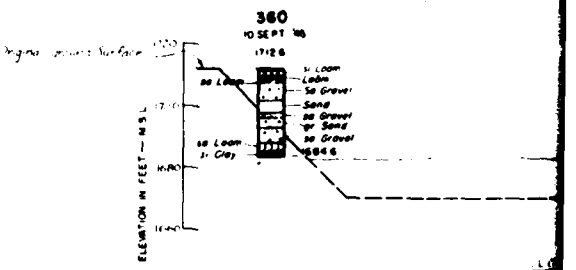
PROFILE

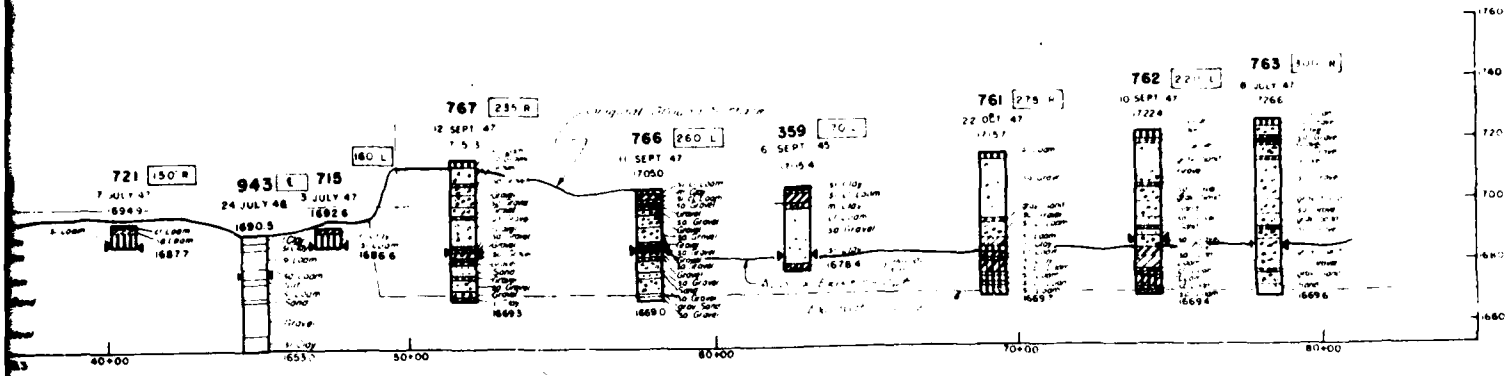
SCALE HORIZ
VERT



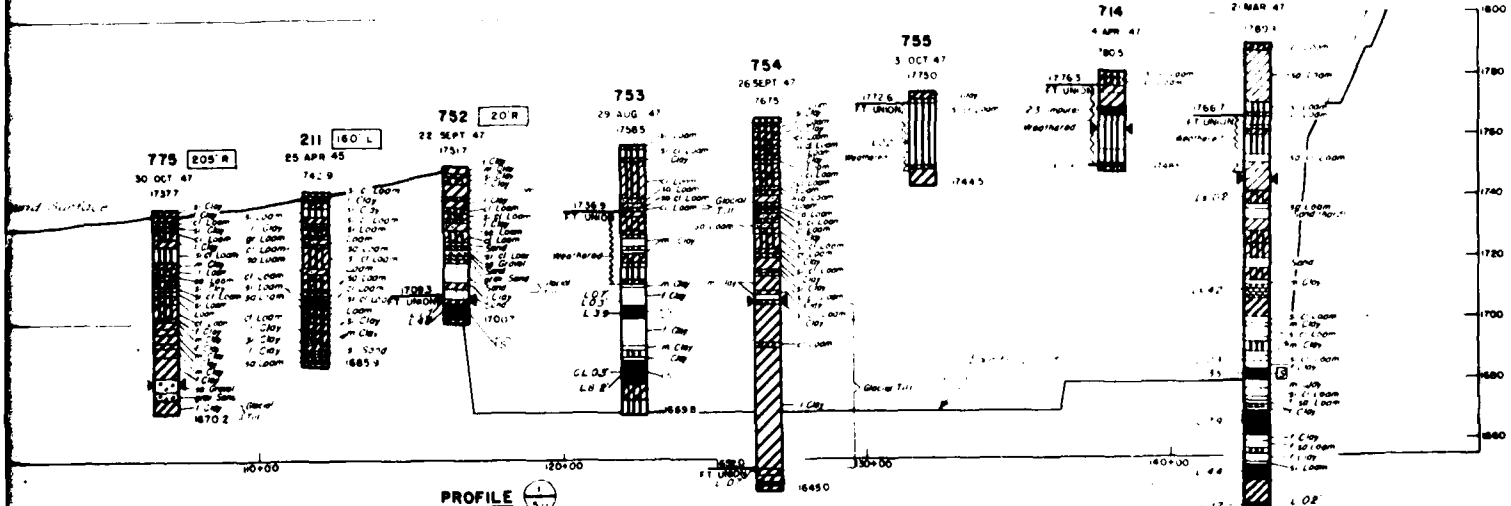
PROFILE

SCALE HORIZ
VERT

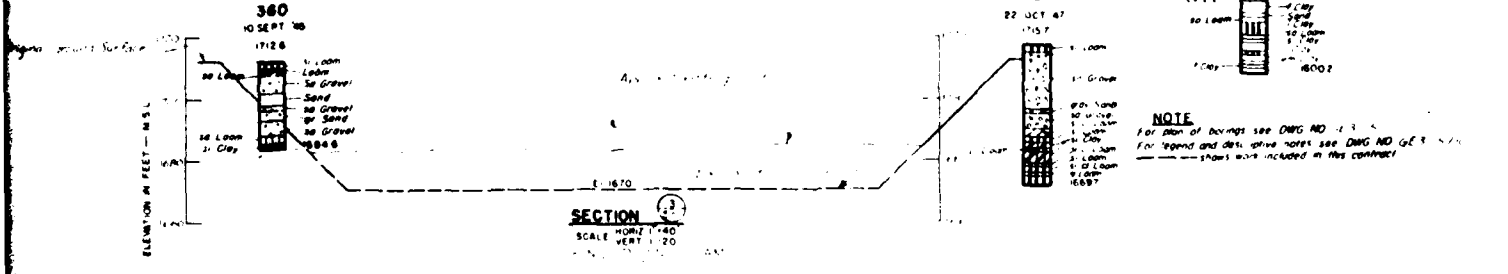




PROFILE (1/5)
SCALE HORIZ 1"=200
VERT 1"=20



PROFILE (1/5)
SCALE HORIZ 1"=200
VERT 1"=20



SECTION (3/5)
SCALE HORIZ 1"=40
VERT 1"=20

NOTE
For plan of borings see DWG NO GE 3-5/1
For legend and data, drive notes see DWG NO GE 3-5/2
—— shows work included in this contract

REV	DATE	REVISION (indicated by △)	BY	CHKD	APP'D

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
BISMARCK, N.D.

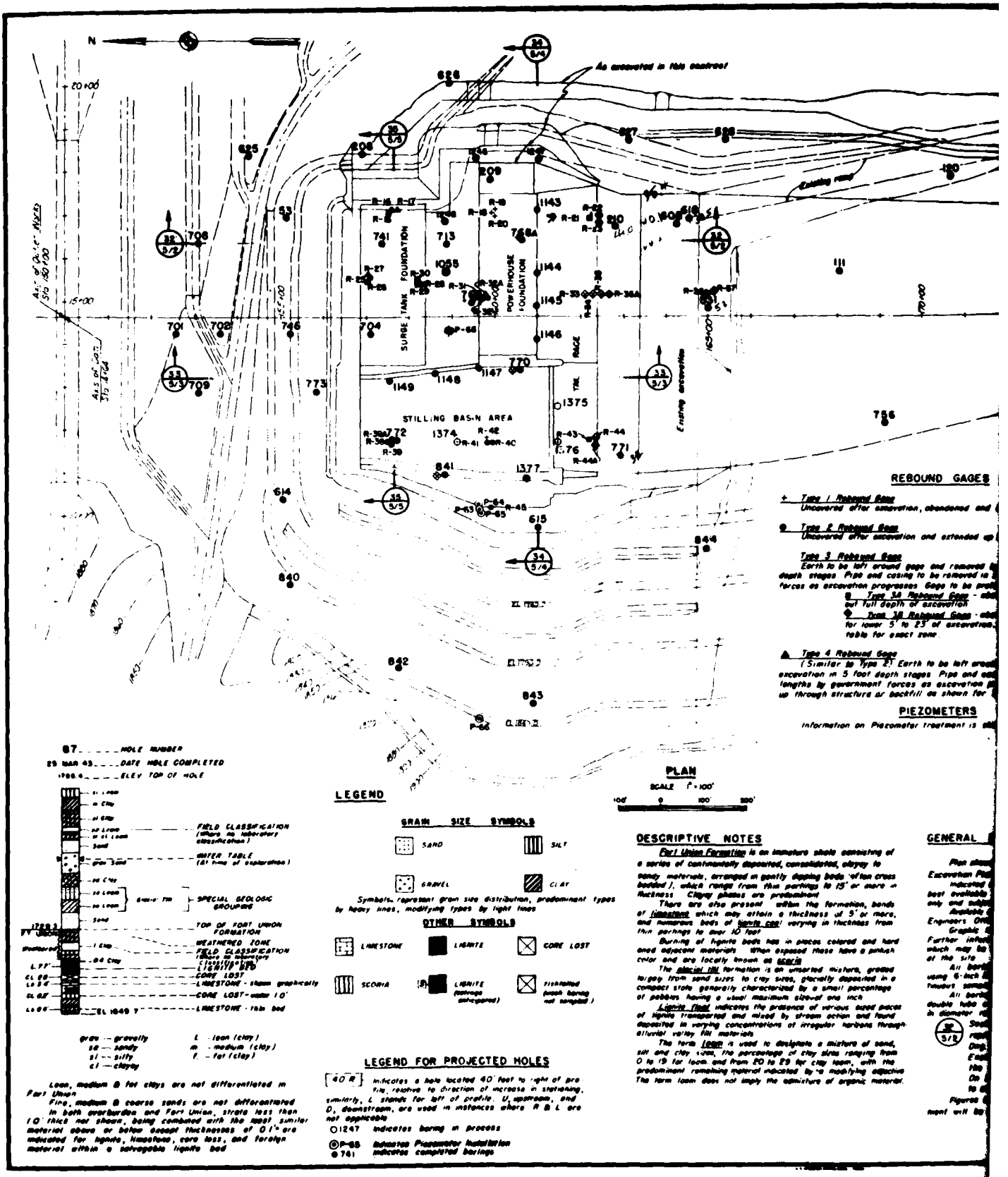
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
INTAKE CHANNEL
PROFILE AND SECTIONS

AUGUST 1948

SCALE AS SHOWN

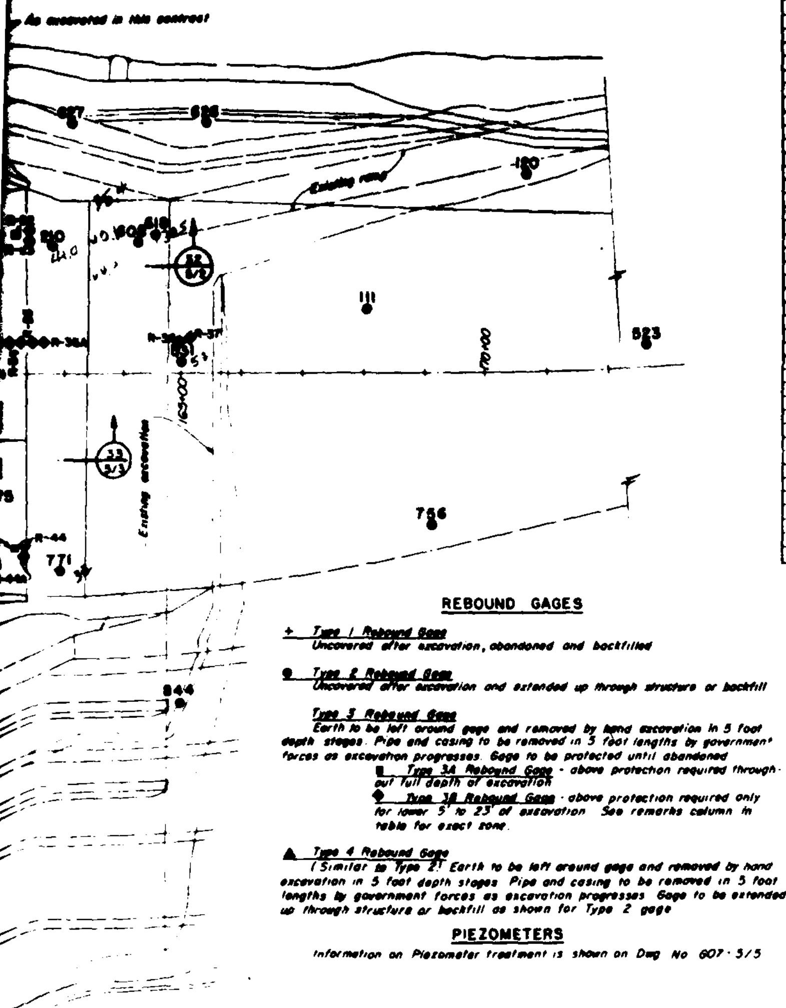
DRAWING NUMBER
GE3-5/2

2


N
20+00
15+00
As excavated in this contract
STILLING BASIN AREA
SURGE TANK FOUNDATION
POWERHOUSE FOUNDATION
RACE
TAIL RACE
Existing road
PLAN
SCALE 1"=100'
REBOUND GAGES
Type 1 Rebound Gage
Uncovered after excavation, abandoned and
Type 2 Rebound Gage
Uncovered after excavation and extended up
Type 3 Rebound Gage
Earth to be left around gage and removed in
depth stages Pipe and casing to be removed in
forces as excavation progresses Gage to be prot
Type 3a Rebound Gage - abo
out full depth of excavation
Type 3B Rebound Gage - abo
for lower 5' to 25' of excavation
table for exact zone
Type 4 Rebound Gage
(Similar to Type 3) Earth to be left around
excavation in 5 foot depth stages Pipe and casi
lengths by government forces as excavation p
up through structure or backfill as shown for
PIEZOMETERS
Information on Piezometer treatment is
87 ---- HOLE NUMBER
25 MAR 43 ---- DATE HOLE COMPLETED
1788.9 ---- ELEV TOP OF HOLE
FIELD CLASSIFICATION (Where no laboratory classification)
WATER TABLE (At time of exploration)
SPECIAL GEOLOGIC GROUPINGS
TOP OF FORT UNION FORMATION
WEATHERED ZONE
FIELD CLASSIFICATION (Fort Union formation)
LIGNITE BED
CORE LOST
LIMESTONE - shown graphically
CORE LOST - water 10'
EL 1649.7 ---- LIMESTONE - thin bed
gra — gravelly
sa — sandy
si — silty
cl — clayey
L — lean (clay)
m — medium (clay)
f — fat (clay)
Lean, medium & fat clays are not differentiated in Fort Union
Fine, medium & coarse sands are not differentiated
In both overburden and Fort Union, strata less than 10' thick not shown, being combined with the most similar material above or below except thicknesses of 0.1' are indicated for lignite, limestone, core loss, and foreign material within a salvageable lignite bed
LEGEND
GRAIN SIZE SYMBOLS
SAND
SILT
GRAVEL
CLAY
Symbols represent grain size distribution, predominant types by heavy lines, modifying types by light lines
OTHER SYMBOLS
LIMESTONE
LIGNITE
CORE LOST
SCORIA
LIGNITE (Ratings anticipated)
FISHTAILED (Hole boring not completed)
LEGEND FOR PROJECTED HOLES
40 R indicates a hole located 40' feet to right of pro line, relative to direction of increase in stationing, similarly, L stands for left of profile. U, upstream, and D, downstream, are used in instances where R & L are not applicable
O1247 indicates boring in process
P-65 Indicates Piezometer installation
741 indicates completed borings
DESCRIPTIVE NOTES
Fort Union Formation is an immature strata consisting of a series of continentally deposited, consolidated, clayey to sandy materials, arranged in gently dipping beds (often cross bedded), which range from thin partings to 15' or more in thickness. Clayey phases are predominant
There are also present within the formation, beds of limestone which may attain a thickness of 5' or more, and numerous beds of lignite coal varying in thickness from thin partings to over 10 feet
Burning of lignite beds has in places colored and hard ened adjacent materials. When exposed these have a pinkish color and are locally known as scoria
The glacial till formation is an unsorted mixture, graded to gap from sand sizes to clay sizes, glacially deposited in a compact state generally characterized by a small percentage of pebbles having a usual maximum size of one inch
Lignite float indicates the presence of various sized pieces of lignite transported and mixed by stream action and found deposited in varying concentrations of irregular horizons through alluvial valley fill materials
The term Lean is used to designate a mixture of sand, silt and clay sizes, the percentage of clay sizes ranging from 0 to 19 for loam, and from 20 to 29 for clay loam, with the predominant remaining material indicated by the modifying adjective The term loam does not imply the admixture of organic material.
GENERAL

Rebound Gage Treatment									
Gage No.	Type of Treatment	Meas. Pipe Dia. (In.)	Approximate Location: Station	Offset	Elev. of Plate	[illegible]	Approx. El. of [illegible]	[illegible]	Remarks
R-6	3A	1½	157 + 80	305' Lt	1605	Every 5'	1641		
R-8	2	1½	157 + [illegible]	290' Lt	1566	Every 5'	1641	1703	
R-11	2	1½	157 + [illegible]	250' Lt	1518	Every 5'	1681	1709	
R-28	1	2	159 + [illegible]	349' Lt	1560	1606	1612		
R-29	1	2	159 + [illegible]	250' Lt	1568	1606	1612		
R-30	1	2	159 + 98	240' Lt	1519	1606	1612		
R-31	3A	1	162 + 80	290' Lt	1601	Every 5'	1643		Protect only when excavation is between El. 1655 & 1646±
R-32	3B	3	162 + [illegible]	295' Lt	1569	1640	1645		
R-33	3B	3	162 + [illegible]	285' Lt	1519	1650	1645		
R-33A	1	Unknown	160 + 60	107' Lt	1604	1609	1612		
R-15	3A	1	157 + 06	91' Lt	1606	Every 5'	1641		
R-16	3A	1	156 + 98	86' Lt	1565	Every 5'	1641		
R-17	4A	1	156 + 97	95' Lt	1515	Every 5'	1641	1703	
R-18	3A	1	158 + 30	76' Lt	1606	Every 5'	1641		
R-19	3A	1	158 + 20	76' Lt	1563	Every 5'	1641		
R-20	3A	1	158 + 20	66' Lt	1516	Every 5'	1641		
769	1	Unknown	159 + 67	35' Lt	1609	1614	1619		
R-31	2	2	159 + 58	48' Lt	1563	1605	1617	1655	
R-32	2	2	159 + 67	48' Lt	1515	1604	1606	1655	
R-32A	2	2	159 + 02	43' Lt	1464	1604	1606	1655	
R-33	3B	2	162 + 80	55' Lt	1605	1650	1645		Protect only when excavation is below El. 1655±
R-34	3B	2	162 + 29	67' Lt	1565	1649	1645		
R-35	3B	2	162 + 39	57' Lt	1515	1650	1650		
R-35A	3B	2	162 + 50	57' Lt	1466	1650	1650		Protect only when excavation is between El. 1659 & 1650±
R-36	3B	1½	164 + 93	51' Lt	1605	1654	1650		
R-37	3B	1½	165 + 02	52' Lt	1514	1654	1650		
770	3B	Unknown	160 + 70	118' Rt	1606	1610	1594		
R-38	2	2	157 + 48	290' Rt	1565	1645	1650	1702	Protect only when excavation is between El. 1651 & 1606 then abandon
R-39	2	2	157 + 57	295' Rt	1516	1645	1650	1700	
R-39A	2	2	157 + 57	285' Rt	1605	1645	1650	1700	
R-40	2	3	159 + 89	291' Rt	1597	1602	1603	167[illegible]	
R-41	2	3	159 + 79	290' Rt	1565	1601	1603	1671	Protect only when excavation is between El. 1644 & 1641
R-42	1	3	159 + 79	280' Rt	1516	1601	1603		
R-43	3A	1	161 + 90	310' Rt	1603	Every 5'	1637		
R-44	3B	2	161 + 96	307' Rt	1515	1659	1641		
R-44A	3B	2	161 + 96	317' Rt	1464	1659	1641		Protect only when excavation is between El. 1636 & 1631± then abandon
641	3B	Unknown	158 + 86	561' Rt	1626	1631	1628		
R-45	2	1½	159 + 90	445' Rt	1565	1660	1665	1685	

Approx. elevations shown at time of setting. Gages apt to be encountered 1' to 2' higher, due to subsequent rebound



PLAN

SCALE 1" = 100'

100' 0 100' 200'

REBOUND GAGES

+ *Type 1 Rebound Gage*
Uncovered after excavation, abandoned and backfilled

● *Type 2 Rebound Gage*
Uncovered after excavation and extended up through structure or backfill

Type 3 Rebound Gage
Earth to be left around gage and removed by hand excavation in 5 foot depth stages. Pipe and casing to be removed in 5 foot lengths by government forces as excavation progresses. Gage to be protected until abandoned

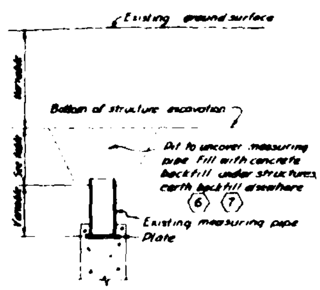
■ *Type 3A Rebound Gage* - above protection required throughout full depth of excavation

◆ *Type 3B Rebound Gage* - above protection required only for lower 5' to 23' of excavation. See remarks column in table for exact zone.

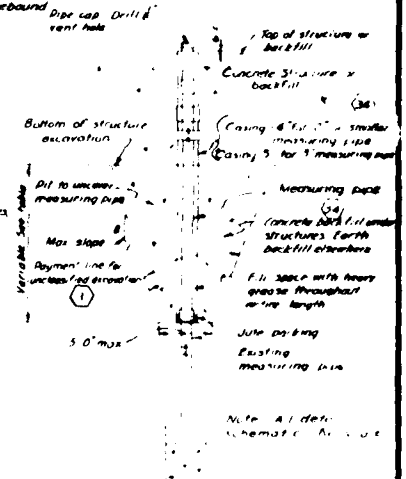
▲ *Type 4 Rebound Gage*
(Similar to Type 2) Earth to be left around gage and removed by hand excavation in 5 foot depth stages. Pipe and casing to be removed in 5 foot lengths by government forces as excavation progresses. Gage to be extended up through structure or backfill as shown for Type 2 gage

PIEZOMETERS

Information on Piezometer treatment is shown on Dwg. No. 607-5/5



TYPE 1 REBOUND GAGE



TYPE 2 REBOUND GAGE

DESCRIPTIVE NOTES

Fort Union Formation is an immature shale consisting of a series of continentally deposited, consolidated, clayey to sandy materials, arranged in gently dipping beds (often cross bedded), which range from thin partings to 15' or more in thickness. Clayey phases are predominant.

There are also present within the formation, bands of limestone which may attain a thickness of 5' or more, and numerous beds of lignite coal varying in thickness from thin partings to over 10 feet.

Burning of lignite beds has in places colored and hardened adjacent materials. When exposed these have a pinkish color and are locally known as scoria.

The glacial till formation is an unsorted mixture, graded largely from sand sizes to clay sizes, glacially deposited in a compact state generally characterized by a small percentage of pebbles having a usual maximum size of one inch.

Lignite float indicates the presence of various sized pieces of lignite transported and mixed by stream action and found deposited in varying concentrations of irregular horizons through alluvial valley fill materials.

The term loam is used to designate a mixture of sand, silt and clay sizes, the percentage of clay sizes ranging from 0 to 19 for loam and from 20 to 29 for clay loam, with the predominant remaining material indicated by a modifying adjective. The term loam does not imply the admixture of organic material.

GENERAL NOTES

Plan shows generalized excavation lines, for details see Excavation Plan Dwg. No. 607-6/1

Indicated water table elevations, although derived from best available data, should be regarded as approximate only and subject to considerable variations.

Available samples may be inspected at the Corps of Engineers Office at the damsite.

Graphic logs give boring information in condensed form. Further information is shown on the complete boring logs which may be inspected at the Corps of Engineers Office at the site.

All borings in overburden made by churn type rig using 6-inch inside diameter open end drive tube. Continuous samples recovered.

All borings in Fort Union made by rotary type rig using double tube core barrel. Continuous core 5⅜-inches in diameter recovered.

(32/5/2) Section designation with cross reference. Numerator represents section designation, denominator represents Dwg. No. of drawing on which section is taken or shown. Example: Section 32 is taken on Dwg. No. 607-5/1 and the section is actually shown on Dwg. No. 607-5/2. On Dwg. No. 607-5/2 the section reference is 32-5/1 to show that the section is shown on Dwg. No. 607-5/1.

Figures in hexagons indicate item numbers under which payment will be made.

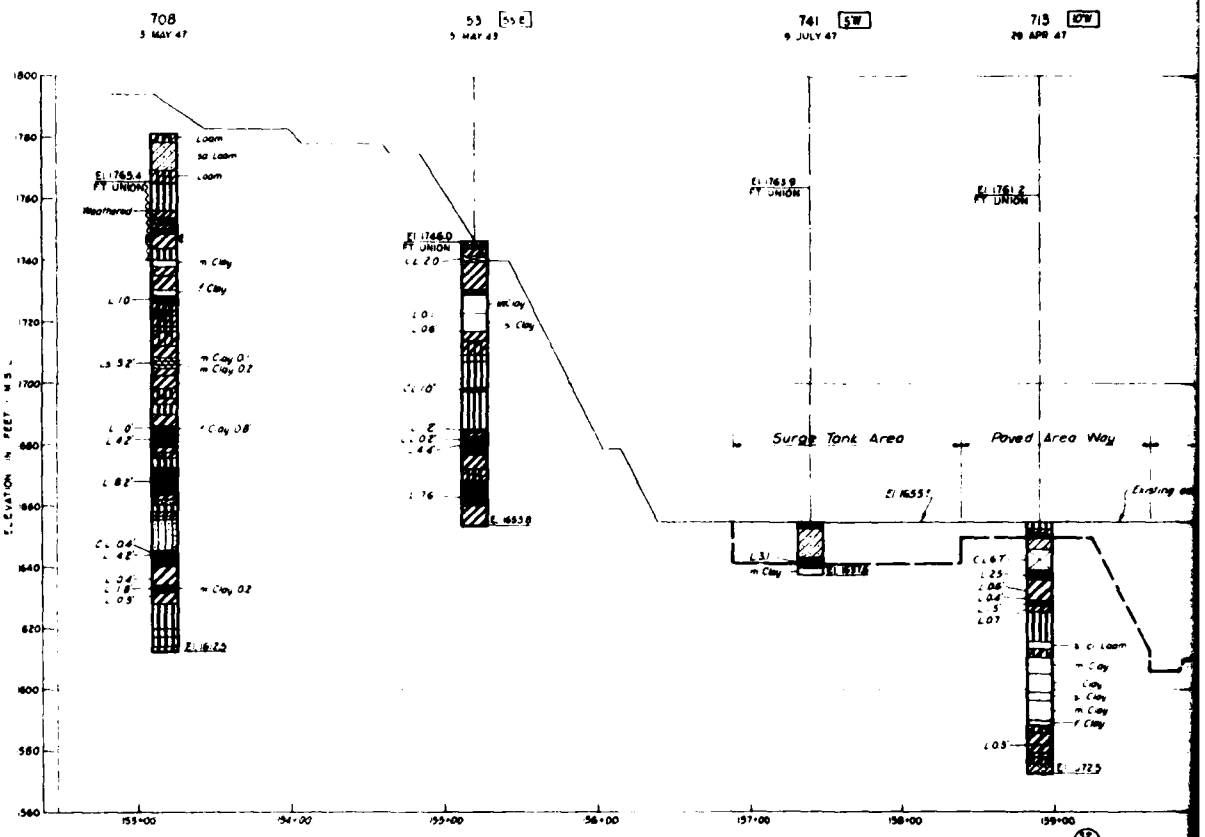
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
STILLING BASIN AND [illegible]
FOUNDATION EXPLORATION
LOCATION OF BORINGS & REBOUND [illegible]

[illegible] 1949

607-5/1

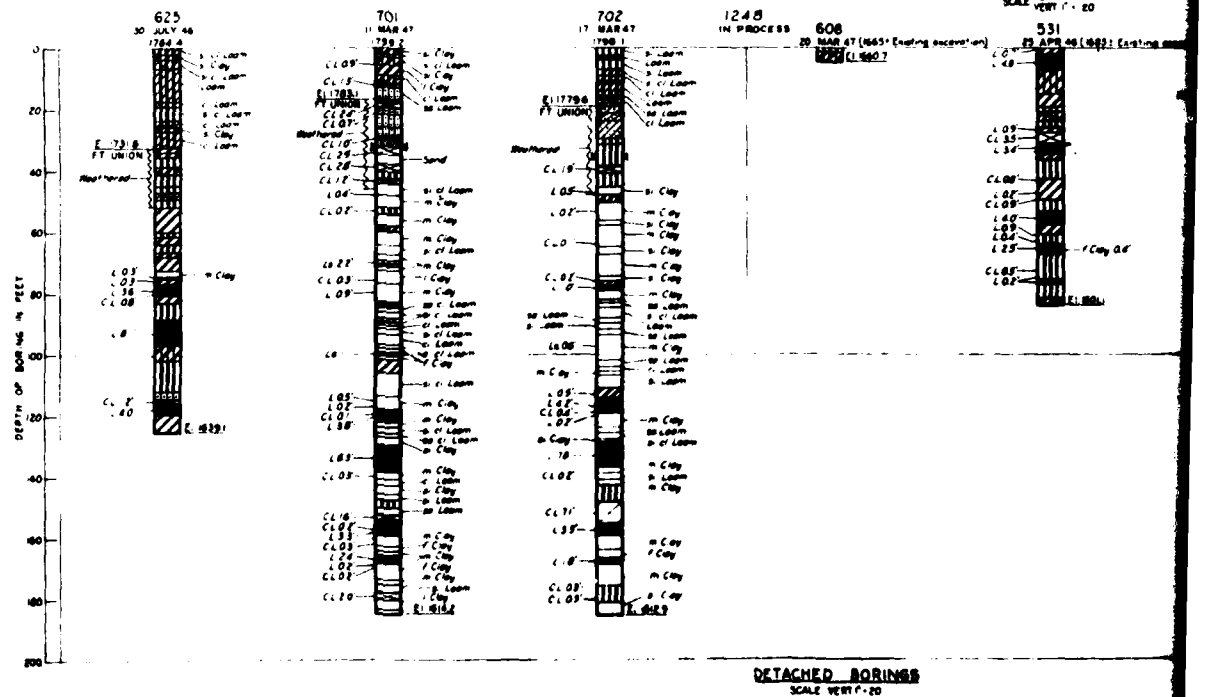
2



PROFILE

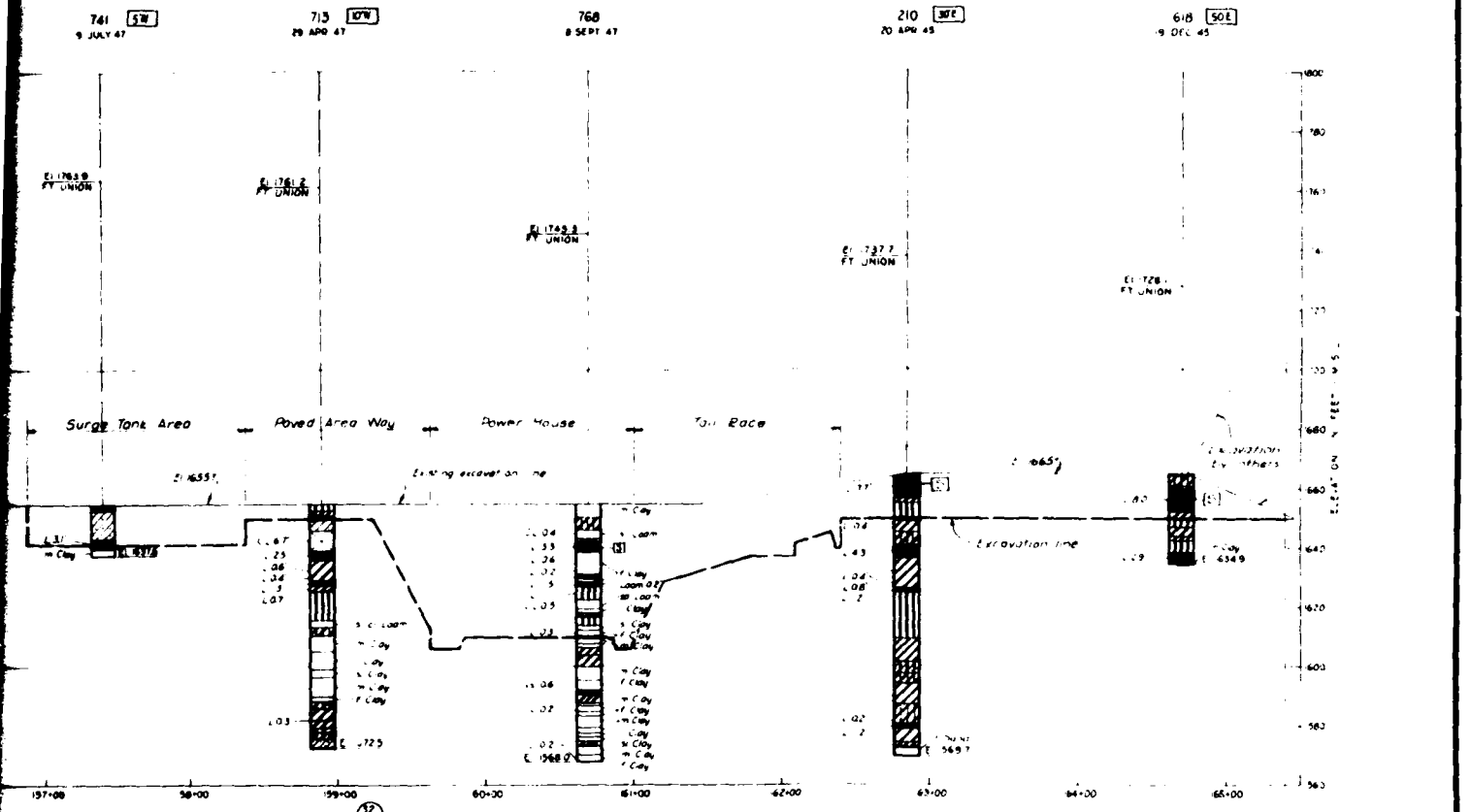
STATIONING ALONG ℄ OUTLET WORKS

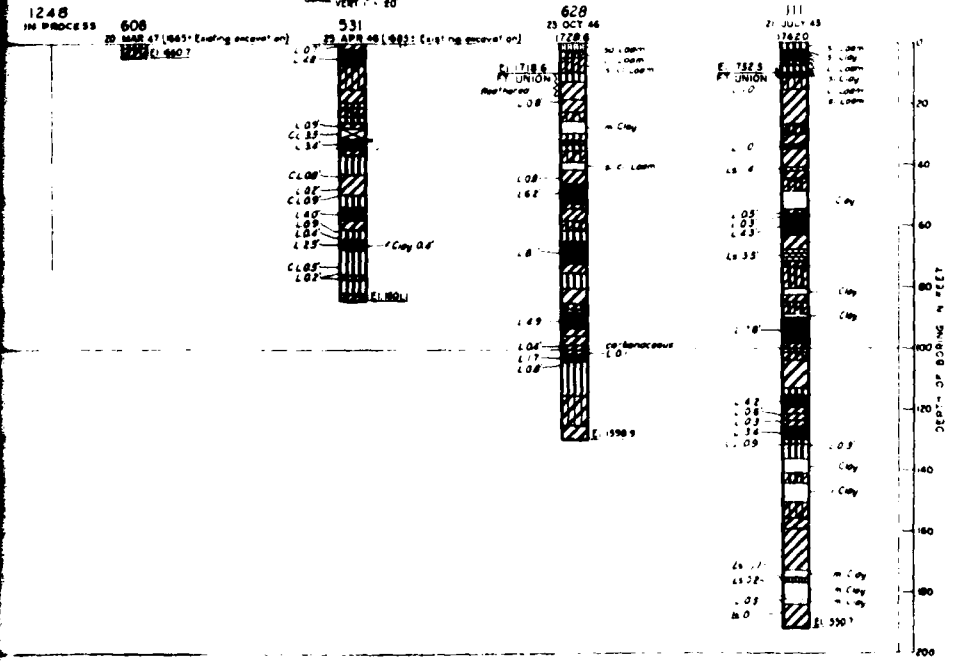
SCALE HOR 1" = 40'
VERT 1" = 20



DETACHED BORINGS

SCALE VERT 1" = 20





DETACHED BORINGS
SCALE VERT 1" = 20

NOTES

For location of bo ngs, legend and rem arks see Dwg No GOT 5/1

Borings dated in parenthesis prior to the start encountered below existing excavation

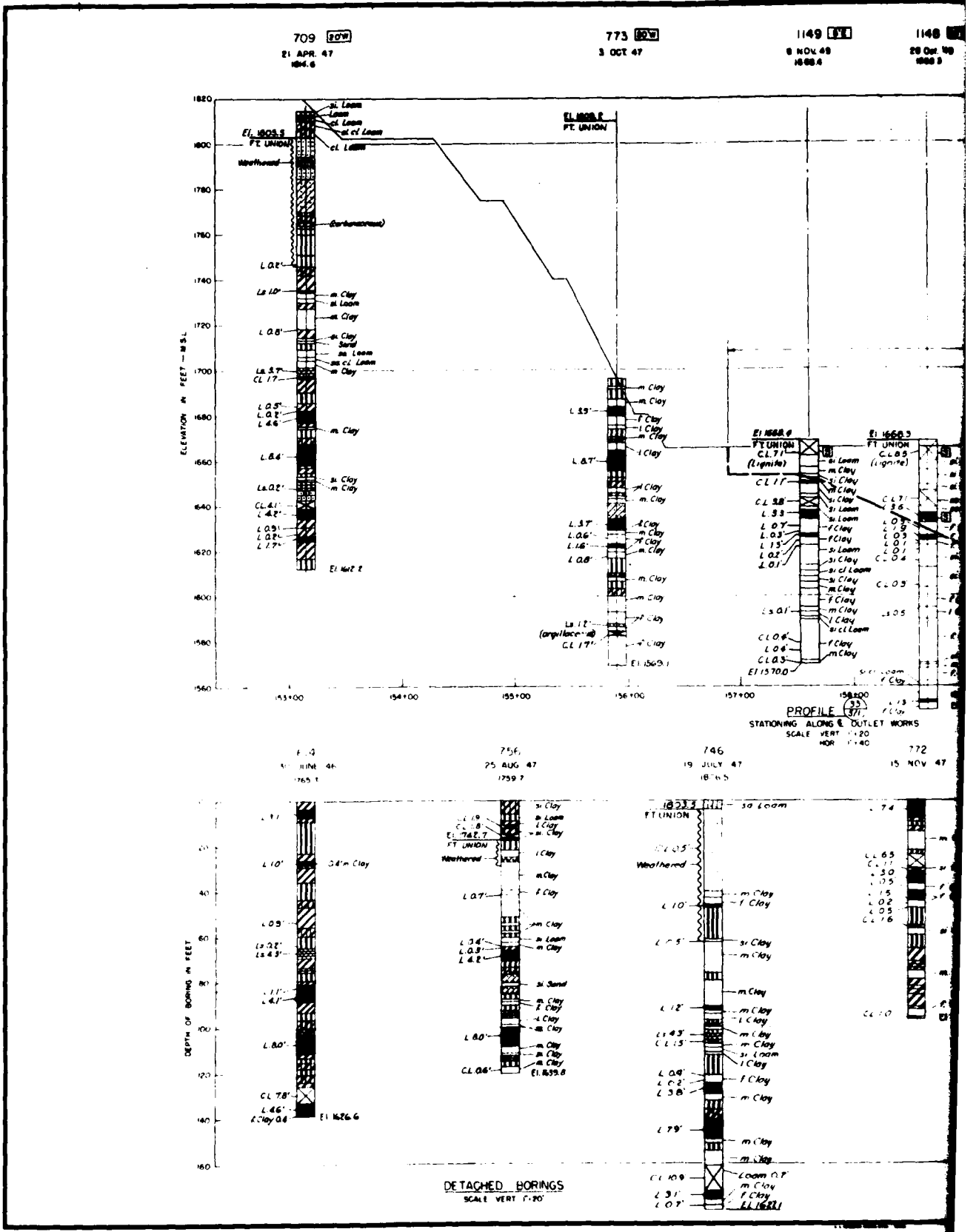
For method of locating borings, and explanation of cross reference system, see Dwg No GOT 5/1

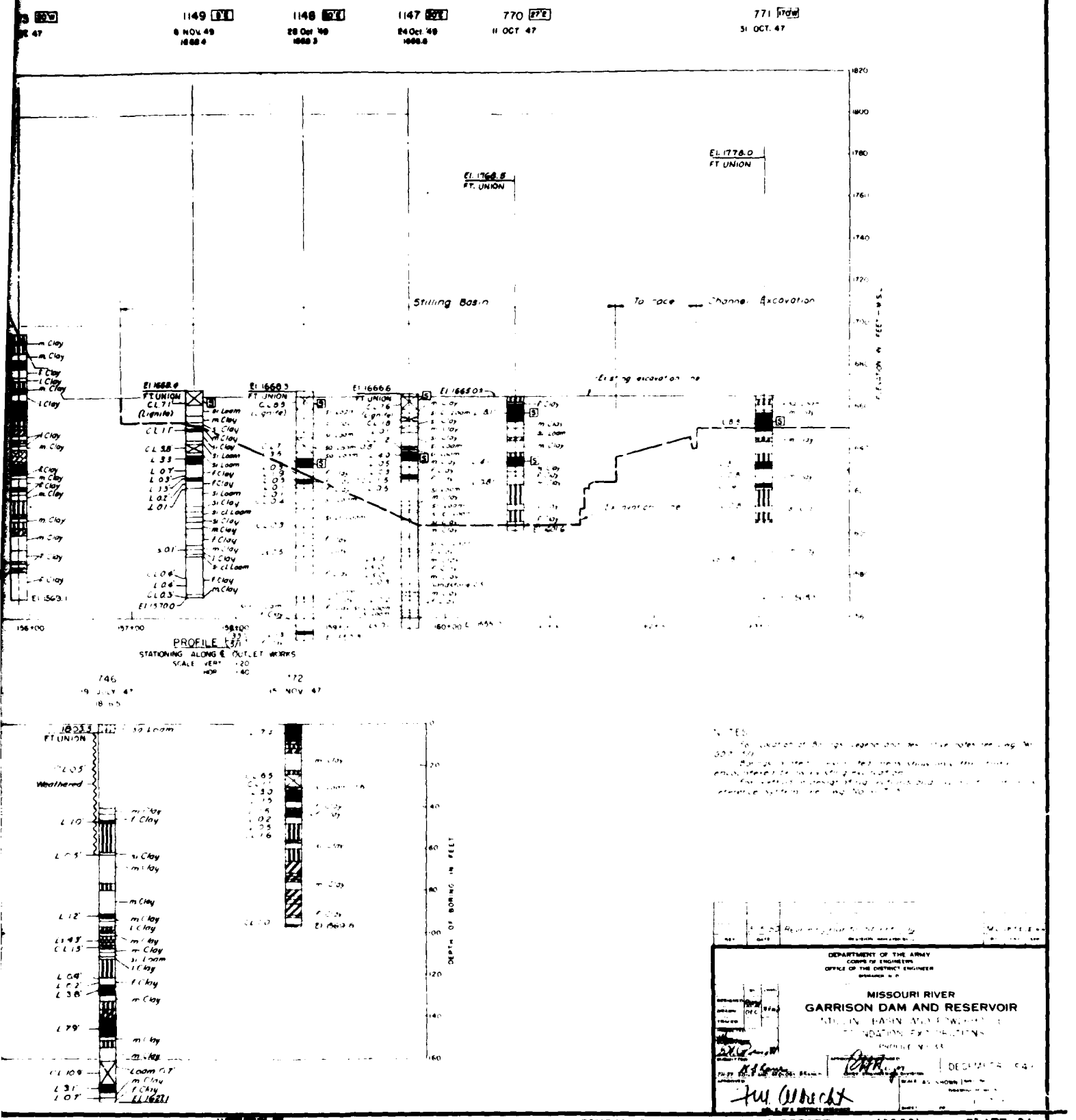
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

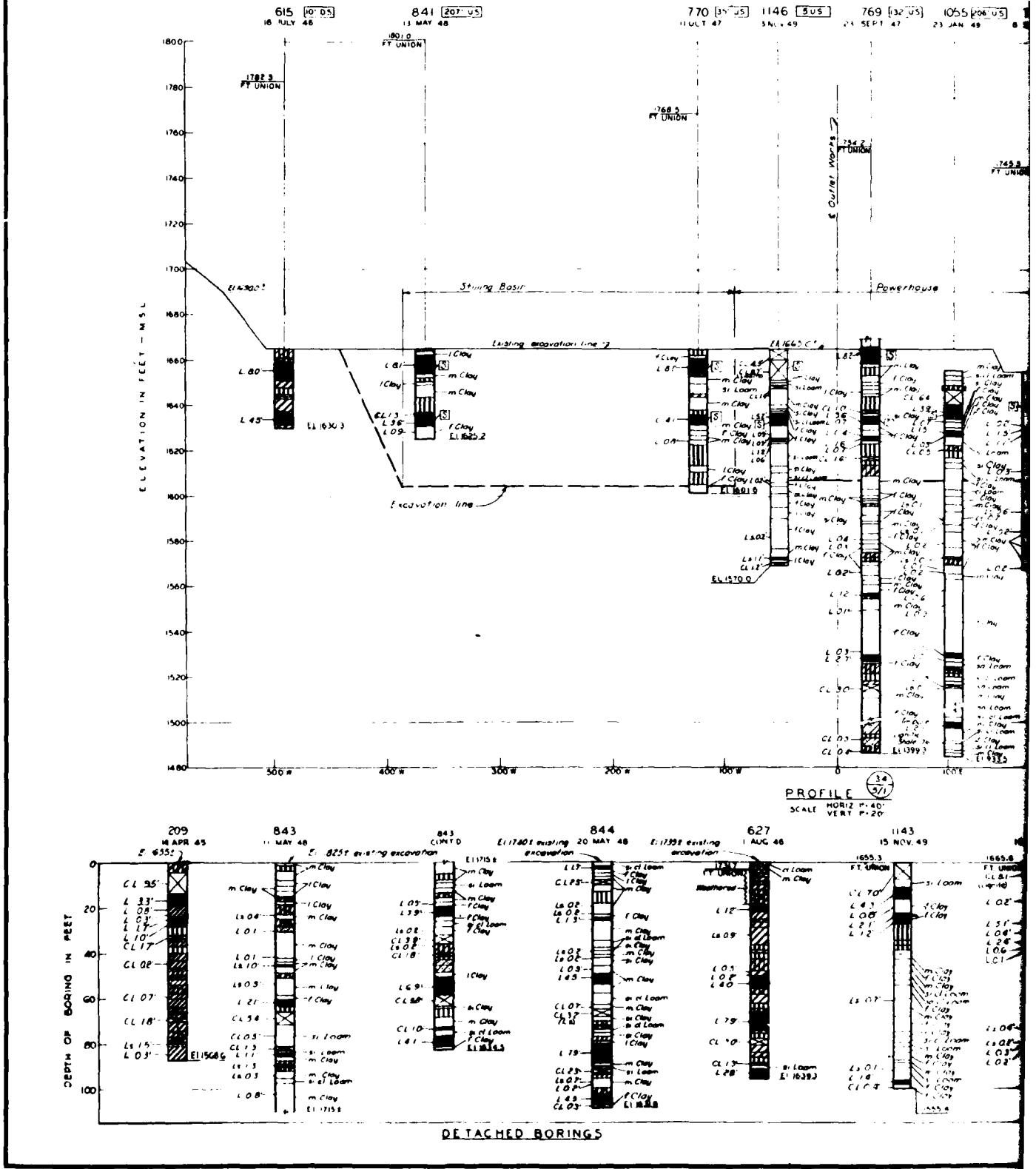
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
STILLING BASIN AND POWERHOUSE
FOUNDATION EXPLORATIONS
PROFILE NO 12

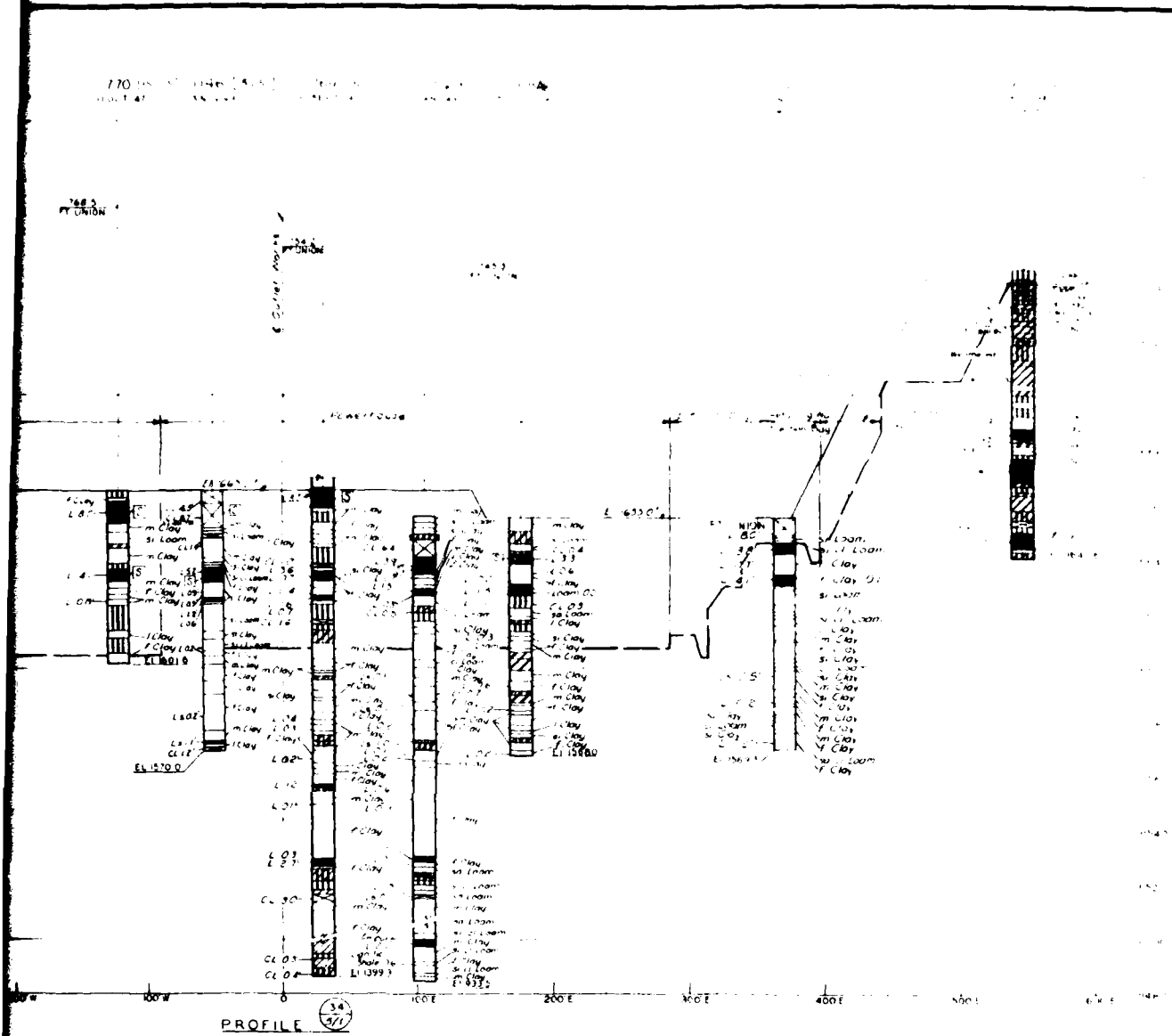
DECEMBER 1949

GOT 5/2


709
21 APR. 47
1694.6
773
3 OCT 47
1149
8 NOV 48
1148
ELEVATION IN FEET — M.S.L.
FT. UNION
PROFILE
STATIONING ALONG ℄ OUTLET WORKS
SCALE VERT 1"=20'
HOR 1"=40'
DEPTH OF BORING IN FEET
DETACHED BORINGS
SCALE VERT 1"=20'
772
15 NOV 47


1149
6 NOV 49
1148
28 Oct '49
1147
24 Oct '49
770
11 OCT 47
771
31 OCT. 47
Stilling Basin
To face Channel Excavation
EL 1778.0
FT UNION
EL 1760.8
FT. UNION
EL 1668.8
FT UNION
EL 1660.3
FT UNION
EL 1666.6
FT UNION
EL 1665.0
EL 1563.1
EL 1570.0
156+00
157+00
158+00
160+00
PROFILE
STATIONING ALONG ℄ OUTLET WORKS
SCALE VERT 1:20
HOR 1:40
146
19 JULY 47
172
15 NOV 47
FT UNION
Weathered
EL 1662.1
DEPTH OF BORING IN FEET
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
DECEMBER 19


615 10' DS
16 JULY 46
841 20.7' US
13 MAY 48
770 35' US
11 OCT 47
1146 5 US
5 NOV 49
769 13.2' US
24 SEPT 47
1055 20.6' US
23 JAN 49
ELEVATION IN FEET – M.S.L.
1800
1780
1760
1740
1720
1700
1680
1660
1640
1620
1600
1580
1560
1540
1520
1500
1480
1801.0 FT. UNION
1782.3 FT. UNION
1768.5 FT. UNION
1754.2 FT. UNION
1745.8 FT. UNION
El 1630.3
El 1625.2
El 1601.9
El 1570.0
El 1399.3
El 1633.5
El 1663.5
Stilling Basin
Powerhouse
Existing excavation line
Excavation line
S. Outlet Works
500 W
400 W
300 W
200 W
100 W
0
100 E
PROFILE
SCALE HORIZ. 1"=40'
VERT. 1"=20'
209
16 APR 45
E. 6555
843
11 MAY 48
E. 8251 existing excavation
843 CONT'D
844
El 1740± existing excavation
20 MAY 48
El 1739± existing excavation
627
1 AUG 46
1143
15 NOV. 49
DEPTH OF BORING IN FEET
0
20
40
60
80
100
El 1568.6
El 1715.8
El 1714.3
El 1713.8
El 1639.3
DETACHED BORINGS



PROFILE

SCALE HORIZ 1"=40'
VERT 1"=20'

627
1 AUG 46
El 1395 E existing excavation

1143
15 NOV. 49

1144
10 NOV. 49

1145
18 NOV. 49

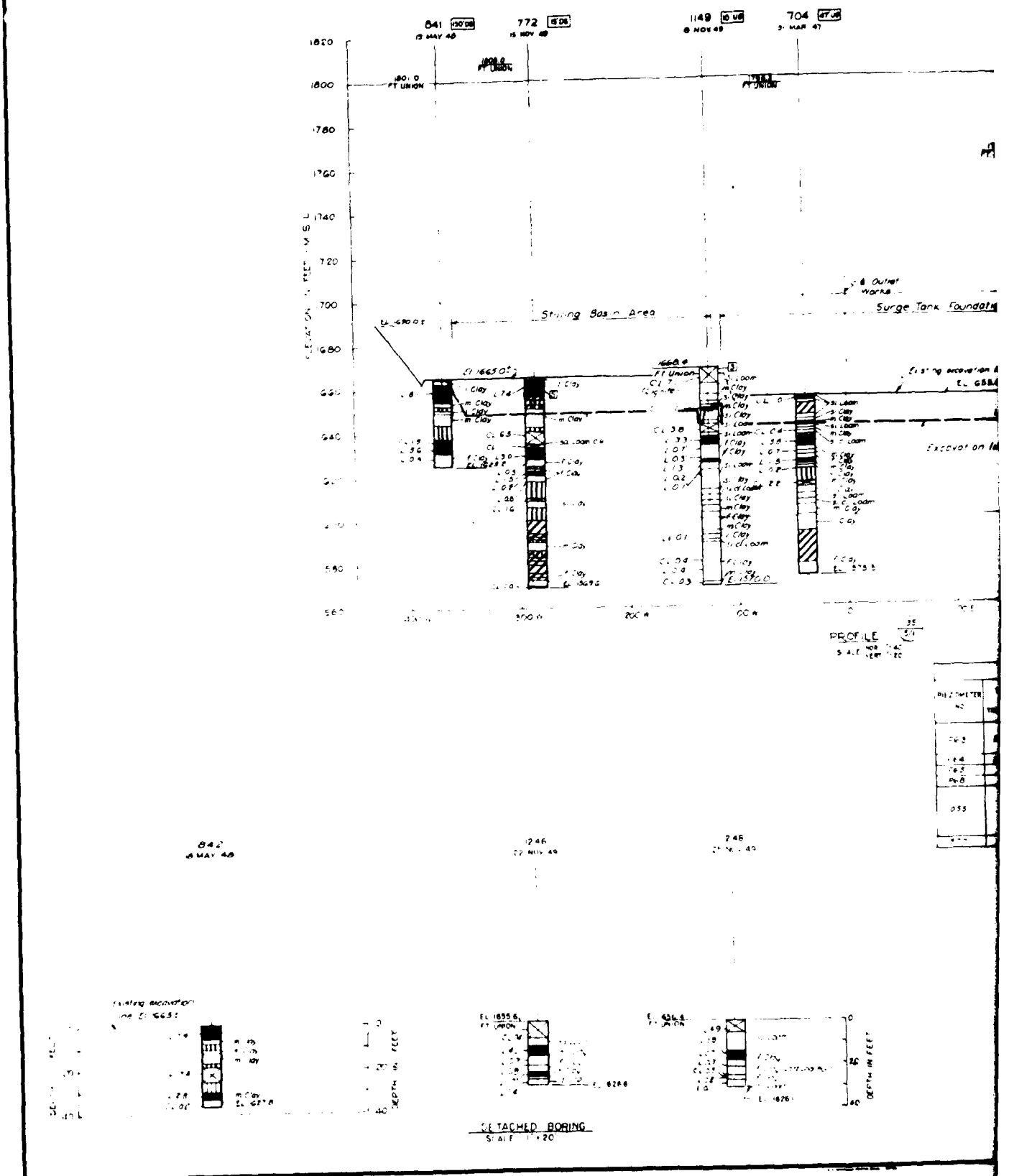
1246
IN PROGESS

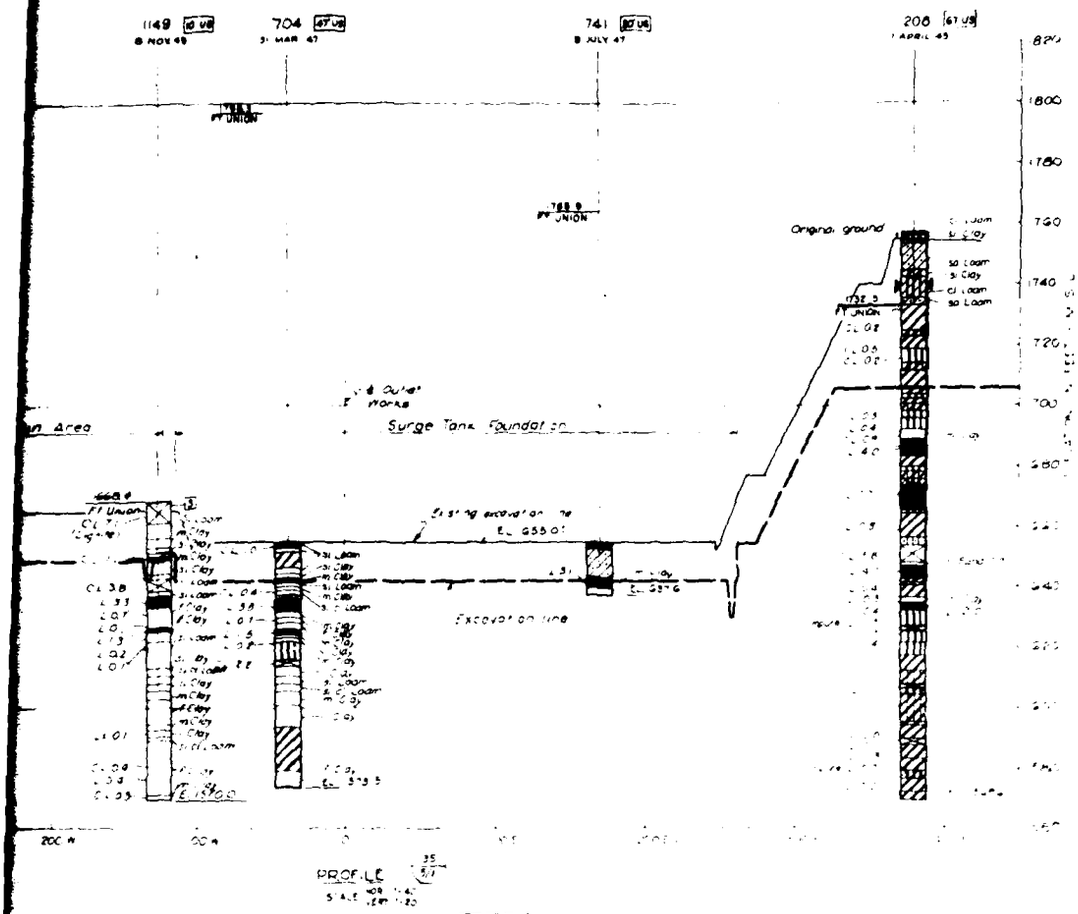
NOTES

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
STILLING BASIN AND POWERHOUSE
EXCAVATION EXPLORATION

Fred. Albrecht


841
13 MAY 48
772
15 NOV 48
1149
6 NOV 49
704
3 MAR 47
Stilling Basin Area
Surge Tank Foundation
Outlet Works
Existing excavation
Excavation
PROFILE
SCALE
842
6 MAY 48
1246
12 NOV 49
2 46
DEPTH IN FEET
ATTACHED BORING
SCALE



PIEZOMETER TREATMENT

PIEZOMETER NO.	TYPE OF TREATMENT	DIAMETER	LOCATION	DEPTH OF PIEZOMETER	TOP OF SCREEN ELEV.	BOTTOM OF SCREEN ELEV.	REMARKS
P-3	NONE	2					
P-4	NONE	2					
P-5	2	2					
P-6R	2	2					
335	4	4"					

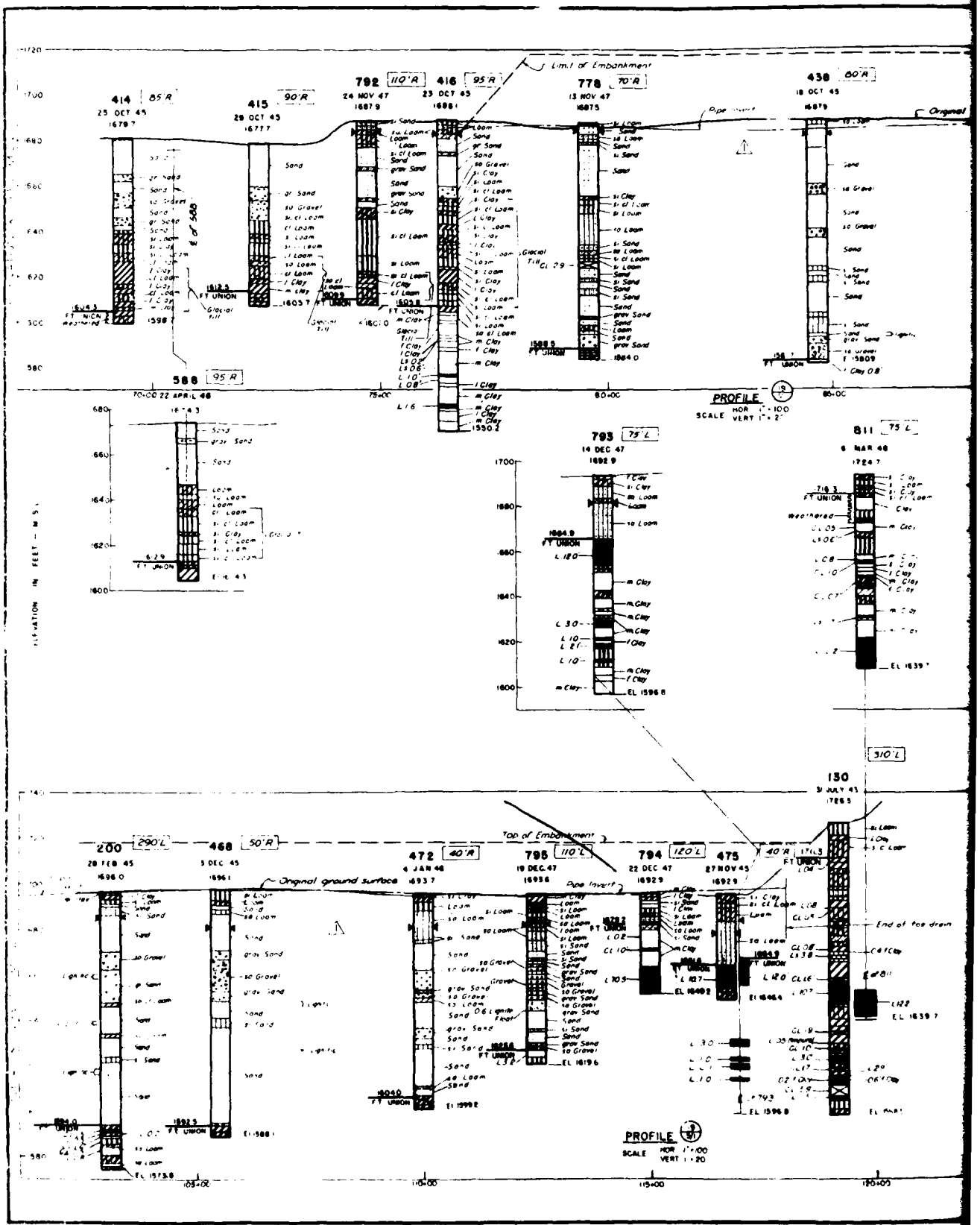
NOTE

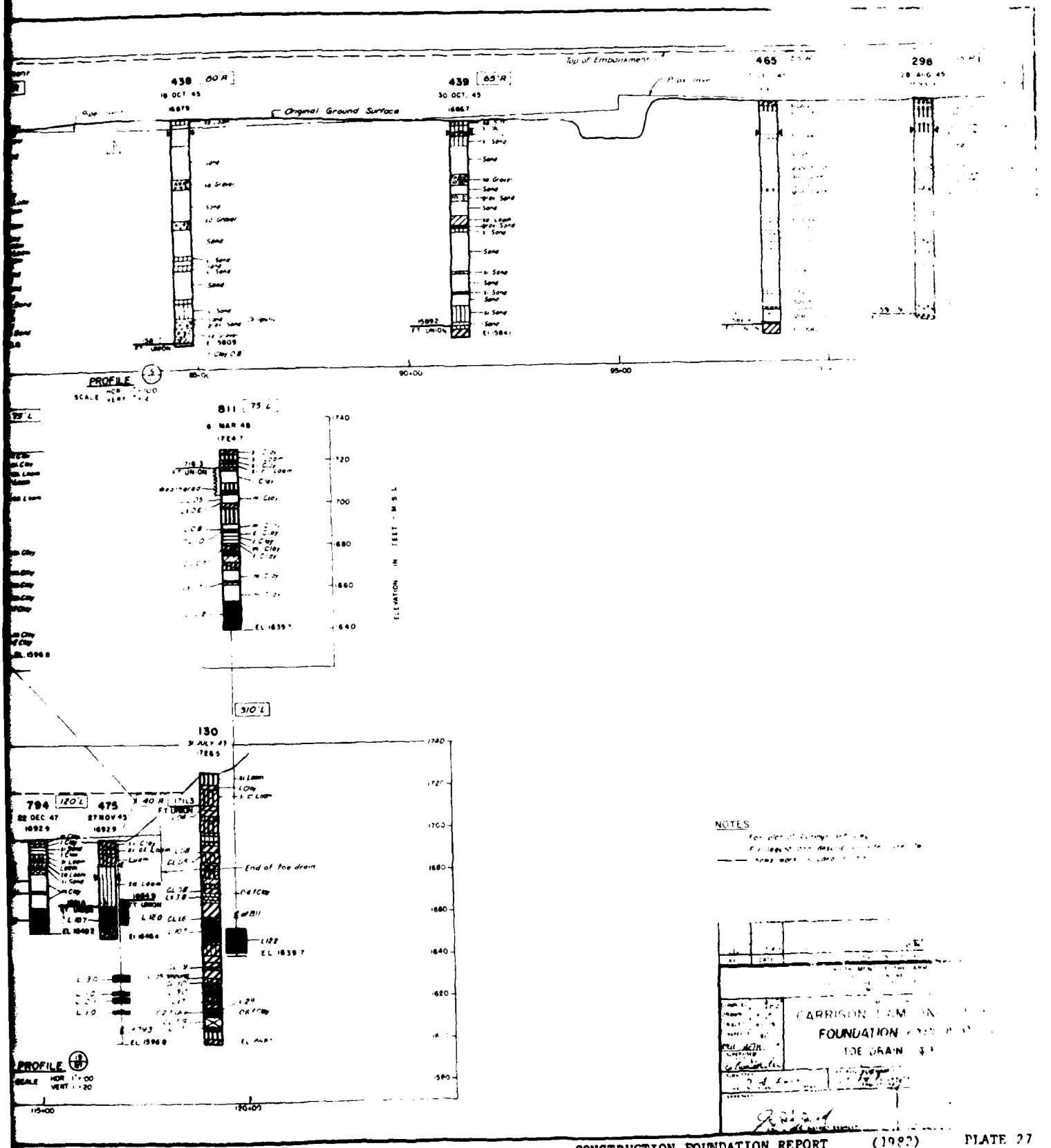


DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

MISSOURI RIVER
GARRISON DAM AND RESERVOIR

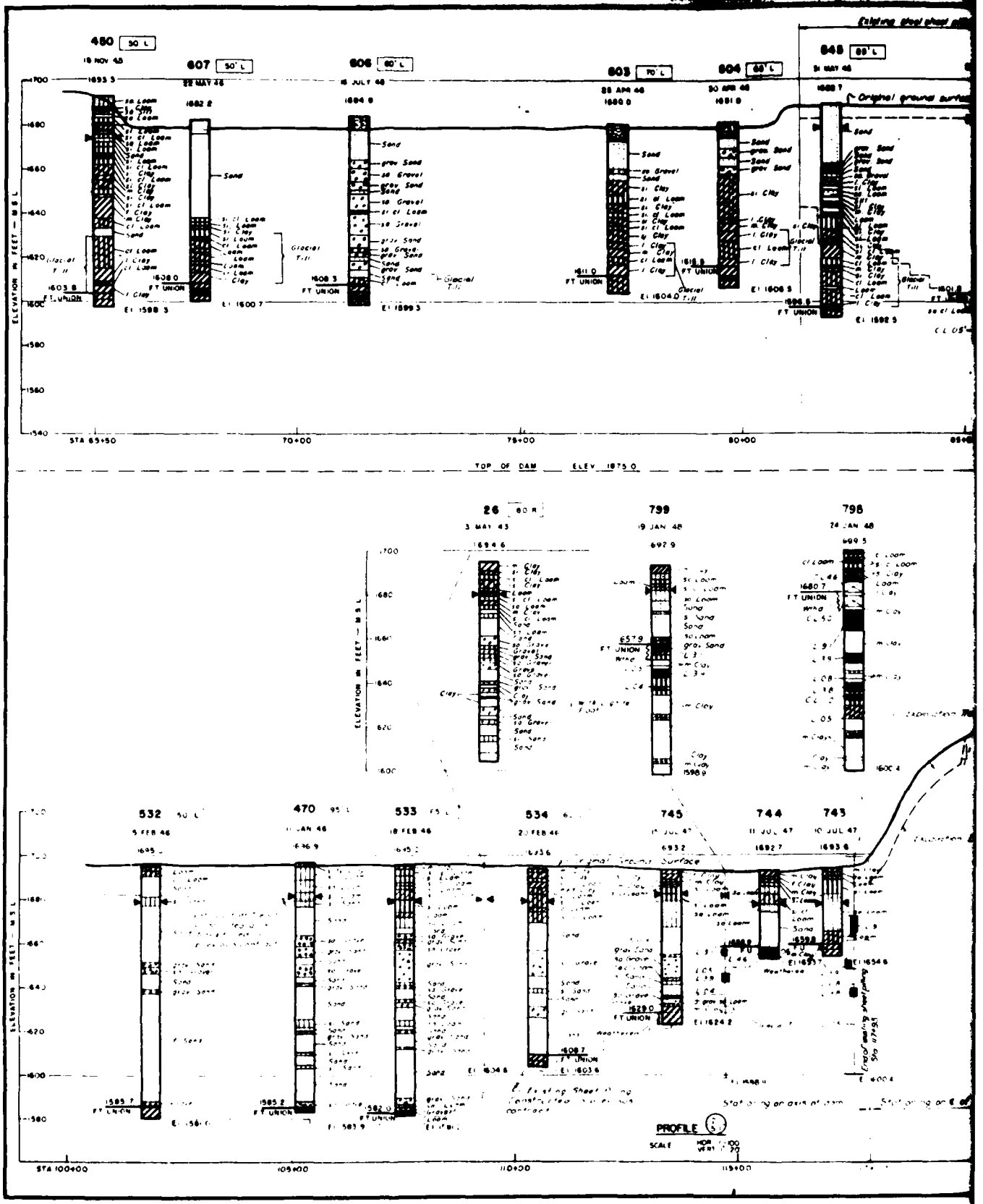
CONSTRUCTION FOUNDATION REPORT (1982) PLATE 26

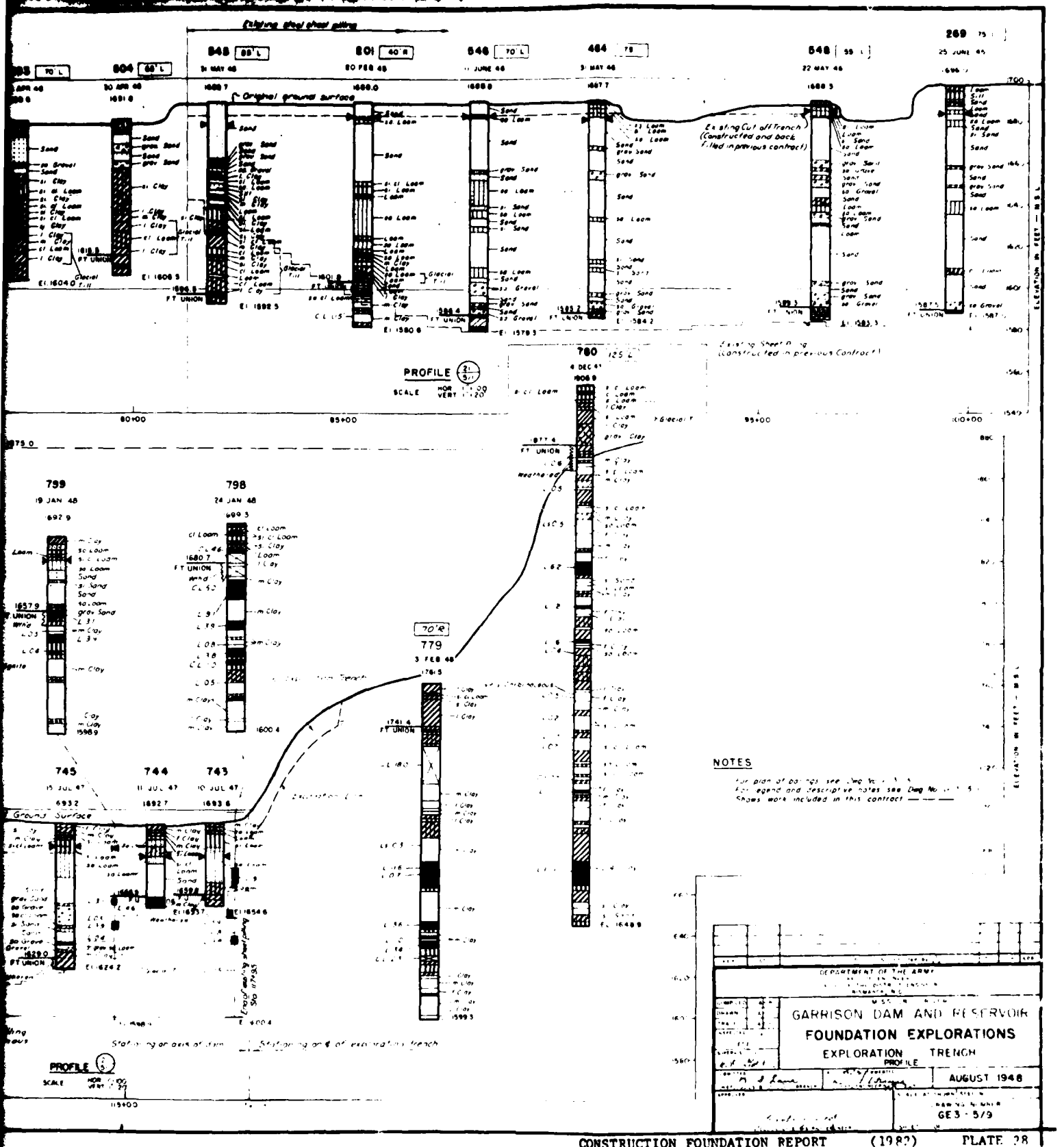

Limit of Embankment
414 65'R
25 OCT 45
1678.7
415 90'R
29 OCT 45
1677.7
792 110'R
24 NOV 47
1687.9
416 95'R
23 OCT 45
1688.1
778 70'R
13 NOV 47
1687.5
438 80'R
18 OCT 45
1687.9
588 95'R
10+00 22 APRIL 46
PROFILE
HOR 1" = 100
VERT 1" = 20
793 75'L
14 DEC 47
1692.9
811 75'L
6 MAR 48
1724.7
310'L
130
31 JULY 43
1726.5
200 290'L
28 FEB 45
1696.0
468 50'R
5 DEC 45
1696.1
472 40'R
4 JAN 46
1693.7
795 110'L
19 DEC 47
1693.6
794 120'L
22 DEC 47
1692.9
475 40'R
27 NOV 45
1692.9
Top of Embankment
Original ground surface
Pipe invert
End of toe drain
PROFILE
SCALE HOR 1" = 100
VERT 1" = 20
105+00
110+00
115+00
180+00



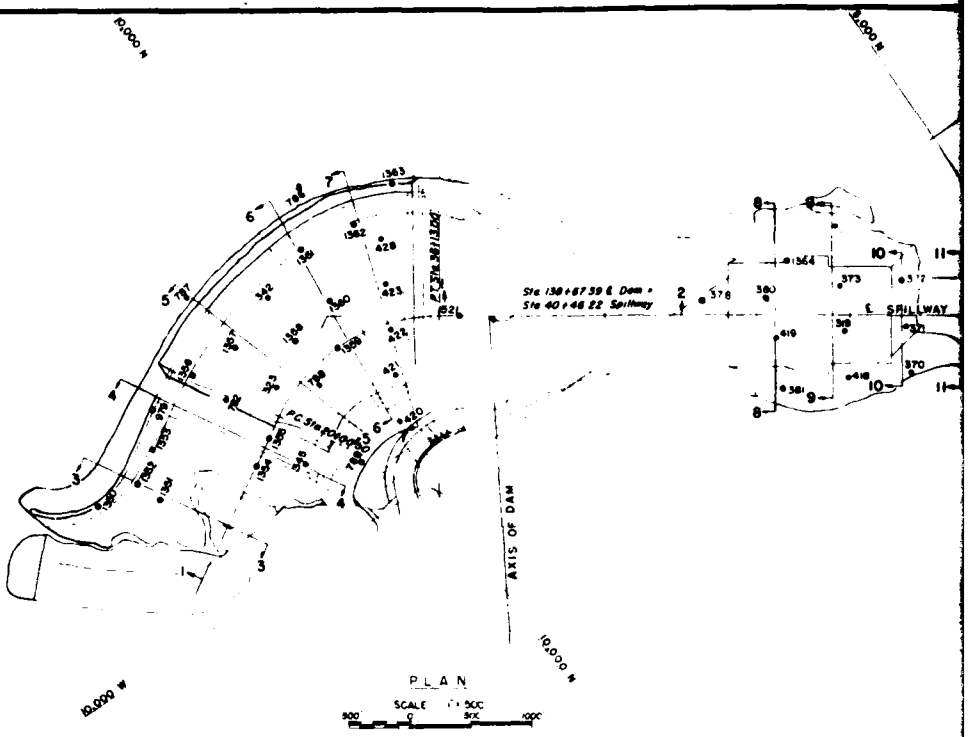
CONSTRUCTION FOUNDATION REPORT (1982) PLATE 27

2


480
607
606
803
804
848
TOP OF DAM ELEV 1875.0
26
799
798
532
470
533
534
745
744
743
PROFILE
STA 65+50
70+00
75+00
80+00
STA 100+00
105+00
110+00
115+00



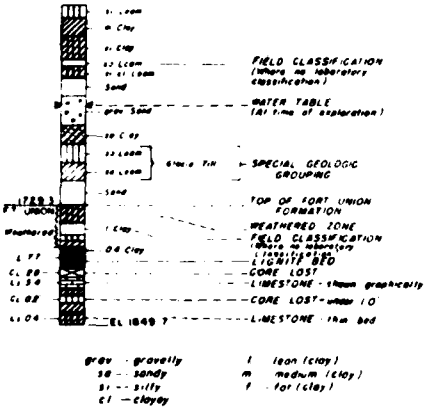
CONSTRUCTION FOUNDATION REPORT (1982) PLATE 28



87 ... HOLE NUMBER

25 MAR 43 ... DATE HOLE COMPLETED

1785.4 ... ELEV. TOP OF HOLE



grav - gravelly
sa - sandy
si - silty
cl - clayey

l - lean (clay)
m - medium (clay)
f - fat (clay)

Lean, medium & fat clays are not differentiated in Fort Union.

Fine, medium & coarse sands are not differentiated in both overburden and Fort Union, strata less than 1.0' thick not shown, being combined with the most similar material above or below except thicknesses of 0.1' are indicated for lignite, limestone, core loss, and foreign material within a salvageable lignite bed.

LEGEND

GRAIN SIZE SYMBOLS

SAND — SILT

GRAVEL — CLAY

Symbols represent grain size distribution, predominant types by heavy lines, modifying types by light lines

OTHER SYMBOLS

LIMESTONE — LIGNITE — CORE LOST

SCORIA — LIGNITE (Recovery anticipated) — Fishtailed (Hole boring not sampled)

LEGEND FOR PROJECTED HOLES

[40 R] indicates a hole located 40 feet to right of projection relative to direction of increase in stationing. Similarly, L stands for left of profile, U, upstream, and D, downstream, are used in instances where R & L are not applicable.

○1247 indicates boring in process

●HA-1600 indicates Hand Auger boring

⊙P-65 indicates Piezometer installation

●741 indicates completed borings

DESCRIPTIVE NOTES

Fort Union Formation is a Tertiary clay-shale it consists of a series of continentally deposited compact, clayey to sandy materials, arranged in gently dipping beds (often cross bedded), which range from thin partings to 15' or more in thickness. Clayey phases are predominant.

Within the formation there are horizons of *limestone* and *sandstone* which may reach a thickness of about 5'. Often these horizons are discontinuous in the form of concretions which may attain a thickness of 5' or more and may be greater than 25' in diameter.

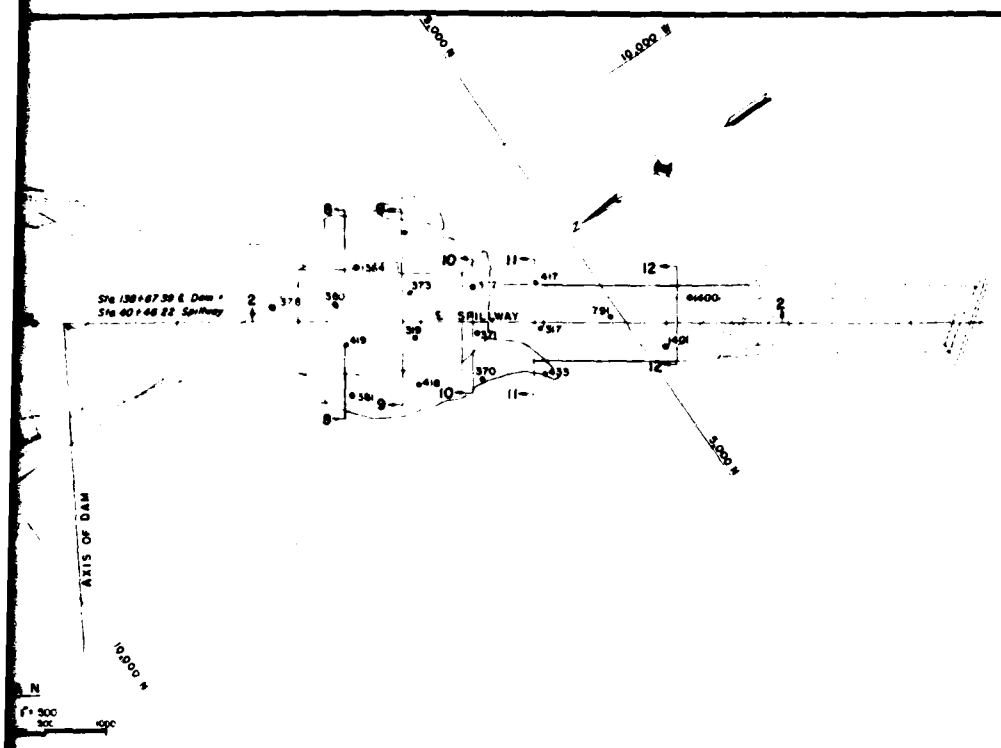
Lignite beds vary in thickness from thin partings to over 10', and are usually water bearing, particularly the thicker beds.

Burning of lignite beds has in places colored and hardened adjacent materials. When exposed these have a pinkish color and are locally known as *scoria*.

The *glacial till* formation is an unsorted mixture, graded largely from sand sizes to clay sizes, glacially deposited in a compact state generally characterized by a small percentage of pebbles having a usual maximum size of one inch. Occasional cobbles and boulders are also found in the till.

Lignite float indicates the presence of various sized pieces of lignite transported and mixed by stream action and found deposited in varying concentrations at irregular horizons in the glacial or alluvial materials.

The term *loam* is used to designate a mixture of sand, silt and clay sizes, the percentage of clay sizes ranging from 0 to 19 for loam and from 20 to 29 for clay loam, with predominant remaining material indicated by a modifying adjective. The term loam does not imply the admixture of organic material.



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GENERAL NOTES

Plan shows generalized excavation lines, for details see Excavation Plans.

Indicated water table elevations, although derived from best available data, should be regarded as approximate only and subject to considerable variations.

Borelogs samples may be inspected at the Corps of Engineers Office at the damsite.

Graphic logs give boring information in condensed form. Further information is shown on the complete boring logs which may be inspected at the Corps of Engineers Office at the site.

Generally borings in overburden made by churn type rig using 6 inch inside diameter open end drive tube. Continuous samples recovered.

Generally borings in Fort Union made by rotary type rig using double tube core barrel. Continuous core 5 $\frac{1}{8}$ inches in diameter recovered.

NOTES

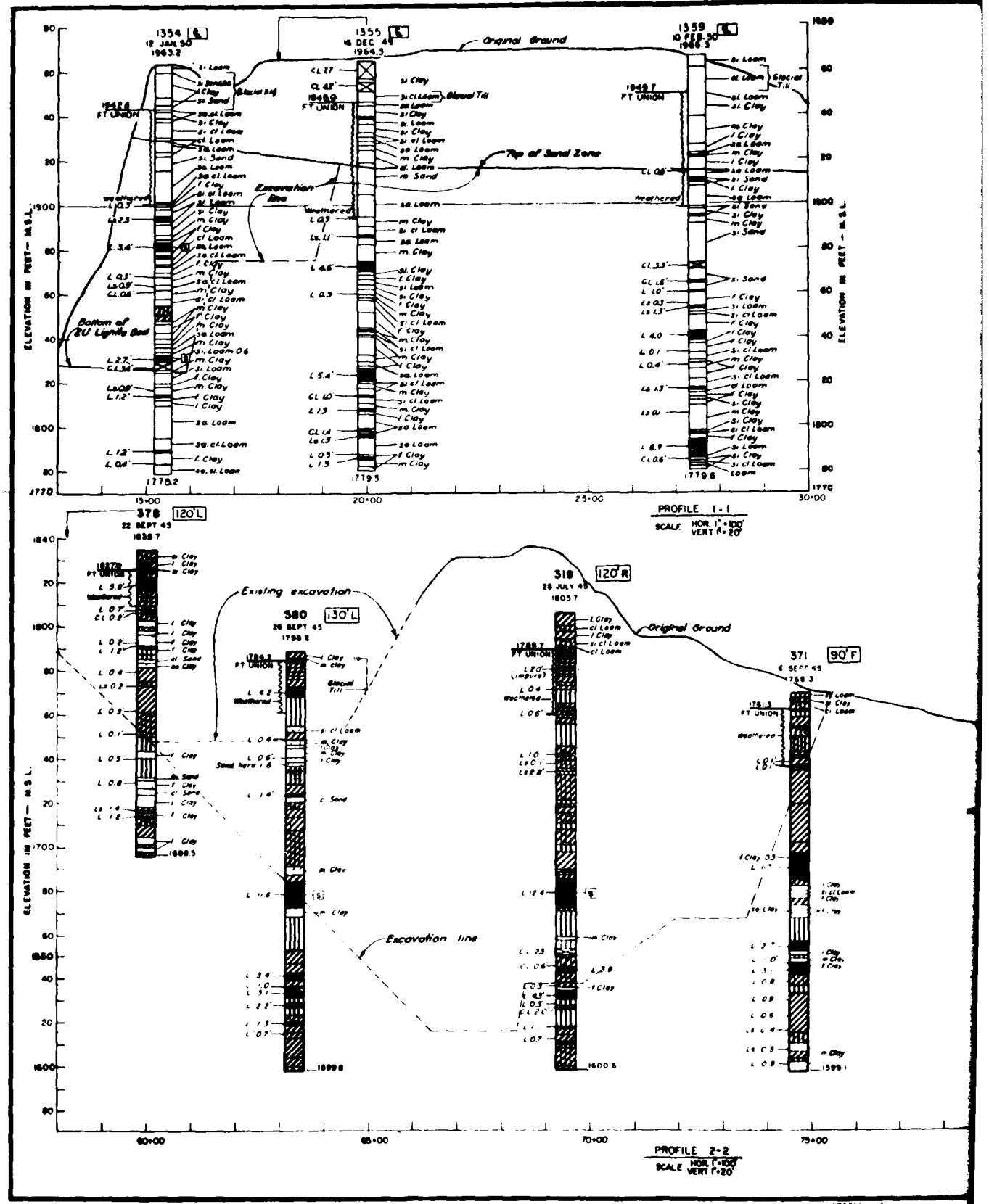
For profiles and sections of Spillway see Dwg Nos GE 10-5/2, 5/3, 5/4, 5/5, 5/6, 5/7, 5/8, 5/9

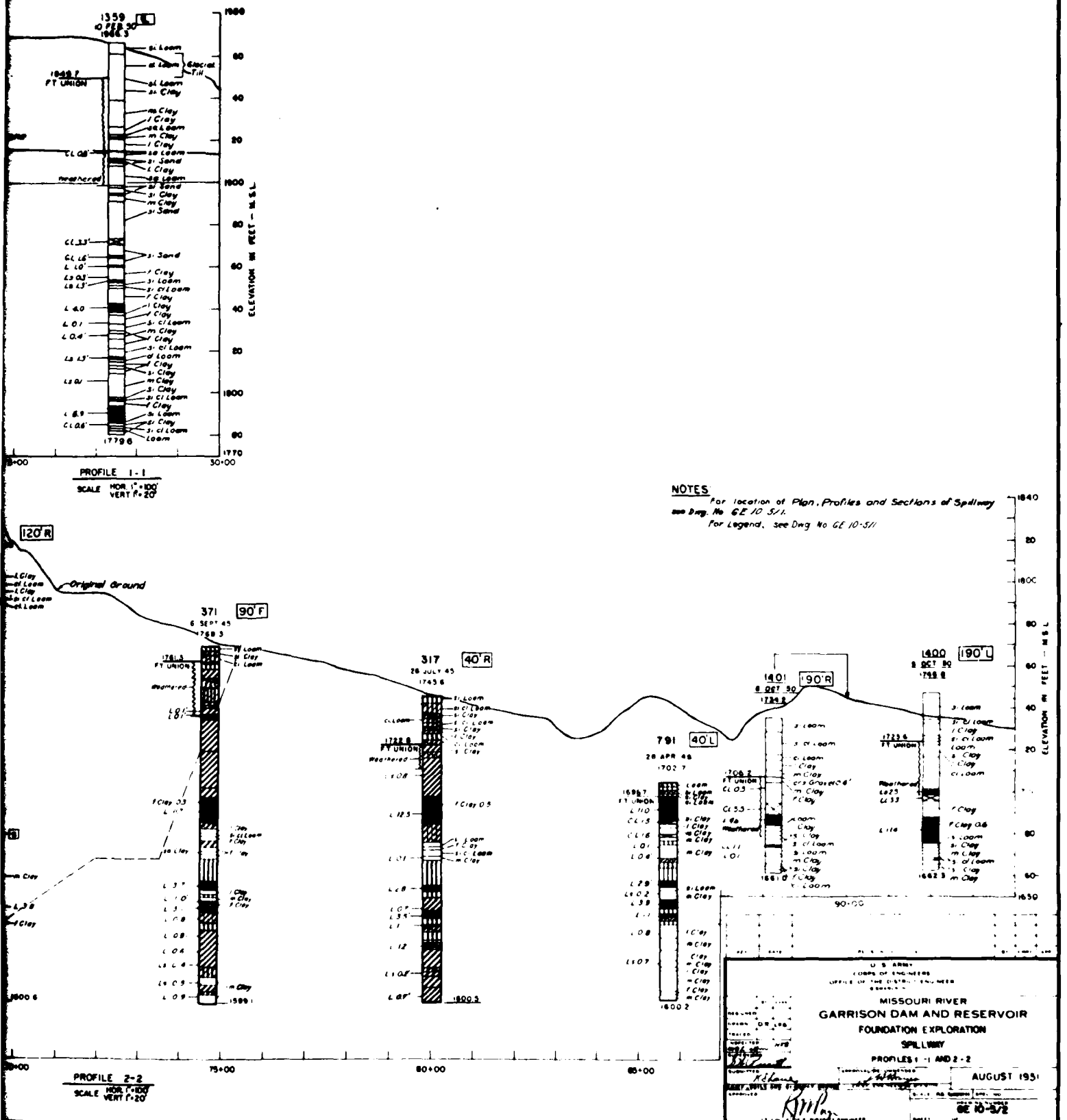
U S ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEBR.

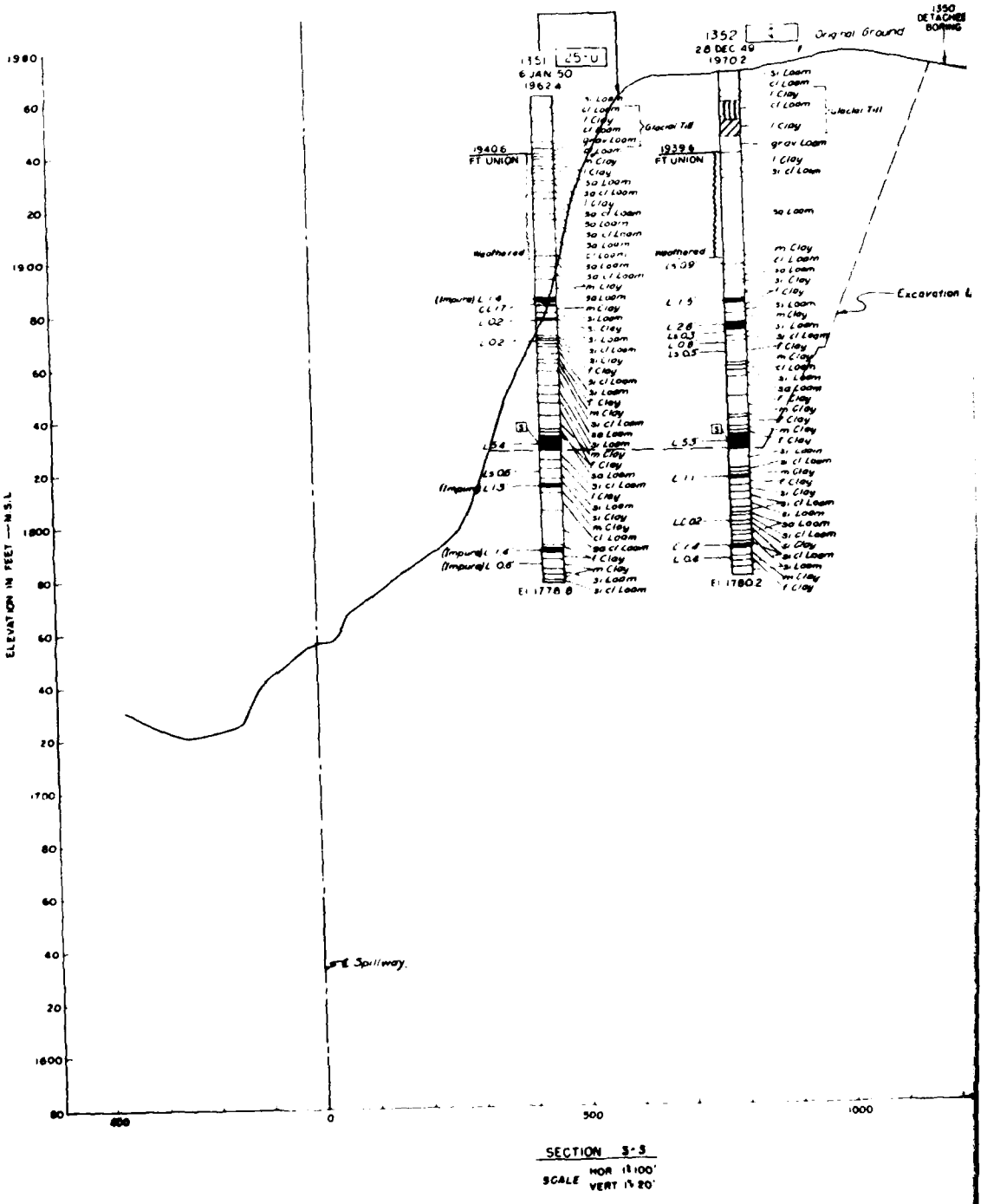
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
SPILLWAY
PLAN AND LEGEND

AUGUST 1951

GE 10-5/1

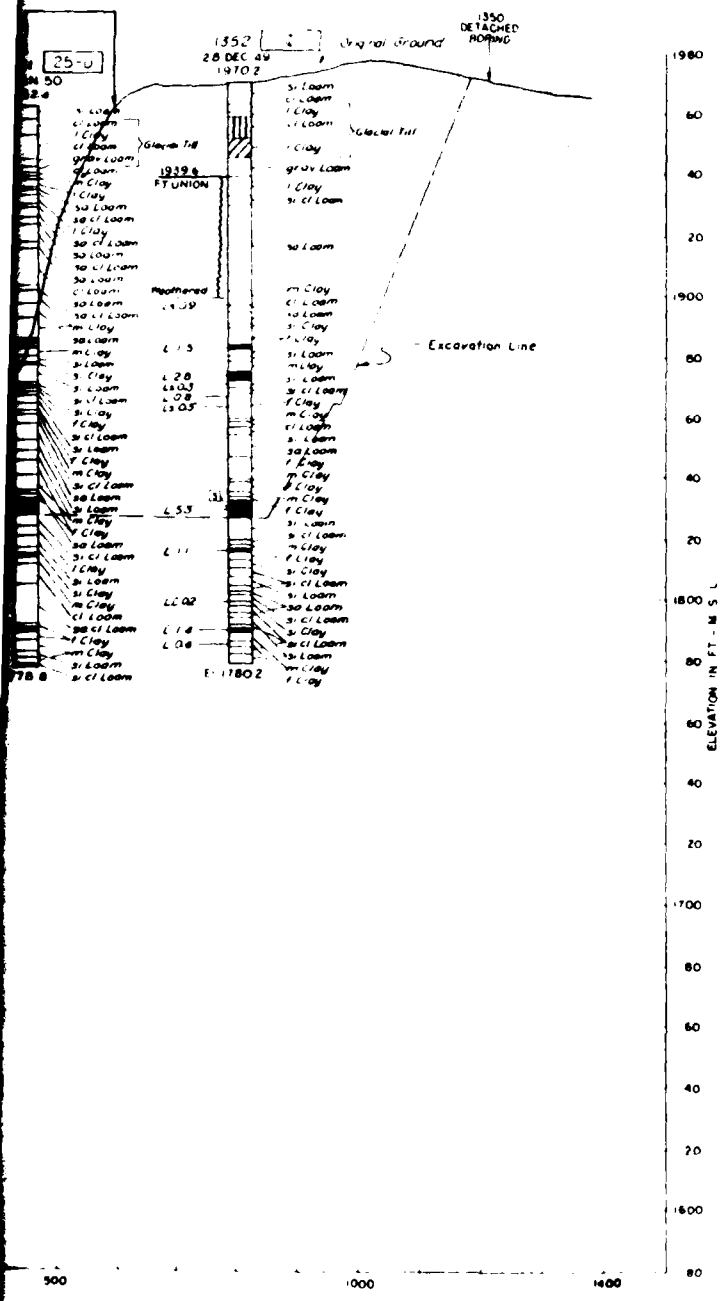

1354
12 JAN 50
1963.2
1355
16 DEC 49
1964.3
1359
10 FEB 50
1966.3
Original Ground
Top of Sand Zone
Excavation line
Bottom of 2U Lignite Seal
FT UNION
Glacial Till
weathered
ELEVATION IN FEET — M.S.L.
1770.2
1779.5
1779.6
15+00
20+00
25+00
30+00
PROFILE 1-1
SCALE HOR. 1" = 100'
VERT 1" = 20'
378 120'L
22 SEPT 45
1838.7
380 130'L
26 SEPT 45
1798.2
319 120'R
28 JULY 45
1805.7
371 90'F
6 SEPT 45
1768.3
Existing excavation
Original Ground
Excavation line
1698.5
1799.8
1600.6
1799.1
60+00
65+00
70+00
75+00
PROFILE 2-2
SCALE HOR. 1" = 100'
VERT 1" = 20'

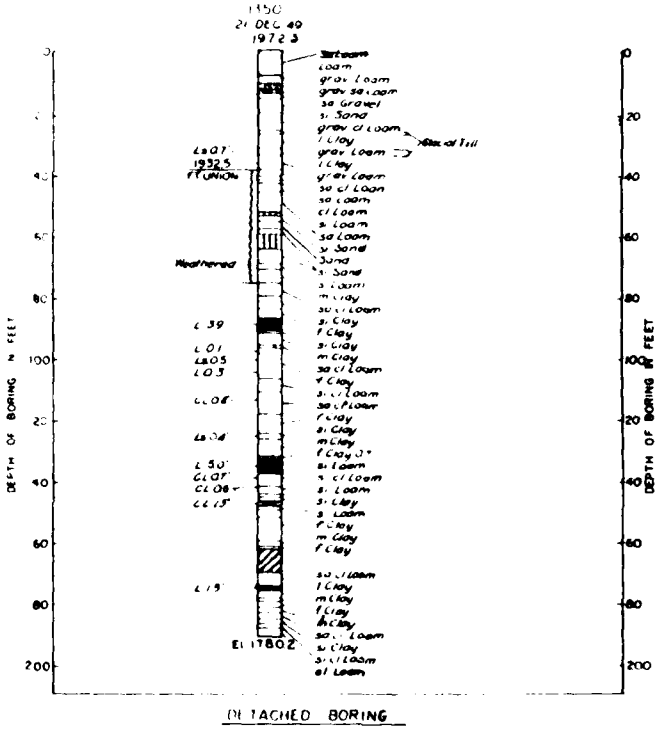

PROFILE 1-1
SCALE HOR. 1" = 100'
VERT 1" = 20'
ELEVATION IN FEET - M.S.L.
PROFILE 2-2
SCALE HOR. 1" = 100'
VERT 1" = 20'
Original Ground
NOTES
For location of Plan, Profiles and Sections of Spillway see Dwg. No GE 10-5/1.
For Legend, see Dwg No GE 10-5/1
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATION
SPILLWAY
PROFILES 1-1 AND 2-2
AUGUST 1951
GE 10-5/2



SECTION S-S

SCALE HOR 1" = 100'
VERT 1" = 20'





DETACHED BORING

NOTES

For location of Plan and Profiles of Spillway see Drg No. GE 10-5-1
For Legend see Drg No. GE 10-5-1

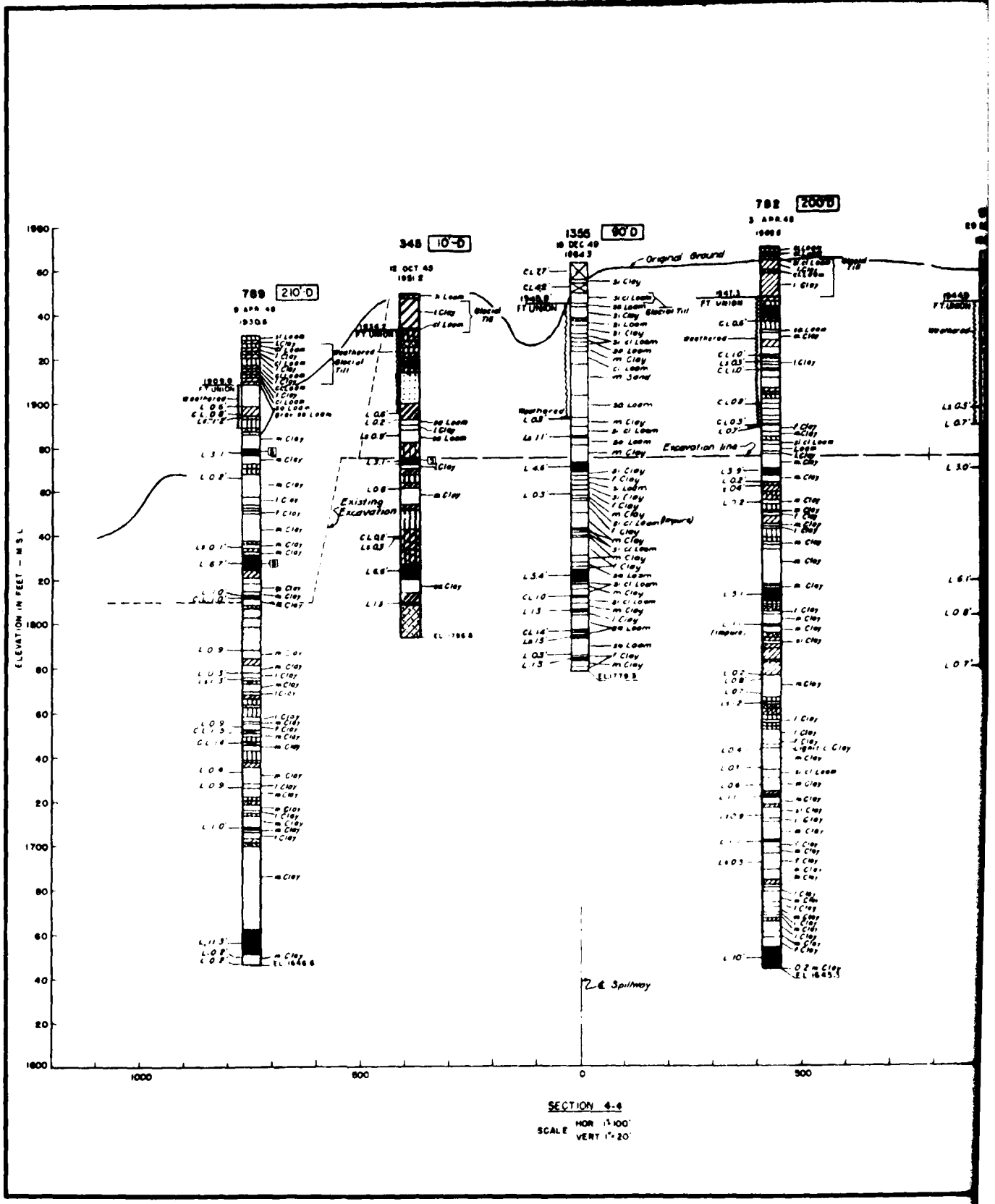
SECTION 3-3
SCALE HOR 1" = 100'
VERT 1" = 20'

U. S. ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEBR.

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
SPILLWAY
SECTION 3-3 AND DETACHED BORING

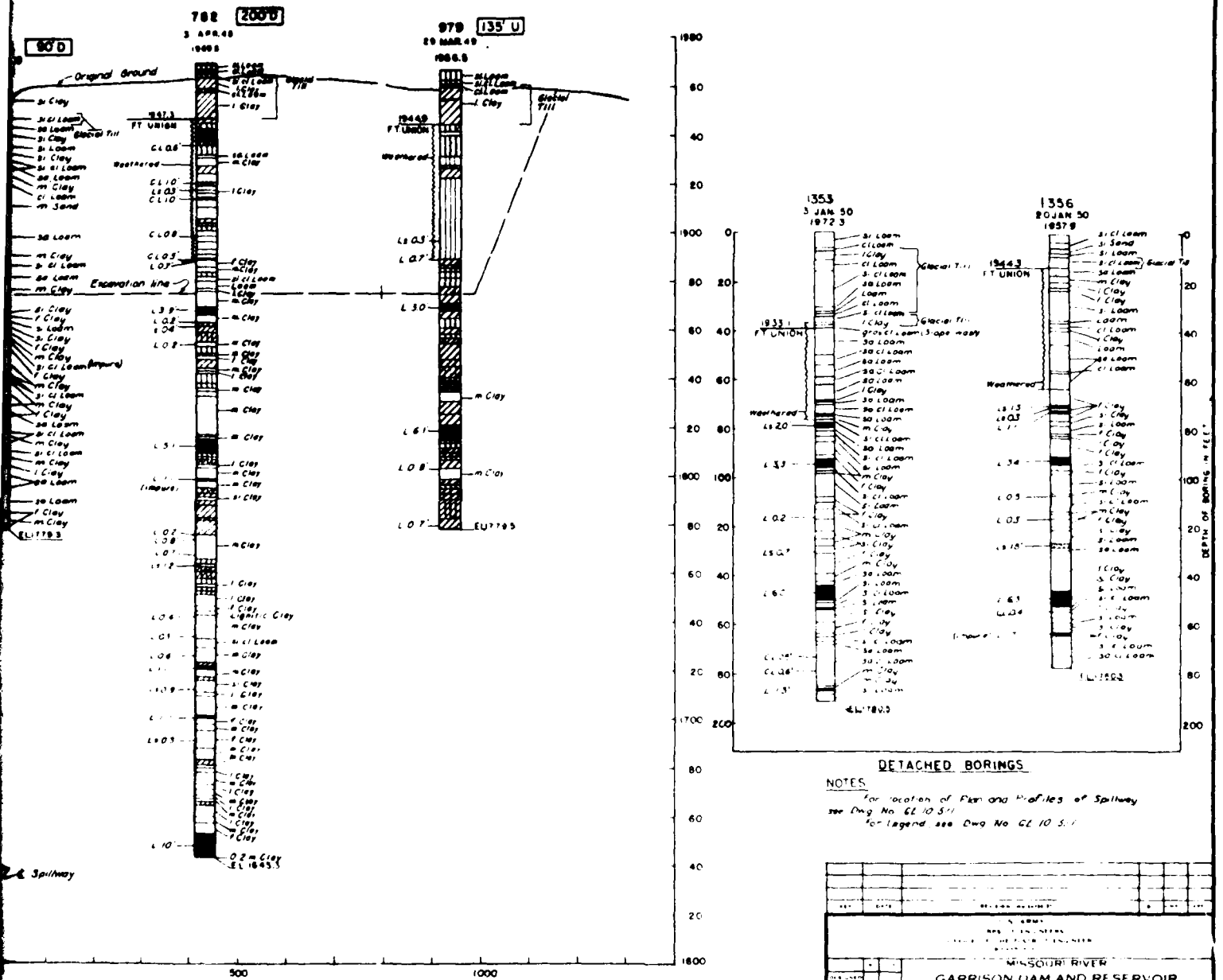
AUGUST 1951

GE 10-5-3



SECTION 4-4

SCALE HOR 1"=100'
VERT 1"=20'



DETACHED BORINGS

NOTES

For location of Plan and Profiles of Spillway see Dwg No GE 10 5.1

For legend see Dwg No GE 10 5.1

MISSOURI RIVER

GARRISON DAM AND RESERVOIR

FOUNDATION EXPLORATION

SPILLWAY

SECTION 4 4 AND DETACHED BORINGS

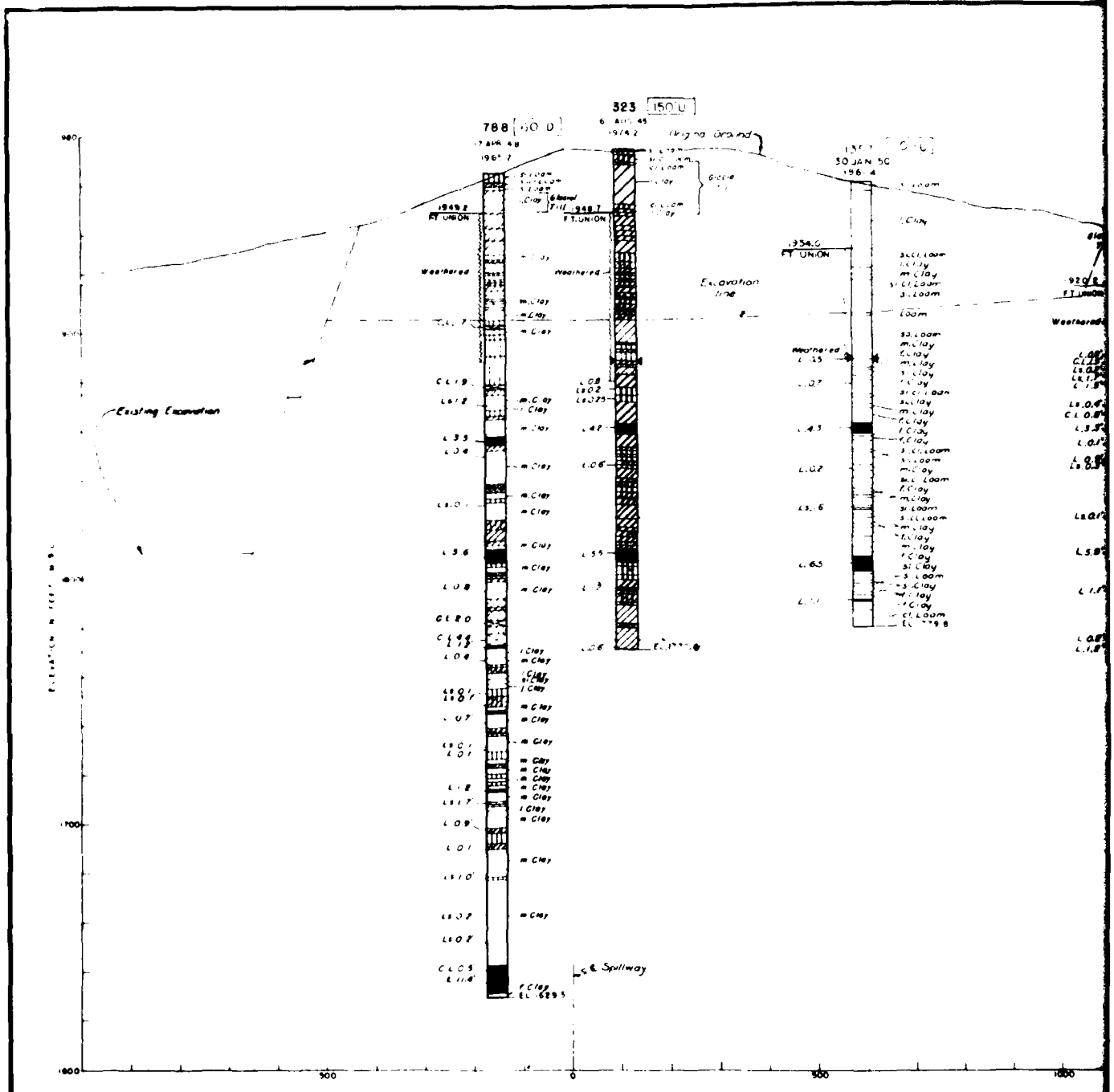
AUGUST 1951

GE 10-8/4

4-4

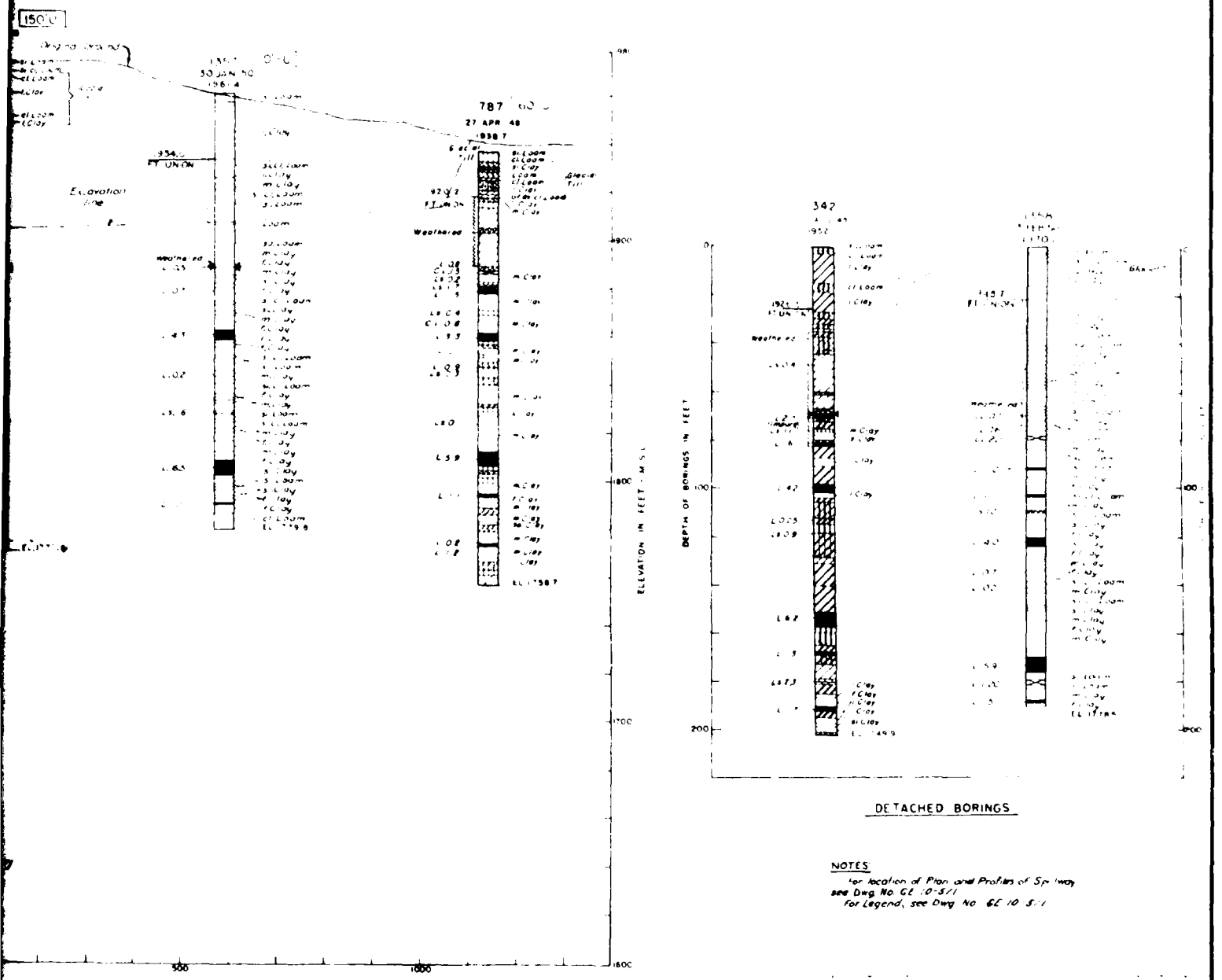
1"=100'

1"=20'



SECTION 5-5

SCALE HOR 1" = 100'
VERT 1" = 20'



DETACHED BORINGS

NOTES

for location of Plan and Profiles of Spillway see Dwg. No. GE 10-5/1

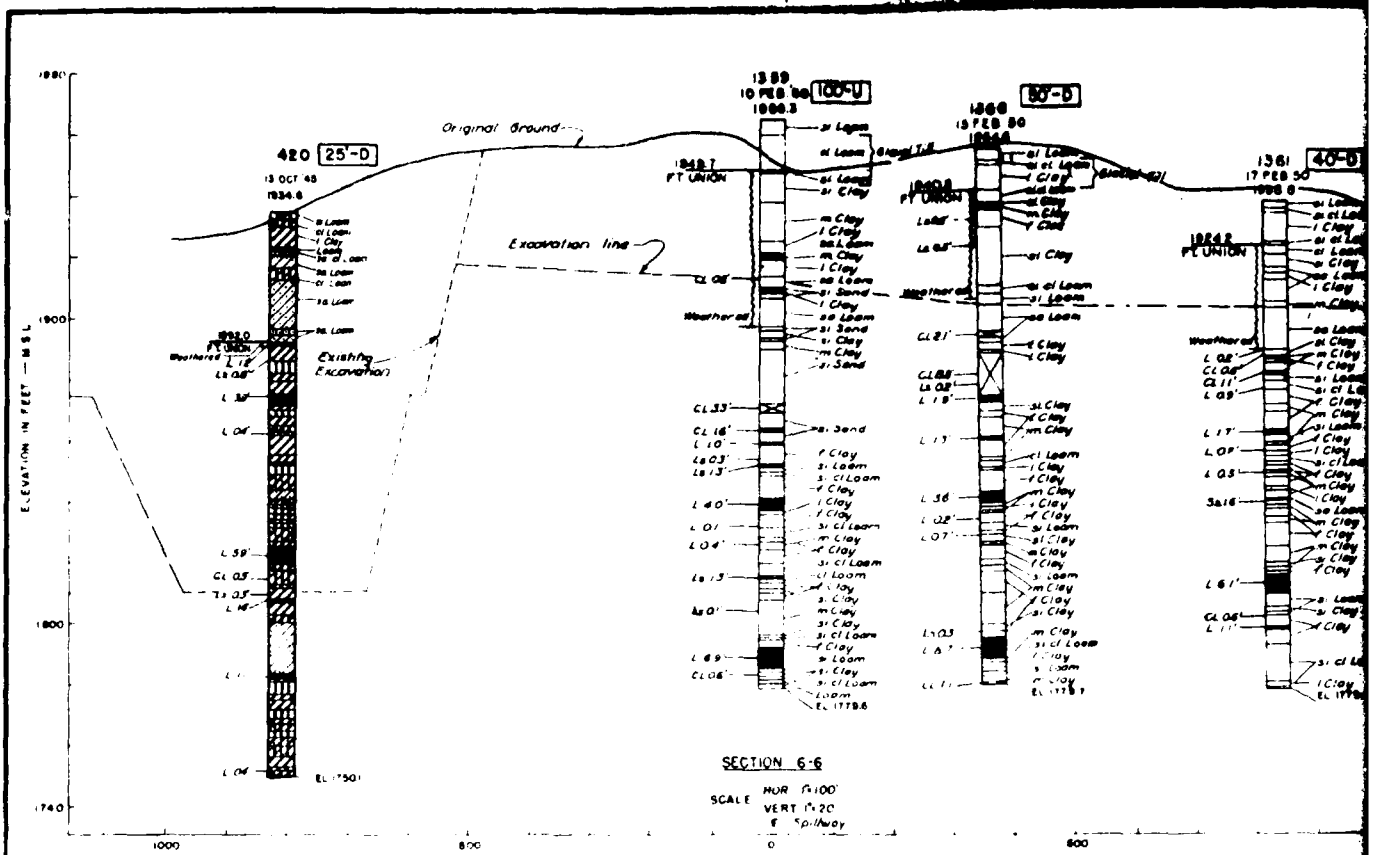
for Legend, see Dwg. No. GE 10-5/1

U. S. ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
SPILLWAY
SECTION S-S AND DETACHED BORINGS

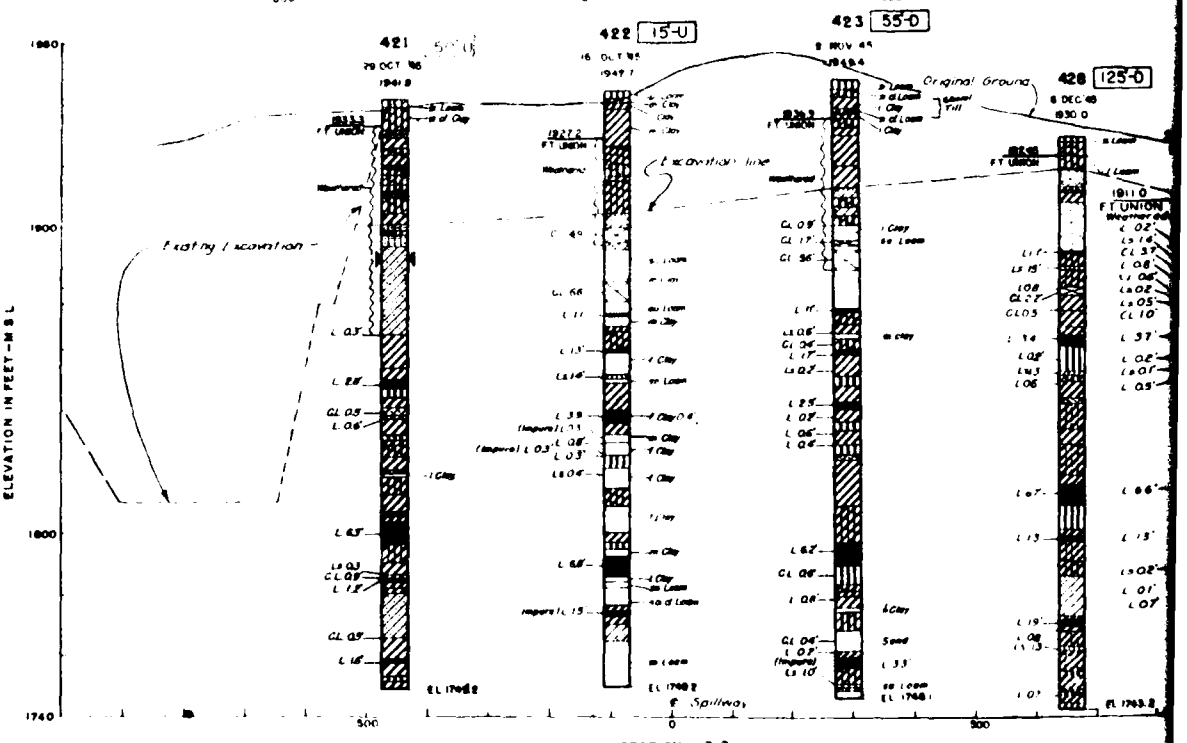
AUGUST 1951

GE 10-5/5



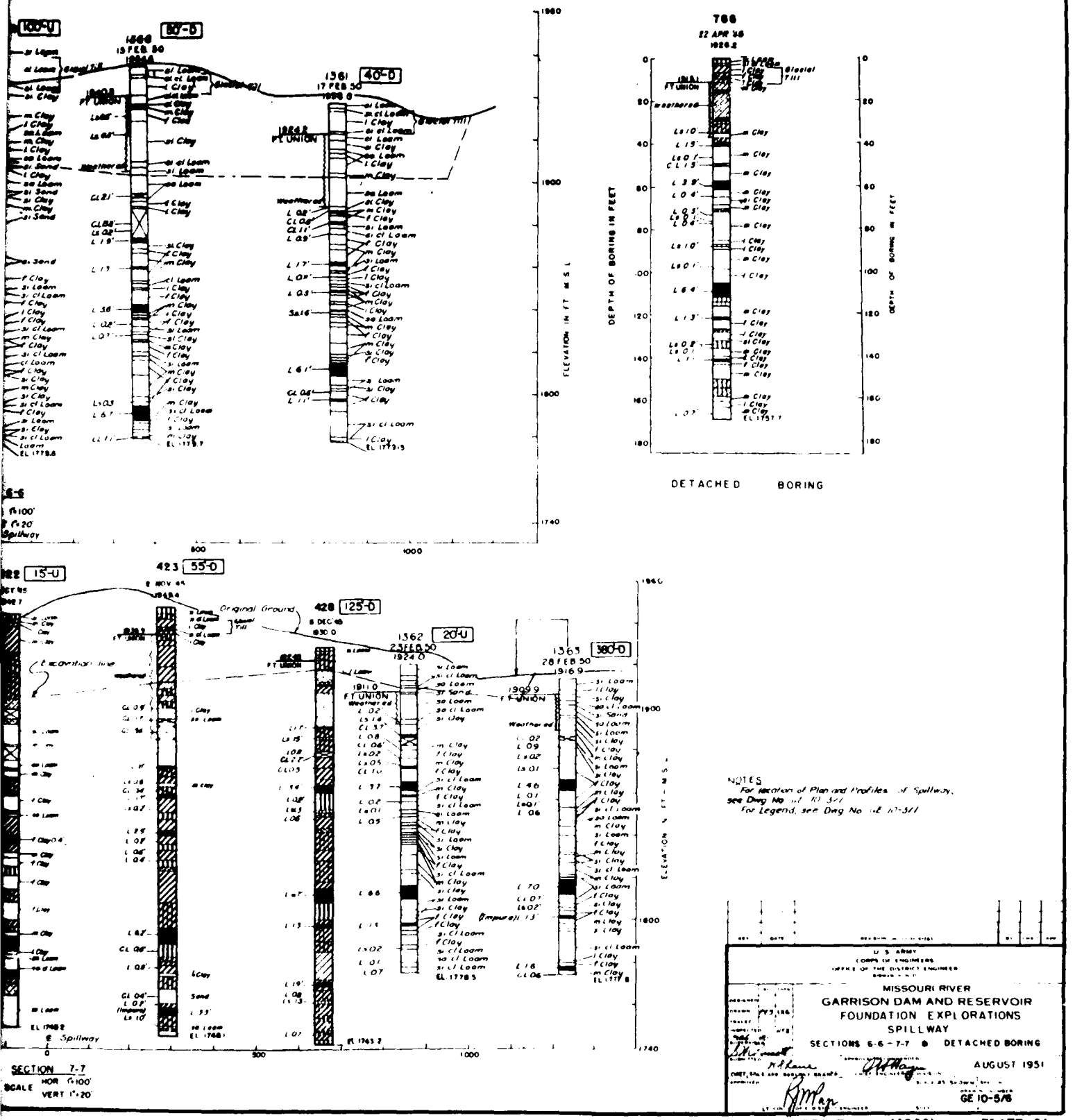
SECTION 6-6

SCALE HOR 1"=100'
VERT 1"=20'



SECTION 7-7

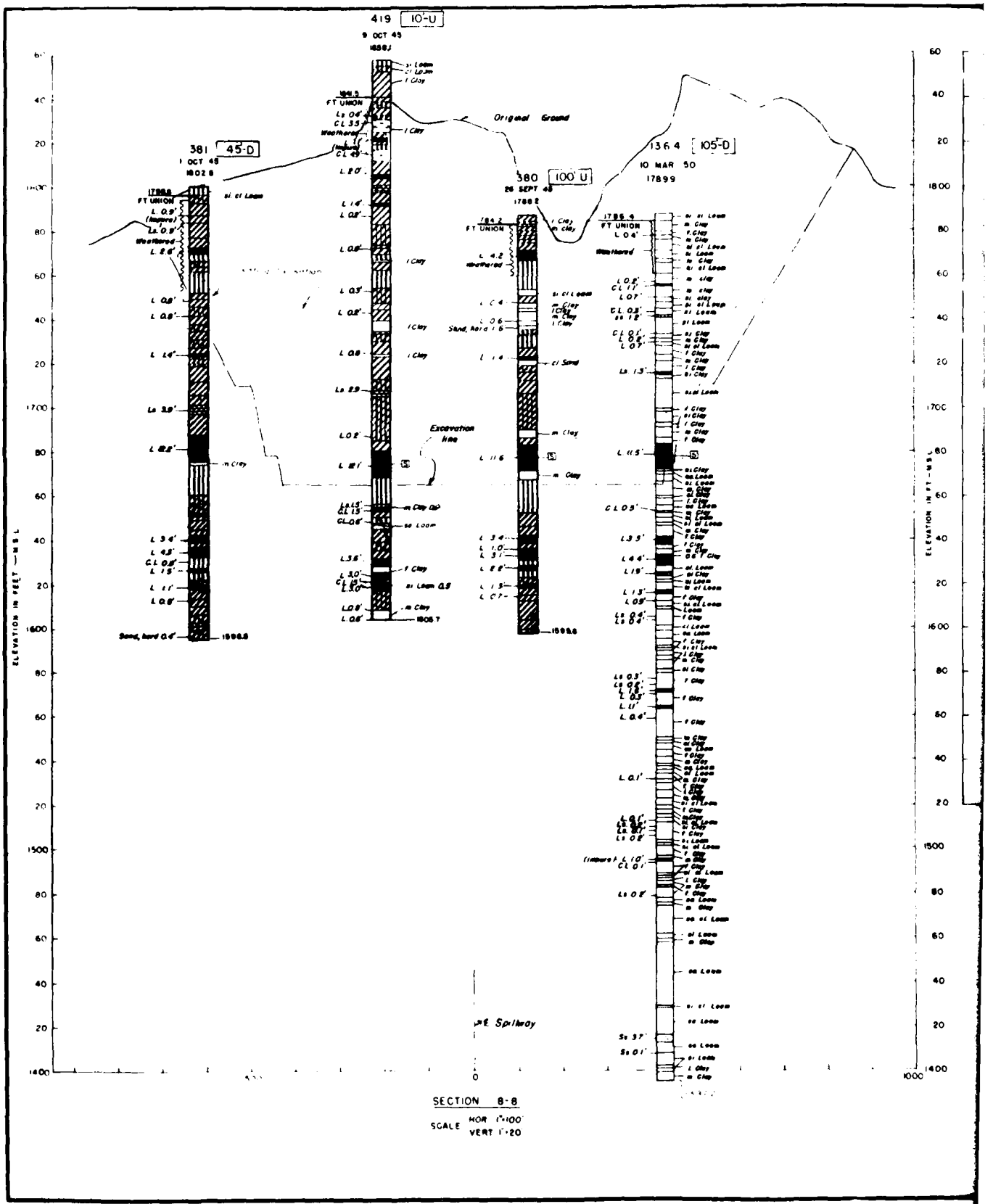
SCALE HOR 1"=100'
VERT 1"=20'

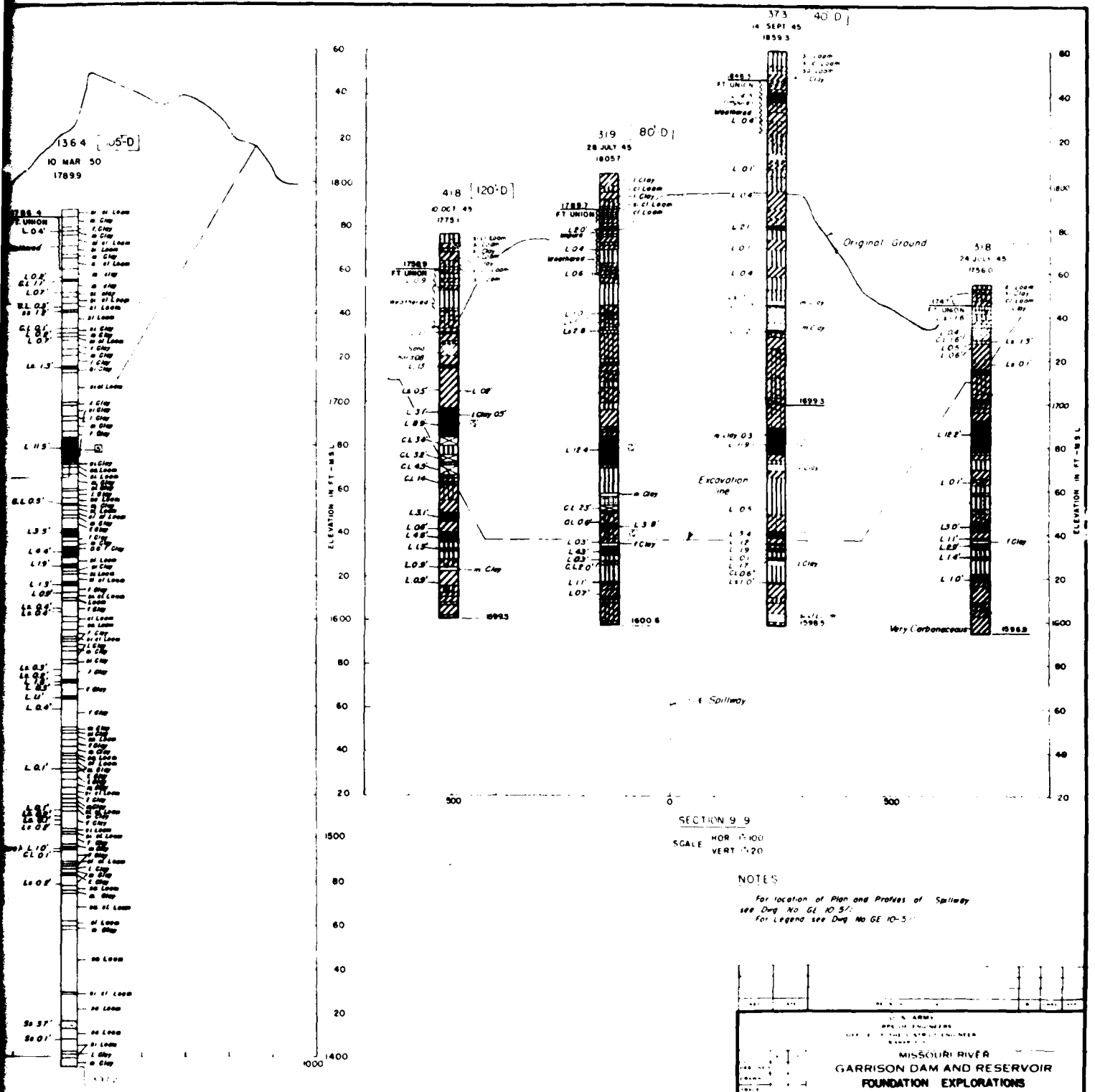


NOTES
For location of Plan and Profiles of Spillway, see Dwg No ... (E 10-5/1)
For Legend, see Dwg No ... (E 10-5/1)

U S ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEBR

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
SPILLWAY
SECTIONS 6-6 - 7-7 & DETACHED BORING
AUGUST 1951
GE 10-5/6


419 10'-U
9 OCT 45
381 45-D
1 OCT 45
380 100'U
26 SEPT 45
1364 105-D
10 MAR 50
17899
Original Ground
Excavation line
SE Spillway
ELEVATION IN FEET — MSL
ELEVATION IN FT — MSL
SECTION 8-8
SCALE HOR 1"=100'
VERT 1"=20'



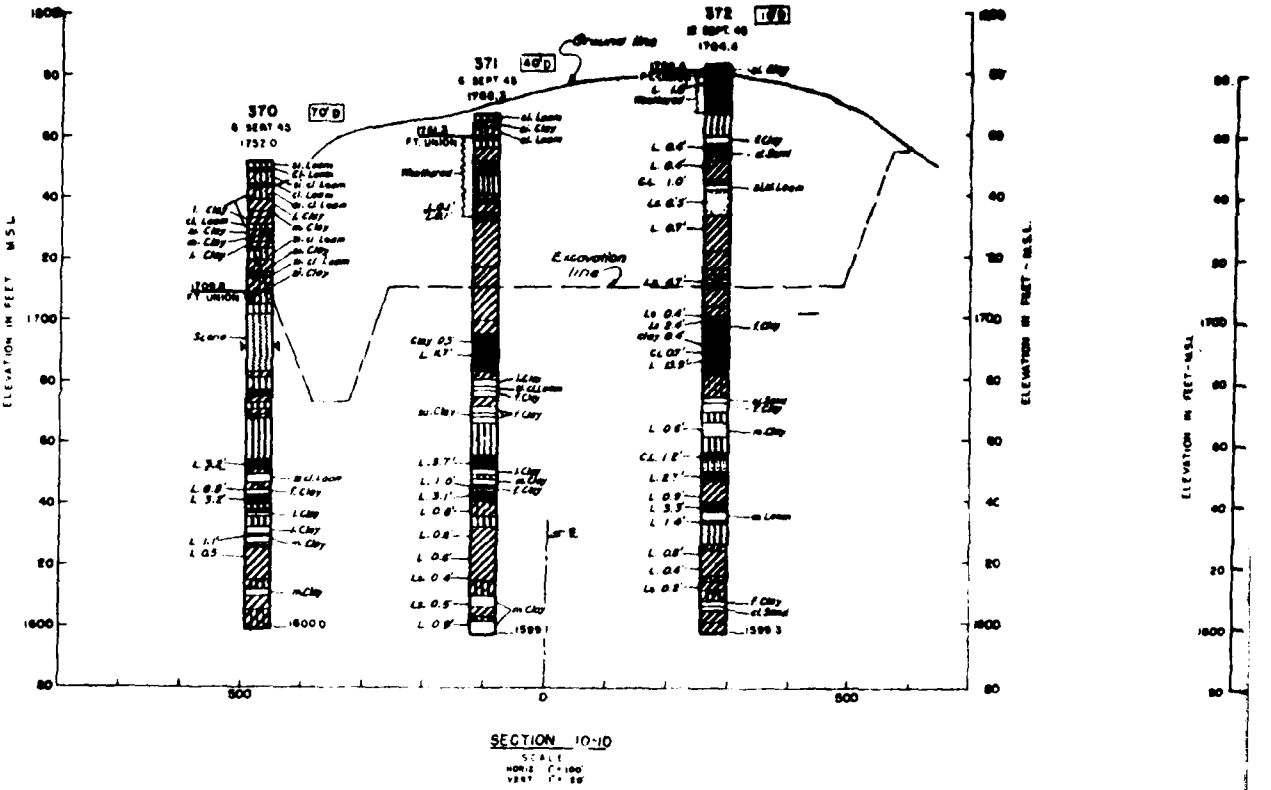
NOTES

For location of Plan and Profiles of Spillway see Drwg No GE 10-5/1
For Legend see Drwg No GE 10-5/1

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
SPILLWAY
SECTIONS 8-8 AND 9-9

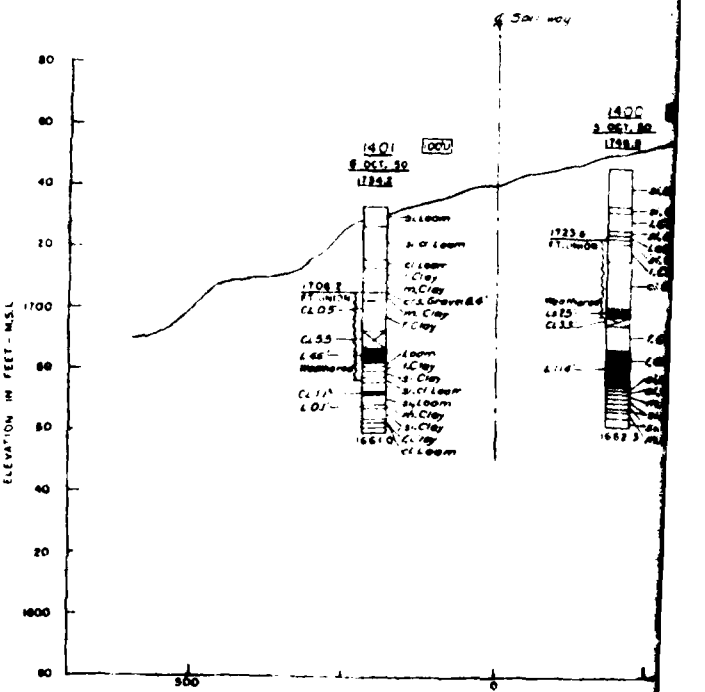
AUGUST 1951

GE 10-5/7



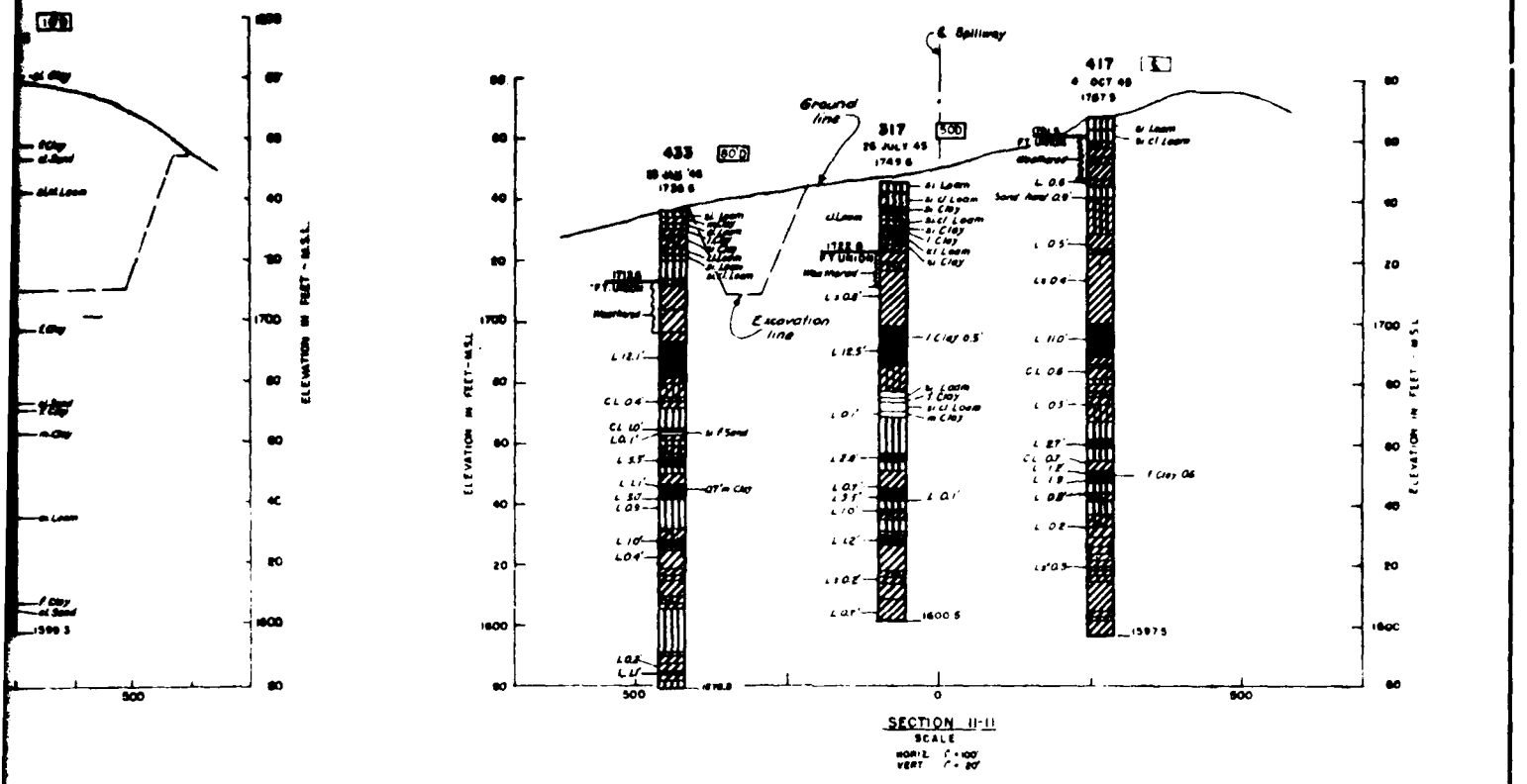
SECTION 10-10

SCALE

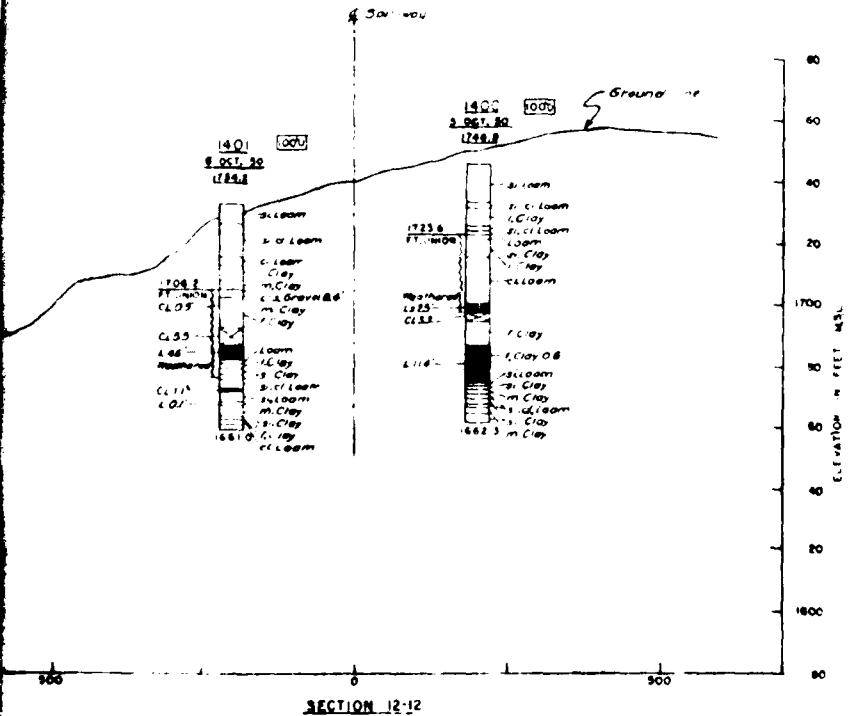


SECTION 12-12

SCALE



SECTION 11-11
SCALE



SECTION 12-12
SCALE

NOTES

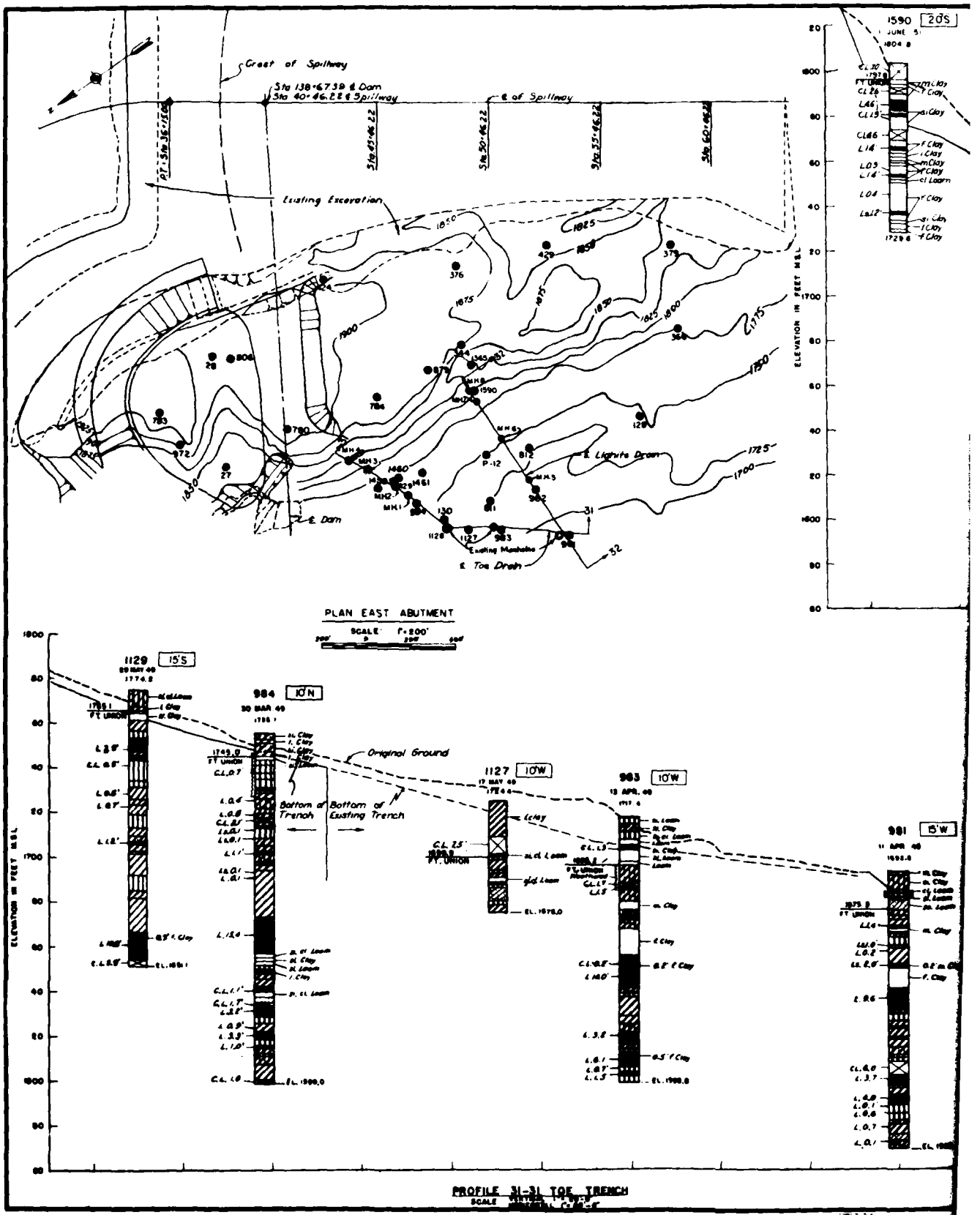
For location of Pits and trace of Spillway see Dwg No GE 10-5-1
For Legend, see Dwg No GE

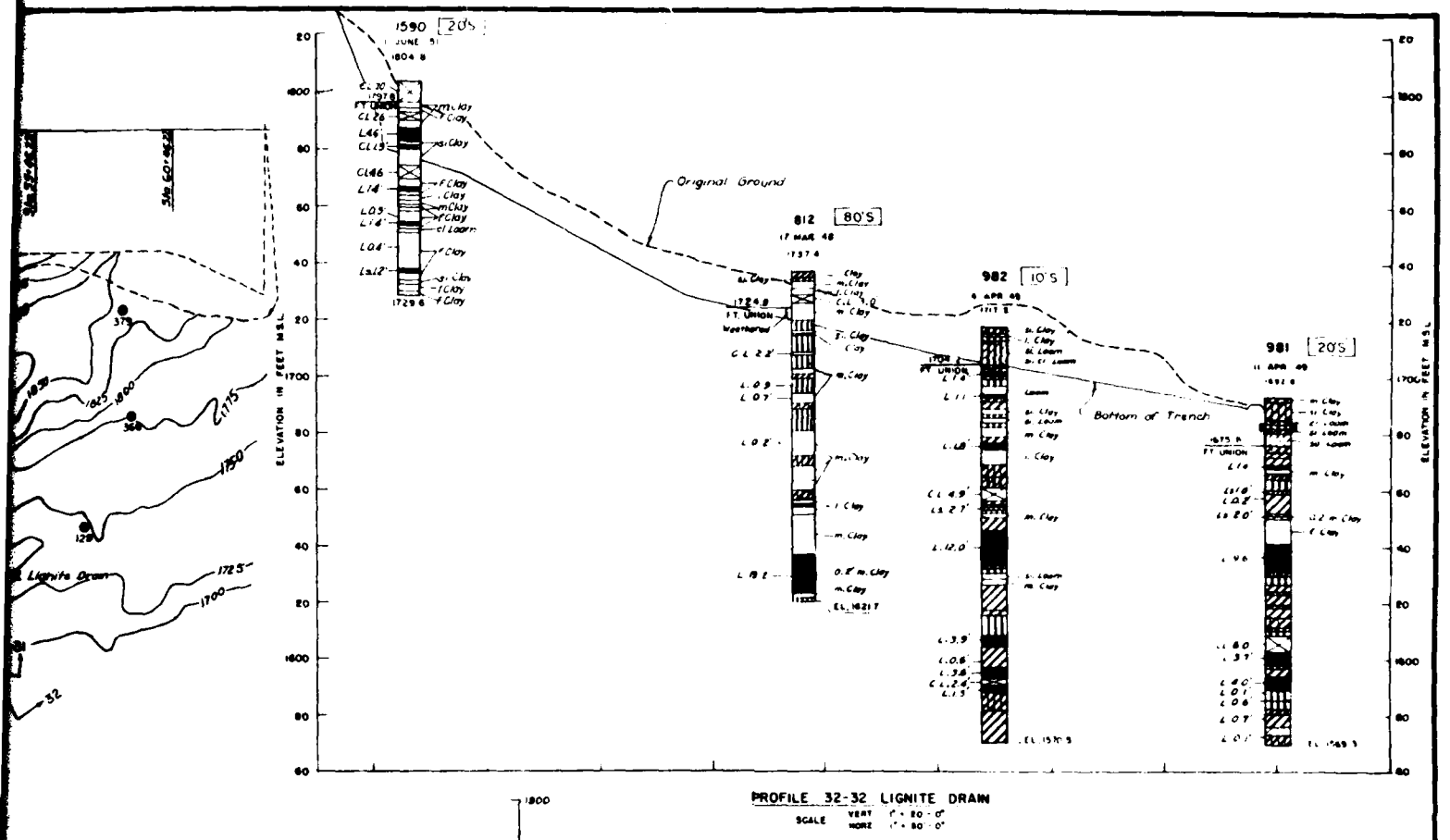
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATION
SPILLWAY
SECTIONS 10-10, 11-11, 12-12

AUGUST 1951

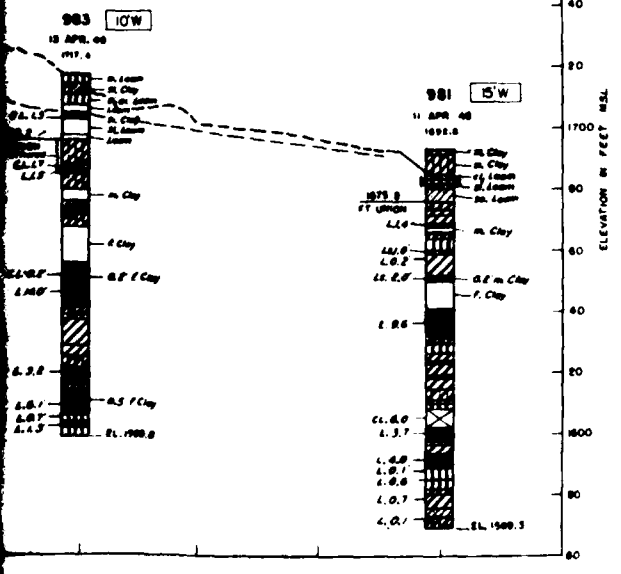
GE 10-6/8


Crest of Spillway
Sta 138+67.39 ℄ Dam
Sta 40+46.22 ℄ Spillway
℄ of Spillway
Existing Excavation
1850
1825
1900
1875
1800
1775
1750
1725
1700
℄ Dam
℄ Lignite Drain
℄ Toe Drain
Existing Manhole
MH1
MH2
MH3
MH4
MH5
1590
20S
1129
15'S
984
10'N
1127
10'W
983
10'W
981
15'W
Original Ground
Bottom of Trench
Bottom of Existing Trench
PY. UNION
ELEVATION IN FEET M.S.L.
PLAN EAST ABUTMENT
SCALE 1"=200'
PROFILE 31-31 TOE TRENCH



PROFILE 32-32 LIGNITE DRAIN

SCALE VERT 1" = 80' - 0"
HORZ 1" = 80' - 0"



NOTES

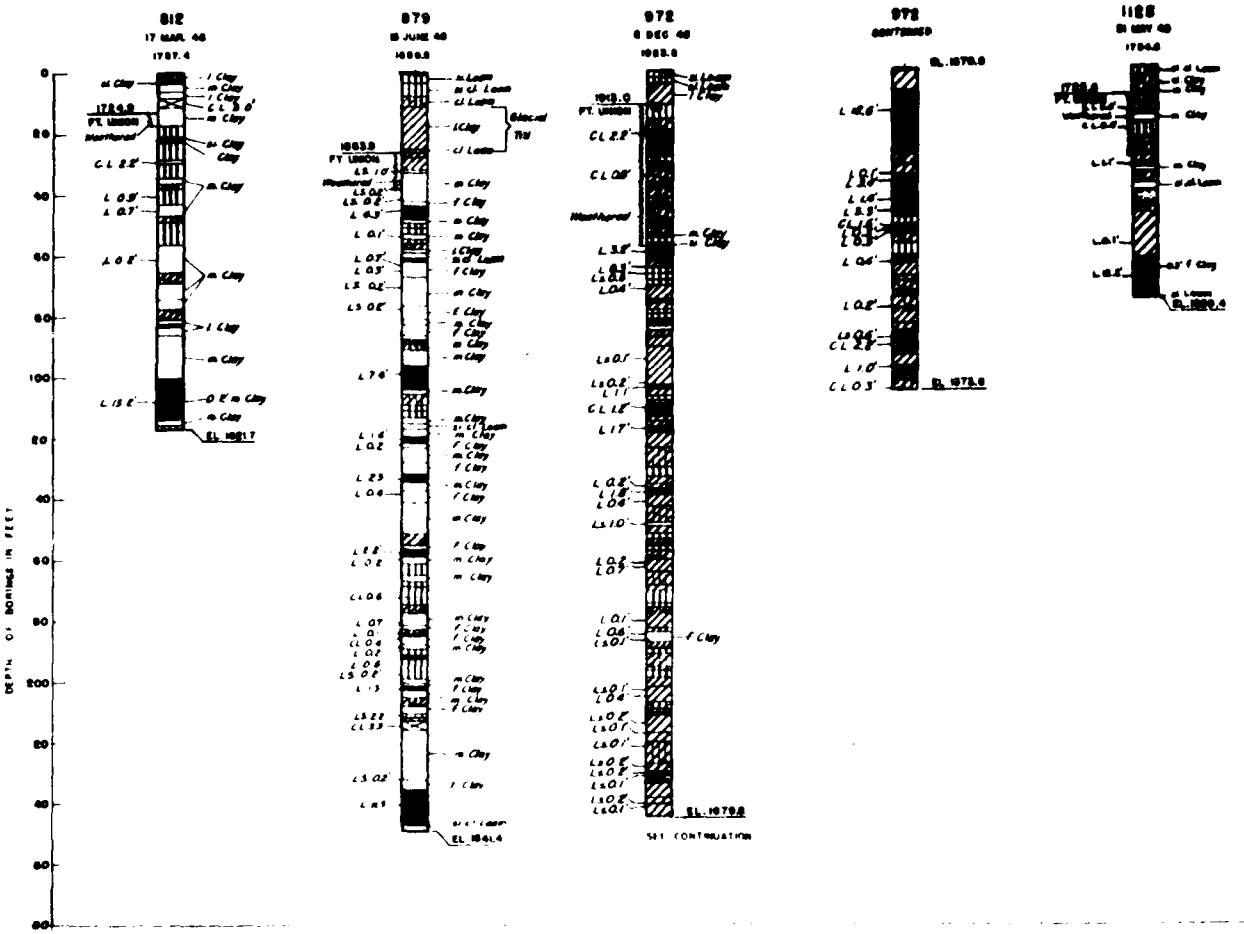
For Legend see Dwg No. SE 10-5/7
For additional Borings see Dwg Nos SE 10-5/10 & 5/11

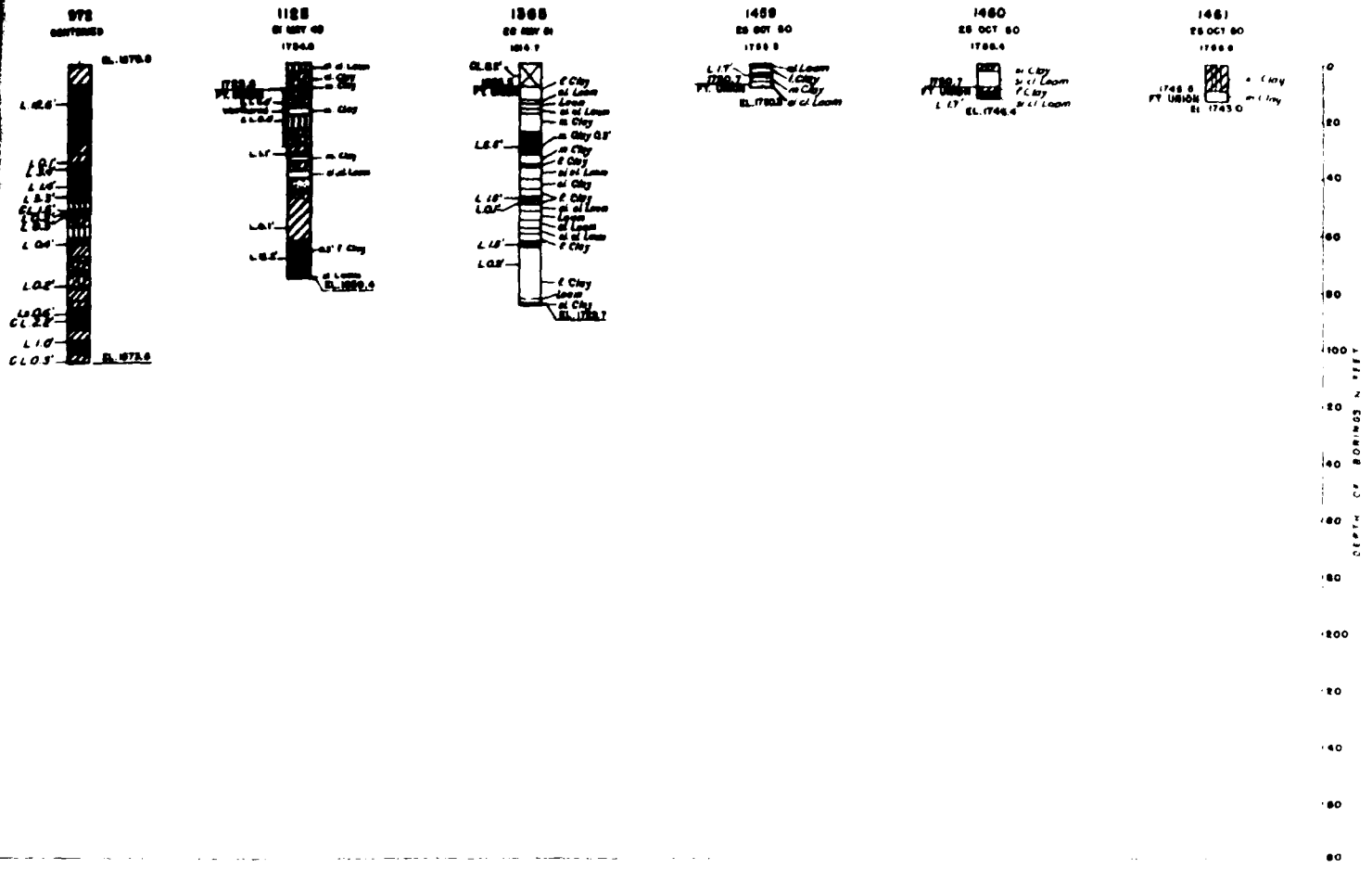
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEBR.

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
EAST ABUTMENT
PLAN AND PROFILES 31 & 32-32

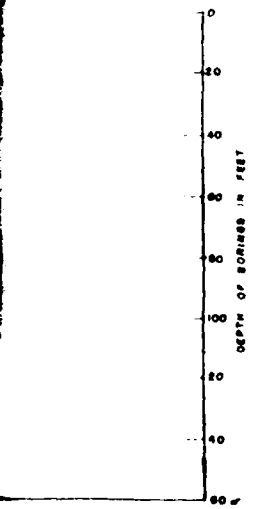
AUGUST 1951

SE 10-5/9


812
17 MAR. 46
879
972
972
CONTINUED
1188
DEPTH OF BORINGS IN FEET
DETACHED BORINGS
27
20 MAY 46
27
CONTINUED
DEPTH OF BORINGS IN FEET



DETACHED BORINGS



NOTES

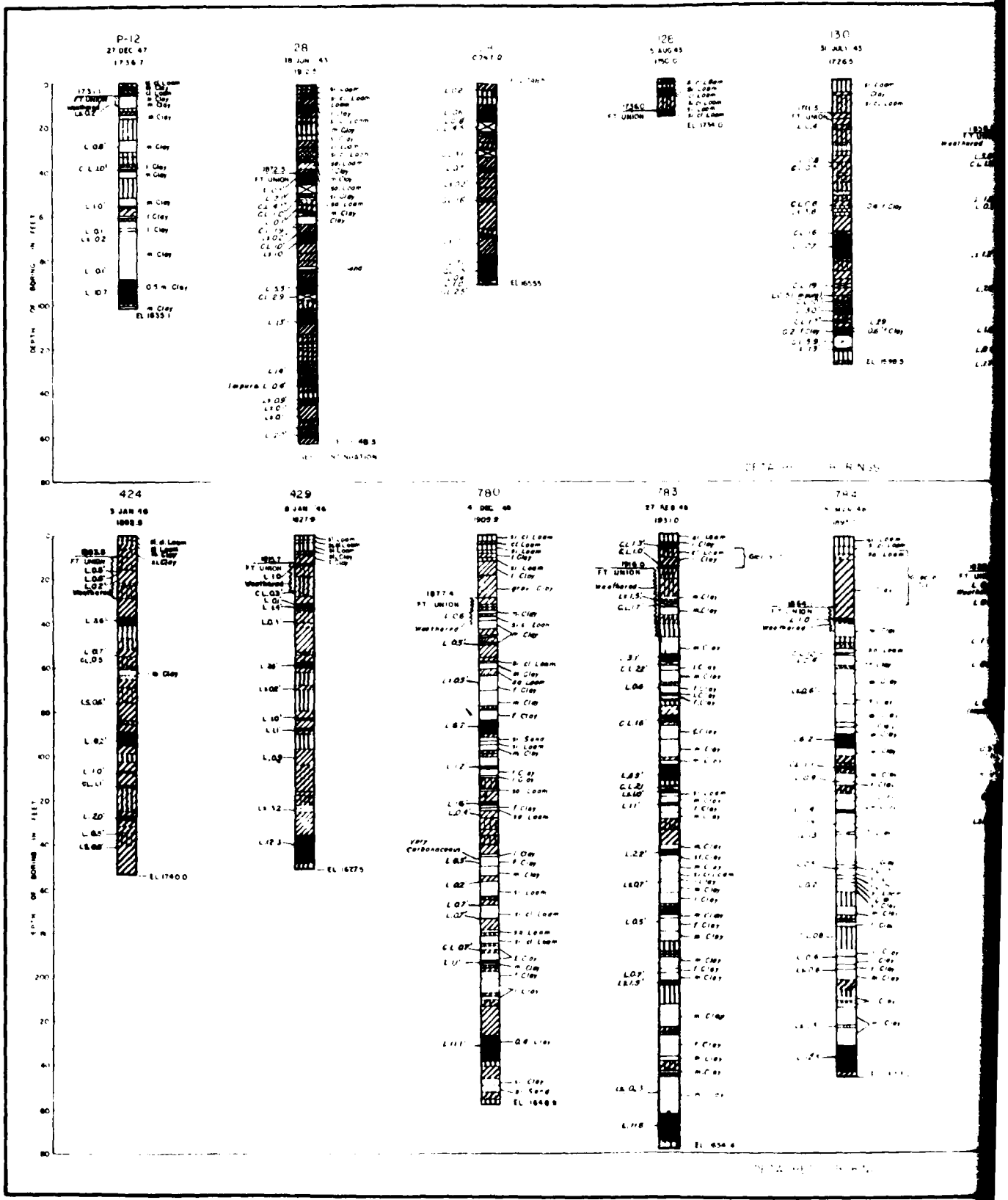
For Plan and location of Exploratory Borings see Dwg No GE 10-3/9
For Legend see Dwg No GE 10-3/1
For additional borings see Dwg Nos GE 10-3/9 & 3/1

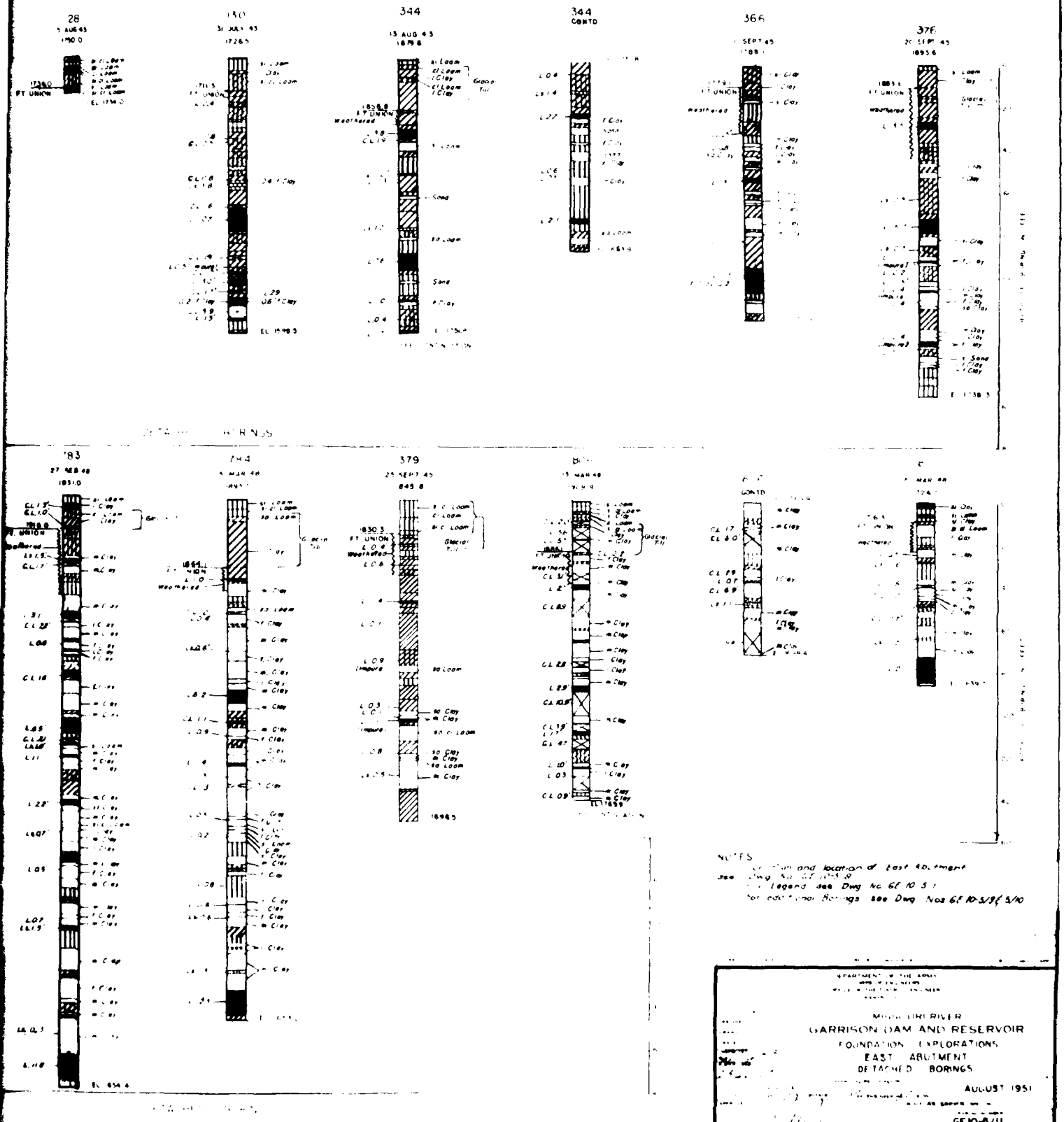
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
EAST ABUTMENT
DETACHED BORINGS

AUGUST 1951

GE 10-8/10


P-12
27 DEC 47
28
18 JUN 43
126
5 AUG 65
130
31 JUL 43
424
5 JAN 46
429
8 JAN 46
780
4 DEC 46
783
27 NOV 46
744
DEPTH OF BORING IN FEET
FT UNION
Weathered
EL 1740.0
EL 1677.5
EL 1648.9
EL 1654.6

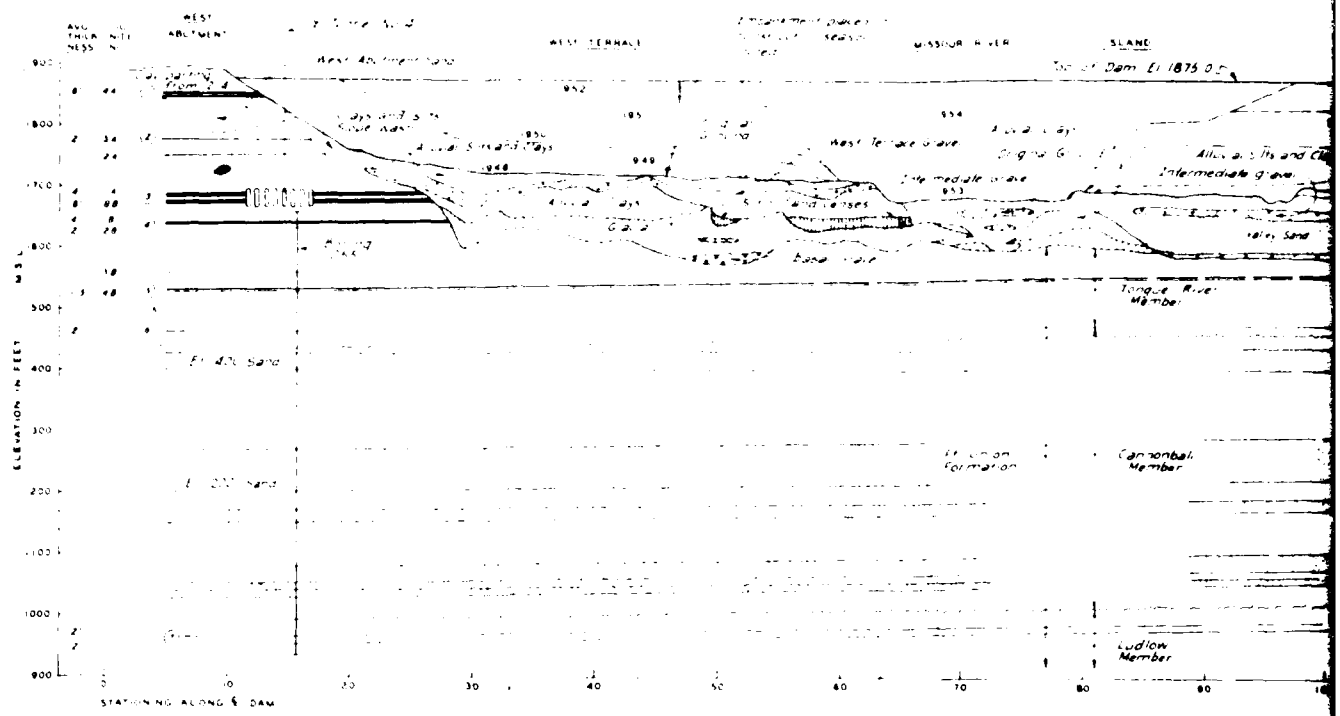


NOTES

1. For plan and location of East Abutment see Dwg No. GE 10-5-9
2. For Legend see Dwg No. GE 10-5-1
3. For additional Borings see Dwg Nos GE 10-5/9f 5/10

DEPARTMENT OF THE ARMY
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
FOUNDATION EXPLORATIONS
EAST ABUTMENT
DETACHED BORINGS
AUGUST 1951
GE 10-6/11

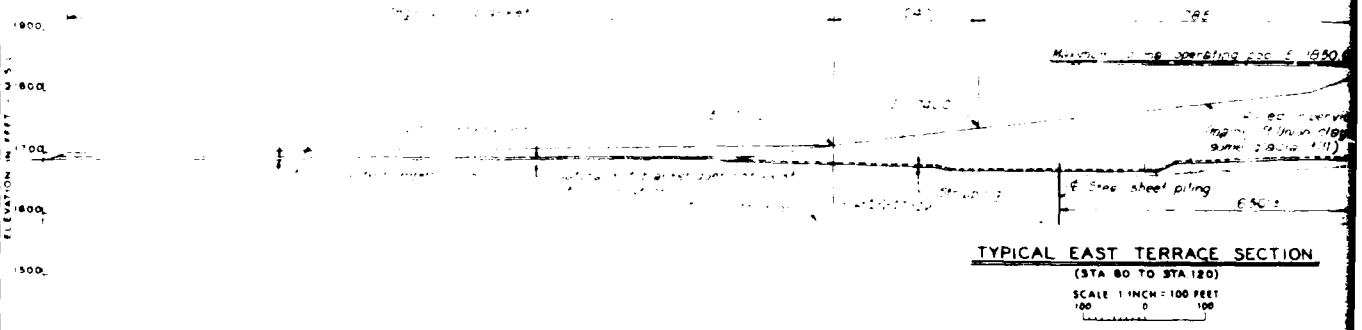
CORPS OF ENGINEERS



LONGITUDINAL PROFILE - ℄ DAM

LOOKING UPSTREAM

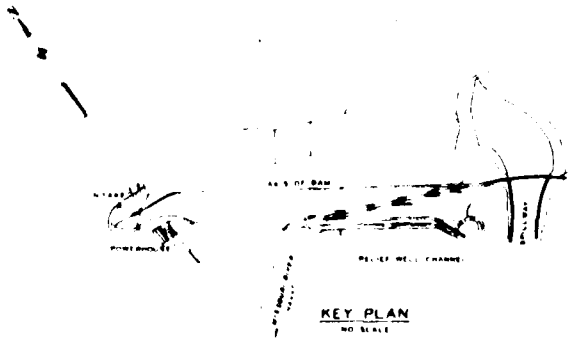
SCALE: HOR 1 IN = 500 FT
VERT 1 IN = 100 FT



TYPICAL EAST TERRACE SECTION

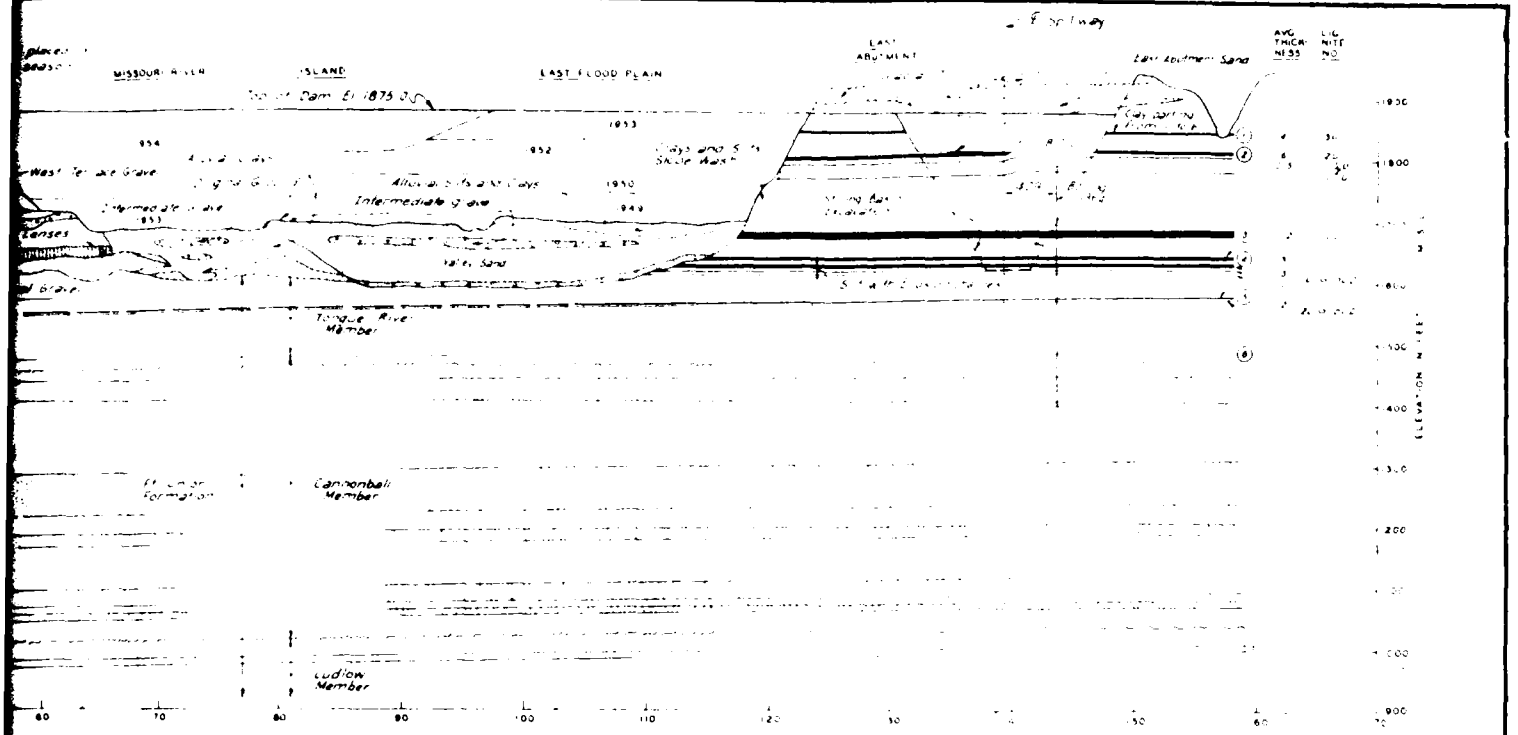
(STA 80 TO STA 120)

SCALE 1 INCH = 100 FEET
100 0 100



KEY PLAN

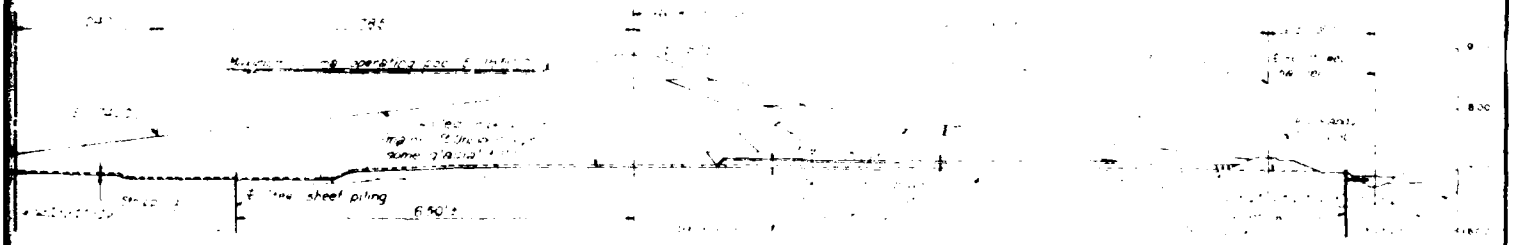
NO SCALE



LONGITUDINAL PROFILE - ℄ DAM

LOOKING UPSTREAM

SCALE: HOR 1 IN = 500 FT
VERT 1 IN = 100 FT



TYPICAL EAST TERRACE SECTION

(STA 80 TO STA.120)

SCALE 1 INCH = 100 FEET

100 0 100

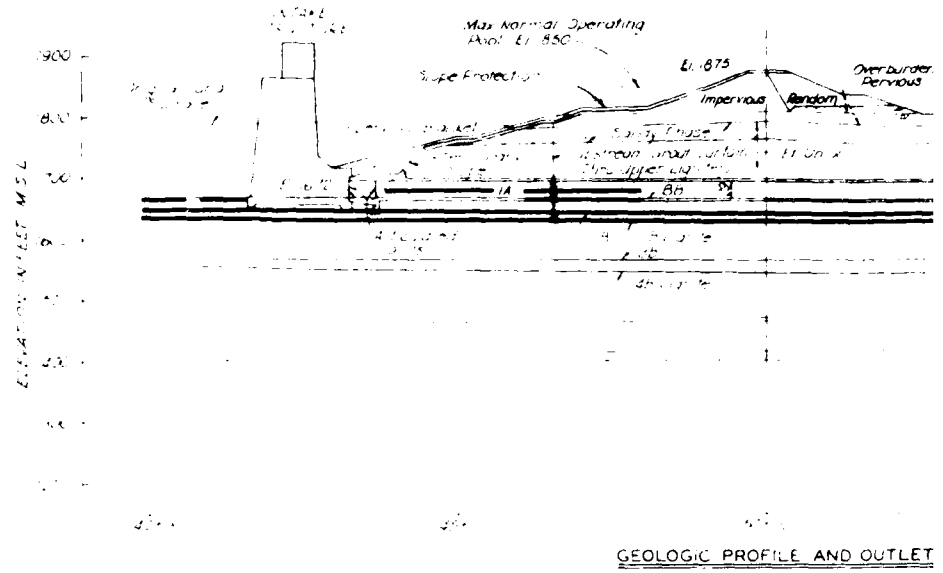
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

MISSOURI RIVER

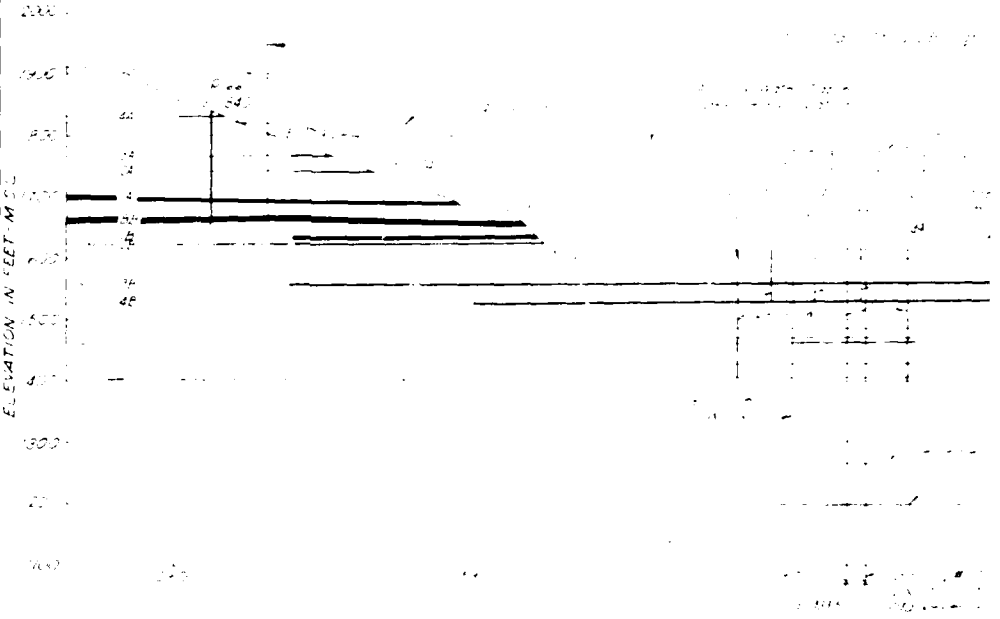
GARRISON DAM AND RESERVOIR
UNDERSEEPAGE STUDIES
GENERALIZED GEOLOGIC PROFILE
AND SECTION

THIS PLAN ACCOMPANIES CONTRACT No
DA 25 066 eng MODIFICATION No

CORPS OF ENGINEERS



GEOLOGIC PROFILE AND OUTLET

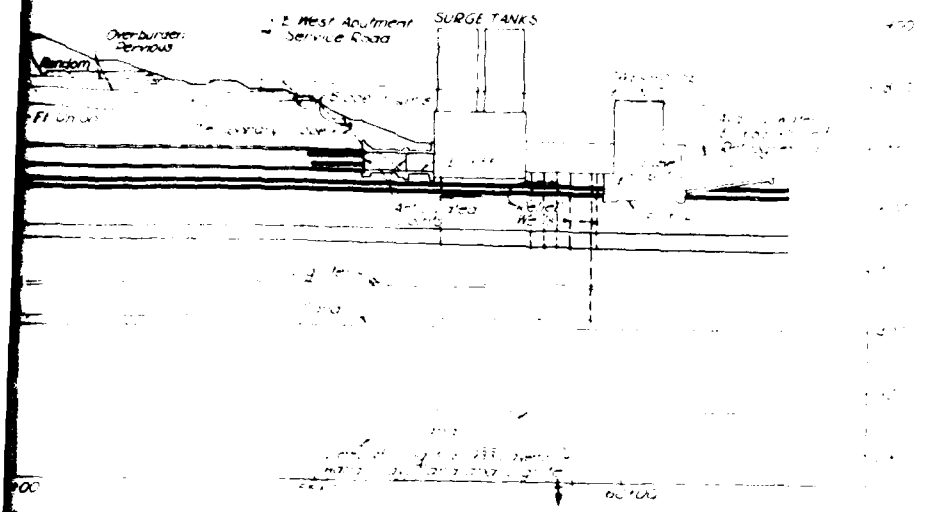


GEOLOGIC SECTION AT STA

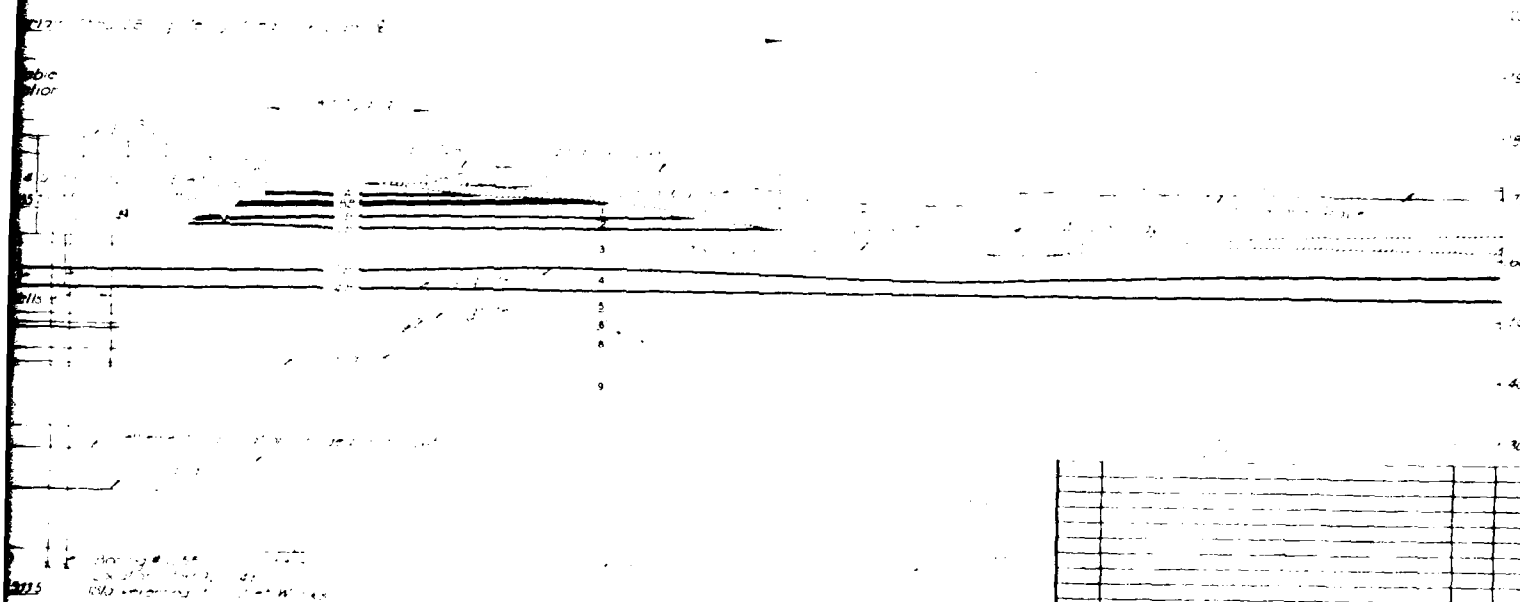
UNITS LOOKING NORTH
SCALE 1 INCH =

A PAPER REPRODUCIBLE "RECORD COPY" MUST BE MADE BEFORE EVERY ADDENDA AND/OR MODIFICATION

ADDENDUM NO.	DATE	MODIFICATION DATE



ILE AND OUTLET WORKS



SECTION AT STA 159+75

UNITS LOOKING NORTH

SCALE: 1 INCH = 100 FEET

GENERAL NOTES

SAFETY PAYS

THIS PLAN ACCOMPANIES CONTRACT NO DA-25-066-eng

MODIFICATION NO

DATE	DESCRIPTION	MADE	APPRD
	REVISIONS		

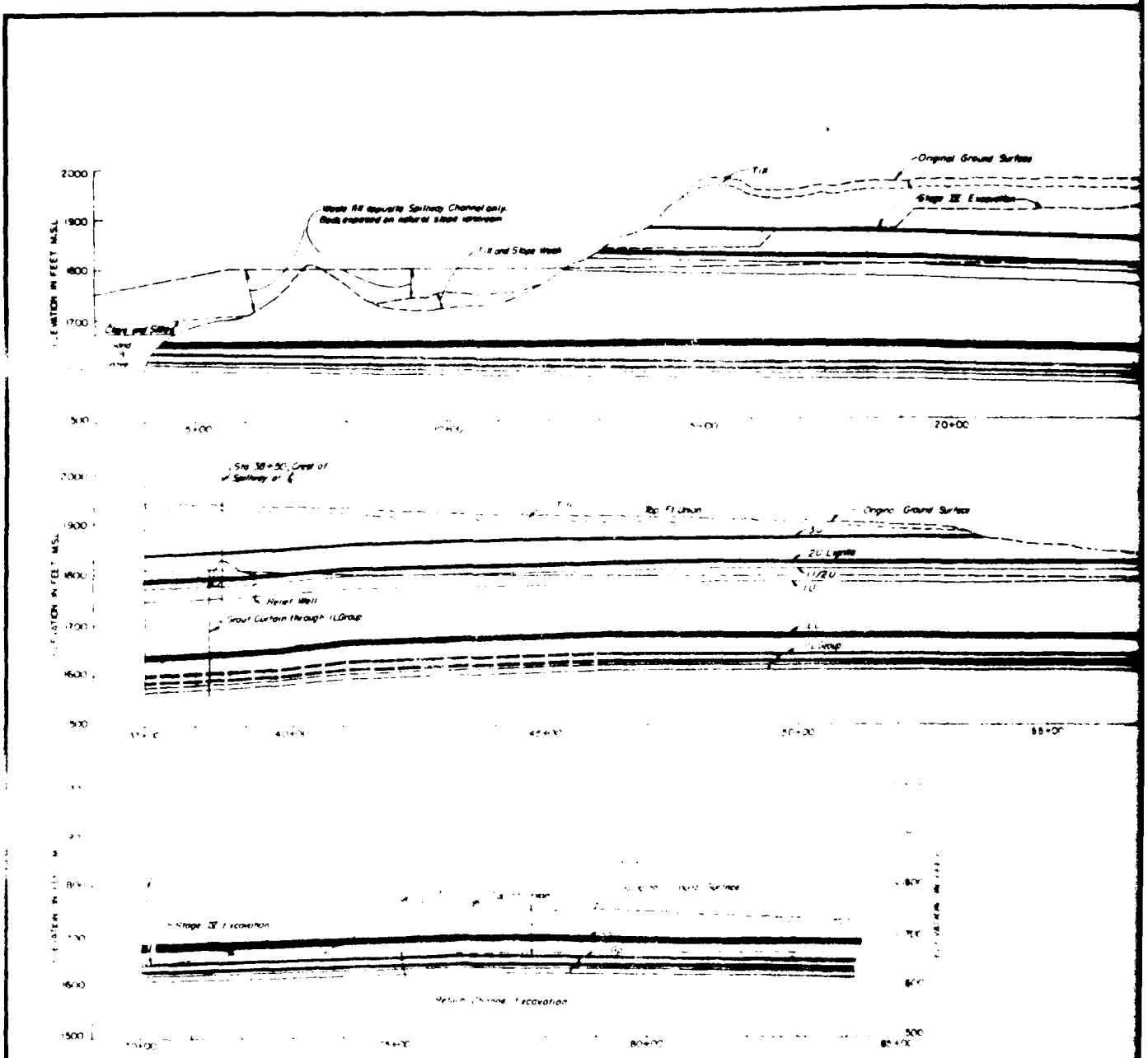
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

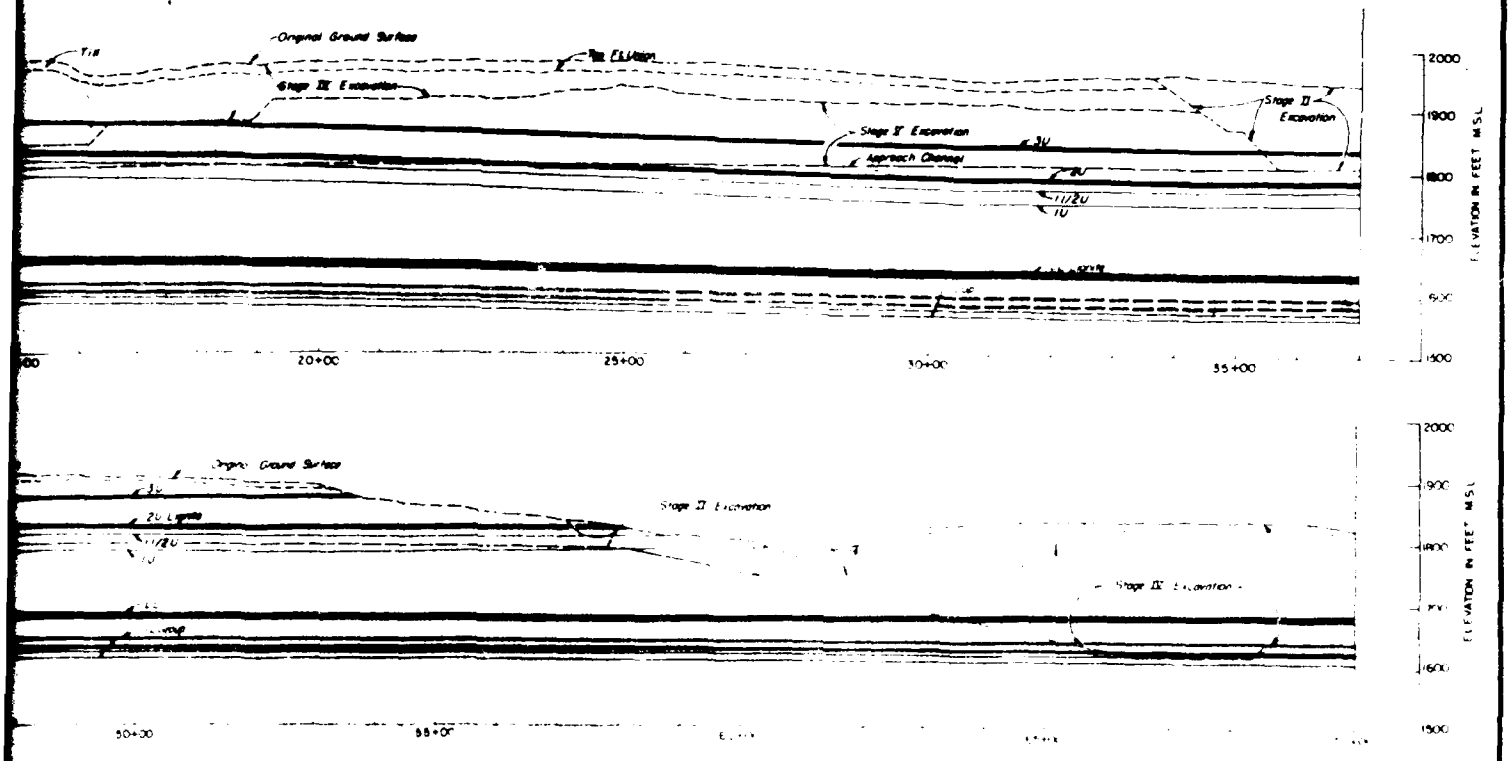
MISSOURI RIVER

GARRISON DAM AND RESERVOIR
UNDERSEEPAGE STUDIES
GEOLOGIC PROFILE OF OUTLET WORKS AND GEOLOGIC SECTION THRU POWERHOUSE

DESIGNED BY GMA
DRAWN BY REA C.J.B.
TRACED BY REA J.B.
CHECKED BY GMA
SUBMITTED BY
RECOMMENDED
APPROVED
CHIEF, ENGINEERING DIVISION
DATE MAY 1964
APPROVED
CHIEF, ENGINEERING & DESIGN BRANCH
SCALE AS SHOWN
SPEC. NO.
DRAWING NUMBER
CHIEF, U.S. DISTRICT ENGINEER
SHEET

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 41


Original Ground Surface
Stage III Excavation
Waste fill opposite Spillway Channel only
Fill and Slope Wash
Sta. 38+50, Crest of Spillway at ℄
Original Ground Surface
Sheet Pile Wall
Grout Curtain through ILGroup
Stage III Excavation

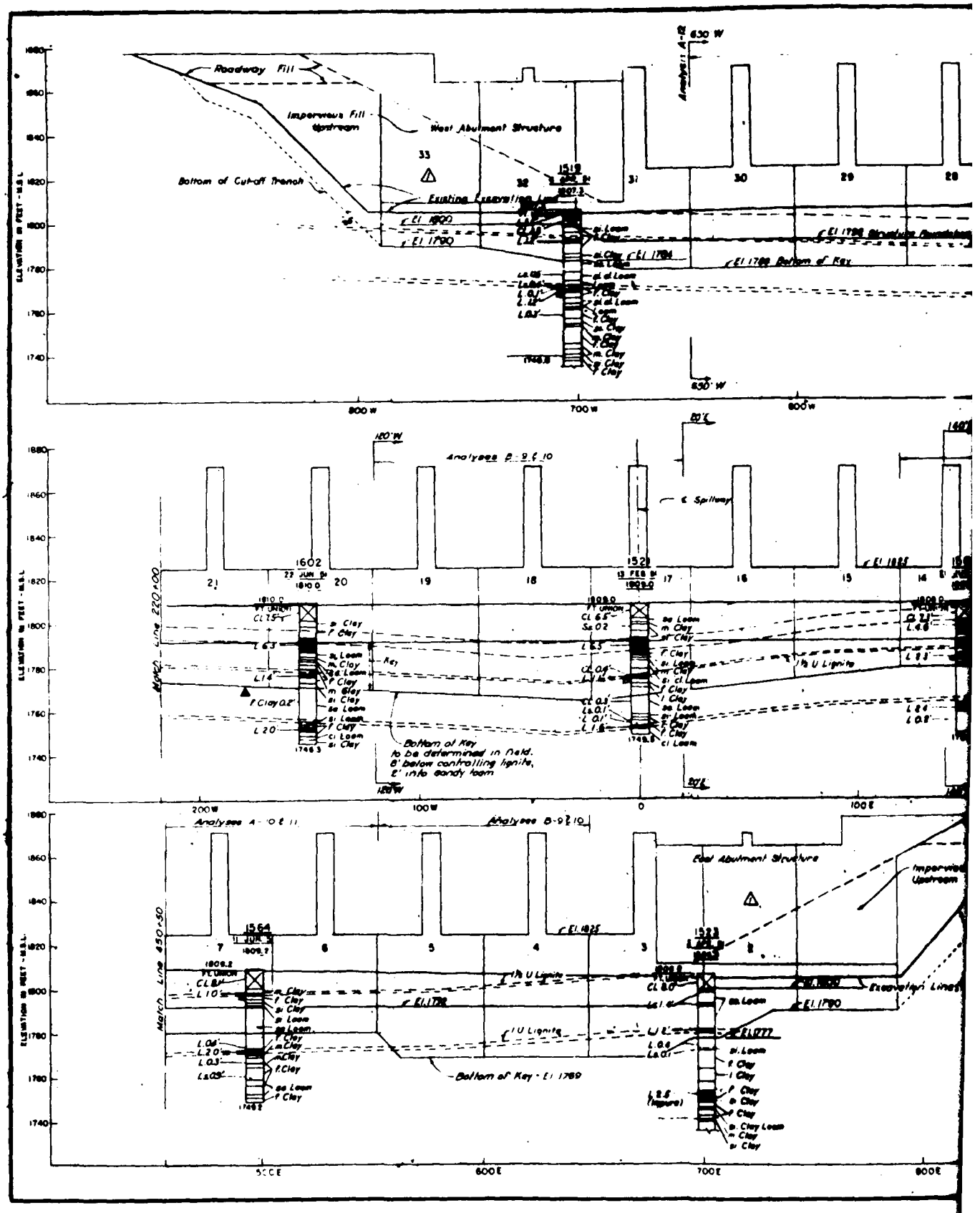


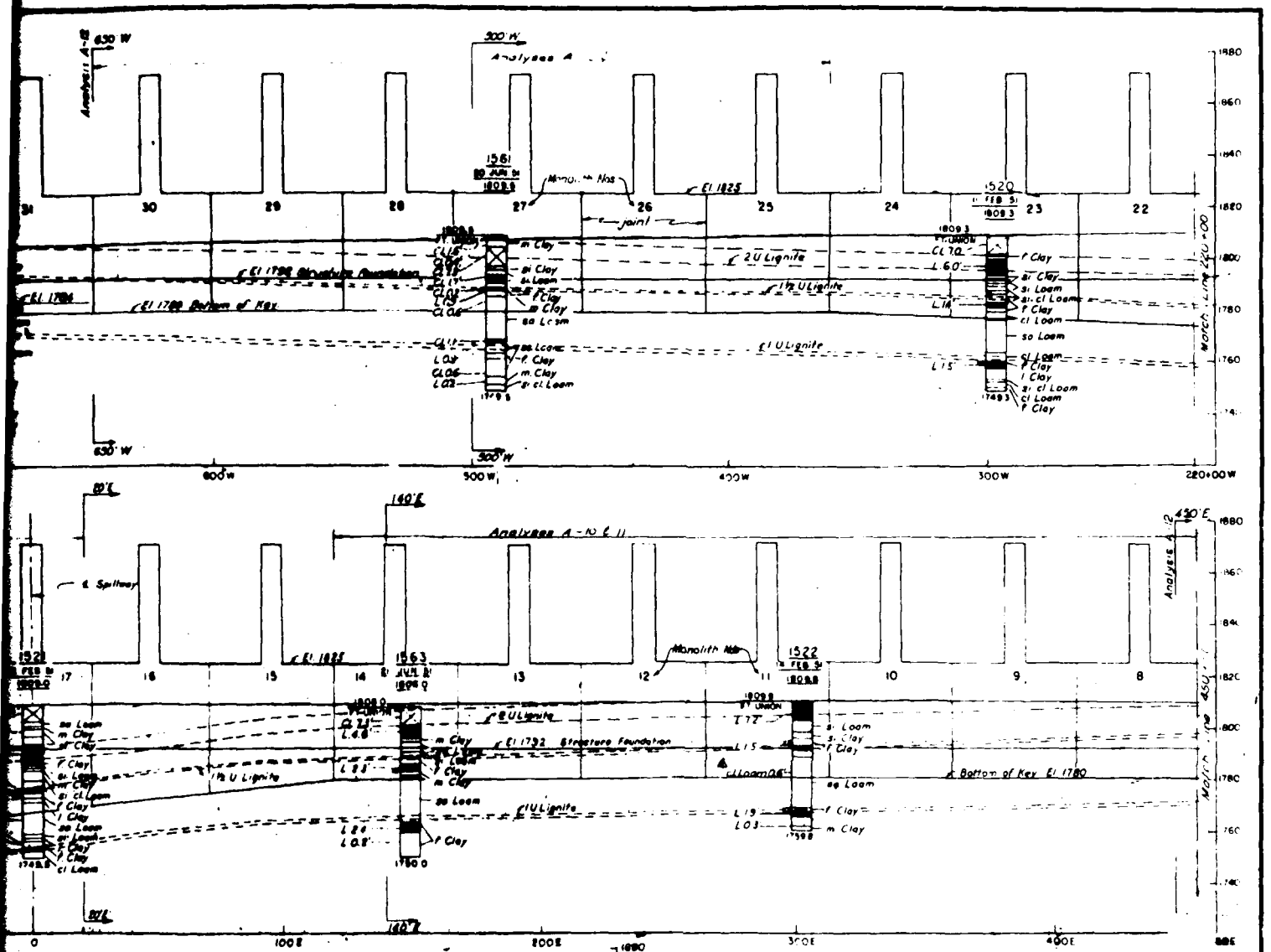
U. S. ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

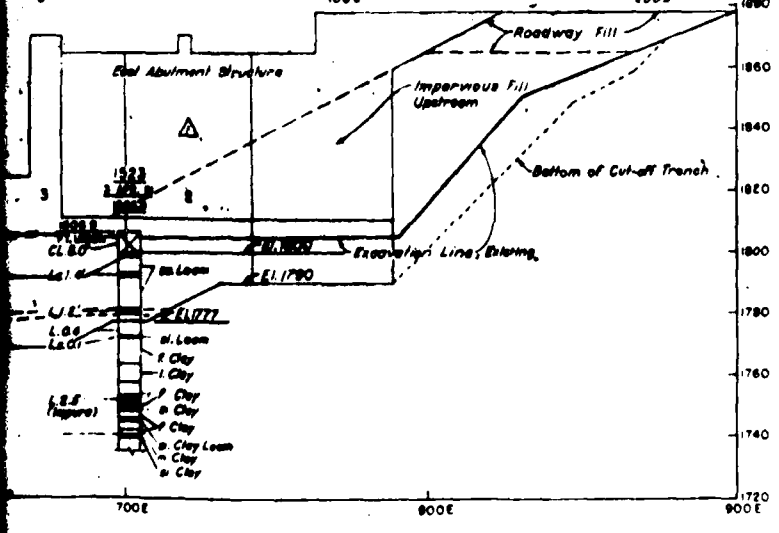
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SPILLWAY
GENERALIZED GEOLOGIC PROFILE
CENTERLINE OF CHANNEL

DECEMBER 1959

GSX-5721


Roadway Fill
Impervious Fill Upstream
West Abutment Structure
Bottom of Cut-off Trench
Existing Excavation Line
El 1800
El 1790
El 1784
El 1788 Bottom of Key
Analyses A-12
650' W
800 W
700 W
600 W
Analyses B-9 & 10
℄ Spillway
Key
Bottom of Key to be determined in field. 8' below controlling lignite, 2' into sandy loam
180'W
200W
100W
0
100E
Analyses A-10 & 11
Analyses B-9 & 10
March Line 220+00
March Line 450+50
Coal Abutment Structure
Impervious Upstream
Excavation Lines
Bottom of Key - El 1789
500E
600E
700E
800E
ELEVATION IN FEET - U.S.L.





NOTES:

Borings located 55' upstream of ℄ Crest, position of lignite beds taken from contour studies of each bed.
The symbol XX indicates slickensides, as observed in samples.
For results of pressure tests, see Dwg No GSX-5/25
Sections 630'W, 500'W etc. indicate sections analyzed for stability, where the particular stability analyses apply, are shown. (see Dwg No GSX-5/41 for summary of stability analyses.)

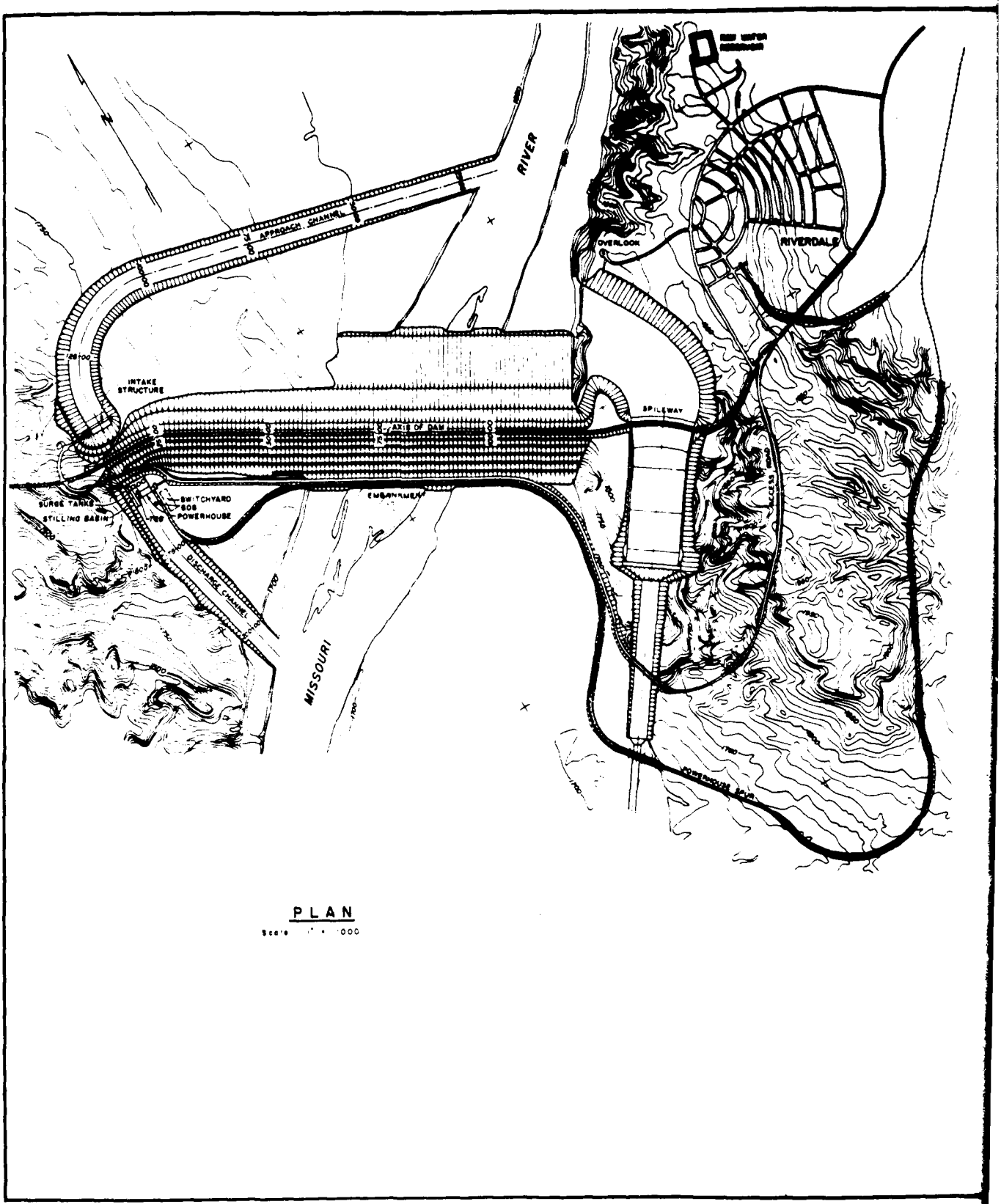
U S ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SPILLWAY
DETAILED GEOLOGIC PROFILE
℄ SPILLWAY CREST

DECEMBER 1951

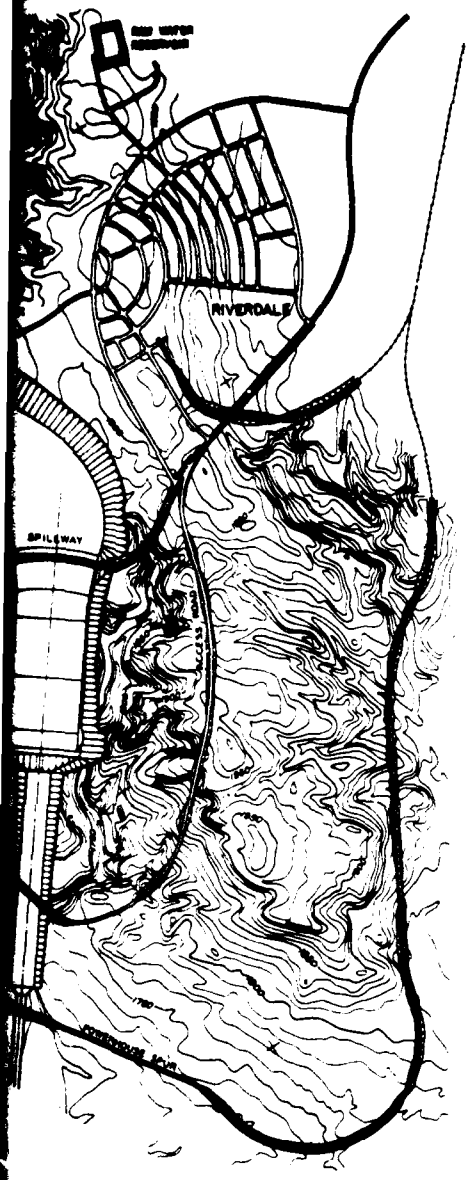
DRAWING NUMBER GSX 5/22

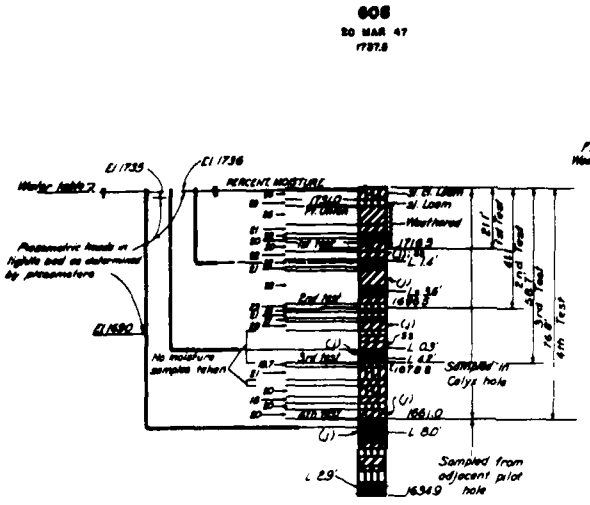
CONSTRUCTION FOUNDATION REPORT (1982) PLATE 43

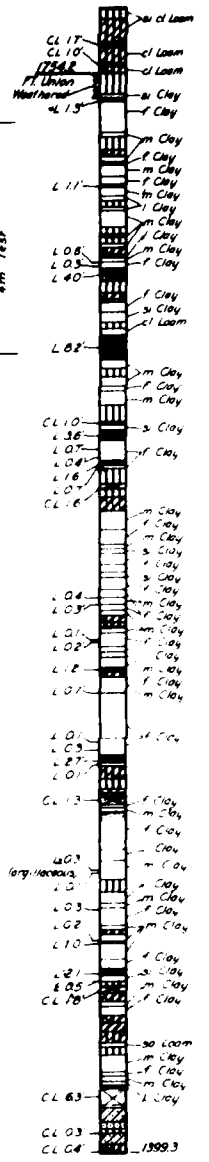


PLAN

Scale 1" = 1000







GRAIN SIZE SYMBOLS

SAND — SILT

GRAVEL — CLAY

Symbols represent grain size distribution, predominant types by heavy lines, modifying types by light lines

OTHER SYMBOLS

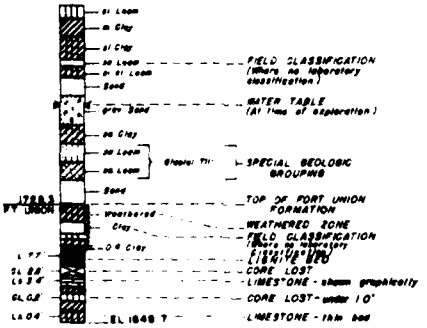
LIMESTONE — LIGNITE — CORE LOST

SCORIA — LIGNITE (isotropic coincided) — FISHPOLED (trash boring not sampled)

87 ____ HOLE NUMBER

28 MAR 47 ____ DATE HOLE COMPLETED

1788.4 ____ ELEV TOP OF HOLE



grav — gravelly
sa — sandy
sl — silty
cl — clayey

l — lean (clay)
m — medium (clay)
f — fat (clay)
( ) — joints
ss — slickensides

Lean, medium & fat clays are not differentiated in Fort Union

Fine, medium & coarse sands are not differentiated in both overburden and Fort Union, strata less than 1.0' thick not shown, being combined with the most similar material above or below except thicknesses of 0.1' are indicated for lignite, limestone, core loss, and foreign material within a salvageable lignite bed

NO.	DATE	REVISION (indicated by △)	BY	APP'D

CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
BISMARCK, N.D.

COMPILED
DRAWN
TRACED
COMPUTED
CHECKED

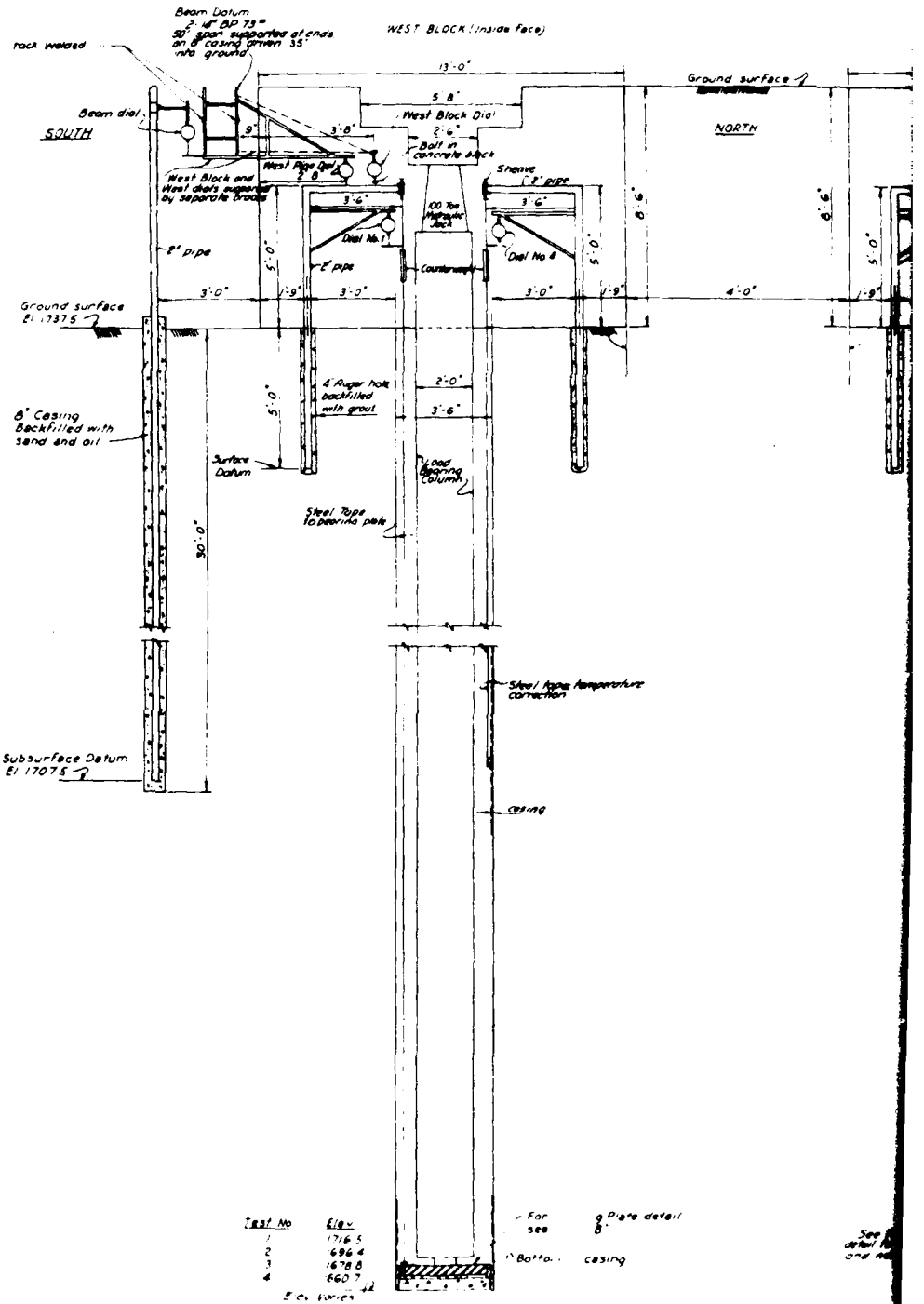
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SOIL PROFILE & LOCATION OF BEARING TEST HOLE NO. 608

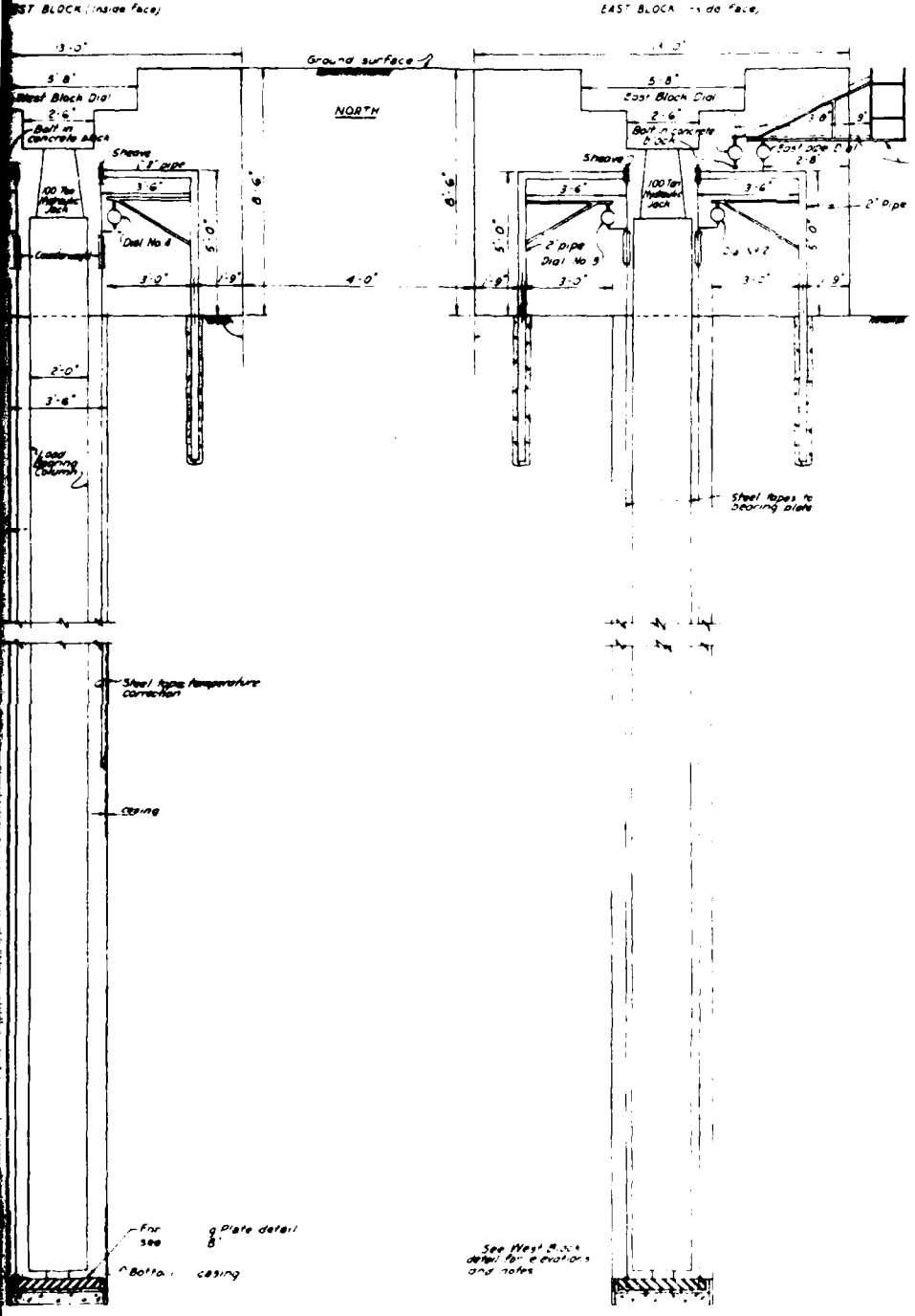
SUBMITTED
RECOMMENDED
APPROVED

December 1947

SCALE AS SHOWN
DRAWING NUMBER
GDR - 511
SHEET

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 44


Beam Datum
2-14" BP 73 #
30' span supported at ends on 8" casing driven 35' into ground
rack welded
WEST BLOCK (Inside face)
13'-0"
Ground surface
Beam dial
SOUTH
5'8"
West Block Dial
3'8"
2'6"
Bolt in concrete block
NORTH
West Block and West dials supported by separate brace
West Pipe Dial
2'8"
Sheave
2" PIPE
3'6"
100 Ton Hydraulic Jack
Dial No 1
Dial No 4
2" pipe
2" pipe
Counterweight
5'0"
6'6"
3'0"
1'9"
4'0"
Ground surface El 17375
4 Auger holes backfilled with grout
2'0"
3'6"
8" Casing Backfilled with sand and oil
Surface Datum
Load Bearing Column
Steel Tape to bench plate
30'0"
Steel tape temperature correction
Subsurface Datum El 17075
casing
Test No
Elev
1
1716 5
2
1696 4
3
1678 8
4
660 7
For see
Plate detail 8
Bottom casing



NOTE

See "Plate 8" for construction drawing and other details

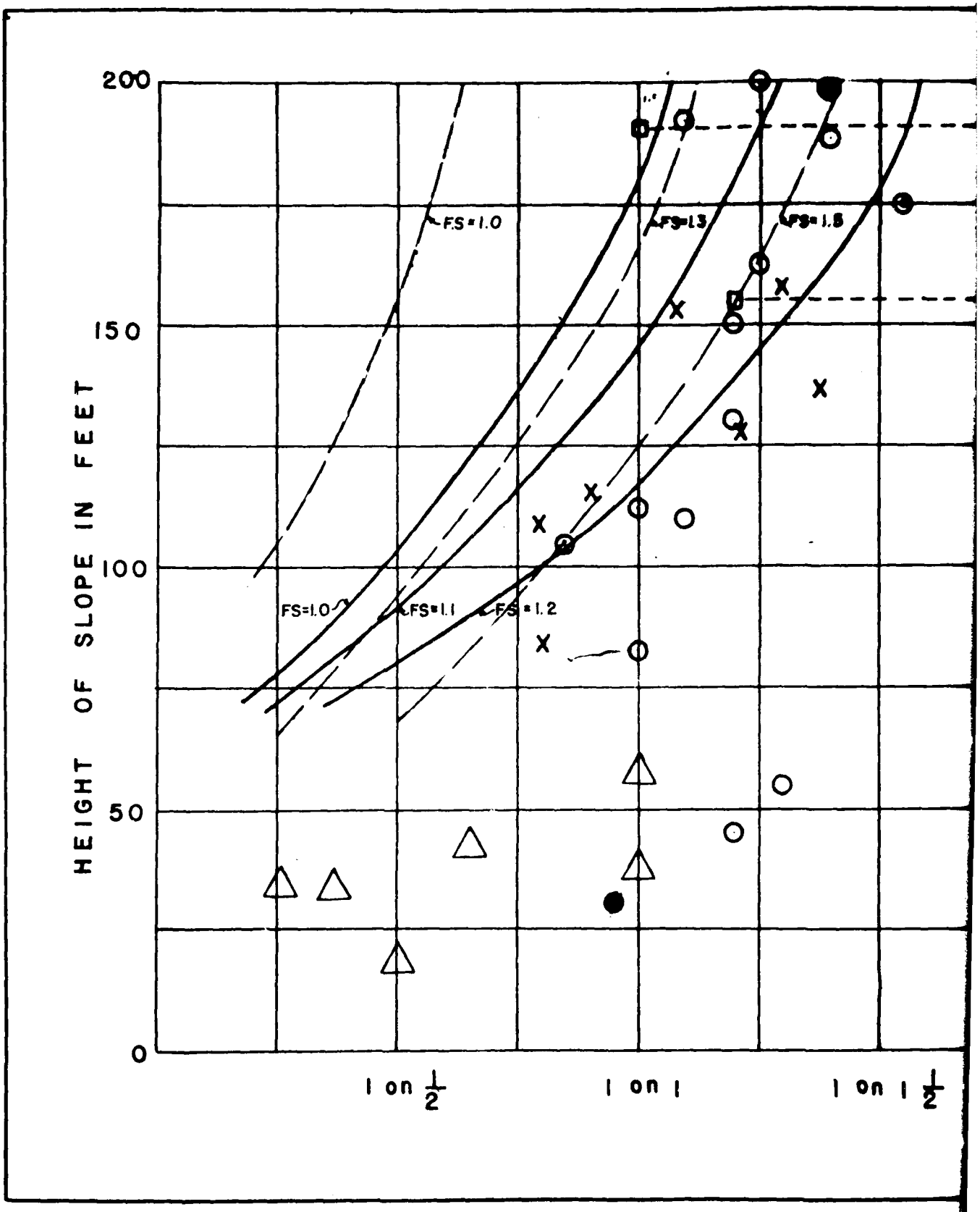
KEY	DATE	REVISION (Initialed by △)	BY

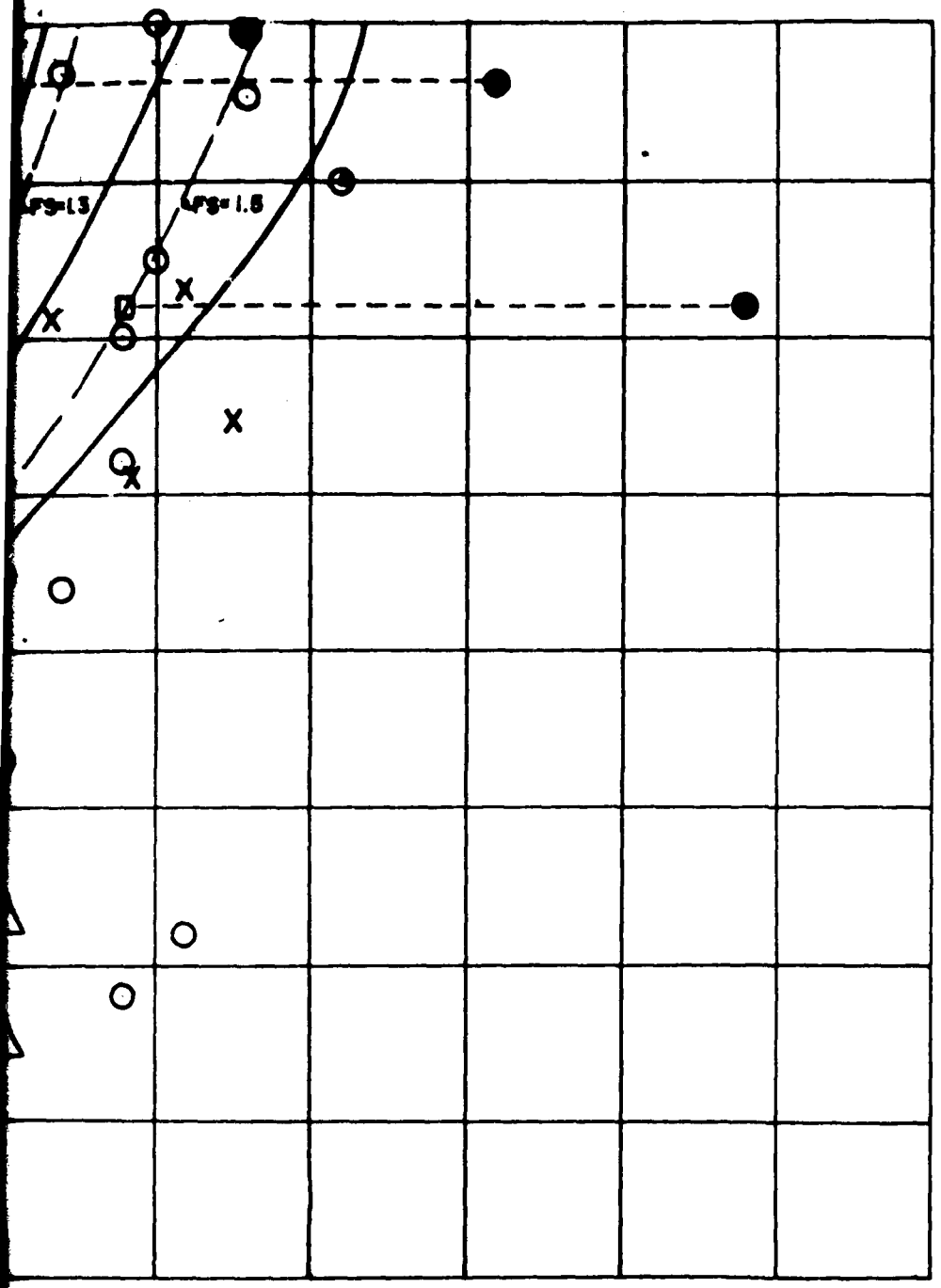
WAR DEPARTMENT
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
BISMARCK, N.D.

DESIGNED S.V.P.
DRAWN A.J. A.K.
TRACED
INSPECTED
APPROVED

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
LOAD BEARING TEST
IN 42" DIA HOLE 608 -
DIAL & DATUM LOCATIONS

SUBMITTED
DATE DEC 1947
SCALE 1"=1'-0" SPEC NO
APPROVED
DRAWING NUMBER
GVA-525
SHEET OF


200
150
100
50
0
HEIGHT OF SLOPE IN FEET
FS=1.0
FS=1.3
FS=1.5
FS=1.0
FS=1.1
FS=1.2
1 on $\frac{1}{2}$
1 on 1
1 on 1 $\frac{1}{2}$



LEGEND

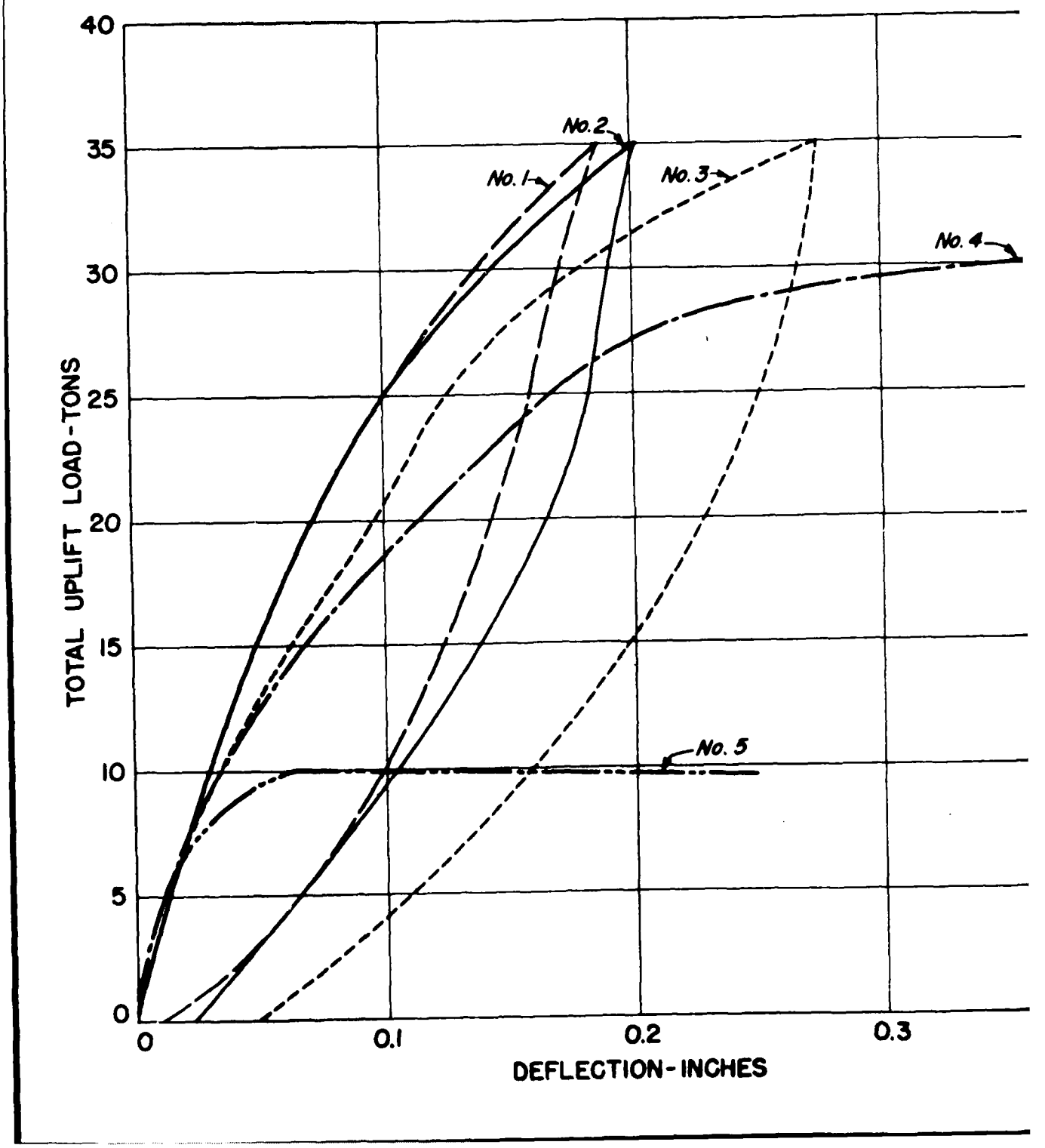
- X — TEMPORARY EXCAVATED SLOPES IN POWERHOUSE AREA
- ● — SLOPE MEASURED AFTER FAILURE
- ○ — SLOPE AS MEASURED
- □ — PROBABLE CONDITION OF SLOPE BEFORE FAILURE
- △ — APPROXIMATE SLOPES OBSERVED IN LIGNITE STRIP MINES AND RAILROAD CUTS
- FS — FACTOR OF SAFETY
- —— COHESION 0.70 T/SQ.FT. ϕ 20°
- — — COHESION 0.70 T/SQ.FT. ϕ 30°

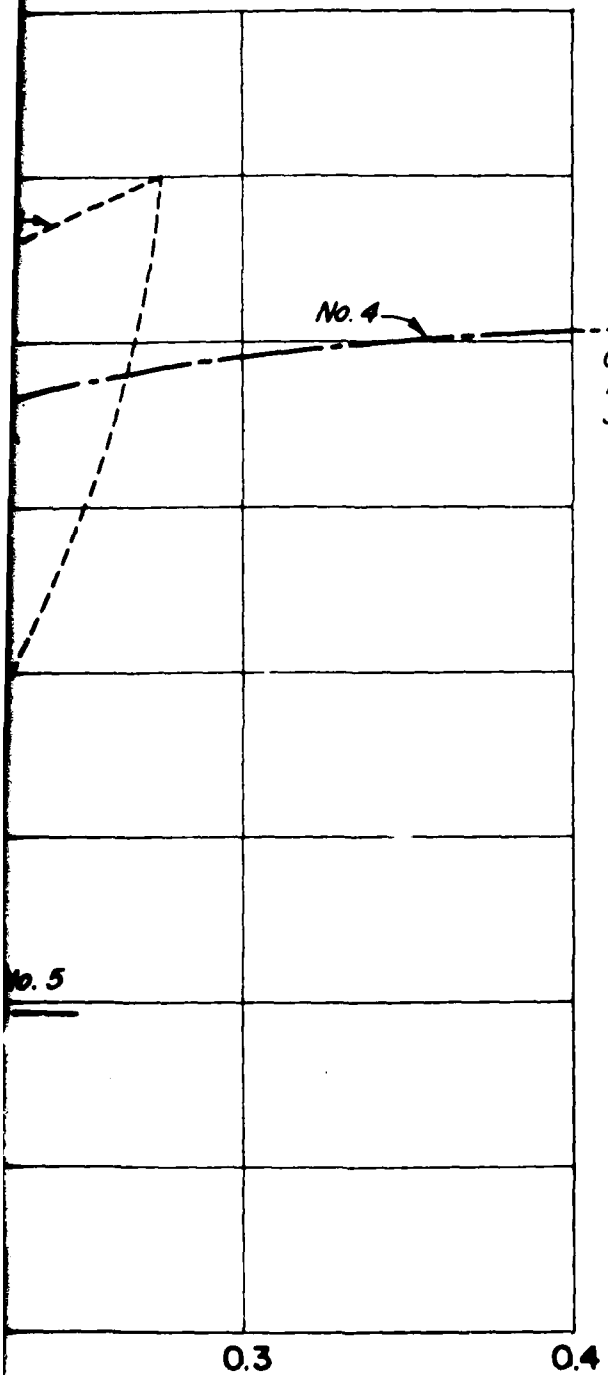
GARRISON RESERVOIR
MISSOURI RIVER BASIN
NORTH DAKOTA

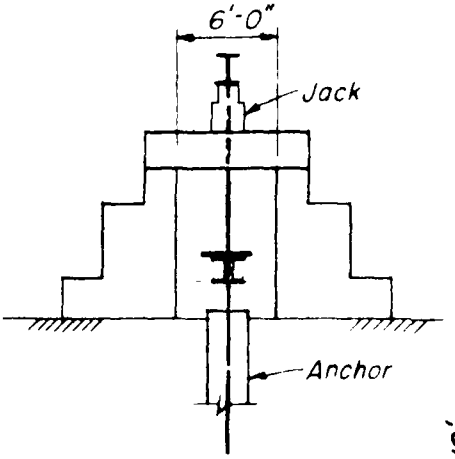
ANALYTICAL STUDIES OF FIELD SLOPES IN FT. UNION

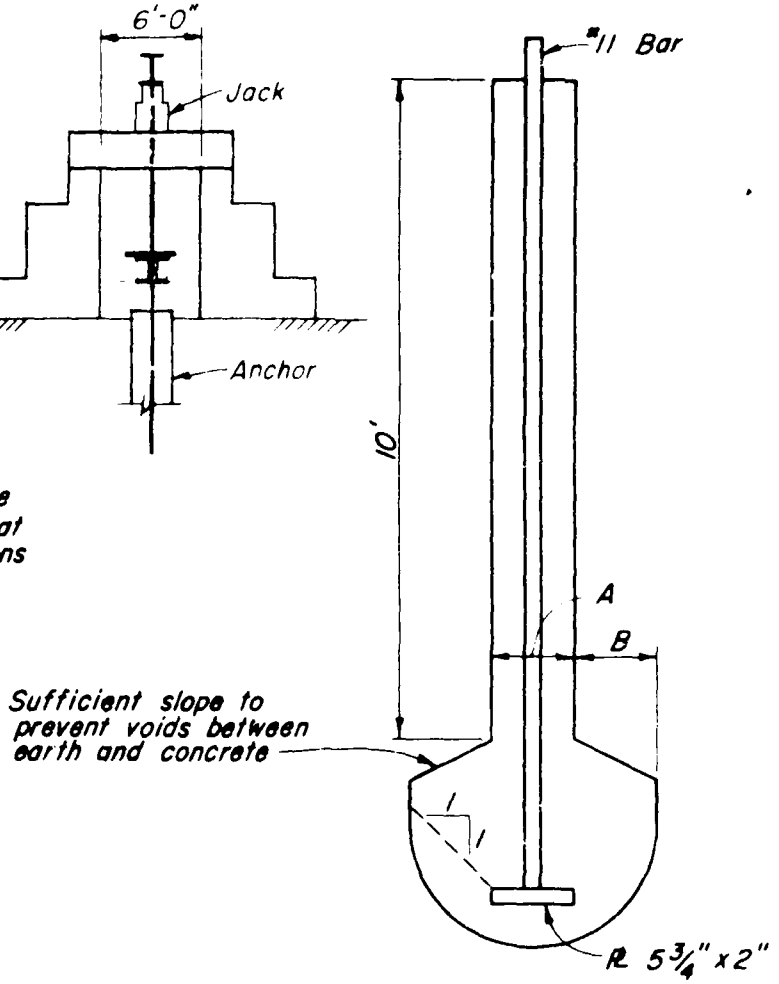
U.S. ENGINEER OFFICE, BISMARCK, N. DAK.

Dwg. No. GEX 7/2


40
35
30
25
20
15
10
5
0
TOTAL UPLIFT LOAD-TONS
0
0.1
0.2
0.3
DEFLECTION-INCHES
No. 1
No. 2
No. 3
No. 4
No. 5







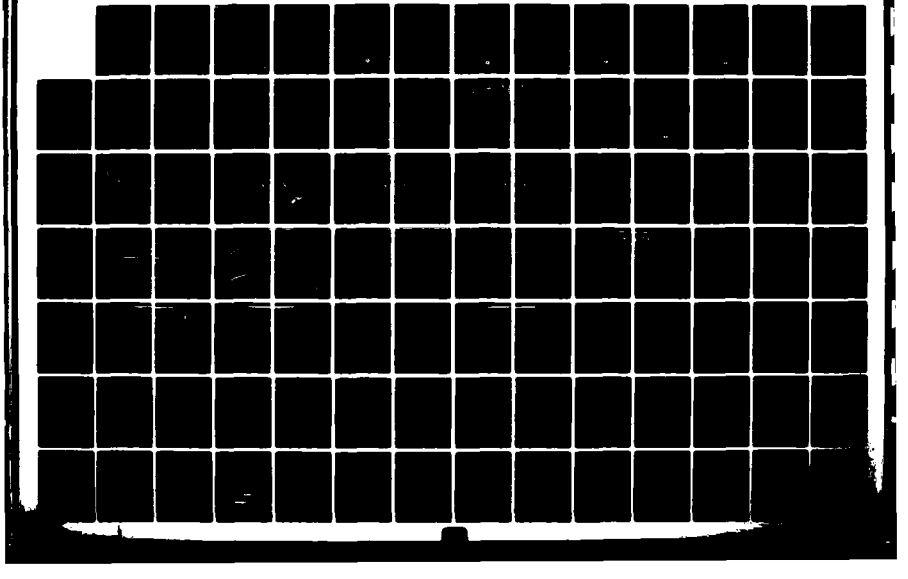
SYMBOL	CURVE NO.	A In.	B In.
— — —	1	8	12
———	2	6	9
- - - - -	3	6	6
—·—·—	4	6	3
—··—··—	5	6	0

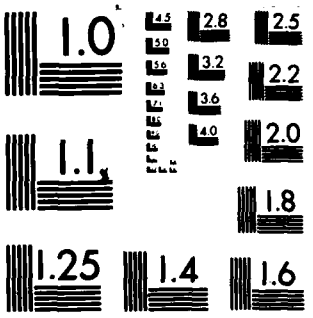
ANCHOR TEST DATA

Design Memorandum No. 1 PLATE IV-4

AD-A140 035 CONSTRUCTION FOUNDATION REPORT MISSOURI RIVER GARRISON DAM LAKE SAKAKAWEA VOLUME 2 DRAWINGS(U) ARMY ENGINEER DISTRICT OMAHA NE NOV 83 2/4

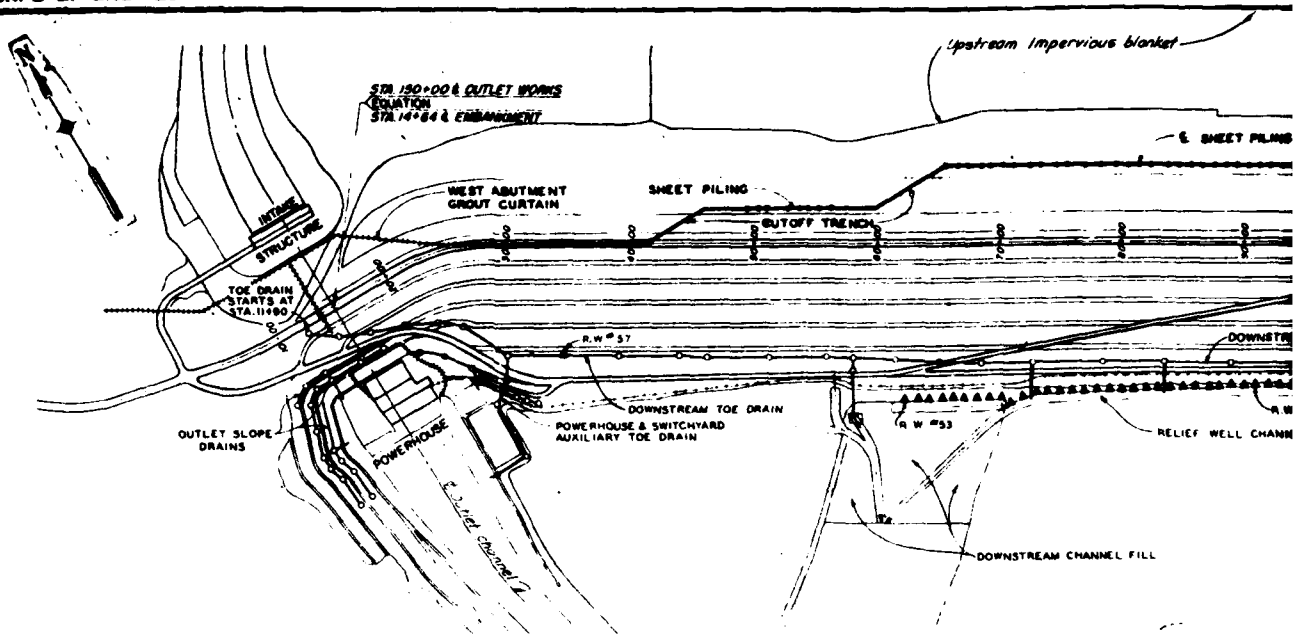
UNCLASSIFIED F/G 13/13 NL



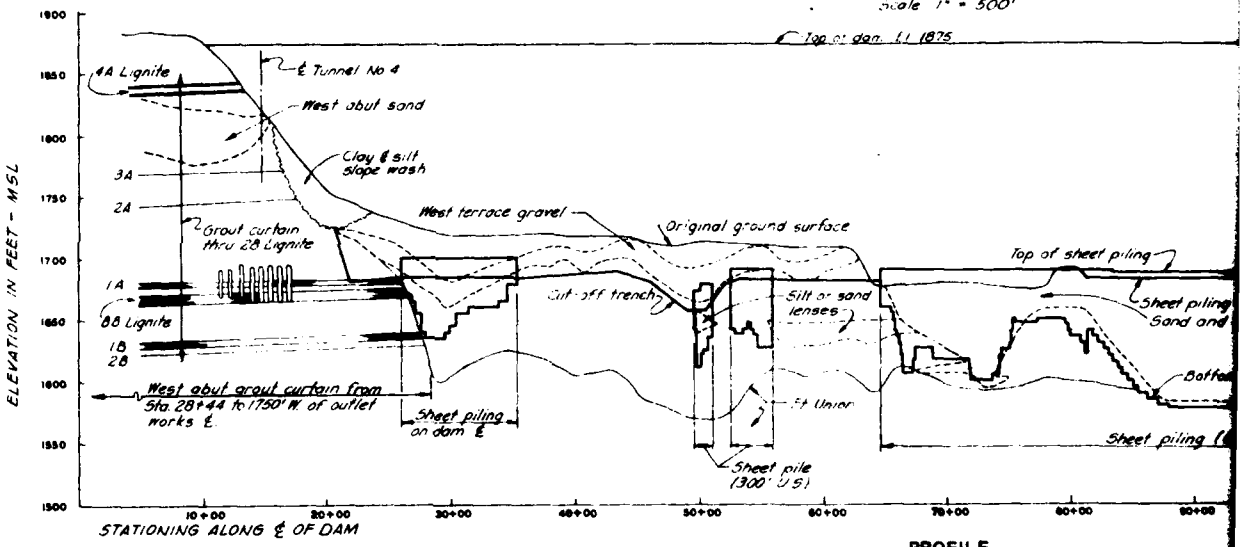


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

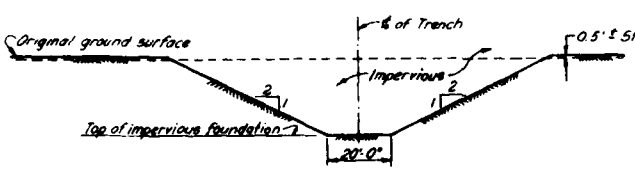
CORPS OF ENGINEERS



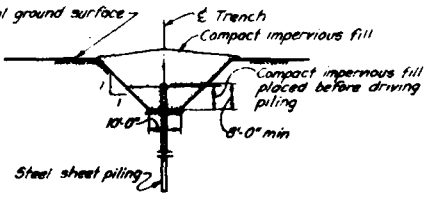
PLAN
Scale 1" = 500'



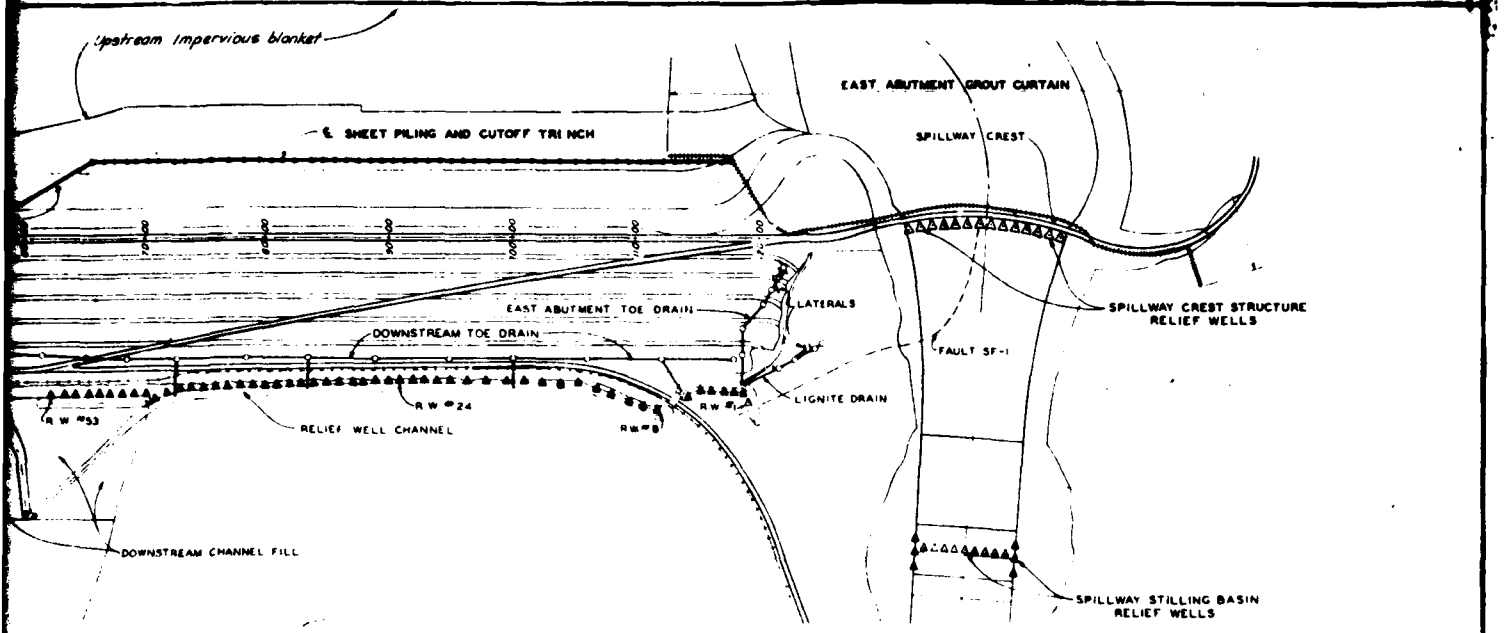
PROFILE
(ALONG SHEET PILING, CUT-OFF TRENCH & GROUT CURTAIN)
Scales: Vert. 1" = 50'
Horiz. 1" = 500'



TYPICAL SECTION THRU CUT-OFF TRENCH
Scale: 1" = 20'

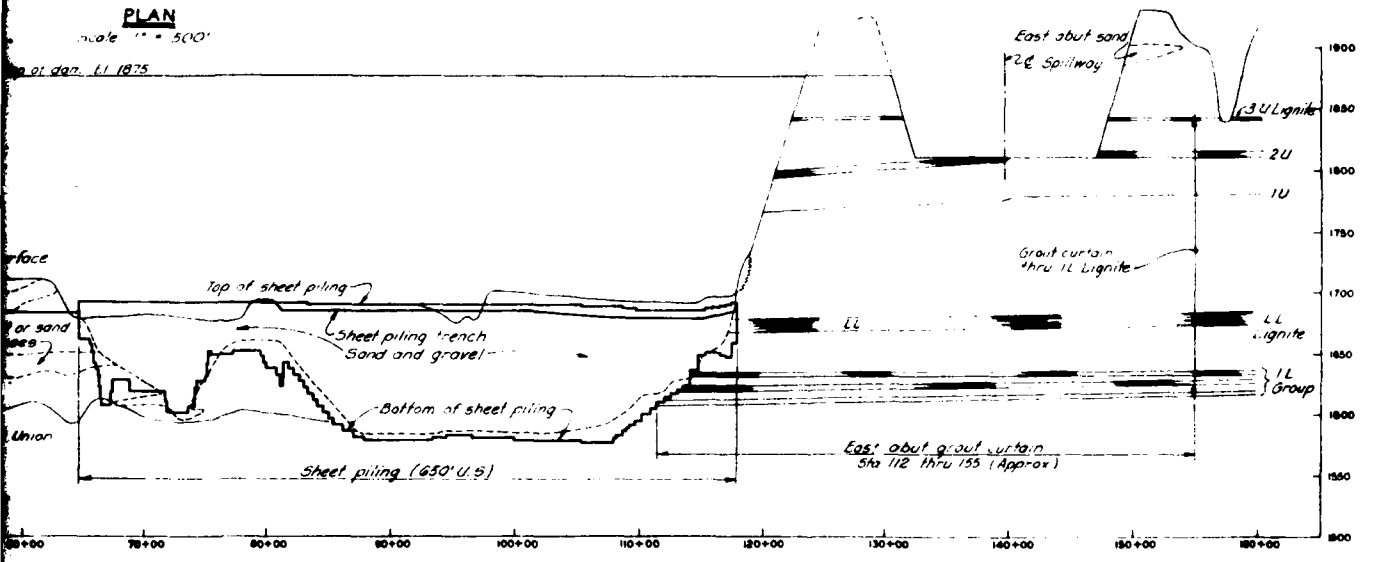


TYPICAL SECTION THRU SHEET PILING TRENCH
Scale: 1" = 20'



PLAN

Scale 1" = 500'

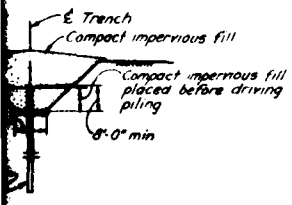


PROFILE

SHEET PILING, CUT-OFF TRENCH & GROUT CURTAIN)

Scales: Vert. 1" = 50'
Horiz. 1" = 500'

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



SECTION THRU PILING TRENCH

Scale: 1" = 20'

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

DESIGNED BY O.W.A.
DRAWN BY R.W.W.
TRACED BY
CHECKED BY C.V.J.
SUBMITTED BY
APPROVED BY
APPROVED BY
APPROVED BY

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
UNDERSEEPAGE STUDIES
SEEPAGE CONTROL

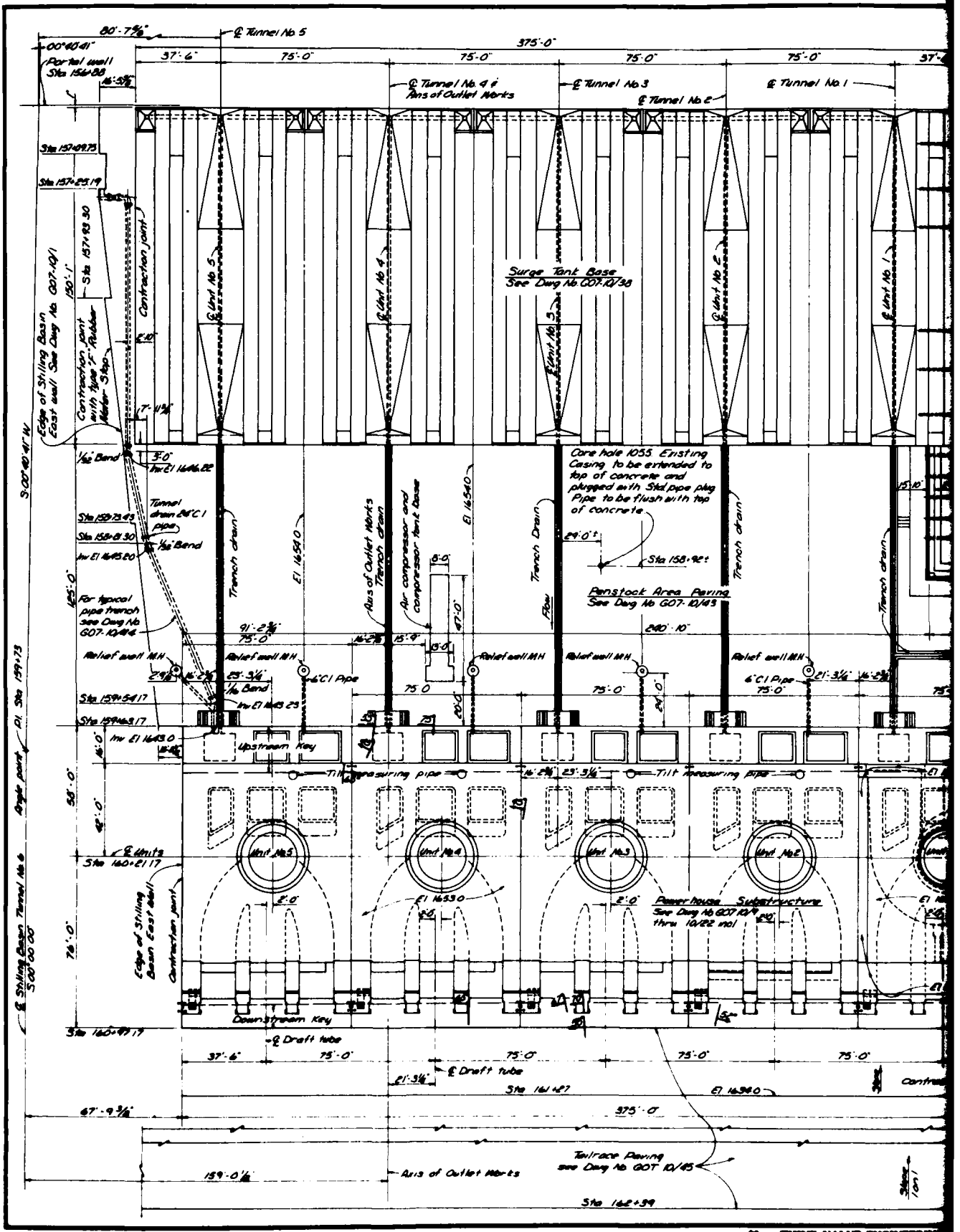
APPROVED Charles L. Hoyt
CHIEF, ENGINEERING DIVISION

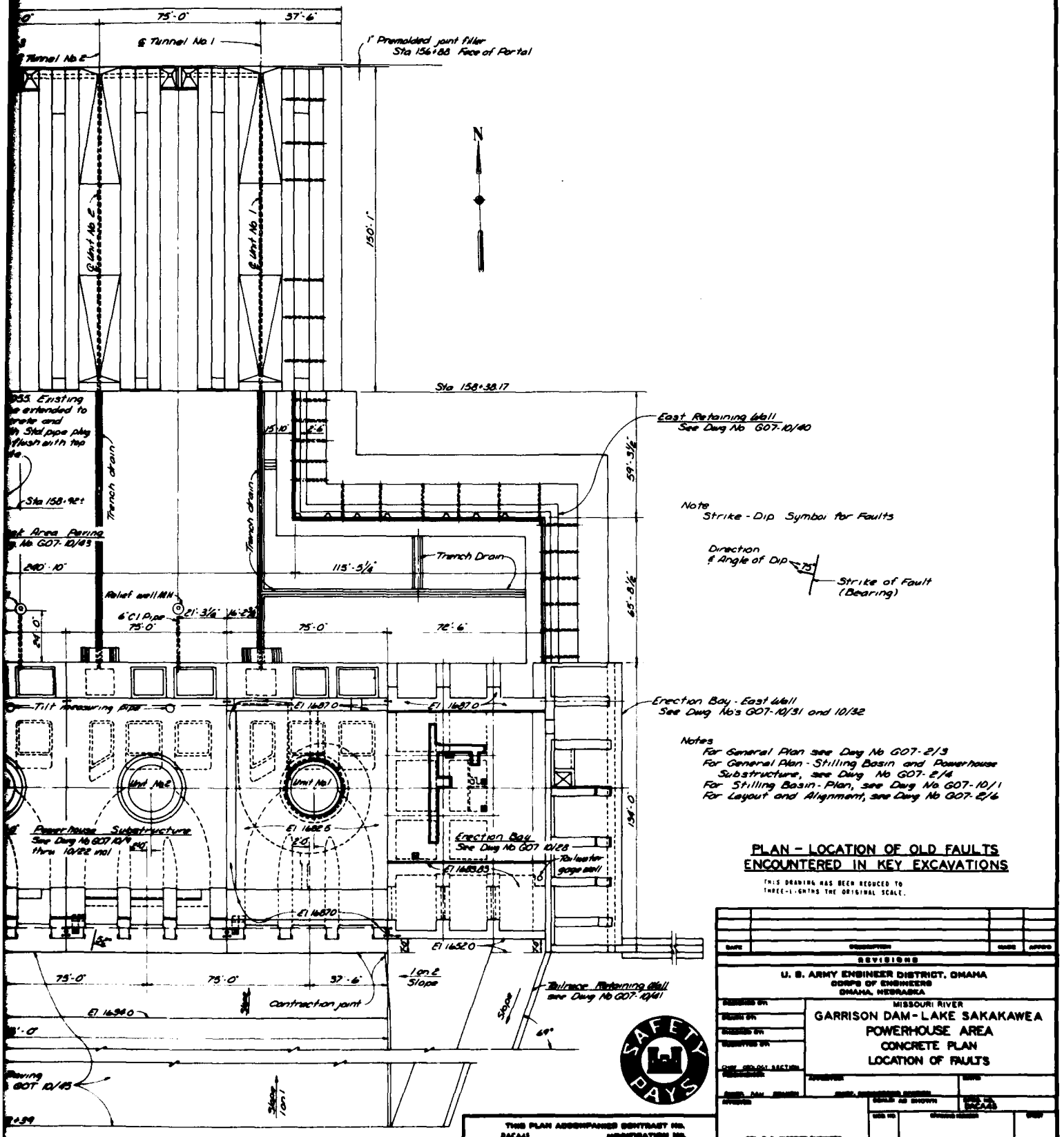
SAFETY DAM

THIS PLAN ACCOMPANIES CONTRACT NO DA-25-066 ---- MODIFICATION NO

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 48

2


℄ Tunnel No 5
℄ Tunnel No 4 & Axis of Outlet Works
℄ Tunnel No 3
℄ Tunnel No 2
℄ Tunnel No 1
Surge Tank Base
See Dwg No GOT-10/38
Core hole 1055. Existing Casing to be extended to top of concrete and plugged with Std pipe plug Pipe to be flush with top of concrete
Penstock Area Paving
See Dwg No GOT-10/43
Trench drain
Relief well MH
6"C I Pipe
Upstream Key
Tilt measuring pipe
Unit No 5
Unit No 4
Unit No 3
Unit No 2
Power house Substructure
See Dwg No GOT 10/19 thru 10/22 incl
Downstream Key
℄ Draft tube
Tailrace Paving
see Dwg No GOT 10/45
Axis of Outlet Works
Edge of Stilling Basin East wall
Contraction joint
Sta 162+39



PLAN - LOCATION OF OLD FAULTS ENCOUNTERED IN KEY EXCAVATIONS

THIS DRAWING HAS BEEN REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE.

DATE	DESCRIPTION	ISSUED	APPVD
	REVISIONS		

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

MISSOURI RIVER
GARRISON DAM - LAKE SAKAKAWEA
POWERHOUSE AREA
CONCRETE PLAN
LOCATION OF FAULTS

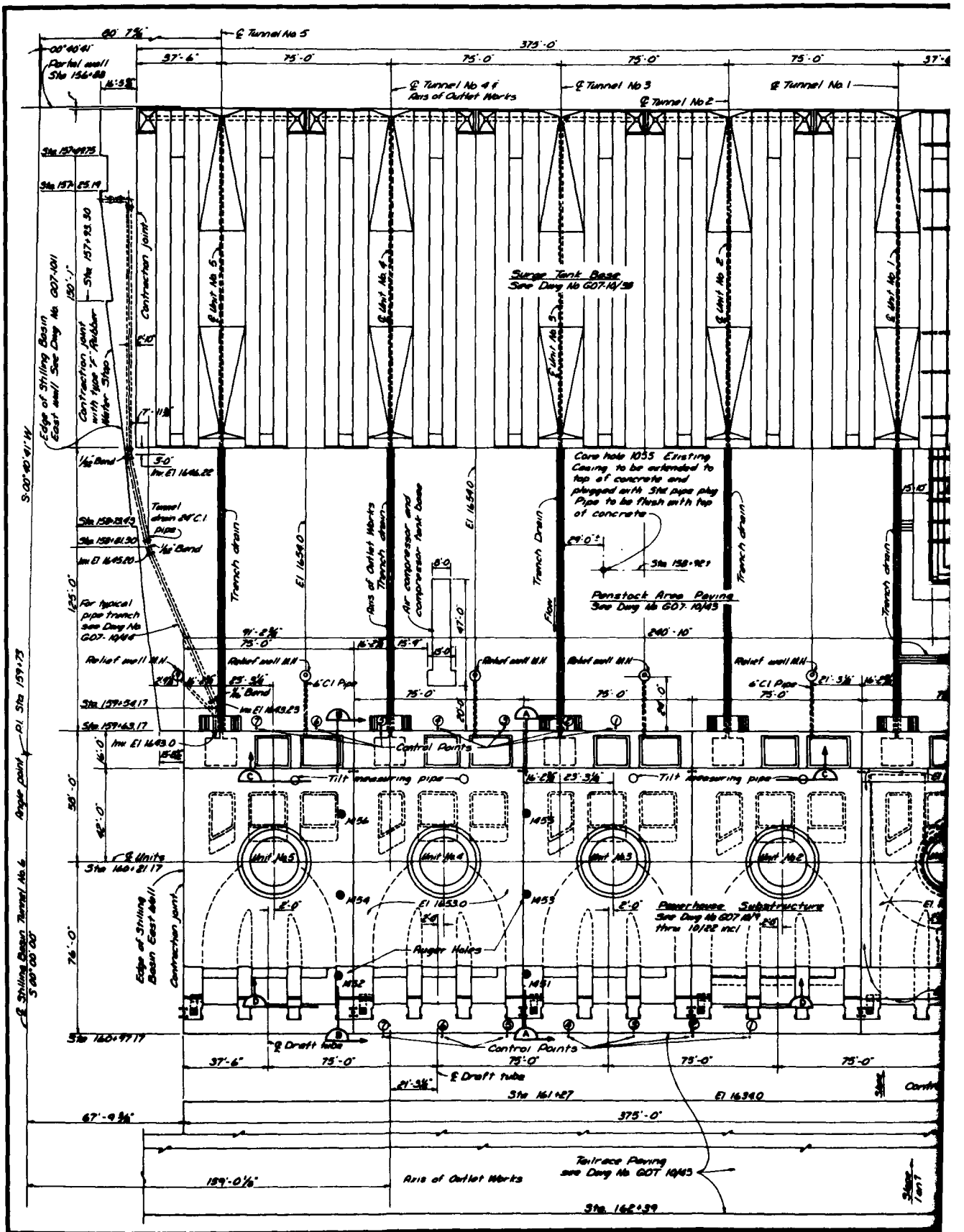
SCALES AS SHOWN

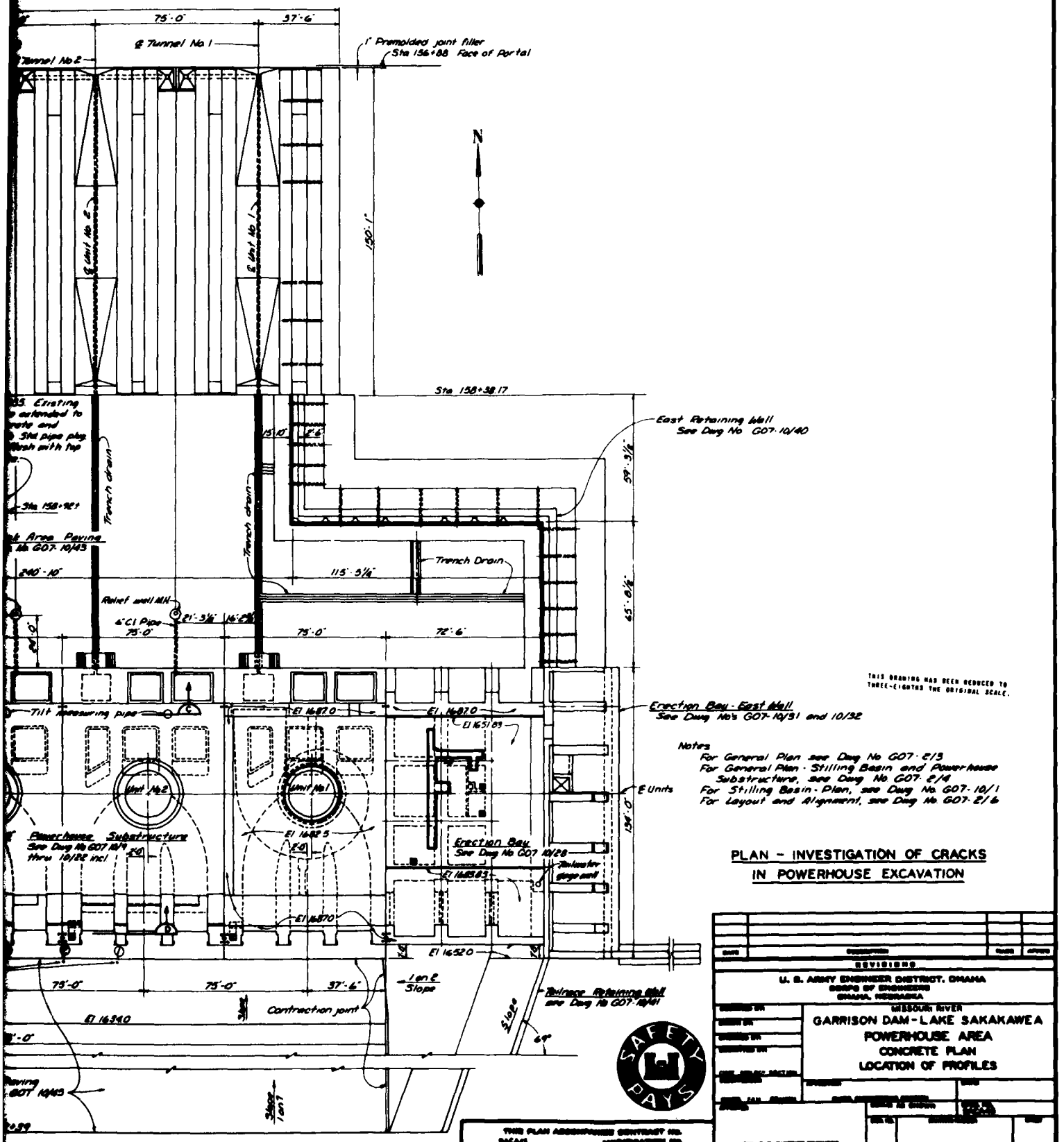
DACA45

THIS PLAN ACCOMPANIES CONTRACT NO. DACA45 MODIFICATION NO.

$$ - THINK VALUE ENGINEERING - $$

2


℄ Tunnel No 5
℄ Tunnel No 4 & Axis of Outlet Works
℄ Tunnel No 3
℄ Tunnel No 2
℄ Tunnel No 1
375'-0"
Surge Tank Base
See Dwg No GOT-10/59
Core hole 1055 Existing Casing to be extended to top of concrete and plugged with Std pipe plug Pipe to be flush with top of concrete
Penstock Area Paving
See Dwg No GOT-10/43
Trench drain
Relief well M.H.
Tilt measuring pipe
Control Points
Unit No.5
Unit No.4
Unit No.3
Unit No.2
Powerhouse Substructure
See Dwg No GOT-10/9 thru 10/22 incl
Purger Holes
℄ Draft tube
Tailrace Paving
see Dwg No GOT 10/45
Axis of Outlet Works
℄ Shilling Basin Tunnel No 6
Edge of Shilling Basin East wall
Contraction joint
Sta 162+39



THIS DRAWING HAS BEEN REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE.

Notes
For General Plan see Dwg No GO7-2/3
For General Plan - Stilling Basin and Powerhouse Substructure, see Dwg No GO7-2/4
For Stilling Basin - Plan, see Dwg No GO7-10/1
For Layout and Alignment, see Dwg No GO7-2/6

PLAN - INVESTIGATION OF CRACKS IN POWERHOUSE EXCAVATION

DATE	DESCRIPTION	PLANS	APPVD
	REVISIONS		

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

MISSOURI RIVER
GARRISON DAM - LAKE SAKAKAWEA
POWERHOUSE AREA
CONCRETE PLAN
LOCATION OF PROFILES

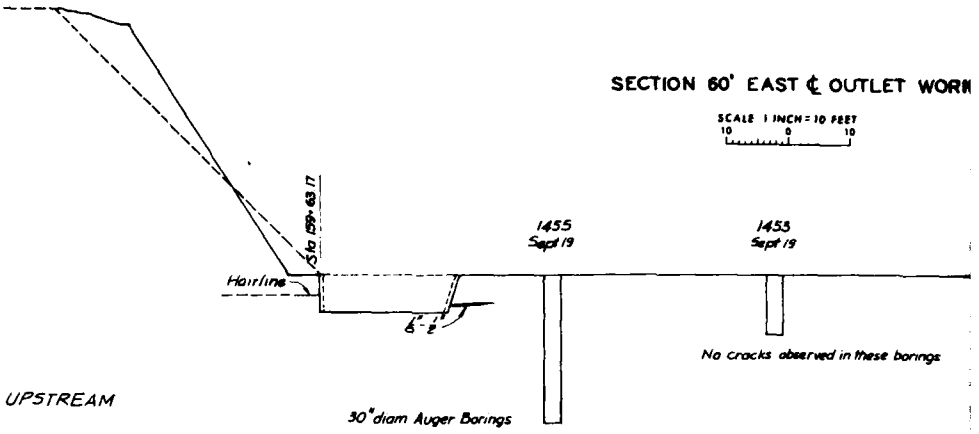
DESIGNED
DRAWN
TRACED
CHECKED
SUBMITTED
CHIEF, ENGINEERING BRANCH
CHIEF, DESIGN BRANCH

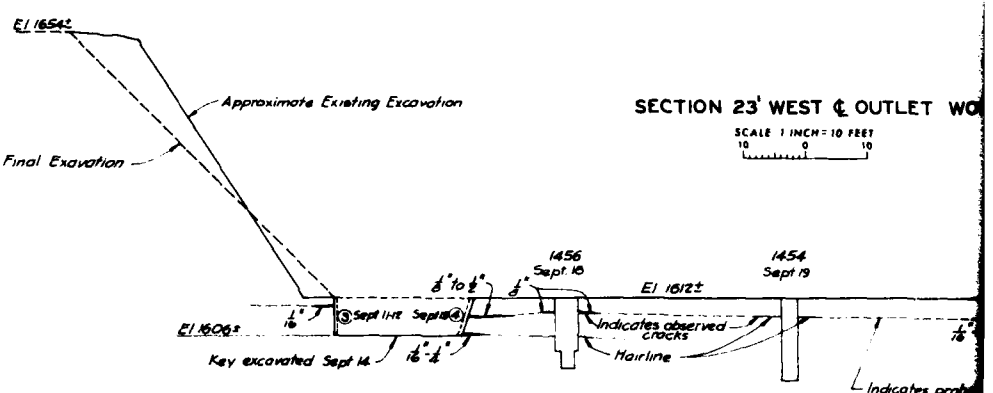
DATE
SUBMITTED
APPROVED
CHIEF, ENGINEERING DIVISION

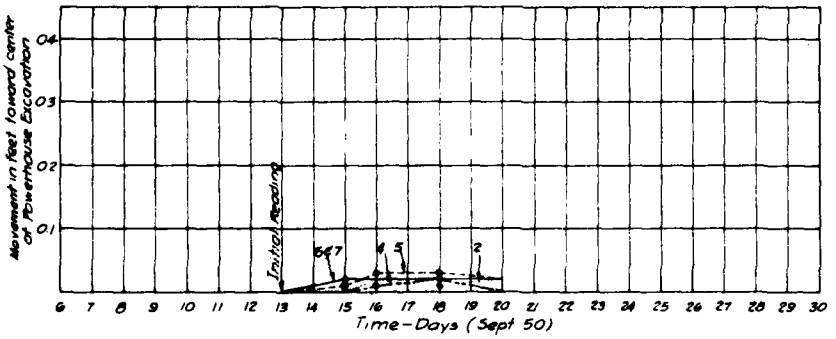
CONTRACT NO. DACA45
SPECIFICATION NO.
DRAWING NO.
SHEET

SAFETY PAYS

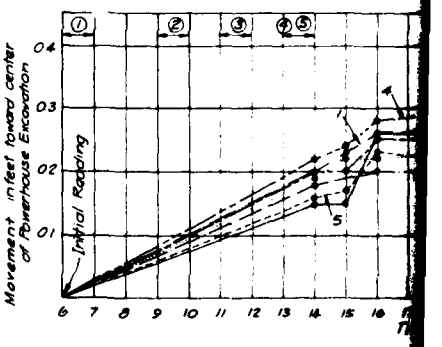
THIS PLAN ASSOCIATED CONTRACT NO. DACA45 SPECIFICATION NO.





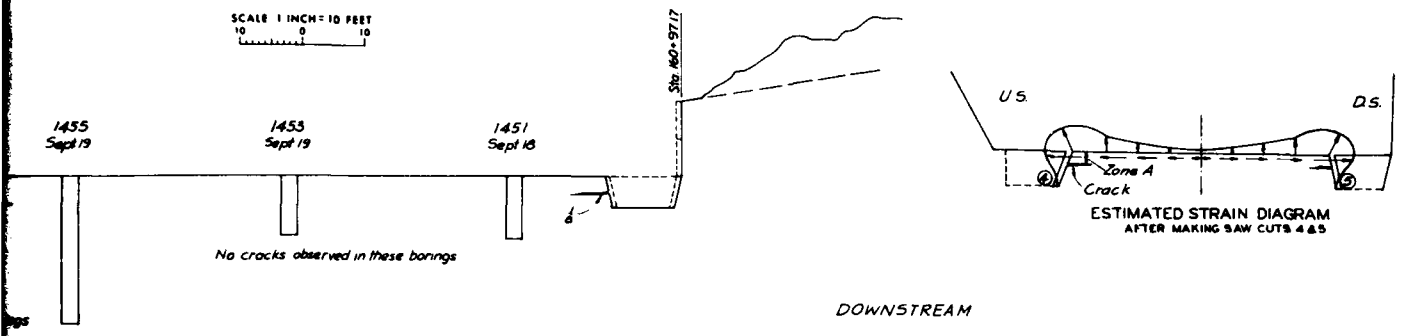


MOVEMENT ALONG STA. 159+63.17

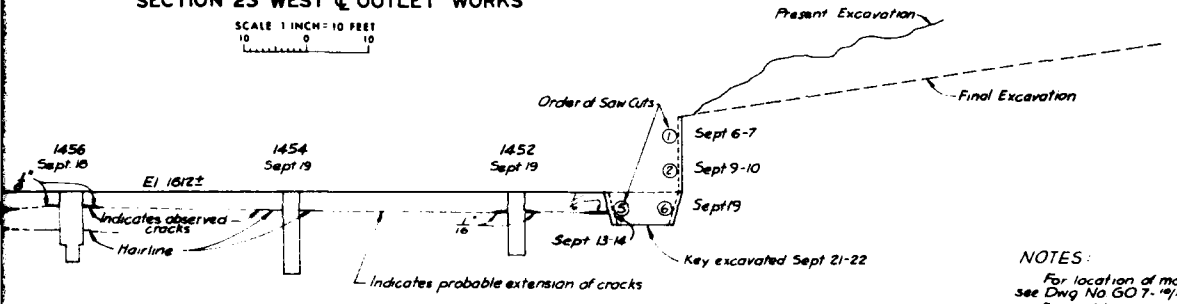


MOVEMEN

SECTION 60' EAST ℄ OUTLET WORKS



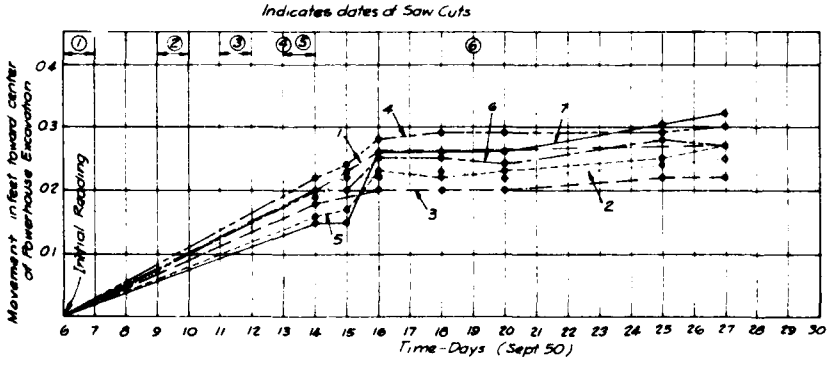
SECTION 23' WEST ℄ OUTLET WORKS



NOTES:

For location of movement control points 1 thru 7 see Dwg No GO7-[illegible]/14 Plate No 1

For profiles showing cracks along keys see Dwg No GPX-[illegible]/23



MOVEMENT ALONG STA. 160+97.17

THIS DRAWING HAS BEEN REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE.

DATE	DESCRIPTION	ISSUED	APPVD
	REVISIONS		

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

MISSOURI RIVER
GARRISON DAM - LAKE SAKAKAWEA

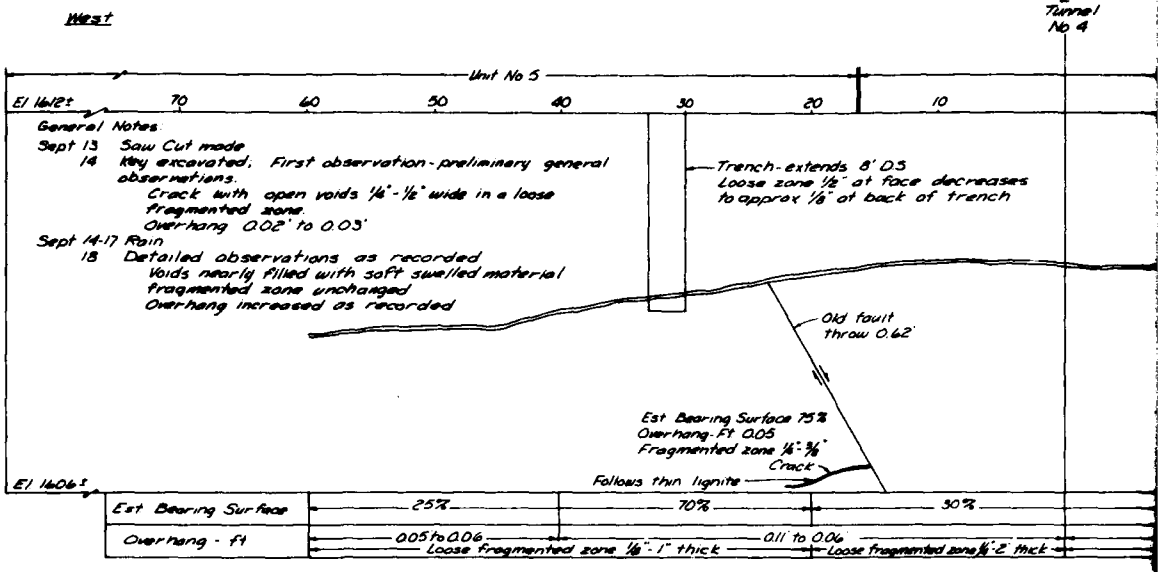
POWERHOUSE FOUNDATION
STUDY OF HORIZONTAL CRACKS
EXCAVATION AND MOVEMENT DATA

DESIGNED BY
DRAWN BY
CHECKED BY
QUANTITIES BY
CHIEF ENGINEERING DIVISION
ASSISTANT
APPROVED
DATE
CHIEF, E & C DIVISION
ASSISTANT
CHIEF ENGINEERING DIVISION
CENTER AS SHOWN
DACA45
SCALE NO
DRAWING NUMBER
SHEET

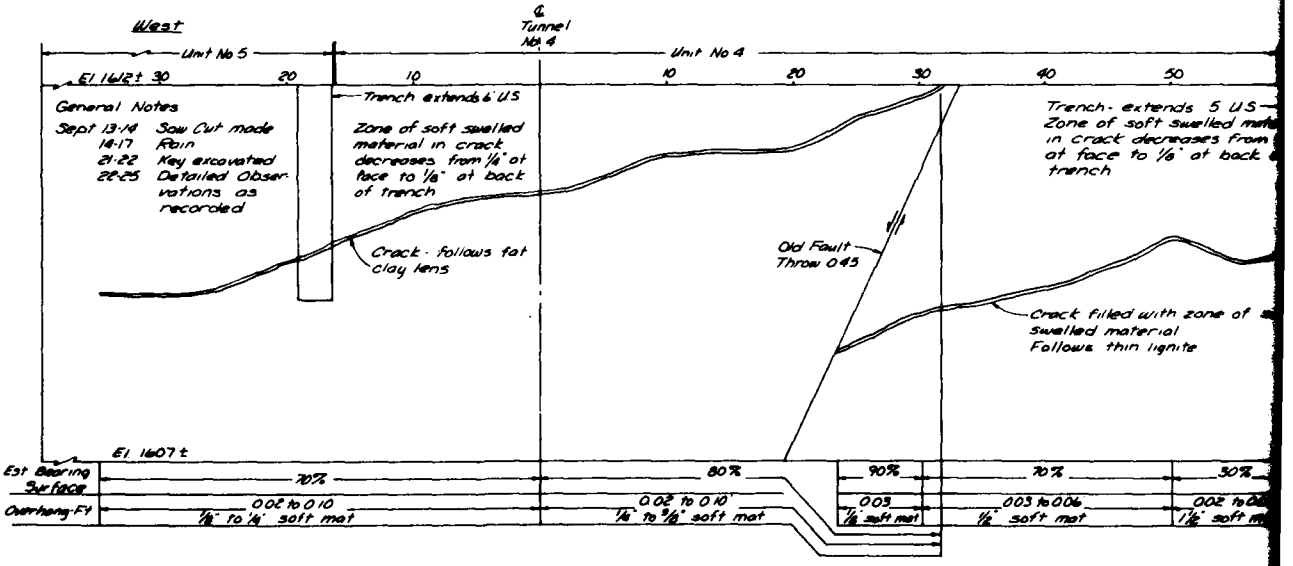
SAFETY PAYS

THIS PLAN ACCOMPANIES CONTRACT NO. DACA45 MODIFICATION NO.

2



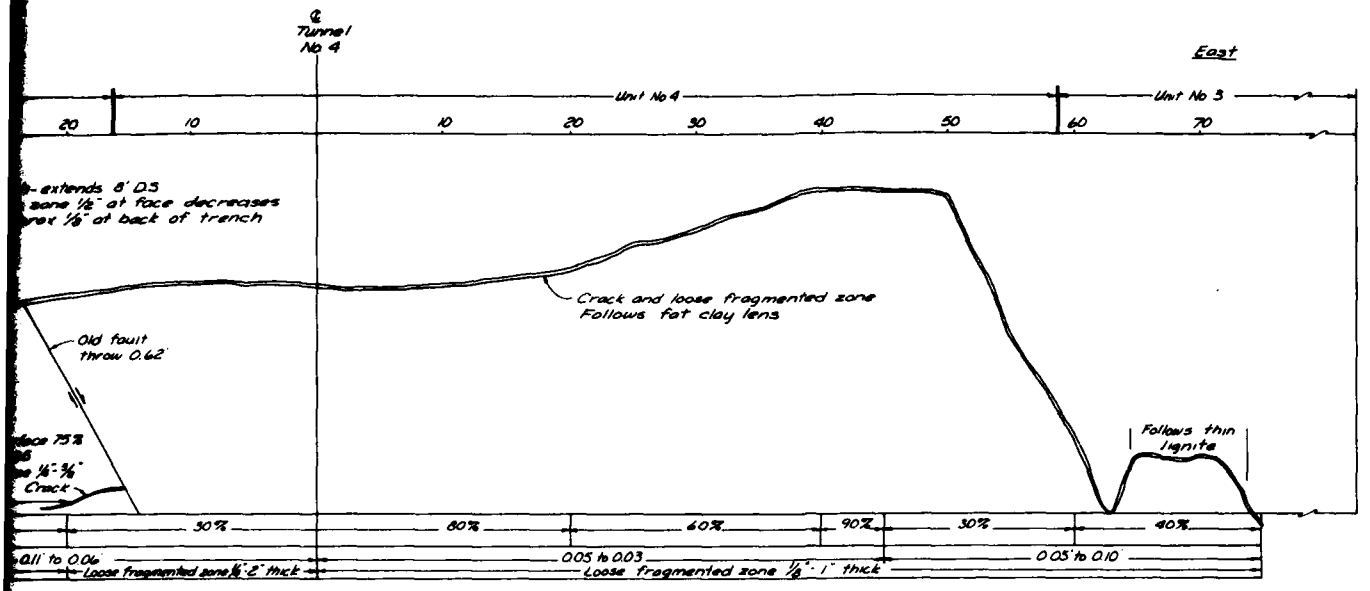
PROFILE C-
UPSTREAM KEY - DOWN



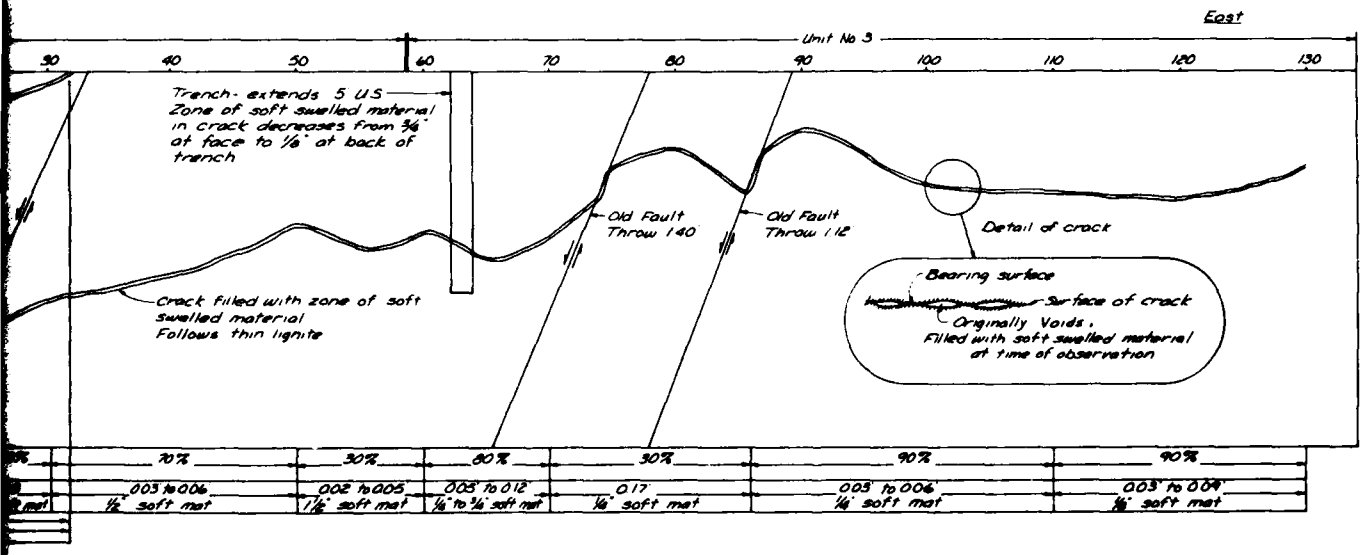
PROFILE D-
DOWNSTREAM KEY - UPST

Notes
For Location Plan see Dwg No G07 10/14 Plate #1
For Geologic Sections thru keys see Dwg No GPX - 6/24

SCALE
HOR: 1" = 5'
VERT: 1" = 1'



PROFILE C-C
UPSTREAM KEY - DOWNSTREAM FACE



PROFILE D-D
DOWNSTREAM KEY - UPSTREAM FACE

THIS DRAWING HAS BEEN REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE.

SCALE
HOR: 1" = 5'
VERT: 1" = 1'

DATE	DESCRIPTION	DESIGN	APPVD

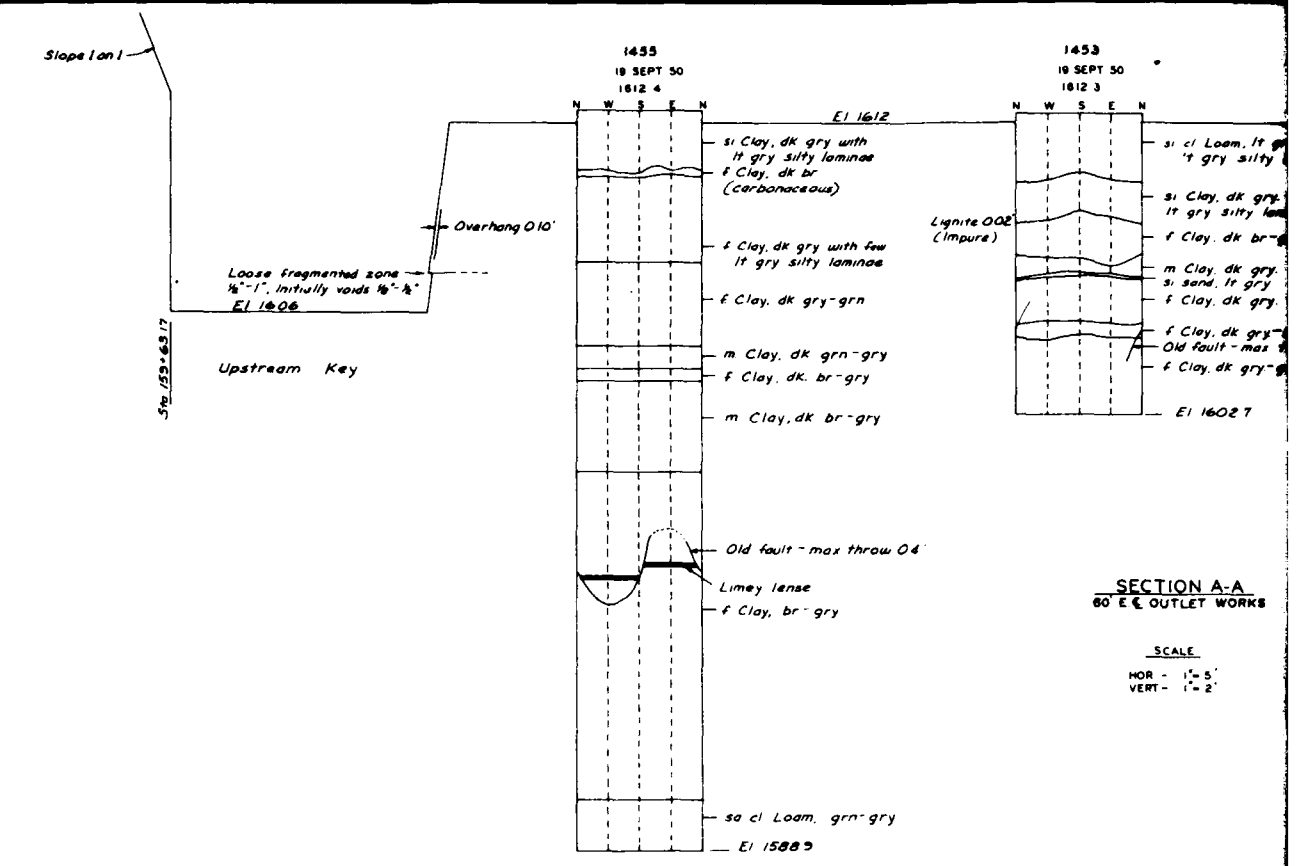
REVISIONS

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

MISSOURI RIVER
GARRISON DAM - LAKE SAKAKAWEA
POWERHOUSE FOUNDATION
STUDY OF HORIZONTAL CRACKS
PROFILES ALONG POWERHOUSE KEYS

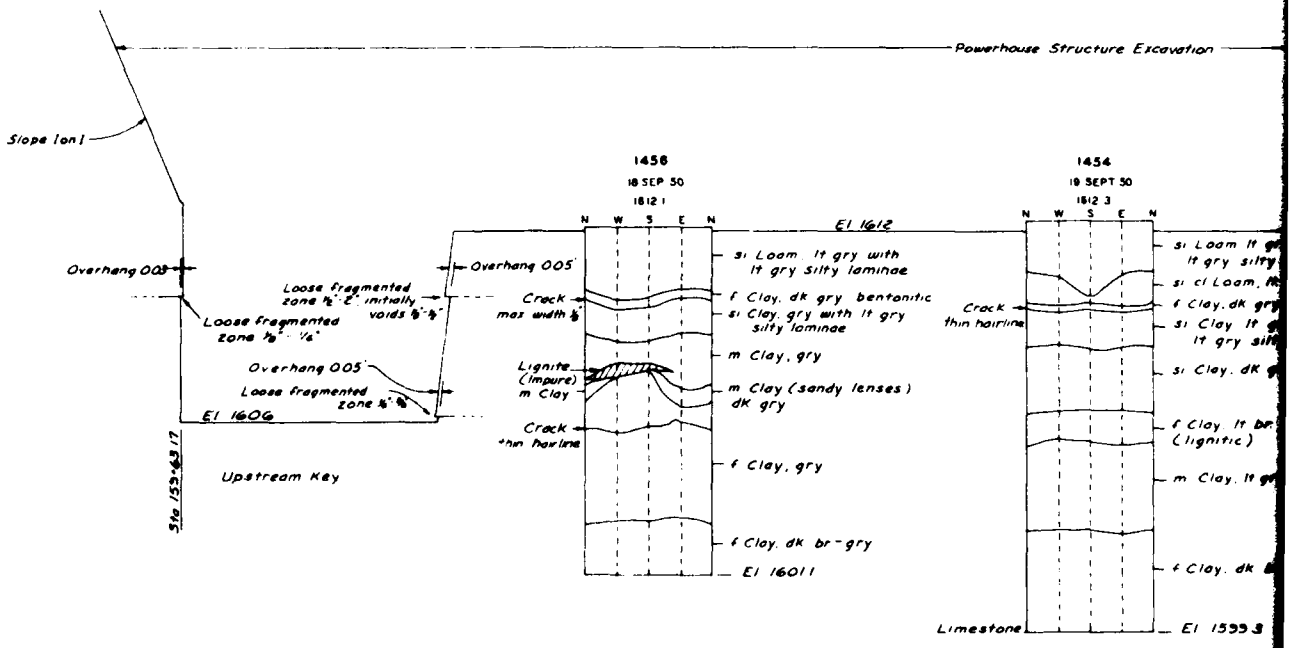
SAFETY PAYS

THIS PLAN ACCOMPANIES CONTRACT NO. DACA45 RECOMMENDATION NO.

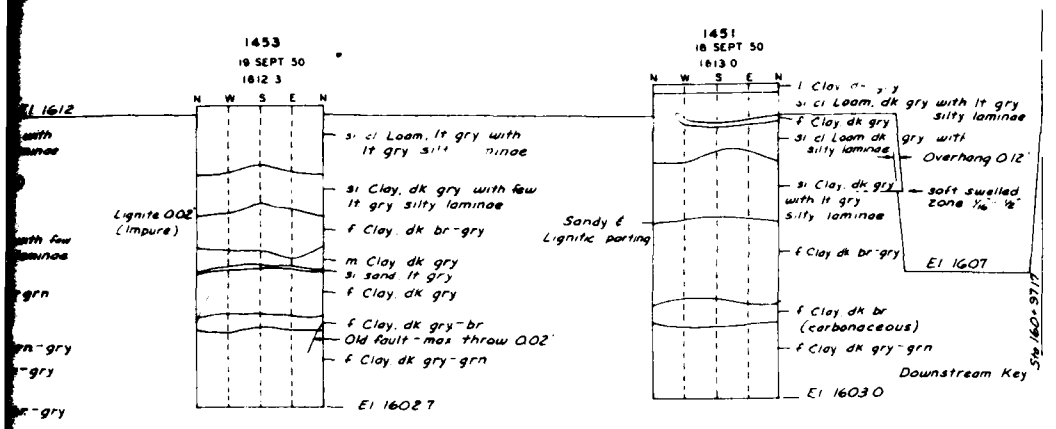


SECTION A-A
60' E ℄ OUTLET WORKS

SCALE
HOR - 1"= 5'
VERT - 1"= 2'



SECTION B-
20' W ℄ OUTLET W

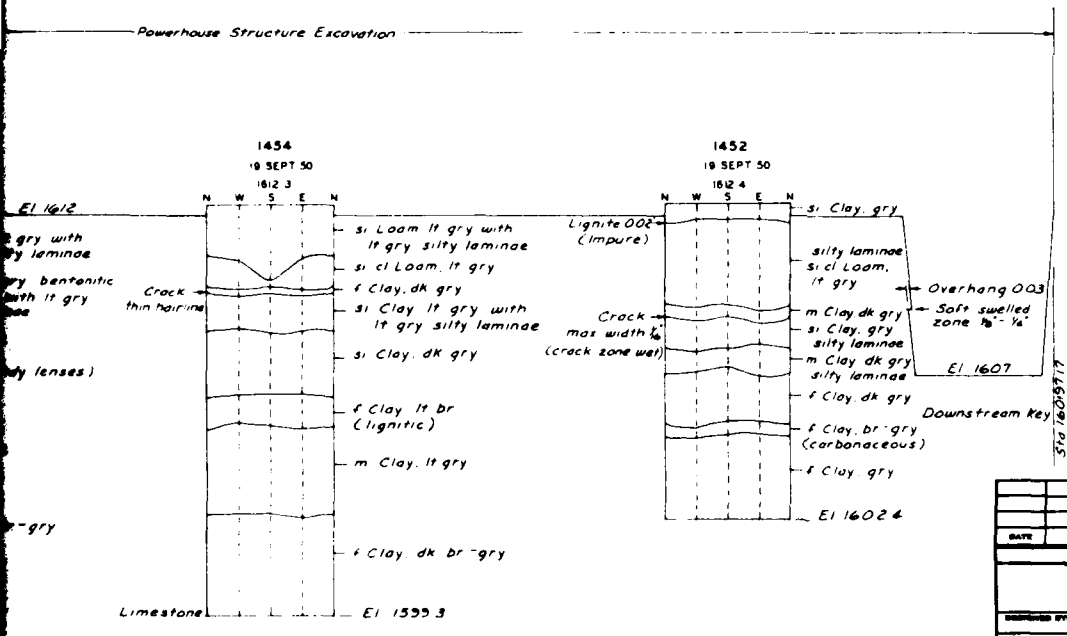


Boring 1451 re-examined and backfilled 23 Sept 50 after excavation of adjacent key completed Hole had been open 5 days with still no development of cracks

SECTION A-A
80' E ℄ OUTLET WORKS

SCALE
HOR - 1" = 5'
VERT - 1" = 2'

Notes
Borings shown are 30" diam Auger holes, except Boring 1456 which is 42" diam for first 8 feet
Boring logs drawn as developments of holes to show variations of material from North face counterclockwise around the hole
For location Plan of Borings see Dwg No G07-19/16 Plate #1
For Profile showing cracks observed along Upstream and Downstream Keys see Dwg No GPX - 8/23



SECTION B-B
20' W ℄ OUTLET WORKS

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

DATE	DESCRIPTION	DRAWN	APPVD
	REVISIONS		

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

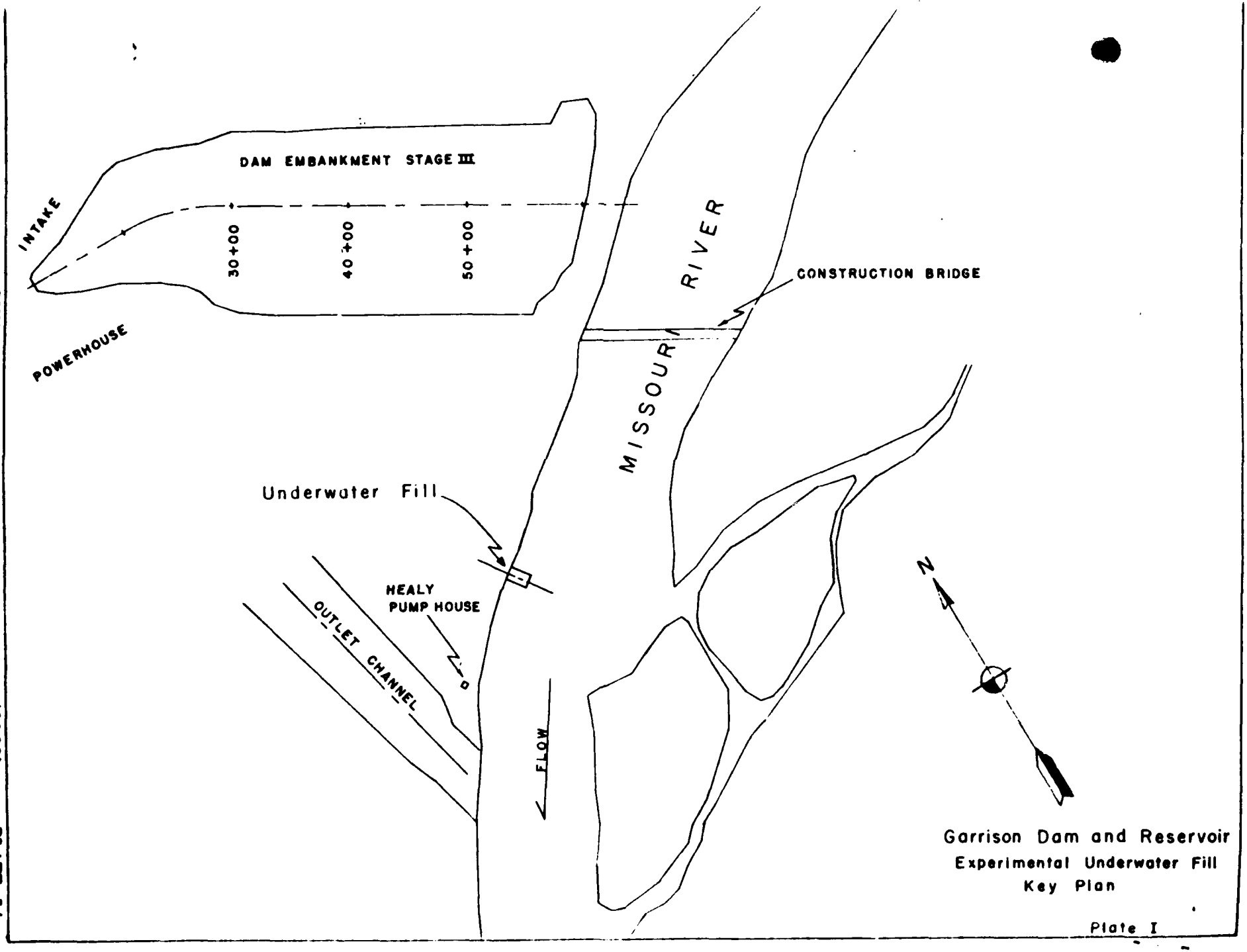
MISSOURI RIVER
GARRISON DAM - LAKE SAKAKAWEA
POWERHOUSE FOUNDATION
STUDY OF HORIZONTAL CRACKS
GEOLOGIC SECTIONS THRU KEYS

DESIGNED BY | APPROVED | DATE
DRAWN BY | CHIEF, ENGINEERING DIVISION
CHECKED BY | SCALE AS SHOWN | SPEC. NO. DACA45
SUBMITTED BY | MOD NO | DRAWING NUMBER | SHEET
CHIEF, C & A BRANCH | APPROVED | CHIEF, ENGINEERING DIVISION

SAFETY PAYS

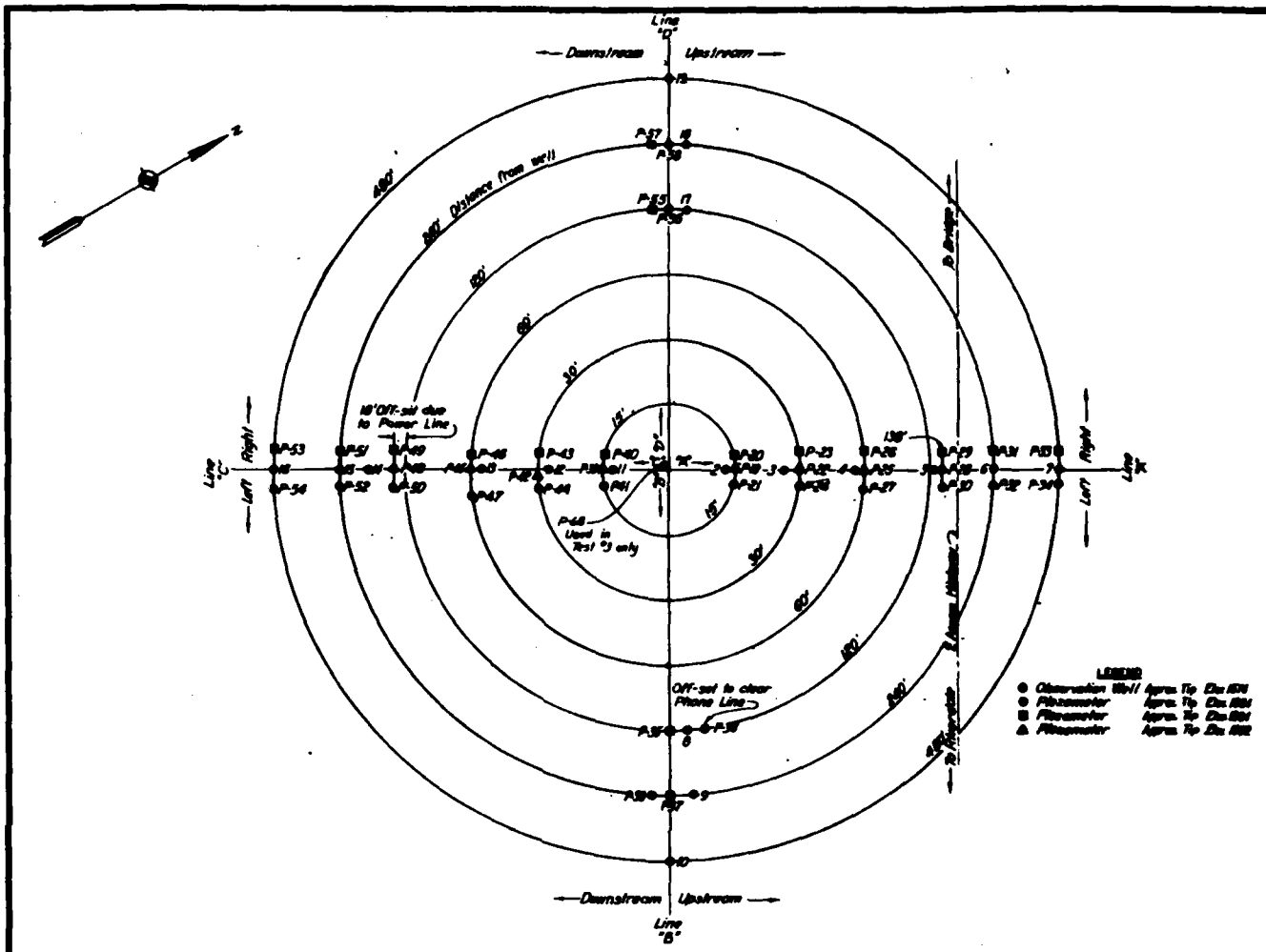
THIS PLAN ACCOMPANIES CONTRACT No. DACA45 MODIFICATION No.

$$ – THINK VALUE ENGINEERING – $$



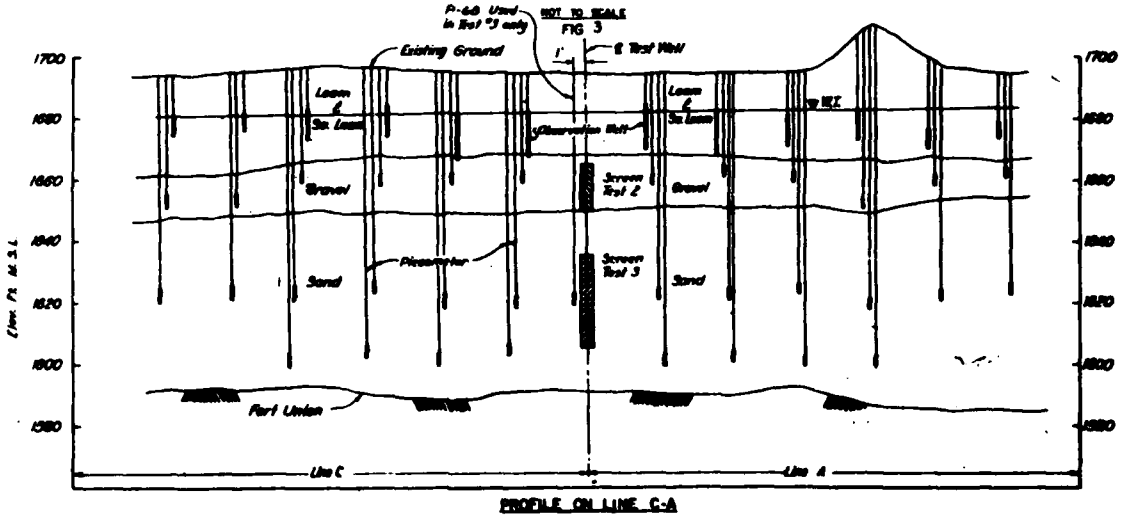
Garrison Dam and Reservoir
Experimental Underwater Fill
Key Plan

Plate I



DETAIL A
PUMPING TEST
HOLE LAYOUT

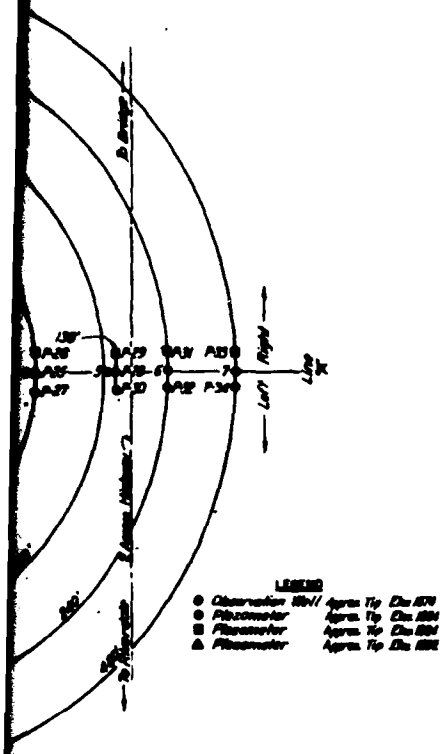
NOT TO SCALE
FIG 3



PROFILE ON LINE C-A

SCALE VERT. 1" = 20'
HORIZ. NO SCALE

FIG. 4



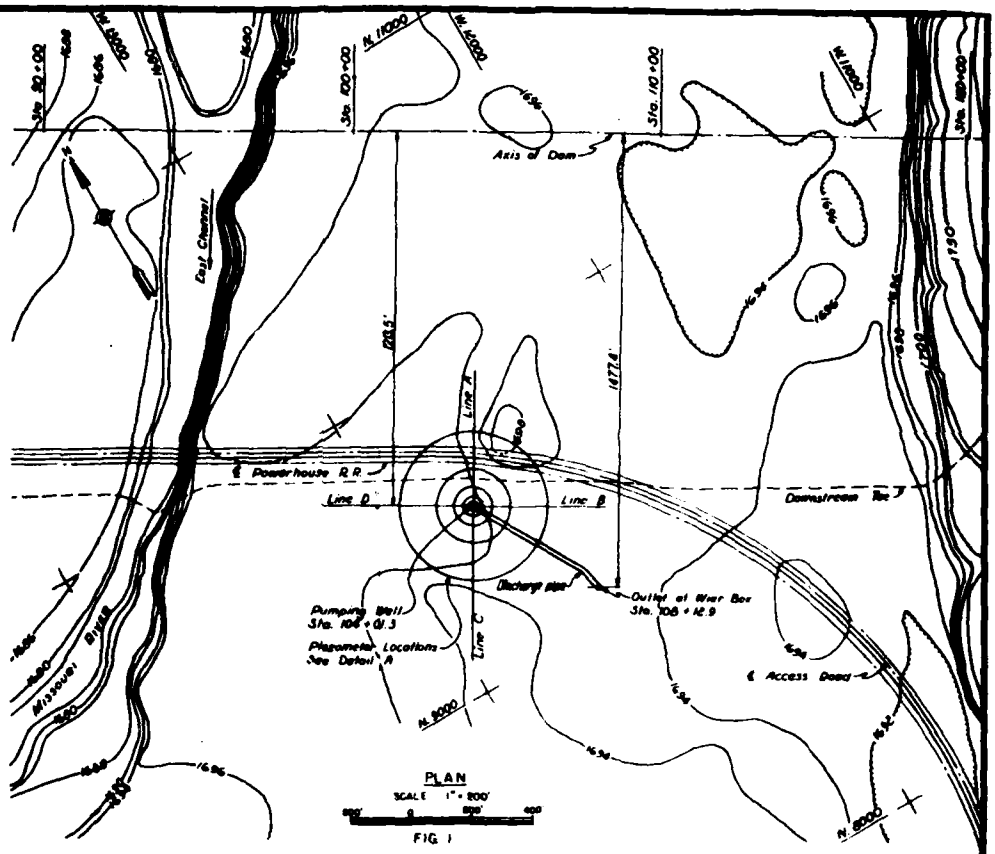


FIG. 1

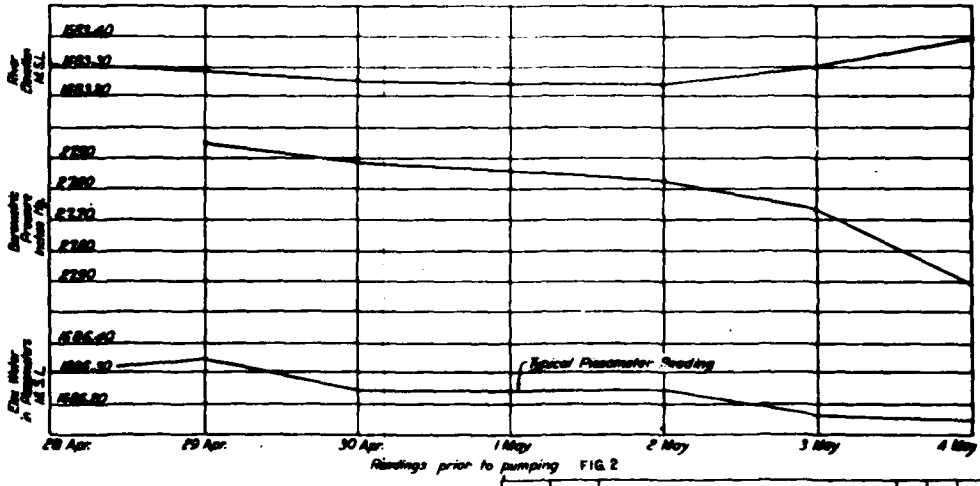
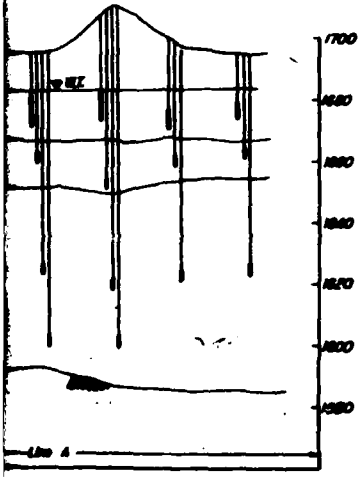
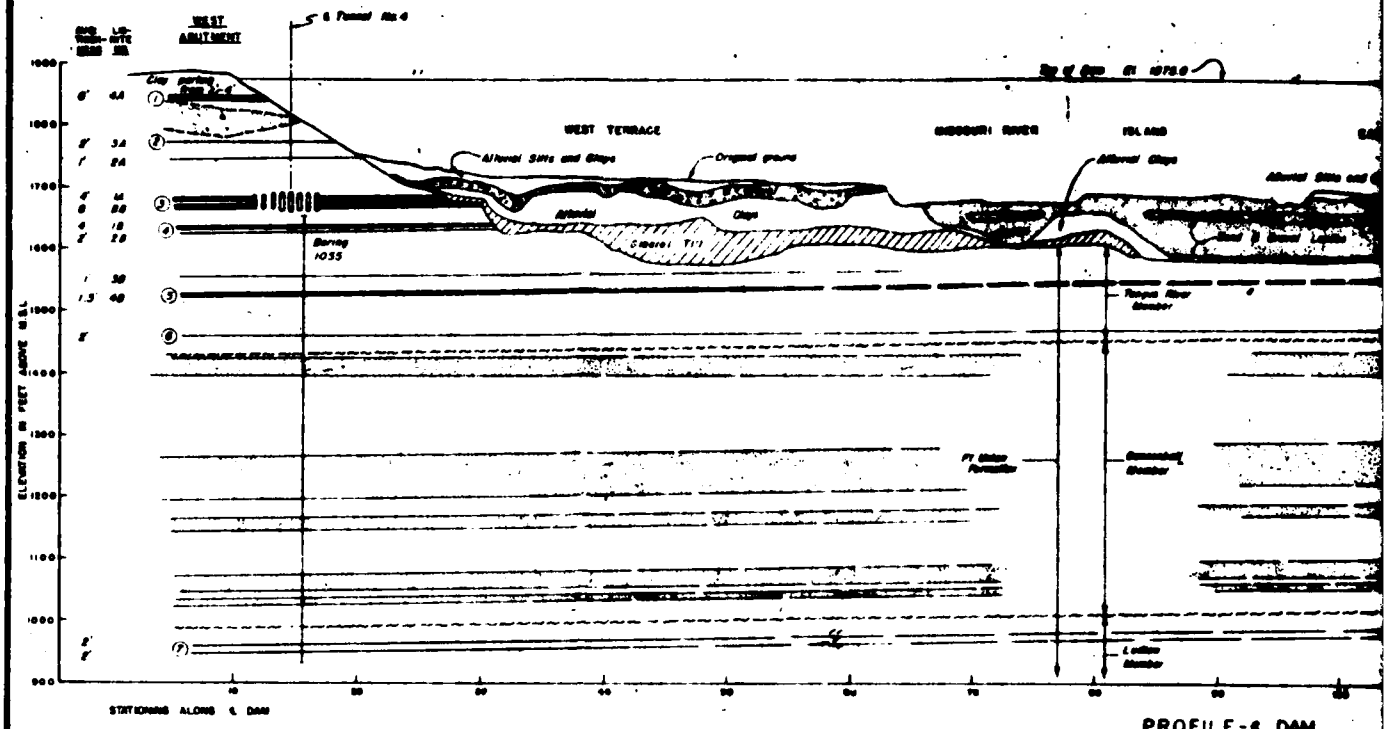


FIG. 2



U. S. ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

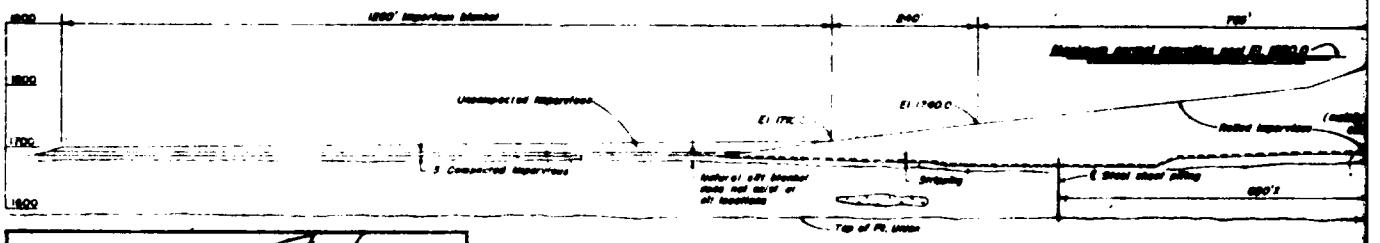
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
PUMPING TEST
GENERAL LAYOUT



PROFILE-℄ DAM

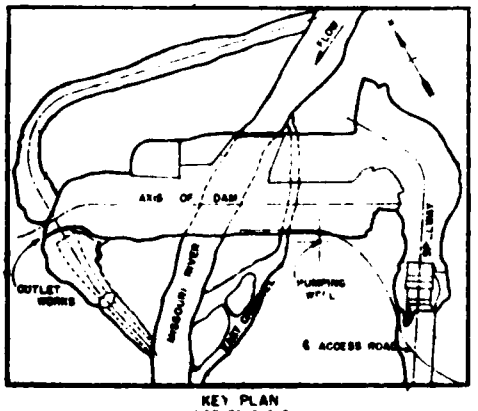
LOOKING UPSTREAM

Fig. No. 1

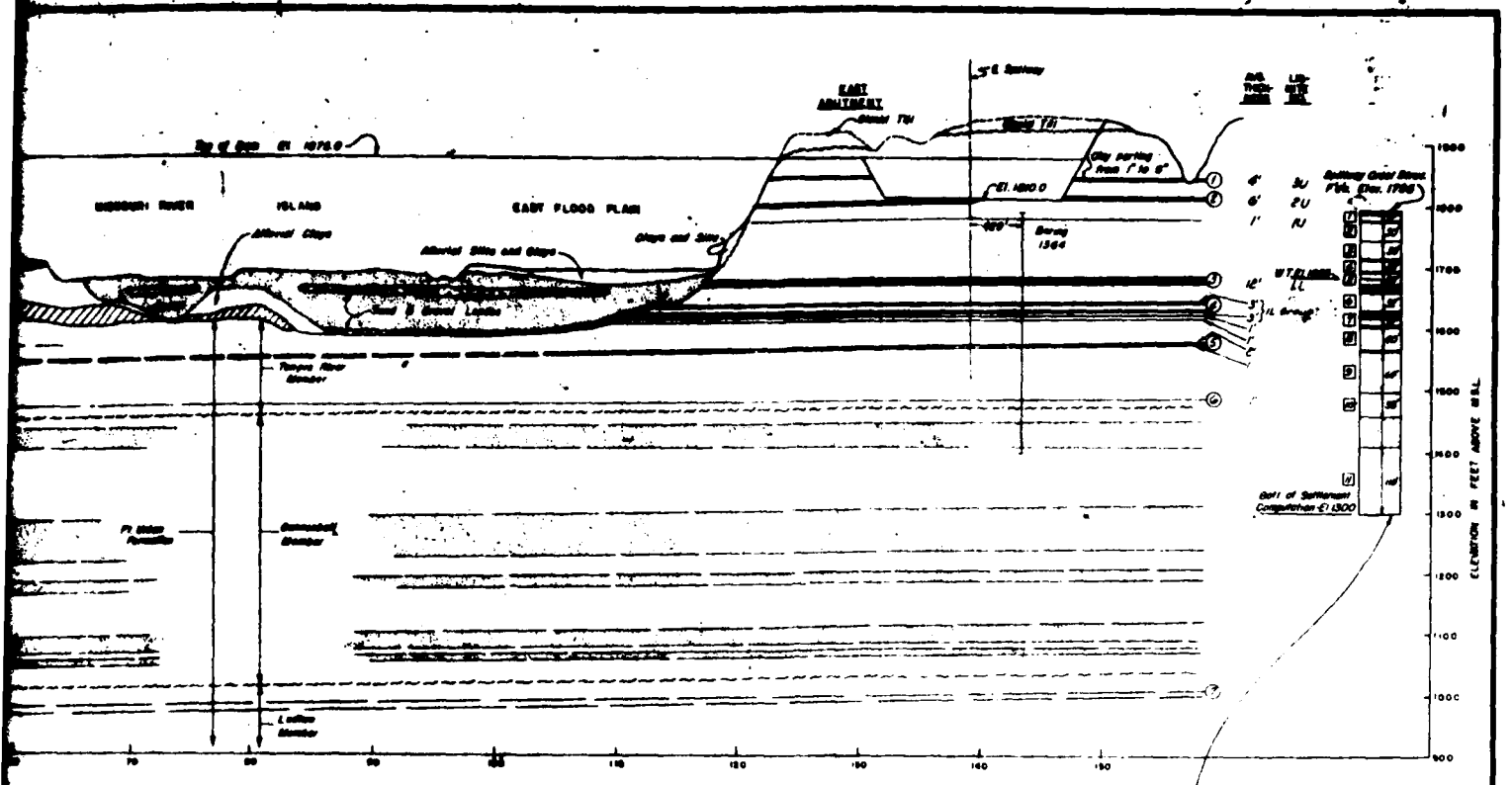


TYPICAL EAST TERRACE SECTION

Fig. No. 2



KEY PLAN
NOT TO SCALE



PROFILE - ℄ DAM

LOOKING UPSTREAM

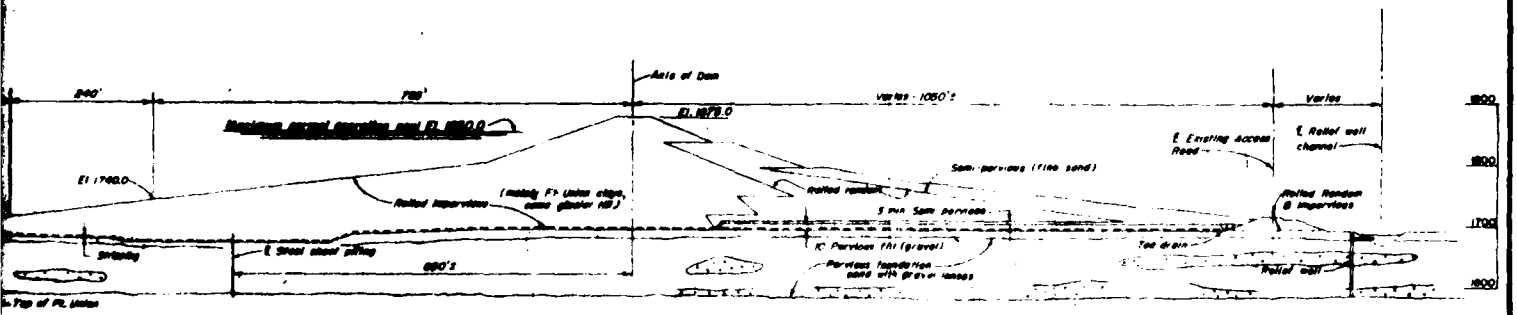
SCALE HOR. 1" = 200'
VERT. 1" = 100'

Fig. No. 1

NOTE

LL bed contains clay parting with maximum observed thickness of 3' approximately 4' below top of bed which is most prevalent south of embankment adjacent to East Flood Plain and disappears to the north and west

Assumed simplified formation for settlement analysis LL's etc represent compressible layers Lignites and sand horizons between considered as non-compressible drainage layers



TYPICAL EAST TERRACE SECTION

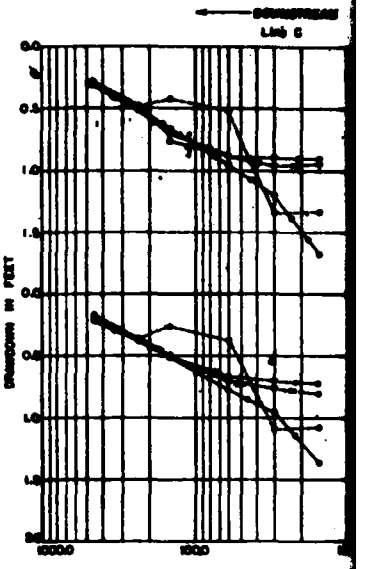
SCALE 1" = 200'

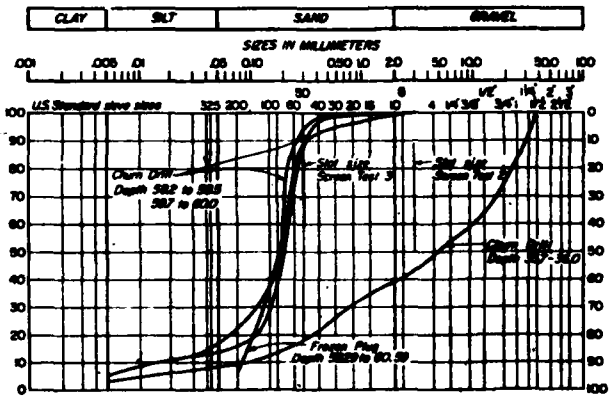
Fig. No. 2

U. S. ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
OMAHA, N. D.

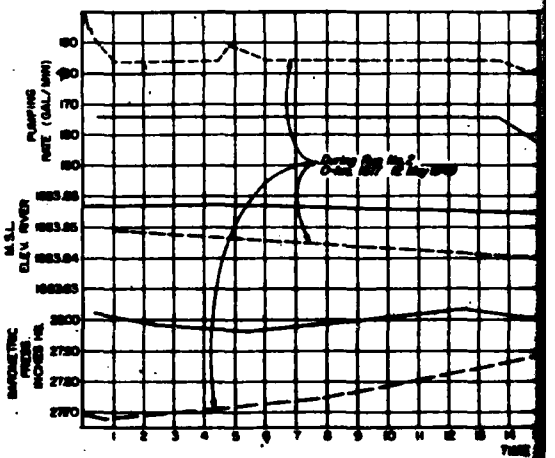
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
GENERALIZED GEOLOGIC PROFILE
℄ SECTION

GEX-5/80

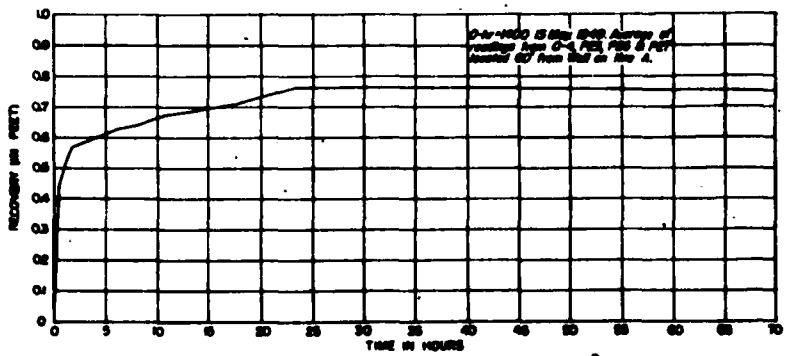




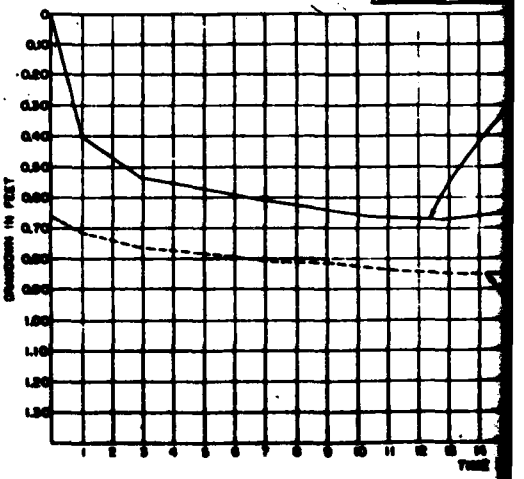
MECHANICAL ANALYSIS CURVES
GARRISON DAM AND RESERVOIR
HOLE 78N (TEST WELL)
FIG. 4



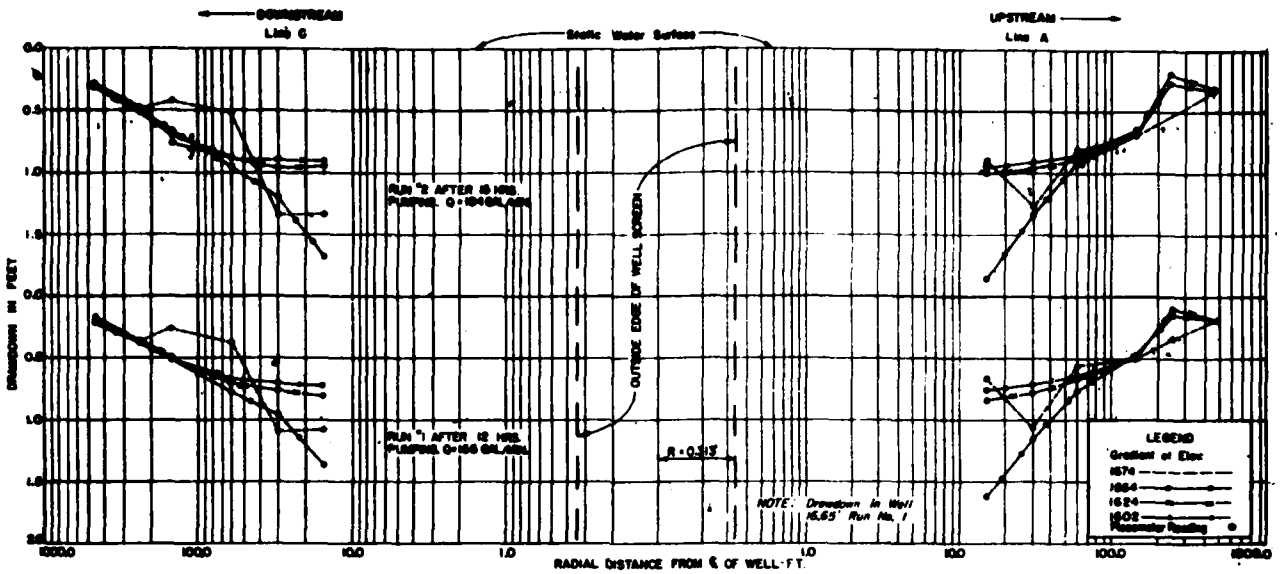
READINGS DURI



TYPICAL RECOVERY VS TIME CURVE TEST #2
FIG. 5

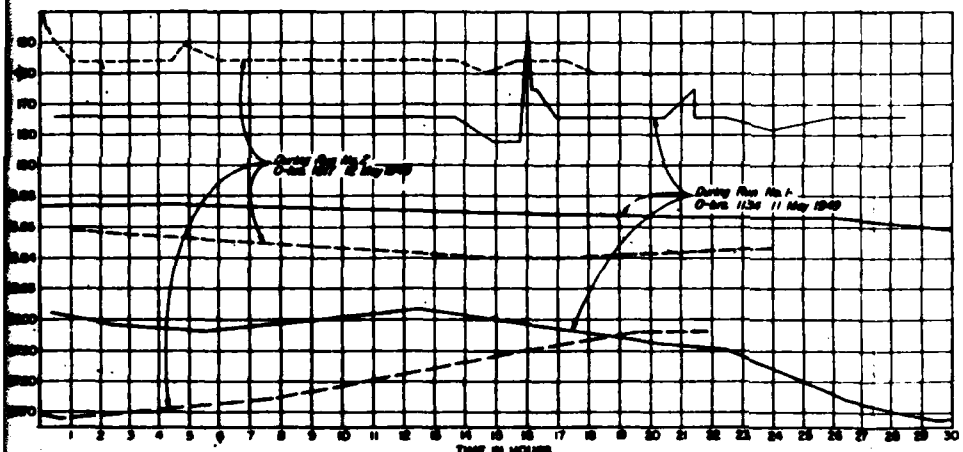


TYPICAL DRAWDOWN VS

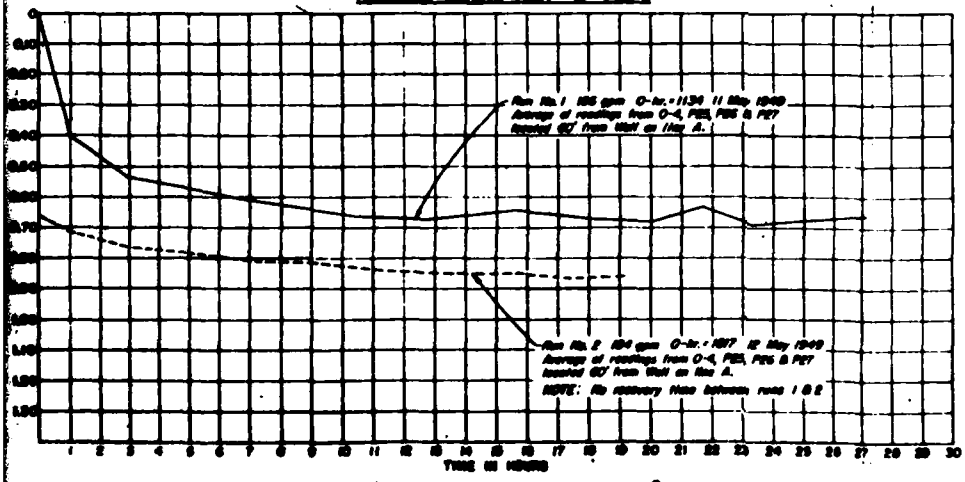


WELL GRADIENTS ON LINES A B C TEST #2 RUNS 1 & 2

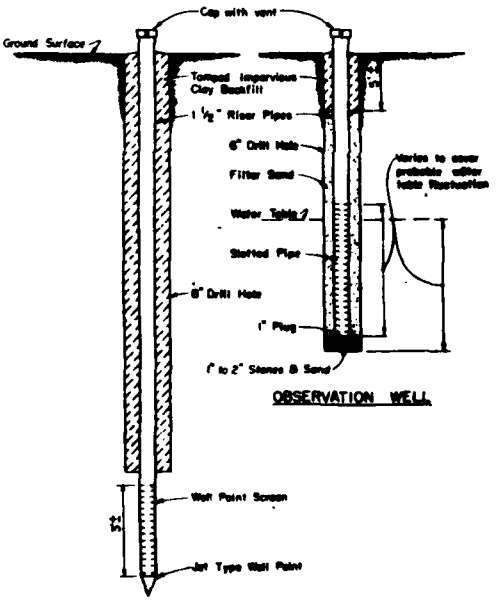
FIG NO. 1



READINGS DURING TEST #2 FIG. 3



TYPICAL DRAWDOWN VS. TIME CURVE TEST #2



TYPICAL PIEZOMETER & OBSERVATION WELL INSTALLATION

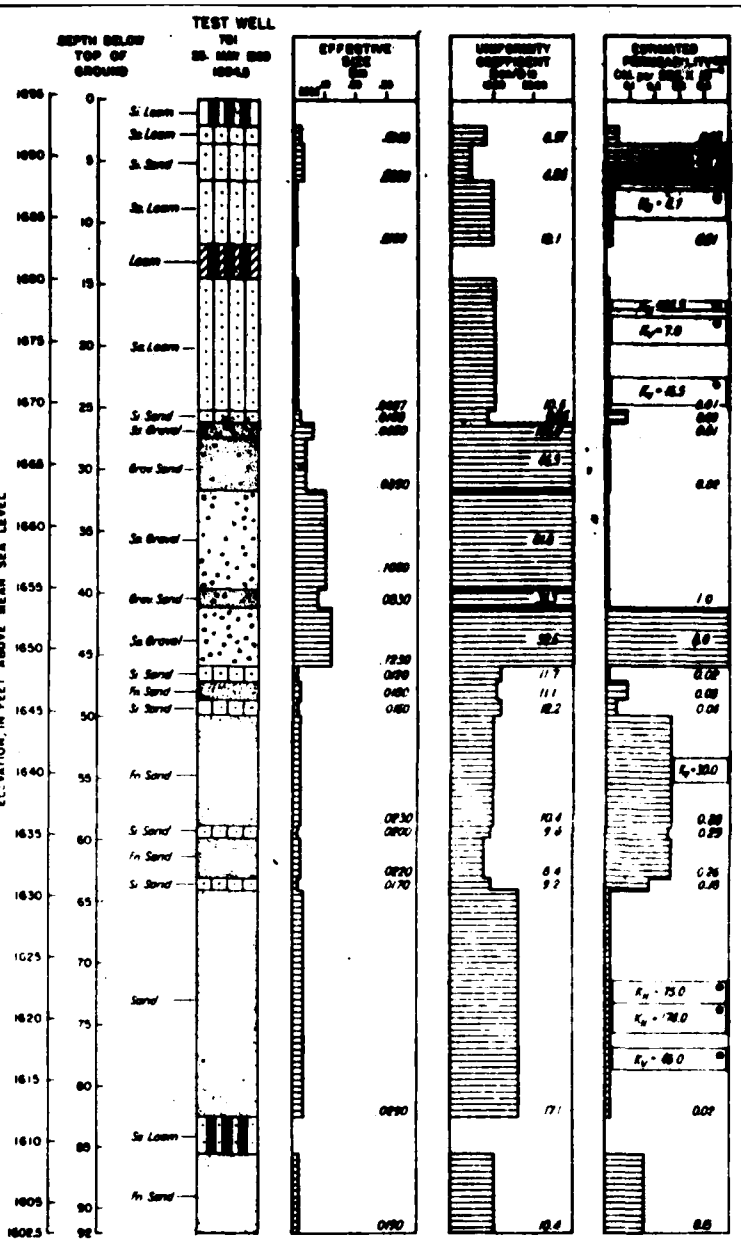
NOT TO SCALE

FIG 6

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OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEBR.

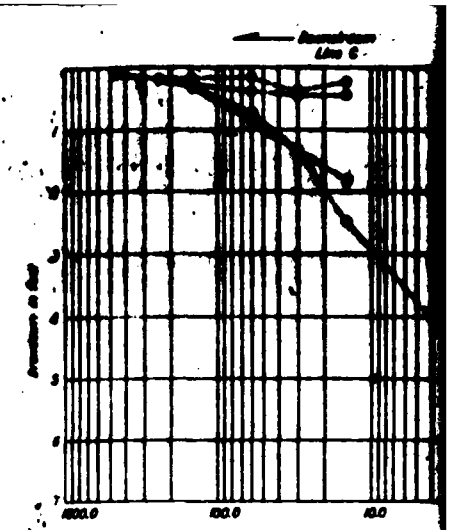
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
PUMPING TEST
SUMMARY OF DATA
TEST NO. 2

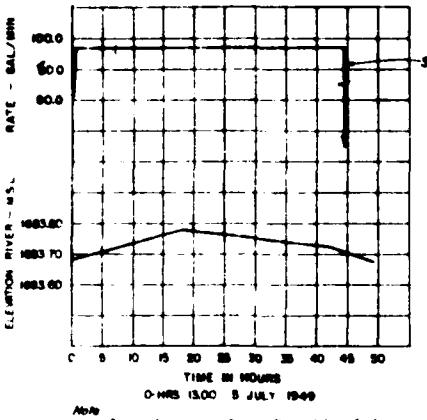
SEX-5/52



• From permeameter tests of frozen clay samples.
•• From grain size d_{10}, d_{20} and d_{50} curves.

FIG. NO. 4

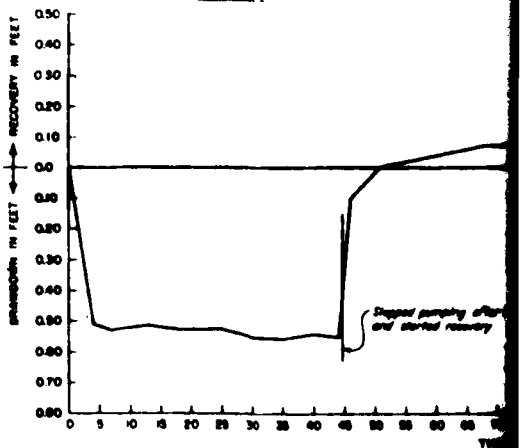




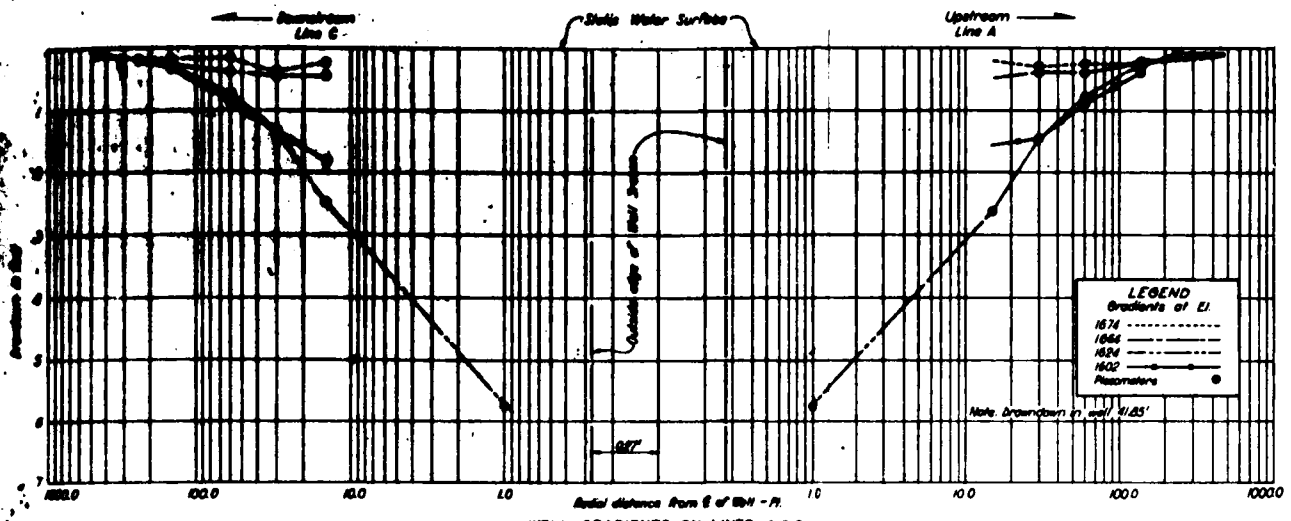
Note: Barometric pressure readings taken during four days were lost or destroyed

READINGS DURING TEST #3

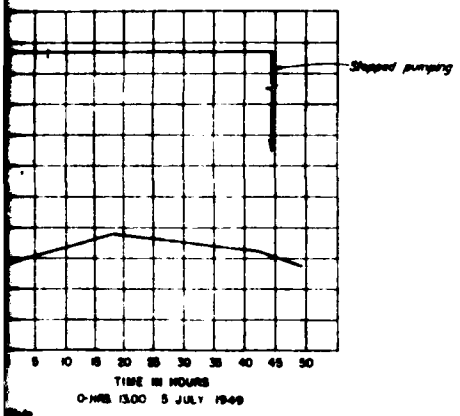
FIG NO 2



TYPICAL DRAWDO

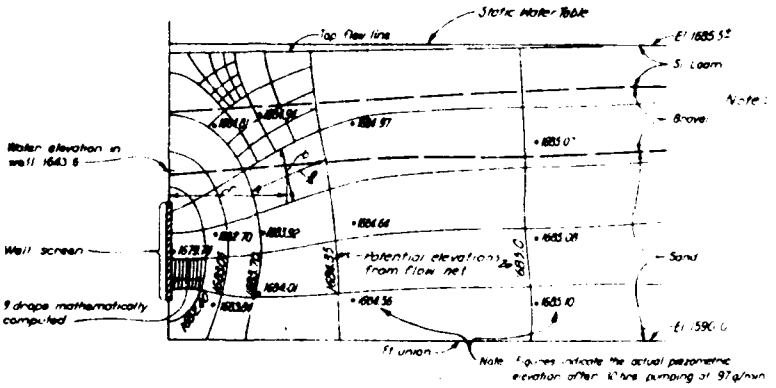


WELL GRADIENTS ON LINES A & C
TEST #3 AFTER 30 HRS. PUMPING AT 97 GPM.
FIG. NO. 1

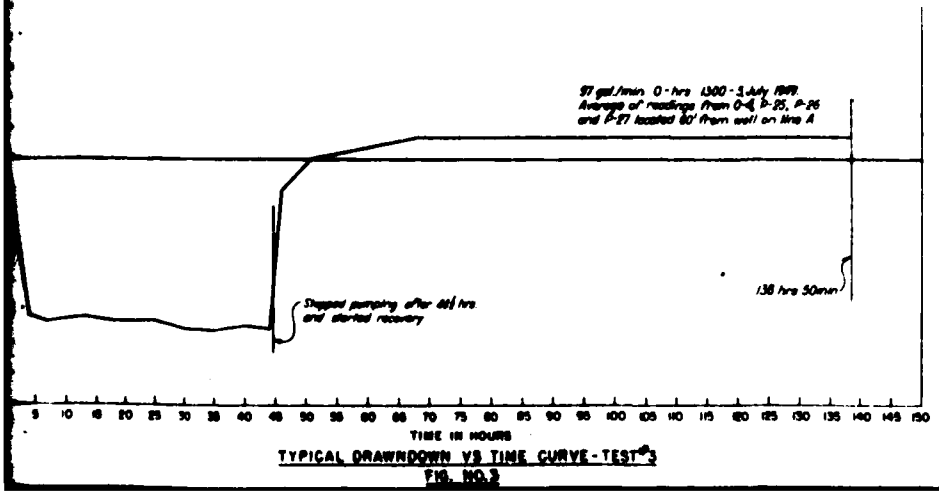


Barometric pressure readings taken during test #3 were lost or destroyed

READINGS DURING TEST #3
FIG NO 2



FLOW NET – TEST #3
ASSUMED HOMOGENEOUS FOUNDATION ON LINE A
FIG NO.5
SCALE 1" = 20'

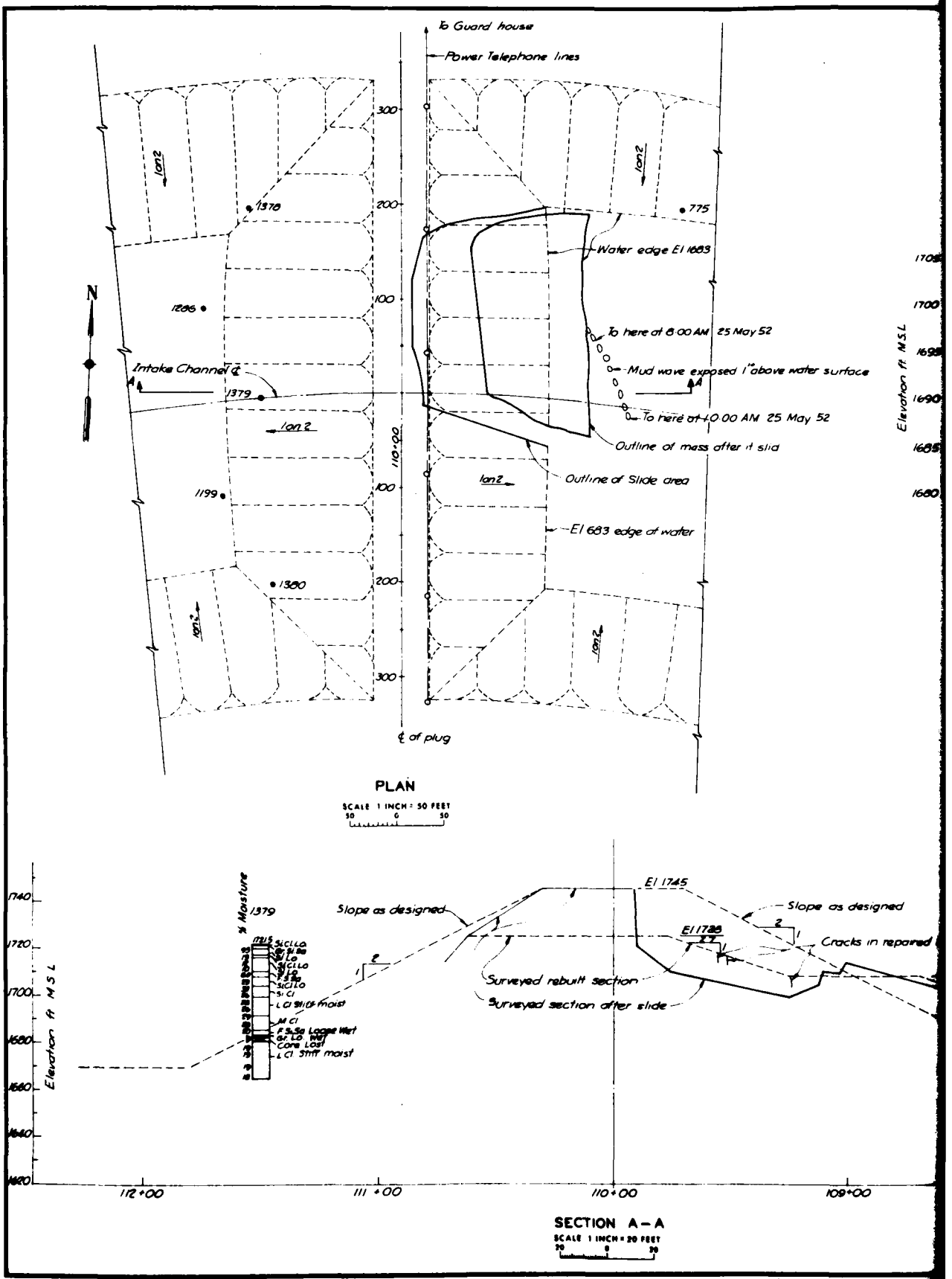


TYPICAL DRAWNDOWN VS TIME CURVE - TEST #3
FIG. NO. 3

U. S. ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEBR.

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
PUMPING TEST
SUMMARY OF DATA
TEST NO 3

OEX-5/63


To Guard house
Power Telephone lines
300
200
100
110+00
100
200
300
1378
775
1286
1379
1199
1380
lon 2
Water edge El 1683
To here at 8:00 AM 25 May 52
Mud wave exposed 1" above water surface
To here at 10:00 AM 25 May 52
Outline of mass after it slid
Outline of Slide area
El 683 edge of water
Intake Channel ℄
℄ of plug
N
A
A
PLAN
SCALE 1 INCH = 50 FEET
50 0 50
1740
1720
1700
1680
1660
1640
1620
Elevation ft M S L
% Moisture
1379
Slope as designed
El 1745
El 1735
Slope as designed
Cracks in repaired
Surveyed rebuilt section
Surveyed section after slide
2
1
112+00
111+00
110+00
109+00
SECTION A – A
SCALE 1 INCH = 20 FEET
20 0 20

775

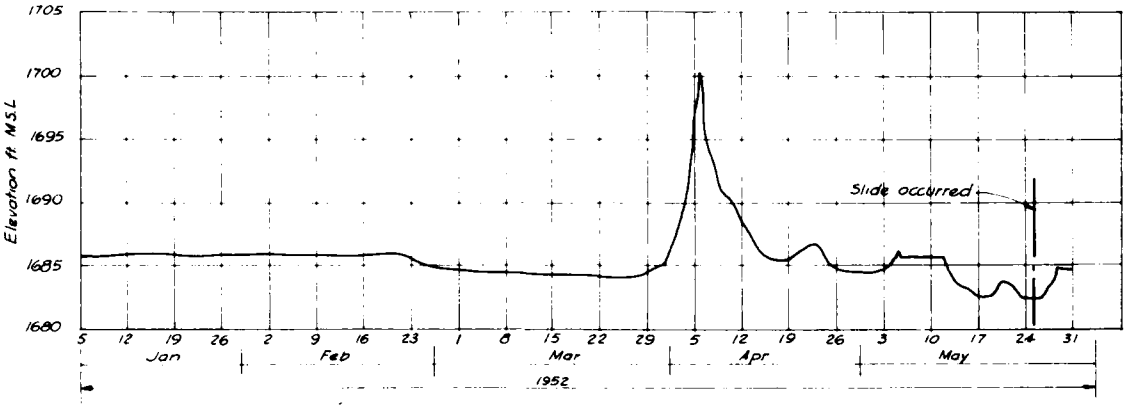
1683

0 AM 25 May 52

exposed 1' above water surface

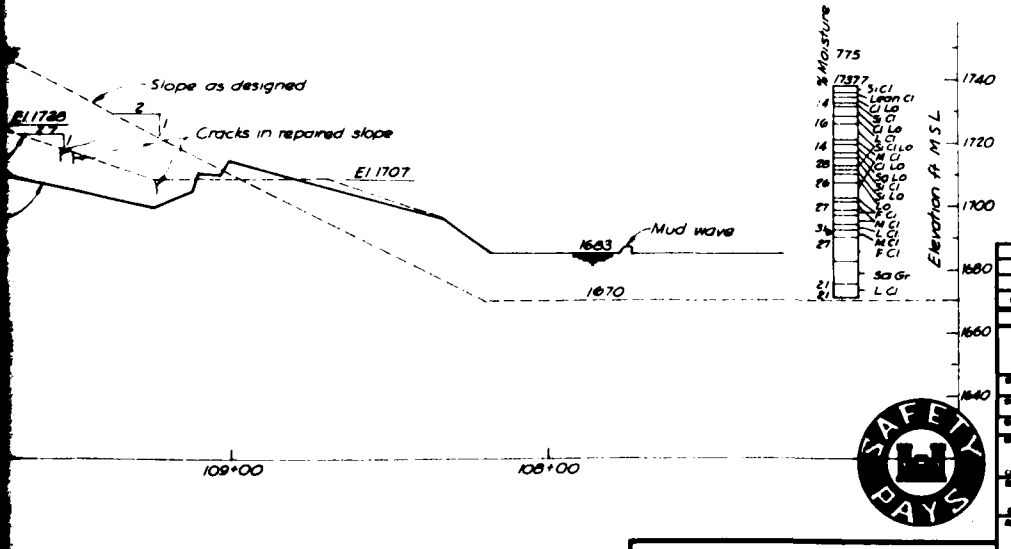
of 4:0 00 AM 25 May 52

ness after it slid



HYDROGRAPH MISSOURI RIVER – AT GARRISON DAM

SCALE: VERTICAL 1" = 5'



THIS DRAWING HAS BEEN REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE.

DATE	DESCRIPTION	CHKD	APPVD

REVISIONS

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

MISSOURI RIVER
GARRISON DAM - LAKE SAKAKAWEA

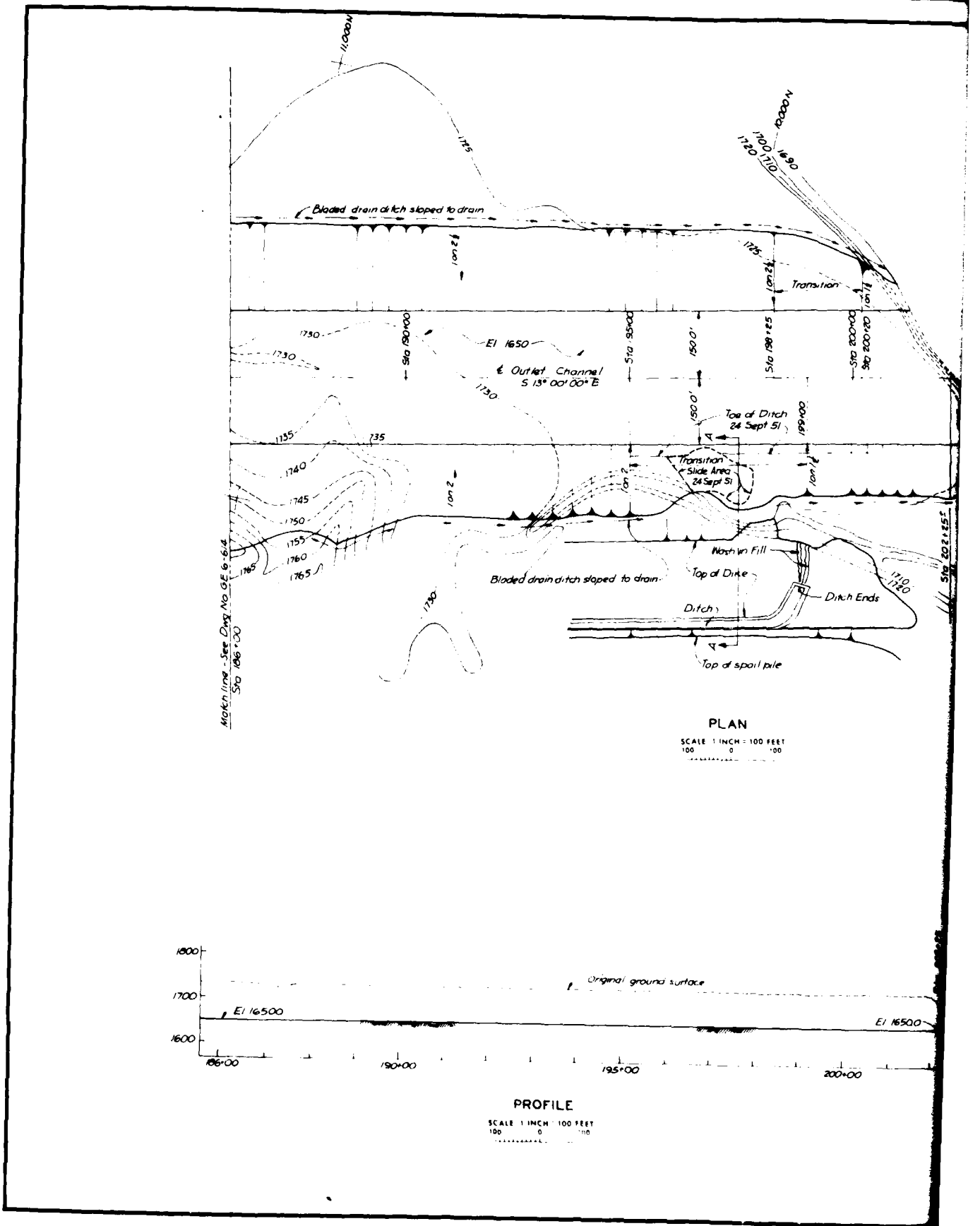
SLIDE
PLUG INTAKE CHANNEL STA. 110

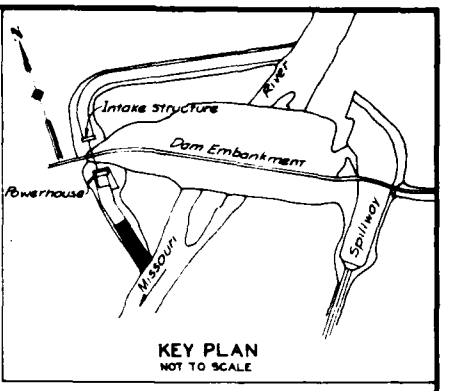
THIS PLAN ACCOMPANIES CONTRACT NO. DACA45
MODIFICATION NO.

$$ – THINK VALUE ENGINEERING – $$

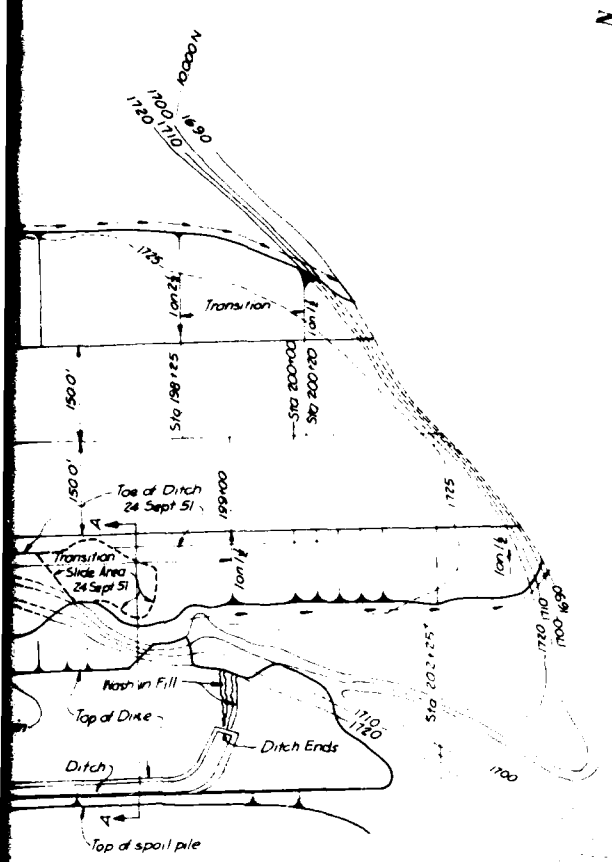
CONSTRUCTION FOUNDATION REPORT (1962) PLATE 59

2


Bloded drain ditch sloped to drain
Transition
El 1650
℄ Outlet Channel
S 13° 00' 00" E
Sta 190+00
Sta 195+00
Sta 200+00
Toe of Ditch
24 Sept 51
Transition
Slide Area
24 Sept 51
Match line - See Dwg No GE 6-614
Sta 186+00
Bloded drain ditch sloped to drain
Natural Fill
Top of Dike
Ditch
Ditch Ends
Top of spoil pile
Sta 202+65
PLAN
SCALE 1 INCH = 100 FEET
1800
1700
1600
Original ground surface
El 16500
El 16500
186+00
190+00
195+00
200+00
PROFILE
SCALE 1 INCH = 100 FEET

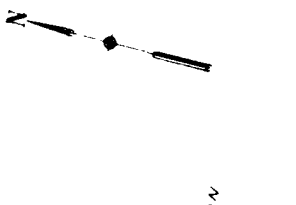


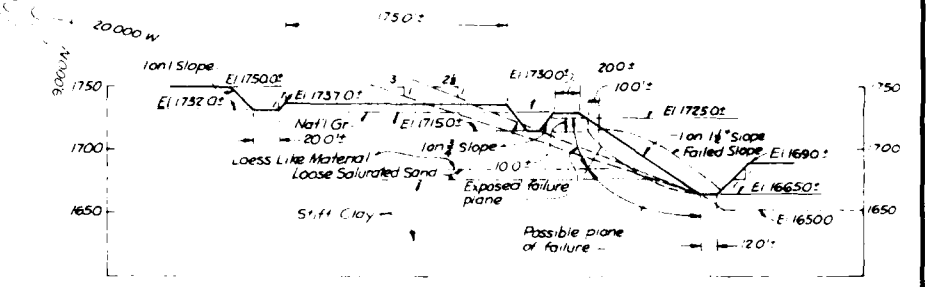
KEY PLAN
NOT TO SCALE



PLAN

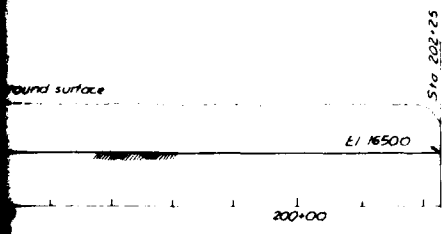
SCALE 1 INCH = 100 FEET
100 0 100





APPROXIMATE SECTION A - A

NOTE Geological data shown on section based on field observation of exposed slope only
Elevation slopes and distances estimated, not surveyed



DATE	DESCRIPTION	BASIC	APPVD
	REVISIONS		

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

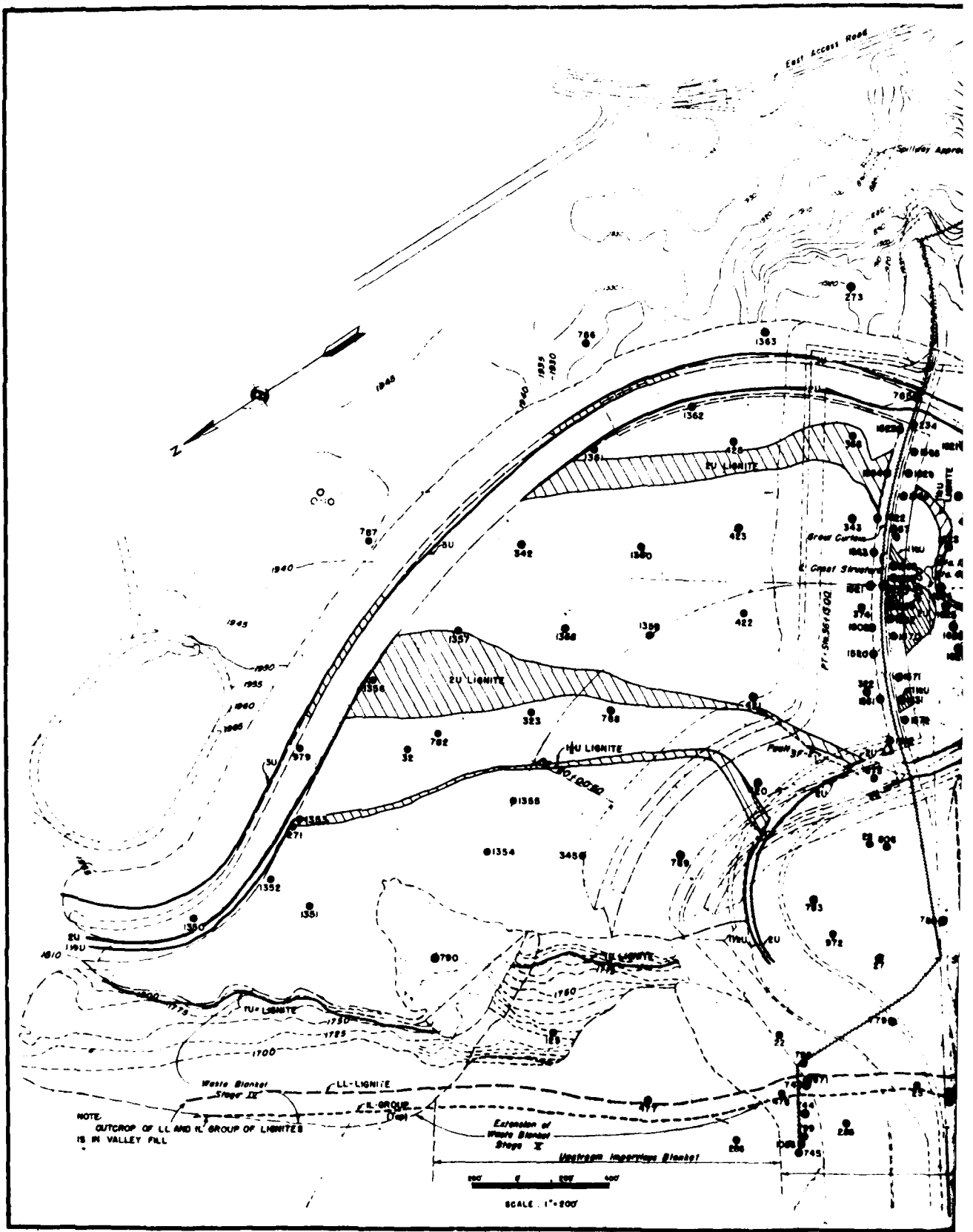
MISSOURI RIVER
GARRISON DAM - LAKE SAKAKAWEA
FIRST SLIDE
OUTLET CHANNEL

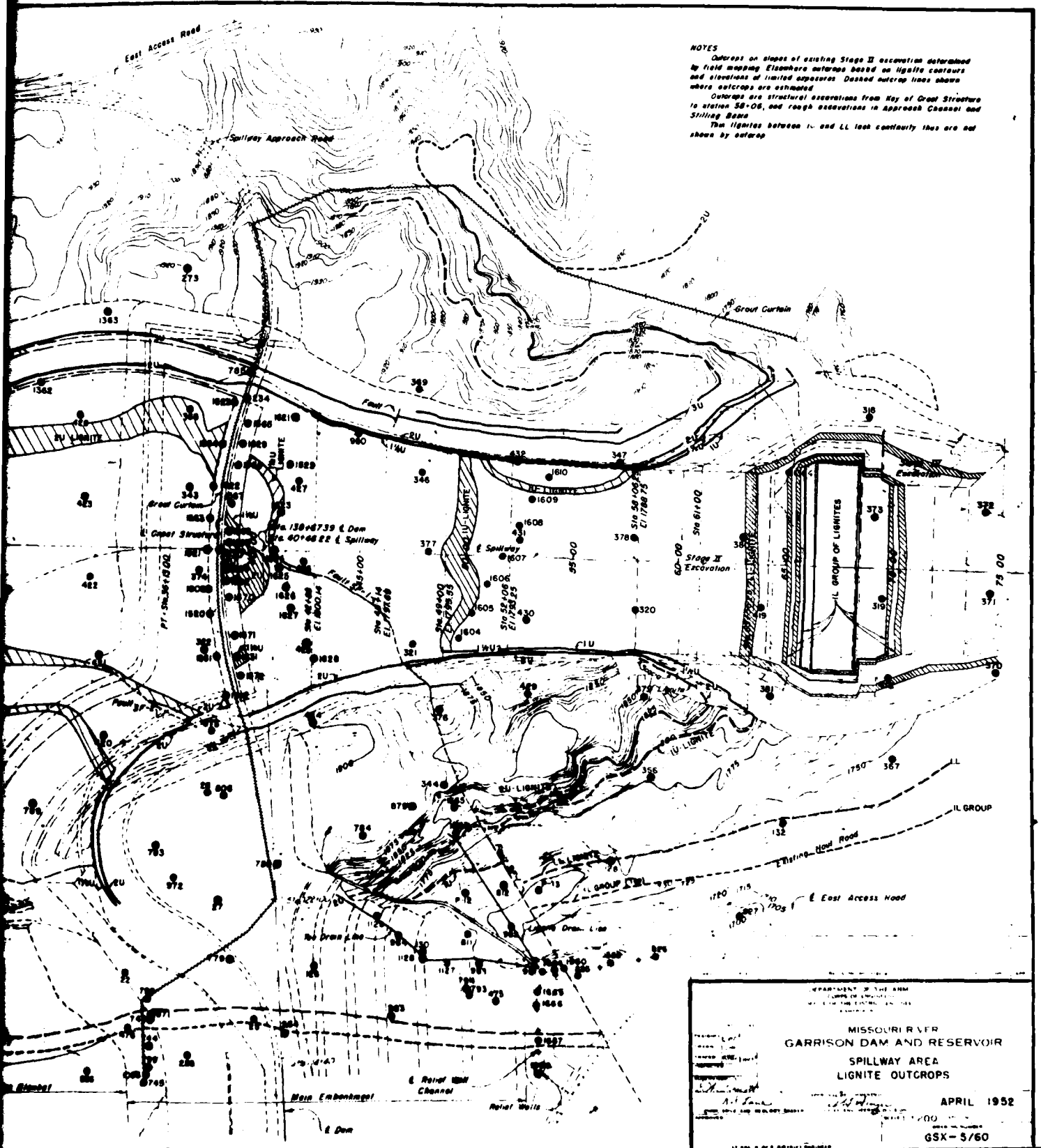
DESIGNED BY
DRAWN BY
CHECKED BY
SUBMITTED BY
RECOMMENDED
CHIEF, ENGINEERING DIVISION
APPROVED
CHIEF, ENGINEERING DIVISION
DATE
SCALE AS SHOWN
CONTR. NO. DACA45
SPEC. NO.
DRAWING NUMBER
SHEET

SAFETY PAYS

THIS PLAN ACCOMPANIES CONTRACT No. DACA45 MODIFICATION No.

$$ - THINK VALUE ENGINEERING - $$


East Access Road
2U LIGNITE
1U LIGNITE
1U+ LIGNITE
LL-LIGNITE
LL-GROUP
Waste Blanket Stage IX
Extension of Waste Blanket Stage X
Upstream Impervious Blanket
NOTE:
OUTCROP OF LL AND IL GROUP OF LIGNITES IS IN VALLEY FILL
SCALE 1"=200'



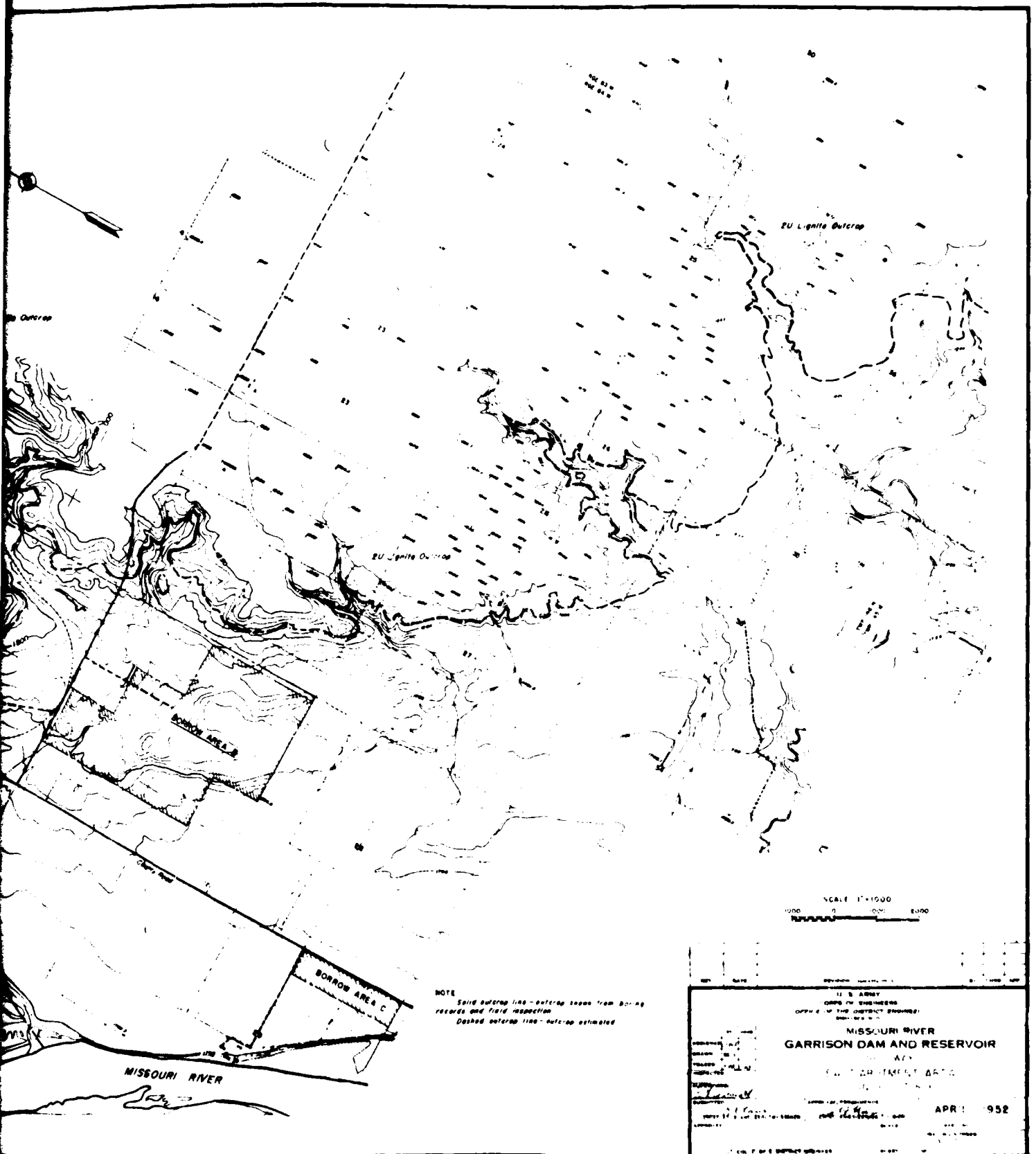
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OMAHA, NEBRASKA

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SPILLWAY AREA
LIGNITE OUTCROPS

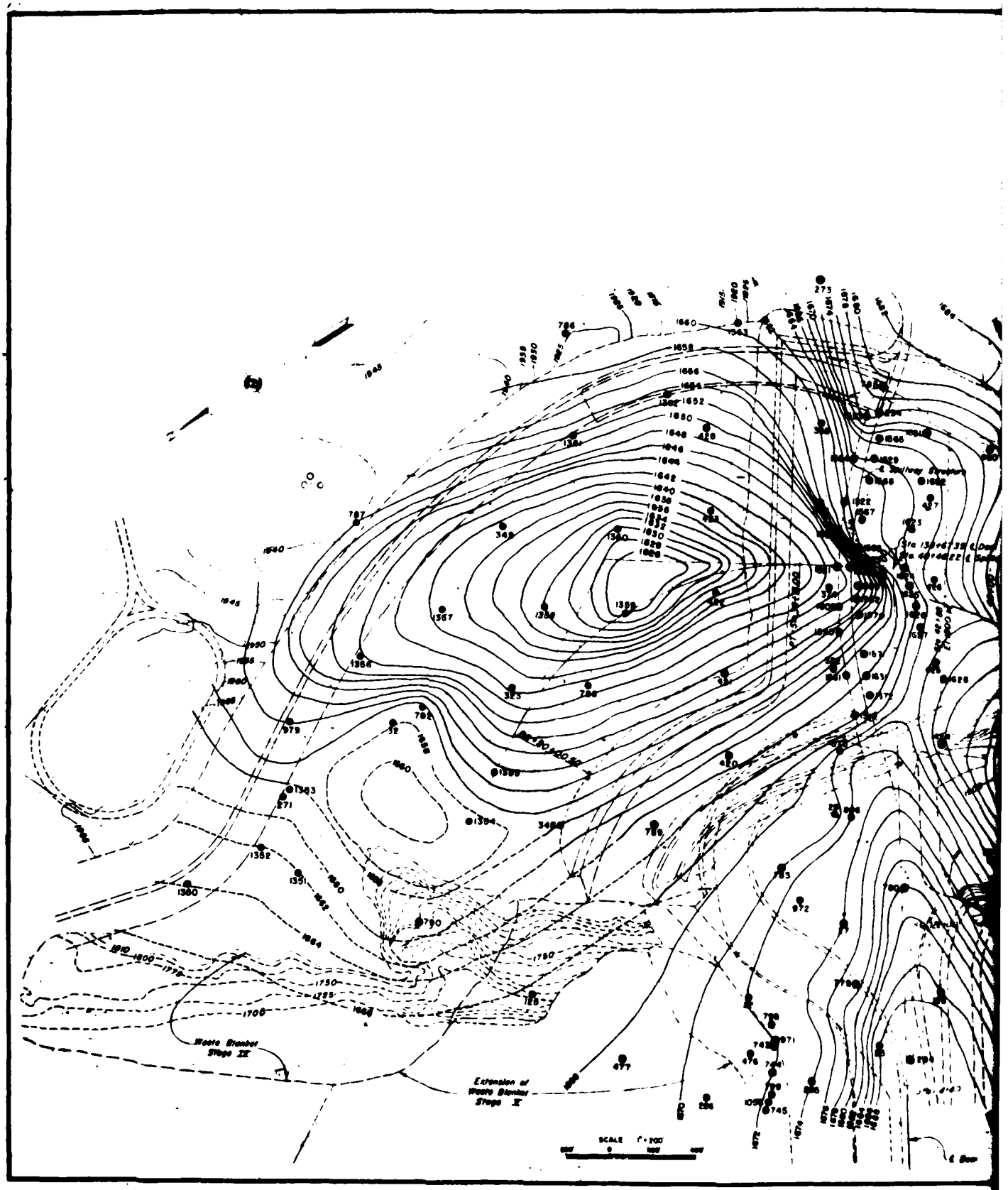
APRIL 1952

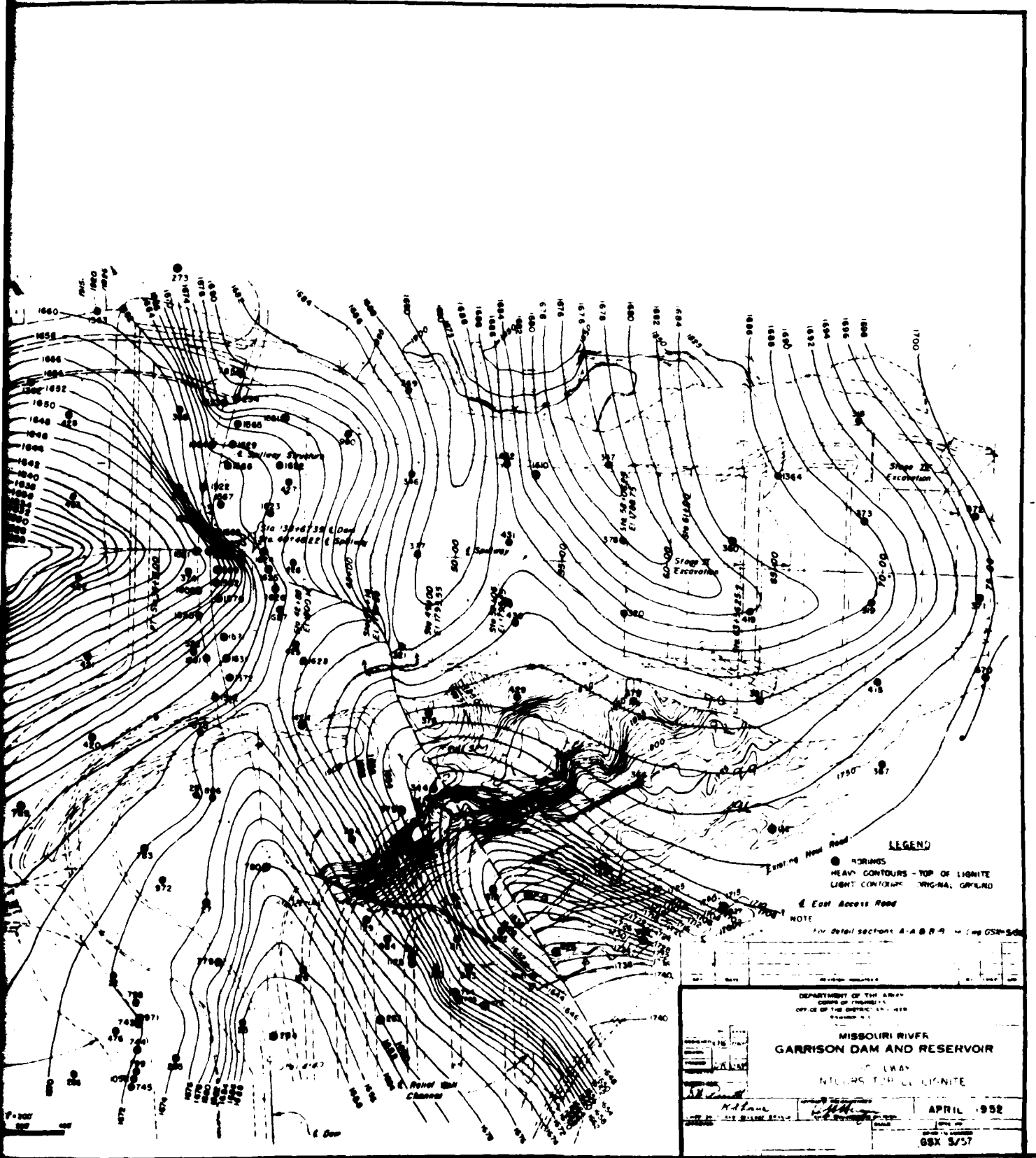
GSX-5/60


RIVERDALE
MISSOURI RIVER



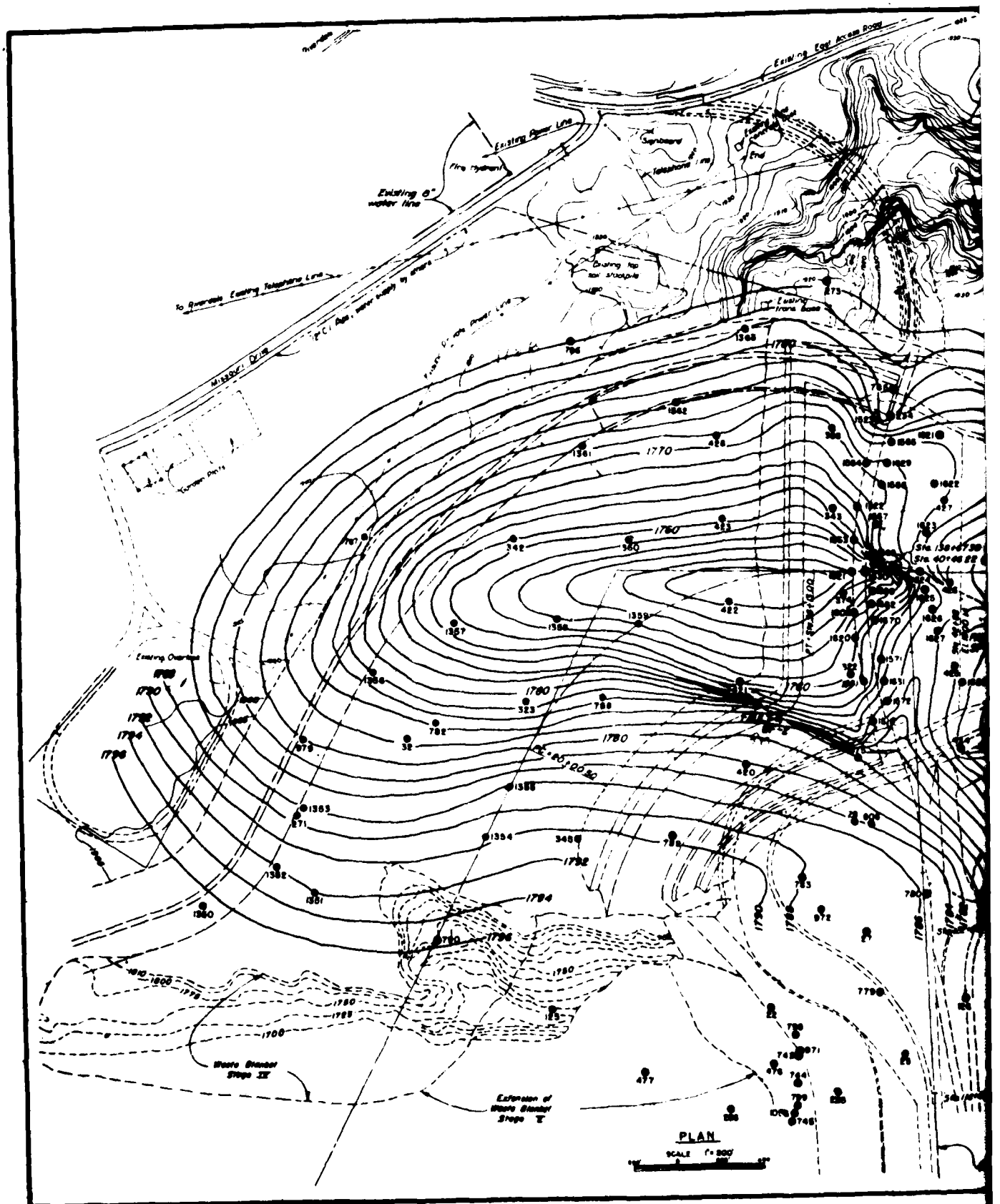
CONSTRUCTION FOUNDATION REPORT (1982) PLATE 62

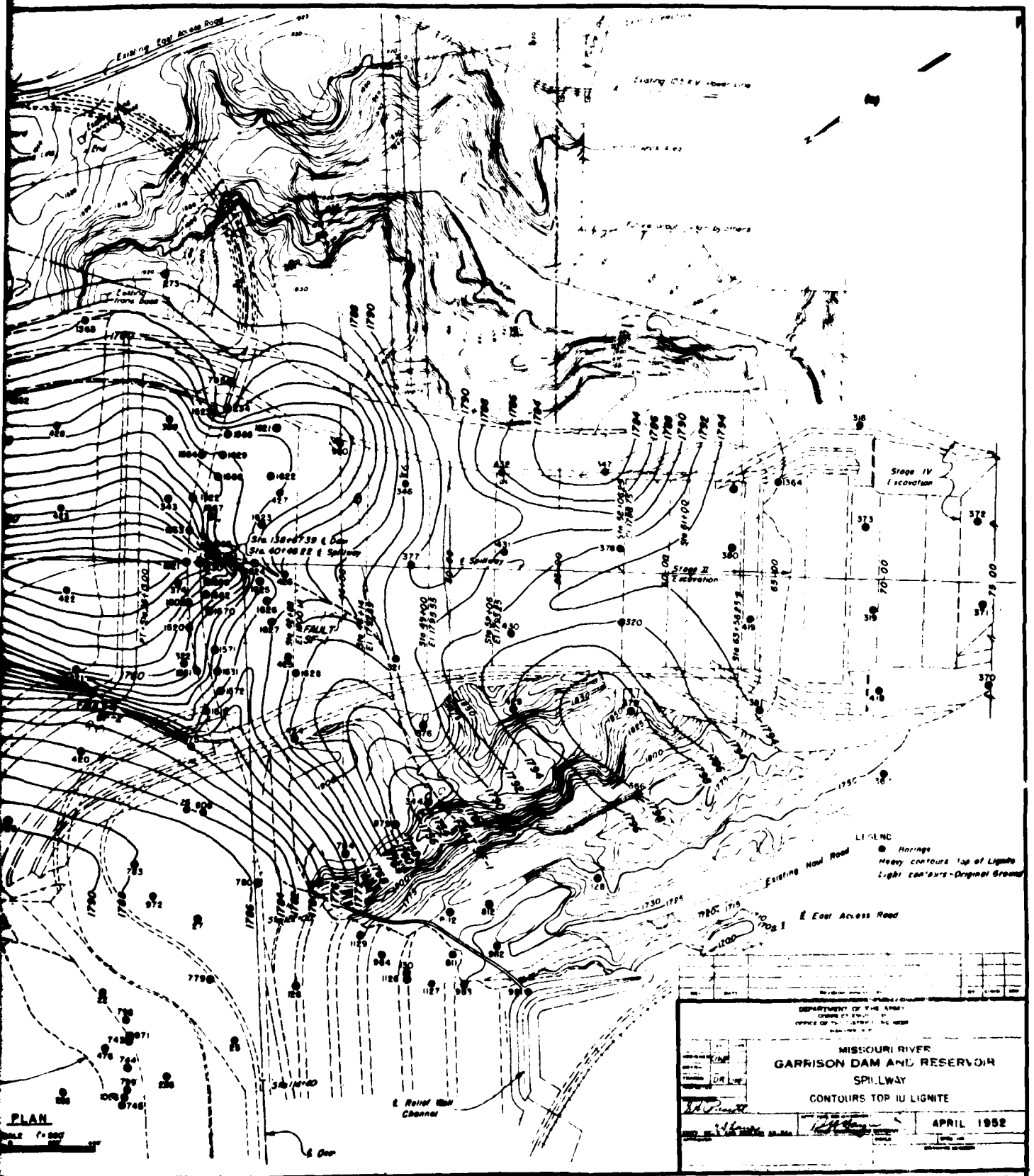

Waste Blanket
Stage IX
Extension of
Waste Blanket
Stage X
SCALE 1"=100'



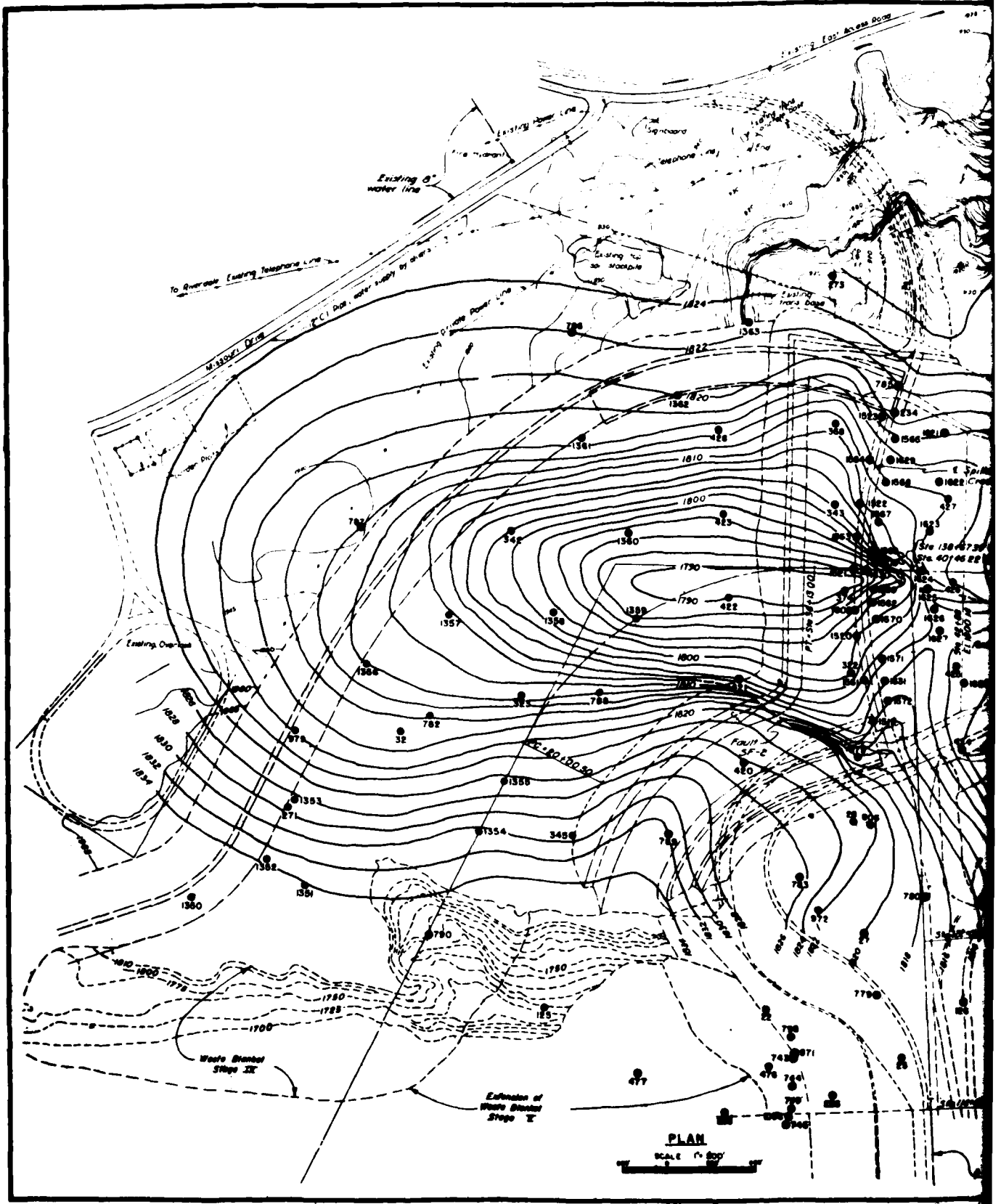
CONSTRUCTION FOUNDATION REPORT (1982) PLATE 63

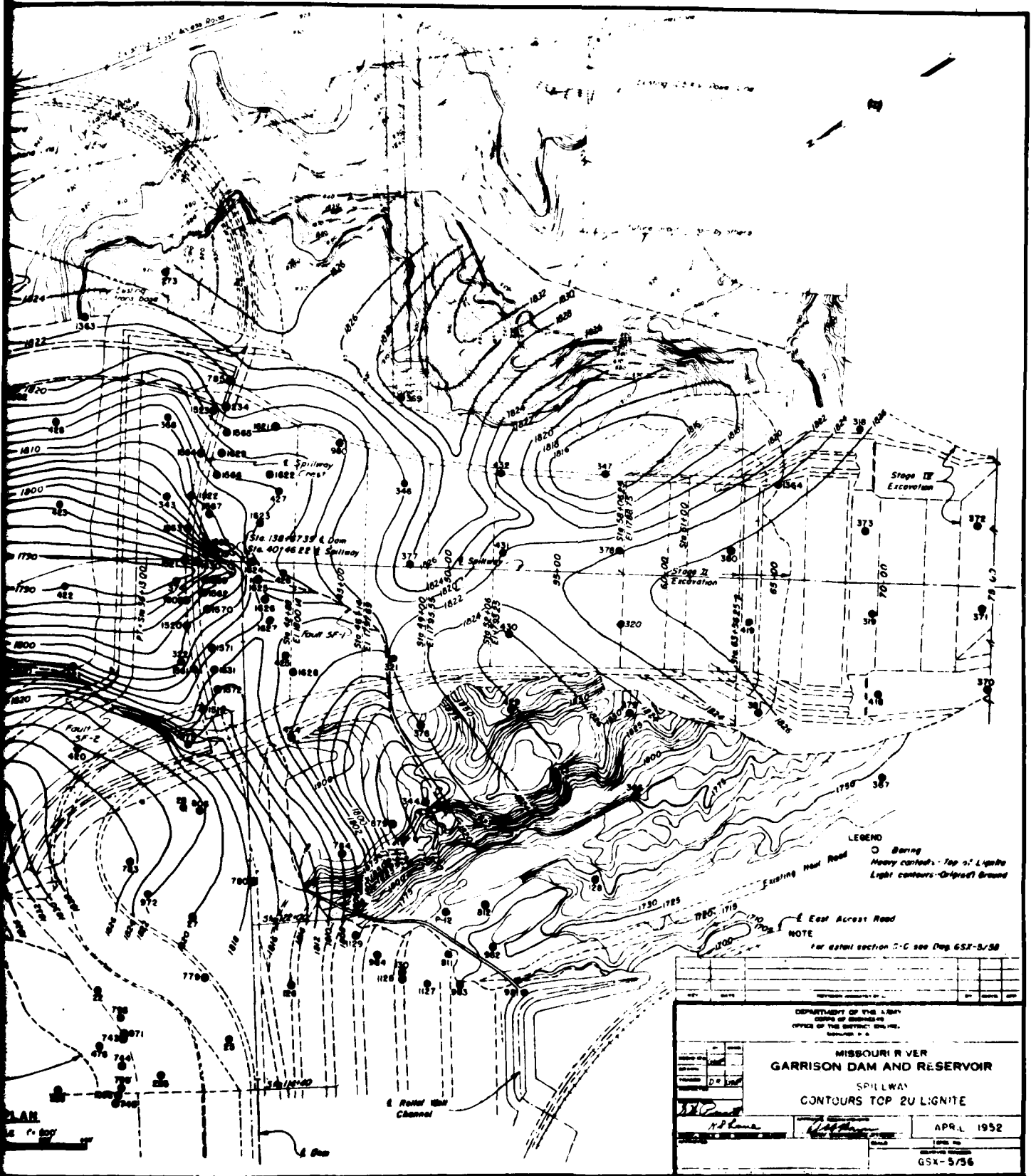
2


Existing Power Line
Existing 6" water line
Existing top soil stockpile
Existing Telephone Line
Existing Overhead
Waste Disposal Stage III
Extension of Waste Disposal Stage II
PLAN
SCALE 1" = 200'

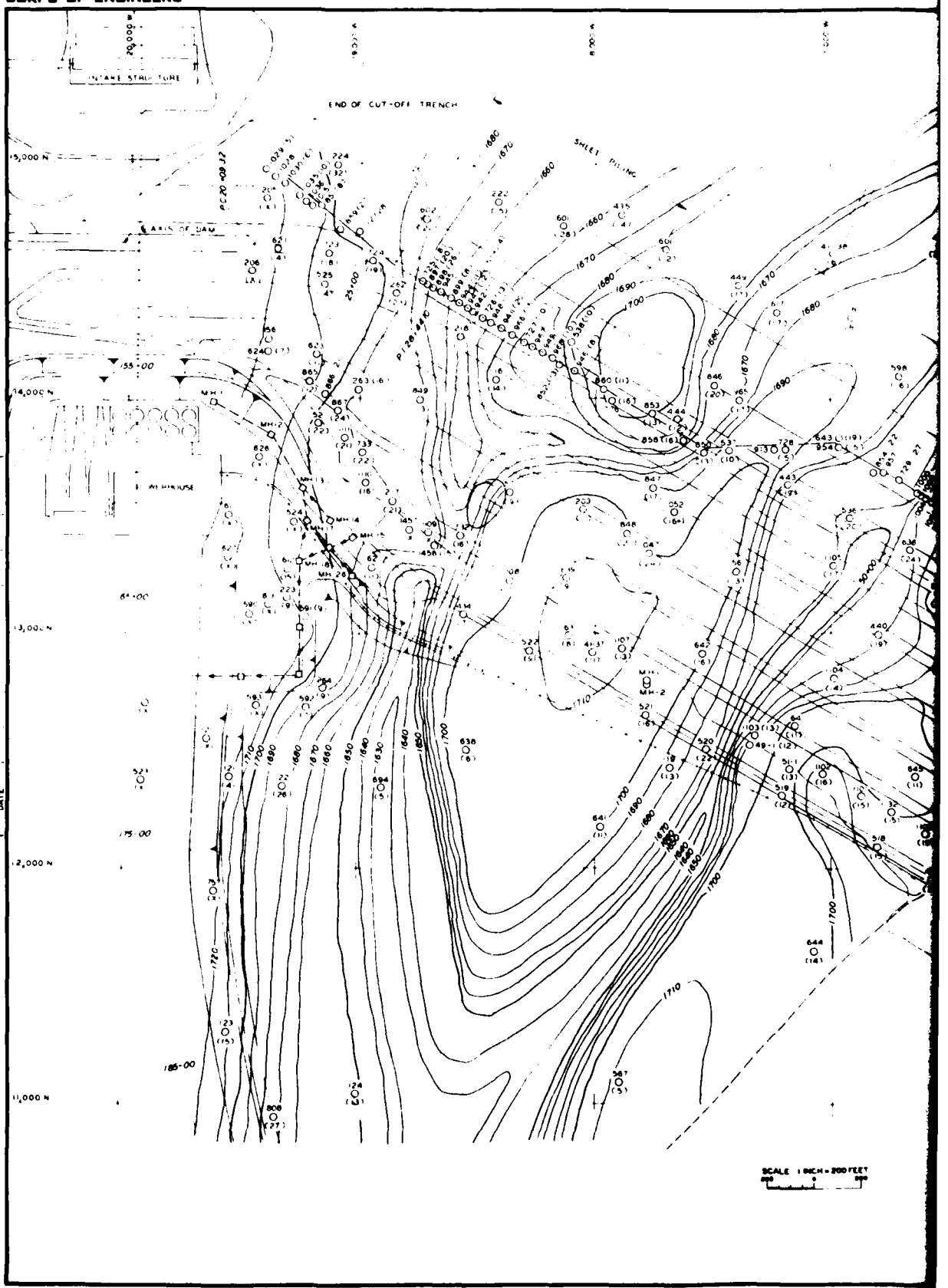


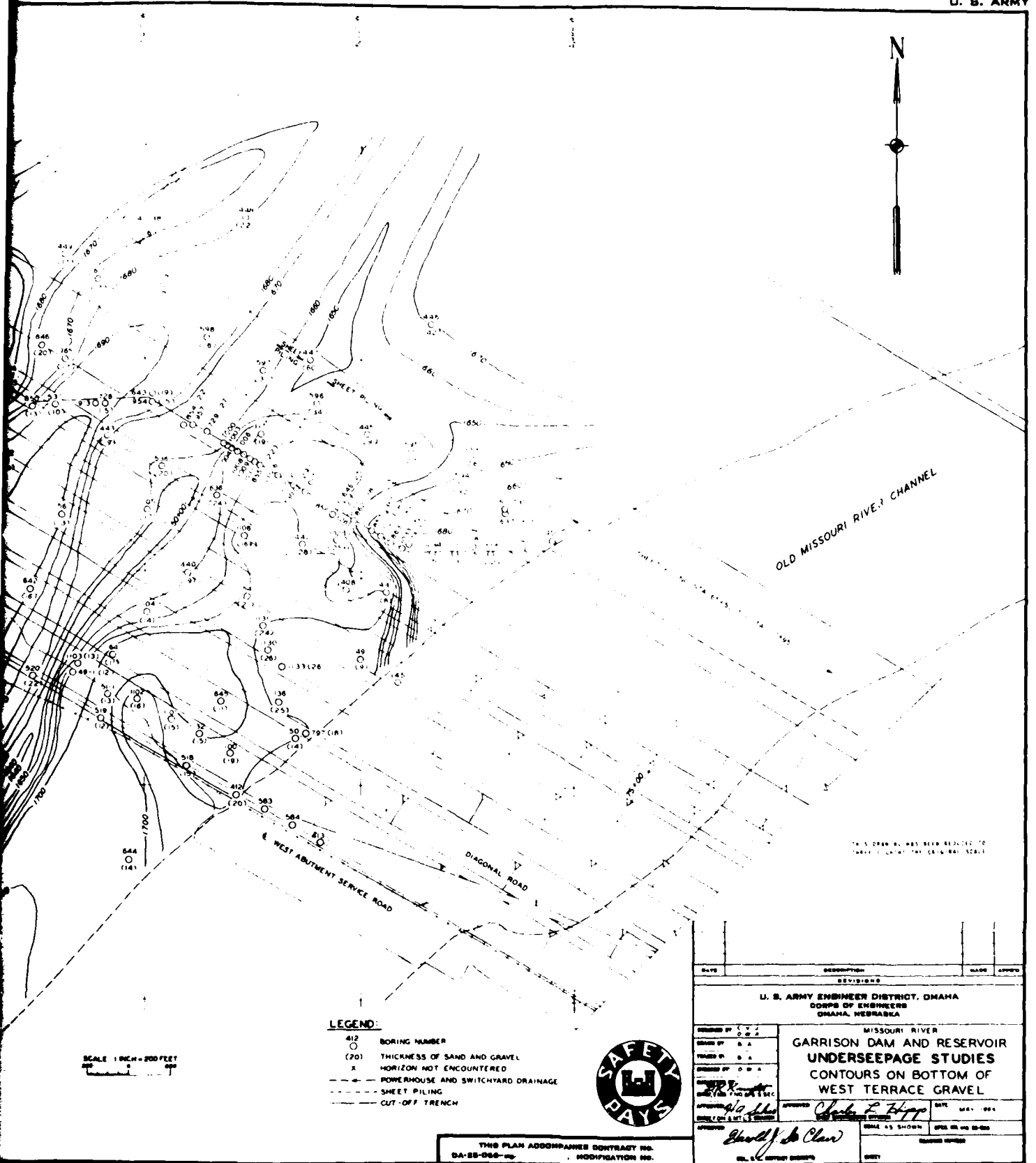
CONSTRUCTION FOUNDATION REPORT (1982) PLATE 64


Existing 6" water line
To Riverside Existing Telephone Line
Existing Overhead
Waste Blanket Stage III
Extension of Waste Blanket Stage II
Fault SF-E
PLAN
SCALE 1" = 800'


Stage III Excavation
Stage II Excavation
℄ Spillway
℄ East Access Road
Existing Haul Road
Fault SF-1
Fault SF-2
LEGEND
Boring
Heavy contours - Top of Lignite
Light contours - Original Ground
NOTE
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SPILLWAY
CONTOURS TOP 2U LIGNITE
APRIL 1952
GSX-5/56

CORPS OF ENGINEERS





DATE	DESCRIPTION	MADE	APPRD
	REVISIONS		

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

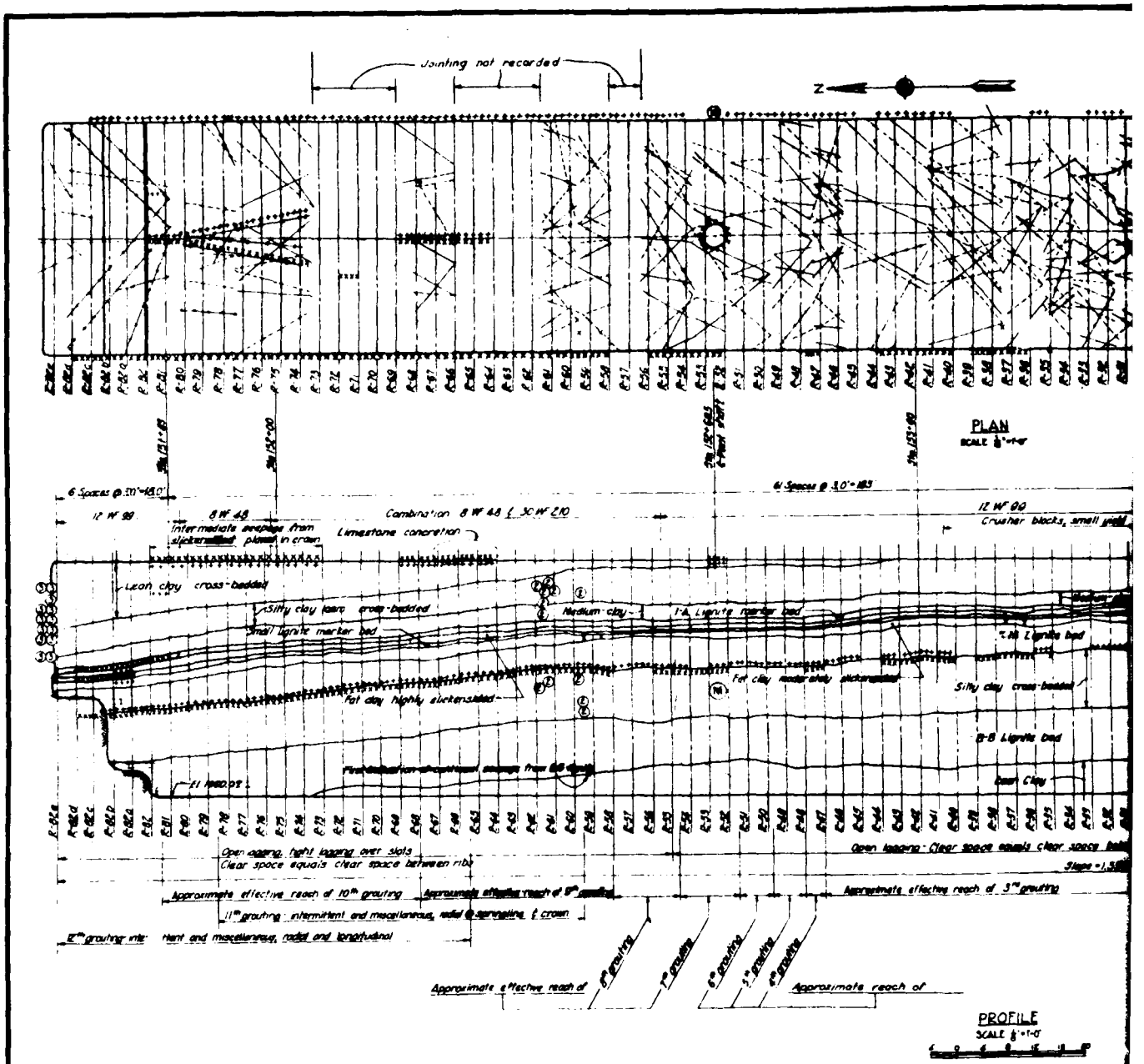
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
UNDERSEEPAGE STUDIES
CONTOURS ON BOTTOM OF
WEST TERRACE GRAVEL

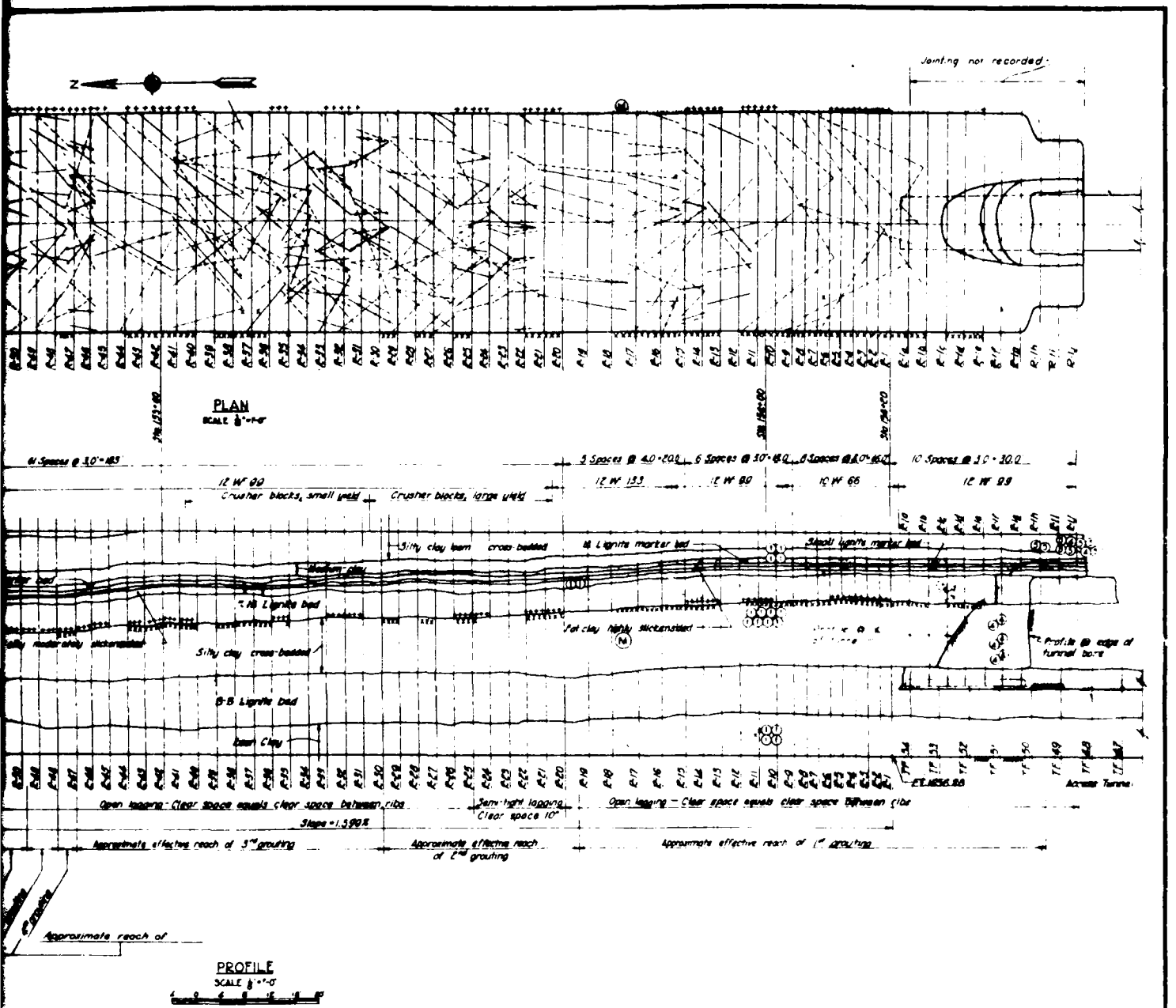
APPROVED Charles L. Hopp — DATE MAY 1951
SCALE AS SHOWN

THIS PLAN ACCOMPANIES CONTRACT NO. DA-25-065-eng- , MODIFICATION NO.

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 66

2


Jointing not recorded
N
PLAN
SCALE
6 Spaces @ 3.0'=18.0'
12 WF 99
8 WF 48
Intermediate seepage from slickensided planes in crown
Limestone concretion
Combination 8 WF 48 & 30 WF 210
6 Spaces @ 3.0'=18.0'
12 WF 99
Crusher blocks, small yield
Loam clay cross-bedded
Silty clay loam cross-bedded
Small lignite marker bed
Medium clay
1-A Lignite marker bed
7-A Lignite bed
Fat clay highly slickensided
Fat clay moderately slickensided
Silty clay cross-bedded
8-B Lignite bed
Boot Clay
Open staging, light lagging over slots
Clear space equals clear space between ribs
Open staging: Clear space equals clear space bet
Approximate effective reach of 10th grouting
Approximate effective reach of 9th grouting
Approximate effective reach of 3rd grouting
11th grouting: intermittent and miscellaneous, radial & spreading, & crown
12th grouting: intermittent and miscellaneous, radial and longitudinal
Approximate effective reach of
9th grouting
7th grouting
6th grouting
5th grouting
4th grouting
Approximate reach of
PROFILE
SCALE



LEGEND

- Joints above springline
- Joints below springline
- Joints extending above & below springline
- Slickensided joint planes
- Seepage west side of vert. ℄
- Seepage east side of vert. ℄
- Samples (no. indicates set)
- Moisture migration sampling station east side

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

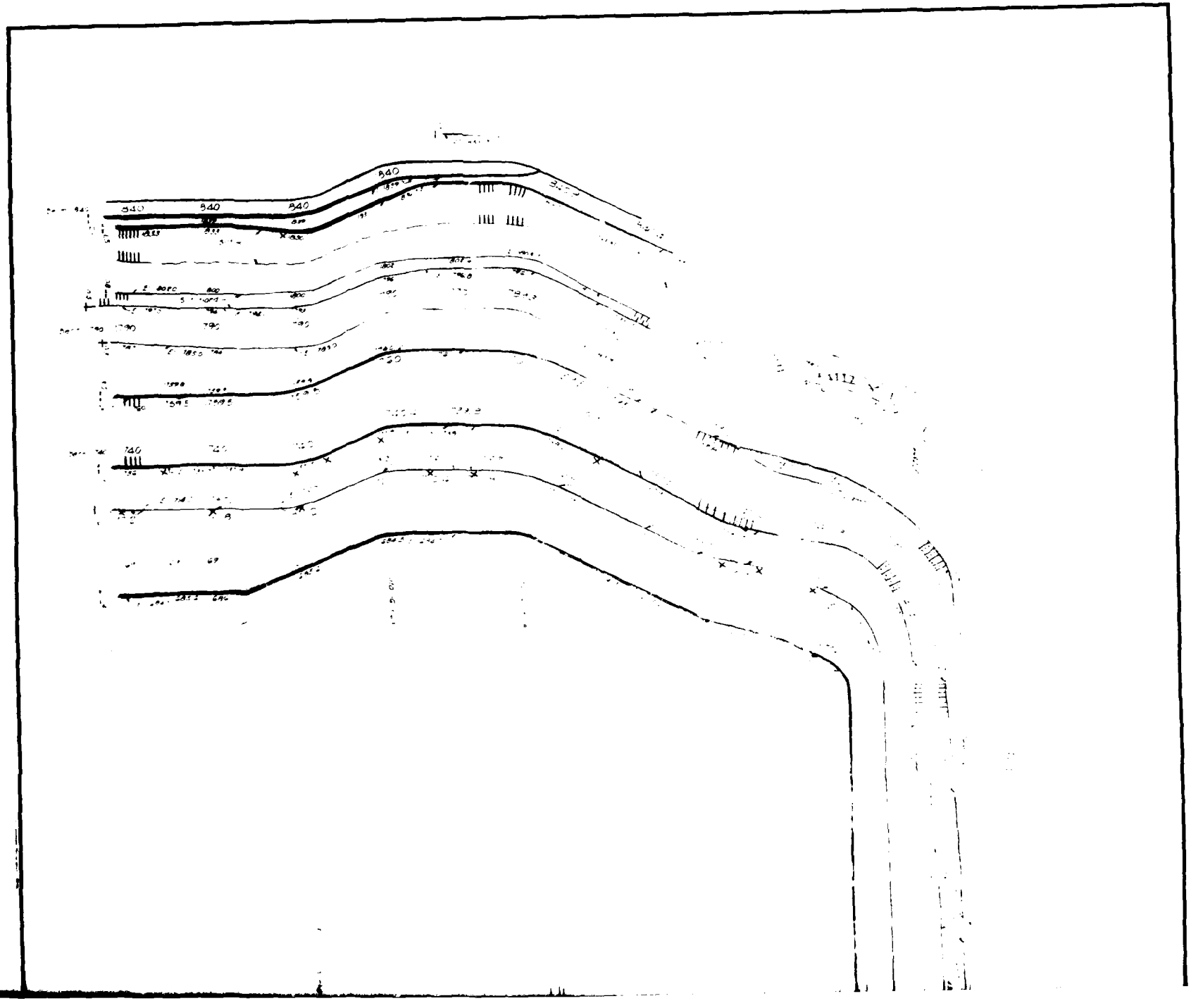
MISSOURI RIVER
GARRISON DAM AND RESERVOIR

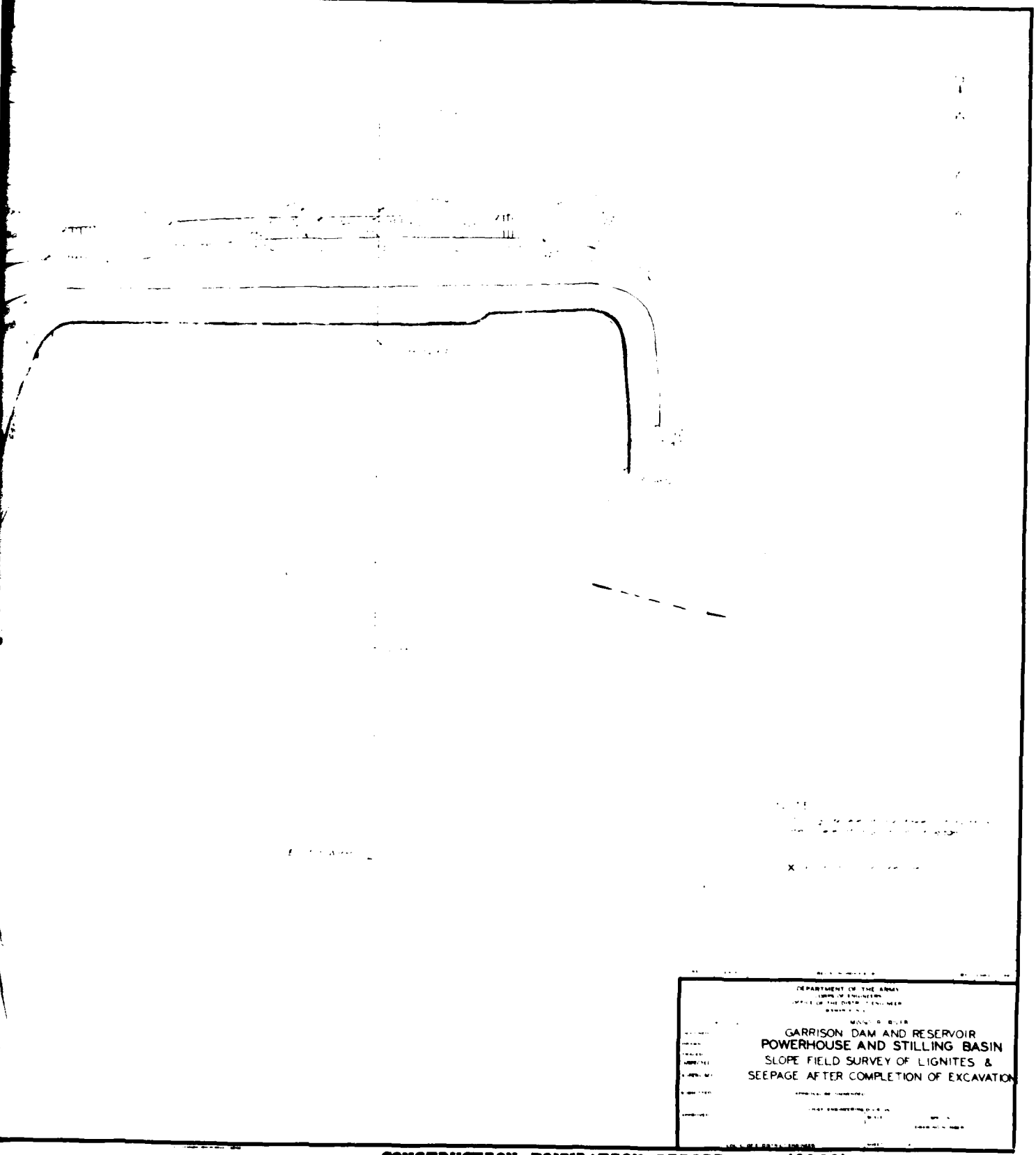
TEST TUNNEL GEOLOGY

AUGUST 1949

GEX-8/17

CONSTRUCTION FOUNDATION REPORT (198?) PLATE 67

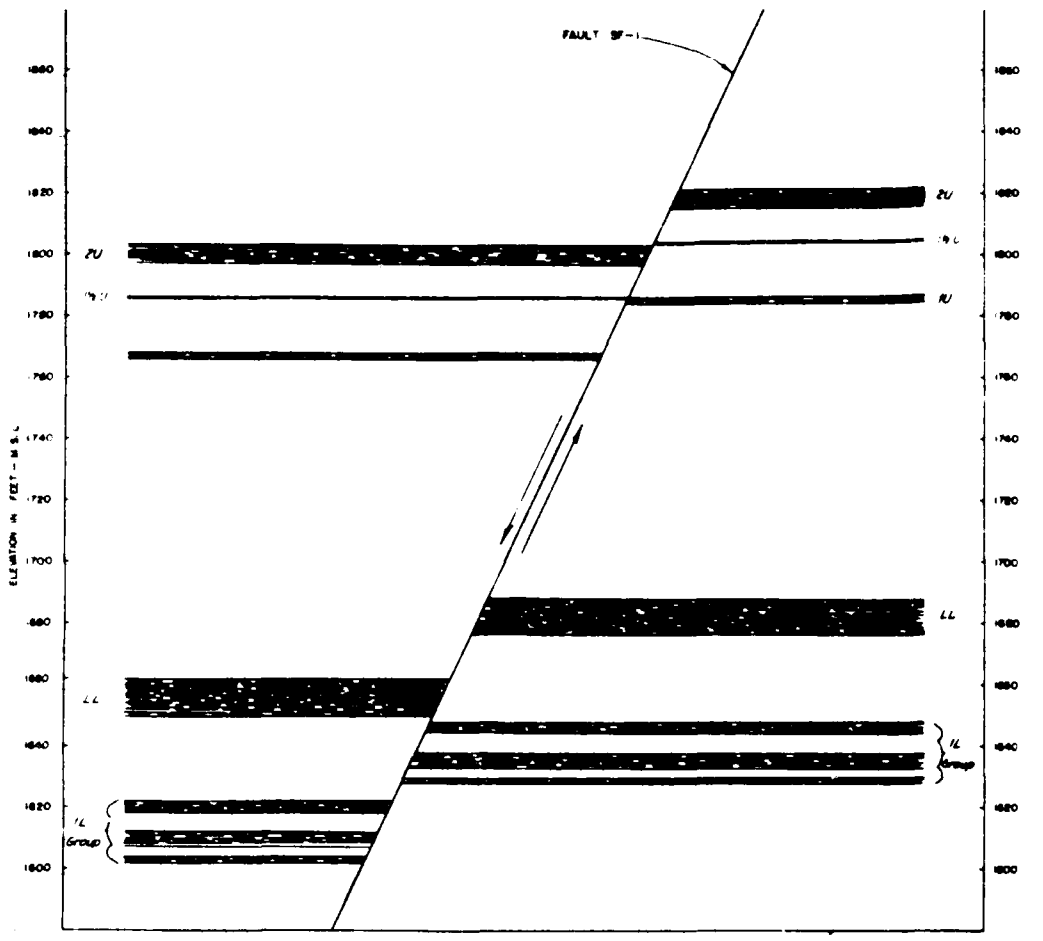




DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DIST. ENGINEER

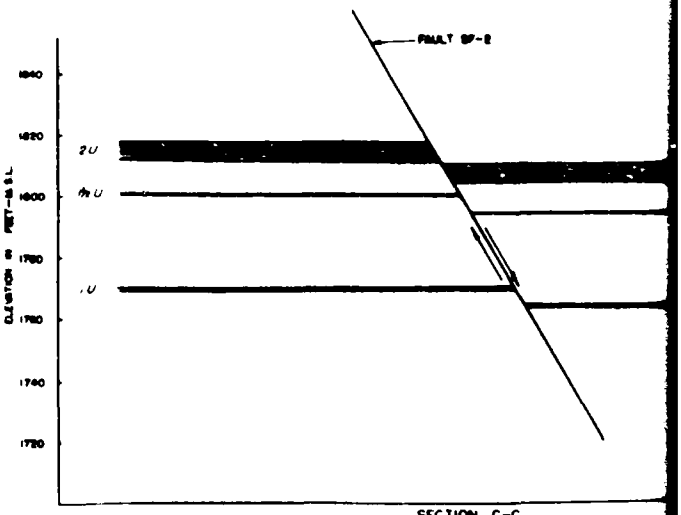
MISSOURI RIVER

GARRISON DAM AND RESERVOIR
POWERHOUSE AND STILLING BASIN
SLOPE FIELD SURVEY OF LIGNITES &
SEEPAGE AFTER COMPLETION OF EXCAVATION



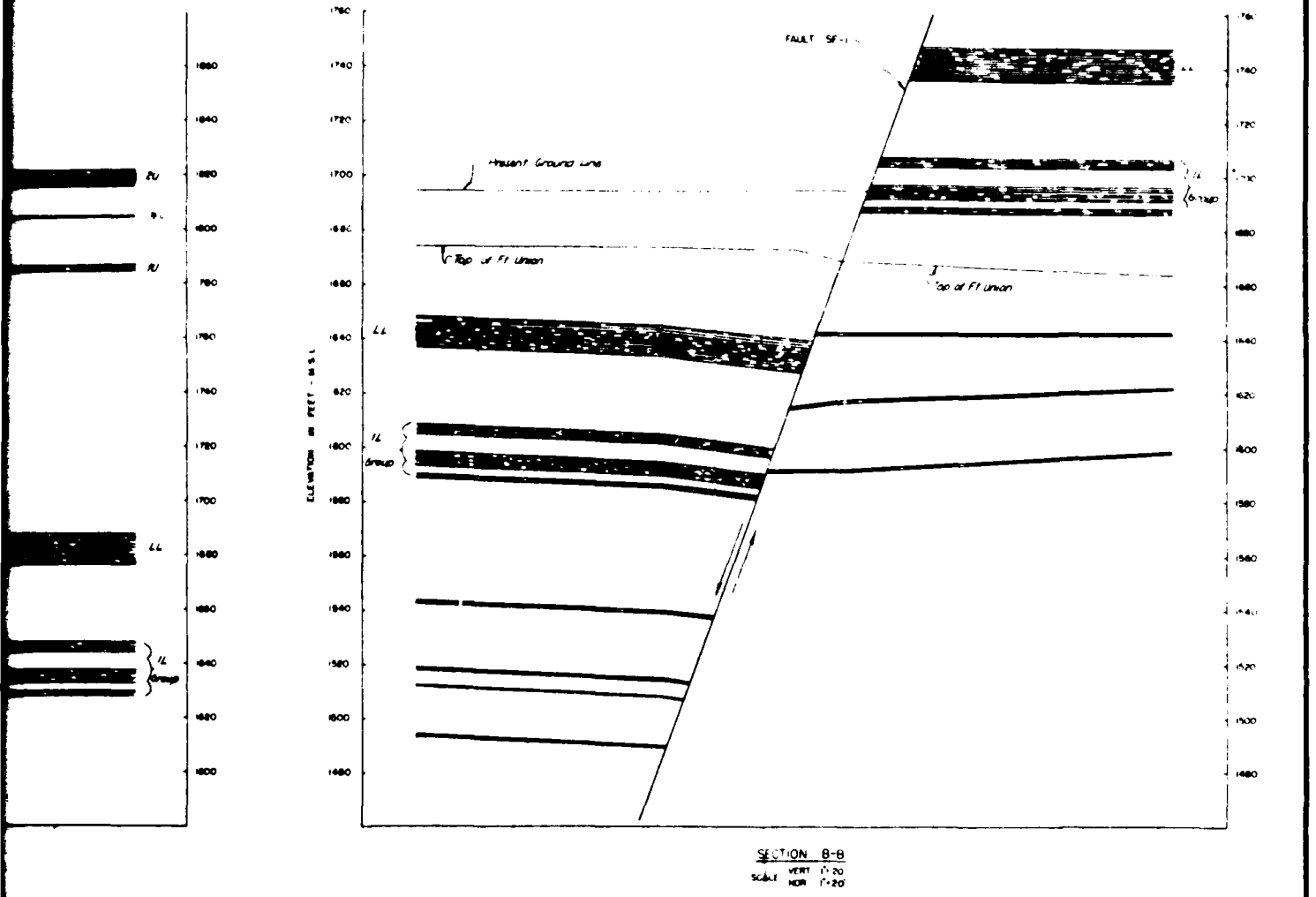
SECTION A-A

SCALE VERT 1" = 20'
HOR 1" = 20'



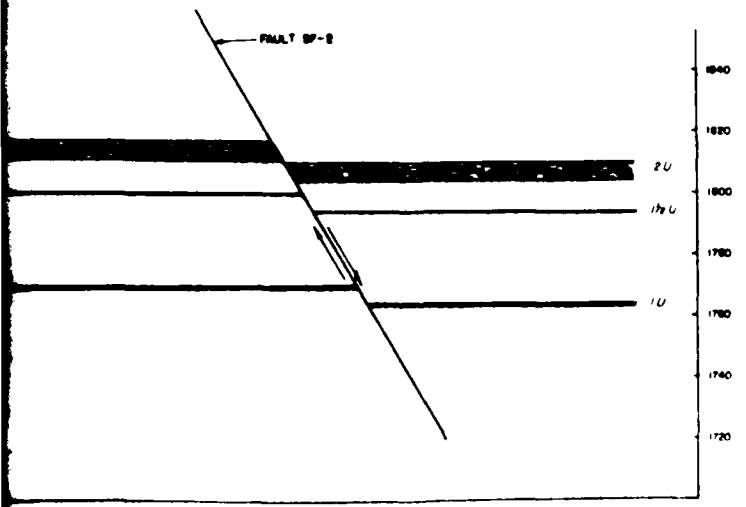
SECTION C-C

SCALE VERT 1" = 20'
HOR. 1" = 20'



SECTION B-B
SCALE VERT 1"=20'
HOR 1"=20'

NOTES
For location of sections A-A and B-B see dwg GSX-5/57
For location of section C-C see dwg GSX-5/56



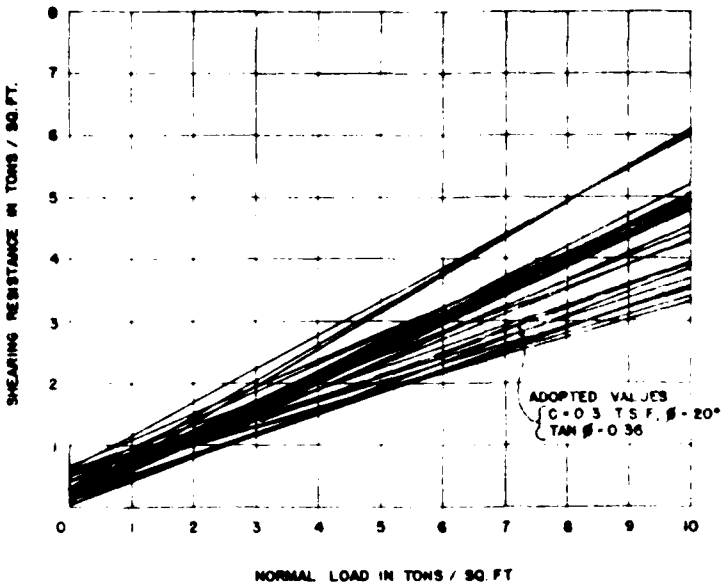
SECTION C-C
SCALE VERT 1"=20'
HOR 1"=20'

U S ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
OMAHA, N E

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SPILLWAY
GENERALIZED GEOLOGIC SECTIONS
MAJOR FAULTS

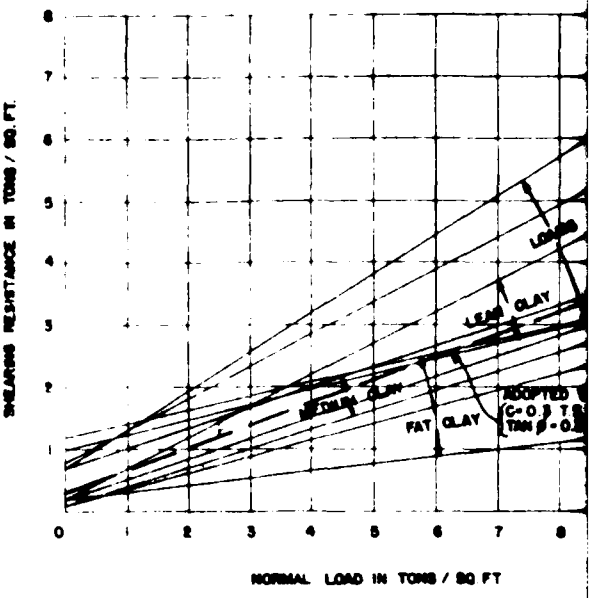
APRIL 1952

GSX-5/58



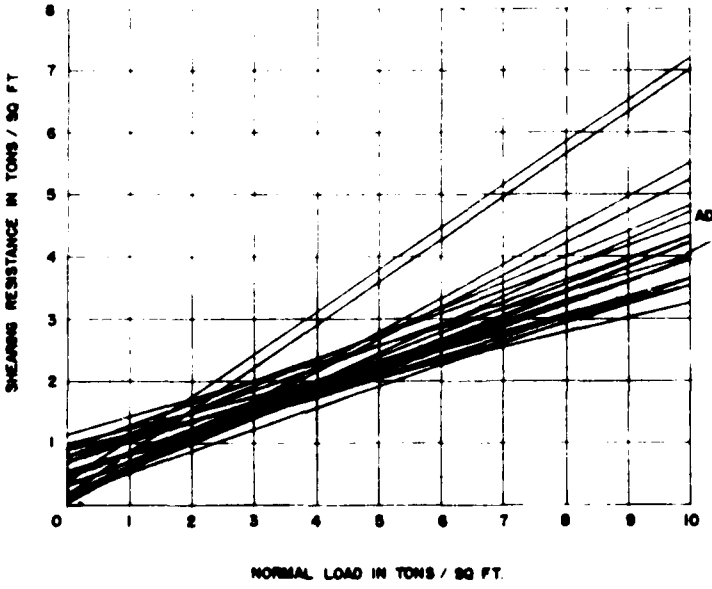
ALLUVIAL CLAY — DIRECT SHEAR TESTS

FIGURE 1



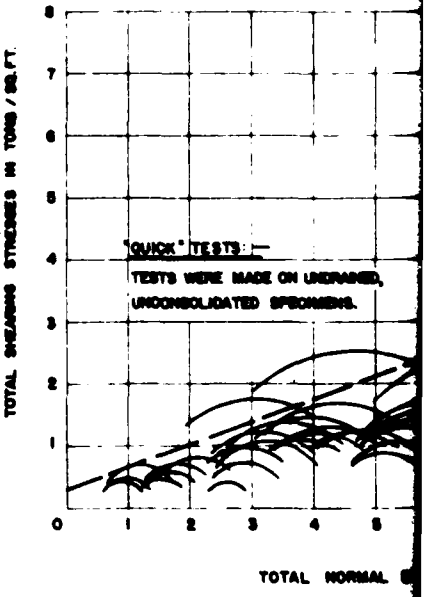
RANGES OF SHEAR STRENGTH FOR VARIOUS M
FROM DIRECT SHEAR TESTS — GLACIAL TILL &
CLAYS

FIGURE 2

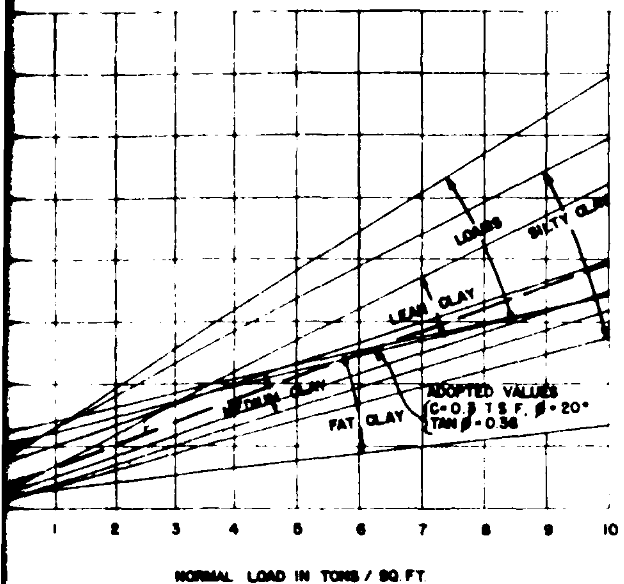


GLACIAL TILL — DIRECT SHEAR TESTS

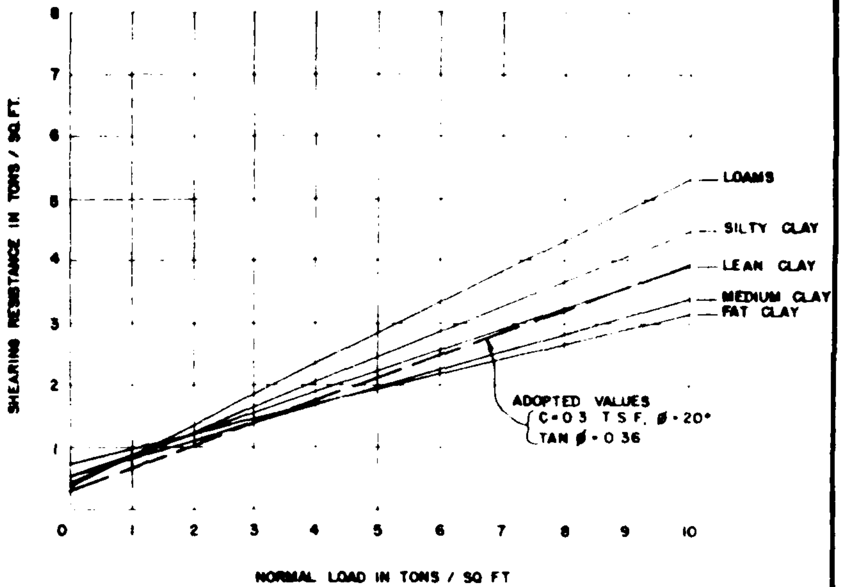
FIGURE 4



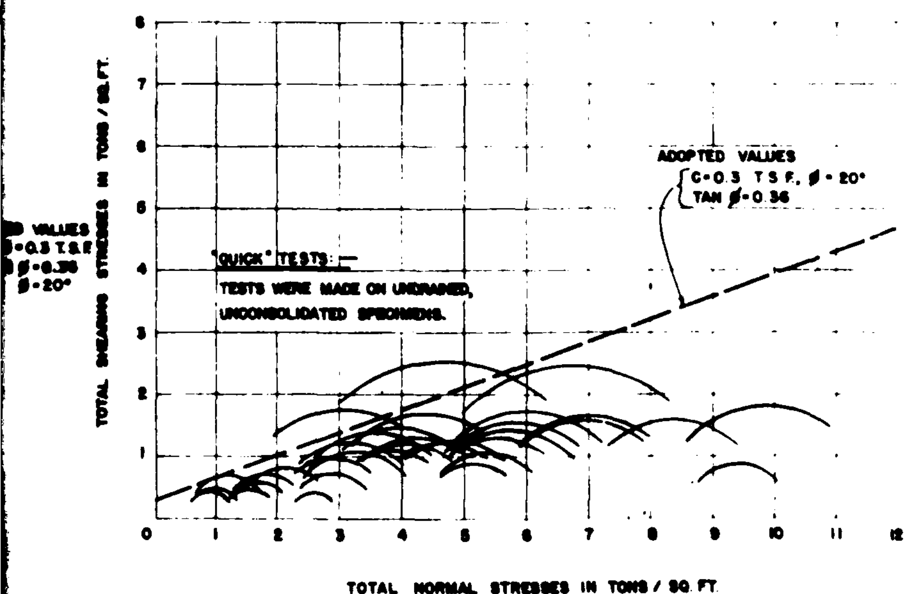
TRIAXIAL
GLACIAL TILL



NGES OF SHEAR STRENGTH FOR VARIOUS MATERIALS
OM DIRECT SHEAR TESTS – GLACIAL TILL & ALLUVIAL
CLAYS
FIGURE 2



AVERAGE SHEAR STRENGTH FOR VARIOUS MATERIALS
FROM DIRECT SHEAR TESTS – GLACIAL TILL & ALLUVIAL
CLAYS
FIGURE 3



TRIAXIAL SHEAR TESTS
GLACIAL TILL & ALLUVIAL CLAYS
FIGURE 5

NOTES:

All tests made on undisturbed samples
All direct shear test results are maximum shear values

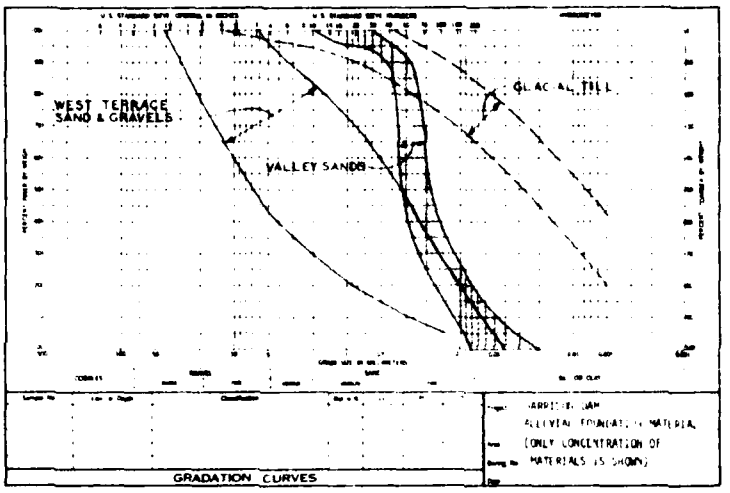
NOTE: From Analysis of Design, Excavation & Main Embankment, Stages I & II

WAR DEPARTMENT
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
BISMARCK, N.D.

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
GRAPHIC SUMMARIES OF SHEAR STRENGTH
GLACIAL TILL & ALLUVIAL CLAYS

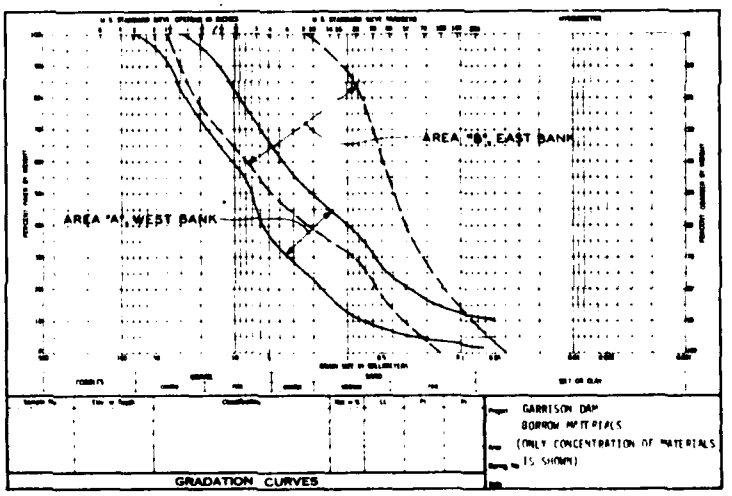
MAY 1948

GEX-7/20



ENG [illegible] 2087

FIGURE 1



ENG [illegible] 2087

FIGURE 3

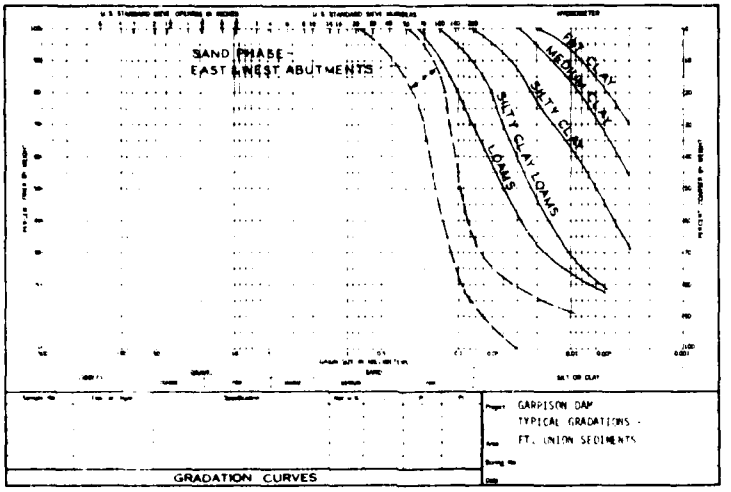


FIGURE 2

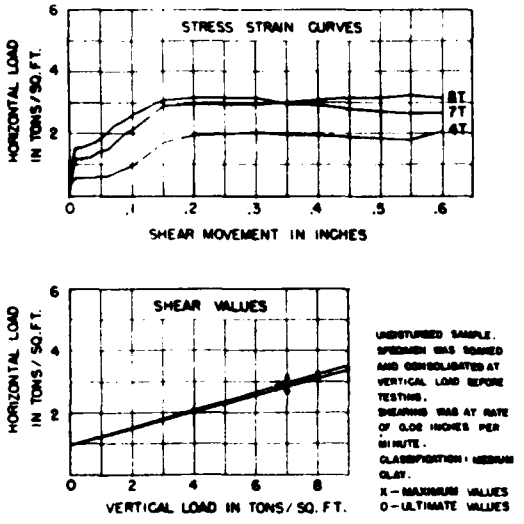
MISSOURI RIVER

GARRISON DAM AND RESERVOIR

TYPICAL GRADATIONS OF FOUNDATION SOILS, FORT UNION FM AND BORROW MATERIALS

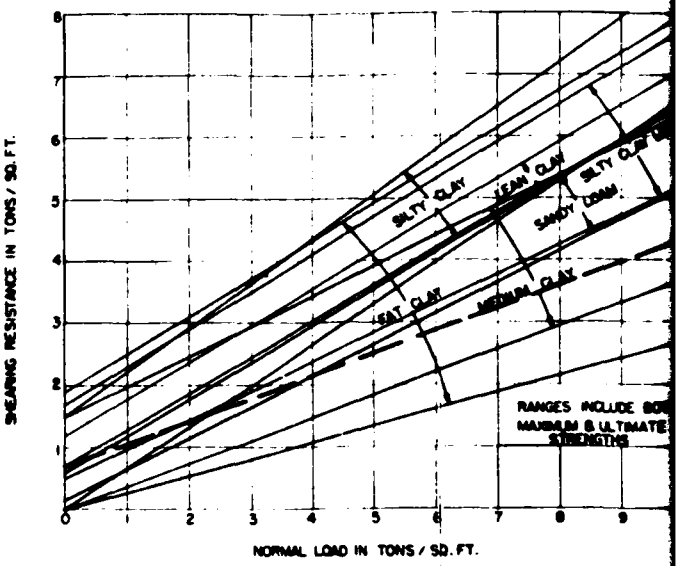
U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

2



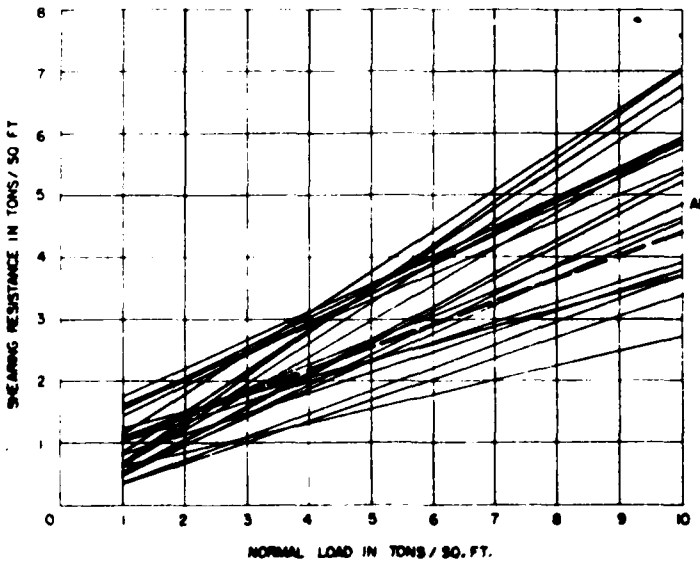
CONSTANT STRAIN DIRECT SHEAR TESTS

FIGURE 1



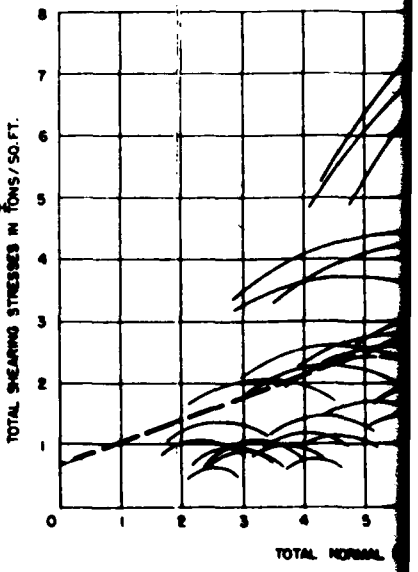
RANGES OF SHEAR STRENGTH FOR VARIOUS MATERIALS FROM DIRECT SHEAR TESTS

FIGURE 2

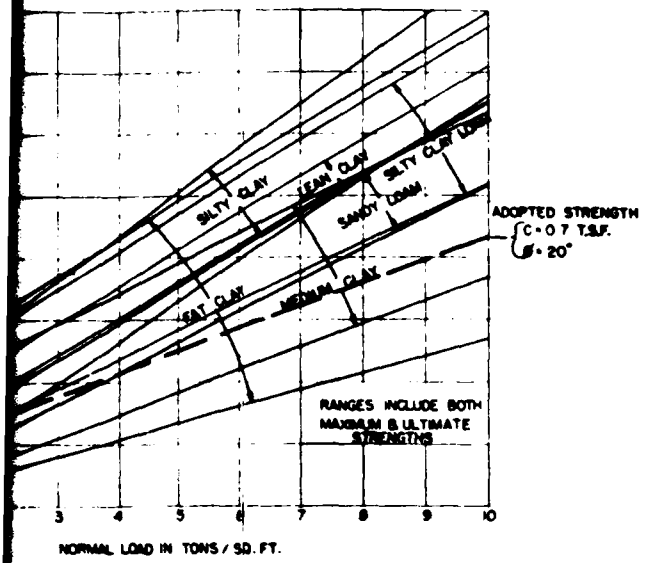


ULTIMATE STRENGTHS — CONSTANT STRAIN DIRECT SHEAR TESTS

FIGURE 4

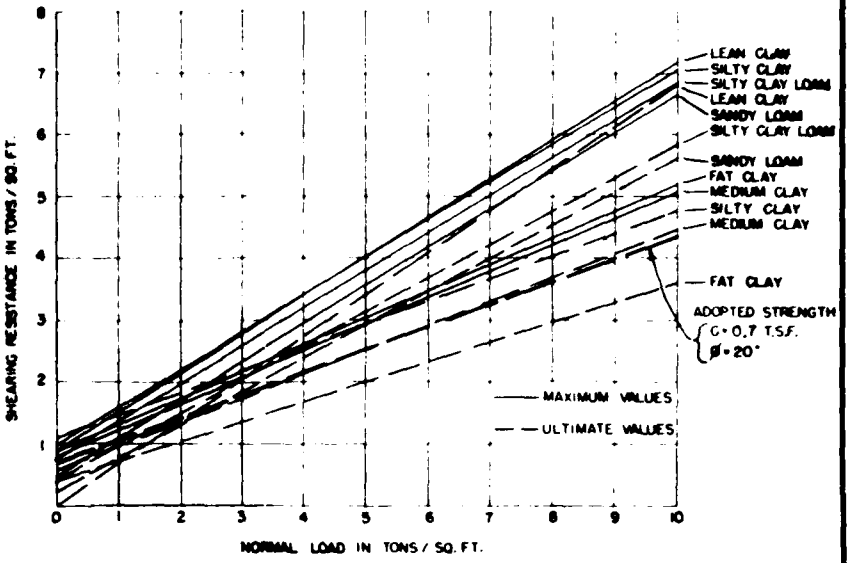


TRIAXIAL



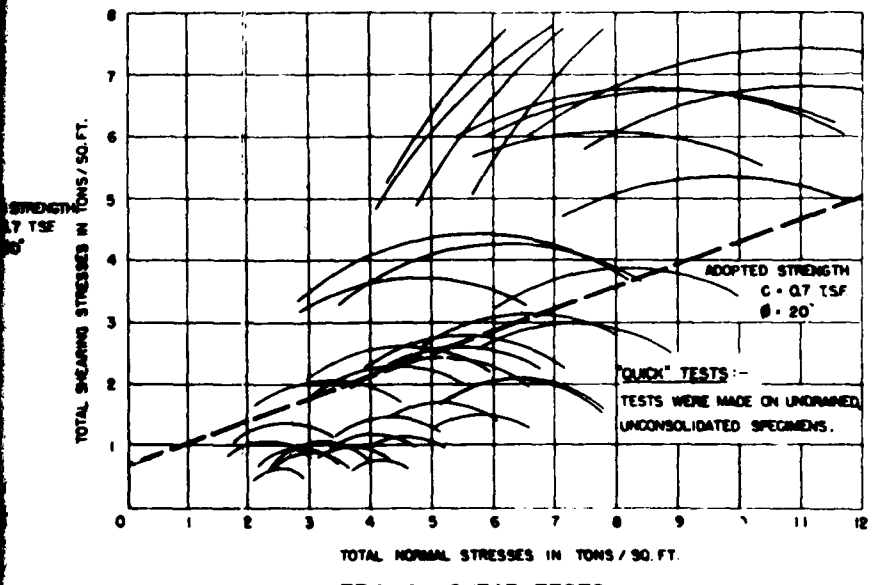
OF SHEAR STRENGTH FOR VARIOUS
S FROM DIRECT SHEAR TESTS

FIGURE 2



AVERAGE SHEAR STRENGTH FOR VARIOUS
MATERIALS FROM DIRECT SHEAR TESTS

FIGURE 3



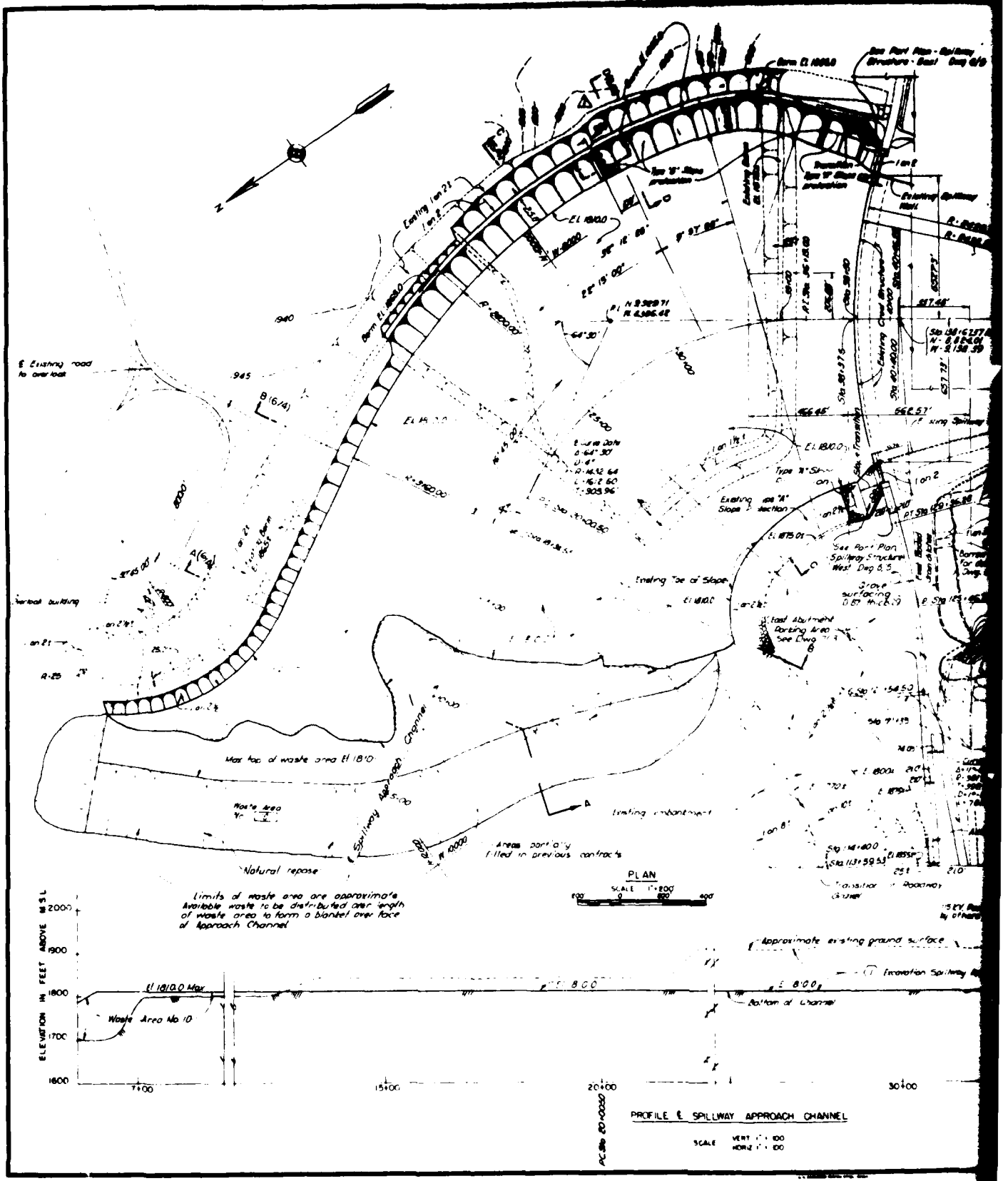
TRIAXIAL SHEAR TESTS

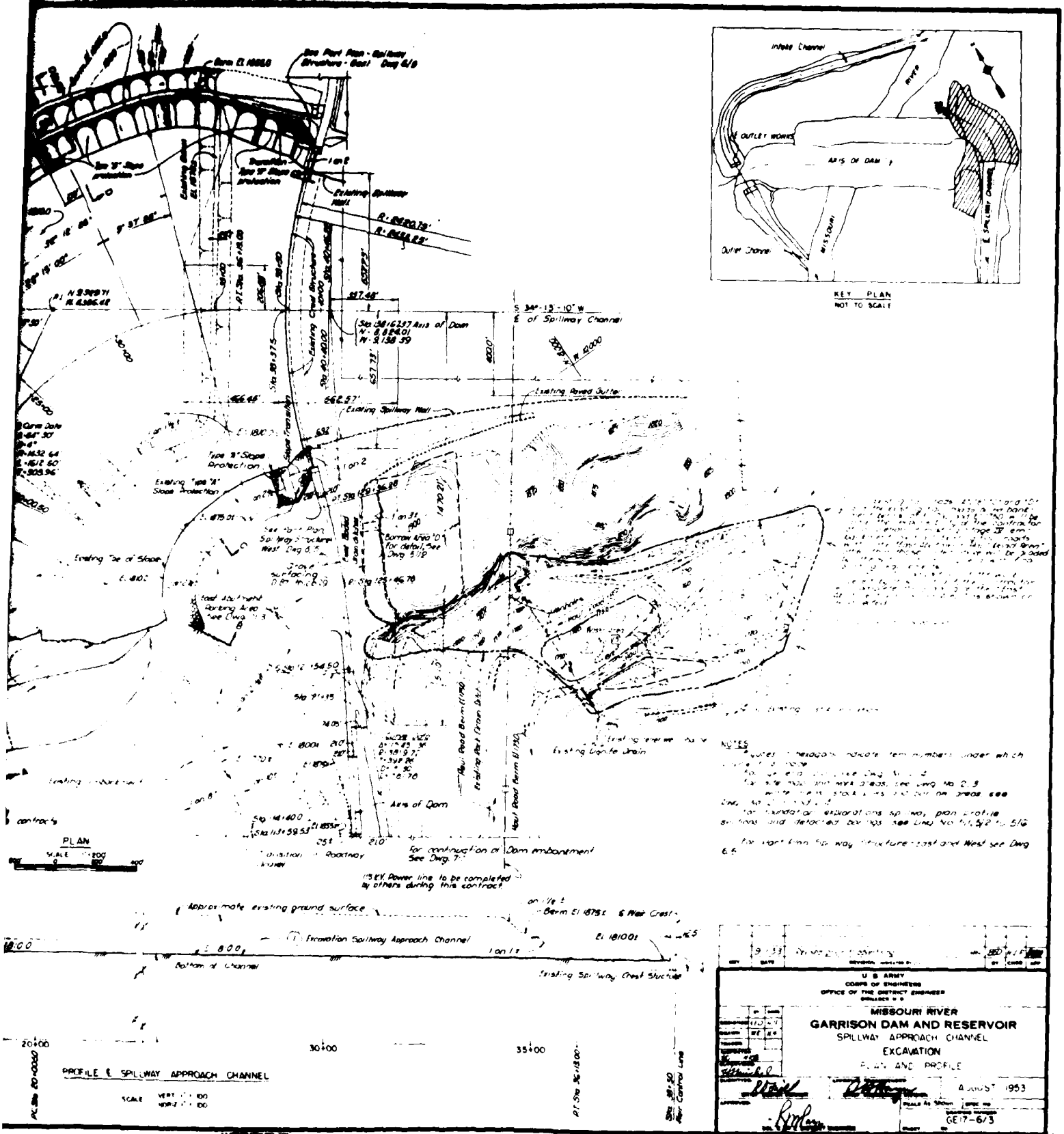
FIGURE 5

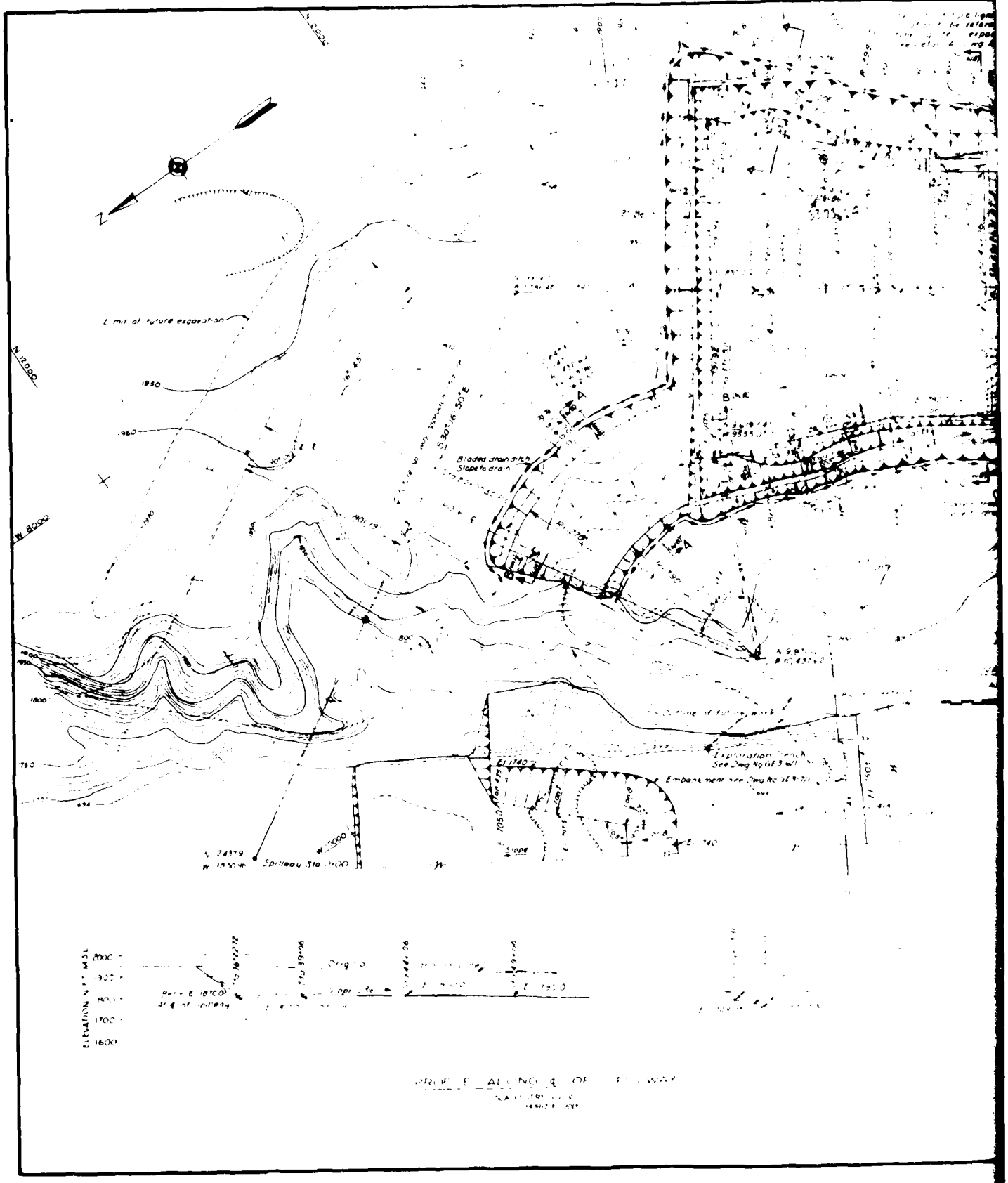
NOTE : All tests made on undisturbed samples

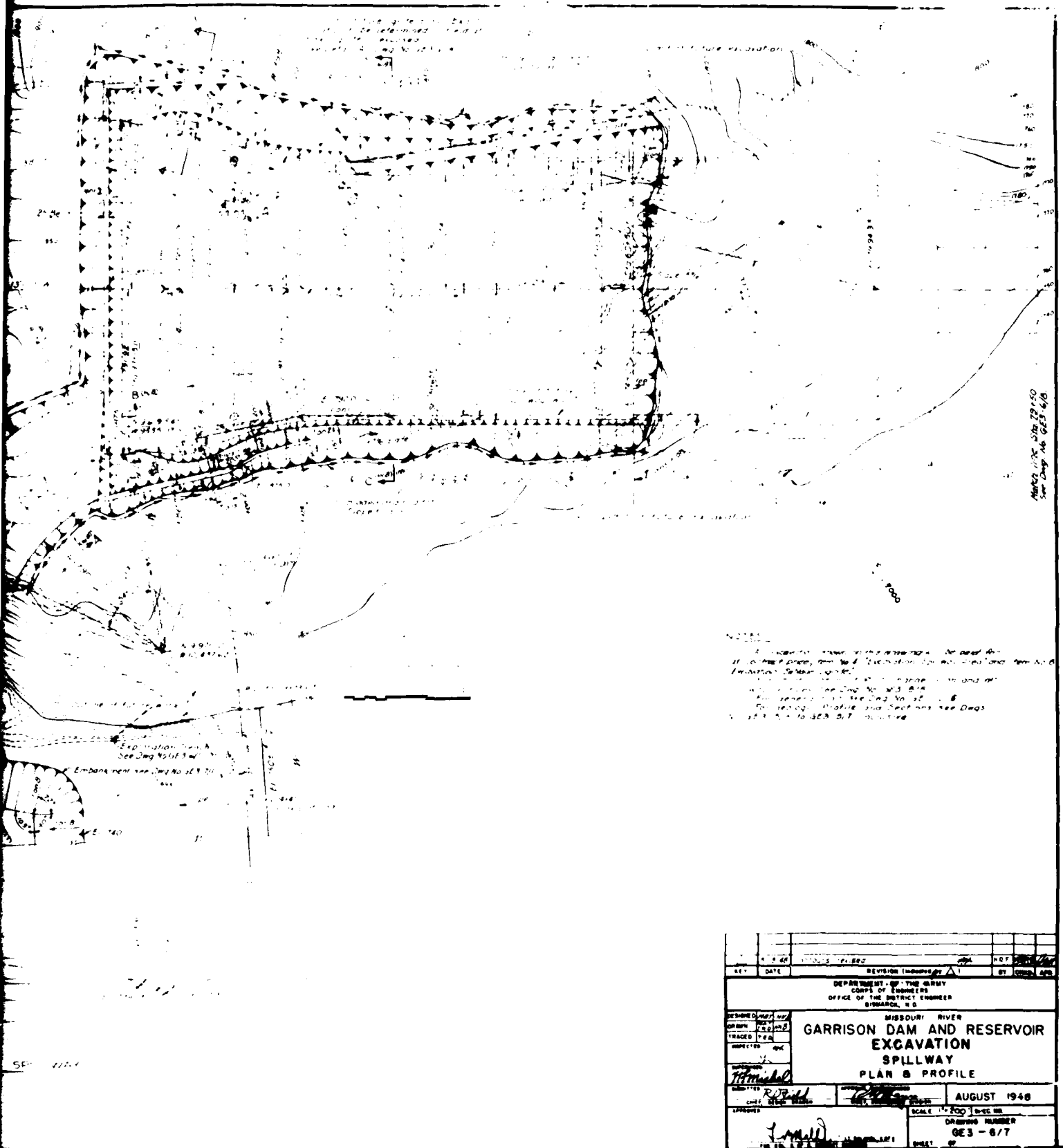
NOTE: From Analysis of Design, Excavation & Main Embankment, Stages I & II

NO.	DATE	REVISION indicated by △	BY
WAR DEPARTMENT CORPS OF ENGINEERS OFFICE OF THE DISTRICT ENGINEER OMAHA, NEB.			
MISSOURI RIVER GARRISON DAM AND RESERVOIR GRAPHIC SUMMARIES OF SHEAR STRENGTH - FORT UNION			
		MAY 1948	
		SCALE	DRAWING NUMBER GEX 7/19


Limits of waste area are approximate
Available waste to be distributed over length of waste area to form a blanket over face of Approach Channel
Max top of waste area El 1810
Waste Area No 10
Natural repose
Spillway Approach Channel
Existing Toe of Slope
Limiting embankment
Areas partially filled in previous contracts
Existing road to overlook
Vertical building
Existing Slope
Type "A" Slope
Grade surfacing
East Abutment Parking Area
See Dwg
See Plan Spillway Structure West
Transition
Approximate existing ground surface
Excavation Spillway
Bottom of Channel
El 1810.0 Max
ELEVATION IN FEET ABOVE M.S.L.
PLAN
SCALE 1"=200'
PROFILE & SPILLWAY APPROACH CHANNEL
SCALE VERT 1"=100
HORIZ 1"=100


Intake Channel
RIVER
OUTLET WORKS
AXIS OF DAM
MISSOURI
Outlet Channel
SPILLWAY CHANNEL
KEY PLAN
NOT TO SCALE
Berm El. 1858.0
Existing Spillway Wall
Existing Paved Gutter
Type 'B' Slope Protection
Existing "toe of Slope"
Existing Light Drain
Axis of Dam
Excavation Spillway Approach Channel
Existing Spillway Crest Structure
Haul Road Berm El. 1780
Existing Haul Road Berm El. 1730
for construction of Dam embankment See Dwg. 7
13 KV Power line to be completed by others during this contract
PLAN
PROFILE & SPILLWAY APPROACH CHANNEL
NOTES
U S ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
OMAHA, N. D.
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SPILLWAY APPROACH CHANNEL
EXCAVATION
PLAN AND PROFILE
AUGUST 1953
GE17-6/3


N
Limit of future excavation
N 12000
1950
1900
1850
1800
1750
1700
Bladed drain ditch
Slope to drain
S 30°16' 50" E
W 8000
Spillway Sta 9+00
Slope
Excavation limit
See Dwg No
Embankment see Dwg No
ELEVATION IN FT MSL
2000
1900
1800
1700
1600
PROFILE ALONG ℄ OF SPILLWAY



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OFFICE OF THE DISTRICT ENGINEER
BISMARCK, N.D.

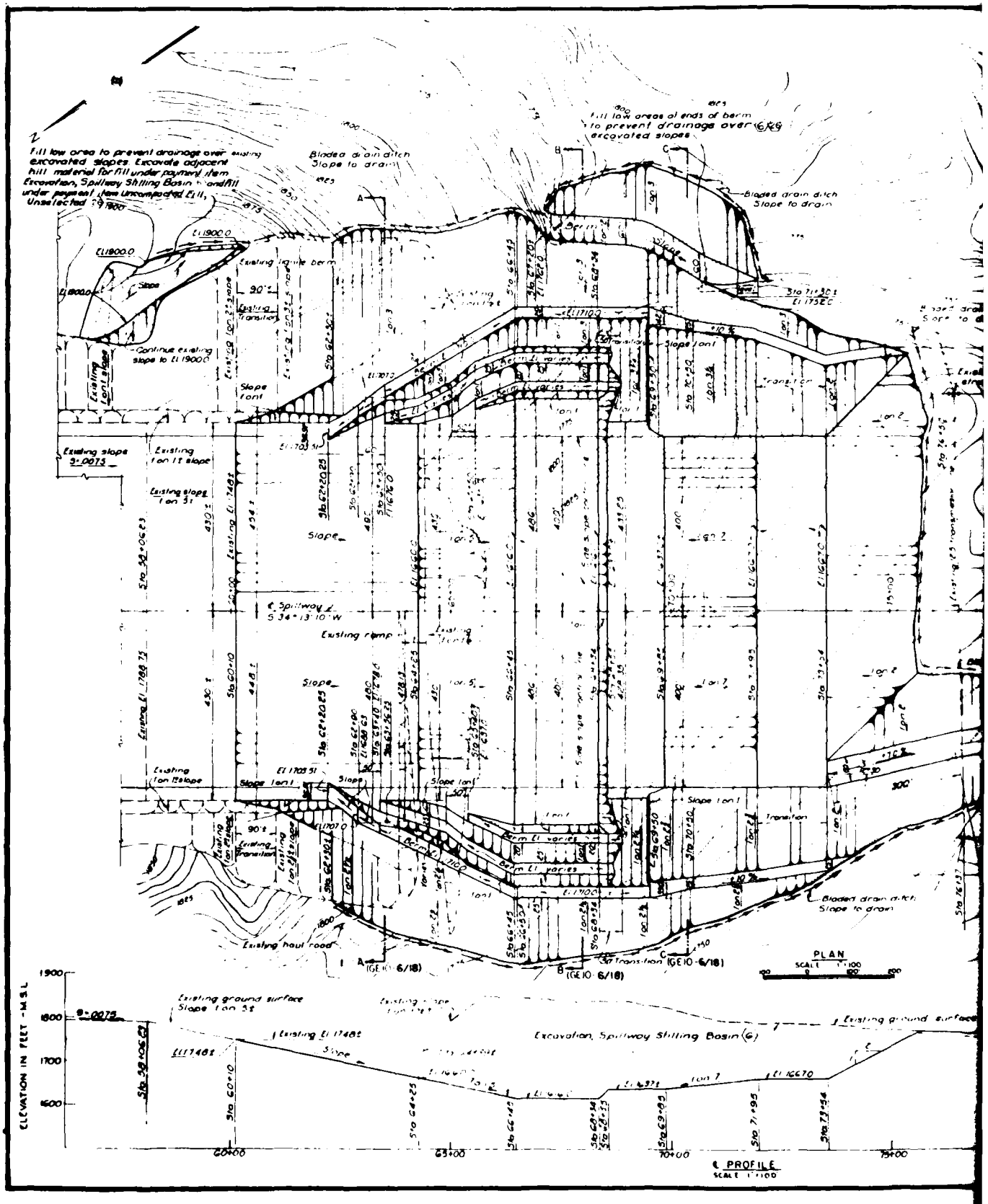
MISSOURI RIVER

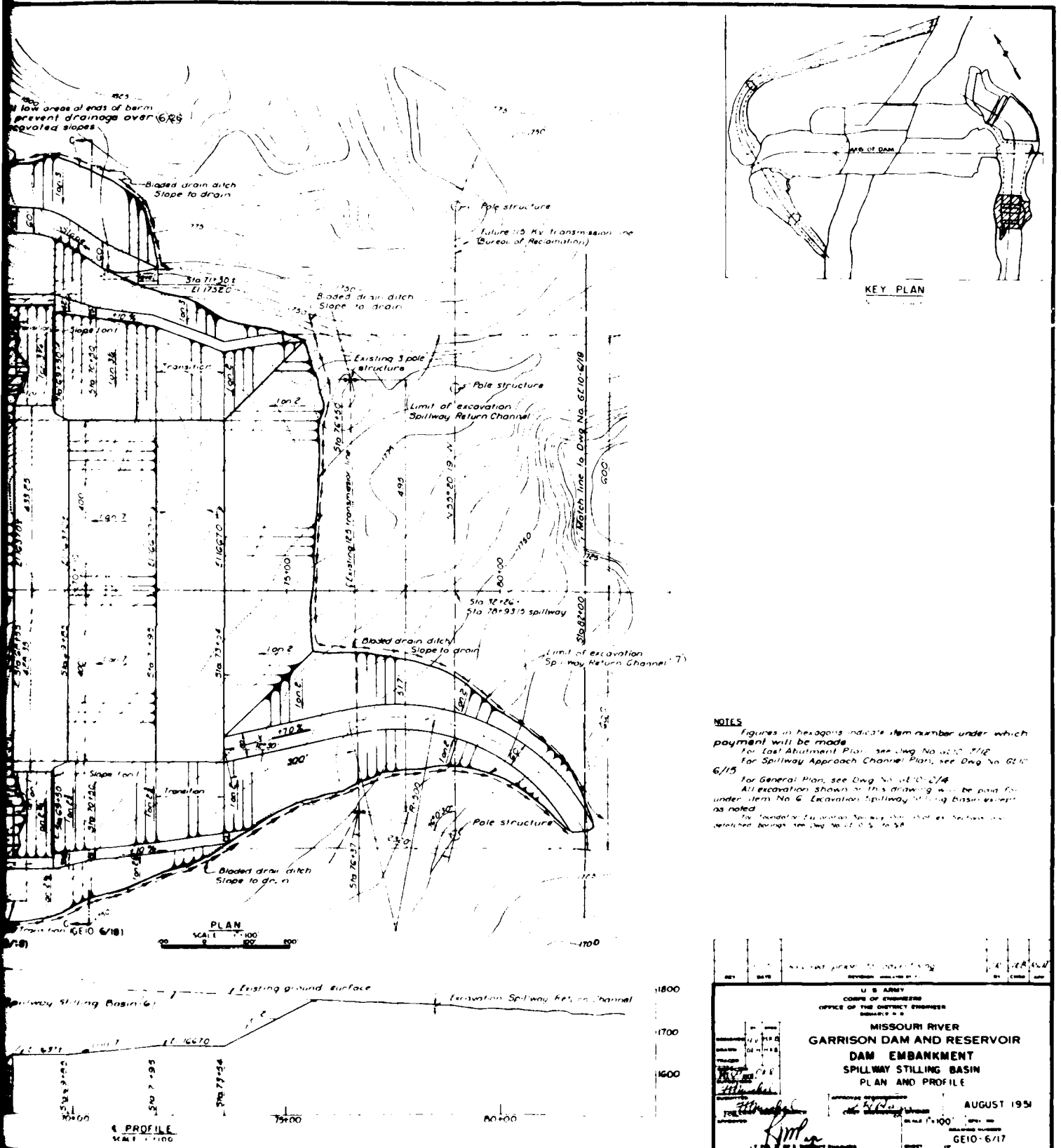
GARRISON DAM AND RESERVOIR
EXCAVATION
SPILLWAY
PLAN & PROFILE

AUGUST 1948

SCALE 1" = 200'

DRAWING NUMBER
GES - 6/7


Fill low area to prevent drainage over existing excavated slopes. Excavate adjacent fill material for fill under payment item Excavation, Spillway Stilling Basin and fill under payment item Unclassified Fill, Unselected
Fill low areas at ends of berm to prevent drainage over excavated slopes
Bladed drain ditch Slope to drain
Continue existing slope to El 1900.0
Existing slope 1:0.075
Existing 1 on 1 slope
Existing slope 1 on 3:1
Existing ramp
Existing haul road
Slope 1 on 1
Slope 1 on 2
Slope 1 on 3
Slope 1 on 5
Transition
Berm El varies
℄ Spillway ℄ S 34° 13' 10" W
PLAN
SCALE 1" = 100'
℄ PROFILE
SCALE 1" = 100'
ELEVATION IN FEET - M.S.L.
Existing ground surface
Slope 1 on 3:1
Existing El 1748±
Excavation, Spillway Stilling Basin (G)
60+00
63+00
70+00
75+00



NOTES

Figures in hexagons indicate item number under which payment will be made

For East Abutment Plan, see Dwg No. GE10-6/16

For Spillway Approach Channel Plan, see Dwg No. GE10-6/15

For General Plan, see Dwg No. GE10-6/14

All excavation shown on this drawing will be paid for under item No. 6, Excavation Spillway Stilling Basin, except as noted

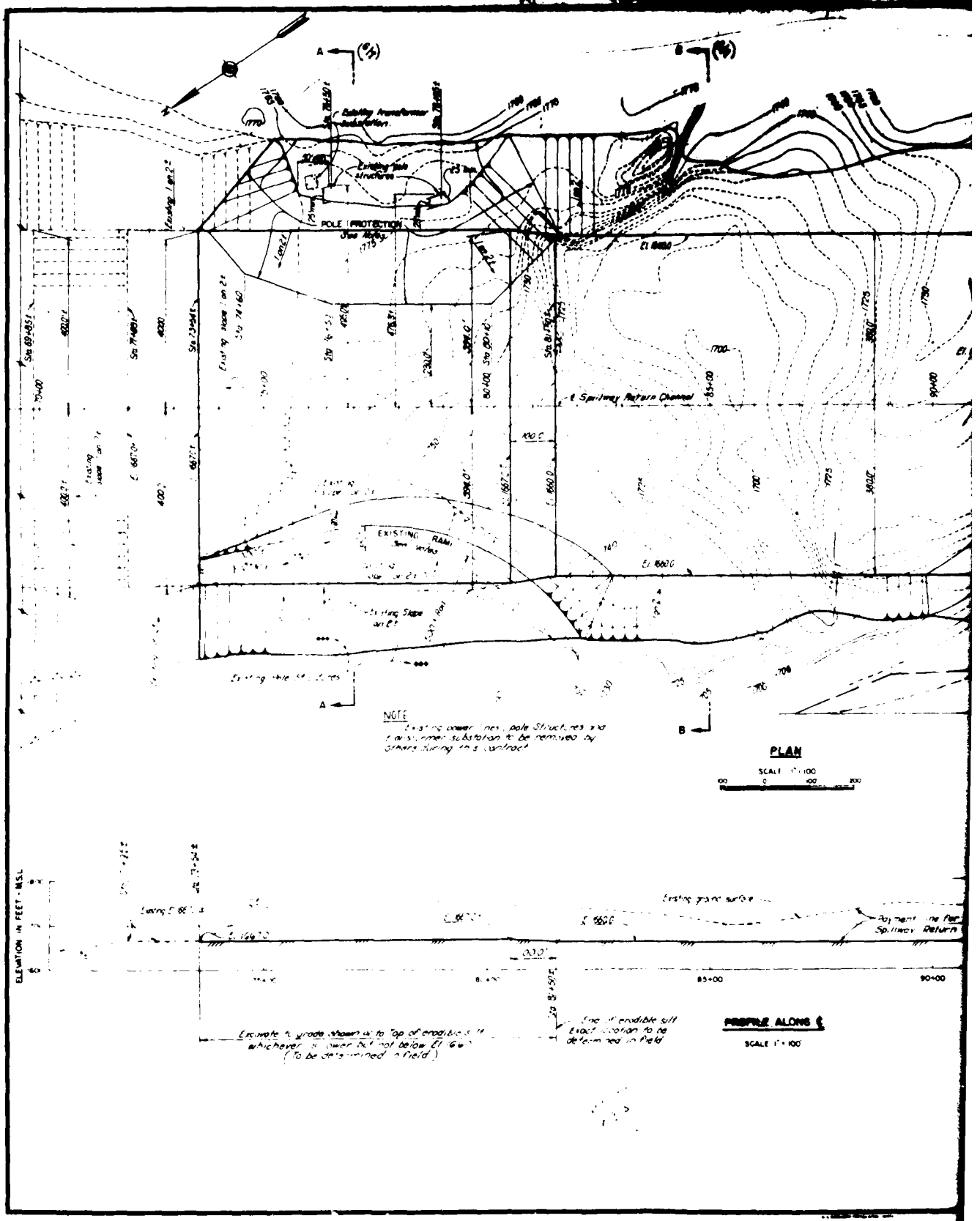
For foundation excavation, see log of borings and detailed borings, see Dwg No. GE10-5/5 to 5/8

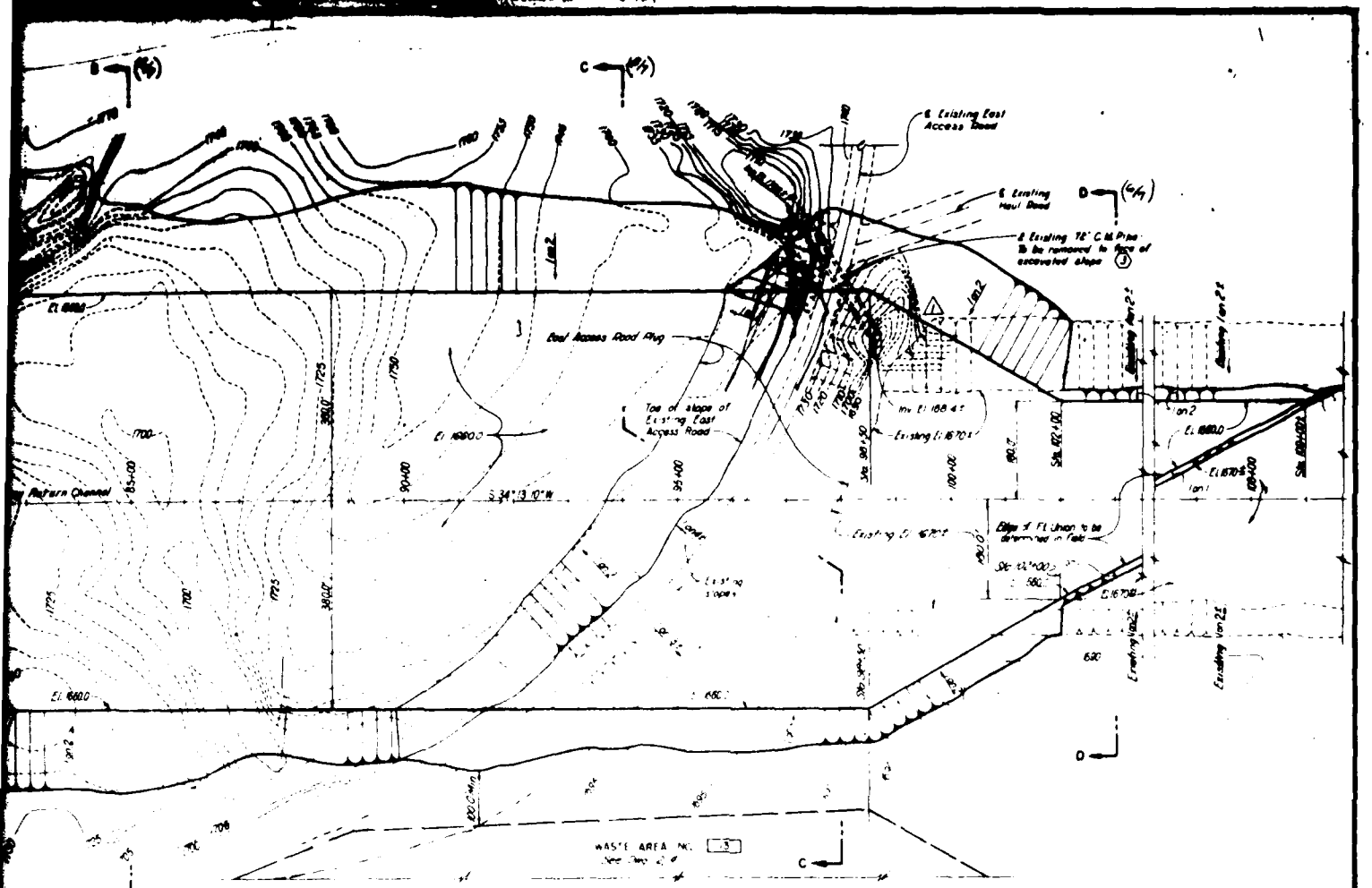
U. S. ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

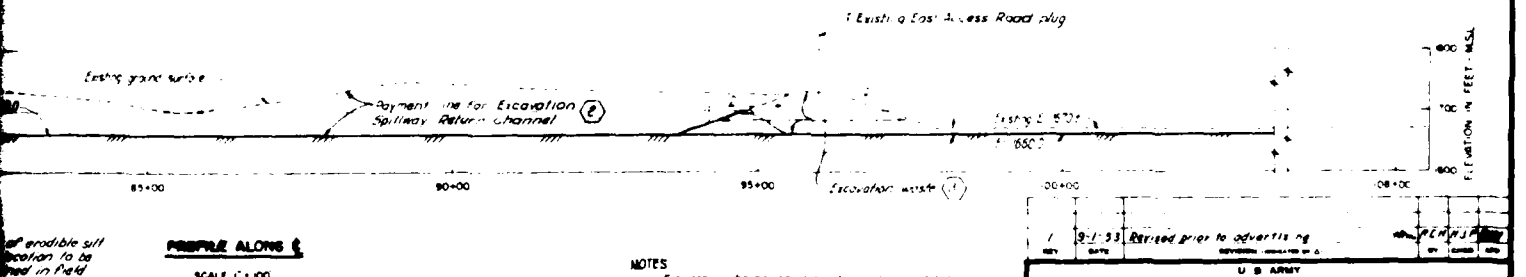
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
DAM EMBANKMENT
SPILLWAY STILLING BASIN
PLAN AND PROFILE

AUGUST 1951

GE10-6/17


POLE PROTECTION
EXISTING RAMP
NOTE
PLAN
SCALE 1" = 100'
ELEVATION IN FEET - MSL
PROFILE ALONG ℄
SCALE 1" = 100'





PROFILE ALONG ℄
SCALE 1" = 100

NOTES
Figures in hexagons indicate item numbers under which payment will be made
For General Plan see Dwg 6/1a
For Sections A-A to D-D inclusive see Dwg 6/7
For Foundation Excavation Plan Profile and Sections See Dwgs 5/3, 5/4, 5/5 and 5/6
⚠ Excavation of existing riprap, base material and East Access Road plug will be paid for under payment item 3 Excavation waste

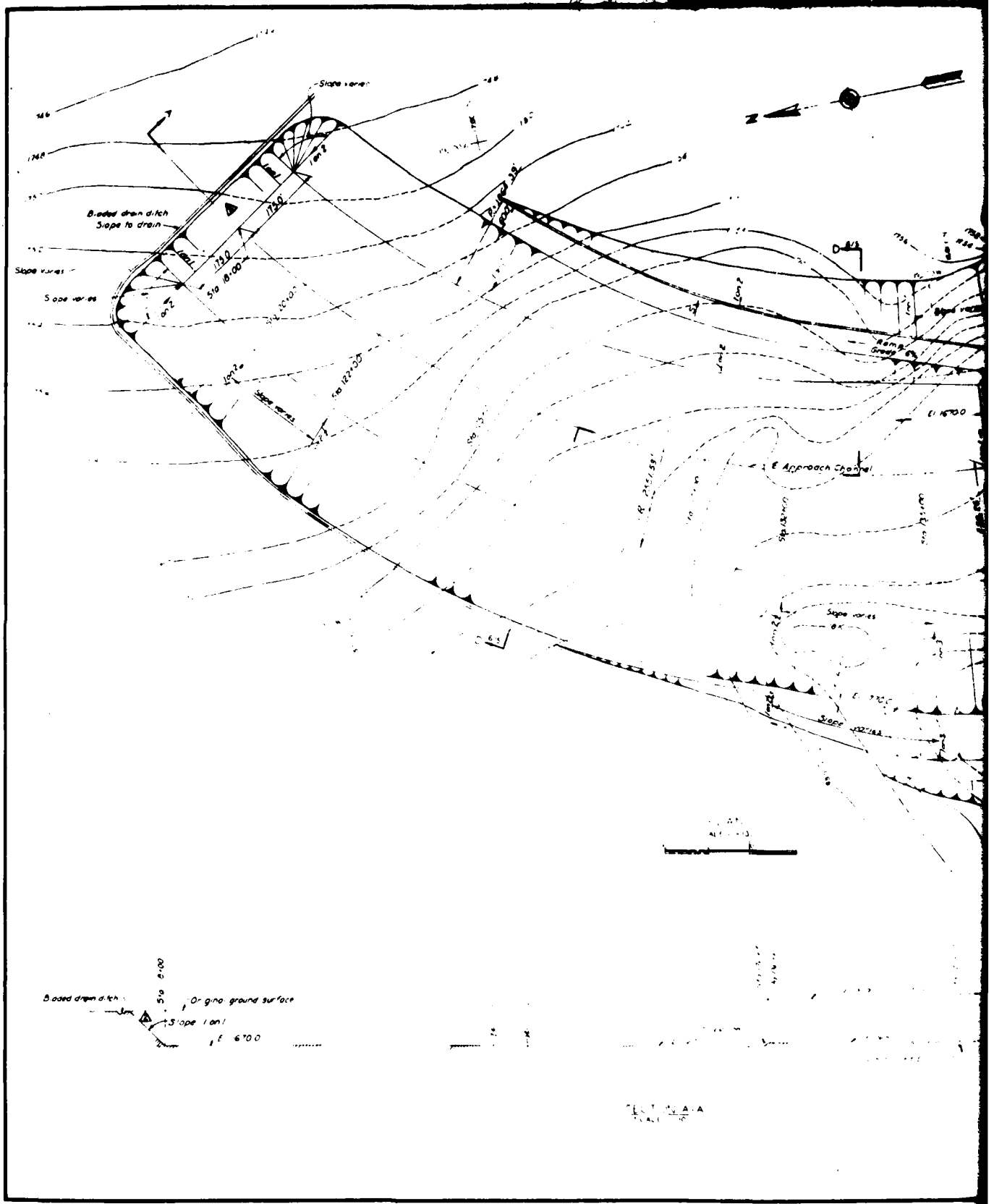
1	9-1-53	Revised prior to advertising	

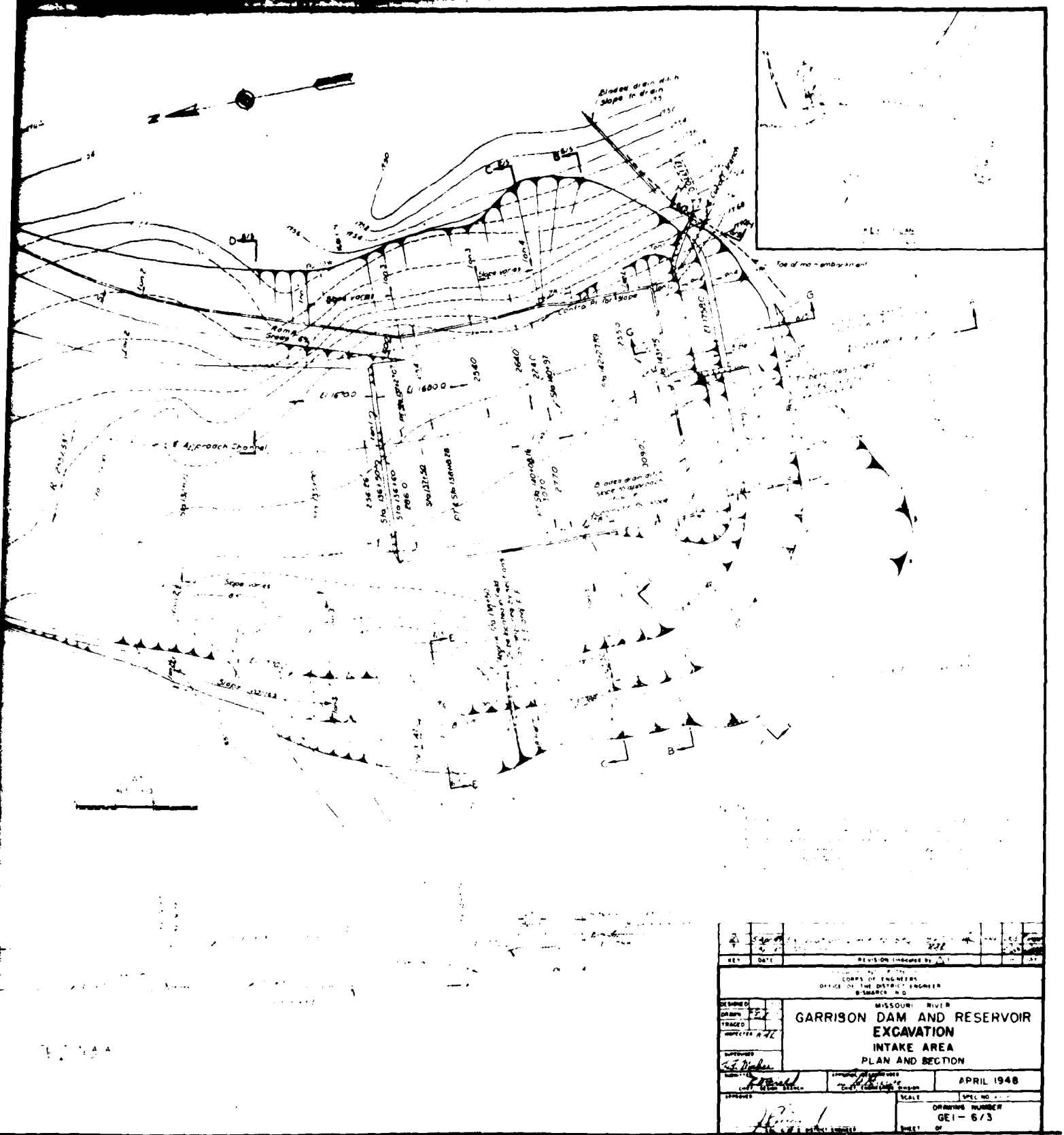
U. S. ARMY
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OFFICE OF THE DISTRICT ENGINEER

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SPILLWAY RETURN CHANNEL
EXCAVATION
PLAN AND PROFILE

AUGUST 1953

GE 17-6/6


Sloped drain ditch
Slope to drain
Slope varies
Slope varies
Sta 18+00
Sta 12+00
Sta 6+00
Original ground surface
Slope 1 on 1
E 6700
E 16700
E Approach Channel
Slope varies
Slope varies
Slope varies
Sloped drain ditch



REV	DATE	REVISION (indicated by A)	BY	APP'D

CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
BISMARCK, N.D.

DESIGNED
DRAWN
TRACED
CHECKED
SUBMITTED
APPROVED

MISSOURI RIVER

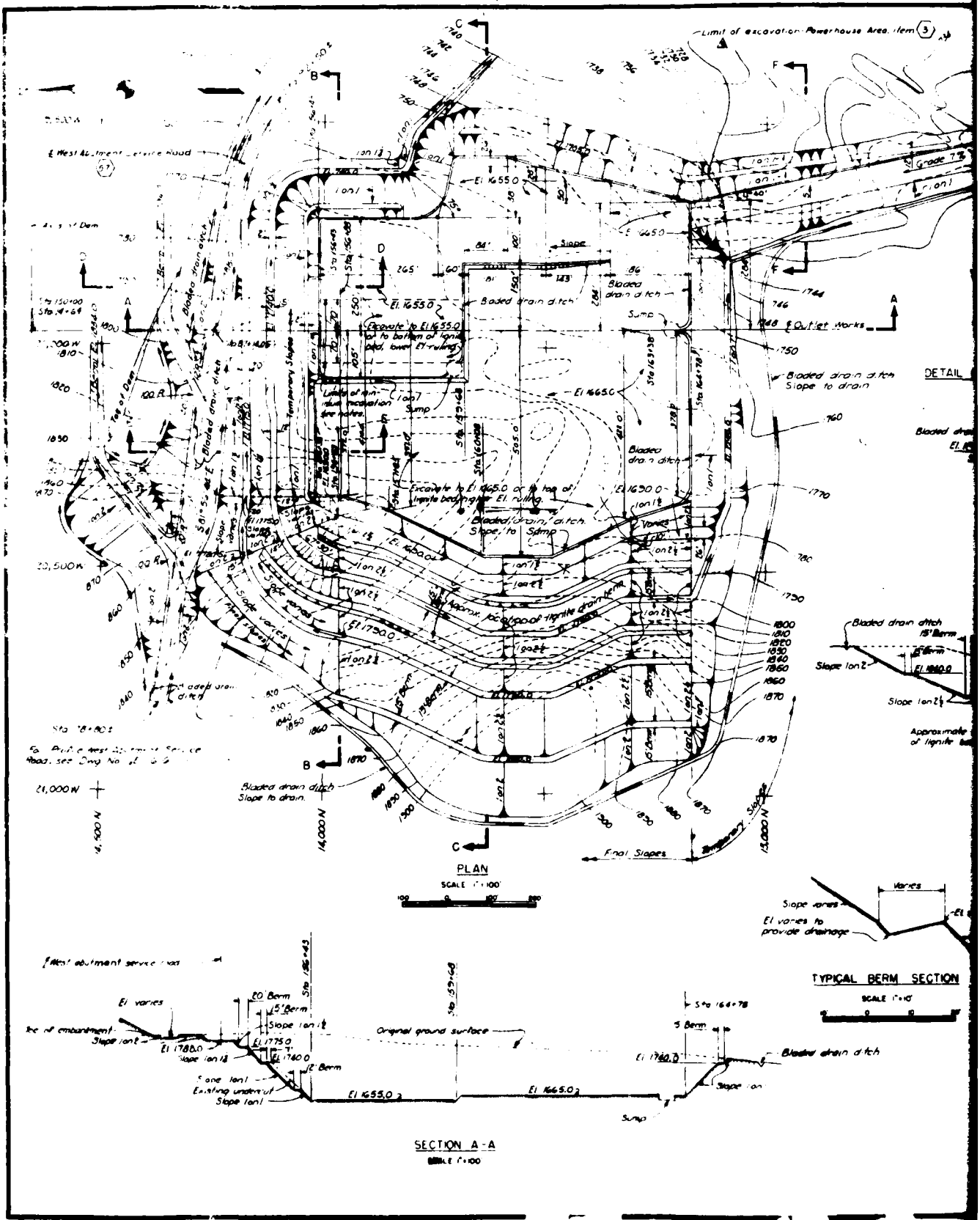
GARRISON DAM AND RESERVOIR
EXCAVATION
INTAKE AREA
PLAN AND SECTION

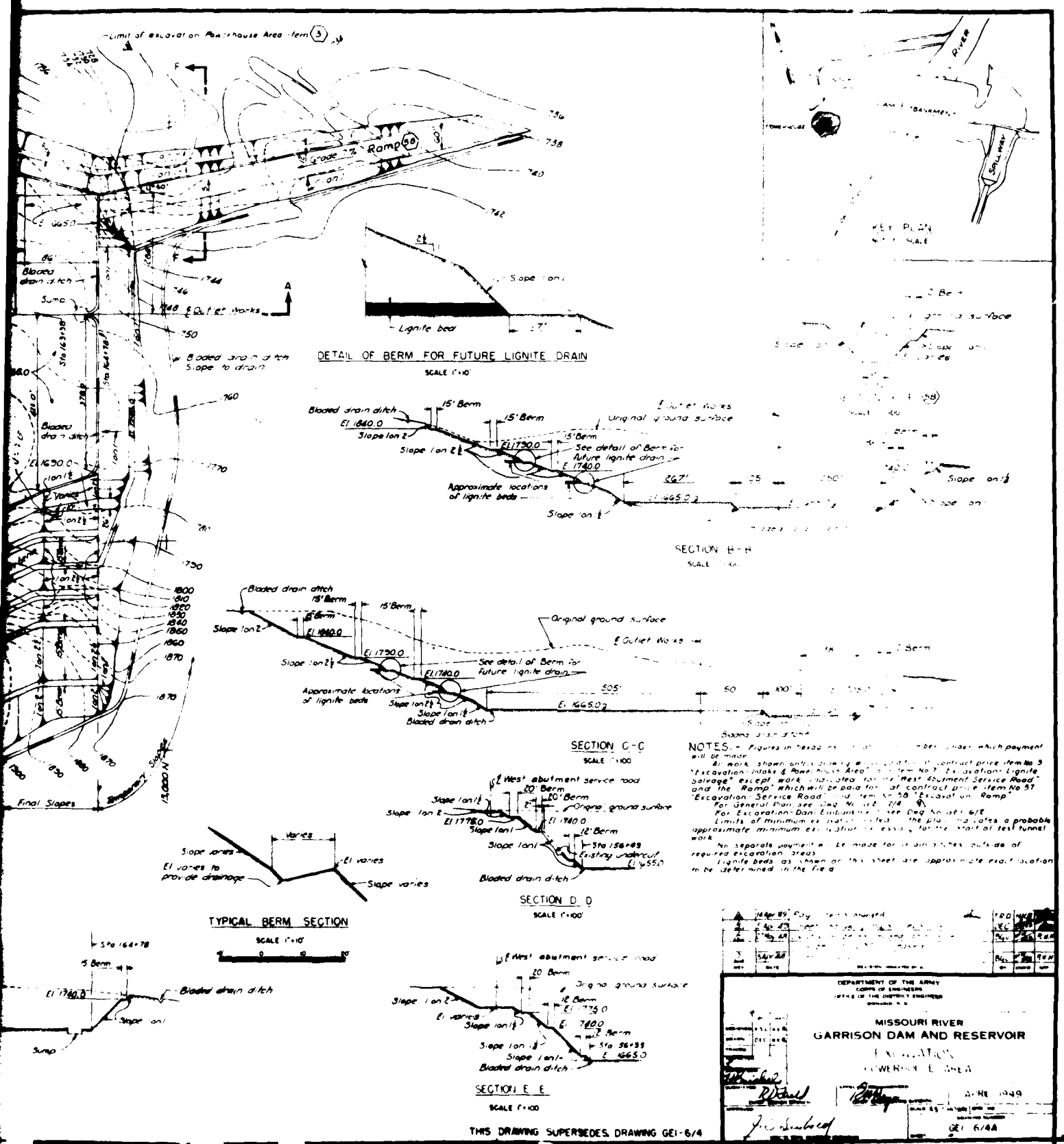
APRIL 1948

SCALE
SPEC NO.

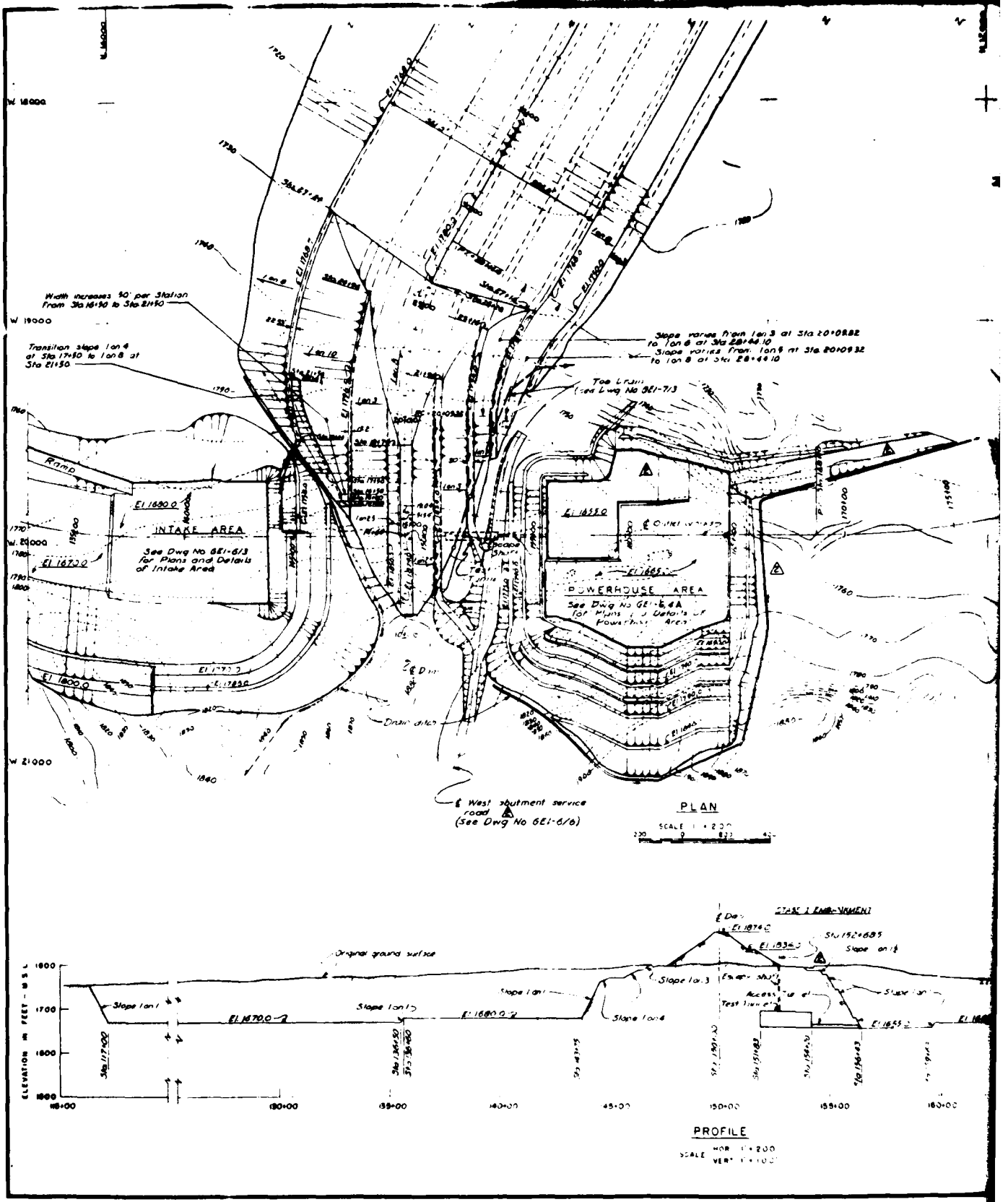
DRAWING NUMBER
GEI - 6/3

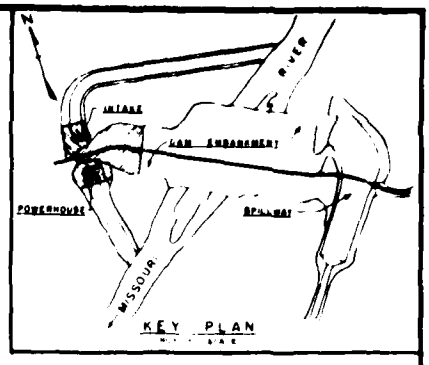
SHEET OF


Limit of excavation Powerhouse Area, Item (3)
Bladed drain ditch
Slope to drain
Excavate to El 1655.0 or to top of lignite bed, lower El ruling
Sump
Bladed drain ditch, Slope to Sump
Excavate to El 1665.0 or to top of lignite bed, higher El ruling
Approx. location of top of lignite drain trench
Final Slopes
Temporary Slopes
Outlet Works
DETAIL
Bladed drain ditch
15' Berm
Slope 1on 2
Slope 1on 2½
Approximate of lignite
PLAN
SCALE 1"=100'
Slope varies
Varies
El varies to provide drainage
TYPICAL BERM SECTION
SCALE 1"=10'
Original ground surface
Bladed drain ditch
Slope 1on
SECTION A-A



CONSTRUCTION FOUNDATION REPORT (1992) PLATE 78


Width increases 50' per Station From Sta 16+50 to Sta 21+50
Transition slope 1 on 4 at Sta 17+50 to 1 on 8 at Sta 21+50
Slope varies from 1 on 3 at Sta 20+08.82 to 1 on 6 at Sta 22+66.10
Slope varies from 1 on 6 at Sta 20+09.32 to 1 on 8 at Sta 22+66.10
Toe Drain (see Dwg No 6E1-7/3
Ramp
El 1690.0
INTAKE AREA
See Dwg No 6E1-6/3 for Plans and Details of Intake Area
El 1670.0
El 1655.0
POWERHOUSE AREA
See Dwg No 6E1-6, 6A for Plans and Details of Powerhouse Area
Drain ditch
West abutment service road (See Dwg No 6E1-6/6)
PLAN
SCALE 1" = 200'
Original ground surface
Slope 1 on 1
Slope 1 on 3
Slope 1 on 4
Slope 1 on 6
Slope 1 on 8
El 1670.0
El 1680.0
El 1655
ELEVATION IN FEET - M.S.L.
1800
1700
1600
1500
150+00
155+00
160+00
PROFILE
SCALE HOR 1" = 200'
VERT 1" = 100'



Slope varies from 1on3 at Sta 20+08.82 to 1on6 at Sta 28+44.10

Slope varies from 1on6 at Sta 20+09.38 to 1on6 at Sta 28+44.10

E OUTLET CHANNEL

POWERHOUSE AREA

PLAN

SCALE 1" = 200'

NOTES

EXCAVATION-DAM EMBANKMENT

Slope 1on3

Slope 1on4

PROFILE

SCALE HOR. 1" = 200'
VERT. 1" = 100'

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEBR.

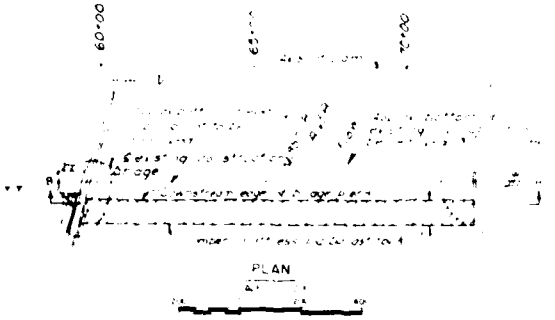
MISSOURI RIVER

GARRISON DAM AND RESERVOIR
EXCAVATION-DAM EMBANKMENT
WEST ABUTMENT
PLAN - PROFILE

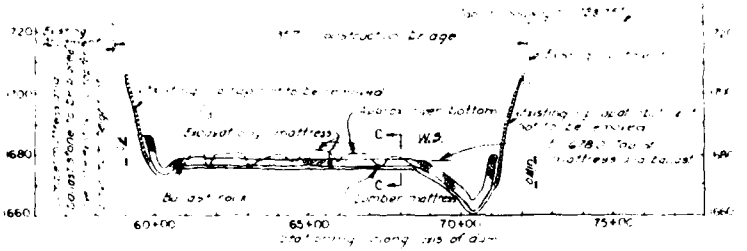
APRIL 1948

DRAWING NUMBER
GEI - 6/2

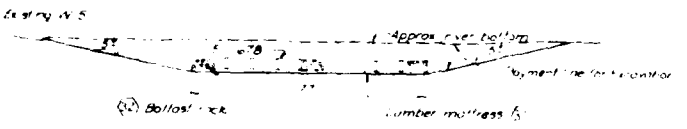
2



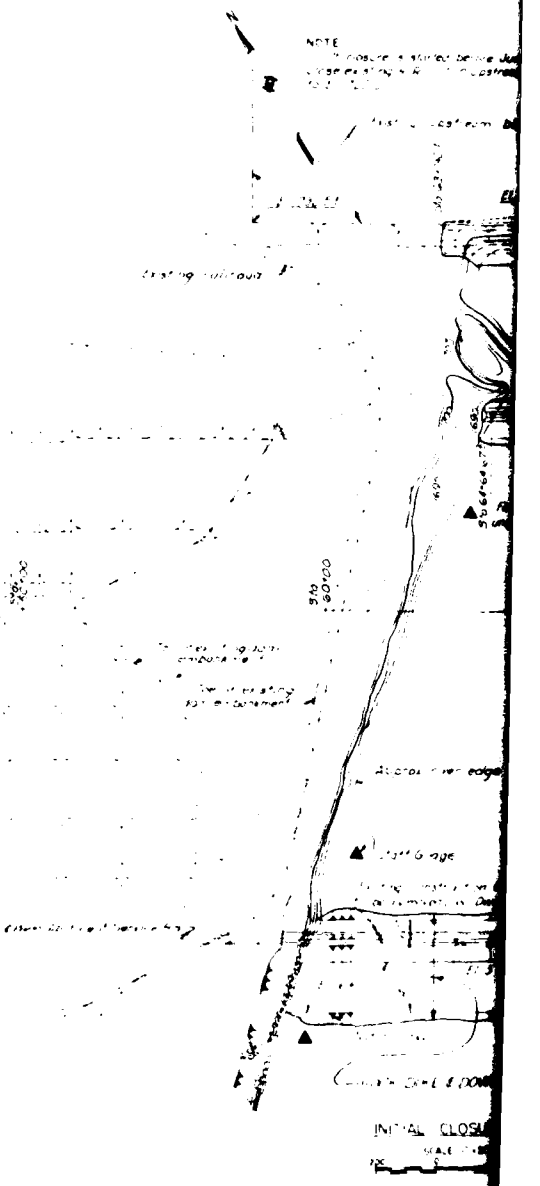
PLAN

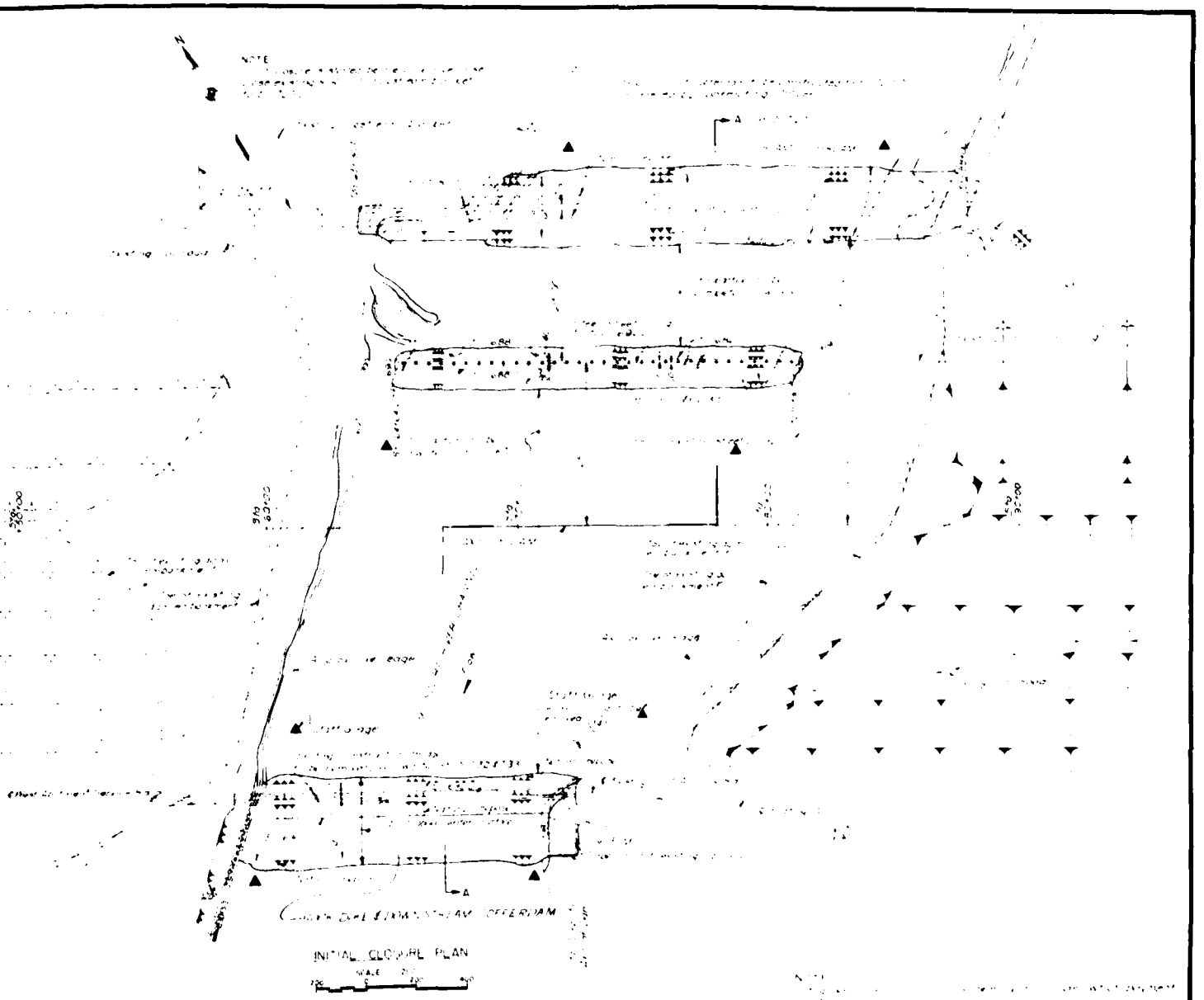


SECTION B-B



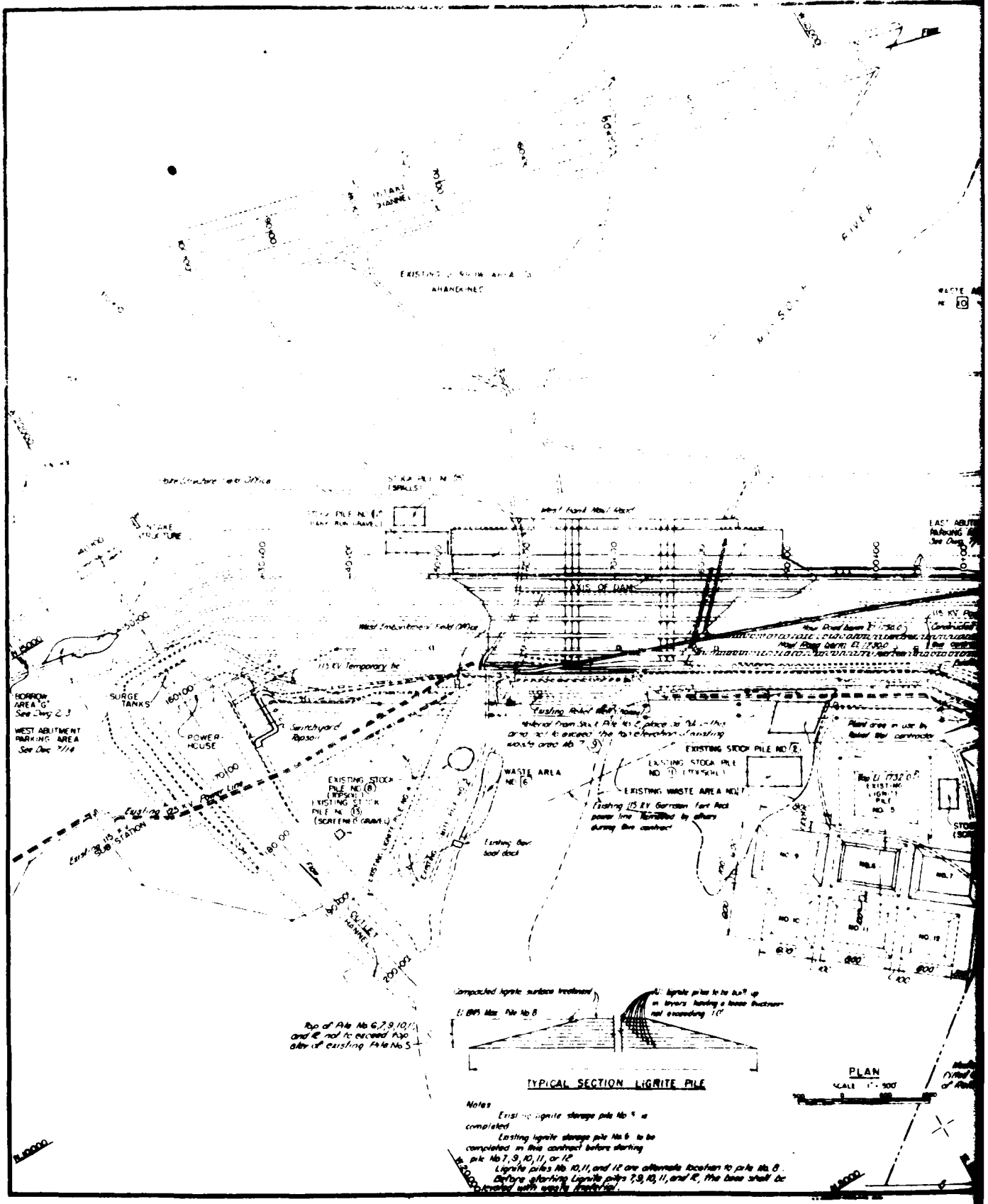
SECTION C-C
LUMBER MATTRESS

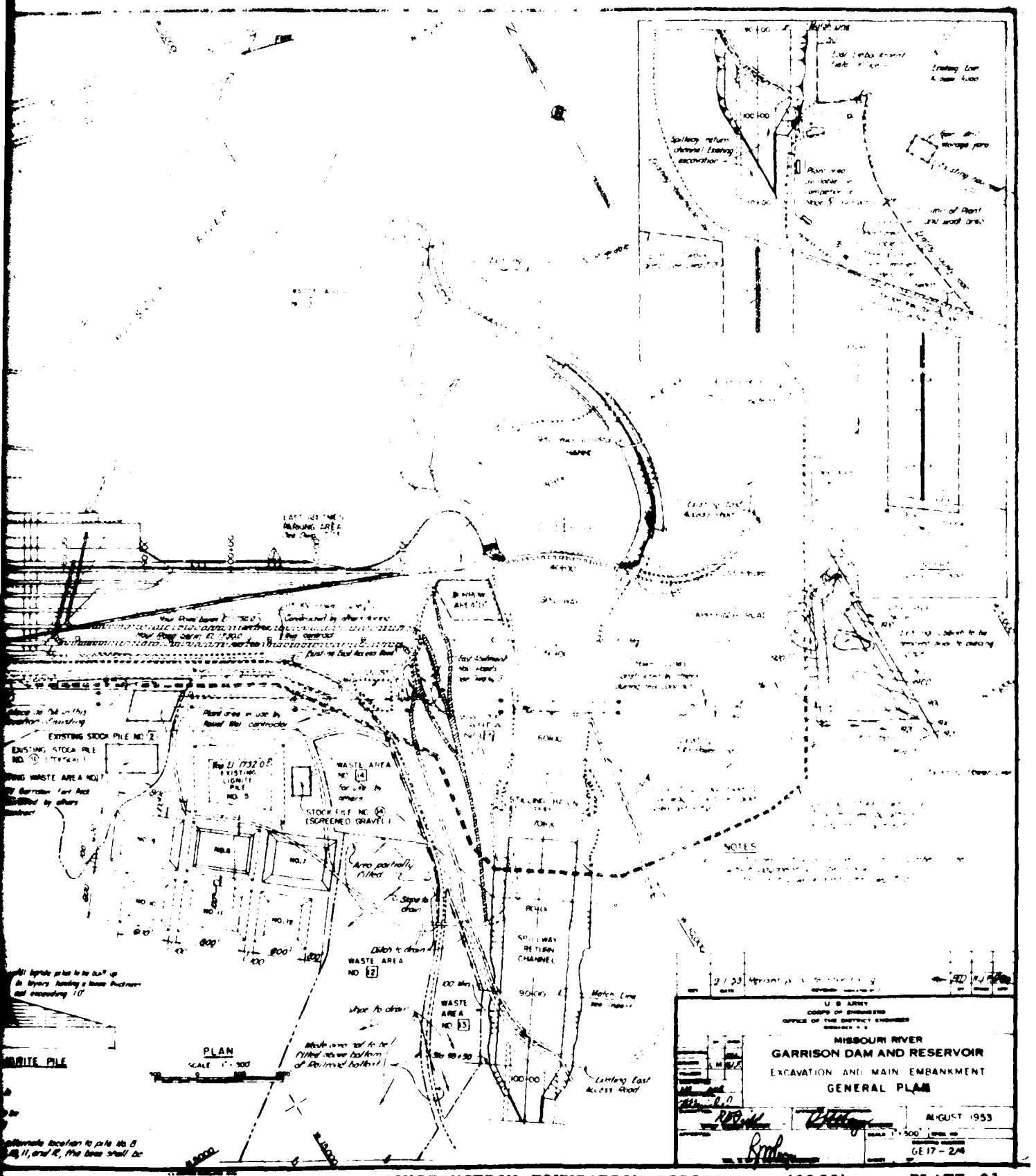


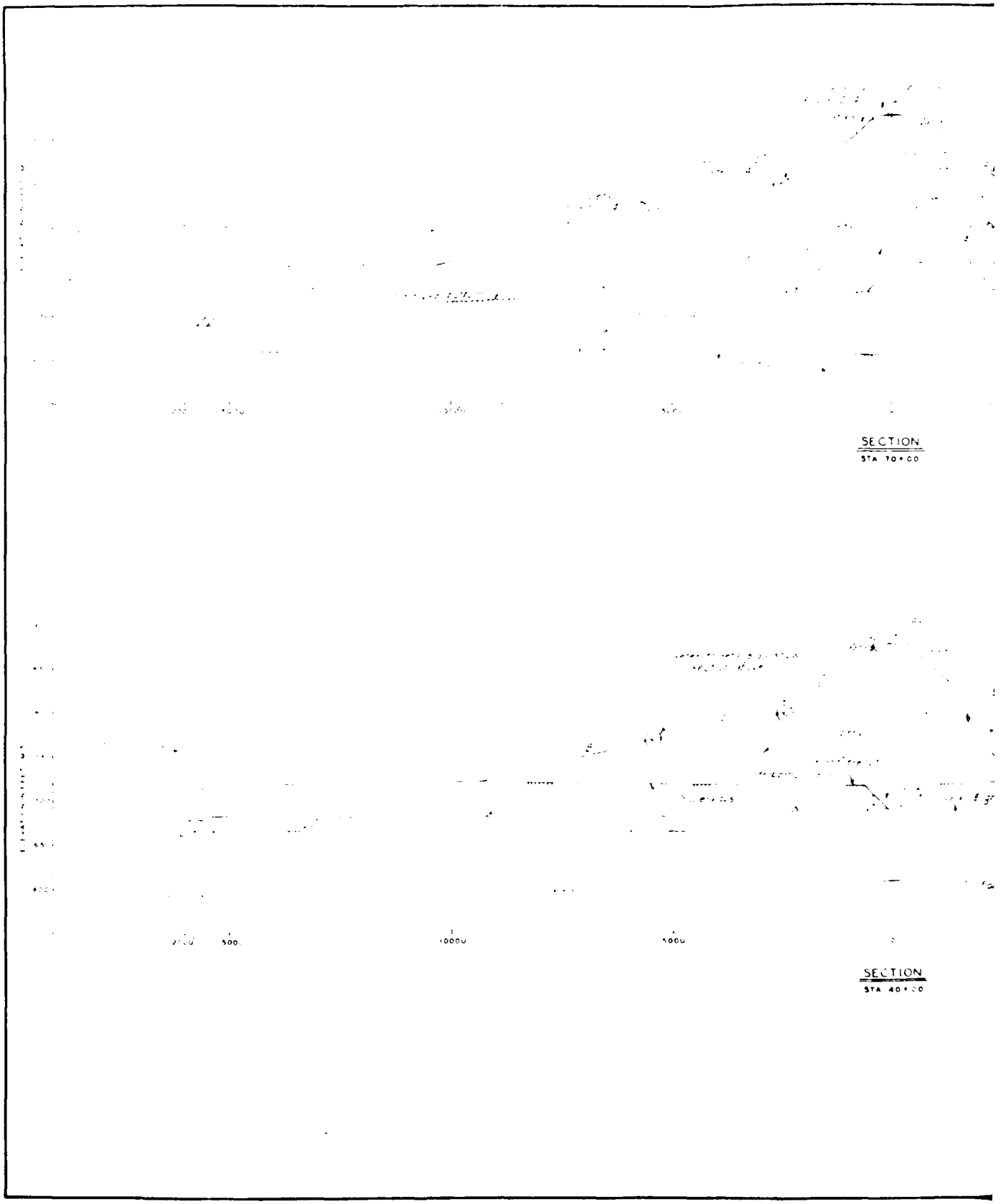


U S ARMY
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OFFICE OF THE DISTRICT ENGINEER

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
EMBANKMENT
INITIAL CLOSURE

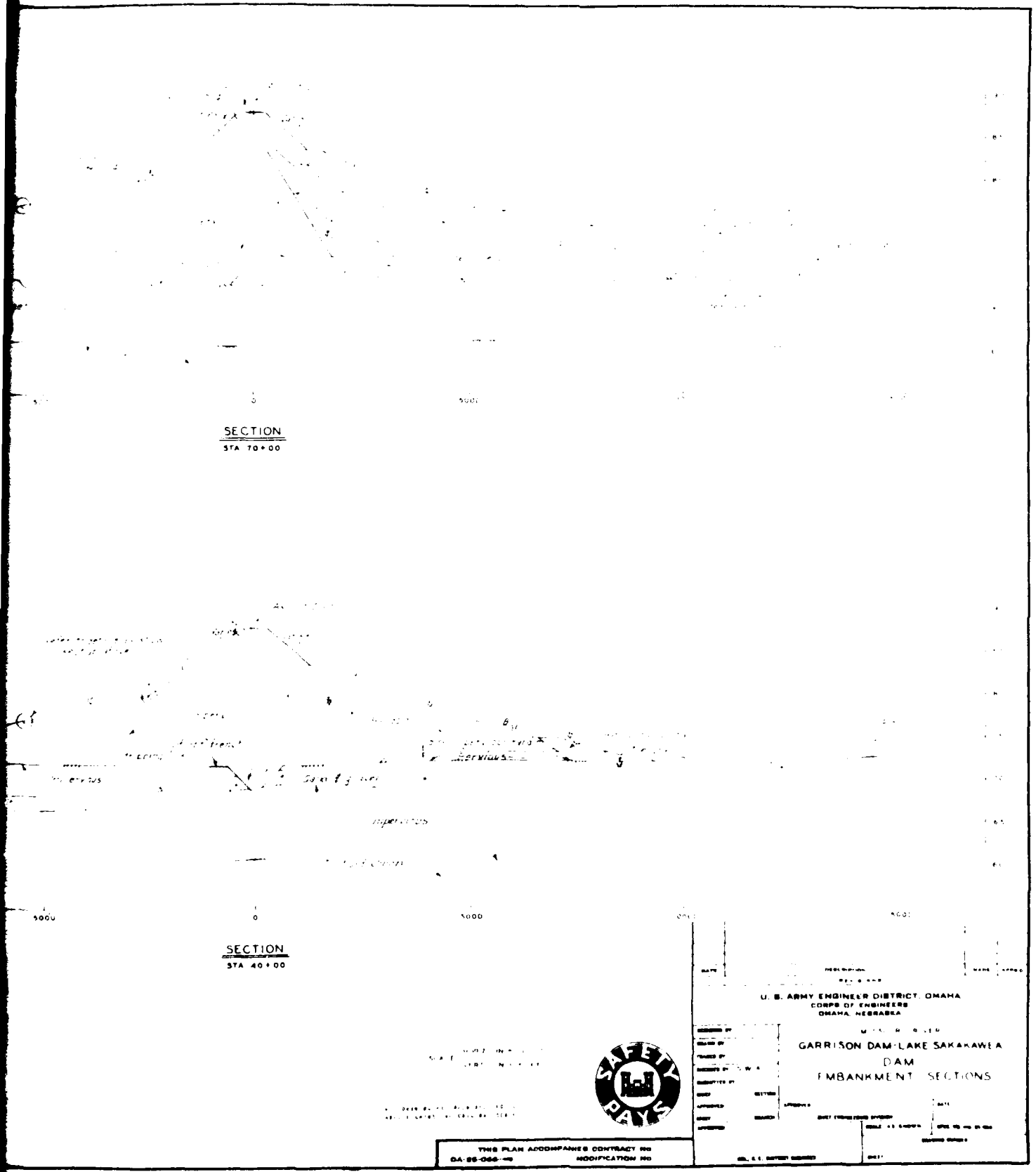

EXISTING
ABANDONED
AXIS OF DAM
SURGE TANKS
POWER HOUSE
Switchyard
EXISTING STOCK PILE NO (8)
EXISTING STOCK PILE NO (5)
WASTE AREA NO 6
EXISTING WASTE AREA NO 7
EXISTING STOCK PILE NO 2
EXISTING STOCA PILE NO 1
BORROW AREA 'C'
See Dwg 2.3
WEST ABUTMENT PARKING AREA
See Dwg 7/16
115 KV Temporary tie
Existing 115 KV Power Line
Existing 115 KV STATION
Existing Road
Existing Rail Road
Existing Barge Load dock
Existing 115 KV Garrison Fort Peck power line Relocated by others during this contract
Plant area in use by Water Res Commission
OUTLET TUNNEL
Compacted lignite surface treatment
El 895 Max Pile No 8
All lignite piles to be built up in layers having a base thickness not exceeding 10'
Top of Pile No 6, 7, 9, 10, 11 and 12 not to exceed R.30 elev of existing Pile No 5
TYPICAL SECTION LIGNITE PILE
PLAN
SCALE 1" = 500'
Notes
Existing lignite storage pile No 9 is completed
Existing lignite storage pile No 6 to be completed in this contract before starting on pile No 7, 9, 10, 11, or 12
Lignite piles No 10, 11, and 12 are alternate location to pile No 8
Before starting Lignite piles 7, 9, 10, 11, and 12, the base shall be treated with sealing treatment


PLAN
NOTES
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
EXCAVATION AND MAIN EMBANKMENT
GENERAL PLAN
AUGUST 1953
GE 17 - 2/4

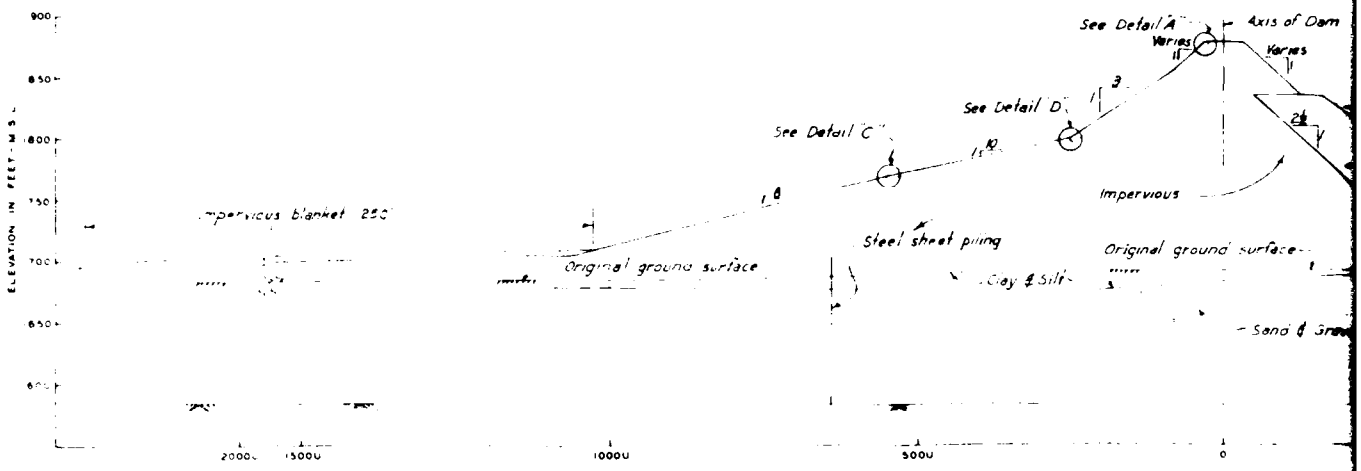


SECTION
STA 70+00

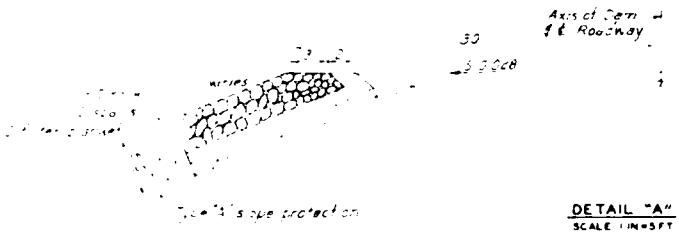
SECTION
STA 40+00



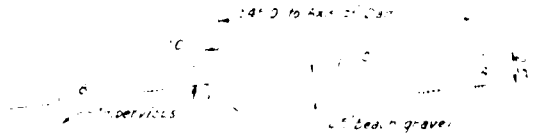
CONSTRUCTION FOUNDATION REPORT (1982) PLATE 82



SECTION
STA. 88+00
SCALE HORIZ 1 IN = 100 FT
VERT 1 IN = 50 FT



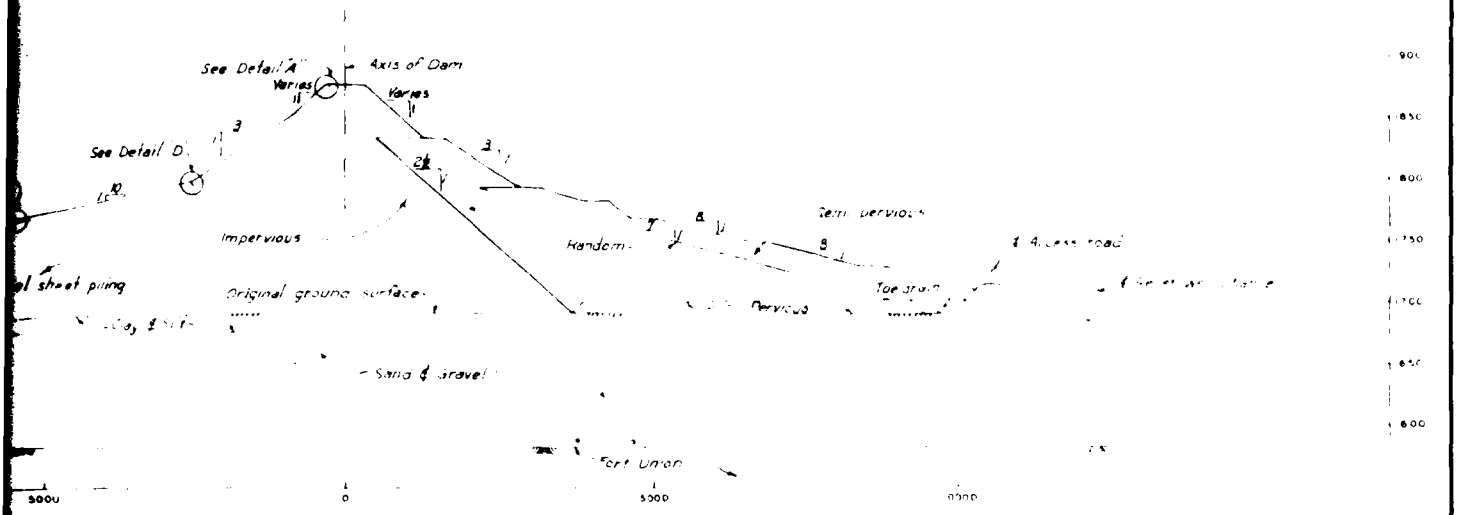
DETAIL "A"
SCALE 1 IN = 5 FT



DETAIL "C"
SCALE 1 IN = 5 FT



DETAIL "D"
SCALE 1 IN = 5 FT



SECTION
STA. 88+00
SCALE HORIZ 1 IN = 100 FT
VERT 1 IN = 50 FT

slope protection

blanket

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PROVIDE INFORMATION ONLY. THE U.S. ARMY
CORPS OF ENGINEERS MAKES NO WARRANTY
AS TO ITS ACCURACY OR COMPLETENESS.

DATE	DESCRIPTION	MADE	APPROVED
	REVISIONS		

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

DESIGNED BY
DRAWN BY
TRACED BY
CHECKED BY
SUBMITTED BY
RECOMMENDED
APPROVED
DATE

MISSOURI RIVER
GARRISON DAM-LAKE SAKAKAWEA
DAM
EMBANKMENT SECTIONS
AND DETAILS

APPROVED
DATE

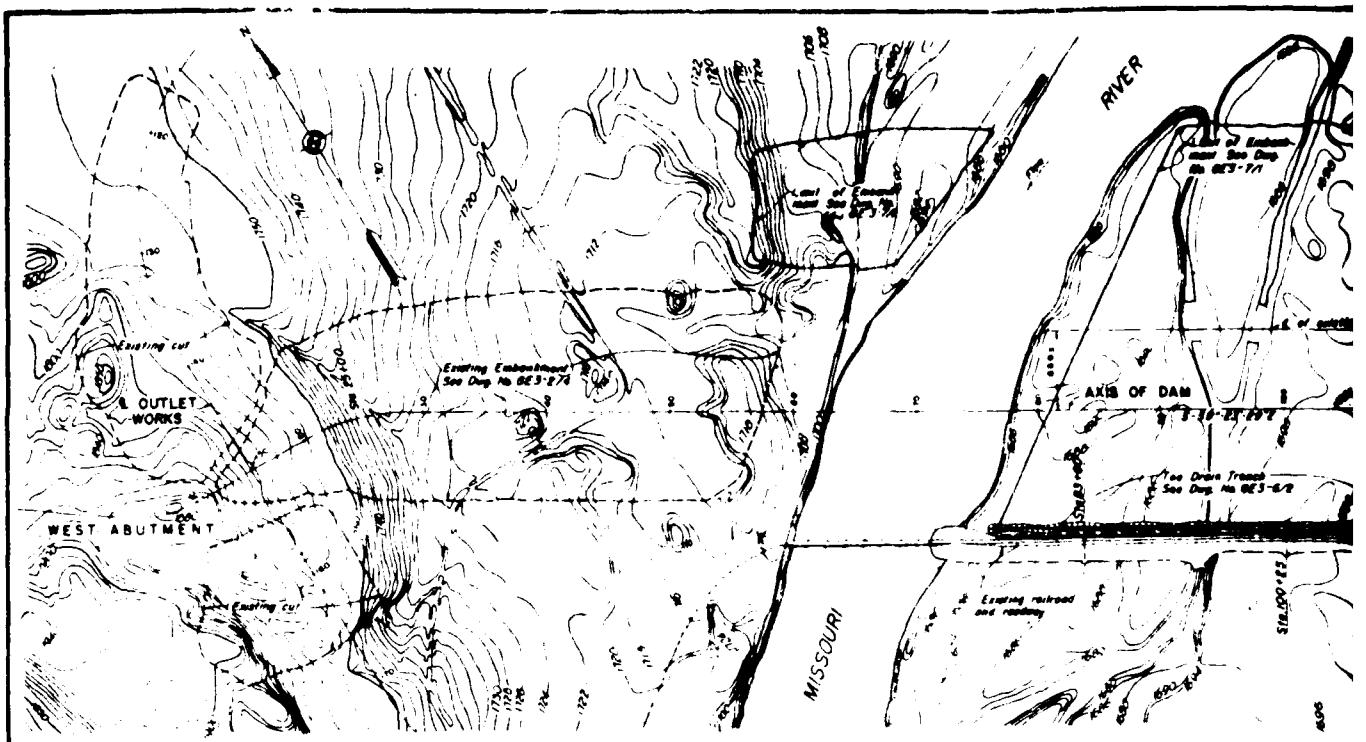
SCALE AS SHOWN
DATE OF SURVEY

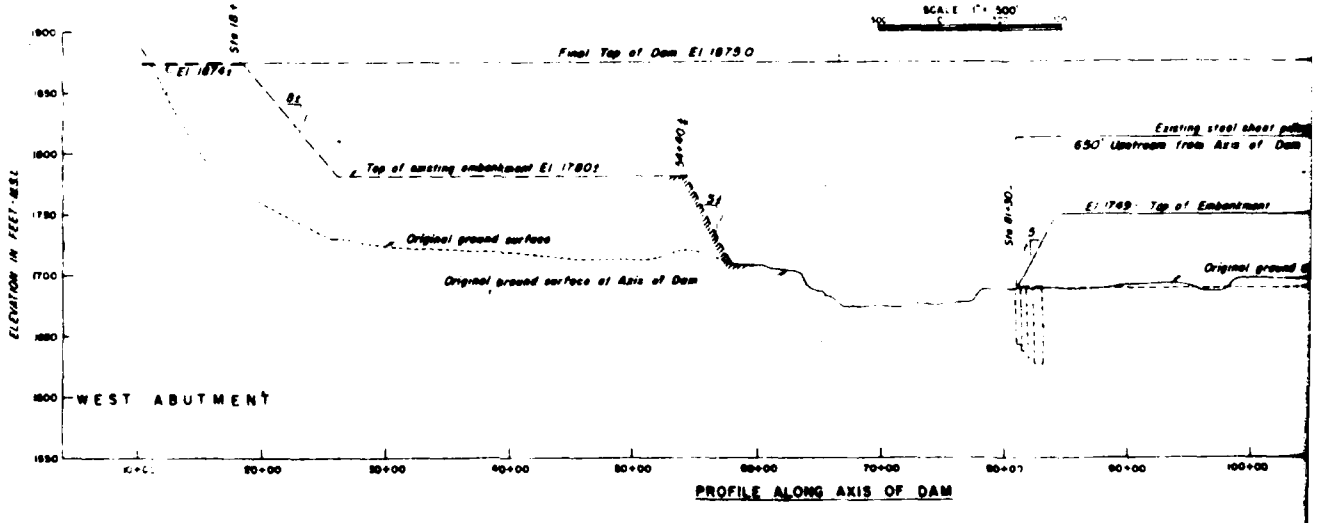
CONTRACT NUMBER

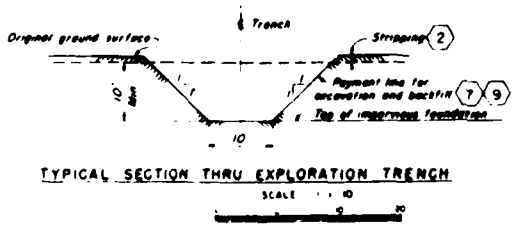
SAFETY PAYS

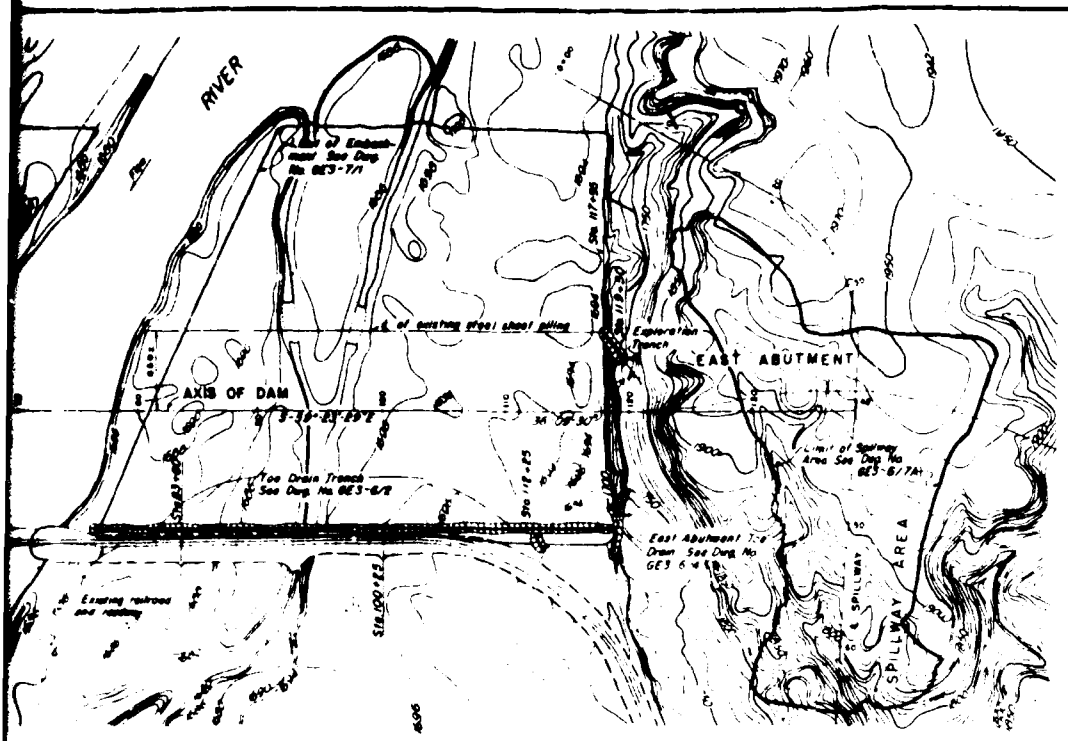
THIS PLAN ACCOMPANIES CONTRACT NO. DA-39-066-eng-
MODIFICATION NO.

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 83


RIVER
AXIS OF DAM
OUTLET WORKS
WEST ABUTMENT
MISSOURI
Existing cut
Existing Embankment
Existing railroad and roadway
Toe Drain Trench
PLAN
SCALE

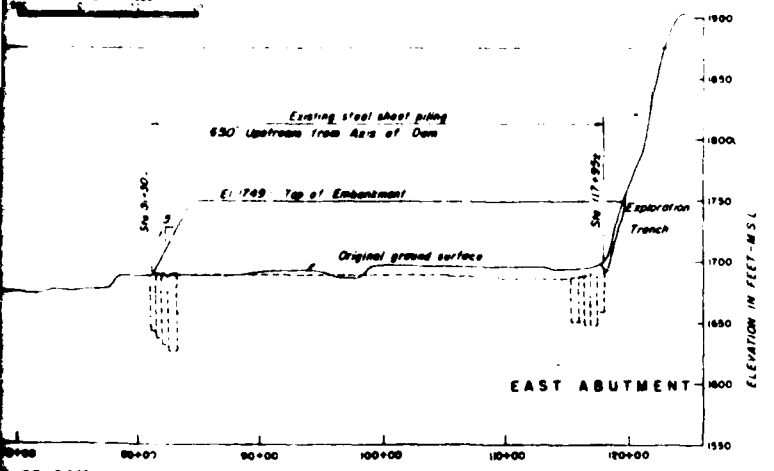

Final Top of Dam El 1879.0
Top of existing embankment El 1780±
Original ground surface
Original ground surface at Axis of Dam
Existing steel sheet pile
650' Upstream from Axis of Dam
El 1769 Top of Embankment
WEST ABUTMENT
ELEVATION IN FEET-MSL
PROFILE ALONG AXIS OF DAM
SCALE HOR
VERT


Trench
Original ground surface
Stripping
Payment line for excavation and backfill
Top of impervious foundation
TYPICAL SECTION THRU EXPLORATION TRENCH
SCALE



PLAN

SCALE 1" = 500'



OF DAM

NOTES

Figures in hexagons indicate item numbers under which payment will be made

For geologic profile of Toe Drain see Dwg No. GE3 5/8

For geologic profile of exploration trench see Dwg No GE3-5/9

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
BISMARCK, N.D.

MISSOURI RIVER

GARRISON DAM AND RESERVOIR FOUNDATION PREPARATION

PLAN-PROFILE AND SECTION

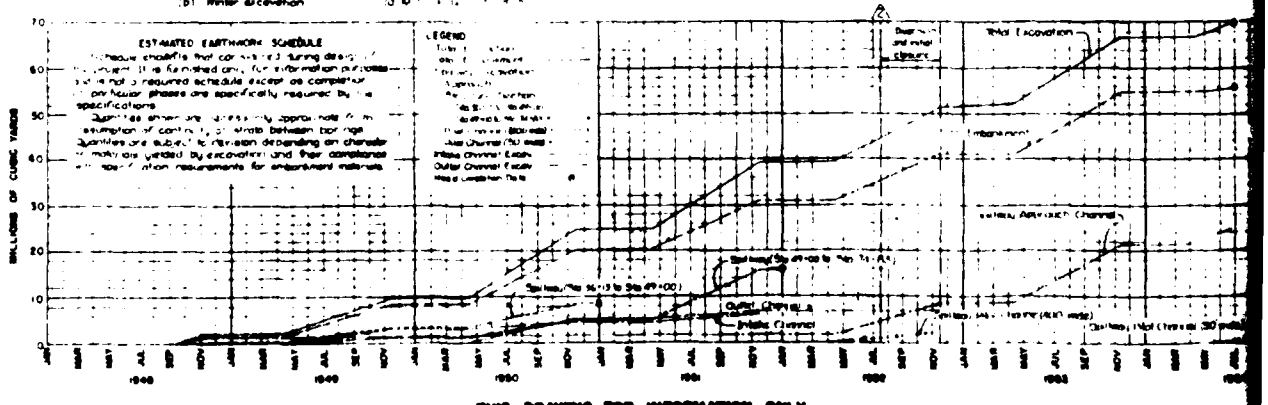
AUGUST 1948

DRAWING NUMBER
GE3 - 6/1

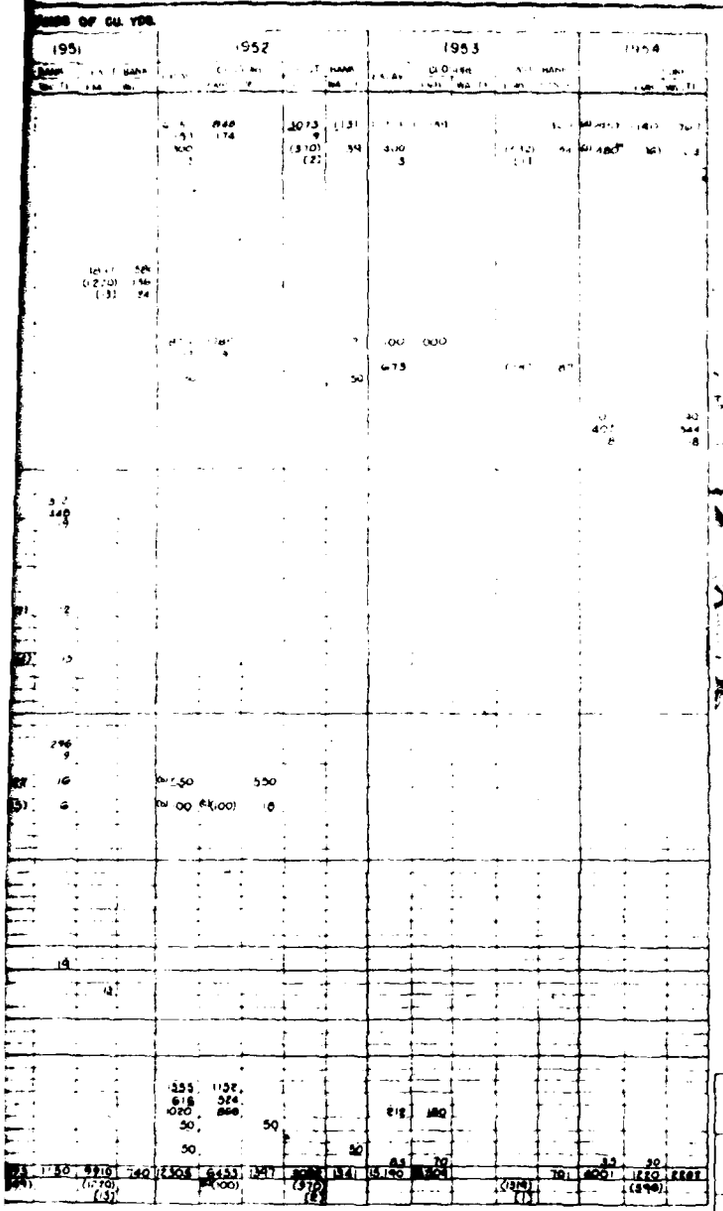
NOTE: QUANTITIES ARE IN THOUSANDS OF CU YDS.

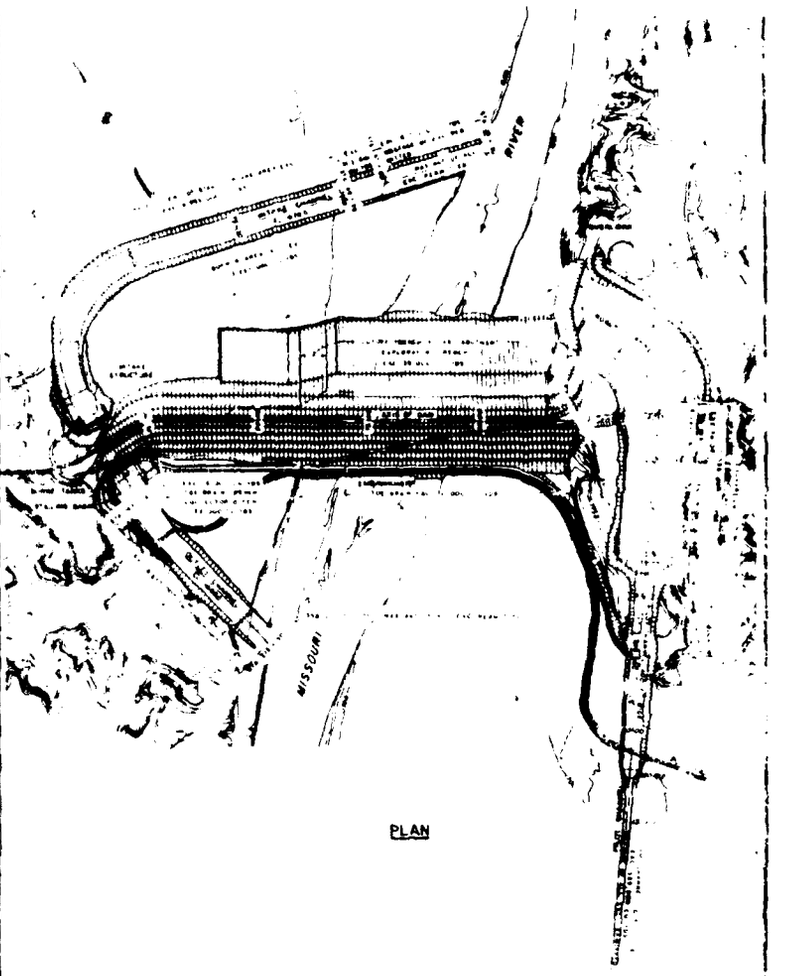
SOURCE	EXCAVATION YIELD	1948-49	1950	1951	1952	1953
	TOTAL EXCAV MEAS	USABLE EMB MEAS	WASTE EMB MEAS	EXCAV	WEST BANK EMB	WASTE	EAST BANK EMB	WASTE	EXCAV	WEST BANK EMB	WASTE	EAST BANK EMB	WASTE	EXCAV	EMB	WASTE	EMB	WASTE	EXCAV	EMB	WASTE
SPILLWAY																					
APPROACH																					
Sta 9+20 to Sta 38+13																					
Impervious & Random	4035	2716	919	1307			925	387													
Rock Excavation	35	35		366			366														
Riprap	286	498	166	100				10													
Miscellaneous	8	5																			
Stripping	118		118	118				118													
STRUCTURE SECTION																					
Sta 38+13 to Sta 49+00																					
Impervious & Random	7819	7327	326	3220			1220	30	4539			4067	366								
Riprap	581	661	76						36			(680)	76								
Masonry & Backfill		04										(0 5)									
Stripping	44		44	44				44													
Sta 49+00 to Sta 74+83																					
Impervious & Random	9725	6300	765	1930			1135	45	4154			2826	50	4397		185	78				
Riprap	1043	1220	136											1043		1220	136				
Miscellaneous & Backfill	58	3	24											55		13	24				
Masonry & Backfill Apron	45		145						45				145								
PILOT CHANNEL																					
Sta 74+83 to Sta 120+75																					
Impervious & Random	4547	2754	805																87	100	1000
Miscellaneous		99																		673	
Riprap	413	787	87																50		
Stripping	50		50																		
PILOT CHANNEL																					
Sta 120+75 to Sta 240+00																					
Impervious & Random	1004		510																		
Miscellaneous	8		8																		
INTAKE CHANNEL																					
Sta 0+00 to Sta 40+00																					
Impervious & Random	249		3																		
Riprap	533		518																		
Stripping			9																		
Sta 40+00 to Sta 49+20																					
Impervious & Random	93		79																		
Rock Excavation	10	3P							14	14	62										
Riprap	78	24							18	14											
Miscellaneous			7						1		7										
Sta 49+20 to Sta 67+00																					
Impervious & Random	1146	927	17	1330	1069	9			1179	81				1167	67	12					
Rock Excavation	50	44							5	44											
Riprap	1222	860		6			23		107	345											
Backfill	513	1303		236			157		295	10		150									
Miscellaneous	97	114	13							(141)				47		(4)	15				
Rock Slope Protection		5																			
Stripping	49		49	22		22			27		27										
OUTLET CHANNEL																					
Sta 0+00 to Sta 64+85																					
Impervious & Random	347		298											147		296					
Riprap	9		9											9							
Sta 64+85 to Sta 84+00																					
Impervious & Random	2042	1518	67						1419	2757	551			1122		16			(a) 550		
Riprap	60	5							50	5											
Rock Excavation	490	502	36						500	(368)	32			10	25	6			(b) 100	(a) (100)	18
Backfill			12						17	12	2										
Stripping	45		45						45		45										
TOE TRENCHES																					
EAST PERIMETER																					
Excavation	6	53		6			53														
Backfill	2	8		2			8														
WEST PERIMETER																					
Excavation	10	8							10	8											
Backfill	5	4							5	4											
COLLECTOR DITCH																					
Excavation	22	8												22		19					
CUTOFF TRENCH																					
Excavation	35	50							20	17				13		13					
EMBANKMENT AREA																					
Stripping	500		500	200				200	100		100										
BORROW AREAS																					
BORROW A																					
Impervious Random	1353	1132																	(355	1137	
General Removal	918	528																	616	524	
Rock Excavation	1232	1068																	1020	868	
Stripping	50		50																50		50
BORROW B																					
Impervious Random	50		50																50		50
Rock Excavation	18	100																			
TOTALS	40,000	34,303	5403	9978	1069	23	3274	169	4500	4369	834	7045	637	1478	1693	50	5910	240	2508	6453	357	5088	184	6190	1000
Salvage Riprap										(464)		(660)			(149)		(1270)			(100)		(570)			
Salvage Rock										(10)		(0 5)					(13)					(8)			

(a) Placed in upstream blanket (c) Placed in Outer Channel (e) Waste Rock
(b) Waste excavation (d) Used in Outer Channel

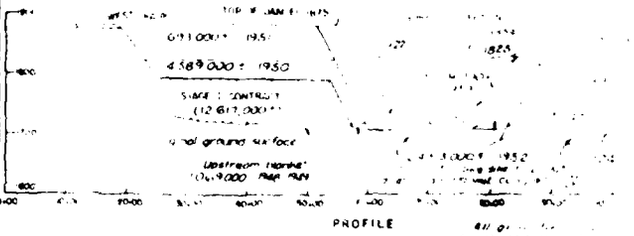


THIS DRAWING FOR INFORMATION ONLY

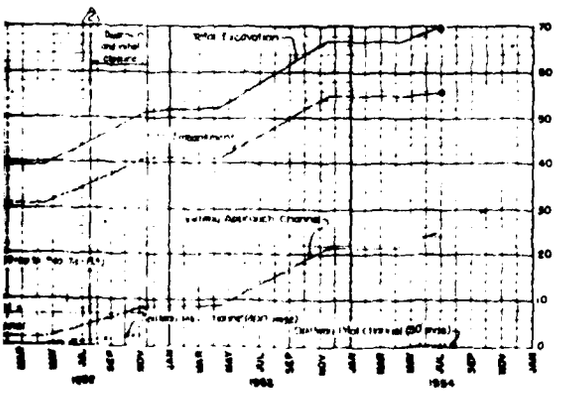




PLAN



PROFILE



NOTES

Quantities shown thus (1970) in Embankment column are salvaged riprap in stock pile

Pervious ... shown include only ... blanket. Bank run gravel includes beach ... pervious berm, channel, gravel for ... bedding and gravel in drains.

Quantities in Excavation column ...

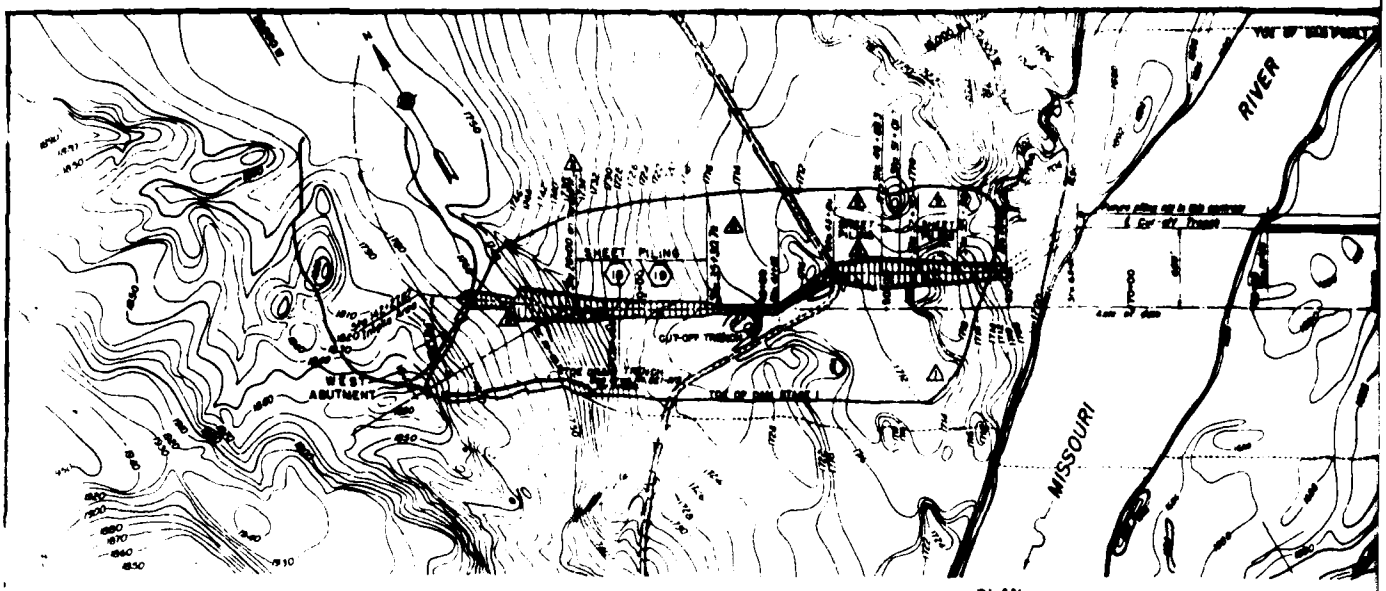
Quantities in Embankment ... quantities multiplied by a Shrinkage ... varying with the source and type of material as ...

Fort Union impervious	Factor ...
Alluvial clays, silts and ...	...088
Random semi pervious	...088 cy
Pervious	...081 cy

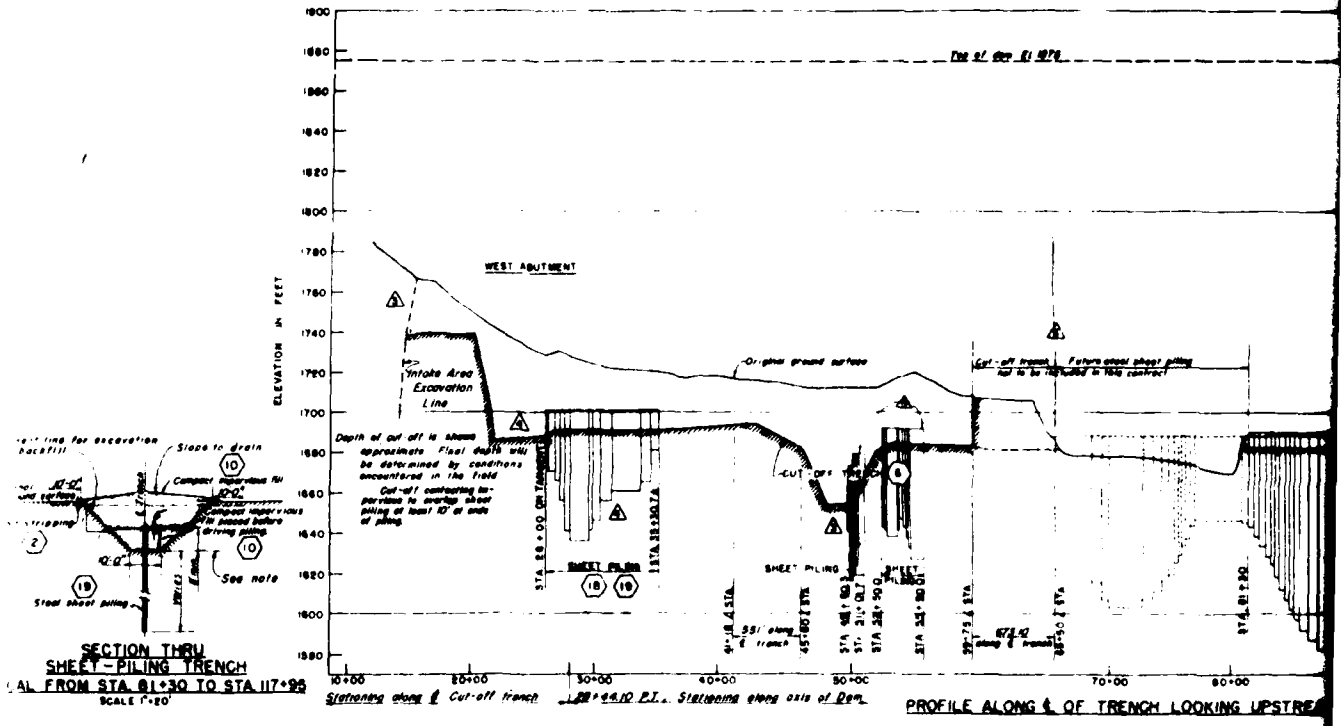
... Excavation ... Types used in embankment is simple ... Because of availability, bank ... will generally be used only pervious zone with only excess in outer part of the ... zone

GARRISON DAM ...
EXCAVATION & ...
EARTHWORK ...

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 85

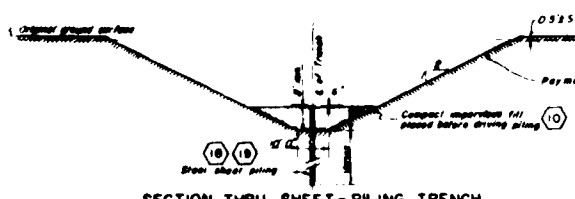


PLAN
SCALE 1" = 800'

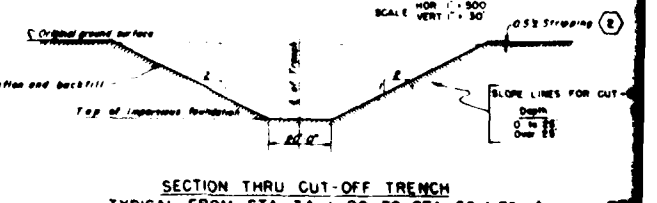


PROFILE ALONG ℄ OF TRENCH LOOKING UPSTREAM

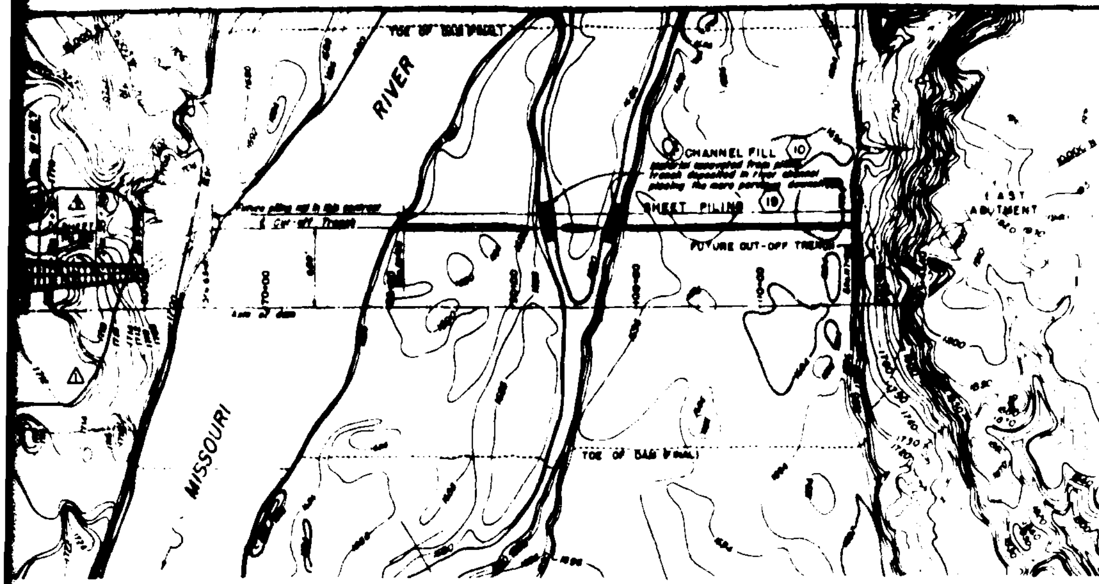
SECTION THRU
SHEET-PILING TRENCH
AL FROM STA. 81+30 TO STA 117+95
SCALE 1"=20'



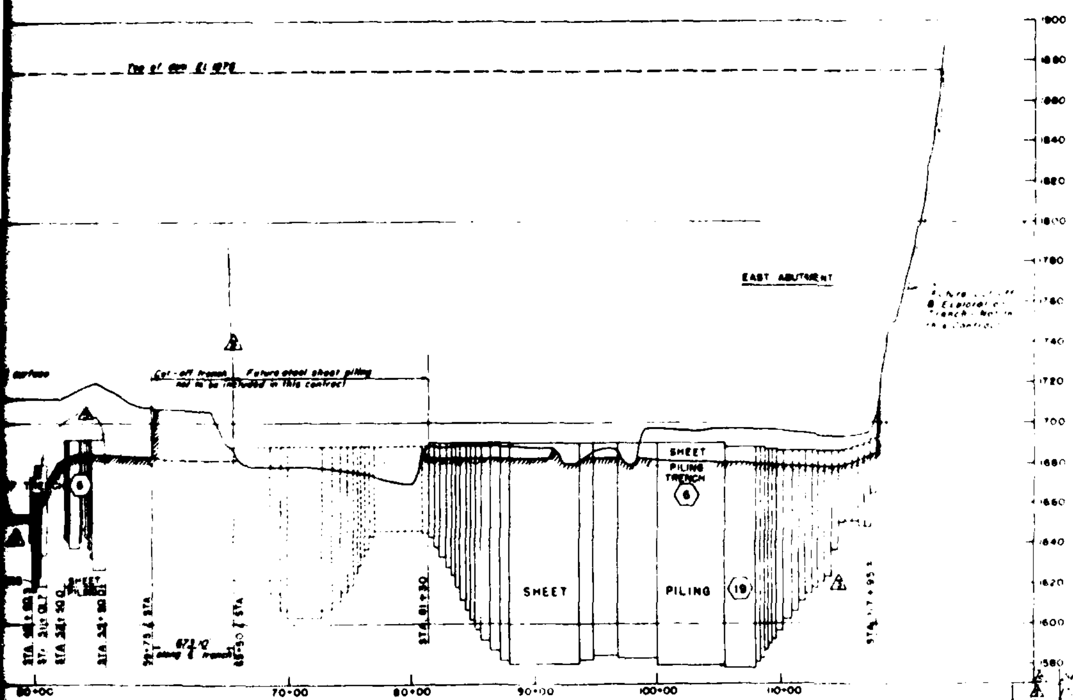
SECTION THRU SHEET-PILING TRENCH
TYPICAL FROM STA. 26+00 ON TANGENT ▲
TO STA. 34+00 ▲



SECTION THRU CUT-OFF TRENCH
TYPICAL FROM STA 34 + 00 TO STA 59 + 75 ▲
AND STA 20 + 25 ON CUT-OFF TRENCH TO 26 + 00 ON TANGENT
SCALE 1"=20'

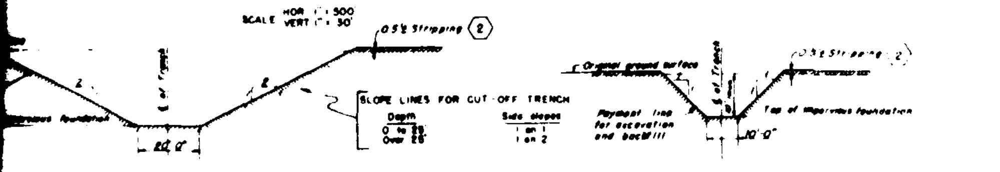


PLAN
SCALE 1" = 500'



PROFILE ALONG ℄ OF TRENCH LOOKING UPSTREAM

SCALE HOR 1" = 500' VERT 1" = 30'



SECTION THRU CUT-OFF TRENCH
...CAL FROM STA 34 + 00 TO STA 59 + 75
...25 ON CUT-OFF TRENCH TO 26 + 00 ON TANGENT
SCALE 1" = 20'

SECTION THRU CUT-OFF TRENCH - TYPICAL
FROM INTAKE AREA TO STA 20+25 ON CUT OF TRENCH
SCALE 1" = 20'

PILING DATA

EAST ABUTMENT AND EAST RIVER CHANNEL

STATION TO STATION	TOP ELEVATION	LENGTH OF PILING	NO OF PIECES
8+30	1691	45	30
8+70	1691	55	34
82+18	1691	66	37
82+82	1691	67	30
83+02	1691	66	22
83+24	1690	77	30
83+74	1690	78	34
84+18	1690	87	30
84+50	1690	88	30
84+80	1690	95	35
85+10	1690	98	80
86+10	1690	105	99
86+86	1690	108	92
87+72	1690	10	980
88+35	1690	108	94
90+32	1690	106	180
96+50	1690	106	248
99+55	1690	110	408
100+46	1688	0	8
102+00	1688	04	78
102+20	1688	108	35
108+68	1687	00	21
109+00	1687	97	22
109+28	1687	94	[illegible]
109+48	1688	80	5
110+18	1688	84	76
110+95	1688	87	38
+45	1688	78	44
11+05	1688	7	34
12+84	1688	66	38
13+05	1688	88	38
13+55	1688	88	4
14+8	1688	66	45
14+70	1688	67	45
6+38	1687	56	44
6+66	1688	37	[illegible]
6+42	1688	40	5
6+84	1685	42	5
7+43	1688	88	16
7+88			

WEST ABUTMENT

STATION TO STATION	TOP ELEVATION	LENGTH OF PILING	NO OF PIECES
26+00	70	80	
26+20	70	30	44
26+80	72	75	7
27+20	70	45	36
27+80	70	60	30
28+00	70	55	4
29+32	70	6	7
29+80	70	45	4
30+40	70	46	15
31+40	70	40	8
33+80	70	55	16
34+64	70	20	
35+30			

AVERAGE LENGTH

STATION TO STATION	TOP ELEVATION	AVERAGE LENGTH	NO OF PIECES
[illegible]	[illegible]	[illegible]	[illegible]

NOTES

Elevations refer to Mean Sea Level Datum.
Contour interval is 2 feet to El [illegible] Contour interval above El [illegible] is [illegible] feet.
Figures in hexagons indicate item number under which payment will be made.
Bottom grade of sheet piling trench and [illegible] grade of top of sheet piling from Sta 81+30 to Sta [illegible] are dependent on position of ground water table. If water table at time of construction, as determined from [illegible] by the Government, is significantly higher than [illegible] (see Dwg No GE 1-5/71), bottom grade of sheet [illegible] trench will be adjusted to approximate existing [illegible].

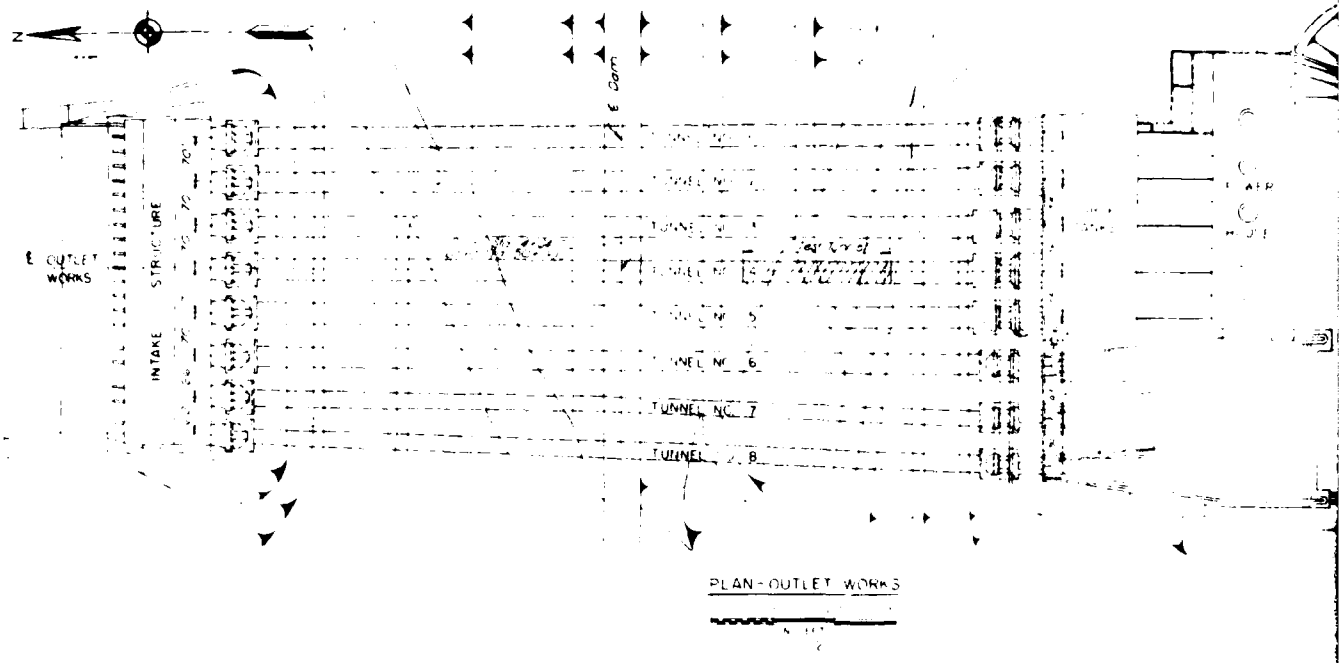
SYM	DATE	REVISION
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Revised [illegible] cut off trench [illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Piling revised Sta 26+00 to Sta [illegible]
[illegible]	[illegible]	[illegible] for extension

WAR DEPARTMENT
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
BISMARCK, N.D.

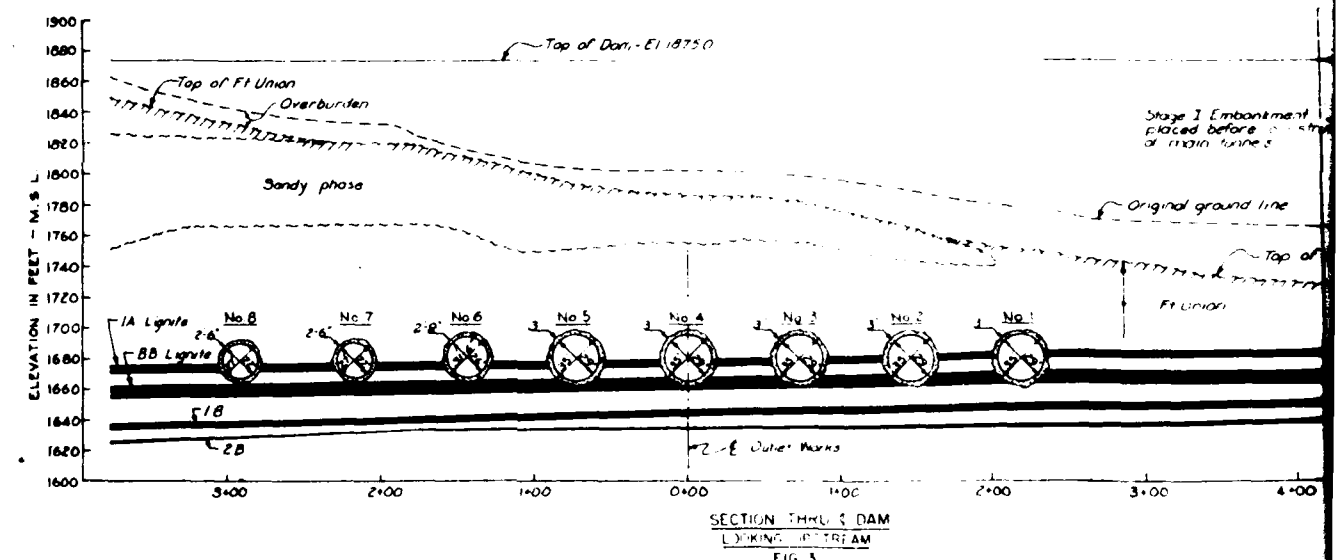
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
FOUNDATION PREPARATION

JULY 1947

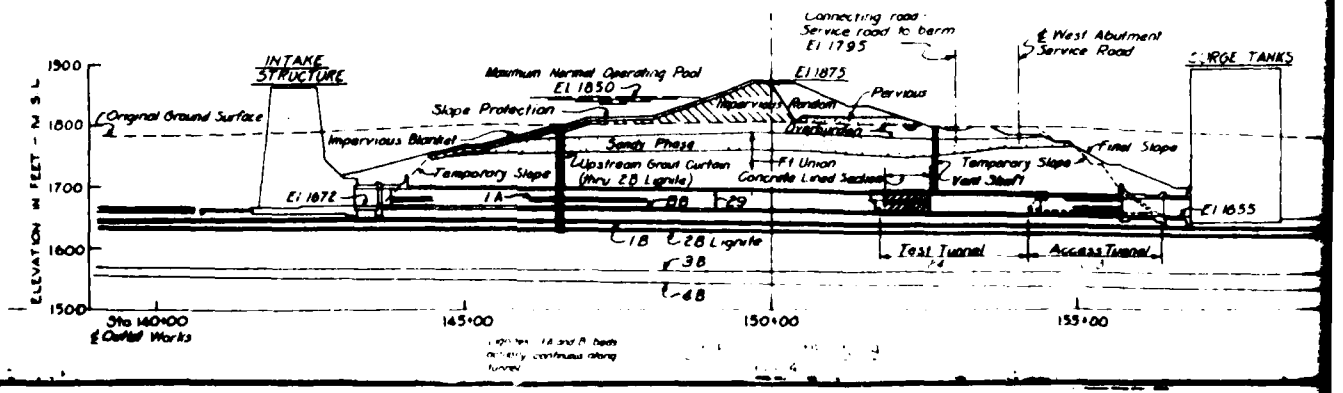
DRAWING NUMBER GE1—6/1

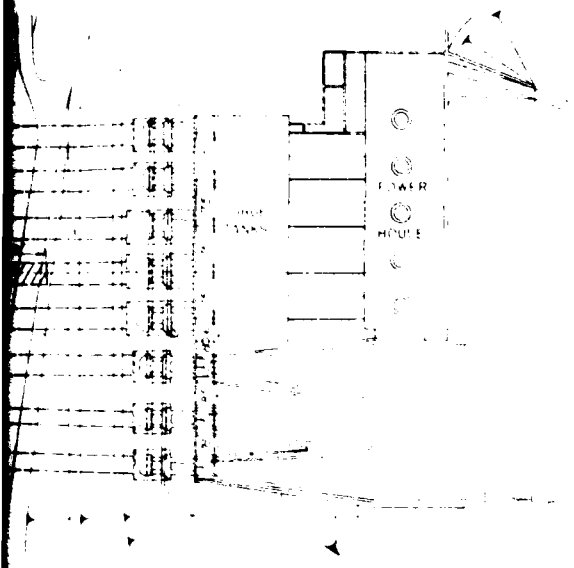


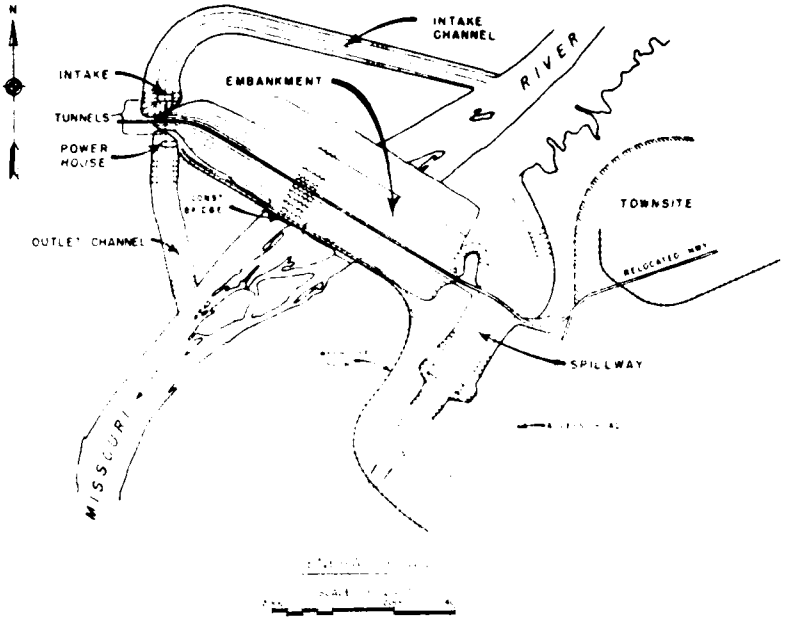
PLAN - OUTLET WORKS



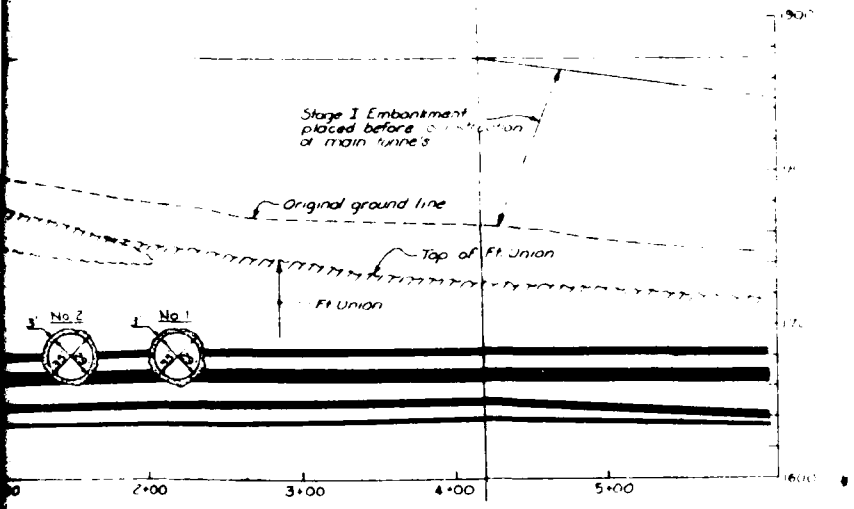
SECTION THRU ℄ DAM
LOOKING UPSTREAM
FIG 3



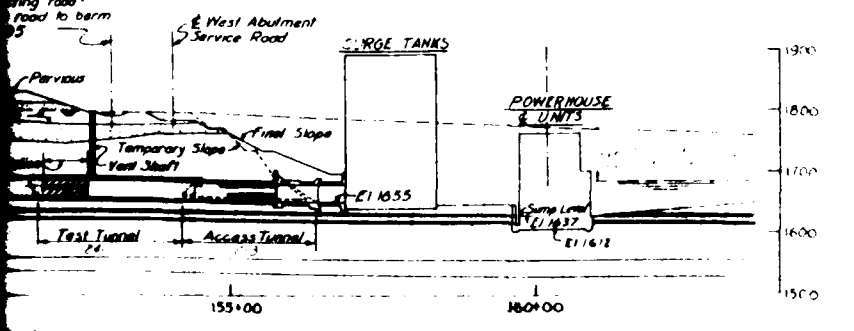

POWER
HOUSE

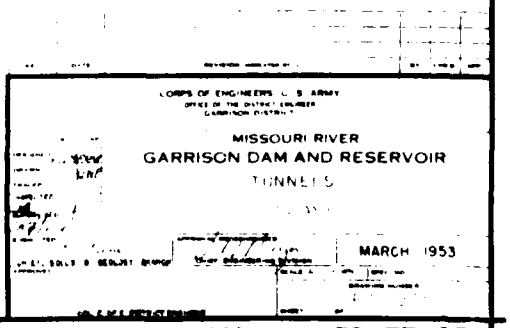

N
INTAKE
INTAKE CHANNEL
EMBANKMENT
RIVER
TUNNELS
POWER HOUSE
OUTLET CHANNEL
TOWNSITE
RELOCATED HWY
SPILLWAY
MISSOURI

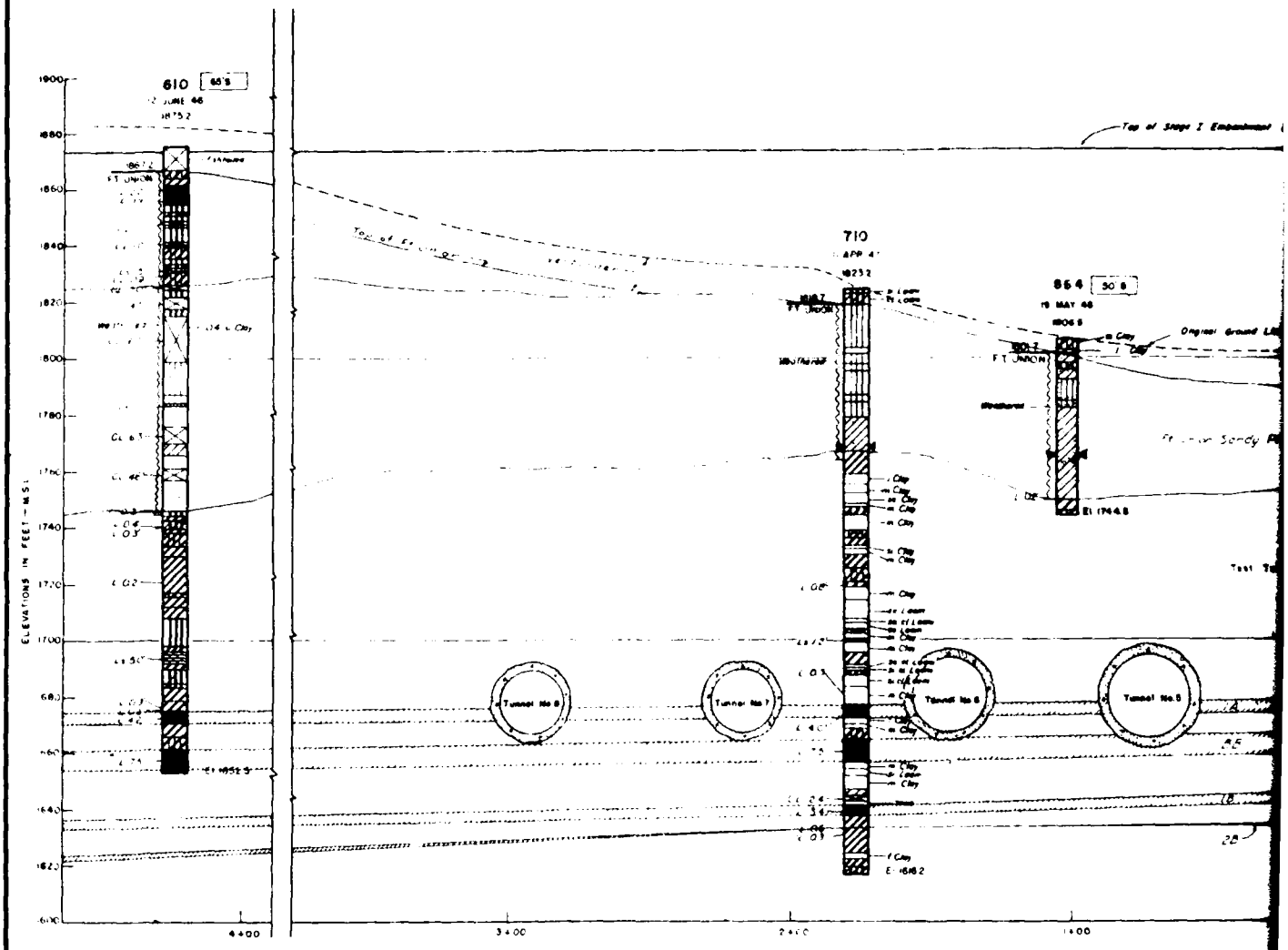
ORKS


Stage I Embankment placed before
of main tunnels
Original ground line
Top of Ft Union
Ft Union
No 2
No 1
2+00
3+00
4+00
5+00

DAM
AM


ting road
road to berm
5
℄ West Abutment
Service Road
SURGE TANKS
Pervious
POWERHOUSE
& UNITS
Final Slope
Temporary Slope
Vent Shaft
El 1655
Sump Level
El 1637
El 1612
Test Tunnel
Access Tunnel
155+00
160+00


CORPS OF ENGINEERS U S ARMY
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
TUNNELS
MARCH 1953



LEGEND

GRAIN SIZE SYMBOLS

Sand — Silt — Gravel — Clay

Symbols represent grain size distribution predominant types by heavy lines modifying types by light lines

OTHER SYMBOLS

Limestone (L.S.) — Core Lost (C.L.)

Lignite (L) — Fishtailed (Wash boring not sampled)

ABBREVIATIONS USED

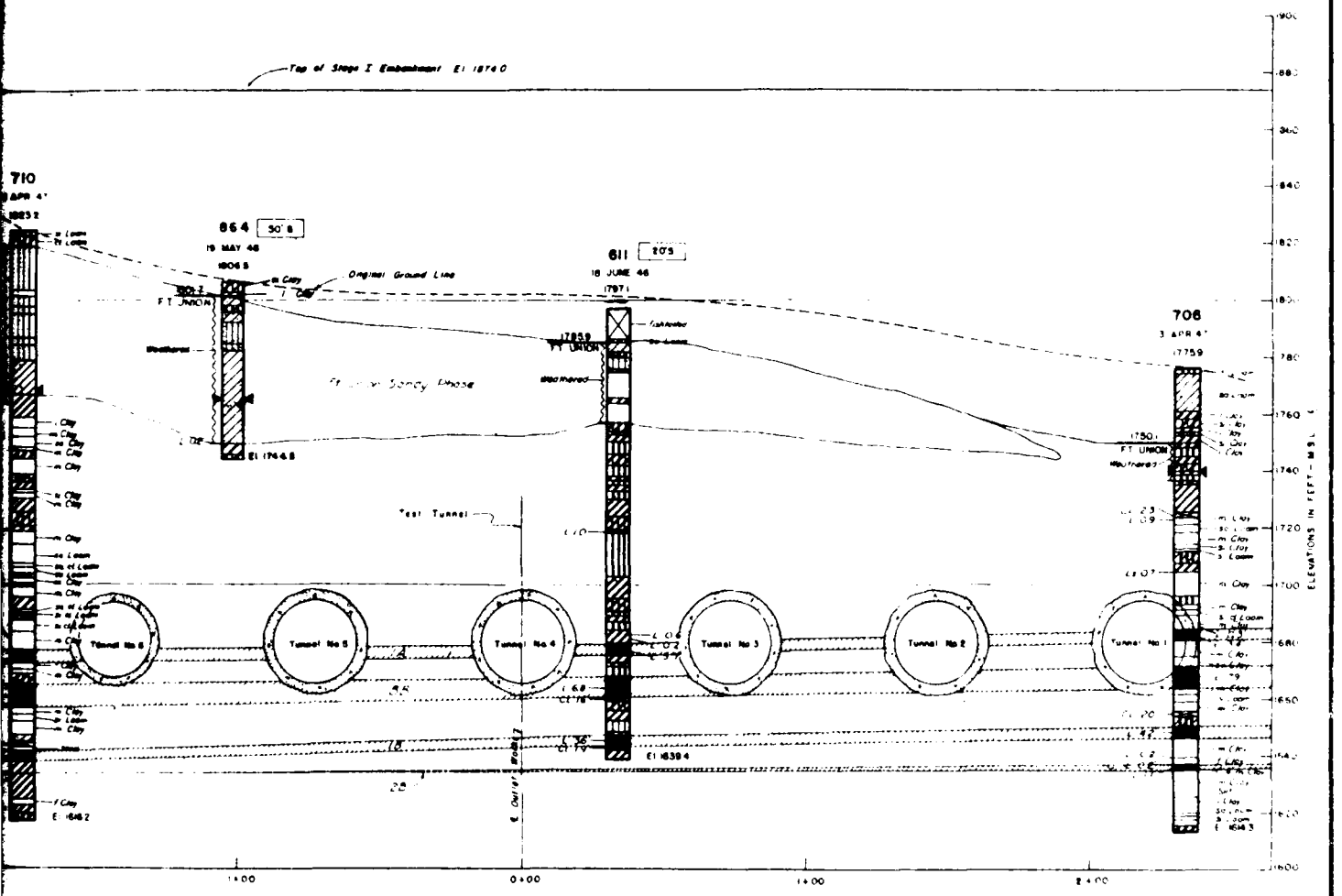
gra — gravelly; ss — sandy; si — silty; cl — clayey; l — lean (clay); m — medium (clay); f — fat (clay)

Lean medium & fat clays are not differentiated in Ft Union

Fine medium & coarse sands are not differentiated

SECTION THRU ℄ D

LOOKING UPSTREAM
SCALE 1"=20'



SECTION THRU ℄ DAM
LOOKING UPSTREAM
SCALE 1"=20'

BREVIATIONS USED

gravelly
sandy
silty
clayey

dium & fat clays are not differentiated

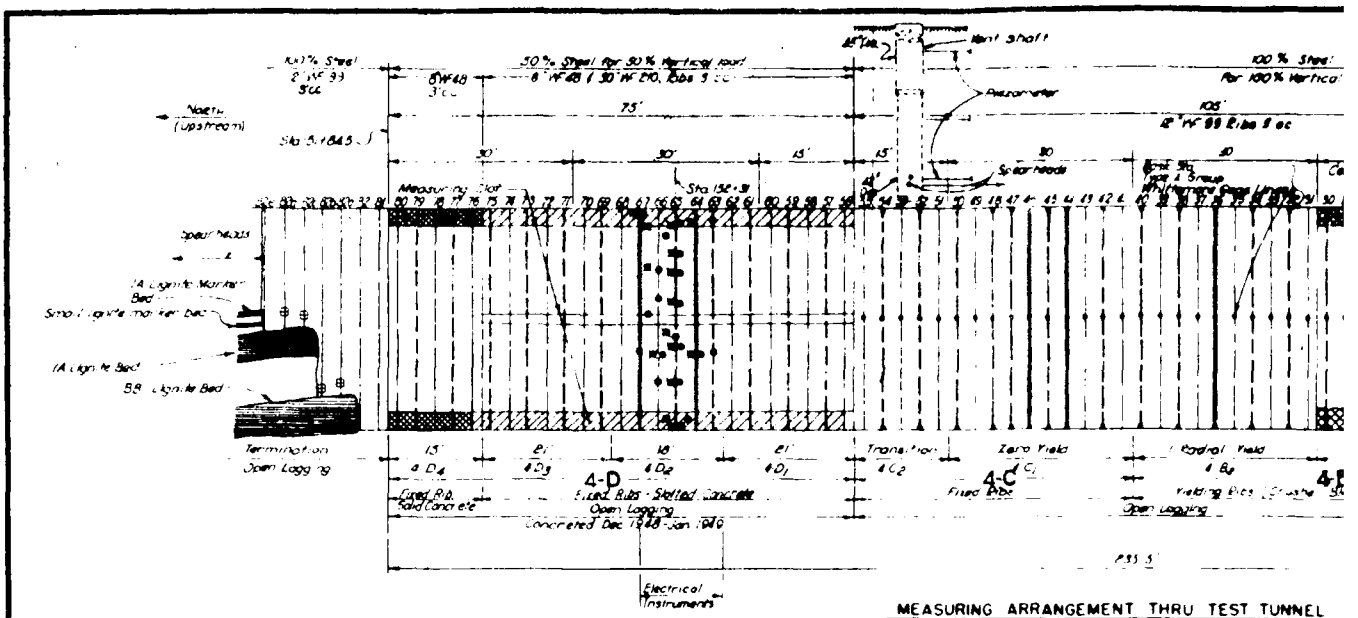
dium & coarse sands are not differentiated

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEBR.

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
GEOLOGIC SECTION
THROUGH TUNNELS

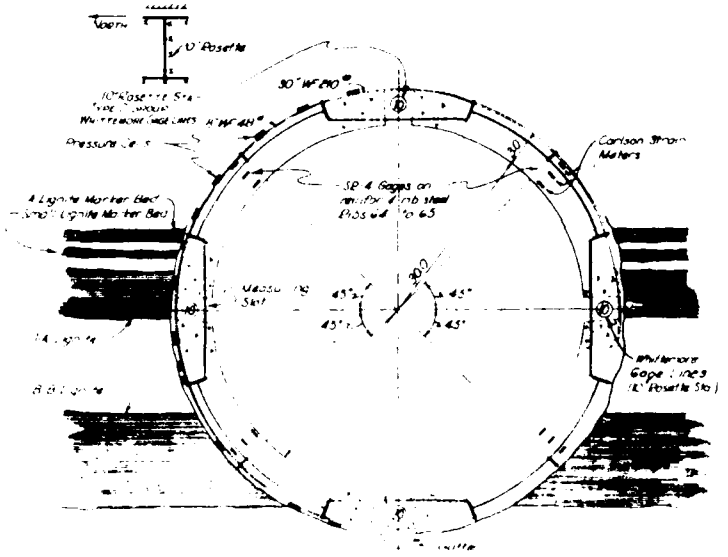
AUGUST 1949

602-5/7



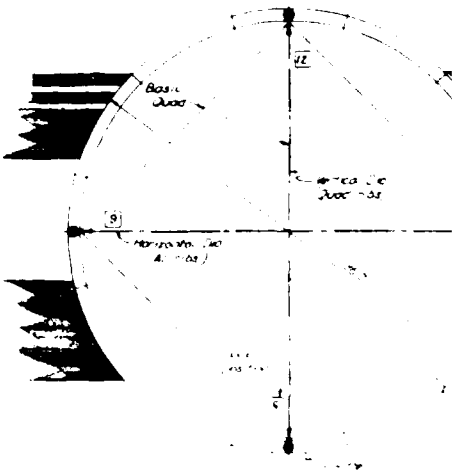
MEASURING ARRANGEMENT THRU TEST TUNNEL

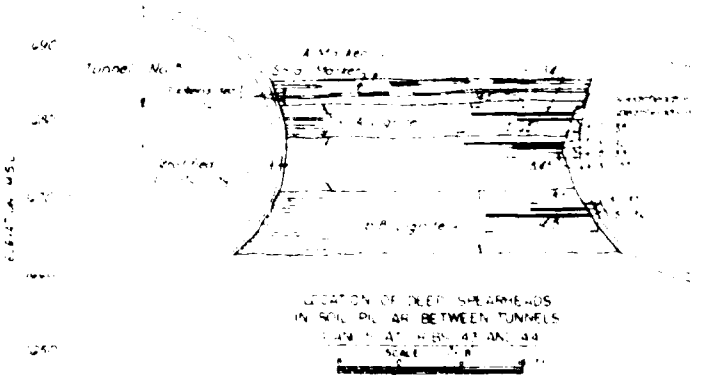
SCALE



CONCRETE SECTION "D" LOOKING NORTH

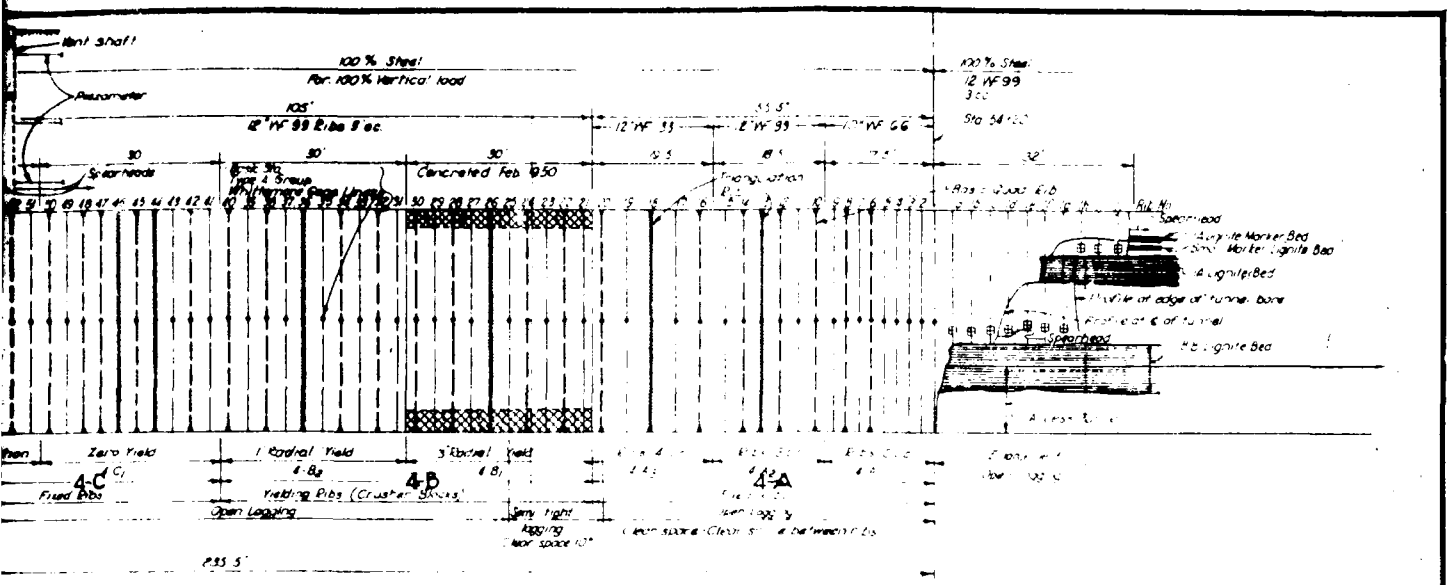
SCALE



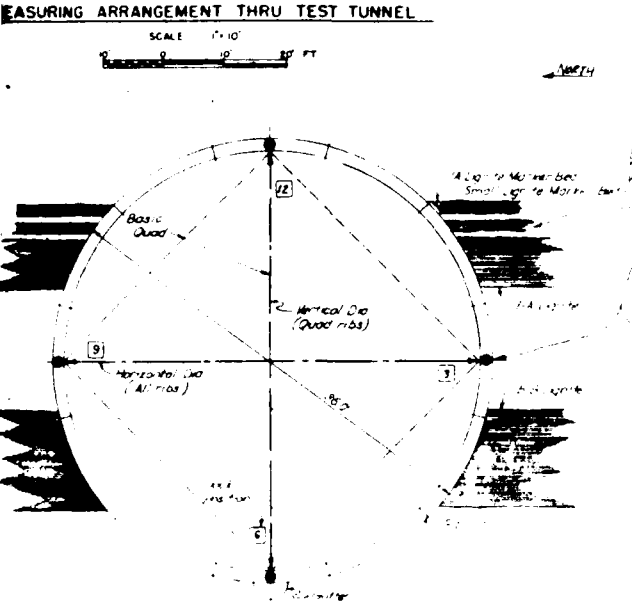


LOCATION OF DEEP SHEARHEADS IN SOIL PILLAR BETWEEN TUNNELS

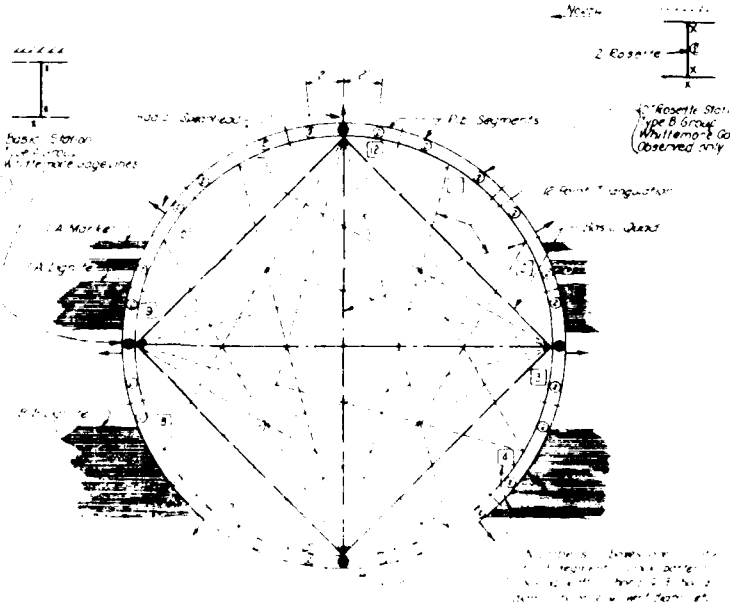
SCALE



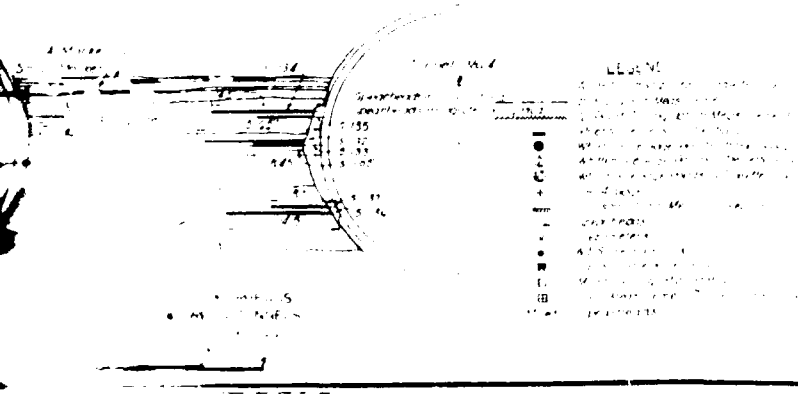
EASURING ARRANGEMENT THRU TEST TUNNEL

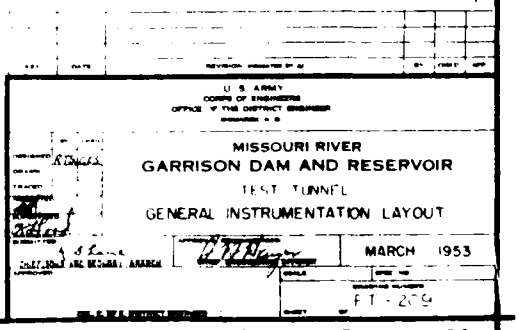


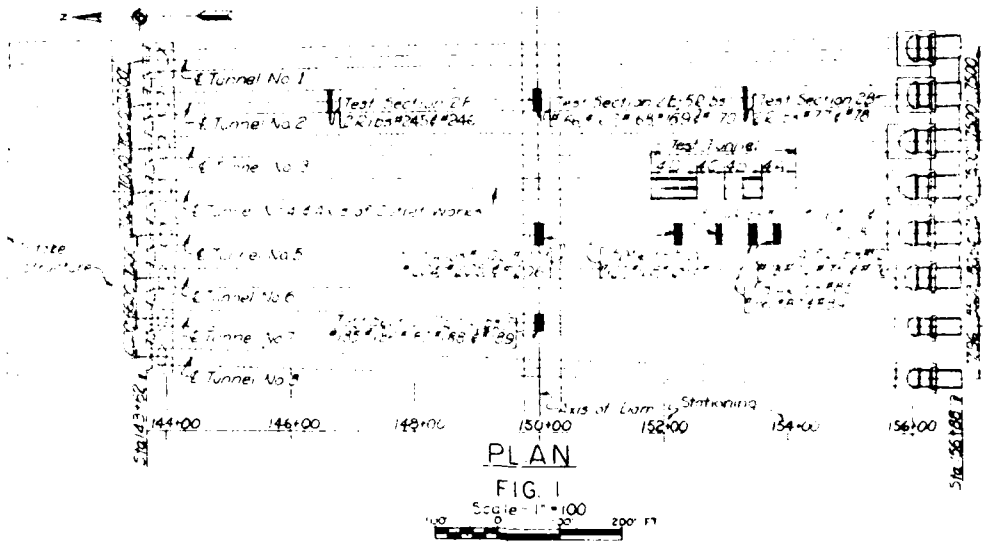
RADIAL QUAD RIB LOOKING NORTH



TRIANGULATION RIB LOOKING NORTH







PLAN

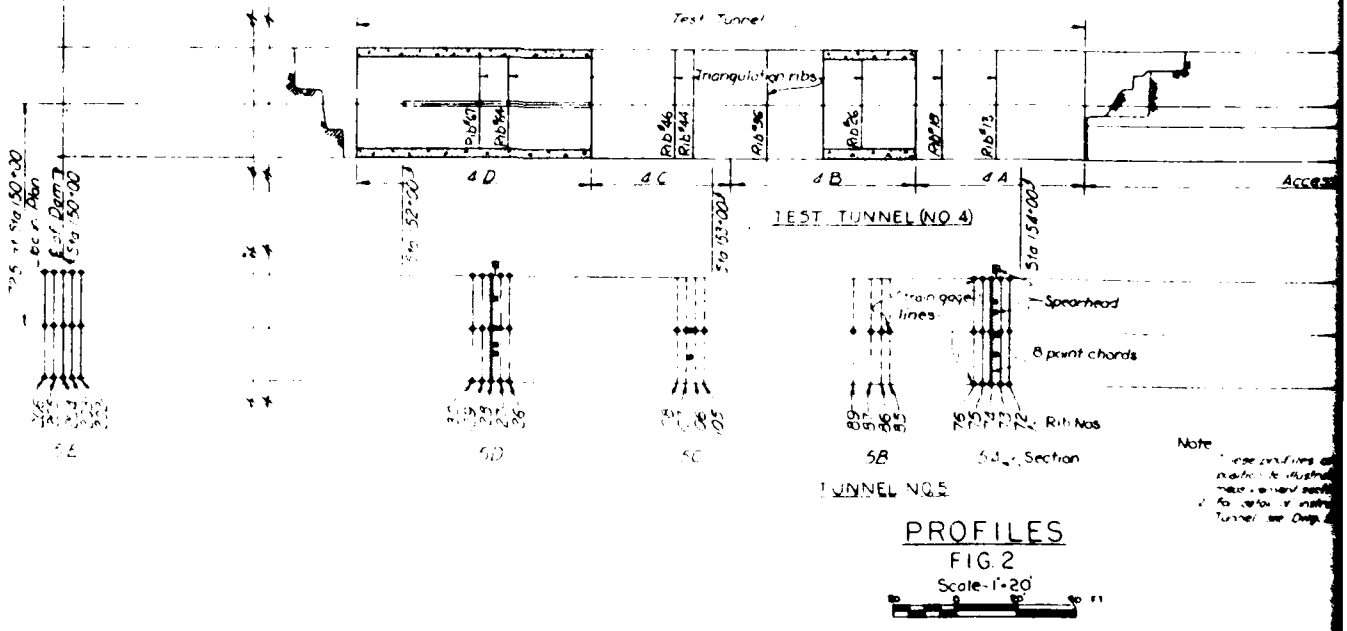
FIG. 1

Scale - 1" = 100'

Table of observation points

Tunnel	2									5																												7				
Section	2B		2E							2F			5A				5B				5C			5D					5E							7E					
	77	78	66	67	68	69	70	245	246	72	73	74	75	76	85	86	87	89	105	106	107	108	126	127	128	129	130	202	203	204	205	206	65	66	67	68	69					
Tape Measurements Hor.	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×					
Tape Measurements Vert.	×	×	×	×	×	×	×	×	×	×	×	×	×	×											×	×	×	×	×	×	×	×	×	×	×	×	×					
Tape Measurements 8 Point Chords												×													×																	
Strain Gage Observations Hor. 3,7,9	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×					
Strain Gage Observations Vert. 6&12	×	×	×	×	×	×	×	×	×	×	×	×	×	×											×	×	×	×	×	×	×	×	×	×	×	×	×					
Strain Gage Observations 12 pts.												×													×																	
Spearheads											*	*								*	*			*	*																	
Rib size	8WF48		10WF72					8WF48		10WF72					10WF72				10WF72				10WF72					10WF72					10WF49									
Rib Spacing	4' oc		3'-5" o.c.					4' oc		3' o.c.					3' o.c.				3' o.c.				3' o.c.					3' o.c.					4' o.c.									

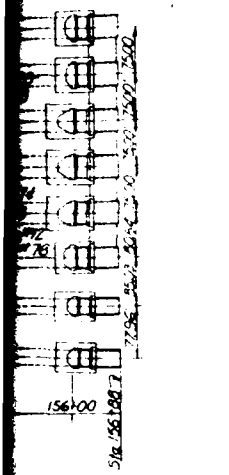
FIG 4

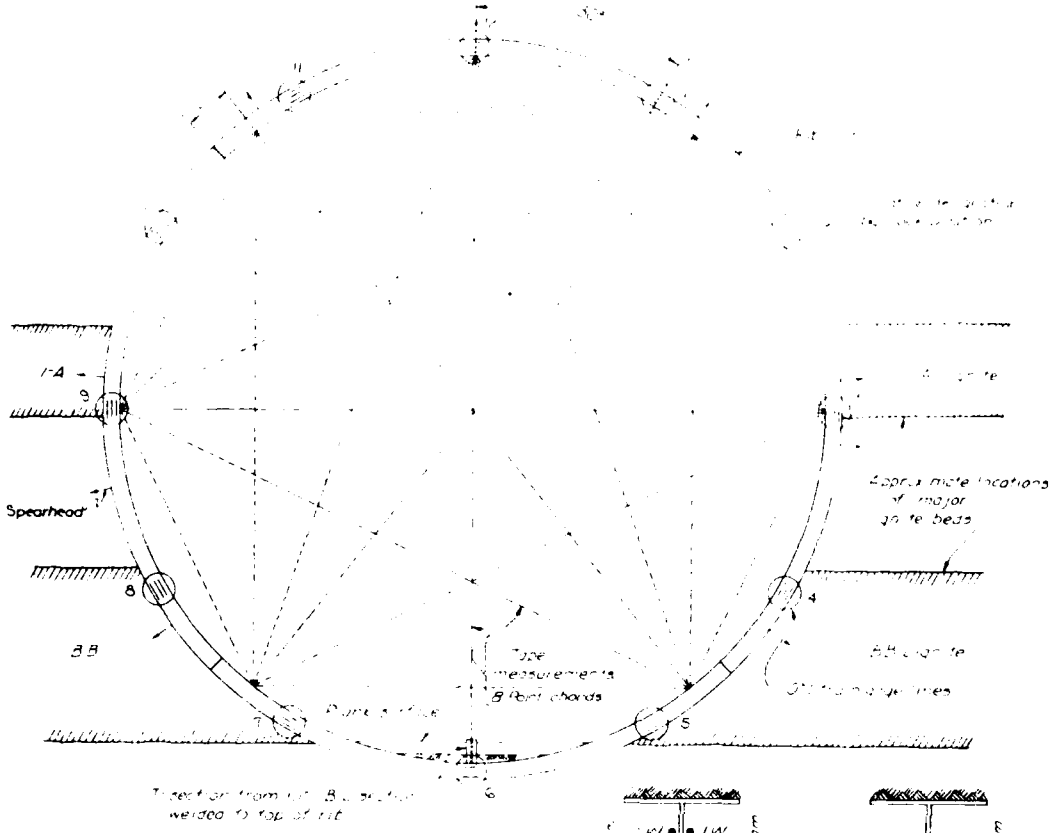


PROFILES

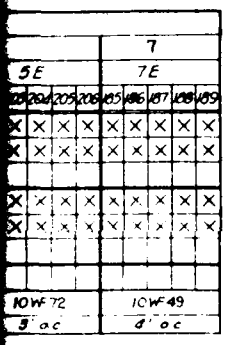
FIG. 2

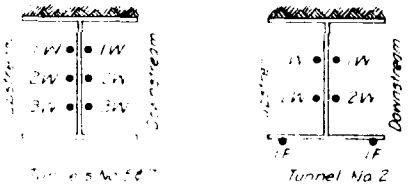
Scale - 1" = 20'



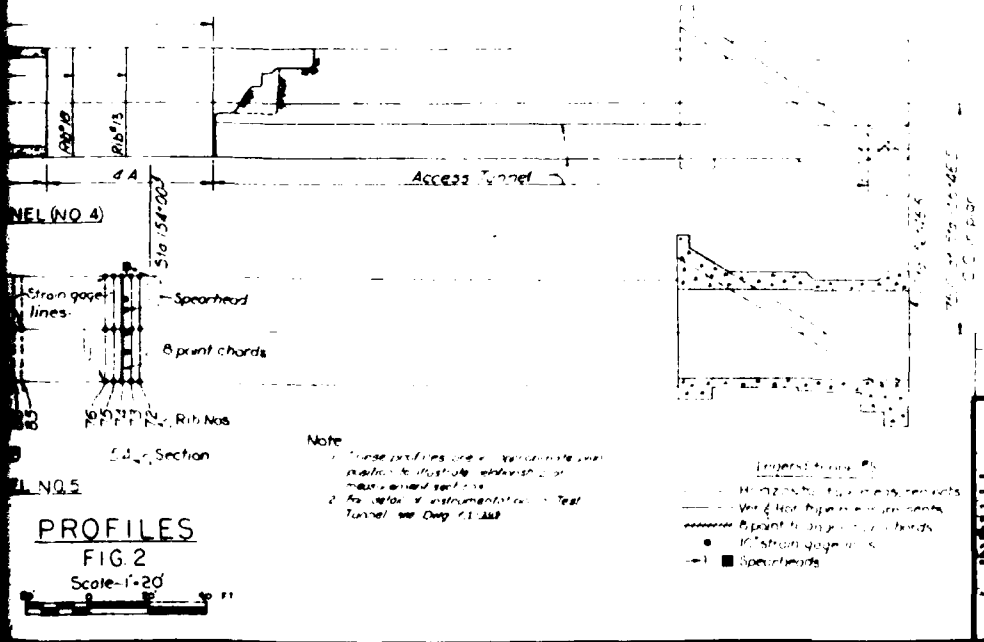


INSTRUMENTATION DETAIL
FIG. 3





TYPICAL LOCATIONS OF STRAIN GAGE LINES
FIG 5



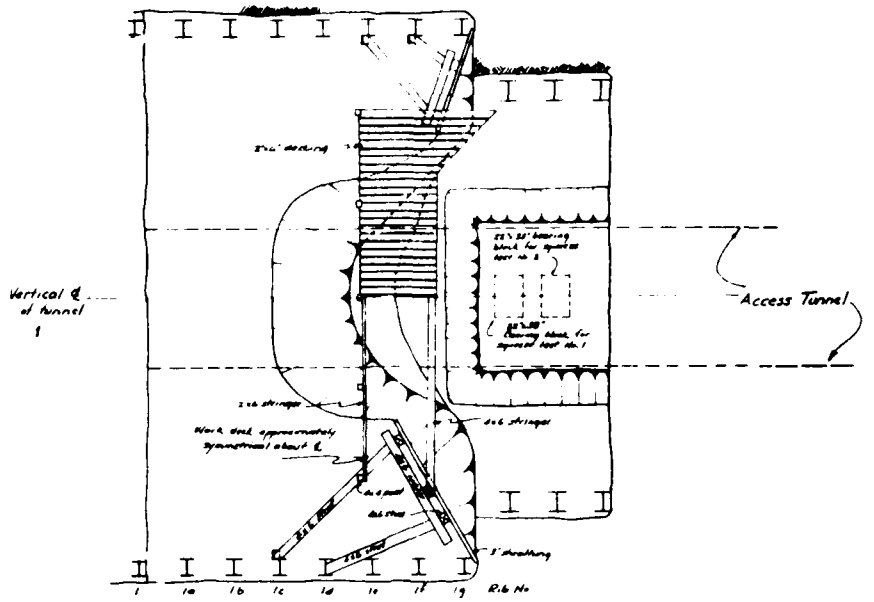
PROFILES
FIG. 2
Scale-1-20'

U. S. ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
TUNNELS
MEASUREMENTS IN RIBS
PLANS AND DETAILS

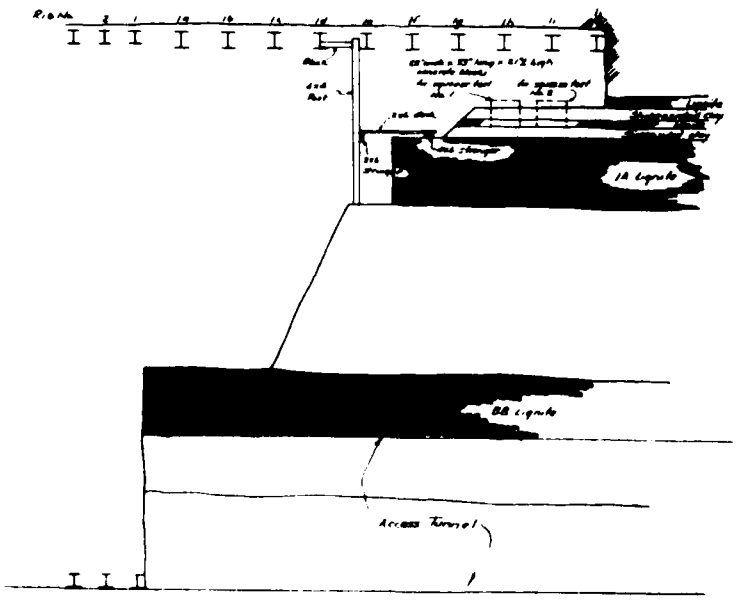
MARCH 1953

ET-210



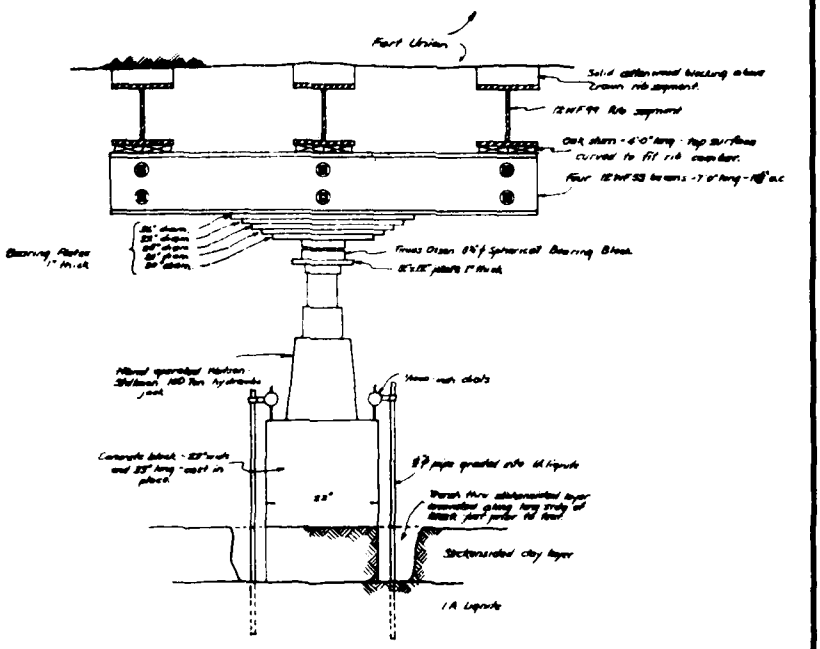
PLAN OF SQUEEZE TEST AREA

Scale - 1" = 8'-0"



LONGITUDINAL SECTION THRU SQUEEZE TEST AREA

Scale - 1" = 8'-0"



SQUEEZE TEST ARRANGEMENT

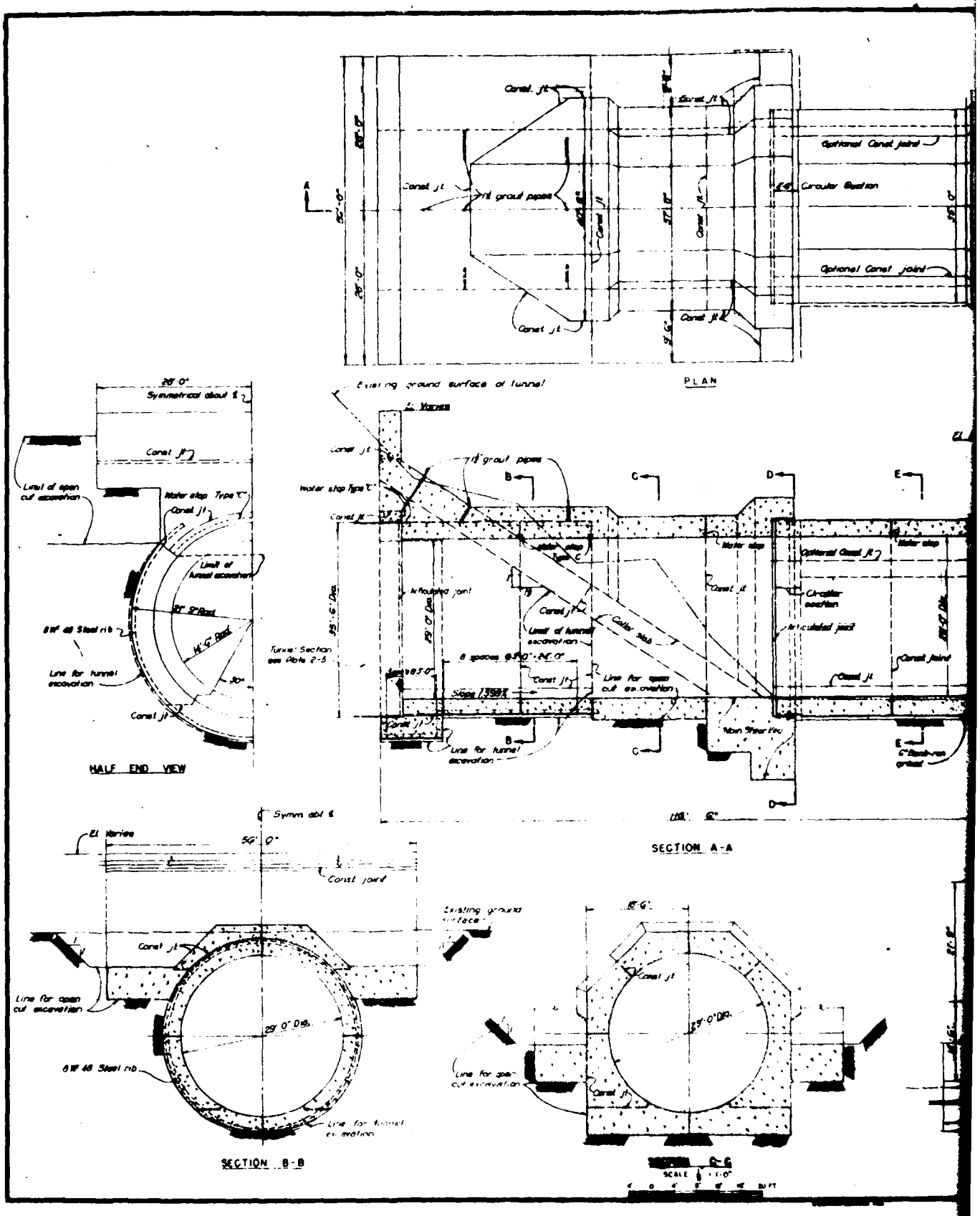
Scale - 1" = 1'-0"

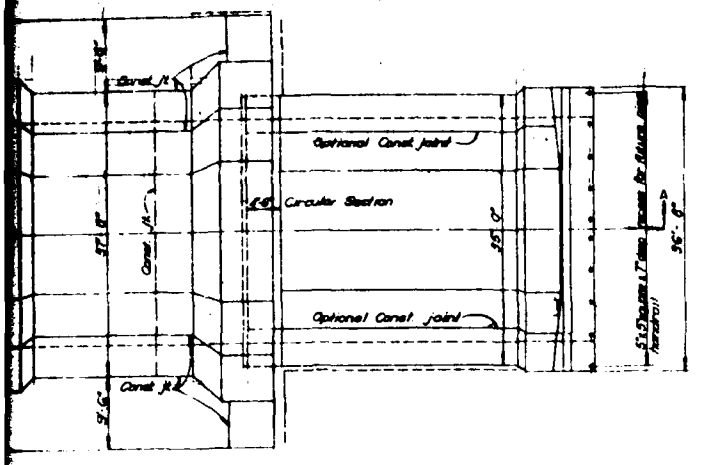
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
TEST TUNNEL
SQUEEZE TESTS
LOCATION AND ARRANGEMENT

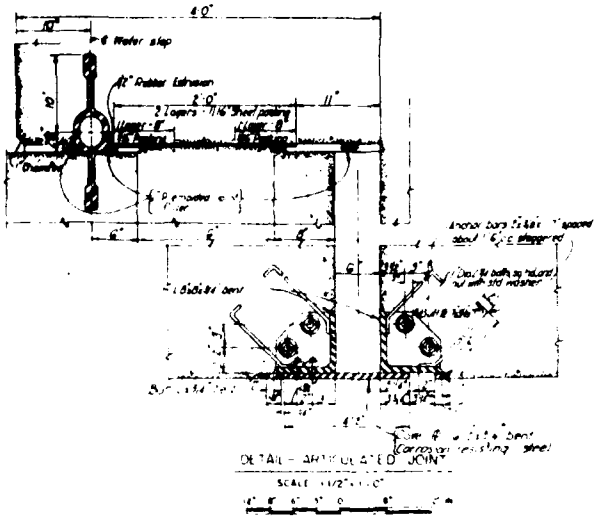
MAY 1949

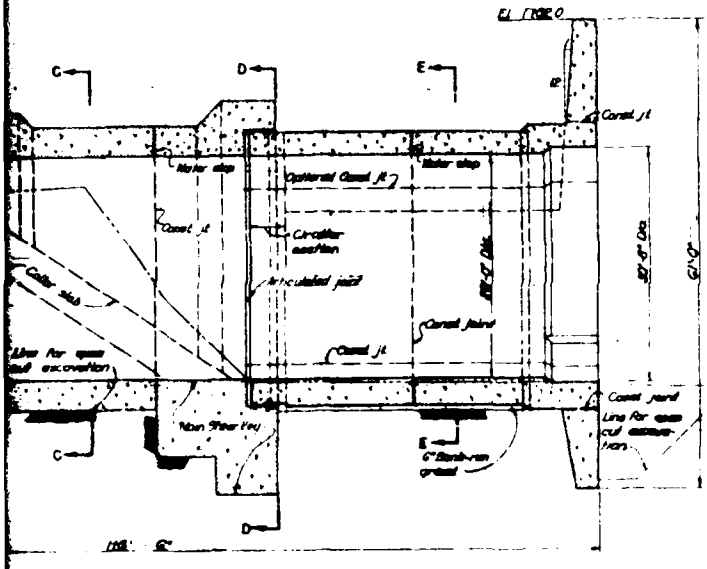
FT - 79


Const. jt
Optional Const joint
Circular Section
fill grout pipes
PLAN
Existing ground surface at tunnel
Varies
Water stop Type C
Limit of open cut excavation
Limit of tunnel excavation
Line for tunnel excavation
Line for open cut excavation
Tunnel Section see Plate 2-5
Collar stub
Articulated joint
Main Shear Key
HALF END VIEW
SECTION A-A
SECTION B-B
SECTION C-C
Symm. about ℄
El. Varies
Const joint
Existing ground surface
29'-0" Dia.
8 WF 48 Steel rib
SCALE

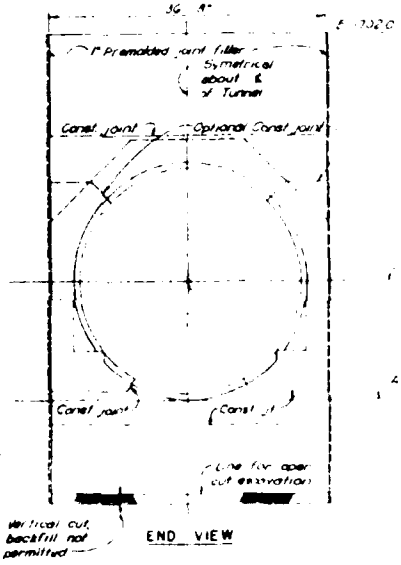


PLAN

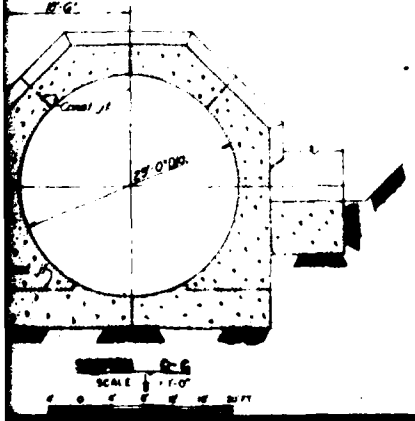




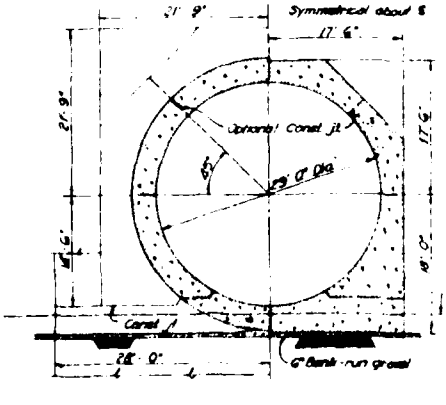
SECTION A-A



END VIEW



SECTION C-C



SECTION D-D

SECTION E-E

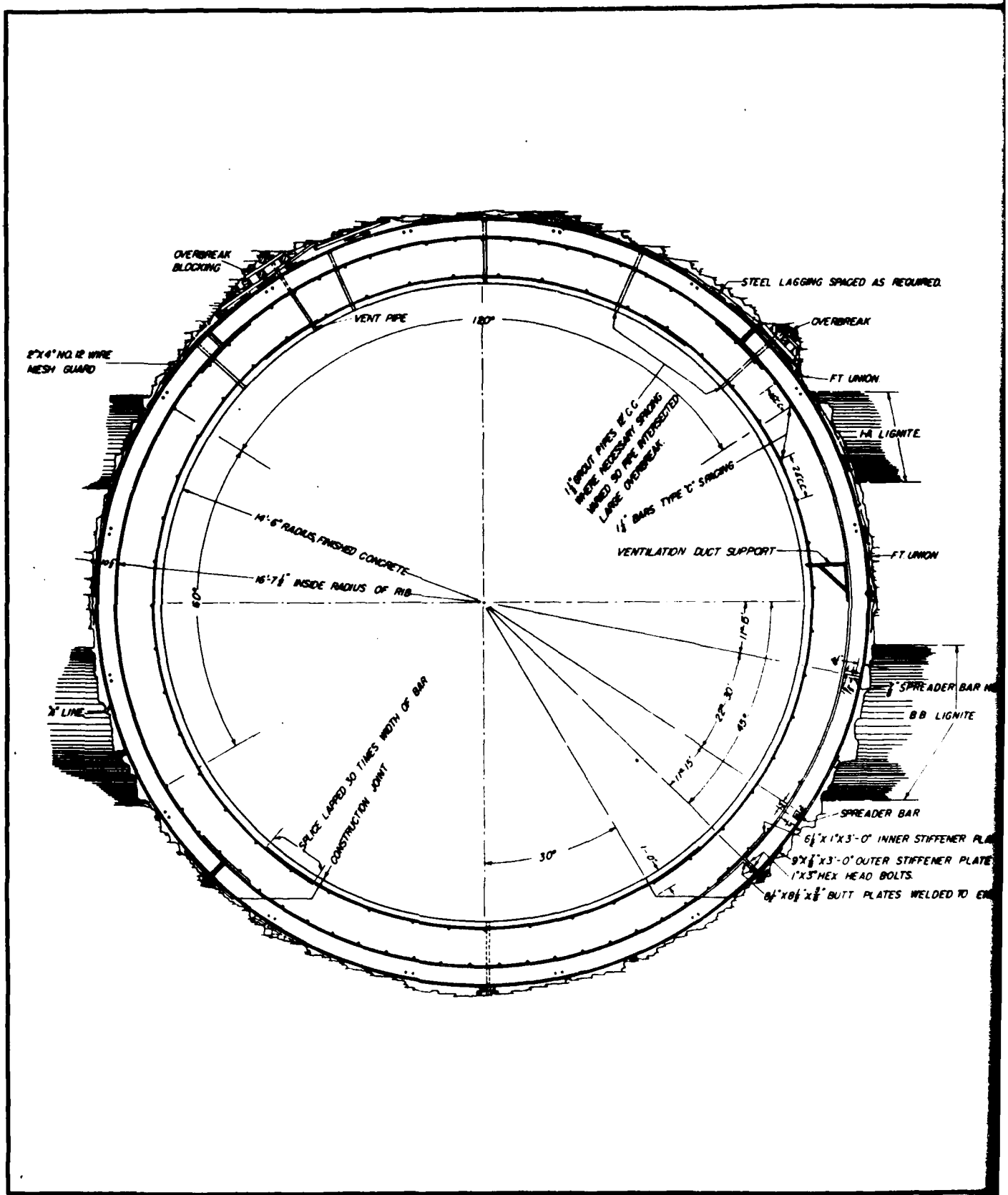
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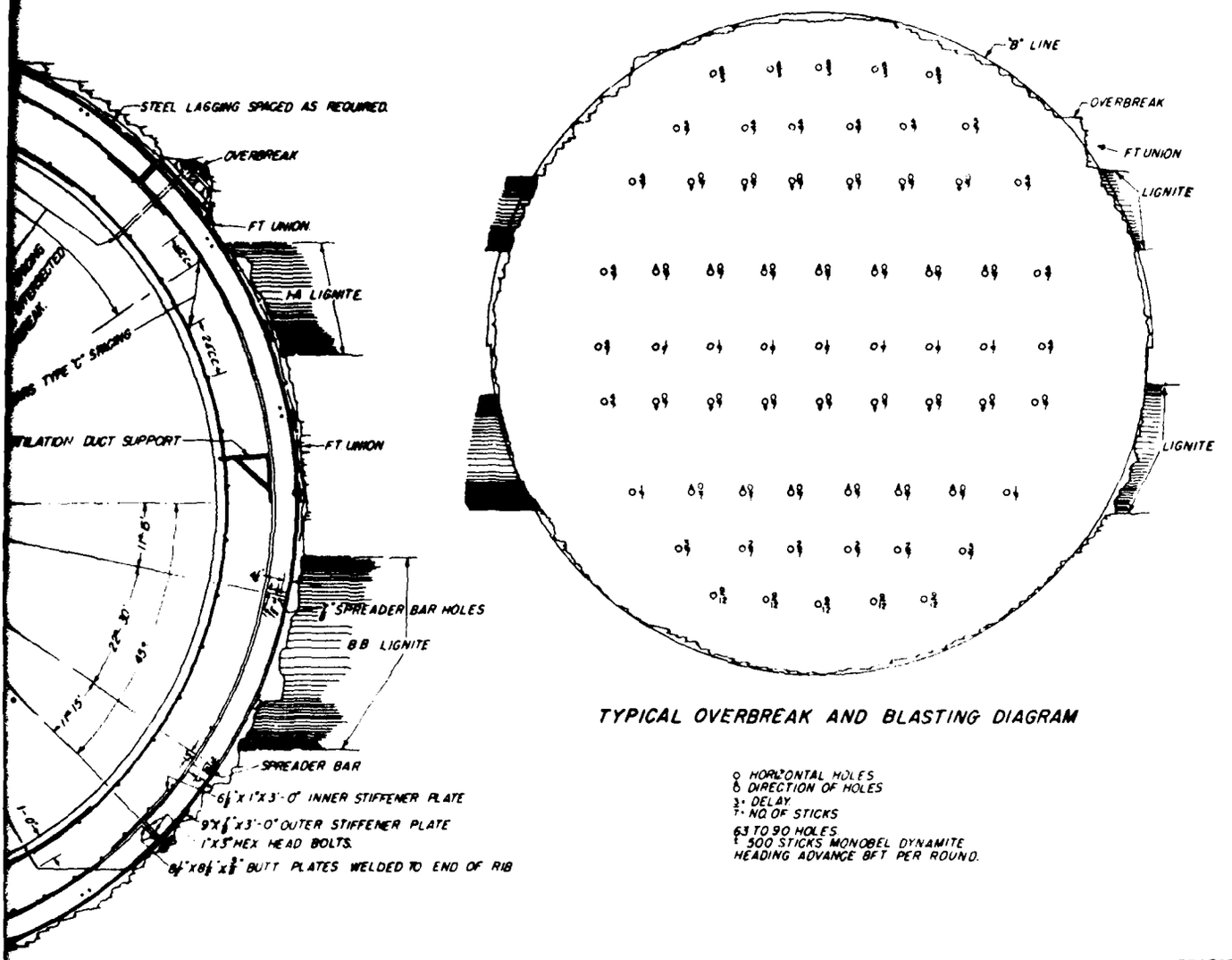
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
29 FT TUNNELS
TYPICAL DOWNSTREAM PORTALS

MARCH 1953

FT-206

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 92


OVERBREAK BLOCKING
STEEL LAGGING SPACED AS REQUIRED.
VENT PIPE
180°
OVERBREAK
2"X4" NO. 12 WIRE MESH GUARD
FT UNION
1½" GROUT PIPES 16' C.C. WHERE NECESSARY SPACING MIXED TO FIT INTERSECTED LARGE OVERBREAK.
HA LIGNITE
1½" BARS TYPE 'C' SPACING
14'-6" RADIUS FINISHED CONCRETE
VENTILATION DUCT SUPPORT
FT UNION
16'-7⅛" INSIDE RADIUS OF RIB
60°
11'-6"
22° 30'
45°
11'-15'
BB LIGNITE
SPLICE LAPPED 30 TIMES WIDTH OF BAR
CONSTRUCTION JOINT
30°
1'-0"
SPREADER BAR
6½"X 1"X 3'-0" INNER STIFFENER PL
9"X⅜"X 3'-0" OUTER STIFFENER PLATE
1"X 3" HEX HEAD BOLTS.
8½"X 8½"X⅜" BUTT PLATES WELDED TO EN



TYPICAL OVERBREAK AND BLASTING DIAGRAM

o HORIZONTAL HOLES
δ DIRECTION OF HOLES
3 DELAY
T NO. OF STICKS

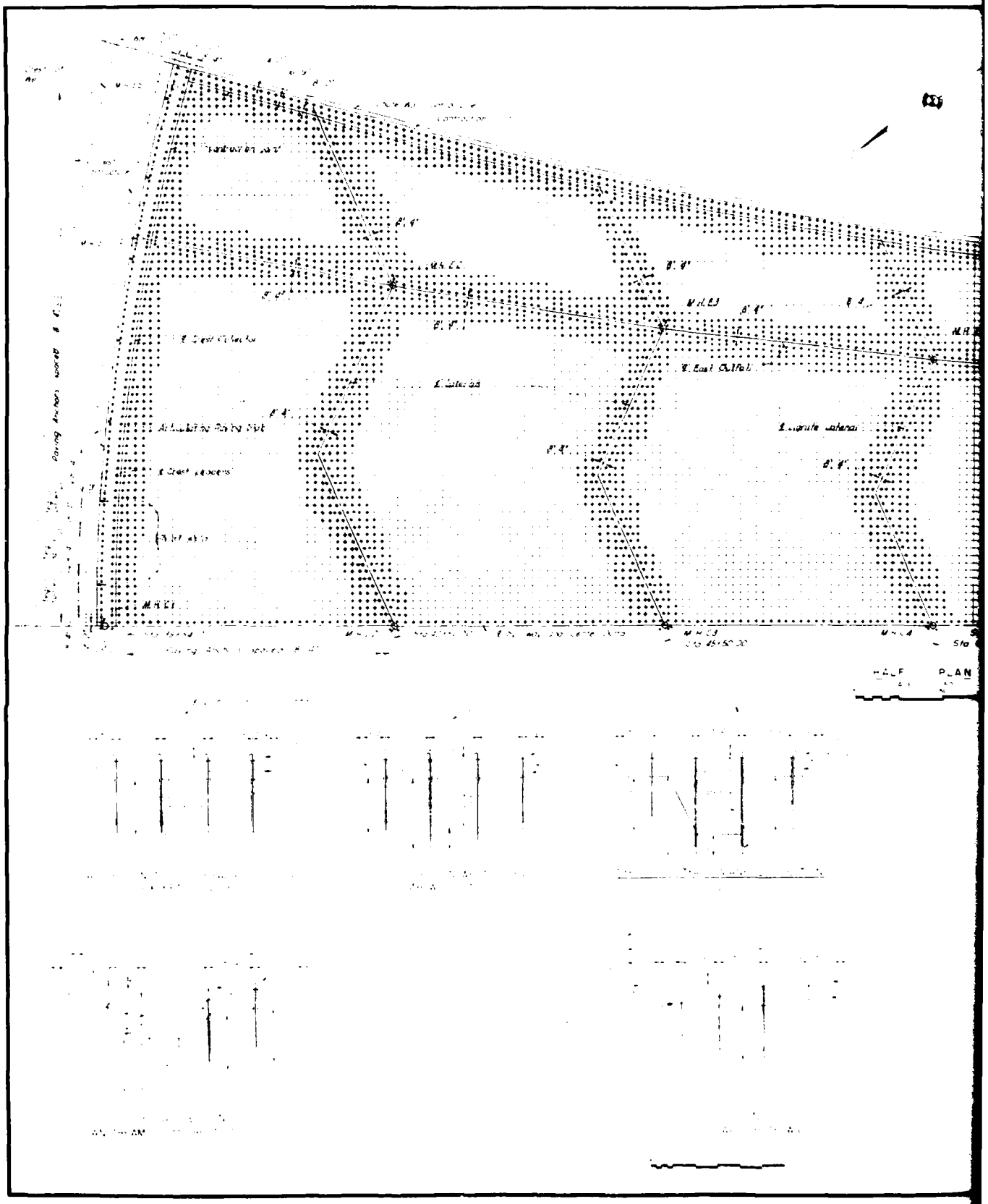
63 TO 90 HOLES
500 STICKS MONOBEL DYNAMITE
HEADING ADVANCE 8FT PER ROUND.

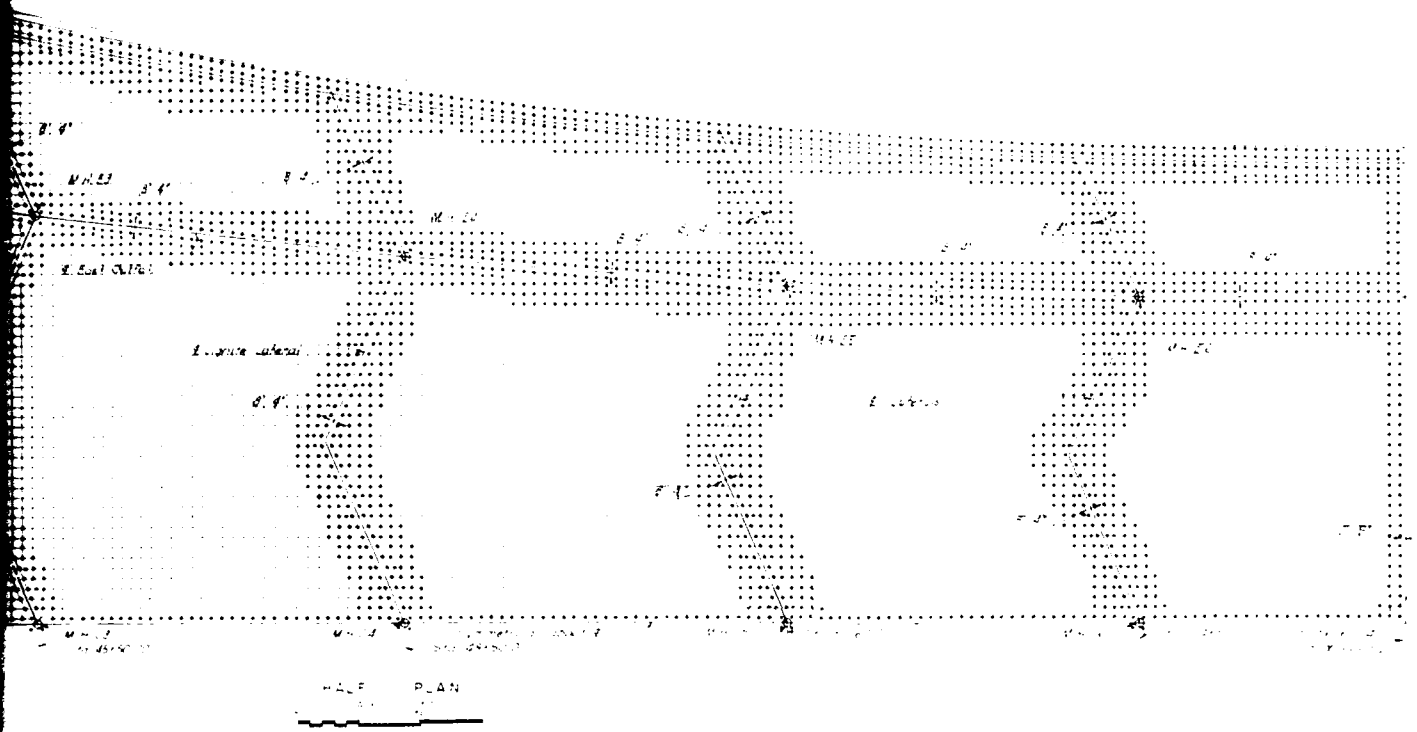
U S ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
29 FT TUNNELS
CONSTRUCTION CROSS SECTIONS

MARCH 1953

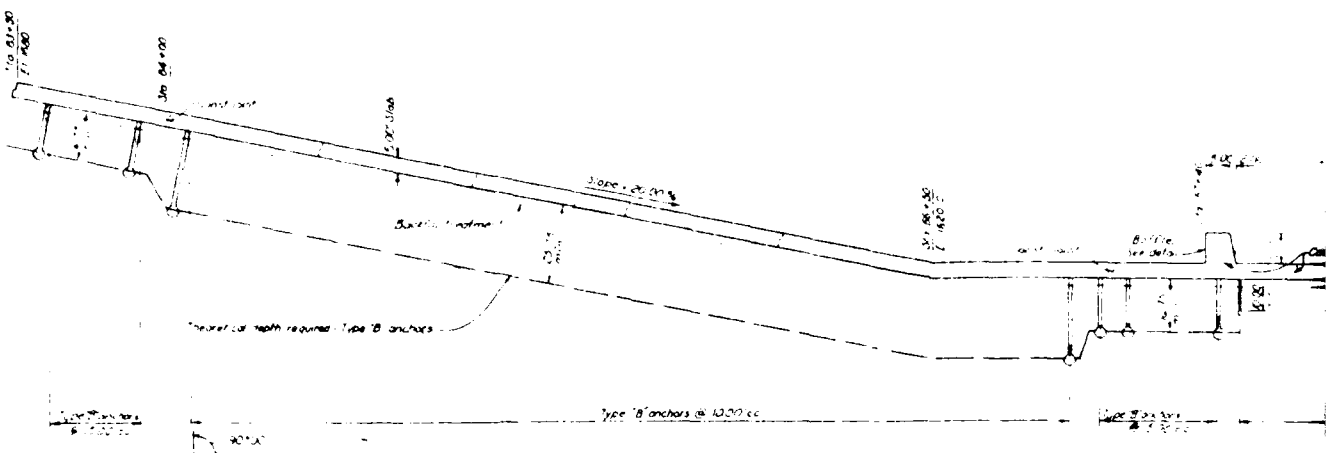
FT-20A

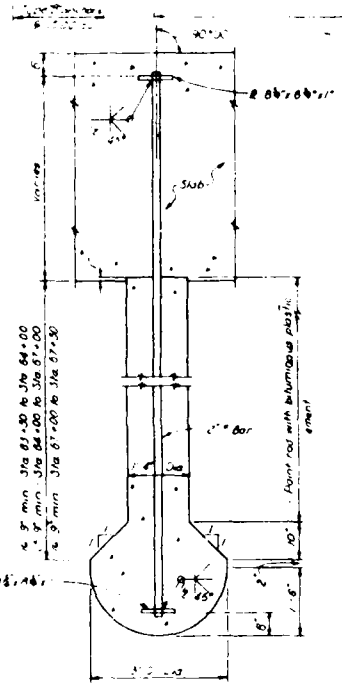




HALF PLAN

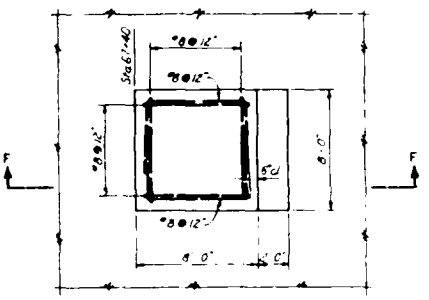
MISSOURI RIVER
GARRISON DAM AND RESERVOIR





TYPE "B" ANCHOR

SCALE $\frac{3}{4}$" = 1'-0"

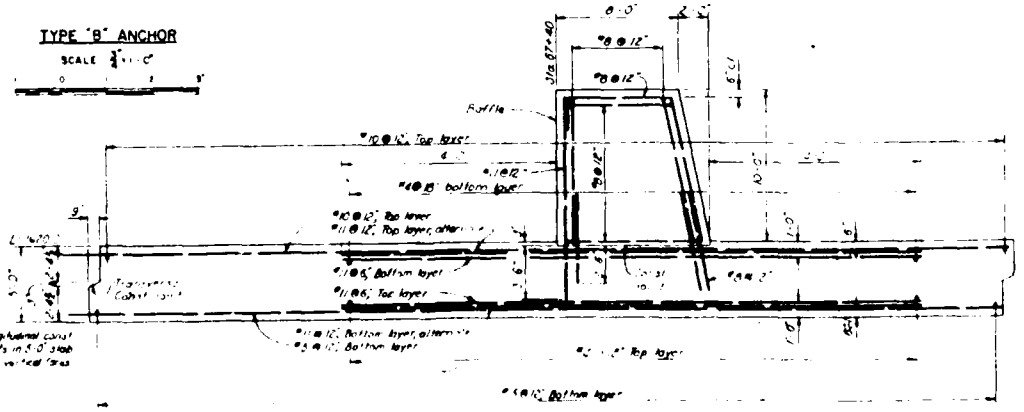


PLAN - BAFFLE

SCALE $\frac{1}{4}$" = 1'-0"

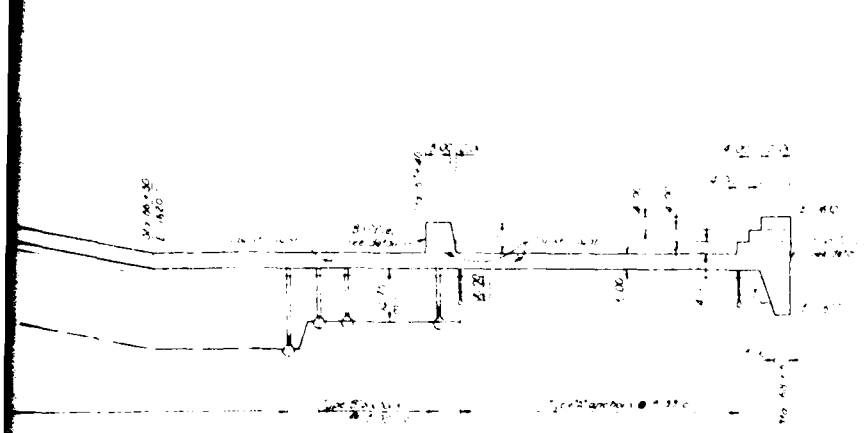
SECTION AT ℄

SCALE 1" = 20'



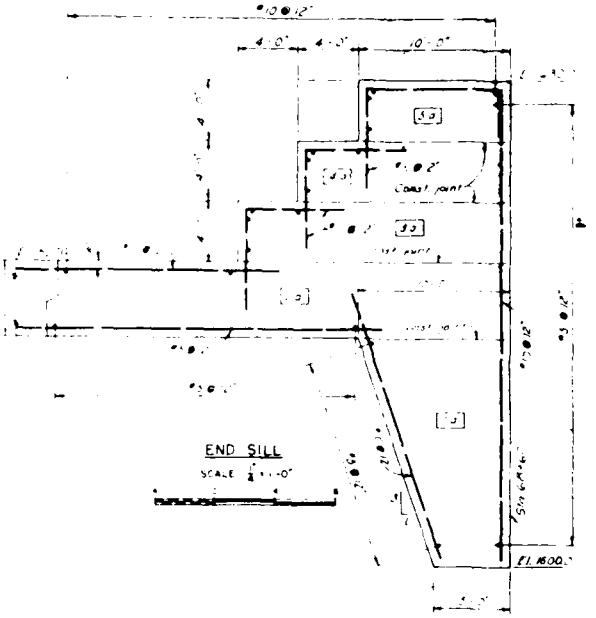
SECTION F F

SCALE $\frac{1}{4}$" = 1'-0"



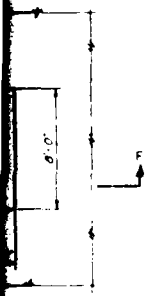
SECTION AT ℄

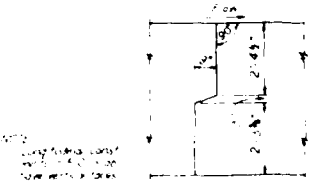
SCALE 1" = 20'



END SILL

SCALE 1/4" = 1'-0"



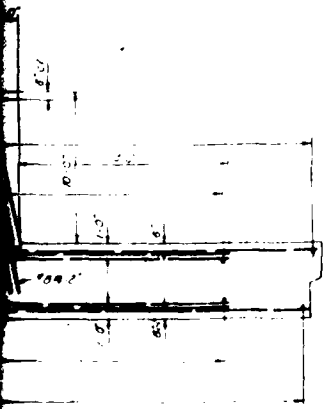


TRANSVERSE CONST. JOINT
INCLINED SLAB

SCALE 1" = 1'-0"

NOTES

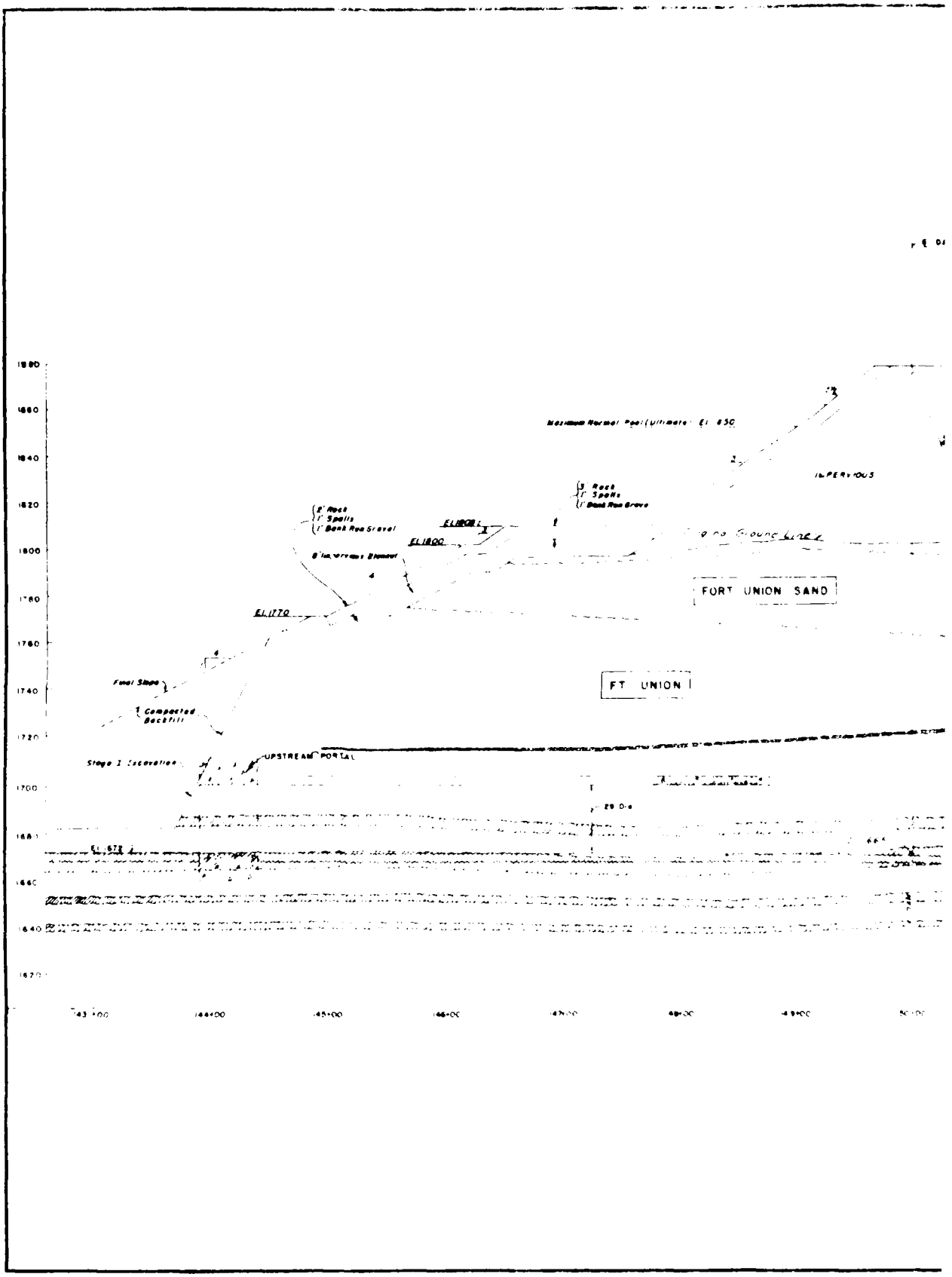
1. Bar ... or extend dowels 30 bar diameter unless otherwise noted.



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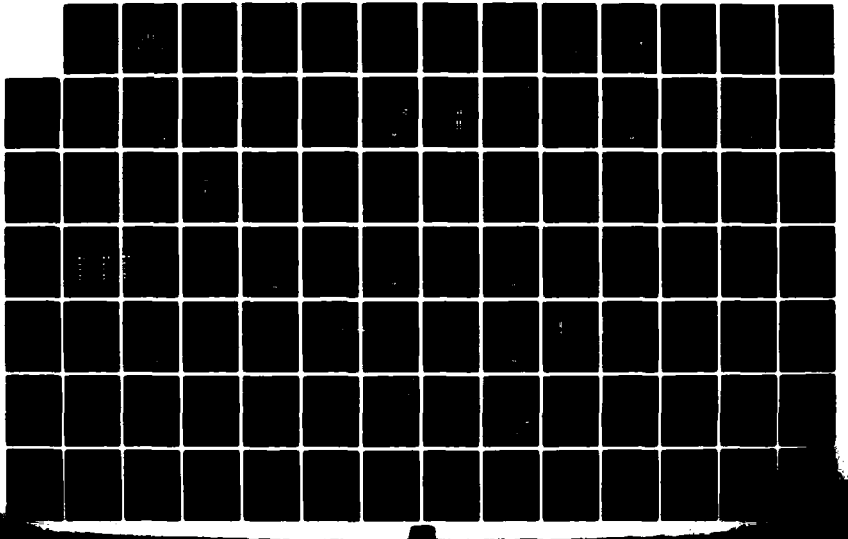
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
CHUTE AND STILLING BASIN SLAB
CONCRETE AND REINFORCEMENT
SLAB AND ANCHOR DETAILS
STA 63+50 TO STA 68+60

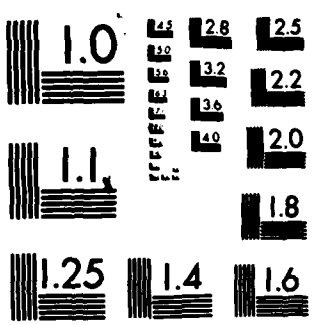
AUGUST 1954


1880
1860
1840
1820
1800
1780
1760
1740
1720
1700
1680
1660
1640
1620
Maximum Normal Pool (Ultimate) El. 850
IMPERVIOUS
Rock
Spalls
Bank Run Gravel
EL.1800
EL.1770
Final Slope
Compacted Backfill
Stage 1 Excavation
UPSTREAM PORTAL
FORT UNION SAND
FT UNION
EL. 678
143+00
144+00
145+00
146+00
147+00
148+00
149+00

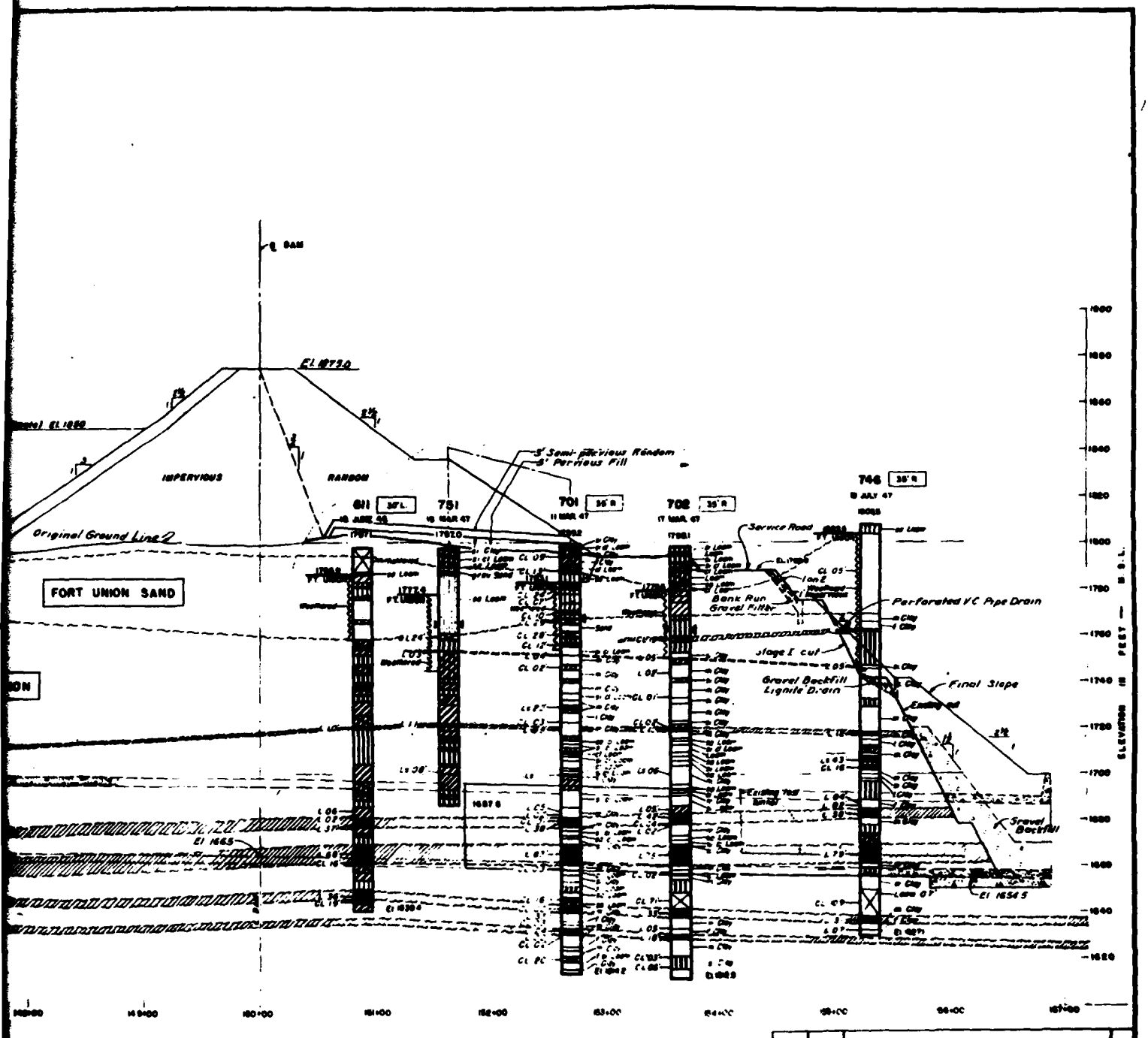
AD-A140 035 CONSTRUCTION FOUNDATION REPORT MISSOURI RIVER GARRISON DAM LAKE SAKAKAWEA VOLUME 2 DRAWINGS(U) ARMY ENGINEER DISTRICT OMAHA NE NOV 83 3/4

UNCLASSIFIED F/G 13/13 NL





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

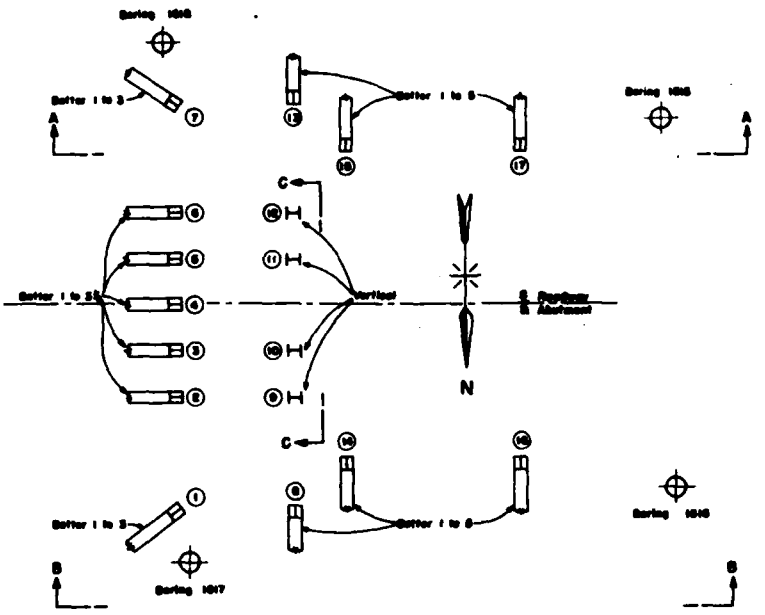


MISSOURI RIVER

GARRISON DAM AND RESERVOIR
FOUNDATION PROFILE
TUNNELS

MAY 1948

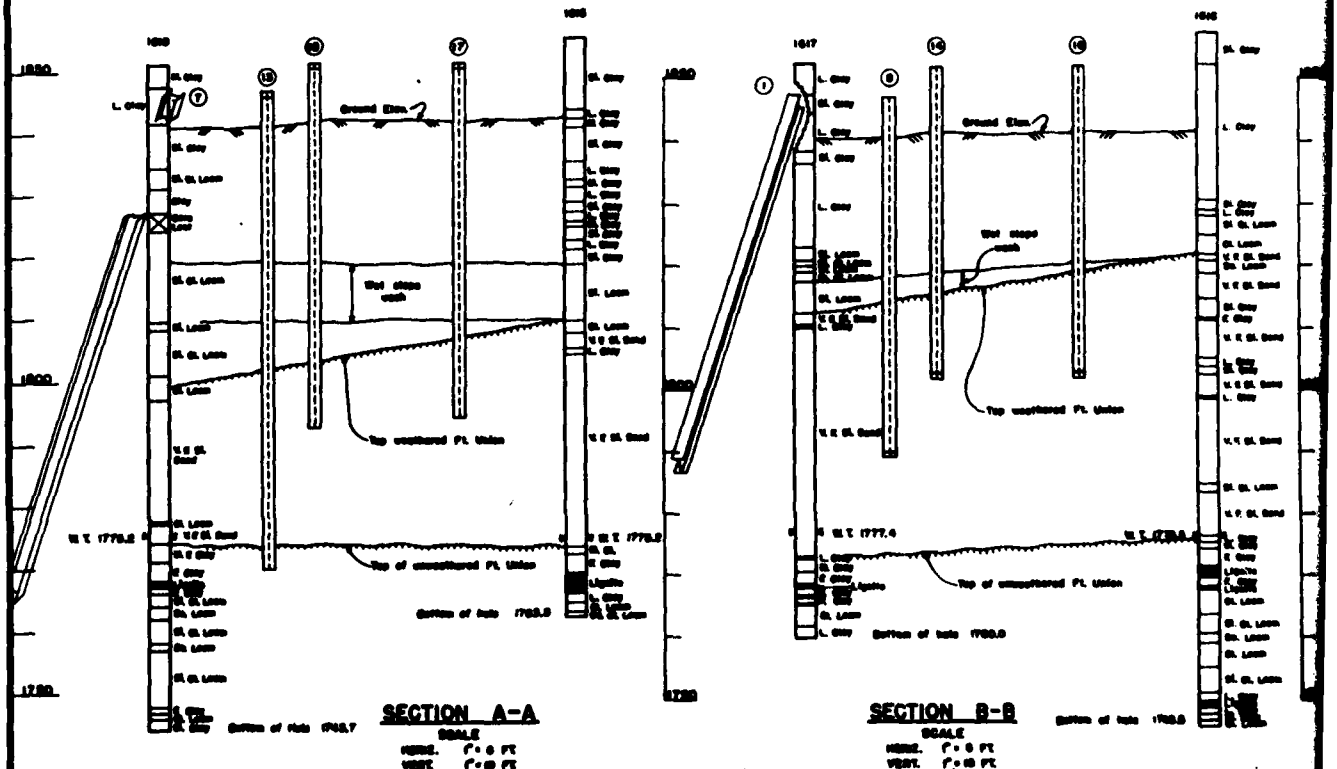
SEX- 9/34



PLAN

SCALE - 1"=10'

PILE NO.	DATE DRIVEN 1953	NO. OF SPLICES	LENGTH (in Feet) OVERALL	OUT-OFF	IN PLACE	BATTER	ELEVATION OUT-OFF	TIP	GROUND
1	23, 24, 29 & 30 AUG.	2	72.0	9.0	62.1	1 to 3	1045.8	1727.0	1060.7
2	22, 23 & 24 AUG.	2	80.2	5.1	75.1	1 to 3½	1045.6	1774.5	1060.8
3	22, 23, 24 & 29 AUG.	4	91.6	3.6	88.0	1 to 3½	1045.8	1782.2	1060.8
4	22, 23, & 24 AUG.	3	84.2	3.4	80.8	1 to 3½	1045.8	1768.1	1060.8
5	22, 23, 24 & 29 AUG.	3	96.0	11.5	85.5	1 to 3½	1045.8	1766.5	1060.8
6	22, 23 & 27 AUG. & SEPT.	3	86.8	1.8	85.0	1 to 3½	1044.8	1765.1	1060.7
7	23, 27 & 30 AUG.	3	98.8	4.6	94.2	1 to 3	1045.8	1765.9	1061.2
8	23, 29 & 30 AUG.	1	80.2	1.8	86.3	1 to 6	1045.8	1768.8	1061.0
9	20, 21 & 30 AUG.	1	80.1	5.4	86.7	Vertical	1045.8	1760.1	1061.3
10	21, 22, 24 & 30 AUG.	2	70.0	8.1	61.9	Vertical	1045.8	1764.9	1061.4
11	21, 22, 23 & 24 AUG. & SEPT.	2	75.0	14.3	60.7	Vertical	1045.8	1766.1	1061.0
12	20, 23, & 31 AUG. & 6 & 7 SEPT.	2	75.2	15.3	60.9	Vertical	1045.8	1765.9	1062.0
13	23, 27 & 30 AUG.	2	80.0	2.3	77.7	1 to 6	1045.8	1770.5	1061.8
14	29 & 31 AUG. & SEPT.	1	90.0	10.0	80.0	1 to 6	1061.3	1802.3	1061.7
15	30 AUG. & SEPT.	1	90.0	1.2	88.8	1 to 6	1061.3	1788.6	1062.0
16	30 AUG. & SEPT.	1	90.1	10.0	80.1	1 to 6	1061.3	1802.2	1062.0
17	6 SEPT	1	90.0	2.8	87.2	1 to 6	1061.3	1785.2	1062.0



SECTION A-A

SCALE

HORIZ. 1" = 6 FT.

VERT. 1" = 10 FT.

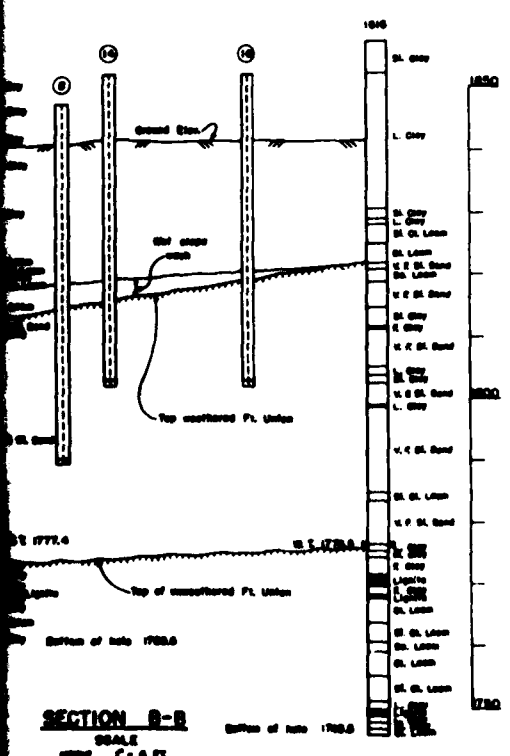
SECTION B-B

SCALE

HORIZ. 1" = 6 FT.

VERT. 1" = 10 FT.

PILE NO.	DATE DRIVEN 1951	NO. OF SPLICES	LENGTHS (in Feet) OVERALL	CUT-OFF	IN PLACE	BATTER	ELEVATION CUT-OFF	TIP	GROUND	VERTICAL PENETRATION (FEET)	BLOWS	AMOUNT INCHES	INCHES PER BLOW	BLOWS PER MINUTE	INDICATED BEARING (TONS)	DEVIATION N	S	E	W	REMARKS
1	25, 26, 28 & 29 AUG.	2	72.0	0.0	62.1	1 to 3	1845.0	1767.9	1840.7	82.8			Refusal	120	156	—	.56'	—	.89'	Ran pile hammer continuously at 120 blows per minute for 30 minutes on 29 August 1951 with no resulting movement of the pile.
2	25, 26 & 28 AUG.	2	69.2	0.1	78.1	1 to 3½	1845.0	1774.6	1840.9	66.3			Refusal	116	148	.17'	—	.08'	—	Ran pile hammer continuously at 116 blows per minute for 15 minutes on 26 August 1951 with no resulting movement of the pile.
3	25, 26, 28 & 29 AUG.	4	91.6	3.6	88.0	1 to 3½	1845.0	1762.2	1840.6	78.4			Refusal	116	149	.19'	—	.06'	—	Ran pile hammer continuously at 116 blows per minute for 15 minutes on 29 August 1951 with no resulting movement of the pile. Top 2.5 feet of pile is 14" BP 73# piling spliced to bring top to grade. No driving done on the 73# piling.
4	25, 26, 28 & 29 AUG.	3	84.2	3.4	80.8	1 to 3½	1845.0	1760.1	1840.9	71.8	100	3/16	0.0019	112	140	.38'	—	—	.41'	
5	25, 26, 28 & 29 AUG.	3	85.0	11.5	83.5	1 to 3½	1845.0	1766.5	1840.9	74.4			Refusal	120	155	.56'	—	—	.68'	Ran pile hammer continuously at 120 blows per minute for 15 minutes on 25 August 1951 with no resulting movement of the pile
6	22, 23 & 27 AUG. & SEPT.	3	86.8	1.8	85.0	1 to 3½	1845.0	1758.1	1840.7	75.6	120	¼	0.0042	120	149	.49'	—	—	.49'	Final penetration of piling made at rate of ¼ inch per 120 blows over a period of 15 minutes.
7	26, 27 & 30 AUG.	3	68.8	4.8	64.2	1 to 3	1845.0	1786.9	1841.2	74.3			Refusal	118	151	.22'	—	—	.02'	Ran pile hammer continuously at 118 blows per minute for 30 minutes on 30 August 1951 with resulting movement of pile of only 1/16 inch per 100 blows.
8	25, 29 & 30 AUG.	1	69.2	1.9	68.3	1 to 5	1845.0	1788.0	1841.0	51.4			Refusal	112	143	—	.70'	.29'	—	Ran pile hammer continuously at 112 blows per minute for 1 hour on 30 August 1951 with resulting movement of pile of only ¾ inch.
9	25, 31 & 30 AUG.	1	60.1	3.4	56.7	Vertical	1845.0	1790.1	1841.3	51.2			Refusal	116	151	—	.27'	.12'	—	Ran pile hammer continuously at 116 blows per minute for 35 minutes on 30 August 1951 with no resulting movement of the pile.
10	31, 25, 29 & 30 AUG.	2	70.0	8.1	61.9	Vertical	1845.0	1784.9	1841.4	56.5			Refusal	112	144	—	.02'	.05'	—	Ran pile hammer continuously at 112 blows per minute for 30 minutes on 30 August 1951 with no resulting movement of the pile.
11	31, 25, 25 & 30 AUG. & SEPT.	2	75.0	14.3	60.7	Vertical	1845.0	1785.1	1841.8	56.7			Refusal	120	157	0	0	0	0	Ran pile hammer continuously at 120 blows per minute for 30 minutes on 6 September 1951 with no resulting movement of the pile.
12	31, 25, 5 30 AUG. & 6, 6, 7 SEPT.	2	75.2	15.3	60.9	Vertical	1845.0	1785.9	1842.0	56.1			Refusal	120	157	.23'	—	—	.12'	Top 8.4 ft. of pile is 14" BP 73 piling. With pile hammer running at 120 blows per minute the last foot of driving was at a rate of one inch per 100 blows. The 14" BP 73 piling then started to buckle and since further penetration of the piling ceased, the driving was discontinued.
13	25, 27 & 30 AUG.	2	80.0	2.3	77.7	1 to 5	1845.0	1770.6	1841.6	71.0			Refusal	116	150	.11'	—	.04'	—	Ran pile hammer continuously at 116 blows per minute for 30 minutes on 30 August 1951 with no resulting movement of the pile.
14	30 & 31 AUG. & SEPT.	1	60.0	10.0	50.0	1 to 5	1851.3	1802.3	1841.7	39.4	30	1/16	0.0083	120	144	—	.81'	—	.22'	
15	30 AUG. & SEPT.	1	69.0	1.2	68.8	1 to 5	1851.3	1783.0	1842.6	48.2	30	1 1/8	0.0500	120	104	.06'	—	.07'	—	
16	30 AUG. & SEPT.	1	60.1	10.0	50.1	1 to 5	1851.3	1808.2	1842.0	38.8			Refusal	116	153	—	.17'	.05'	—	Ran pile hammer continuously at 118 blows per minute for 30 minutes on 5 September 1951 with resulting movement of pile of only 1/16 inch.
17	5 SEPT	1	60.0	2.8	57.2	1 to 5	1851.3	1793.2	1842.9	47.7	40	1	0.0250	118	120	.52'	—	—	.16'	

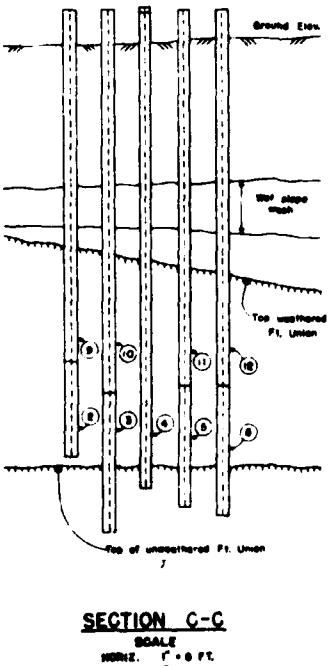


SECTION B-B

SCALE

HORIZ. 1" = 8 FT.

VERT. 1" = 10 FT.



SECTION C-C

SCALE

HORIZ. 1" = 8 FT.

VERT. 1" = 10 FT.

PILE DESIGN DATA

McKiernan-Terry 10-B-3 Pile Hammer

ENGINEERING NEWS FORMULA

Bearing Capacity = $\frac{2 \cdot 1 E \cdot (F')}{S + 0.1}$

S = indicated penetration in inches per blow for last 20 blows

Strokes per minute	90	95	100	105	110	115	120
E = Ft. lbs. energy per blow	6,930 lbs. anvil + 10,000 lbs. ram = 16,930						

Batter of pile	1 to 3	1 to 3½	1 to 5	Vert.
F' = Ft. lbs. energy loss per blow	244	193	98	0

GENERAL NOTES:

Used McKiernan-Terry 10-B-3 double-acting pile hammer on all piling.
All piling furnished was in 60-foot lengths except the 73# piling which was in 20 ft. lengths.
The first splice on each pile was made after driving the initial 60 ft. or 20 ft. sections.
Piles 1 thru 13 are 14 BP 117# piles.
Piles 14 thru 17 are 14 BP 73# piles.
20-inch diameter pilot holes were drilled 60 ft. deep for piles 1 thru 13, 15 ft. for pile 14, and 10 ft. for piles 15 thru 17.
Upon completion of driving operations these holes were back filled with sand.
All elevations are to ℄ of piling.
Deviations measured with respect to ℄ of top of bearing plates.

13	Corrected tonnage of piles under General Notes		

CORPS OF ENGINEERS, U. S. ARMY

MISSOURI RIVER

GARRISON DAM AND RESERVOIR

INTAKE SERVICE BRIDGE ABUTMENT

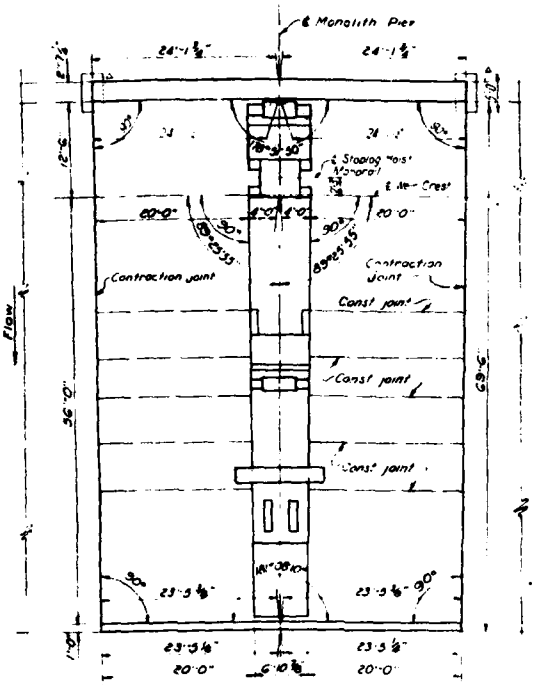
PILE DRIVING DATA

SEPTEMBER 1951

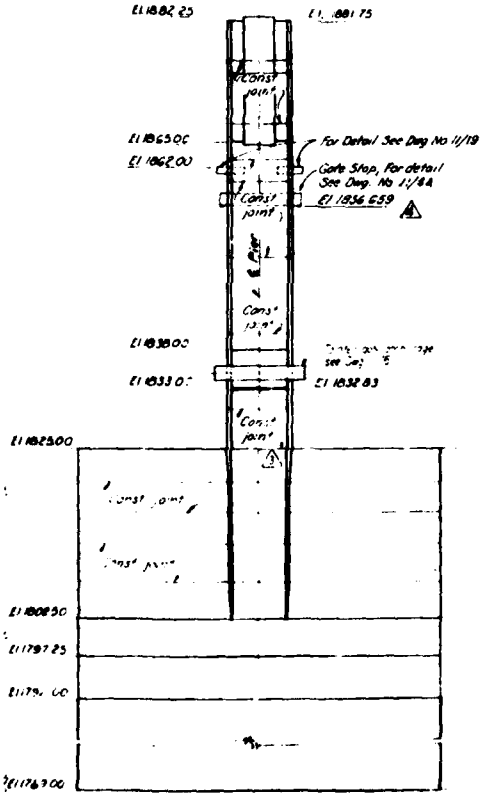
SK-24-6

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 97

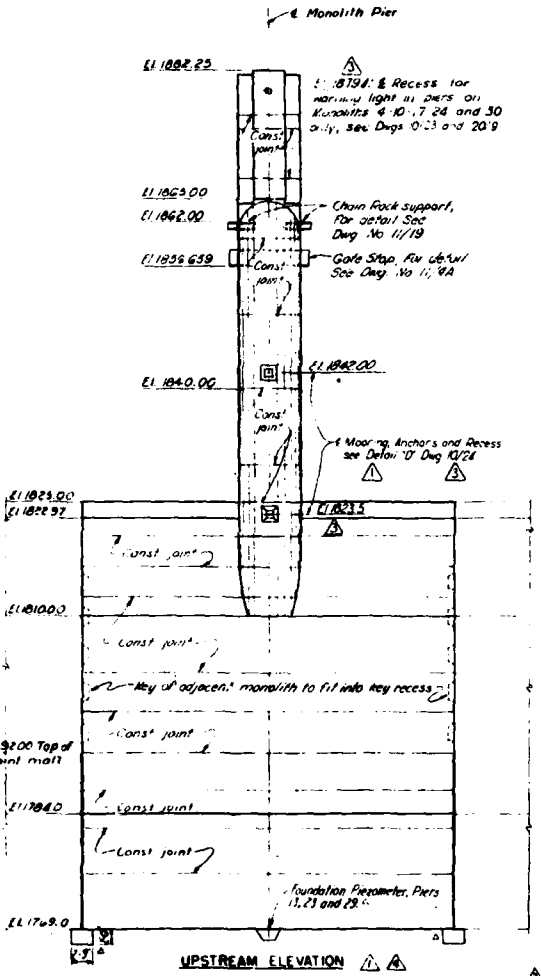
2



PLAN TYPICAL MONOLITH (BRIDGE NOT SHOWN)
SCALE 1/8"=1'-0"



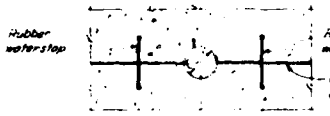
DOWNSTREAM ELEVATION



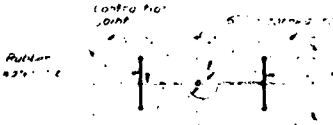
UPSTREAM ELEVATION
SCALE 1/8"=1'-0"

Extend Waterstop 1'-6" below bottom of Key into concrete as shown

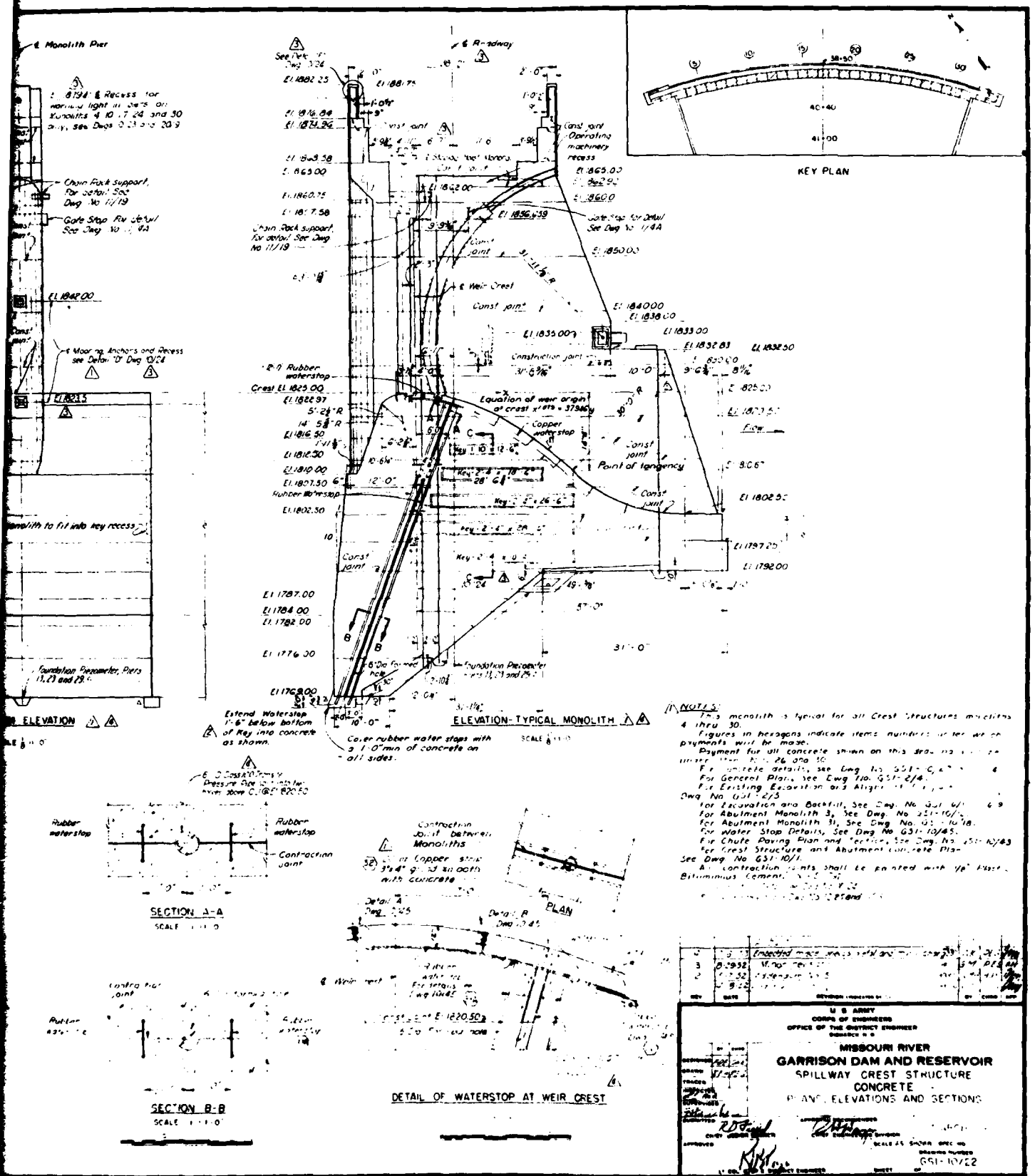
WEIR OGEE COORDINATES	
X	Y
0	0
2	0.10
4	0.36
6	0.76
8	1.31
10	1.99
12	2.81
14	3.75
16	4.80
18	5.82
20	6.96
22	8.20
24	9.33
26	10.31
28	11.80
28.56	12.44



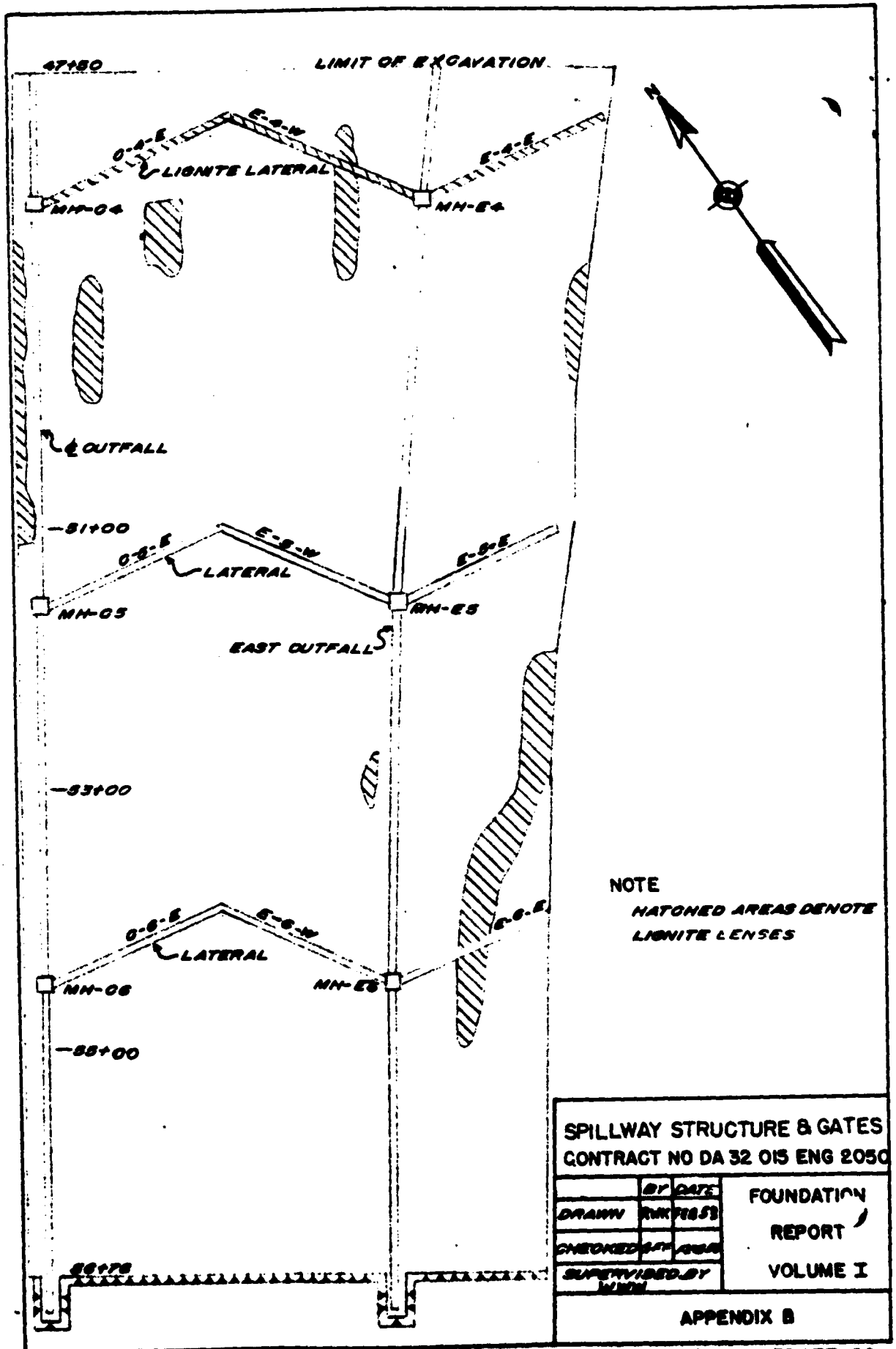
SECTION A-A
SCALE 1"=1'-0"

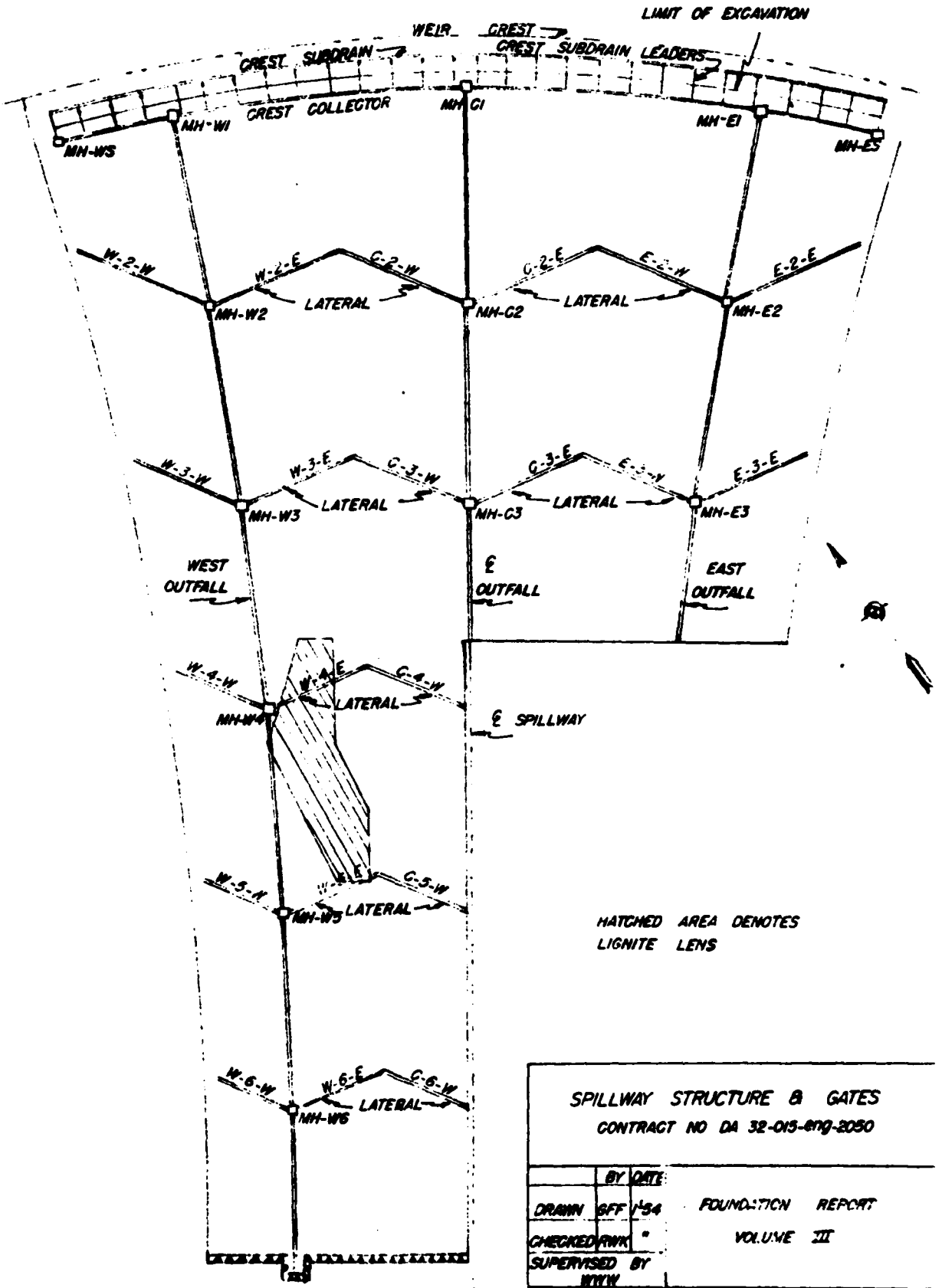


SECTION B-B
SCALE 1"=1'-0"


KEY PLAN
ELEVATION
ELEVATION- TYPICAL MONOLITH
SECTION A-A
SECTION B-B
PLAN
DETAIL OF WATERSTOP AT WEIR CREST
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SPILLWAY CREST STRUCTURE
CONCRETE
PLANS, ELEVATIONS AND SECTIONS
GSI-10/22

2


47+50
LIMIT OF EXCAVATION
E-6-W
0-6-E
LIGNITE LATERAL
E-6-E
MH-04
MH-E4
℄ OUTFALL
-51+00
0-6-E
E-6-W
LATERAL
E-6-E
MH-05
MH-E5
EAST OUTFALL
-53+00
0-6-E
E-6-W
LATERAL
E-6-E
MH-06
MH-E6
-55+00
60+78
NOTE
HATCHED AREAS DENOTE
LIGNITE LENSES
SPILLWAY STRUCTURE & GATES
CONTRACT NO DA 32 015 ENG 2050
BY
DATE
DRAWN
CHECKED
SUPERVISED BY
FOUNDATION
REPORT
VOLUME I
APPENDIX B

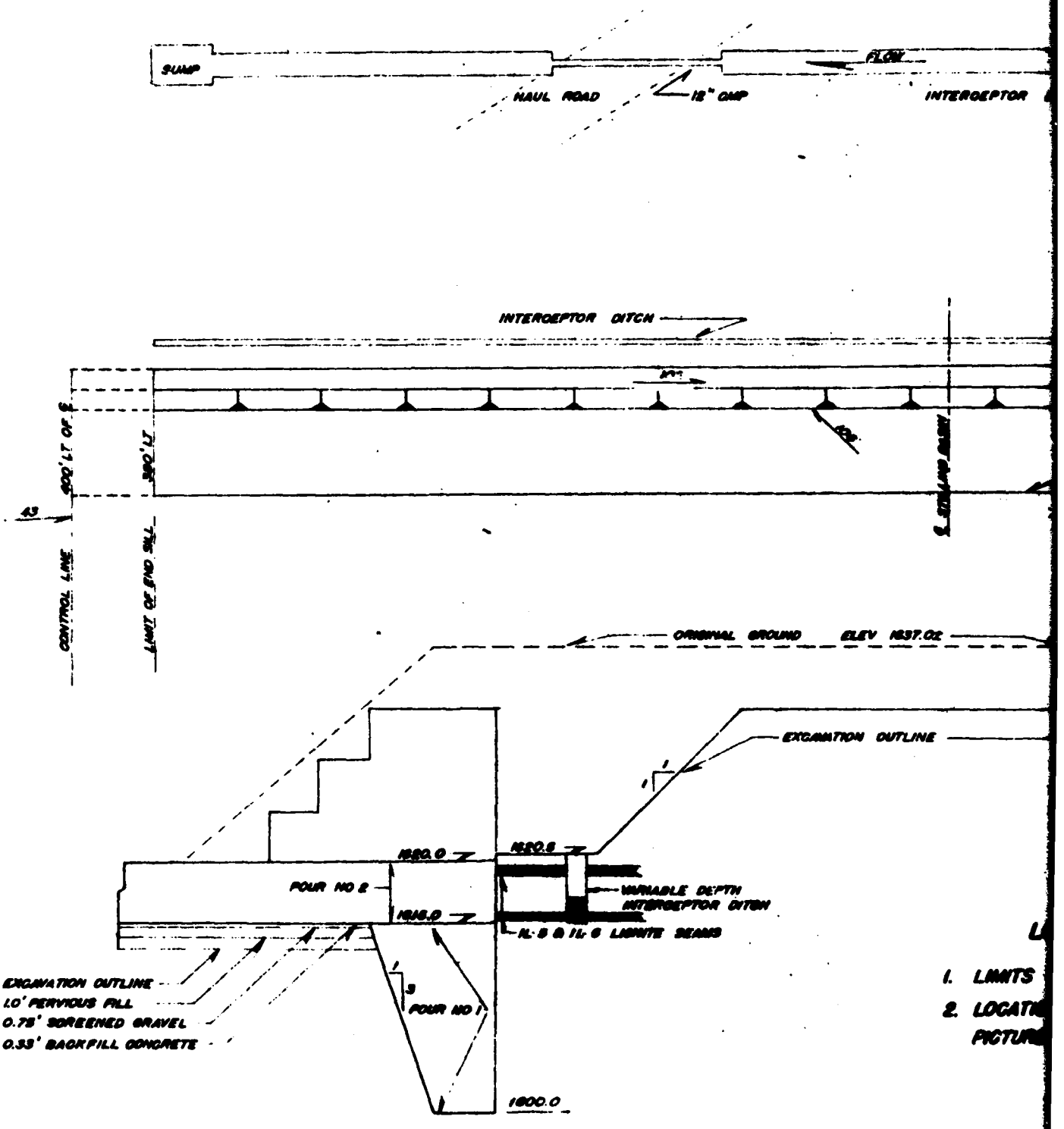


SPILLWAY STRUCTURE & GATES
CONTRACT NO DA 32-015-eng-2050

	BY	DATE
DRAWN	GFF	1-54
CHECKED	FWK	"
SUPERVISED BY WWW		

FOUNDATION REPORT
VOLUME III

APPENDIX B



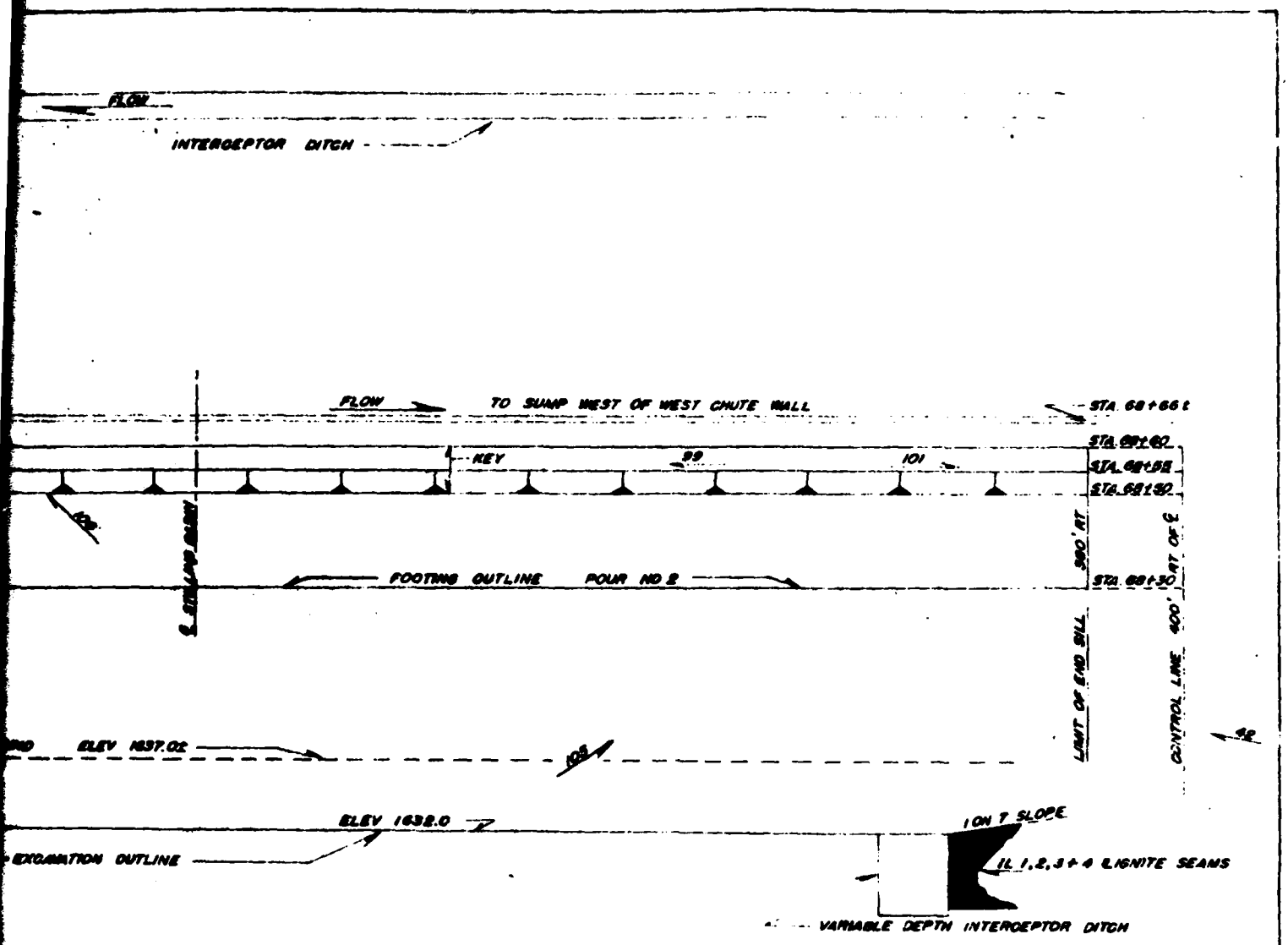
TYPICAL SECTION

END SILL

1. LIMITS

2. LOCATI

PICTUR



LOCATION SKETCH

1. LIMITS OF EXCAVATION OUTLINE
2. LOCATION AND DIRECTION OF PICTURES IN APPENDIX B

SPILLWAY STILLING BASIN

CONTRACT NO. DA-32-CIVIL-ENG-3948

	BY	DATE

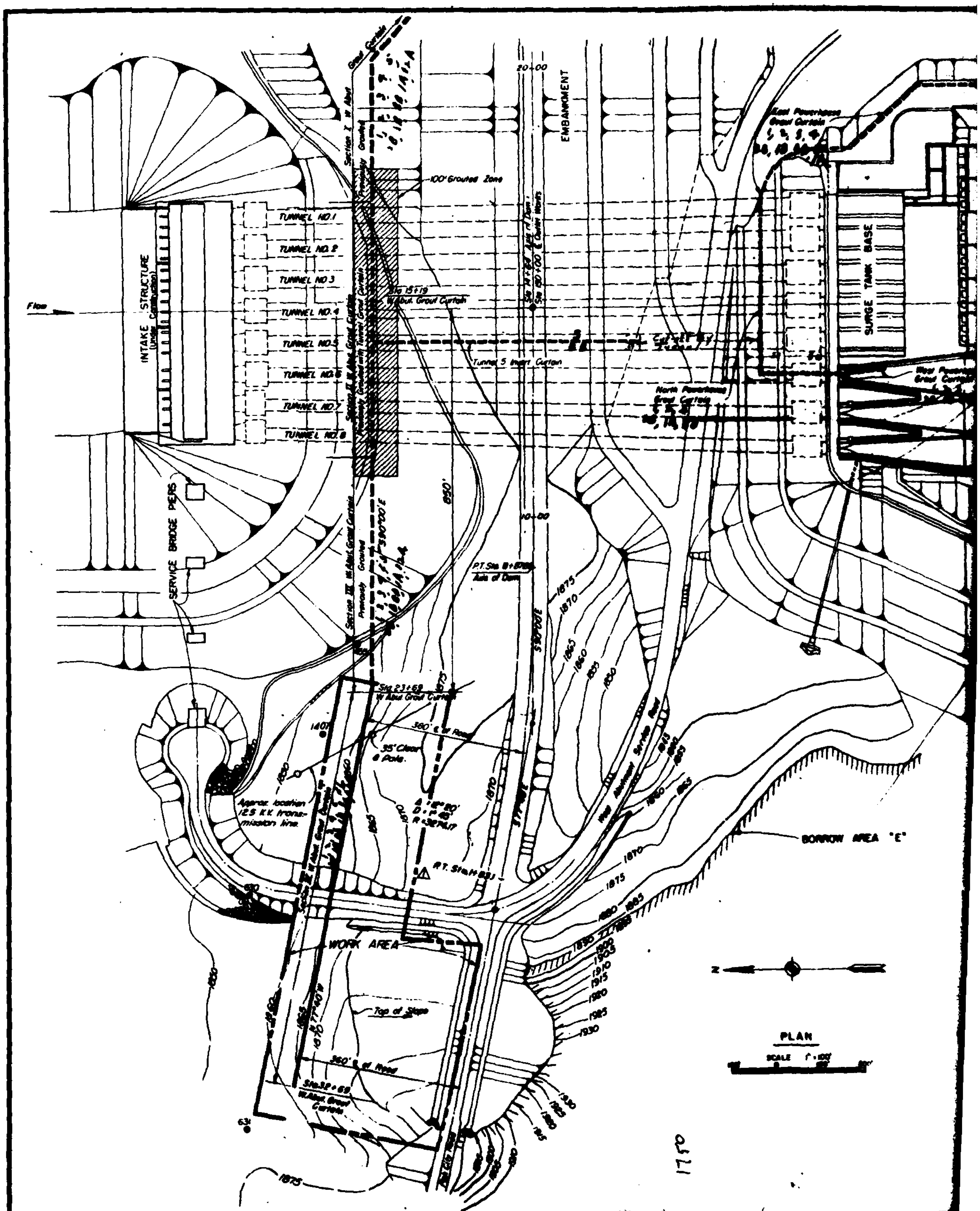
FOUNDATION REPORT

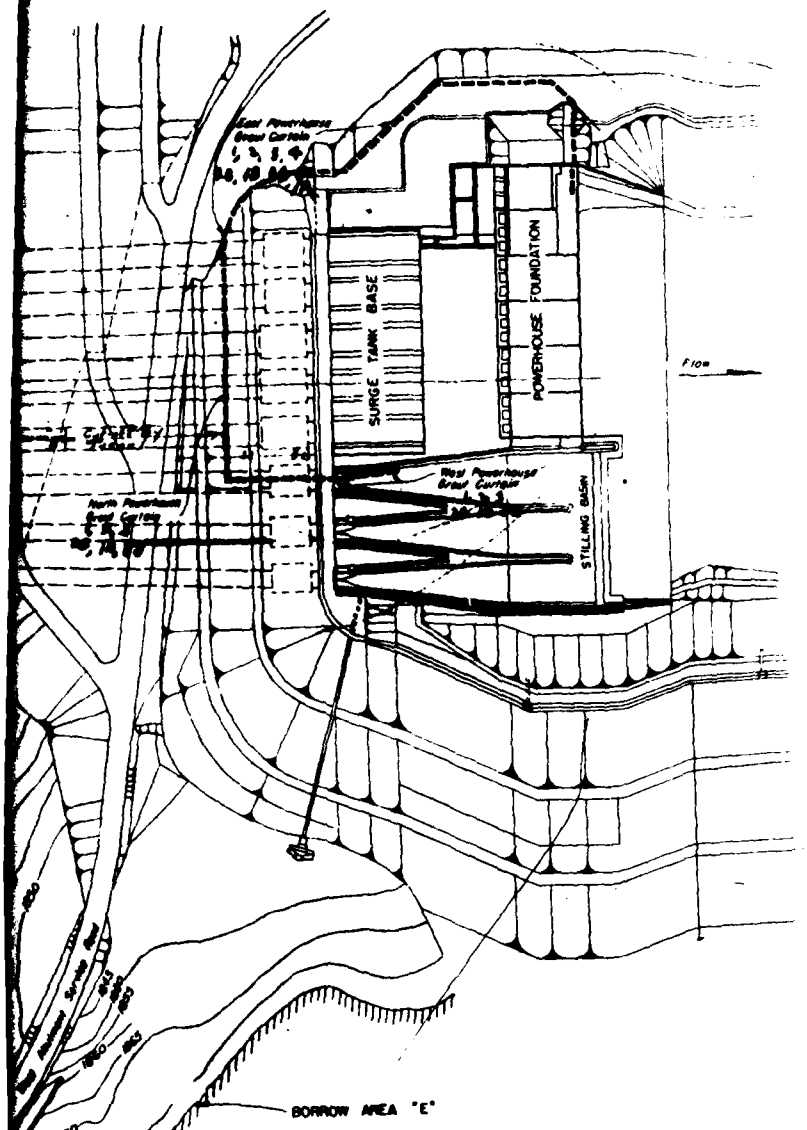
VOLUME I

SUPERVISED BY

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 101

2


INTAKE STRUCTURE
(Under Construction)
Flow
TUNNEL NO.1
TUNNEL NO.2
TUNNEL NO.3
TUNNEL NO.4
TUNNEL NO.5
TUNNEL NO.6
TUNNEL NO.7
TUNNEL NO.8
SERVICE BRIDGE PIERS
100' Grouted Zone
20+00
EMBANKMENT
Sta 15+19
W. Abut. Grout Curtain
Tunnel 5 Invert Curtain
East Powerhouse
Grout Curtain
North Powerhouse
Grout Curtain
West Powerhouse
Grout Curtain
SURGE TANK BASE
10+00
650'
Axis of Dam
Sta 23+69
W Abut Grout Curtain
360' ℄ of Road
35' Clear
℄ Pole.
Approx. location
12.5 K.V. trans-
mission line.
West Abutment Service Road
BORROW AREA "E"
WORK AREA
Top of Slope
Sta 32+69
W.Abut. Grout
Curtain
1875
PLAN
SCALE 1" = 100'



PLAN

SCALE 1"=100'



INDEX TO DRAWINGS

DESCRIPTION	DWG. NO.
PLAN	3613-6/1
STA 23+00 TO STA 27+00	3613-6/2
STA 27+00 TO STA 31+00	3613-6/3
STA 31+00 TO STA 35+00	3613-6/4
STA 35+00 TO STA 39+00	3613-6/5

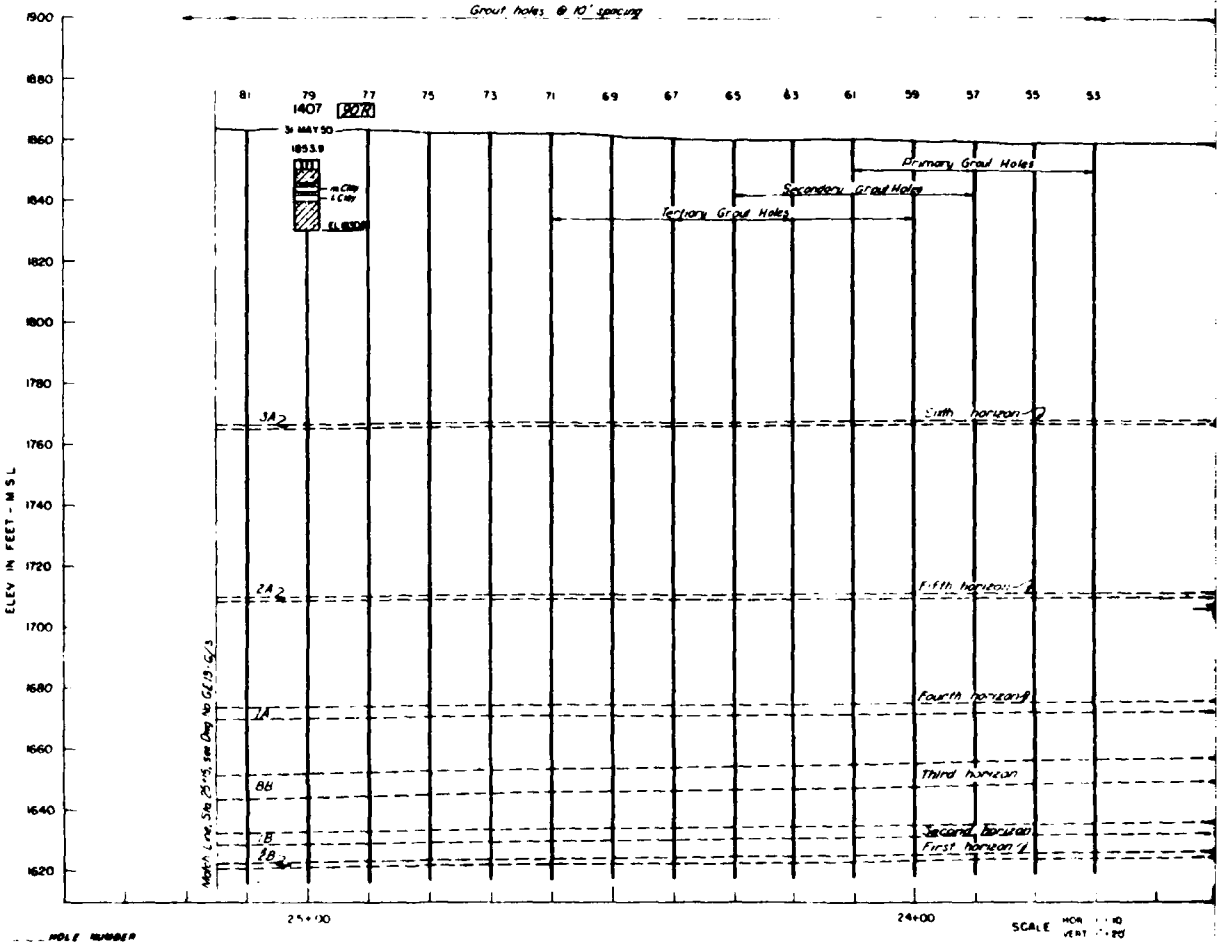
NOTES

GARRISON DAM AND RESERVOIR

MARCH 1953

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 102

2



87 ... HOLE NUMBER
25 MAR 49 ... DATE HOLE COMPLETED
1798.6 ... ELEV TOP OF HOLE

FIELD CLASSIFICATION (where no laboratory classification)
WATER TABLE (At time of exploration)
SPECIAL GEOLOGIC GROUPINGS
TOP OF FORT UNION FORMATION
WEATHERED ZONE
FIELD CLASSIFICATION (Based on laboratory classification)
LIGNITE bed
CORE LOST
LIMESTONE - shown graphically
CORE LOST - under 10'
EL 1649 ? LIMESTONE - rain bed

grav - gravelly
sa - sandy
si - silty
cl - clayey
l - loam (clay)
m - medium (clay)
f - fat (clay)

Loam, medium & coarse sands are not differentiated in Fort Union.
Fine, medium & coarse sands are not differentiated in both overburden and Fort Union, strata less than 1.0 thick not shown, being combined with the most similar material above or below except thicknesses of 0.1' are indicated for lignite, limestone, core loss, and foreign material within a salvagable lignite bed

LEGEND

GRAIN SIZE SYMBOLS

SAND
SILT
GRAVEL
CLAY

Symbols represent grain size distribution, predominant types by heavy lines, modifying types by light lines

OTHER SYMBOLS

LIMESTONE
LIGNITE
CORE LOST
SCORIA
LIGNITE (Average analyses)
Pulverized (Auger boring not sampled)

LEGEND FOR PROJECTED HOLES

40' R Indicates a hole located 40' feet to right of profile, required to direction of increase in stationing. Similarly, L stands for left of profile, U upstream, and D, downstream, are used in instances where R & L are not applicable

●741 Indicates completed borings

DESCRIPTIVE NOTES

Fort Union Formation is a Tertiary clay-shale it consists of a series of continentally deposited compact, clayey to sandy materials, arranged in gently dipping beds (often cross bedded), which range from thin partings to 15' or more in thickness. Clayey phases are predominant.

Within the formation there are horizons of *limestone* and *sandstone* which may reach a thickness of about 5'. Often these horizons are discontinuous in the form of concretions which may attain a thickness of 5' or more and may be greater than 25' in diameter.

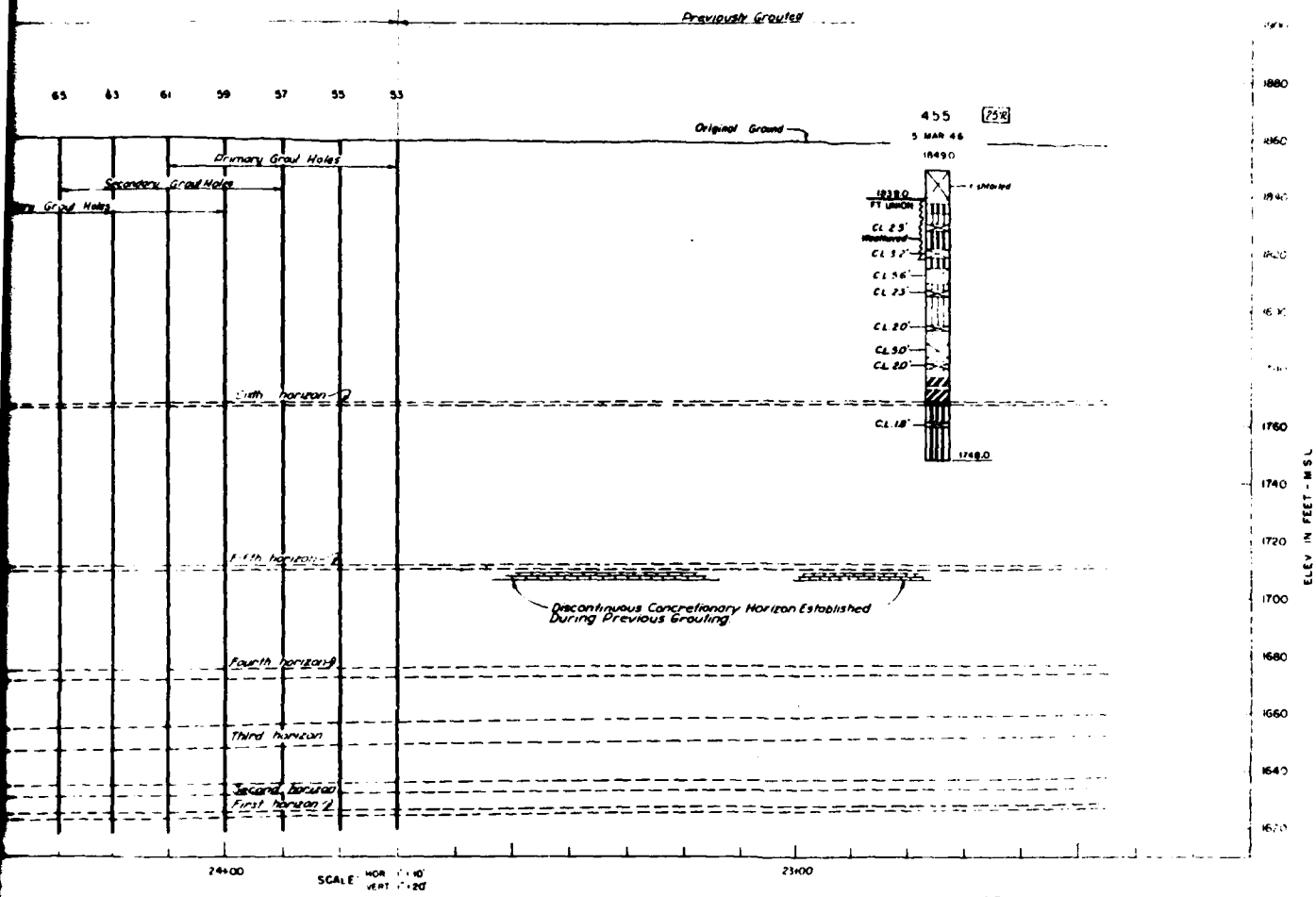
Lignite beds vary in thickness from thin partings to over 10', and are usually water bearing, particularly the thicker beds.

Burning of lignite beds has in places colored and hardened adjacent materials. When exposed these have a reddish color and are locally known as *scoria*.

The *glacial till* formation is an unsorted mixture, graded largely from sand sizes to clay sizes, glacially deposited in a compact state generally characterized by a small percentage of pebbles having a usual maximum size of one inch. Occasional cobbles and boulders are also found in the till.

Lignite float indicates the presence of various sized pieces of lignite transported and mixed by stream action and found deposited in varying concentrations at irregular horizons in the glacial or alluvial materials.

The term *loam* is used to designate a mixture of sand, silt and clay sizes, the percentage of clay sizes ranging from 0 to 19 for loam and from 20 to 29 for clay loam, with predominant remaining material indicated by a modifying adjective. The term loam does not imply the admixture of organic material.



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The **glacial till** formation is an assorted mixture, graded largely from coarse sizes to clay sizes, glacially deposited in a compact state generally characterized by a small percentage of pebbles having a usual maximum size of one inch. Occasional cobbles and boulders are also found in the till

Lignite (ice) indicates the presence of various sized pieces of lignite transported and mixed by stream action and found deposited in varying concentrations of irregular horizons in the glacial or alluvial materials.

The term **loam** is used to designate a mixture of sand, silt and clay sizes, the percentage of clay sizes ranging from 0 to 19 for loam and from 20 to 29 for clay loam, with predominant remaining material indicated by a modifying adjective. The term loam does not imply the admixture of organic material.

GENERAL NOTES

Indicated water table elevations, although derived from best available data, should be regarded as approximate only and subject to considerable variations.

Available samples may be inspected at the Corps of Engineers Office at the damsite

Graphic logs give boring information in condensed form Further information is shown in the complete boring logs which may be inspected at the Corps of Engineers Office at the site

Generally borings in overburden made by churn type rig using 6-inch inside diameter open end drive tube Continuous samples recovered

Generally borings in Fort Union made by rotary type rig using double tube core barrel Continuous core 3 7/8 - inches in diameter recovered

NOTES

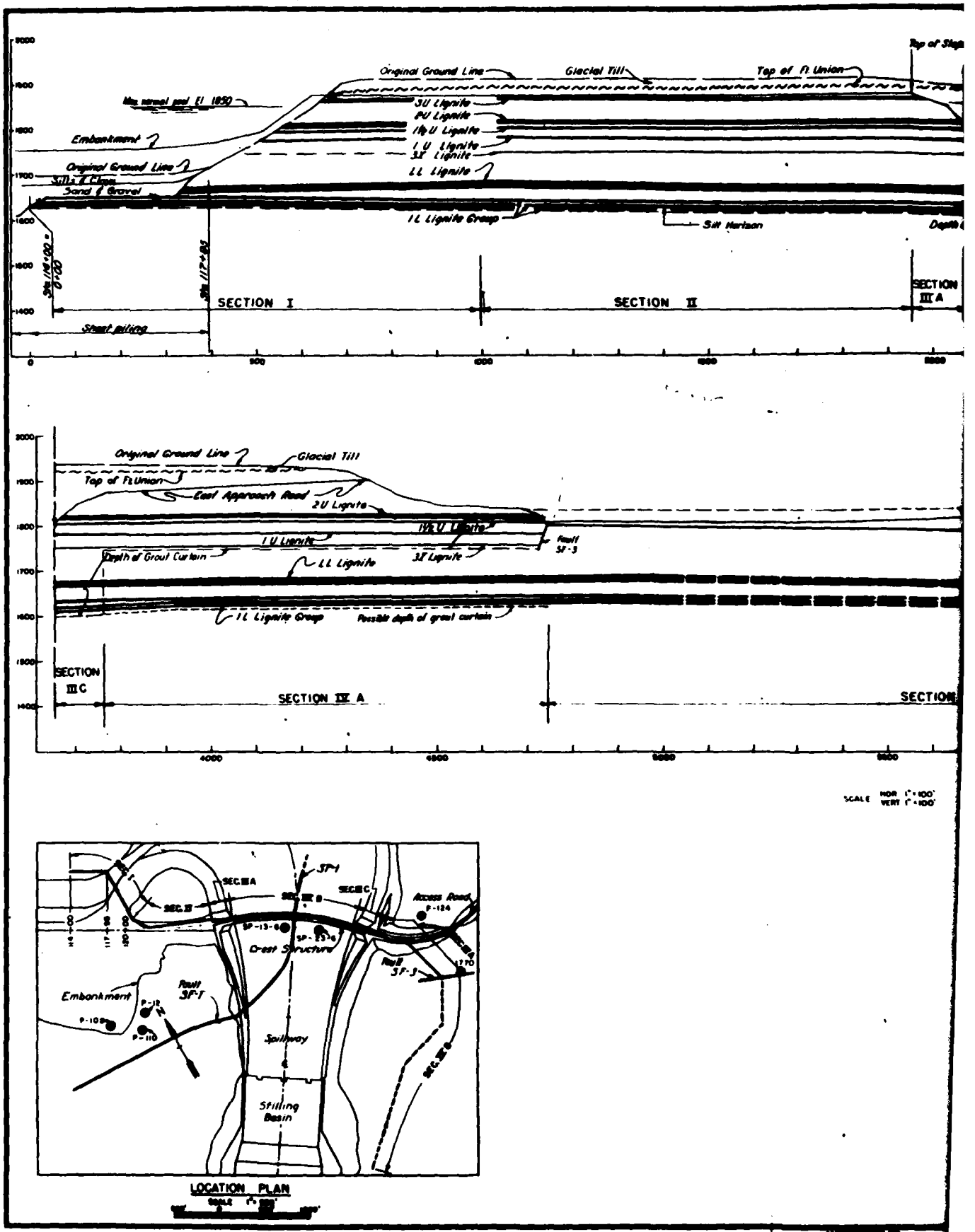
For Plan, see Dwg. [illegible]

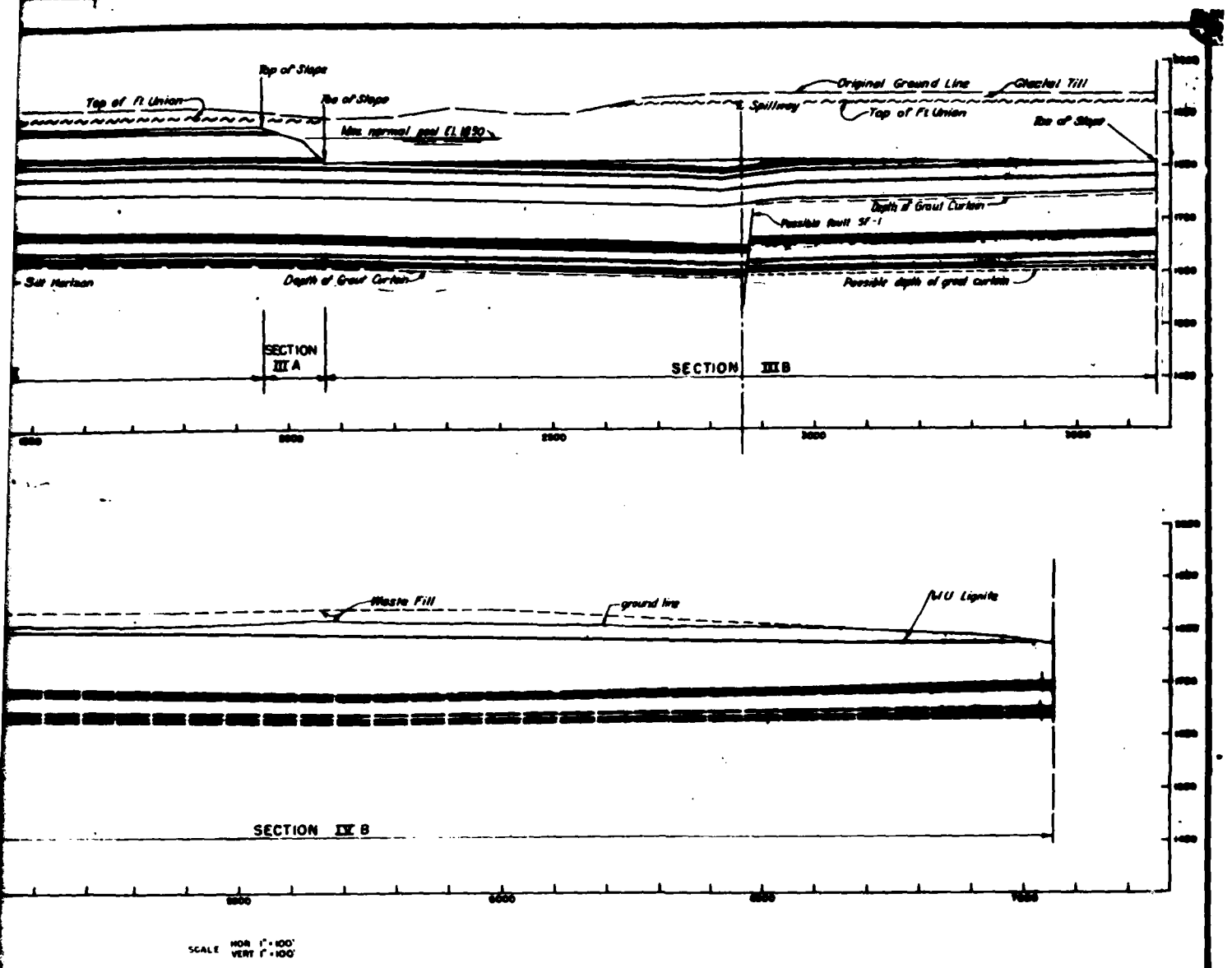
U S ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
WEST EMBANKMENT CUTOFF CURTAIN
SECTION IV
STA 23+60 TO 25+15
MARCH 1953
GE 13-6/2

CONSTRUCTION FOUNDATION REPORT (1992) PLATE 193

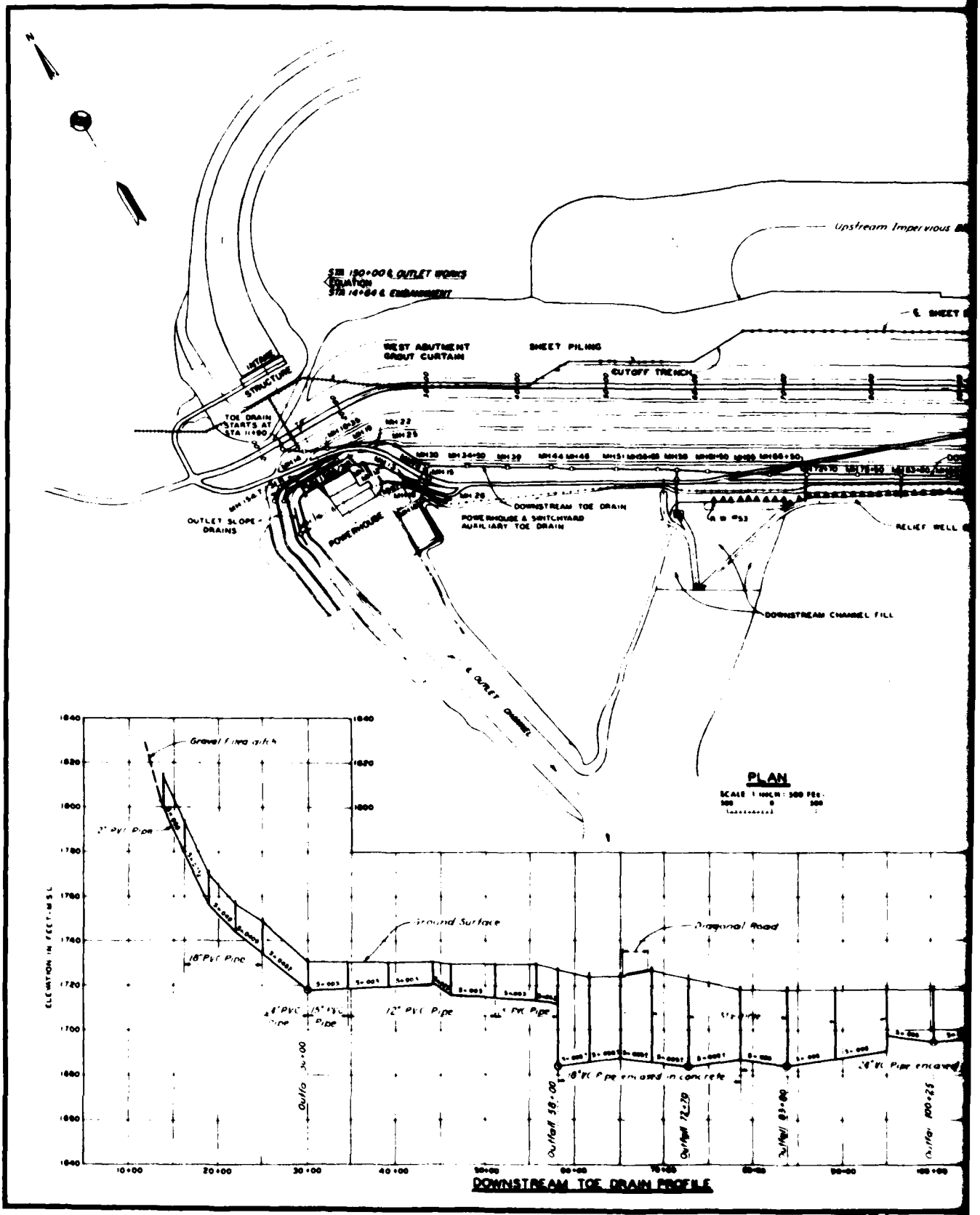
2


Original Ground Line
Glacial Till
Top of Ft Union
Top of Slope
Mississippi gpd El 1850
3U Lignite
2U Lignite
1½U Lignite
1U Lignite
3L Lignite
LL Lignite
Embankment
Original Ground Line
Silts & Clays
Sand & Gravel
1L Lignite Group
Silt Horizon
Depth
Sta 100+00
Sta 112+85
SECTION I
SECTION II
SECTION III A
Sheet piling
Original Ground Line
Glacial Till
Top of Ft Union
East Approach Road
2U Lignite
1½U Lignite
1U Lignite
Fault SF-3
Depth of Grout Curtain
LL Lignite
3L Lignite
1L Lignite Group
Possible depth of grout curtain
SECTION III C
SECTION IV A
SECTION
SCALE HOR 1"=100'
VERT 1"=100'
SF-1
SEC III A
SEC III B
SEC III C
Access Road
P-124
SP-13-6
SP-23-6
Crest Structure
Fault SF-1
Fault SF-3
Embankment
P-108
P-110
Spillway
Stilling Basin
SEC IV B
LOCATION PLAN

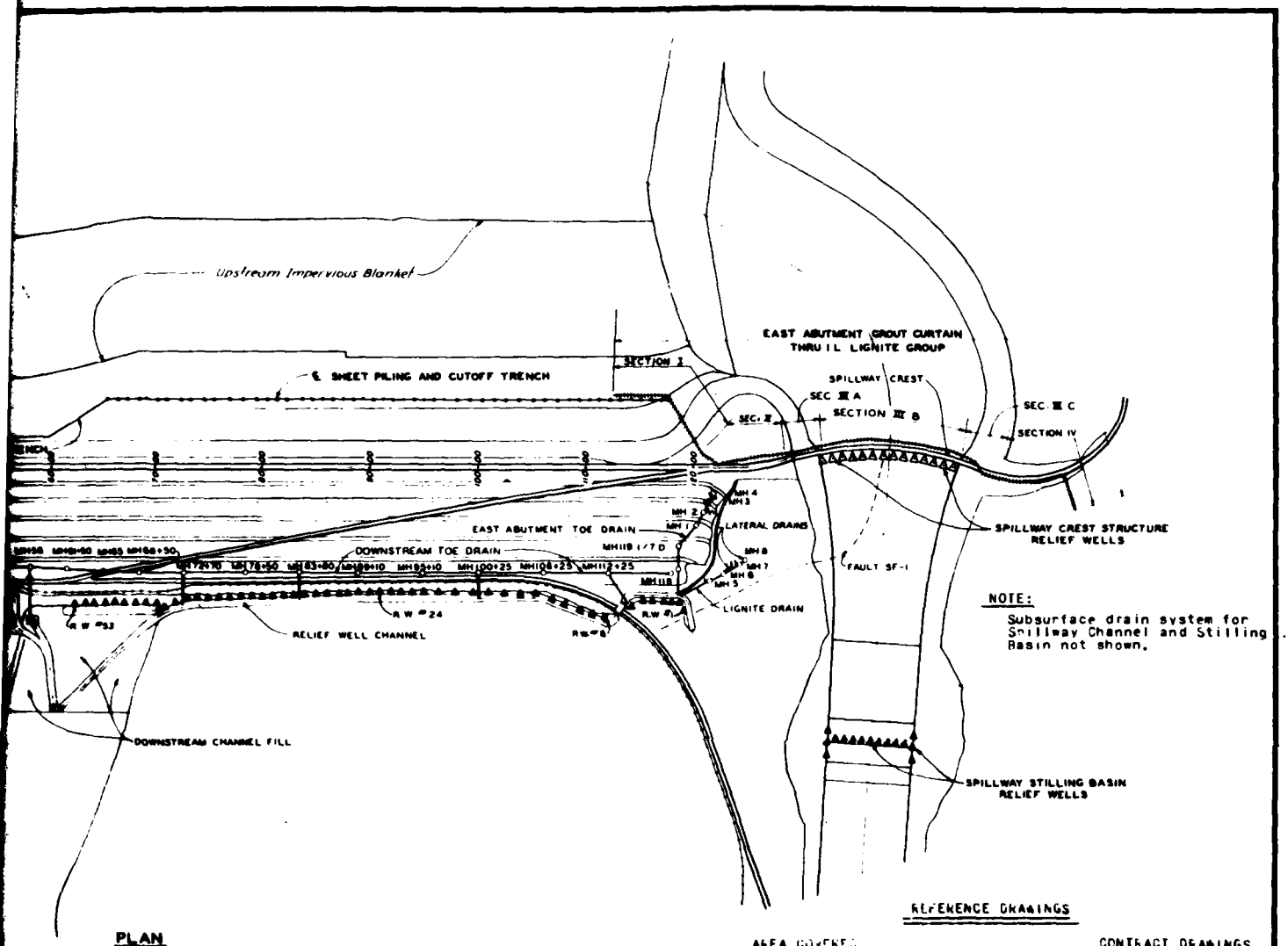


SCALE HOR 1" = 100'
VERT 1" = 100'

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SPILLWAY
GENERALIZED GEOLOGIC PROFILE
EAST ABUTMENT GROUT CURTAIN
APRIL 1982



DOWNSTREAM TOE DRAIN PROFILE

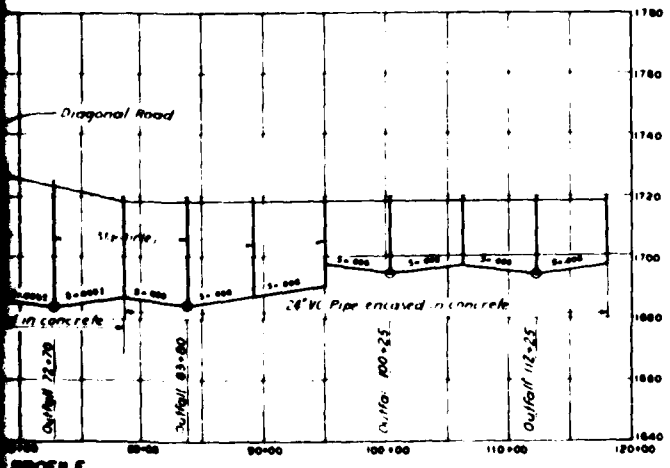


NOTE:

Subsurface drain system for Spillway Channel and Stilling Basin not shown.

PLAN

SCALE 1 INCH = 500 FEET



PROFILE

REFERENCE DRAWINGS

AREA COVERED	CONTRACT DRAWINGS
Outlet Slope Drains	GO7-6/7 & GOX-6/1
Powerhouse & Switchyard Auxiliary	
Toe Drain	GE10-7/42 & GE3-6/16
East Abutment Toe & Lignite Drains	GE10-6/10 & 6/11

Downstream Toe Drain Drawings

Embankment Stage	Area Covered	Contract Drawings
I	sta. 11+90 to 25+90	GE1-7/3
II	sta. 70+50 to 118+00	GE3-6/2, 6/3, & 6/5
III	sta. 25+00 to 55+65	GE6-6/1 & 6/2
IV	sta. 55+65 to 80+20	GE10-6/5 thru 6/9
V	sta. 80+20 to 76+50	GE17-6/1 & 6/2

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

MISSOURI RIVER

GARRISON DAM AND RESERVOIR
UNDERSEEPAGE STUDIES
SEEPAGE CONTROL AND DOWNSTREAM TOE DRAIN PROFILE

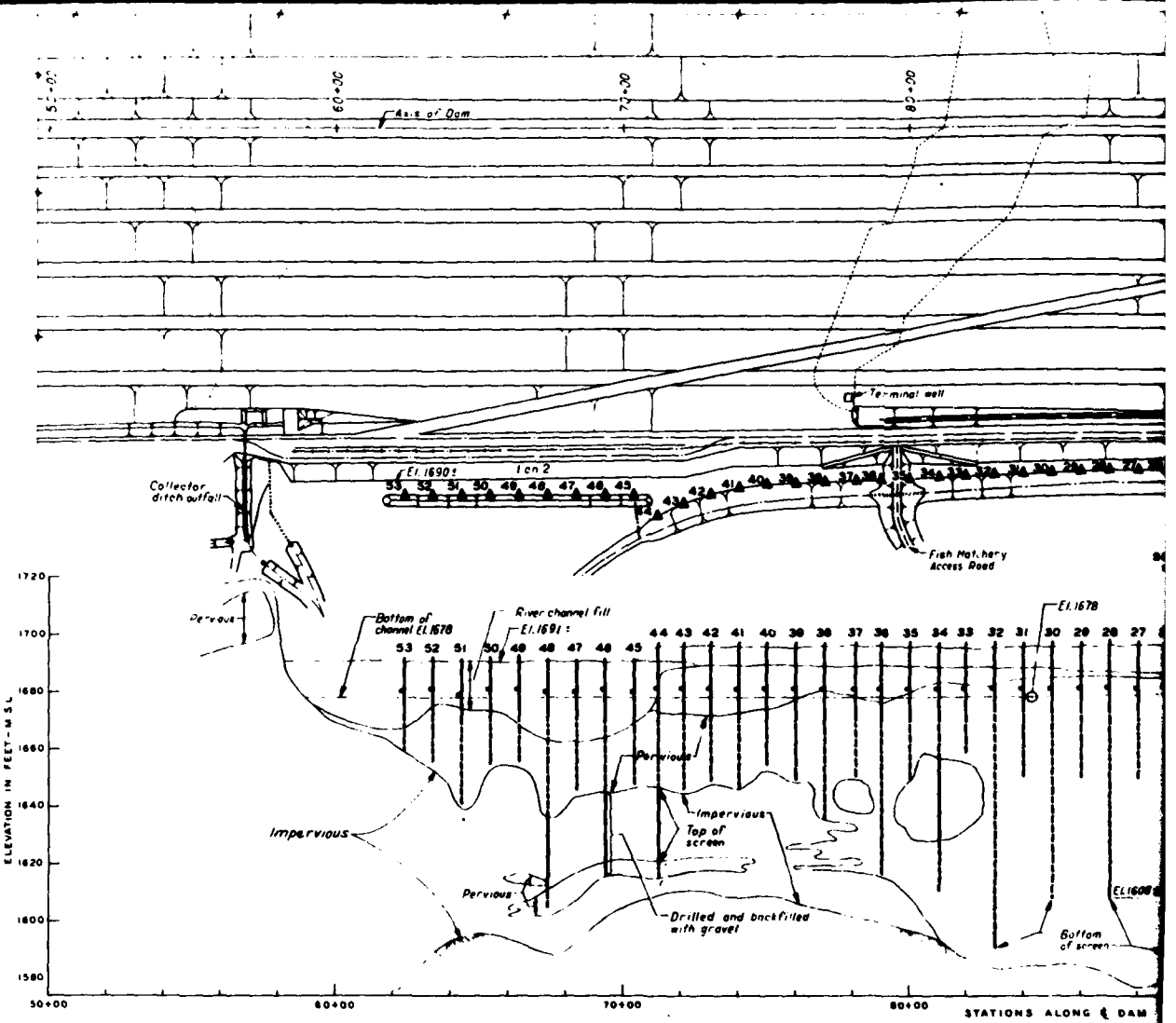
Frank P. Koppy

Gerald J. McClain

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 105

2

CORPS OF ENGINEERS



A 16 Micrometer Film or A Paper Reproducible Record Copy Must Be Made Before Every Addendum and/or Modification

ADDENDUM NO.	
DATE	
MODIFICATION	
DATE	

GENERALIZED GEOLOGIC

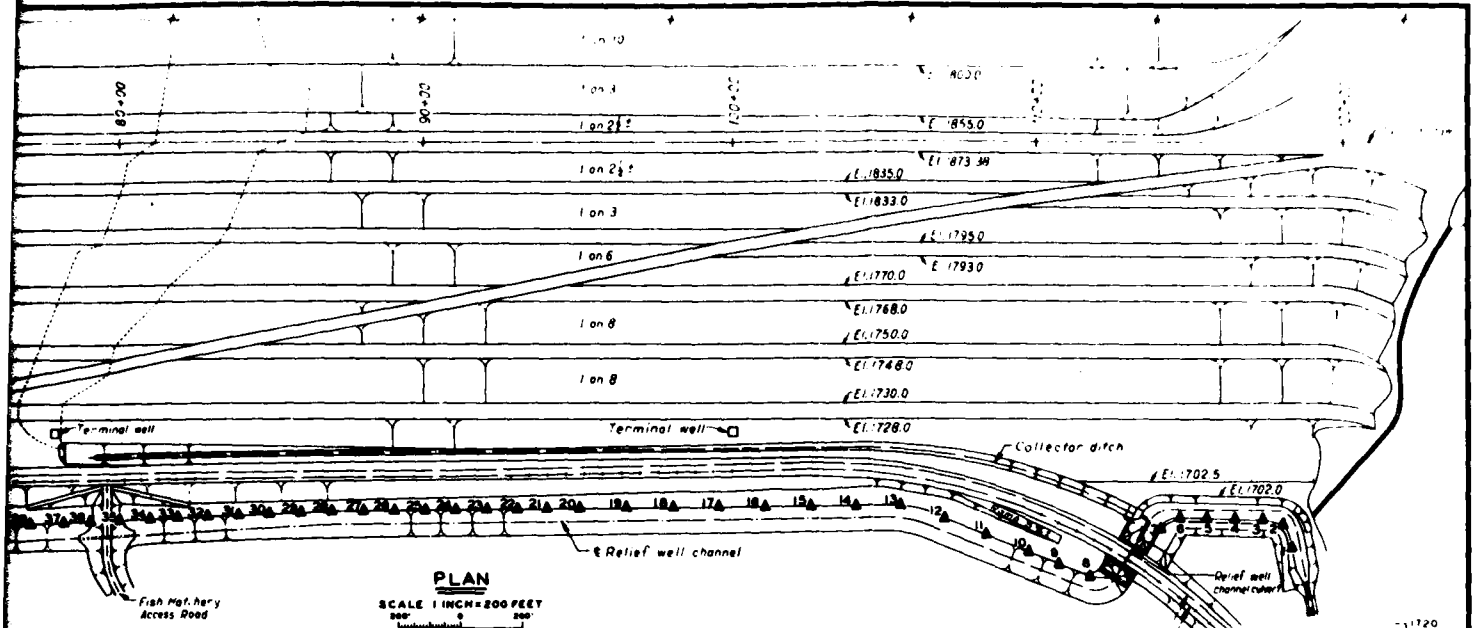
(CONDITIONS BETWEEN BORINGS EST

SCALE VERT 1"=20'
HORIZ 1"=200'

Relief Well No.	Location Sta. Dam Axis	Location Offset	Depth of Well	Elevation Top of Riser	Elevation Invert of Outfall	Pipe Lengths - Feet Riser Pipe	Pipe Lengths - Feet Blank Pipe	Pipe Lengths - Feet Total Screen	Bottom Elevation
1	118 + 31	1331.2'	112.3	1698.11	1686.61	10.67	67.15	34.00	1581.8
2	118 + 01	1342.2'	106.0	1698.47	1686.64	10.67	66.16	29.25	1588.5
3	117 + 38	1311.0'	102.3	1698.88	1686.97	10.67	61.47	30.16	1588.0
4	116 + 48	1311.7'	97.3	1698.36	1686.86	10.67	54.67	32.77	1577.1
5	115 + 38	1310.5'	92.5	1698.33	1686.88	10.67	46.88	34.00	1581.8
6	114 + 69	1312.7'	87.1	1698.08	1687.08	10.67	30.11	34.00	1587.0
7	114 + 01	1244.9'	86.8	1698.47	1687.47	10.67	15.01	38.83	1589.7
8	111 + 76	1418.5'	77.6	1697.31	1685.72	13.21	7.69	34.98	1619.7
9	110 + 78	1379.9'	77.6	1697.37	1685.67	13.07	8.89	33.27	1620.0
10	109 + 79	1340.4'	81.0	1698.01	1686.98	16.37	10.35	36.33	1613.0
11	108 + 39	1303.9'	89.5	1697.72	1688.60	16.27	12.65	60.65	1608.8
12	107 + 01	1289.9'	104.0	1697.31	1688.21	16.87	13.67	74.83	1593.3
13	105 + 39	1284.1'	89.7	1697.39	1683.69	16.87	25.42	57.37	1607.9
14	104 + 08	1282.4'	90.1	1697.76	1685.76	17.18	13.97	29.09	1607.7
15	102 + 58	1280.7'	90.0	1697.63	1683.43	17.35	5.69	67.18	1607.6
16	101 + 88	1284.7'	103.7	1697.27	1688.97	16.87	5.69	80.98	1593.6
17	99 + 39	1285.9'	89.5	1697.58	1688.98	17.35	5.82	66.69	1608.1
18	98 + 09	1287.0'	89.2	1697.08	1688.98	17.66	5.82	66.88	1608.1
19	96 + 58	1287.2'	89.4	1697.62	1688.82	18.54	5.69	65.41	1608.8
20	95 + 08	1287.8'	101.0	1697.50	1688.60	18.18	5.98	69.32	1590.4
21	93 + 58	1288.7'	47.8	1697.85	1688.85	18.88	5.98	69.88	1630.0
22	93 + 08	1289.7'	90.0	1697.55	1688.65	19.97	5.98	64.14	1607.5
23	92 + 08	1290.9'	47.9	1697.76	1688.44	19.48	4.98	23.72	1649.9
24	91 + 08	1292.7'	90.0	1697.68	1688.24	19.76	4.82	69.68	1607.8
25	90 + 08	1294.6'	47.3	1697.90	1688.30	19.35	5.98	23.38	1649.9
26	89 + 08	1296.7'	108.3	1697.60	1680.60	19.88	4.98	85.99	1589.3
27	88 + 07	1298.8'	47.9	1697.77	1680.67	20.86	5.97	21.79	1649.9
28	87 + 07	1298.7'	89.9	1697.75	1680.45	20.54	5.82	69.37	1607.9
29	86 + 07	1299.4'	47.3	1697.23	1680.33	20.07	4.64	22.70	1649.9

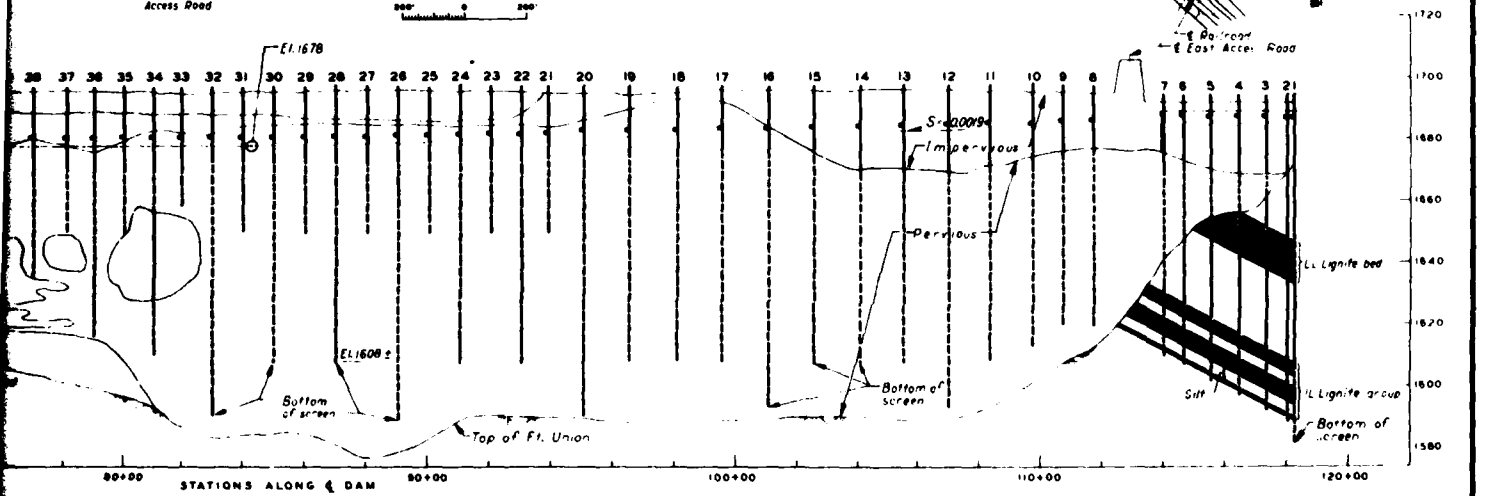
Relief Well No.	Location Sta. Dam Axis	Location Offset	Depth of Well	Elevation Top of Riser	Elevation Invert of Outfall	Pipe L Riser Pipe
30	85 + 06	1203.5'	89.4	1697.15	1680.15	20.18
31	84 + 06	1207.5'	47.0	1697.01	1680.01	20.10
32	83 + 06	1217.4'	106.9	1697.16	1680.06	20.21
33	82 + 06	1218.9'	38.6	1696.93	1680.03	15.90
34	81 + 13	1222.8'	85.6	1696.82	1680.02	23.06
35	80 + 06	1227.0'	47.9	1697.66	1680.06	23.99
36	79 + 08	1231.5'	81.1	1697.25	1680.05	23.45
37	78 + 16	1235.3'	46.9	1697.00	1680.10	23.19
38	77 + 06	1240.8'	61.0	1696.93	1680.13	23.11
39	76 + 06	1245.3'	48.3	1697.28	1680.08	23.46
40	75 + 06	1250.3'	42.8	1697.17	1680.07	23.30
41	74 + 04	1260.4'	90.7	1697.13	1680.03	23.26
42	73 + 10	1288.8'	48.6	1697.39	1680.09	23.32
43	72 + 14	1317.8'	51.8	1697.12	1680.12	23.23
44	71 + 23	1360.8'	82.1	1697.10	1680.30	24.00
45	70 + 40	1398.3'	44.4	1691.63	1679.30	18.26
46	69 + 40	1269.4'	46.8	1691.89	1680.00	18.25
47	68 + 40	1270.5'	46.1	1691.18	1679.18	18.25
48	67 + 40	1271.9'	87.3	1691.57	1679.57	18.25
49	66 + 40	1272.6'	36.5	1692.89	1680.29	18.23
50	65 + 40	1273.6'	37.5	1692.12	1680.12	18.25
51	64 + 40	1274.7'	36.5	1691.08	1678.08	18.24
52	63 + 40	1275.8'	36.6	1692.80	1680.80	18.90
53	62 + 40	1276.8'	38.5	1691.78	1679.78	18.26
57*	34 + 45	895.0'	99.6	Dam	Dam	4.67

* Relief Well located in manhole.



PLAN

SCALE 1 INCH = 200 FEET



GENERALIZED GEOLOGIC PROFILE

(CONDITIONS BETWEEN BORINGS ESTIMATED ONLY)

SCALE VERT 1" = 20'
HORIZ 1" = 200'

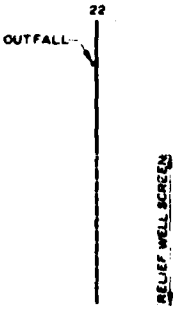
Station		Depth of Well	Elevation		Pipe Lengths - Feet			Bottom Elevation
Sta.	Offset		Top of Riser	Invert of Outfall	Riser Pipe	Blank Pipe	Total Screen	
◆ 06	1203.5'	89.4	1697.15	1680.15	20.18	5.00	64.15	1607.8
◆ 06	1207.5'	47.0	1697.01	1680.01	20.10	4.66	22.28	1650.0
◆ 06	1217.4	106.9	1697.16	1680.06	20.21	4.95	81.83	1590.3
◆ 06	1218.9'	38.6	1696.93	1680.03	15.90	4.65	10.98	1658.3
◆ 13	1222.8'	85.6	1696.82	1680.02	23.06	35.20	28.47	1610.2
◆ 06	1227.0'	47.9	1697.66	1680.06	23.99	4.65	19.35	1649.8
◆ 02	1231.5'	81.1	1697.25	1680.05	23.65	4.65	52.96	1616.2
◆ 16	1235.3'	46.9	1697.00	1680.10	23.19	4.65	19.10	1650.1
◆ 06	1240.8'	61.0	1696.93	1680.13	23.11	4.66	33.27	1635.0
◆ 06	1245.3'	48.3	1697.28	1680.08	23.46	4.65	20.21	1649.0
◆ 06	1250.3'	42.8	1697.17	1680.07	23.30	4.65	14.68	1654.4
◆ 04	1260.4'	50.7	1697.13	1680.03	23.26	4.63	22.61	1646.4
◆ 10	1262.8'	48.6	1697.39	1680.09	23.32	4.65	20.45	1648.8
◆ 14	1317.8'	51.2	1697.12	1680.12	23.23	4.65	23.25	1645.9
◆ 23	1360.8'	82.1	1697.10	1680.30	24.00	32.99	25.85	1615.0
◆ 10	1259.3'	43.4	1691.63	1679.30	18.26	4.67	21.97	1647.2
◆ 10	1269.4'	46.8	1691.89	1680.00	18.25	5.00	23.19	1645.1
◆ 10	1270.9'	46.1	1691.18	1679.18	18.25	4.65	23.51	1645.7
◆ 10	1271.9'	87.3	1691.57	1679.57	18.25	29.88	39.66	1604.3
◆ 10	1272.6'	36.5	1692.29	1680.29	18.25	4.63	13.68	1655.8
◆ 10	1273.6'	37.5	1692.12	1680.12	18.26	4.67	14.63	1654.6
◆ 10	1276.7'	39.5	1691.02	1678.02	18.34	5.01	27.24	1640.5
◆ 10	1275.8'	36.6	1692.80	1680.20	18.90	4.60	13.70	1655.6
◆ 10	1276.8'	32.5	1691.78	1679.78	18.26	4.64	9.71	1659.3
◆ 15	849.0'	99.6	Rem	Rem	4.67	30.51	24.46	1696.9

* located in manhole.

LEGEND

▲ SYMBOL FOR RELIEF WELLS

14 RELIEF WELL NUMBER



SAFETY PAYS

THIS PLAN ACCOMPANIES CONTRACT NO. DA-25-066-eng- , MODIFICATION NO.

THIS DRAWING WAS REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE.

DATE	DESCRIPTION	DRAWN	APPROVED
	REVISIONS		

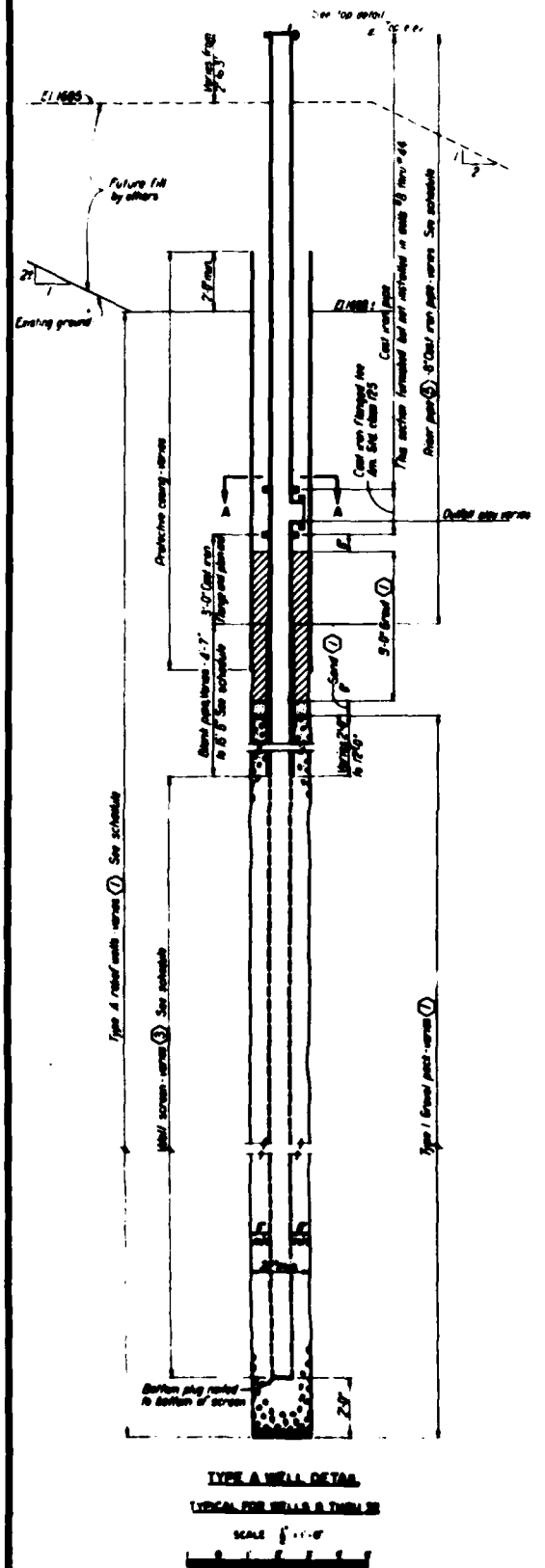
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

MISSOURI RIVER

GARRISON DAM AND RESERVOIR
UNDERSEEPAGE STUDIES
RELIEF WELLS
PLAN AND PROFILE

DESIGNED BY R. P. J.
DRAWN BY R. P. J.
TRACED BY R. P. J.
CHECKED BY R. P. J.
SUBMITTED: Charles E. Hipp
APPROVED: Harold J. McClure
DATE: MAY 1964

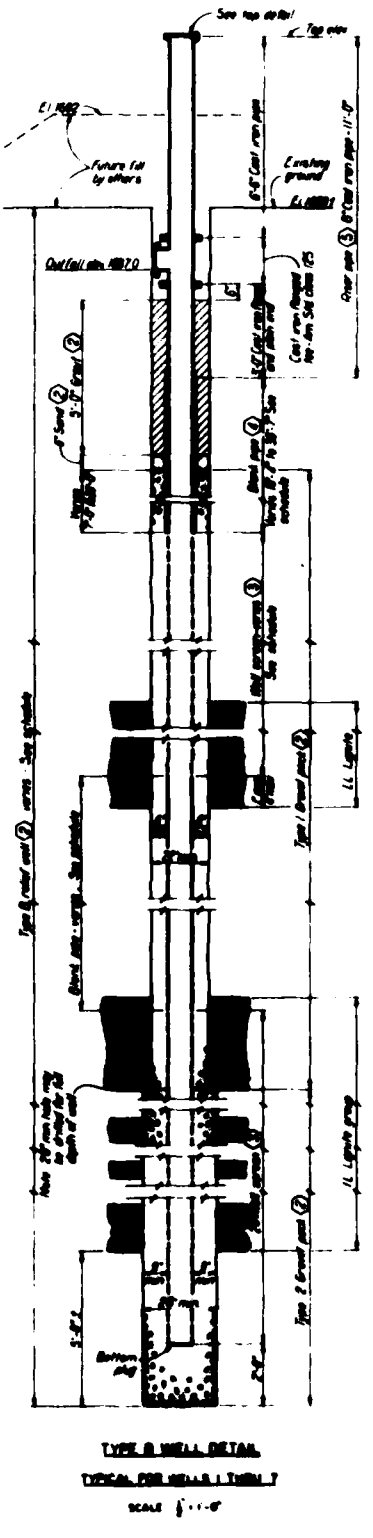
CONSTRUCTION FOUNDATION REPORT (1982) PLATE 106



TYPE A WELL DETAIL

TYPICAL FOR WELLS 6 THRU 10

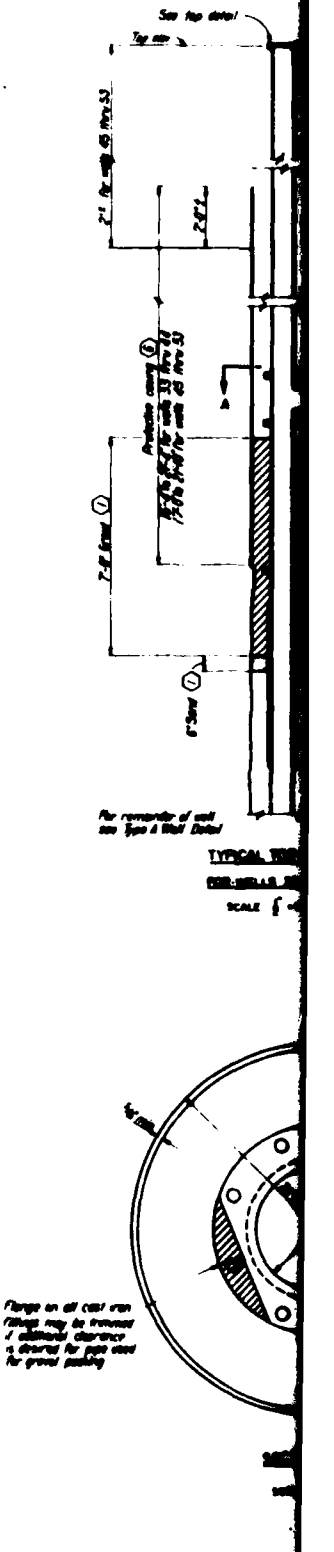
SCALE 1" = 1'-0"

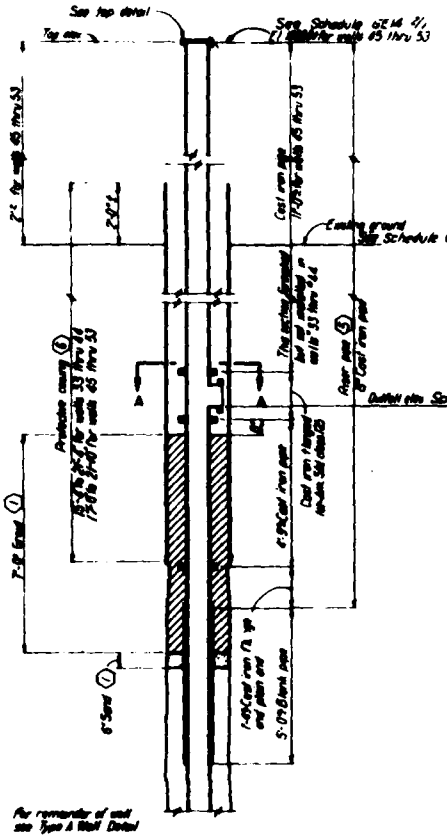


TYPE B WELL DETAIL

TYPICAL FOR WELLS 1 THRU 7

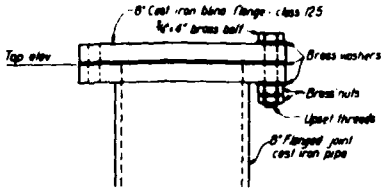
SCALE 1" = 1'-0"





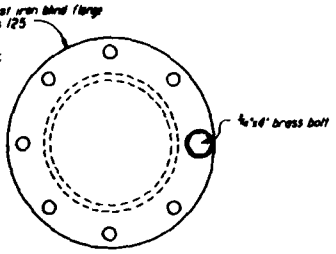
TYPICAL TOP DETAIL

SCALE 1" = 1'-0"



ELEVATION

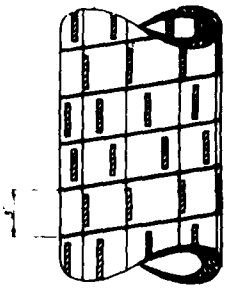
SCALE 3" = 1'-0"



PLAN

TOP DETAIL

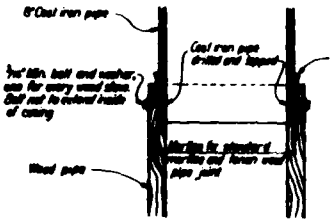
SCALE 3" = 1'-0"



8" I.D. Wood well screen with ½" x 2½" slots spaced 9 per every spiral, with vertical rows staggered as shown.

WELL SCREEN

SCALE 3" = 1'-0"



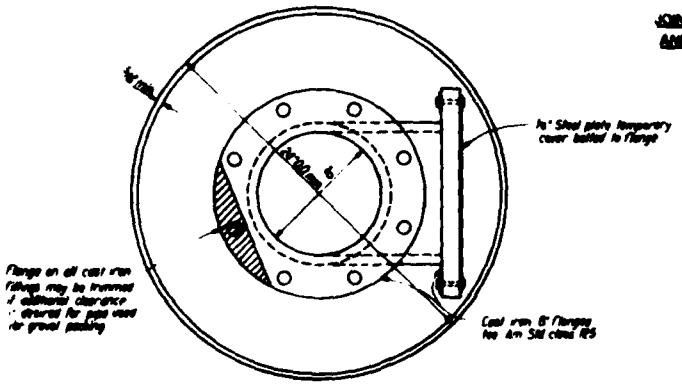
JOINT BETWEEN WOOD AND CAST IRON PIPE

SCALE 3" = 1'-0"

NOTES

For all variable dimensions, see schedule Dwg. No. GE 14-2-1

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



SECTION A-A

SCALE 3" = 1'-0"

NOTE:

1. This drawing included in underseepage studies report for information only.

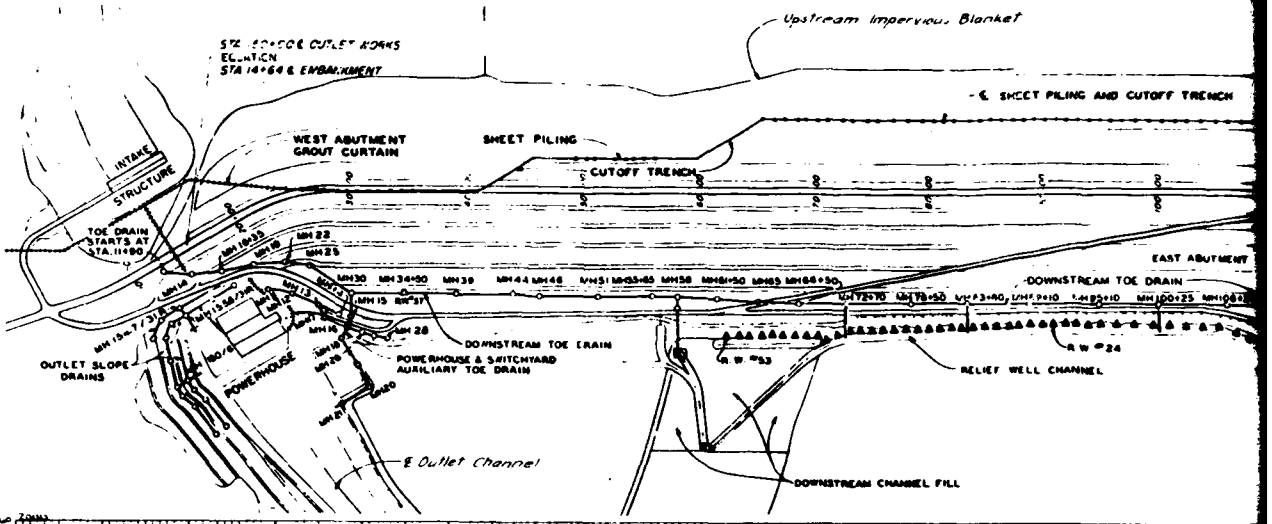
3	2-54	REVISED TO SHOW "AS BUILT" CONDITIONS
2	8-5-53	Addendum No. 2
1	12-2-53	Advertised prior to advertising

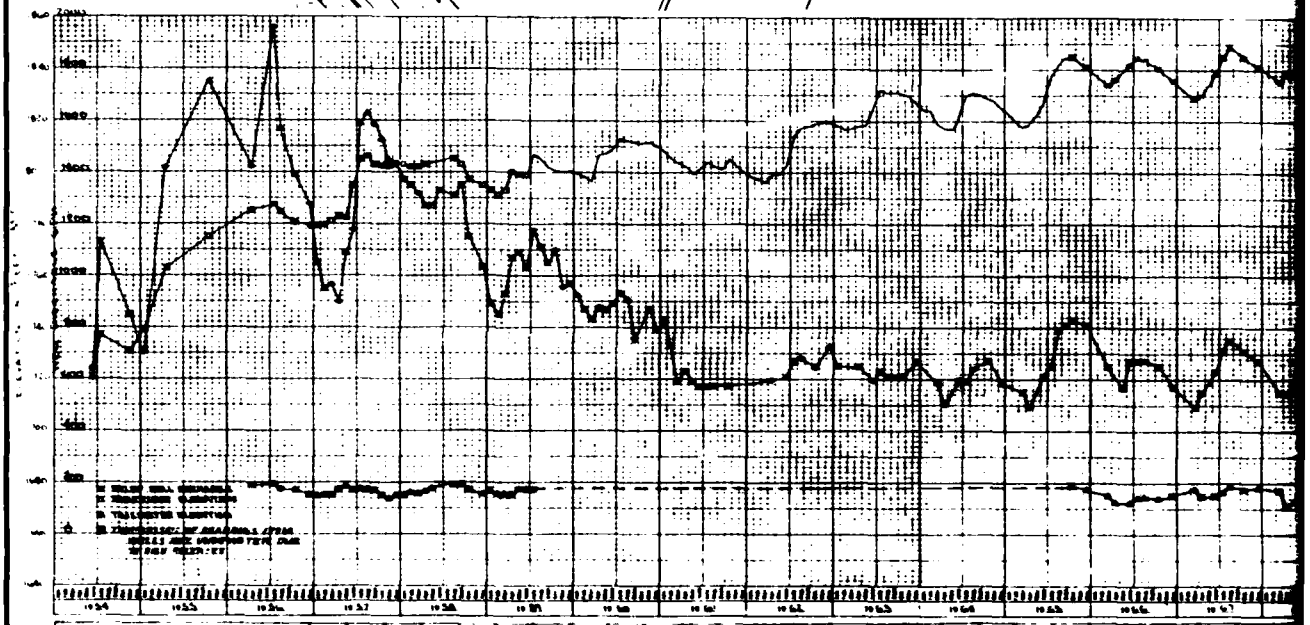
U. S. ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEBR.

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
RELIEF WELLS
DETAILS

NOVEMBER 1952

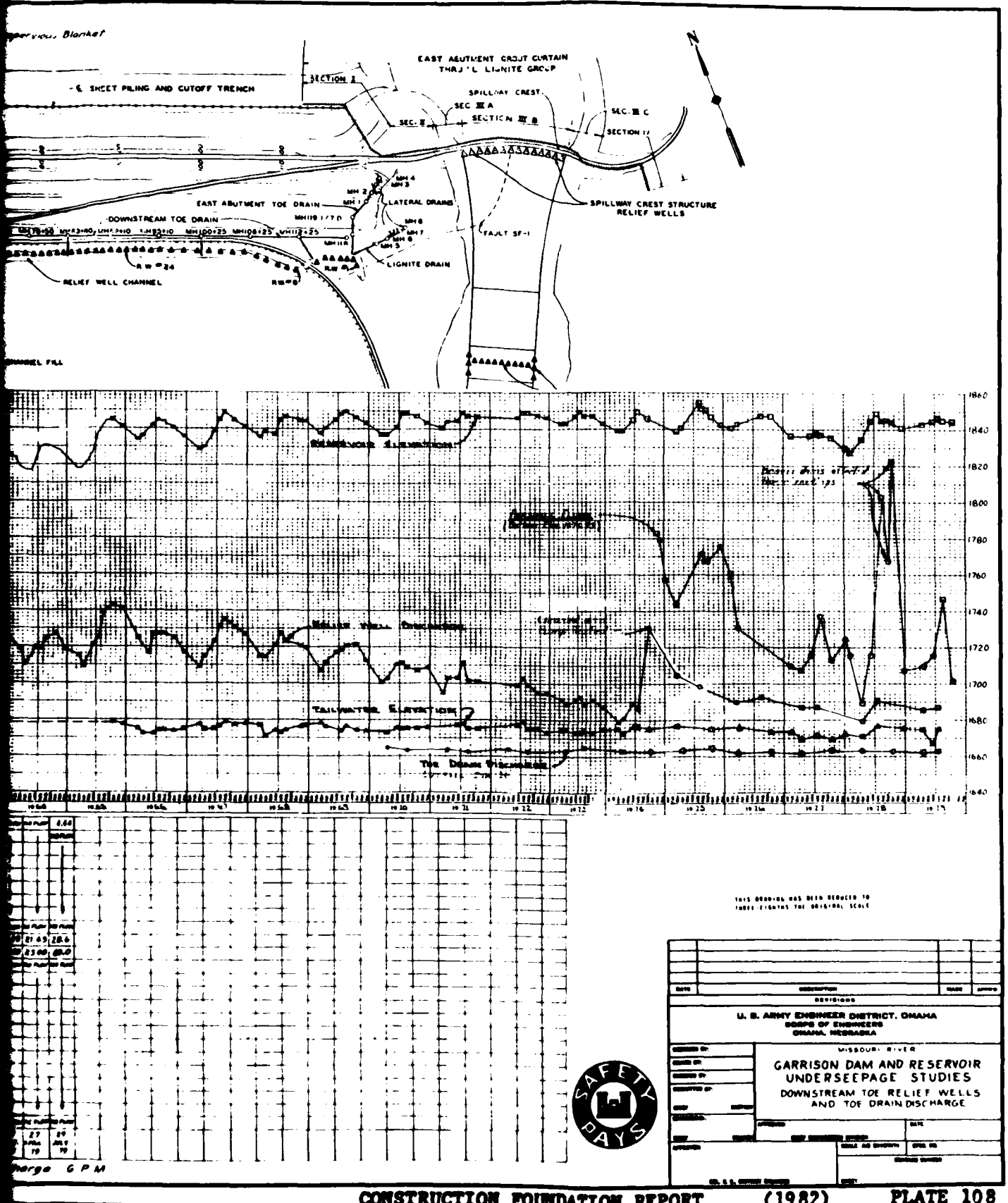
GE 14-6/1





		10 APRIL 1970	8 AUG 1970	8 APRIL 1971	6 AUG 1971	11 APRIL 1972	17 AUG 1972	2 APRIL 1973	2 AUG 1973	8 APRIL 1974	9 OCT 1974	23 SEPT 75	22 OCT 75	1 APRIL 76	28 OCT 76	21 APRIL 77	28 OCT 77	27 APRIL 78	27 OCT 78	29 APRIL 79	29 JULY 79
MH #15 SWITCHYARD																					8.60
MH 30/8 35 D	EAST LEG																				
	WEST LEG																				
MH 25/6 3 D																					
MH 22/5 2 D																					
MH 19/8 2 D																					
MH 16 35/3 15 D																					
MH 14/2 25 D																					
MH 39/8 35 D																					
OUTFALL STA 58		42.9	30.0	35.3	21.4	40.0	24.0	31.6	30.0	28.6	26.1	34.4	42.86	18.75	22.22	16.67	31.58	21.43	21.43	28.6	
MH #9 58/9 10 D	EAST LEG (58 TO 65)	42.9	30.0	31.6	20.7	24.0	24.0	30.0	33.0	30.0	33.3	37.5	54.55	26.09	23.08	18.18	30.00	30.00	23.08	60.0	
	WEST LEG (44 TO 58)																				
OUTFALL STA 72+70																					
MH #4 72 7065 D	EAST LEG (65 TO 72.7)																				
	WEST LEG (72.7 TO 78.5)																				
OUTFALL STA 83+80																					
MH #1 83/9 6.5 D	EAST LEG (83.8 TO 88.1)																				
	WEST LEG (78.5 TO 87.8)																				
OUTFALL STA 100+25																					
MH 100.25/9 6.5 D	E LEG (100.25 TO 112.25)																				
	W LEG (98.1 TO 100.25)																				
OUTFALL STA 112+25																					
MH 112.25/9 6.5 D	E LEG (112.25 TO 118)																				
	W LEG (106.25 TO 112.25)																				

Toe Drain Discharge G P M



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

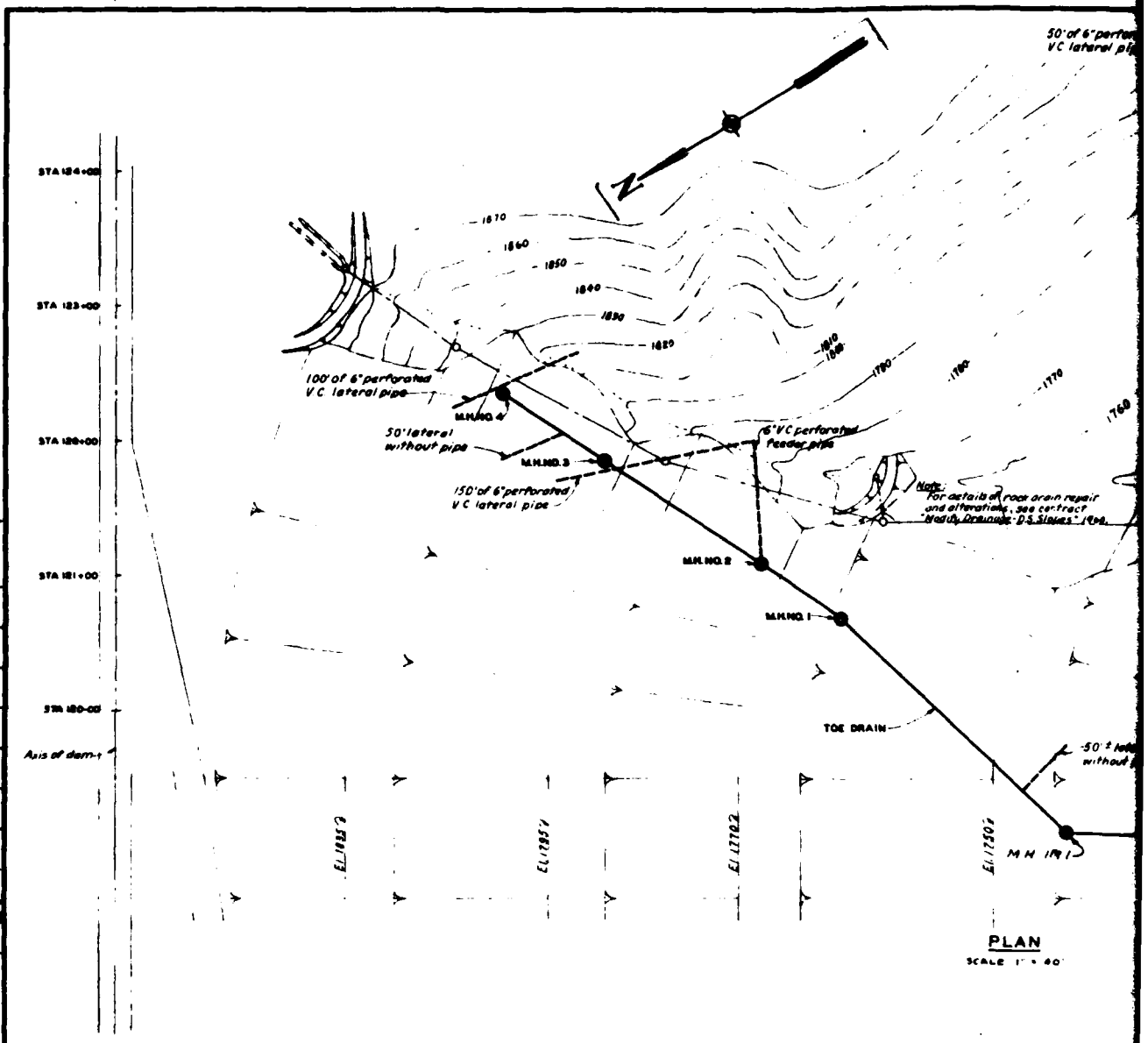
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

MISSOURI RIVER

GARRISON DAM AND RESERVOIR
UNDERSEEPAGE STUDIES
DOWNSTREAM TOE RELIEF WELLS
AND TOE DRAIN DISCHARGE

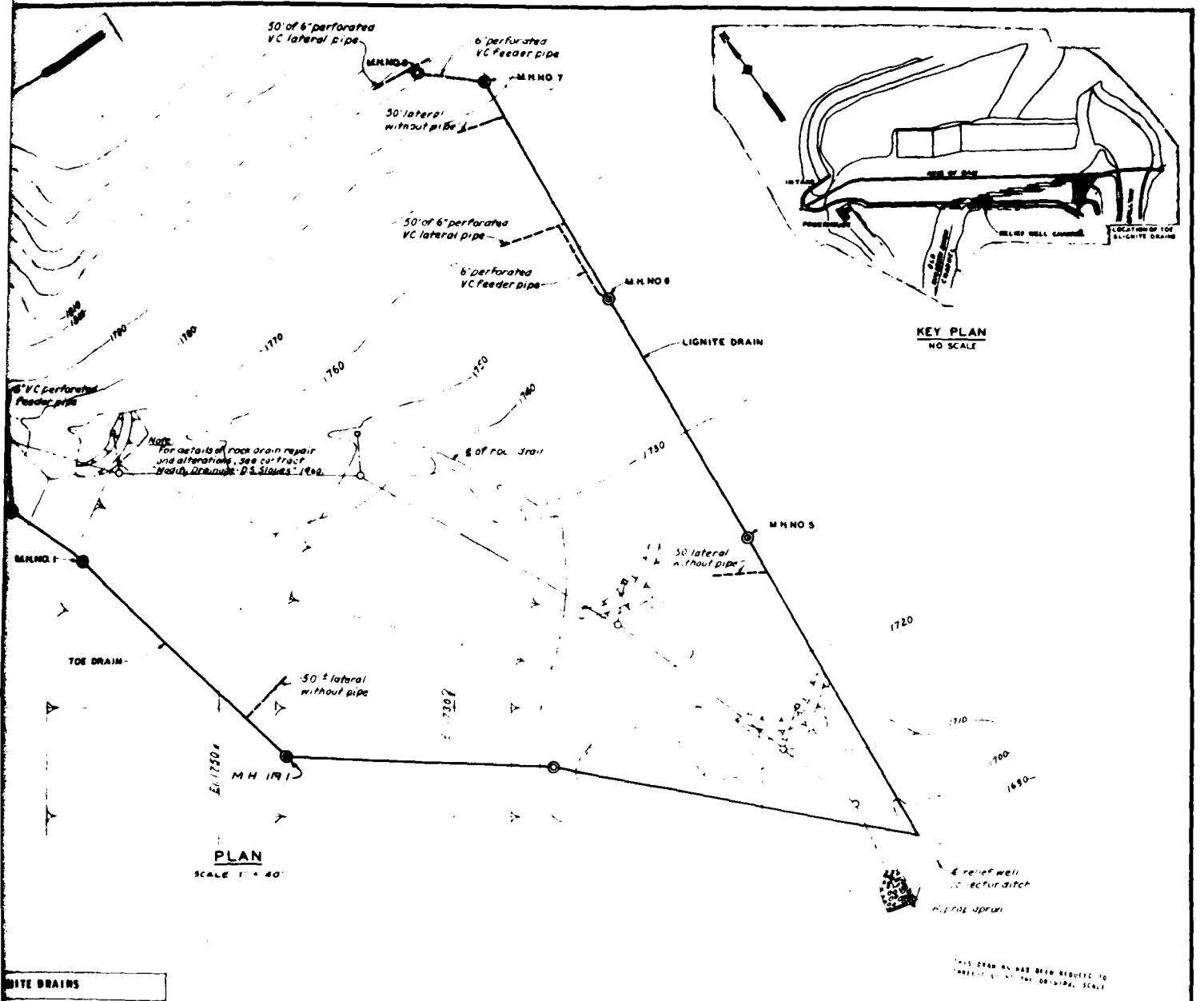
SAFETY DAYS

2



TABULATION OF DISCHARGE OBSERVATIONS EAST ABUTMENT TOE & LIGNITE DRAINS

DATE	G P M																						
E. ABUTMENT TOE DRAIN OUTFALL	DRY																						
M.H. 1 RR. 1/7-8	DRY																						
M.H. 01-12B, 7/8, 39-8	DRY																						
M.H. 02-12B, 1/4, 77-8	DRY																						
M.H. 03-12B, 9/8, 01-8	DRY																						
M.H. 04-12B, 9/8, 05-8	DRY																						
E. ABUTMENT LIGNITE DRAIN OUTFALL	5.1	4.8	4.8	6.4	4.0		5.0	3.3	5.1	6.6	6.5	4.6	4.6	4.6	3.35	2.1	2.24	.98	5.1	1.1	4.0
M.H. 03	4.3	4.6	4.1	7.7	4.3	4.3	2.3	3.0	4.6	4.4	3.0	3.5	3.7	3.5	1.96	1.0					
M.H. 03 EAST LEG	3.3	3.6	3.1	5.0	4.3	4.0	.9	2.6	.6	1.5	1.4	0.8	0.7	2.6	.89	2.24	2.3	1.19	-		.98
M.H. 07-12B, 0/8, 04-8	NO FLOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO FLOW	NO FLOW	NO FLOW	-		NO FLOW
M.H. 03 North Leg	NO FLOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	DRY	NO FLOW	NO FLOW	-		NO FLOW



NOTE Semi-annual record is also available at the District Office

This Plate is a continuation of Plate B-47 Periodic Inspection Report 1969

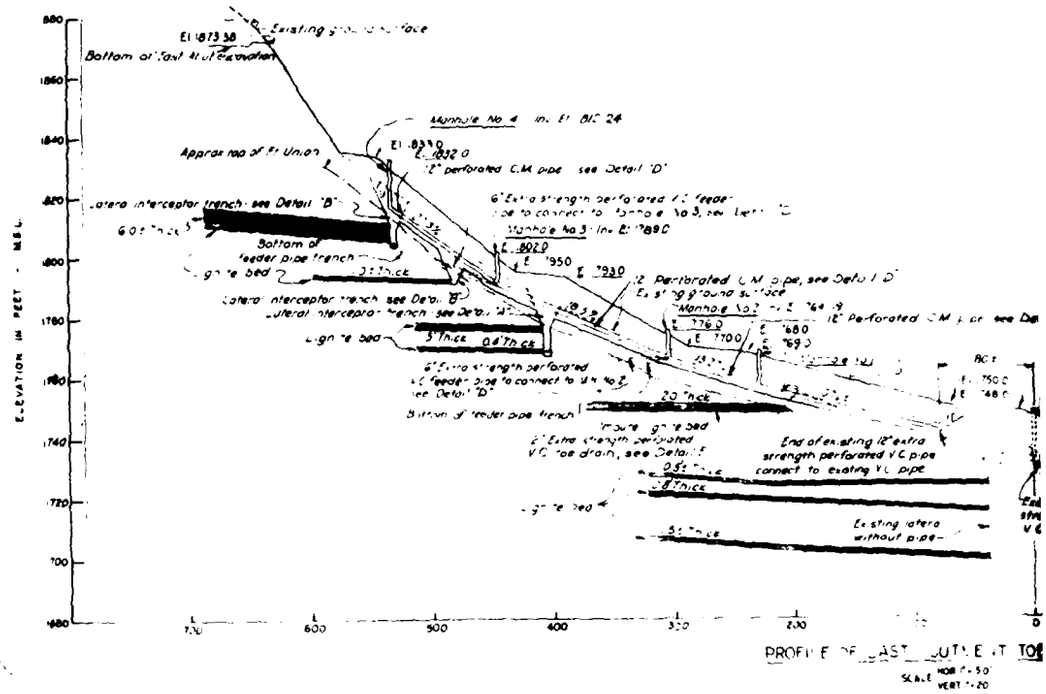
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

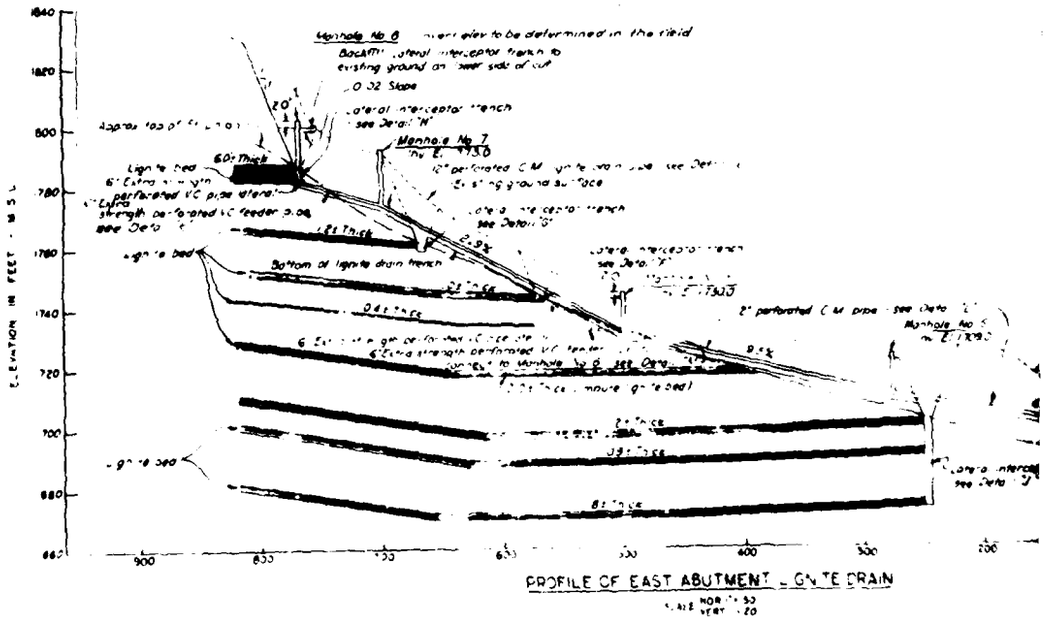
MISSOURI RIVER

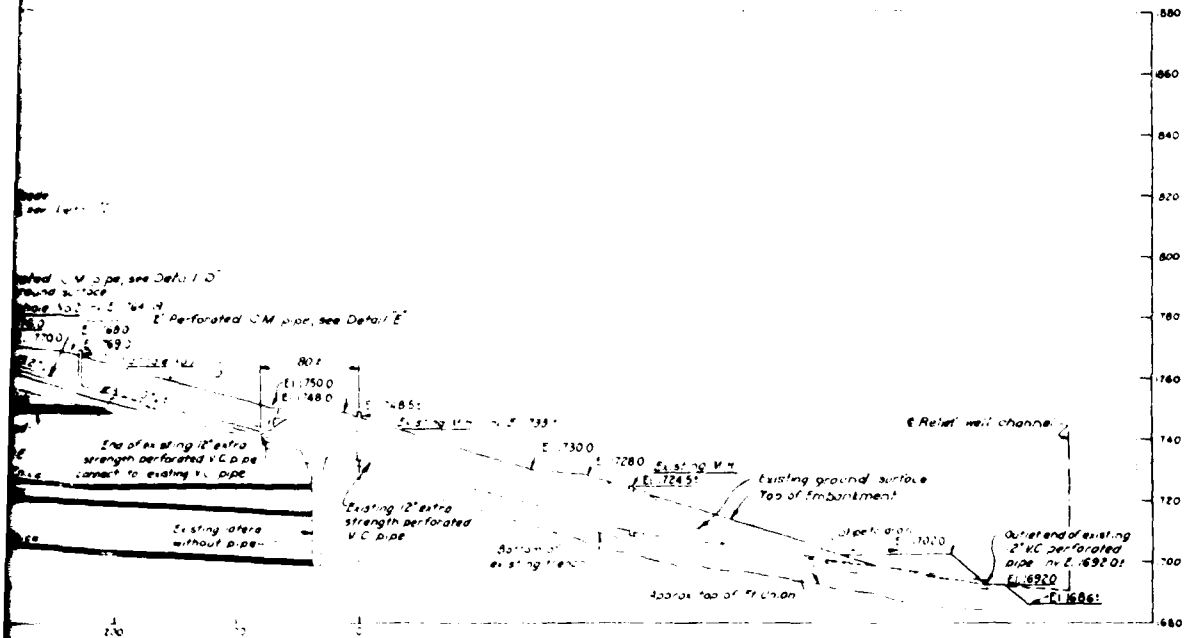
GARRISON DAM AND RESERVOIR
UNDERSEEPAGE STUDIES
TOE AND LIGNITE DRAINS
PLAN AND SEEPAGE OBSERVATIONS

THIS PLAN ACCOMPANIES CONTRACT NO. DA-39-066-eng-
MODIFICATION NO.

SAFETY PAYS

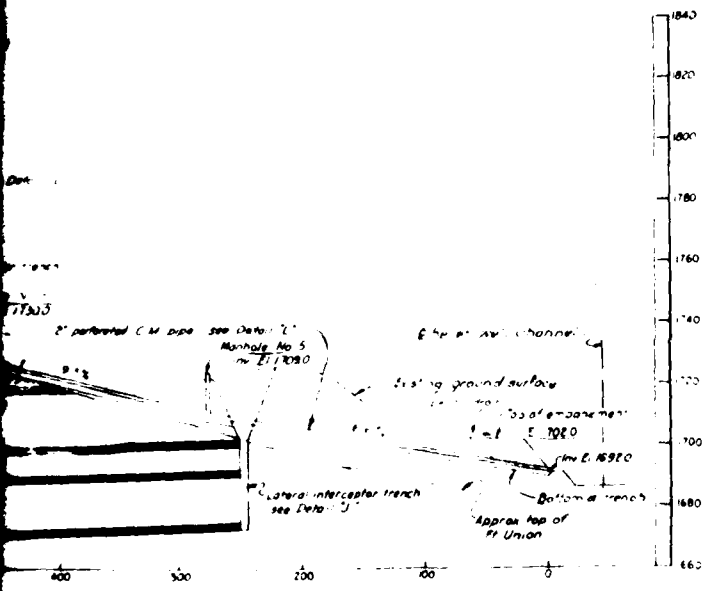

ELEVATION IN FEET - M.S.L.
Bottom of last lift of excavation
Manhole No. 4
Approx top of Ft Union
12" perforated C.M. pipe see Detail 'D'
Lateral interceptor trench see Detail 'B'
Manhole No. 3
Bottom of feeder pipe trench
Light'e bed
12" Perforated C.M. pipe, see Detail 'D'
Existing ground surface
Manhole No. 2
6" Extra strength perforated V.C. feeder pipe to connect to Manhole No. 2 see Detail 'D'
Bottom of feeder pipe trench
Manure gr'e bed
6" Extra strength perforated V.C. toe drain, see Details
End of existing 12" extra strength perforated V.C. pipe connect to existing V.C. pipe
Existing lateral without pipe
PROFILE OF EAST OUTLET TOE
SCALE HOR. 1" = 50'
VERT. 1" = 20'


ELEVATION IN FEET - M.S.L.
Manhole No. 6
Backfill lateral interceptor trench to existing ground on lower side of cut
0.02 Slope
Lateral interceptor trench see Detail 'H'
Approx top of Ft Union
Manhole No. 7
12" perforated C.M. pipe see Detail
Existing ground surface
Light'e bed
6" Extra strength perforated V.C. pipe lateral
6" Extra strength perforated V.C. feeder pipe see Detail
Bottom of lignite drain trench
Manhole No.
Gr'e bed
PROFILE OF EAST ABUTMENT LIGNITE DRAIN
SCALE HOR. 1" = 50'
VERT. 1" = 20'



PROFILE OF EAST OUTLET TOE TRENCH

SCALE HOR. 1"=50'
VERT. 1"=20



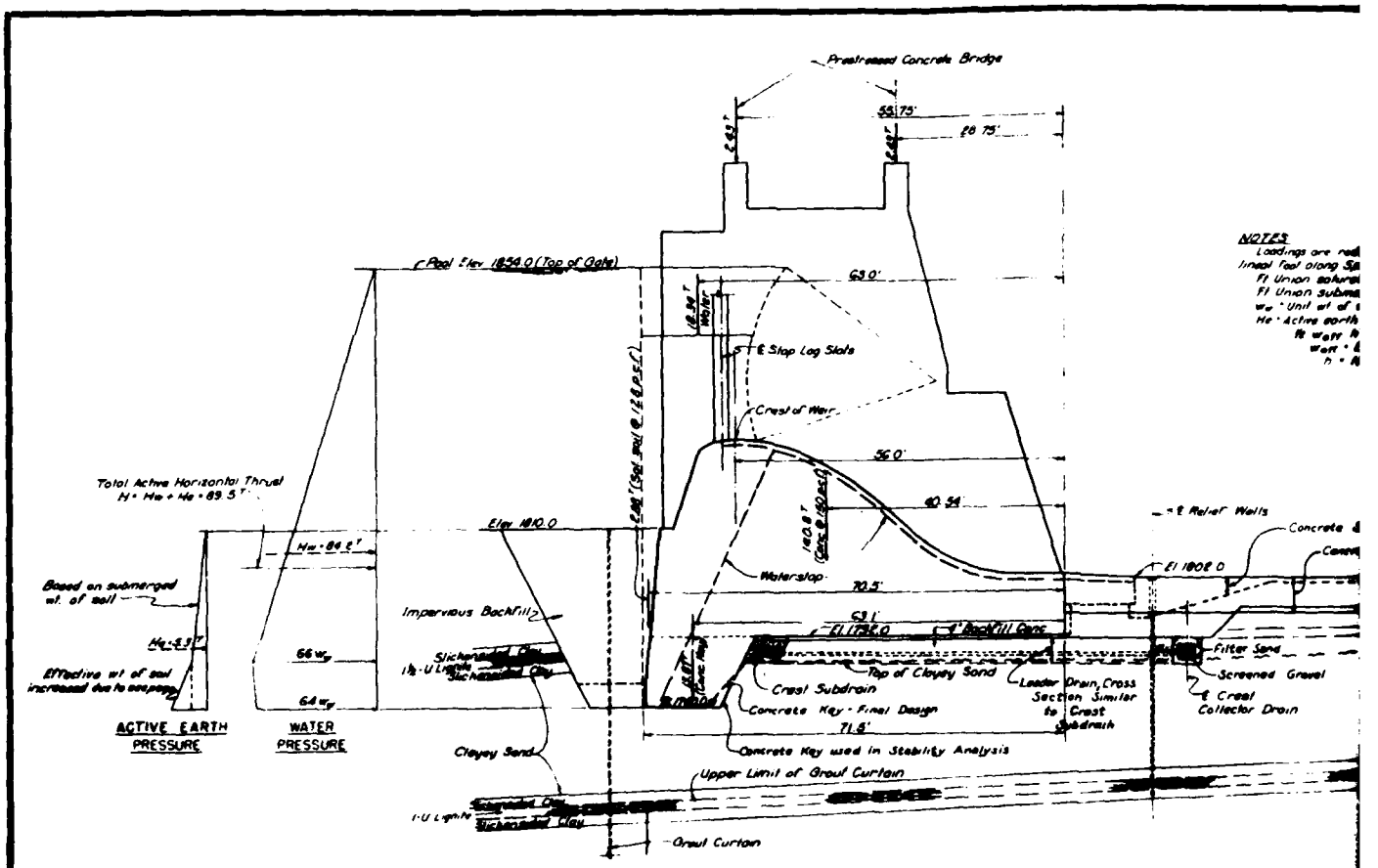
UTMENT LIGNITE DRAIN

NOTE

PROFILES FOR THIS PLATE TAKEN FROM STAGE IV CONTRACT, DRAWING GE 10-6/11

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

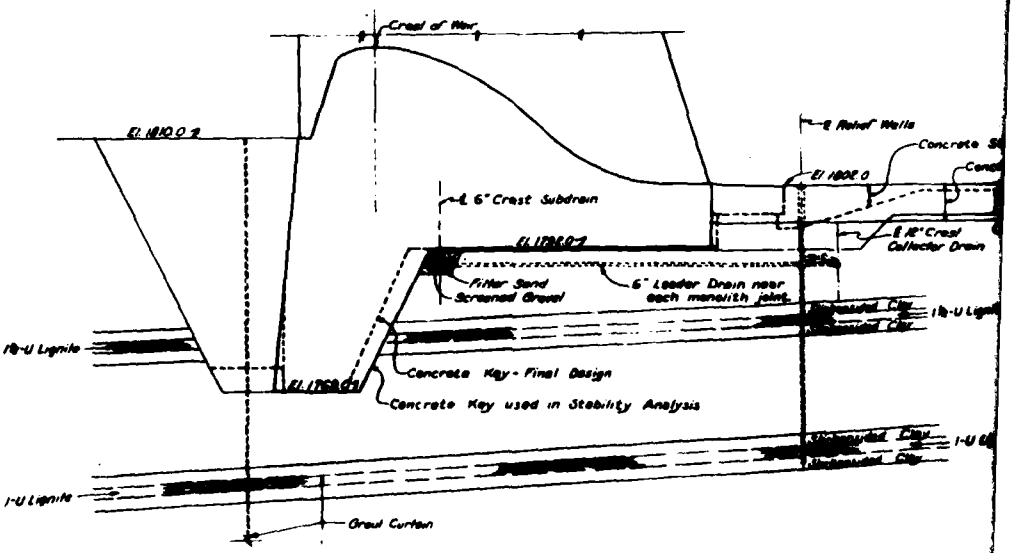
GARRISON DAM AND RESERVOIR
UNDERSEEPAGE STUDIES
TOE AND LIGNITE DRAINS
EAST ABUTMENT PROFILES



SHALLOW KEY SECTION - 140' E. OF ℄

SCALE 1" = 10'

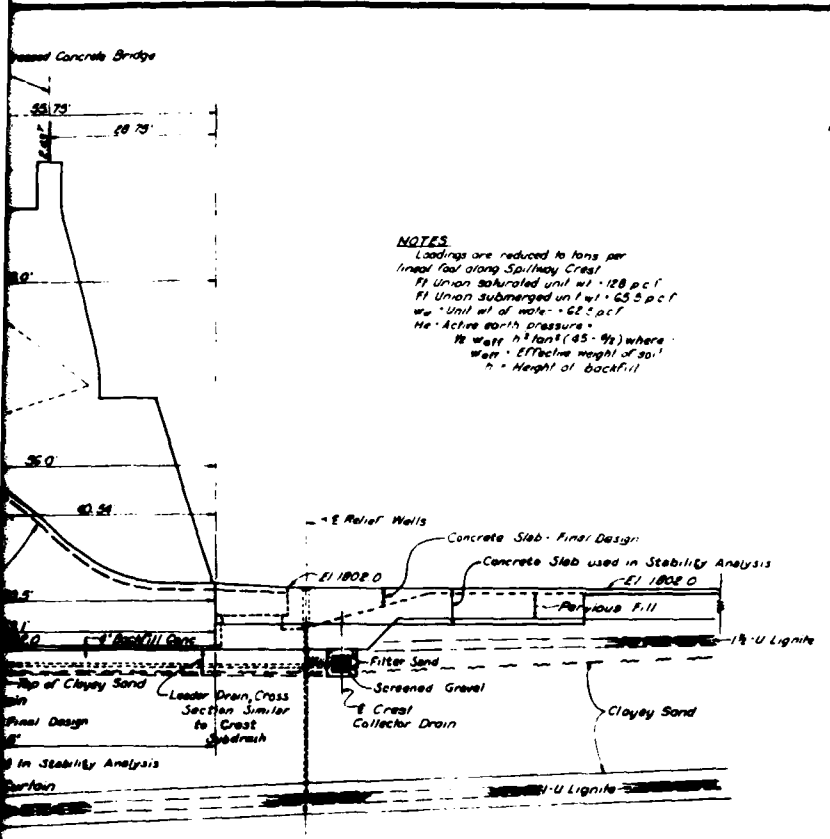
FIG. 1



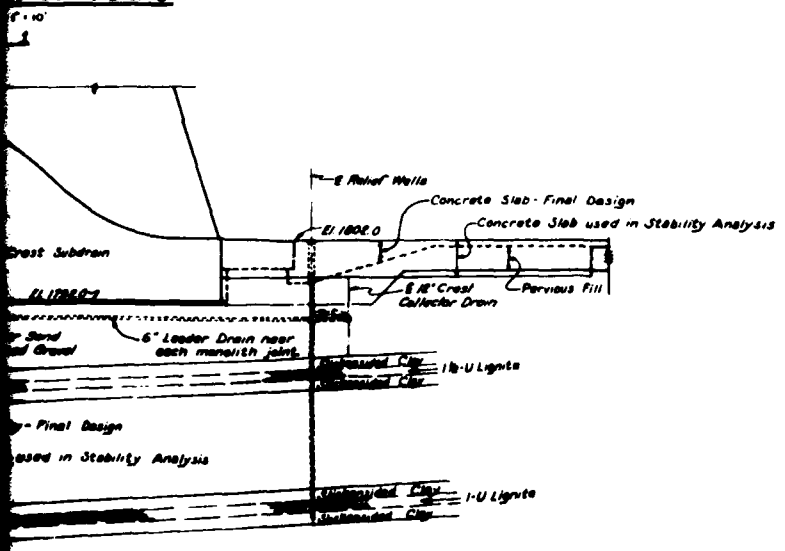
DEEP KEY SECTION - 20' E. OF ℄

SCALE 1" = 10'

FIG. 2



CTION - 140' E. OF ℄

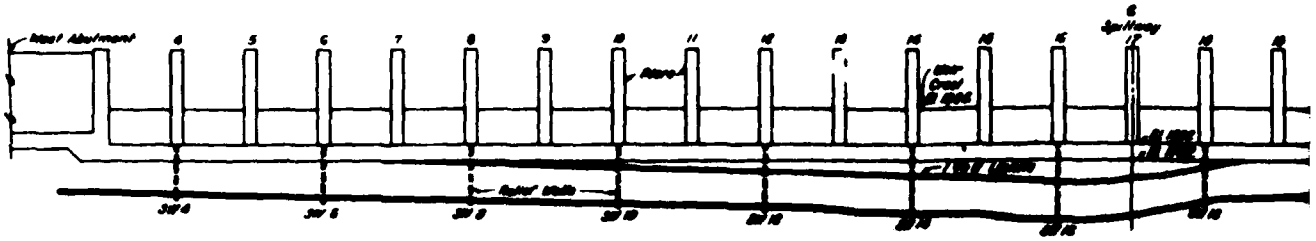


- 20' E. OF ℄

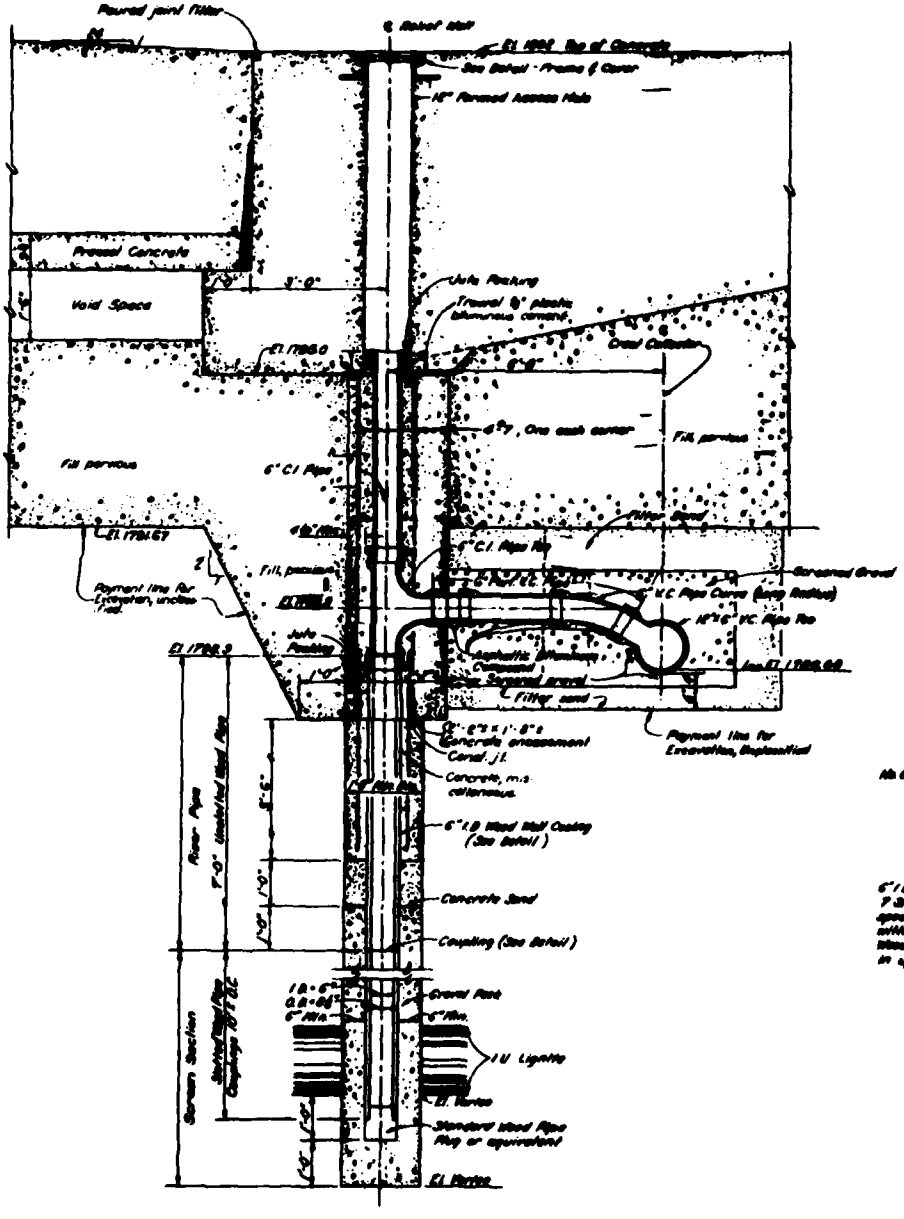
GENERAL NOTES:
1 For flow net and uplift on failure arc, see Dwg No. GSX-5/57
2 Crest structure loading used for Stability Analysis shown in Fig 1, final design section differs slightly, See Plate Nos [illegible]

U. S. ARMY
CORPS OF ENGINEERS
OFFICE OF THE DIVISION ENGINEER
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SPILLWAY CREST STABILITY
GENERALIZED ANALYSIS SECTIONS
March 1952
GSX-5/61

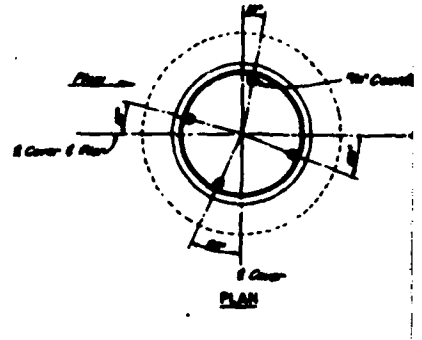
2



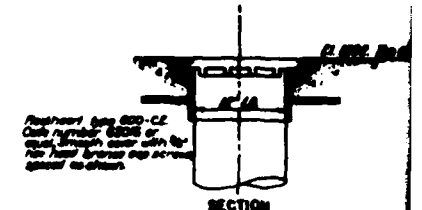
PROFILE ALONG RELIEF WELLS LOOKING UPSTREAM



RELIEF WELL DETAILS

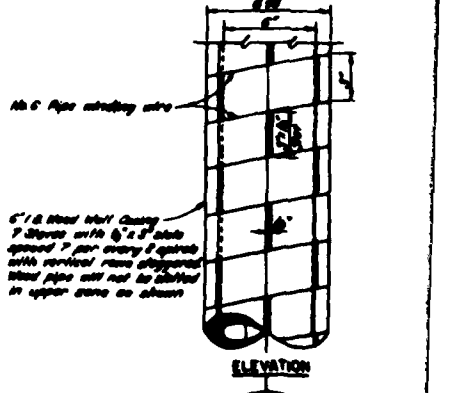


PLAN



SECTION

DETAIL - FRAME & COVER

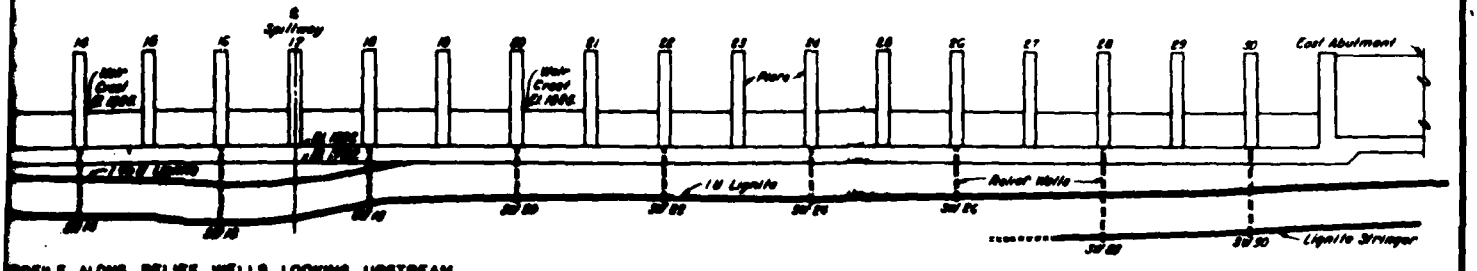


ELEVATION



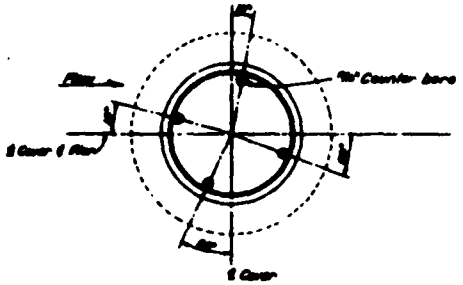
SECTION

DETAIL OF SLOTTED WOOD PIPE

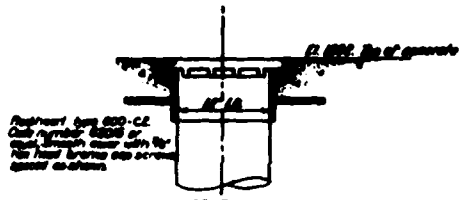


PROFILE ALONG RELIEF WELLS LOOKING UPSTREAM

SCALE 1" = 20'



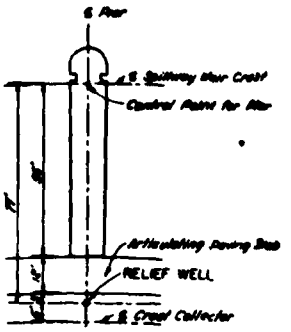
PLAN



SECTION

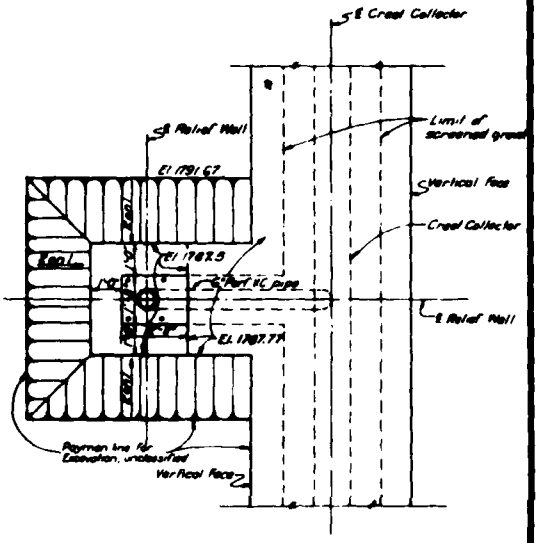
DETAIL - FRAME & COVER

SCALE 1 INCH = 1'-0"



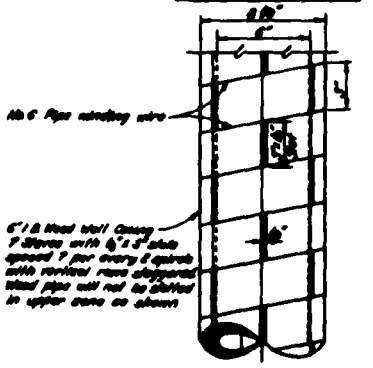
TYPICAL LOCATION OF RELIEF WELL

SCALE 1" = 100'



EXCAVATION PLAN RELIEF WELL PIT

SCALE 1" = 5'



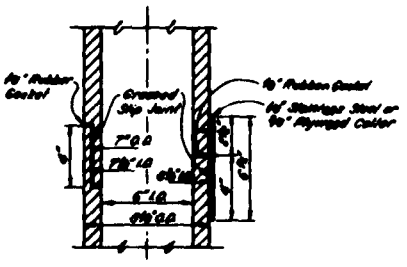
ELEVATION



SECTION

DETAIL OF SLOTTED WOOD PIPE

SCALE 3" = 1'-0"



INSERTED JOINT COUPLING

ALTERNATE DETAIL COLLAR COUPLING

DETAIL OF COUPLING

SCALE 3" = 1'-0"

NOTES

Position of lignites on profile estimated between borings. Exact depth of wells to be determined in field dependent on lignites as encountered.

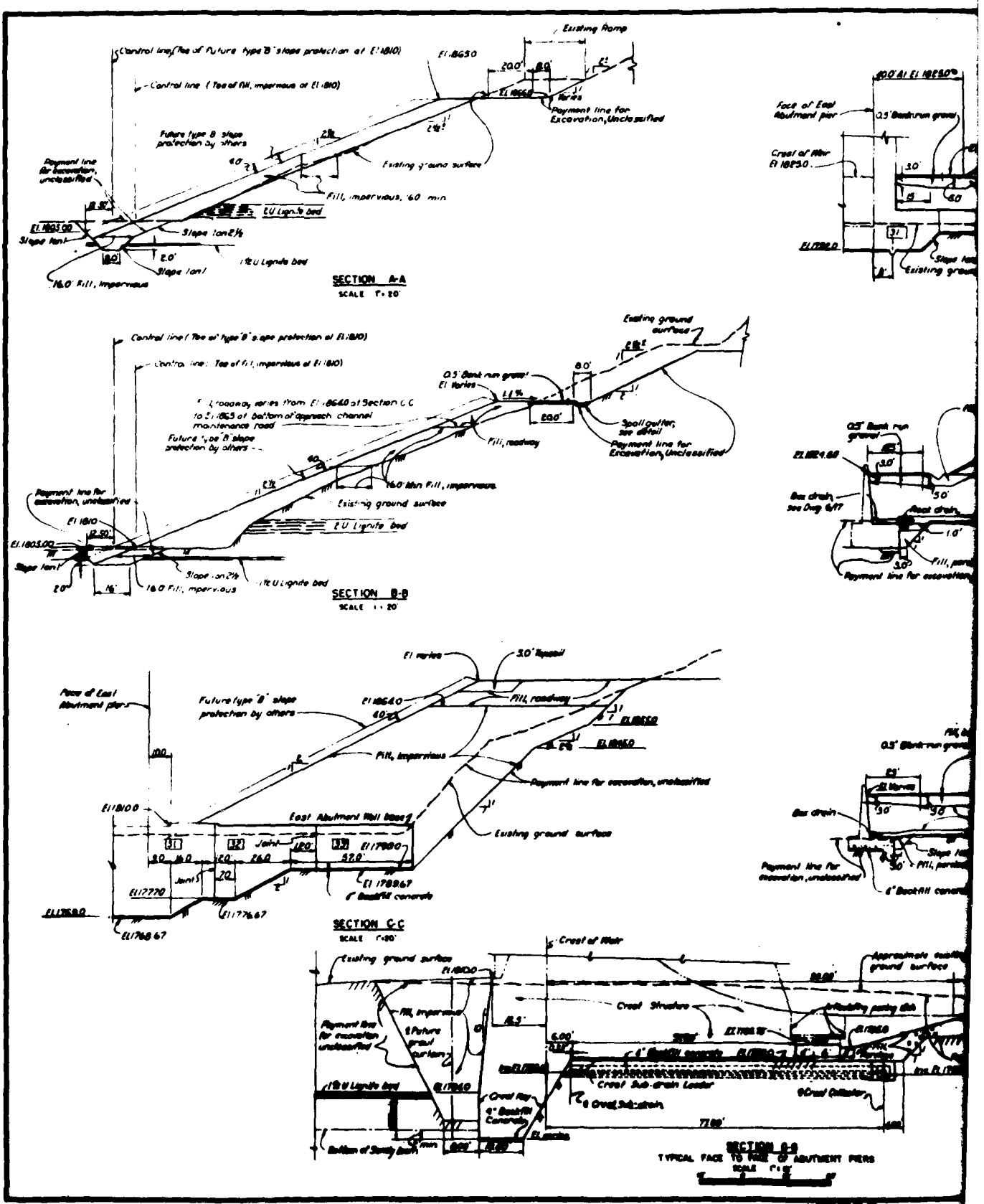
U. S. ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

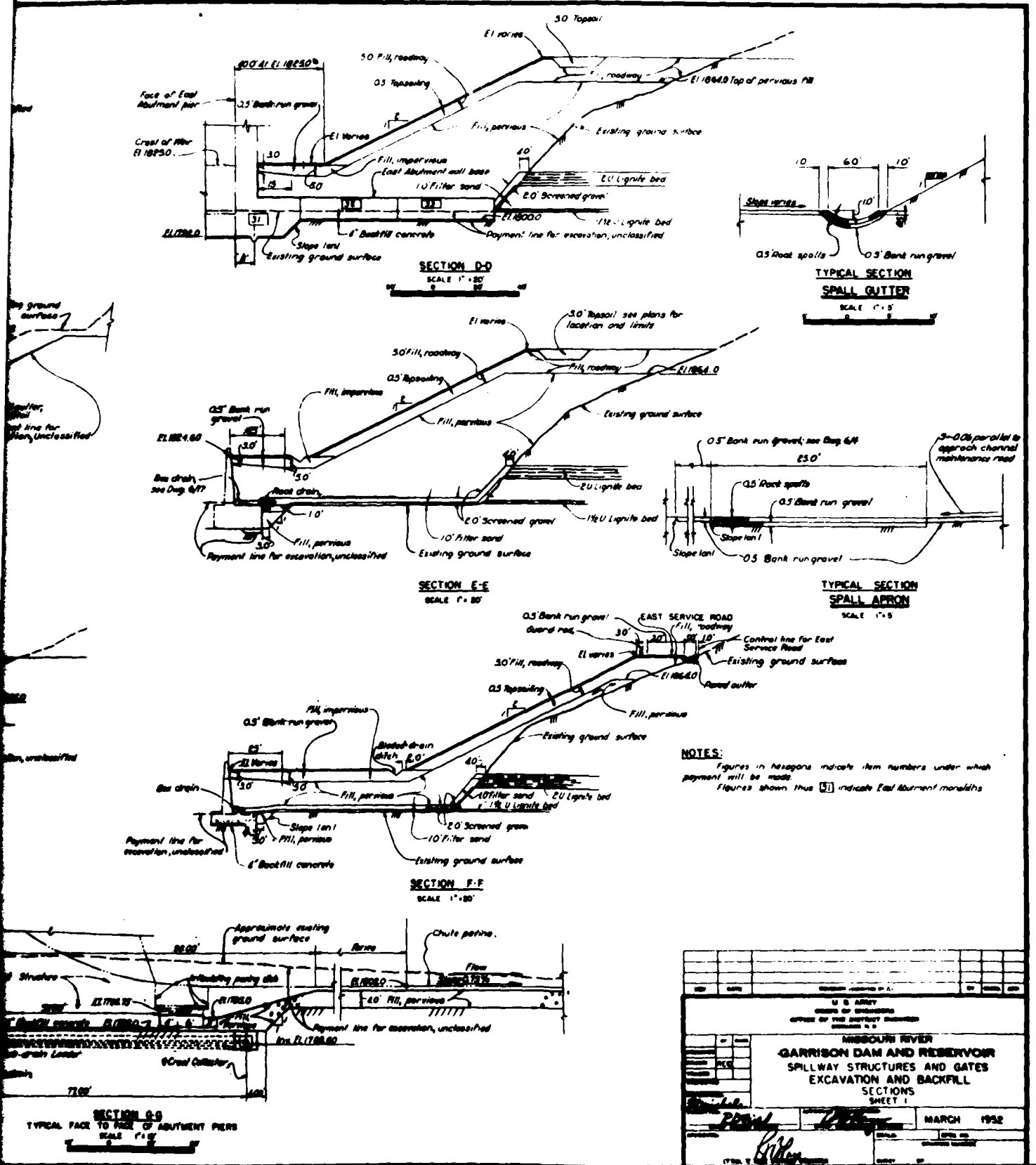
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SPILLWAY STRUCTURES
DRAINAGE
RELIEF WELLS

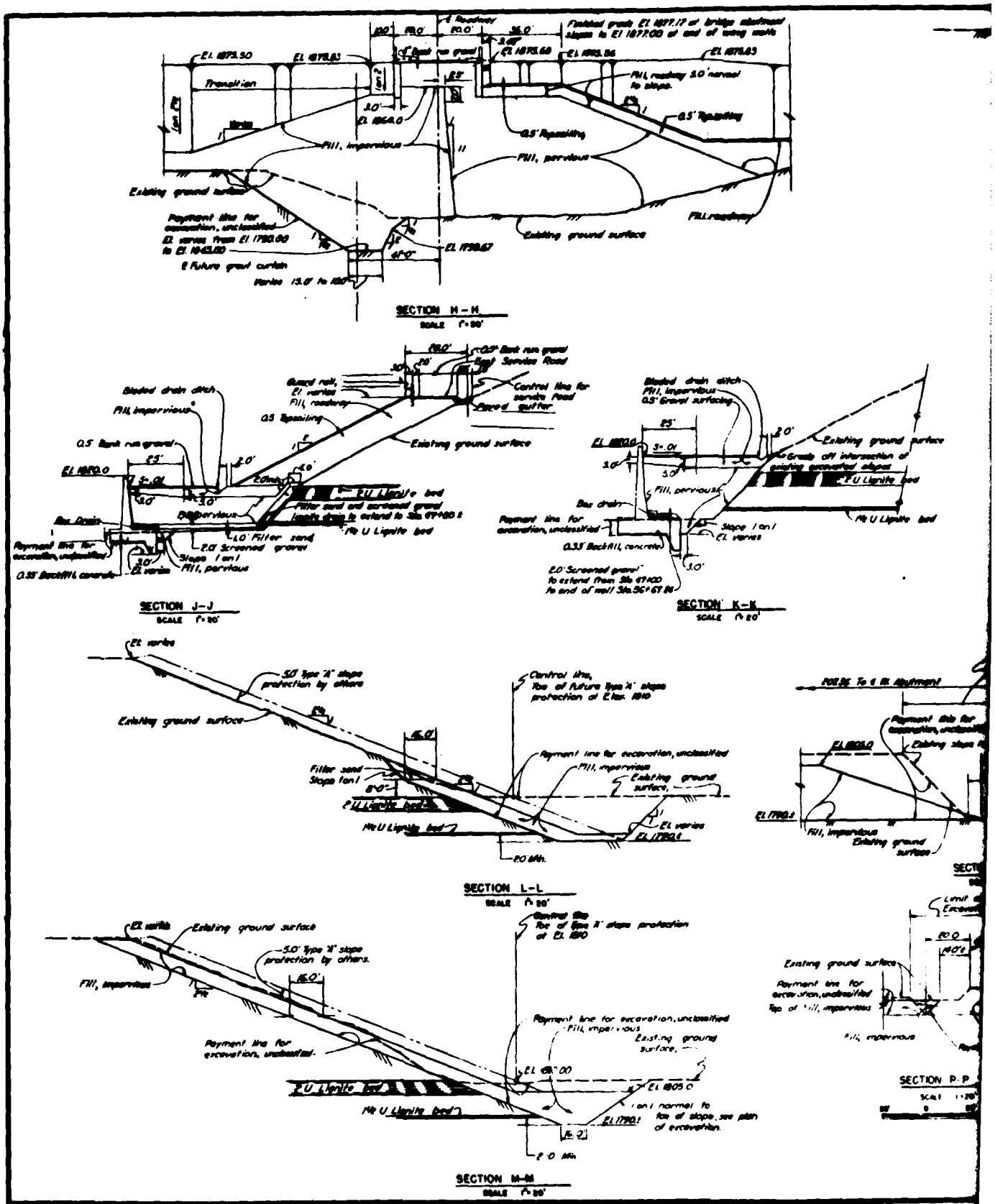
MARCH 1952

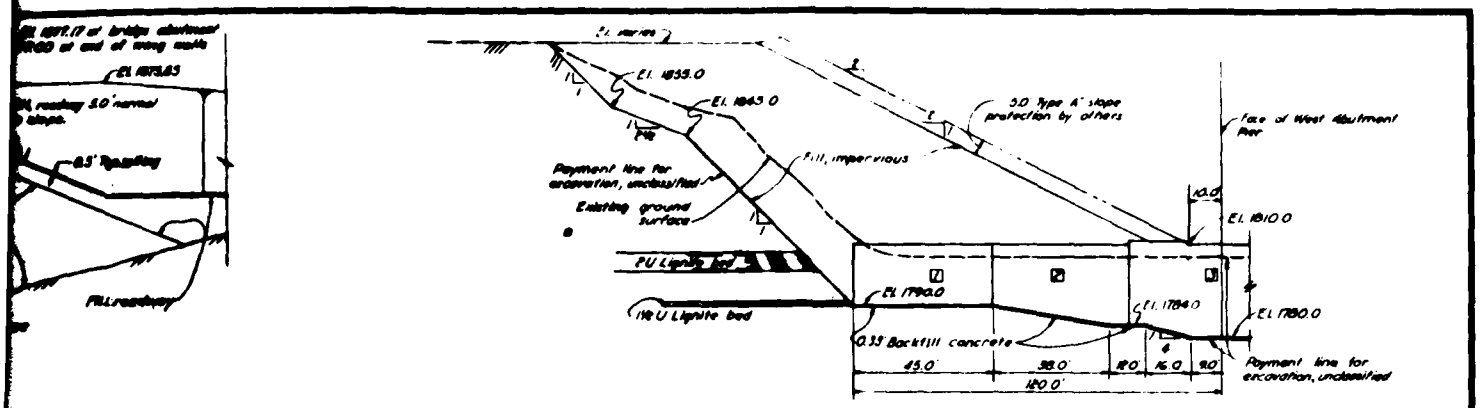
651-678

2

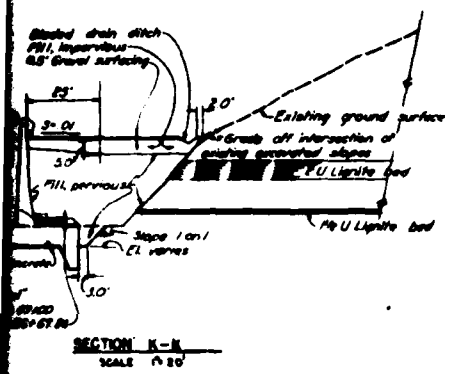

Existing Ramp
Control line (Toe of Future type 'B' slope protection at El 1810)
Control line (Toe of fill, impervious at El 1810)
El 1865.0
El 1866.0
Payment line for Excavation, Unclassified
Future type B slope protection by others
Existing ground surface
Fill, impervious, 60 min.
EU Lignite bed
Slope 1on2½
Slope 1on1
1'E U Lignite bed
16.0' Fill, impervious
SECTION A-A
SCALE 1" = 20'
Face of East Abutment pier
0.5' Blanket run gravel
Crest of Weir El 1825.0
Slope 1on1
Existing ground
Control line (Toe of type 'B' slope protection at El 1810)
Control line (Toe of fill, impervious at El 1810)
Existing ground surface
0.5' Blanket run gravel
El Varies
Roadway varies from El 1864.0 at Section C-C to El 1865 at bottom of approach channel
maintenance road
Future type 'B' slope protection by others
Fill, roadway
Spoil gutter, see detail
Payment line for Excavation, Unclassified
16.0' Min Fill, impervious
Existing ground surface
EU Lignite bed
El 1810
El 1805.00
Slope 1on1
Slope 1on2½
1'E U Lignite bed
16.0 Fill, impervious
SECTION B-B
SCALE 1" = 20'
El varies
3.0' Topsoil
Face of East Abutment pier
Future type 'B' slope protection by others
El 1864.0
Fill, roadway
Fill, impervious
Payment line for excavation, unclassified
El 1810.0
East Abutment Wall Base
Existing ground surface
Joint
El 1798.0
El 1798.67
6' Backfill concrete
El 1776.67
SECTION C-C
SCALE 1"=20'
Existing ground surface
El 1810.0
Fill, impervious
Payment line for excavation unclassified
Future grout curtain
EU Lignite bed
El 1794.0
Crest of Weir
Crest Structure
Crest Sub-drain Leader
Crest Sub-drain
Crest Diffuser
Approximate existing ground surface
El 1788.0
El 1788.67
SECTION D-D
TYPICAL FACE TO FACE OF ABUTMENT PIERS
SCALE 1"=5'


SECTION D-D
SCALE 1" = 20'
TYPICAL SECTION
SPALL GUTTER
SCALE 1" = 5'
SECTION E-E
SCALE 1" = 20'
TYPICAL SECTION
SPALL APRON
SCALE 1" = 5'
SECTION F-F
SCALE 1" = 20'
SECTION G-G
TYPICAL FACE TO FREE OF ABUTMENT PIERS
SCALE 1" = 10'
NOTES:
Figures in hexagons indicate item numbers under which payment will be made.
Figures shown thus [51] indicate East Abutment monoliths.
U S ARMY
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SPILLWAY STRUCTURES AND GATES
EXCAVATION AND BACKFILL
SECTIONS
SHEET 1
MARCH 1952

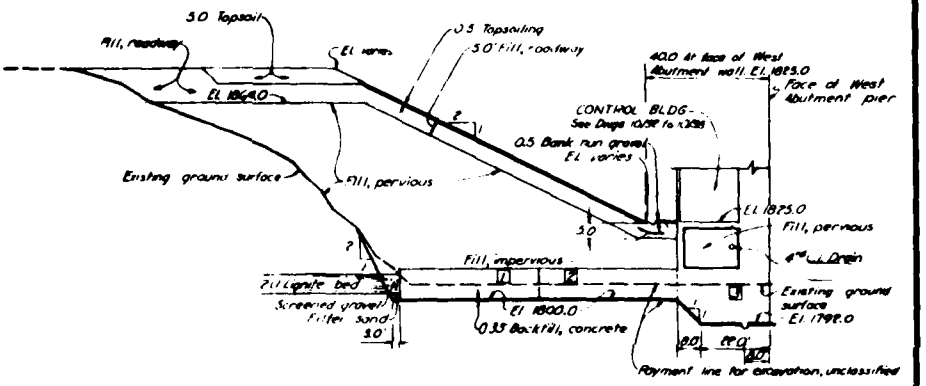

SECTION H – H
SCALE 1" = 20'
SECTION J – J
SCALE 1" = 20'
SECTION K – K
SCALE 1" = 20'
SECTION L – L
SCALE 1" = 20'
SECTION M – M
SCALE 1" = 20'
SECTION P – P
SCALE 1" = 20'
Existing ground surface
Fill, impervious
Fill, pervious
Fill, roadway
Payment line for excavation, unclassified
Payment line for excavation, unclassified
Fill, impervious
Existing ground surface
Filter sand
Slope 1 on 1
Mt U Lignite bed
Fill, impervious
Existing ground surface
Bleeded drain ditch
Fill, impervious
0.5' Gravel surfacing
Existing ground surface
Fill, pervious
Bed drain
Payment line for excavation, unclassified
0.33' Backfill, concrete
2.0' Screened gravel
Mt U Lignite bed
Slope 1 on 1
El. varies
Existing ground surface
Fill, impervious
Existing ground surface
Payment line for excavation, unclassified
Fill, impervious
Existing ground surface
Mt U Lignite bed
Slope 1 on 1 normal to toe of slope, see plan of excavation.
Existing ground surface
Payment line for excavation, unclassified
Fill, impervious



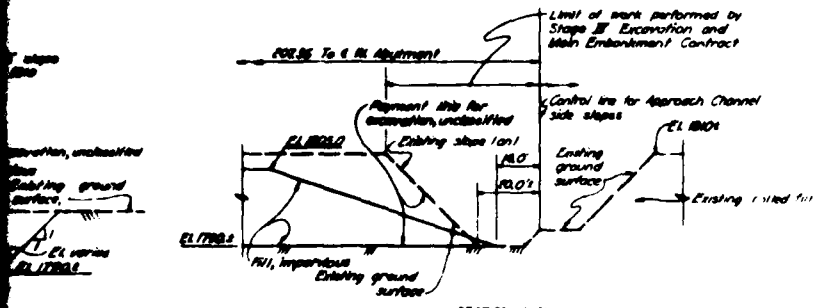
SECTION R-R
SCALE 1" = 20'



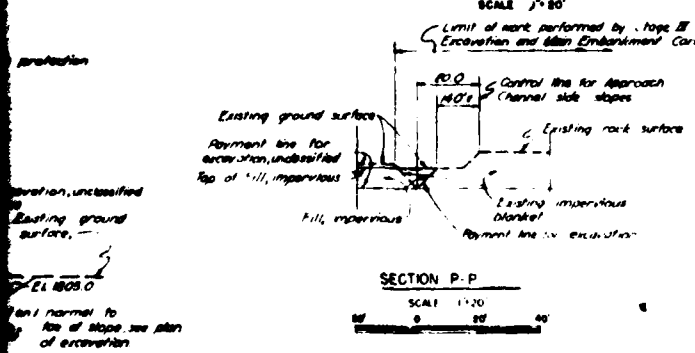
SECTION K-K
SCALE 1" = 20'



SECTION S-S
SCALE 1" = 20'



SECTION N-N
SCALE 1" = 20'



SECTION P-P
SCALE 1" = 20'

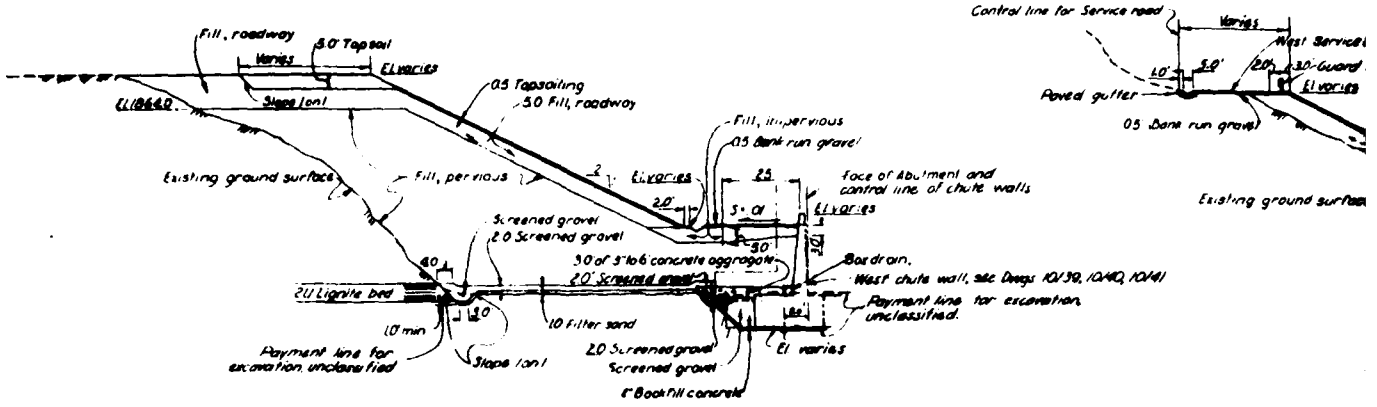
NOTES

Figures in hexagons indicate item numbers under which payment will be made.
Figures shown thus [2] indicate number of [illegible] Structure Excavation

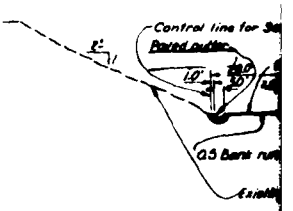
U. S. ARMY
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OFFICE OF THE DISTRICT ENGINEER

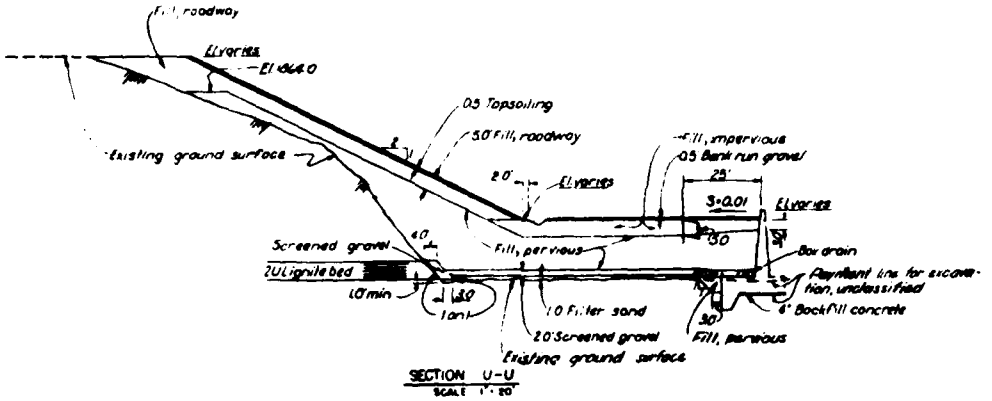
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SPILLWAY STRUCTURES AND GATES
EXCAVATION AND BACKFILL
SECTIONS
SHEET 2

MARCH 1952

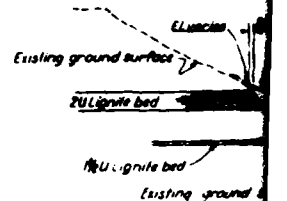


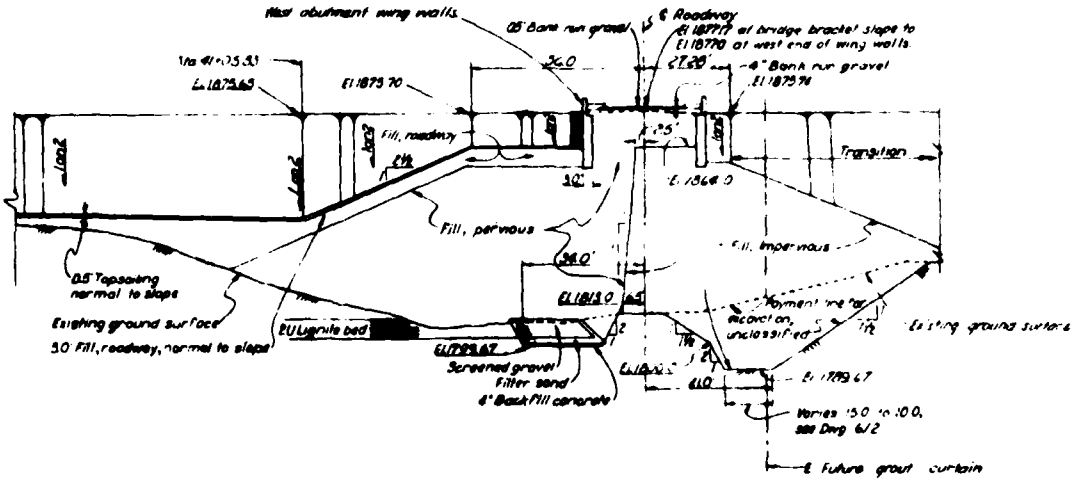
SECTION T-T
SCALE 1" = 20'



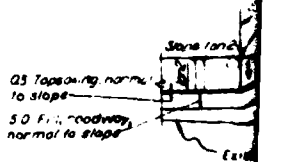


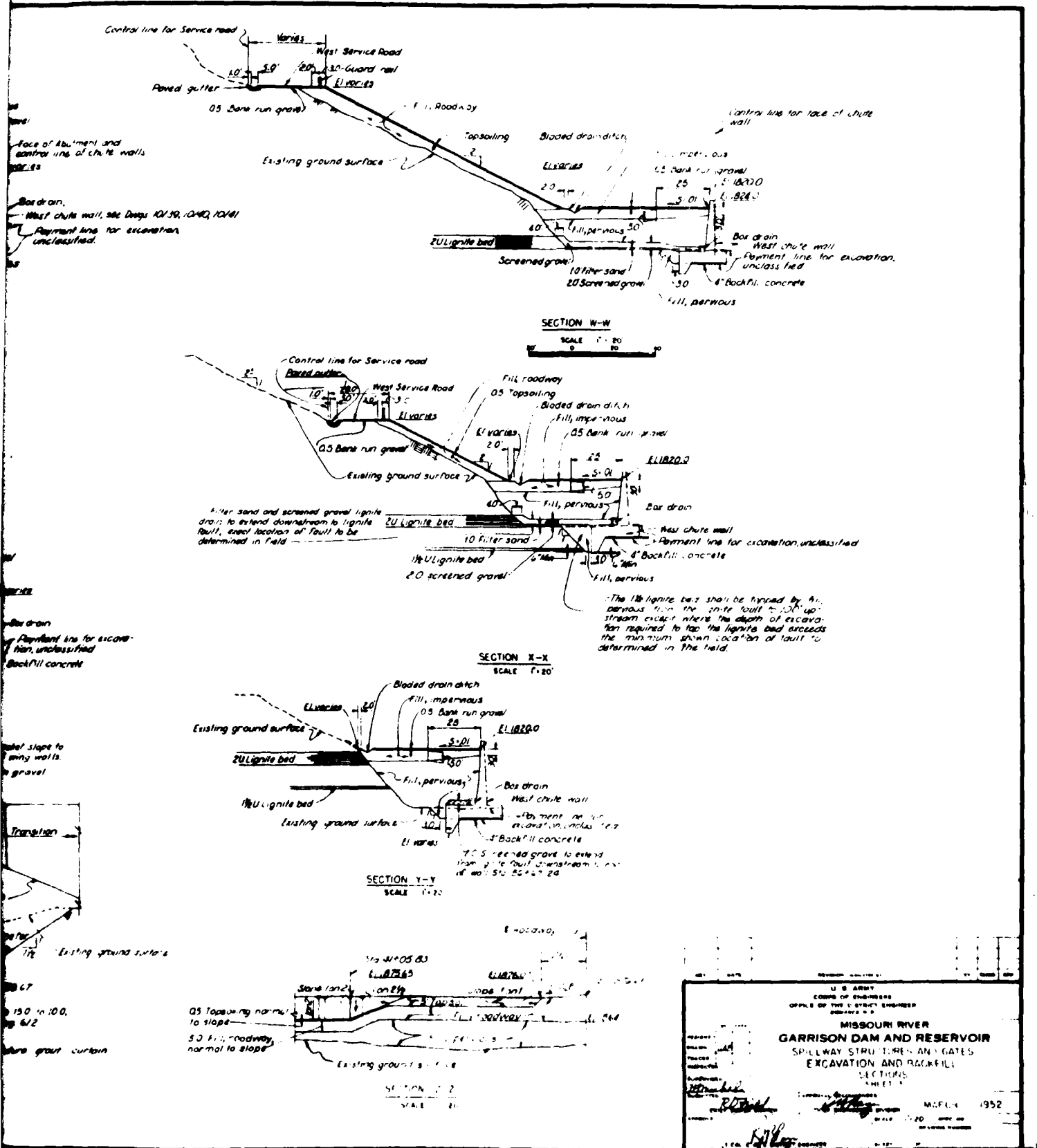
SECTION U-U
SCALE 1" = 20'

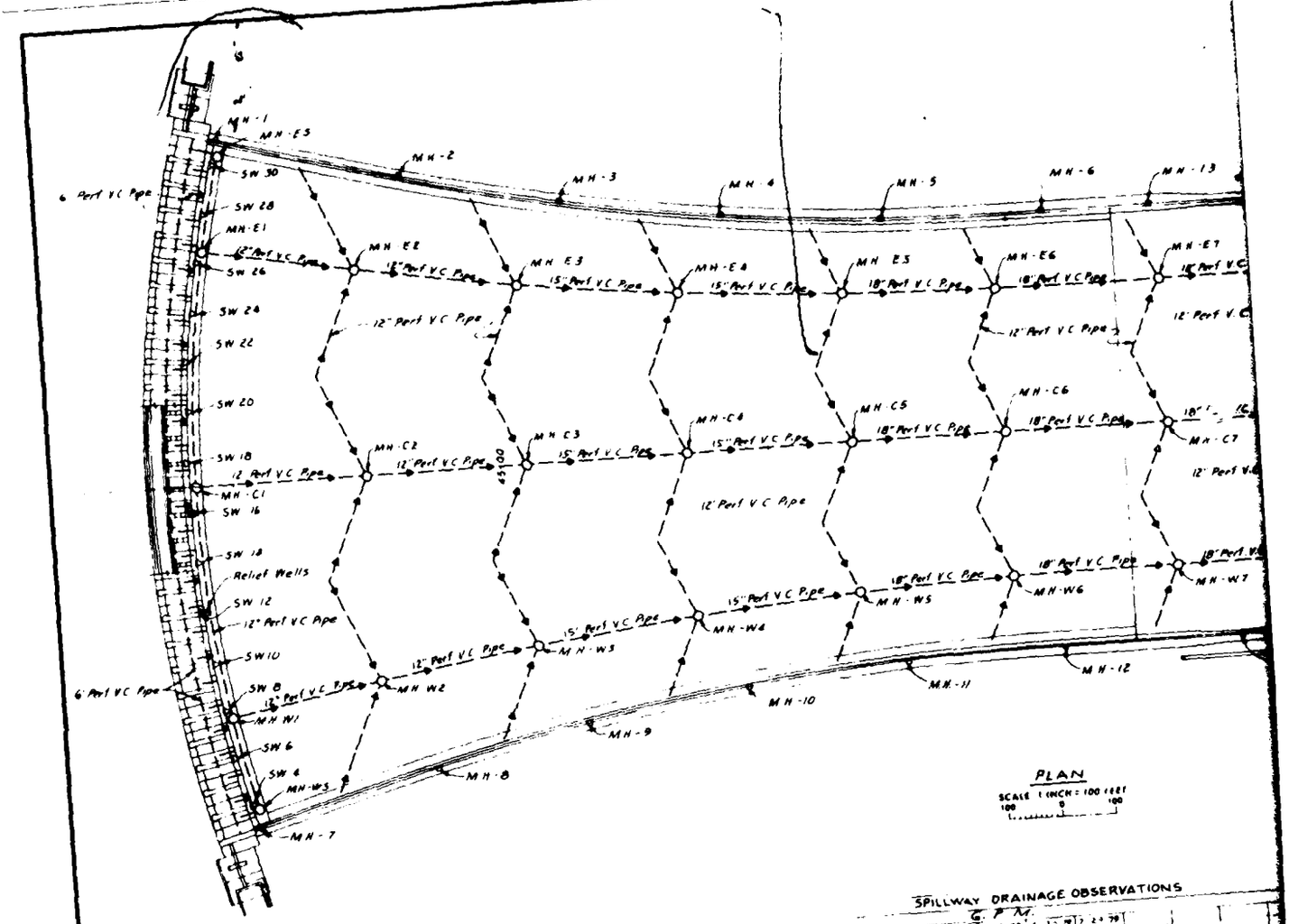




SECTION V-V
SCALE 1" = 20'




Control line for Service road
Varies
West Service Road
Paved gutter
El varies
Fill, roadway
Topsoiling
Bladed drain ditch
Existing ground surface
Fill, impervious
Bank run gravel
Box drain
West chute wall
Payment line for excavation, unclassified
2U Lignite bed
Screened gravel
10 filter sand
20 Screened gravel
6" Backfill concrete
Fill, pervious
SECTION W-W
SCALE
Filter sand and screened gravel lignite drain to extend downstream to lignite fault, exact location of fault to be determined in field
1½U Lignite bed
2.0 screened gravel
The 1½ lignite bed shall be bridged by fill pervious from the onsite fault to 100' upstream except where the depth of excavation required to top the lignite bed exceeds the minimum shown location of fault to determined in the field.
SECTION X-X
SCALE
Transition
Existing ground surface
SECTION Y-Y
SCALE
Stone lining
Fill, roadway normal to slope
Existing ground surface
U S ARMY
CORPS OF ENGINEERS
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SPILLWAY STRUCTURES AND GATES
EXCAVATION AND BACKFILL
SECTIONS
SHEET 1
MARCH 1952



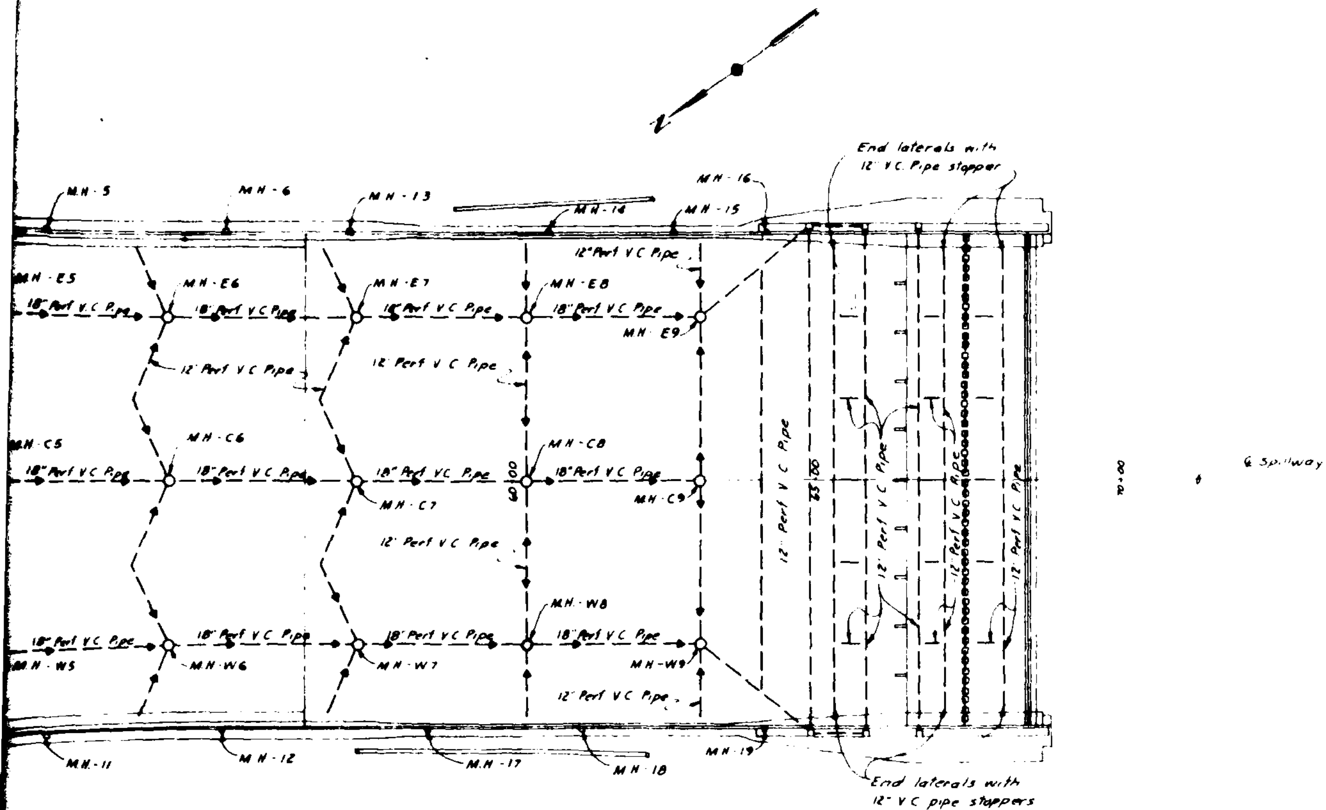
PLAN

SCALE 1 INCH = 100 FEET

100 0 100

SPILLWAY DRAINAGE OBSERVATIONS

DATE	11-22-76	4-23-75	10-22-75	4-1-76	9-21-76	4-21-77	9-21-77	4-28-78	9-5-78	10-29-79	3471
MH #2	SMALL FLOW	NO FLOW	SMALL FLOW	NO FLOW		NO FLOW	NO FLOW	NO FLOW	N.F.	N.F.	
MH #8	NO FLOW	NO FLOW	NO FLOW	NO FLOW		NO FLOW	70 FLOW	NO FLOW	N.F.	N.F.	1.0
MH #6	SMALL FLOW	SMALL FLOW	SMALL FLOW	NO FLOW		NO FLOW	1.0	2.5	FLOW	SMALL FLOW	
MH #12	NO FLOW	NO FLOW	N.F.	NO FLOW		NO FLOW	NO FLOW	N.F.	DAMP	DAMP	
MH-E7 East	FLOW .205	FROZEN		FROZEN	22	21	WET	WET	.5	3.75	
North	4.6				3.30	3.02	2.00	3.6	LAMP	DRY	
West	DRY				DRY	DRY	DRY	DRY	DRY	DRY	
MH-C7 East	DRY				DRY	DRY	DRY	DRY	.736	1.5	
North	.5				3.08	4.62	1.50	1.70	DRY	DRY	
West	DRY				DRY	DRY	DRY	DRY	DAMP	3.75	
MH-W7 East	DRY				DRY	DRY	.75	3.0	4.0	DAMP	
North	7.5				4.08	3.97	DRY	DRY	DAY	DRY	24 GPM
West	.167				0.11	0.18	NO FLOW	N.F.		DRY	
MH-15 or Outfall	NO FLOW						NO FLOW	N.F.			
MH-18 or Outfall	NO FLOW										



PLAN

SCALE 1 INCH = 100 FEET

100 0 100

SPILLWAY DRAINAGE OBSERVATIONS

G.P.M.

[illegible]1-77	6-28-78	7-[illegible]-78	[illegible]-79	7-27-79	
NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW	95/11
NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW	
1.0	.25	Small flow hard to measure	small flow hard to measure	FLOW	.D
NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW	
WET	WET	DAMP	[illegible]	DAMP	
2.00	3.4	[illegible]		3.75	
DRY	DRY	DAMP		DRY	
DRY	DRY	DRY		DRY	
1.50	1.70	1.34		1.5	
DRY	DRY	DRY		DRY	
DRY	DRY	DAMP		DRY	
.75	3.0	4.21		3.75	
DRY	DRY	DRY		DAMP	
NO FLOW	NO FLOW		NO FLOW	DRY	24 GPM
NO FLOW	NO FLOW		NO FLOW	DRY	

THIS DRAWING HAS BEEN REDUCED TO THREE EIGHTHS THE ORIGINAL SCALE

DATE	DESCRIPTION	MADE	APPR'D

REVISIONS

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

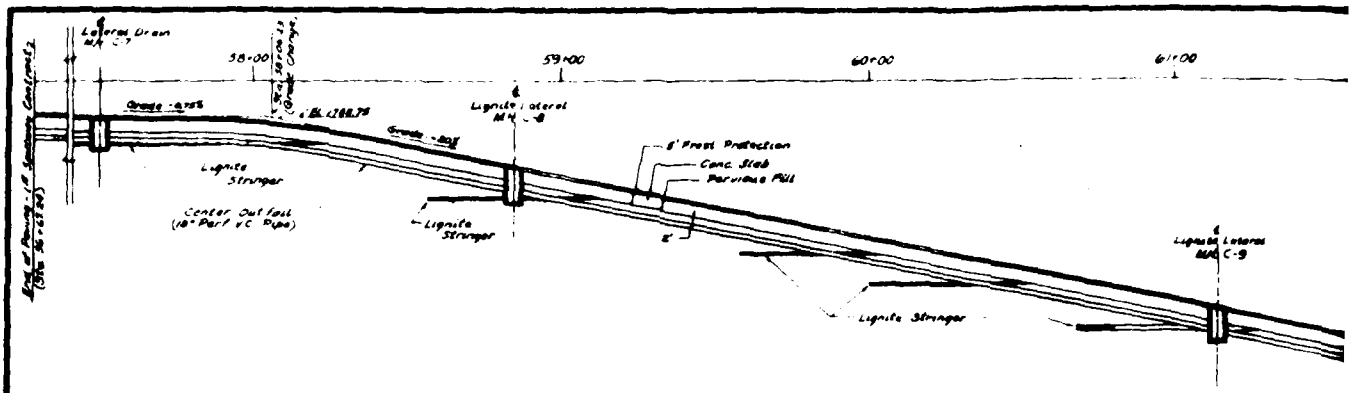
MISSOURI RIVER

GARRISON DAM AND RESERVOIR
UNDERSEEPAGE STUDIES
SPILLWAY
SUB-SURFACE DRAINAGE SYSTEM

SAFETY PAYS

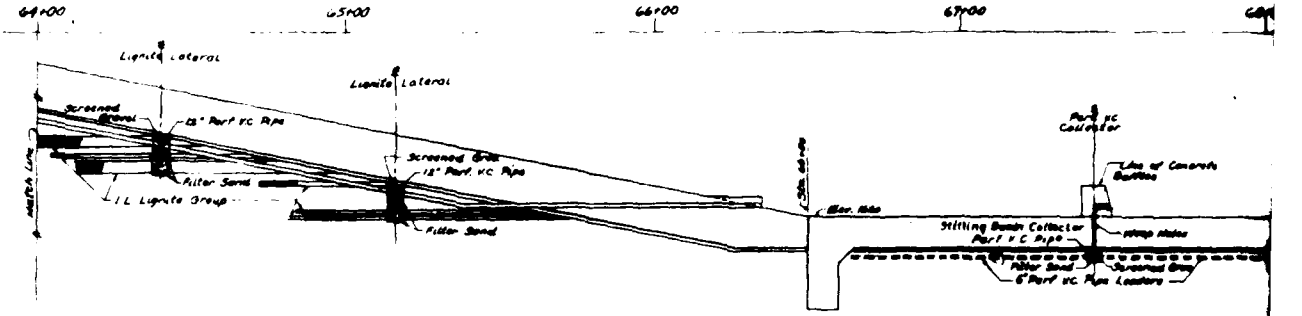
THE PLAN ACCOMPANIES CONTRACT No.
MODIFICATION No.

SCALE AS SHOWN



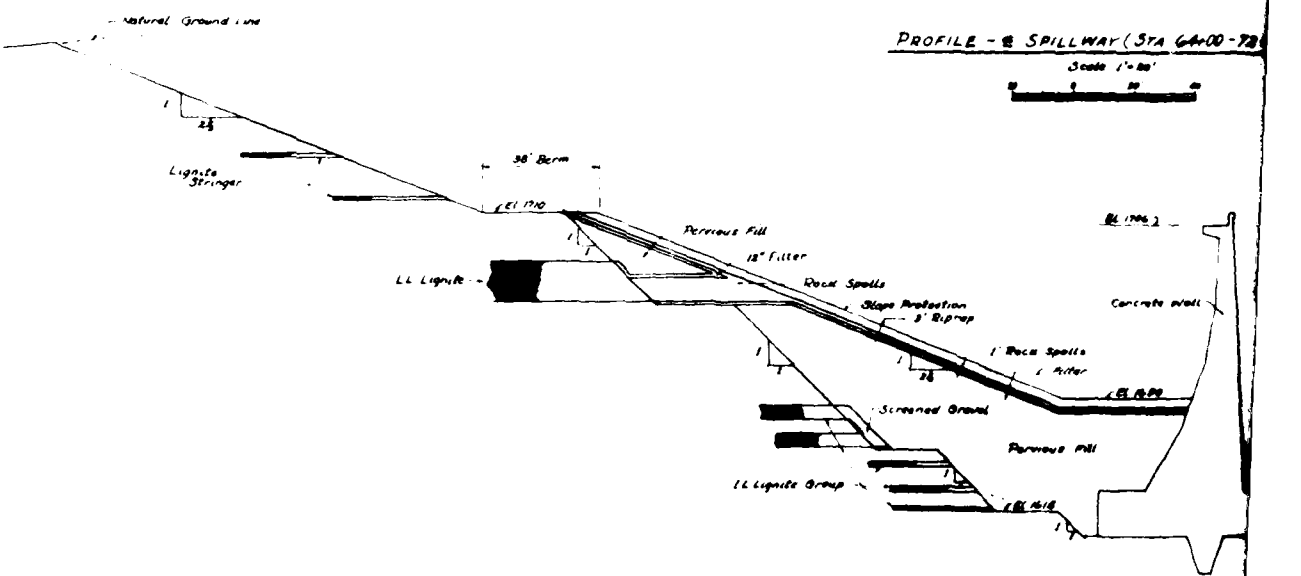
PROFILE - ℄ SPILLWAY (STA 56+67.2

Scale - 1" = 20'



PROFILE - ℄ SPILLWAY (STA 64+00 - 73

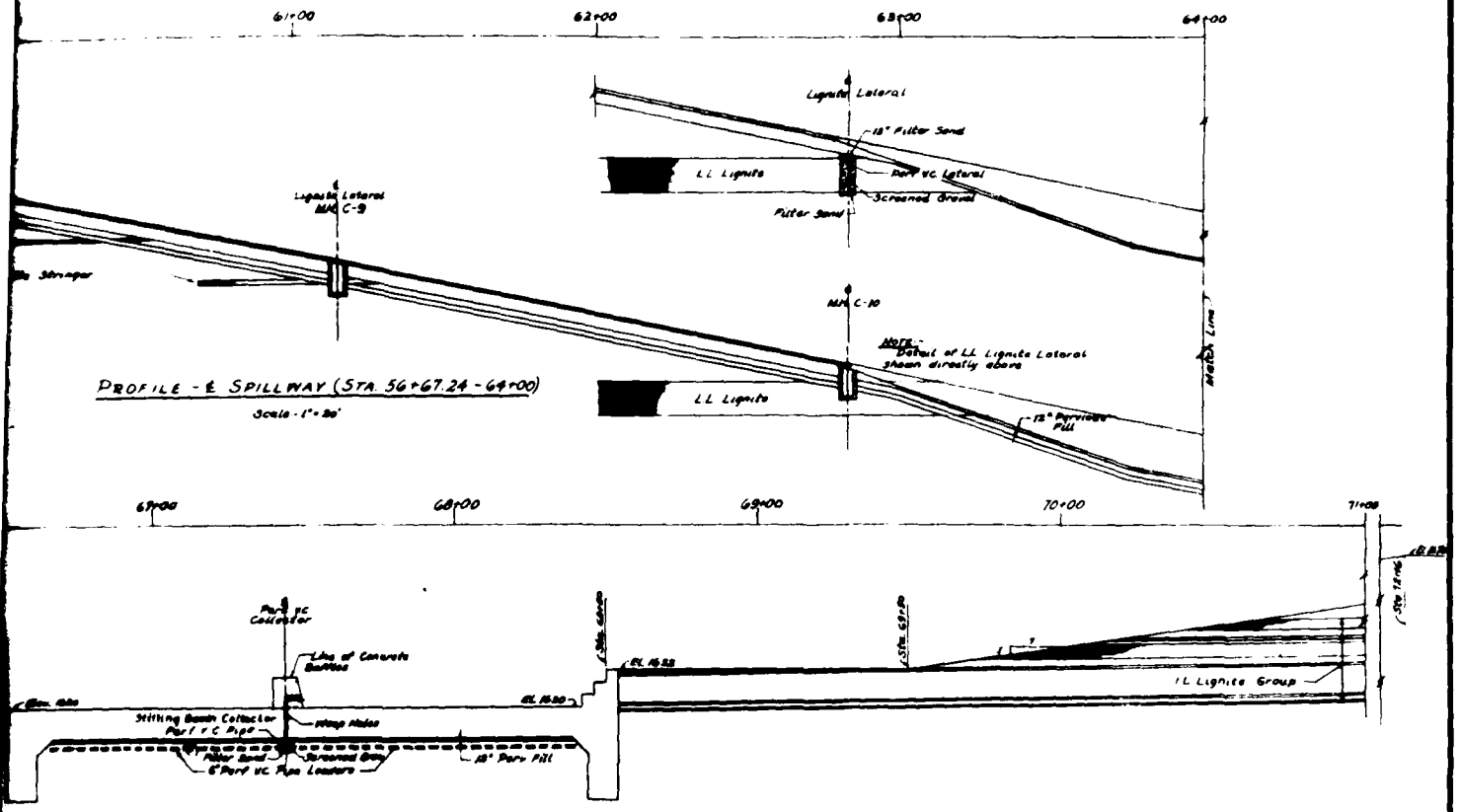
Scale 1" = 20'



SECTION THRU LIGNITE DRAINS ℄ B

BEHIND STILLING BASIN WALL - WEST SI

Scale 1" = 20'

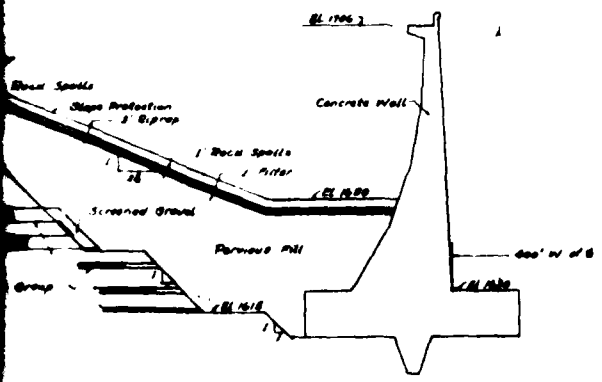


PROFILE - ℄ SPILLWAY (STA. 56+67.24 - 64+00)

Scale - 1" = 80'

PROFILE - ℄ SPILLWAY (STA 64+00 - 72+50)

Scale: 1" = 80'



SECTION THRU LIGNITE DRAINS & BACKFILL BEHIND STILLING BASIN WALL - WEST SIDE - STA. 67+00

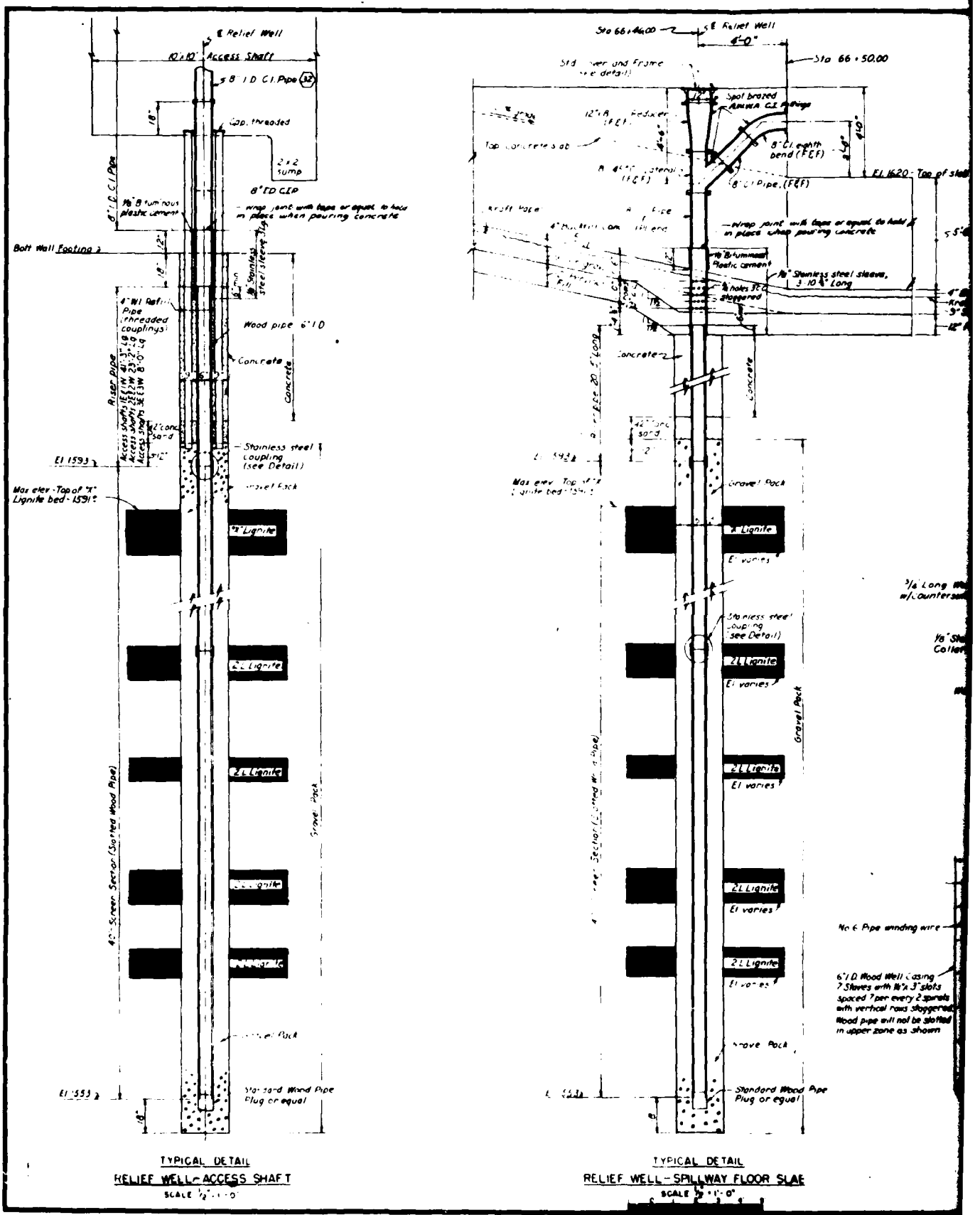
Scale 1"=20'

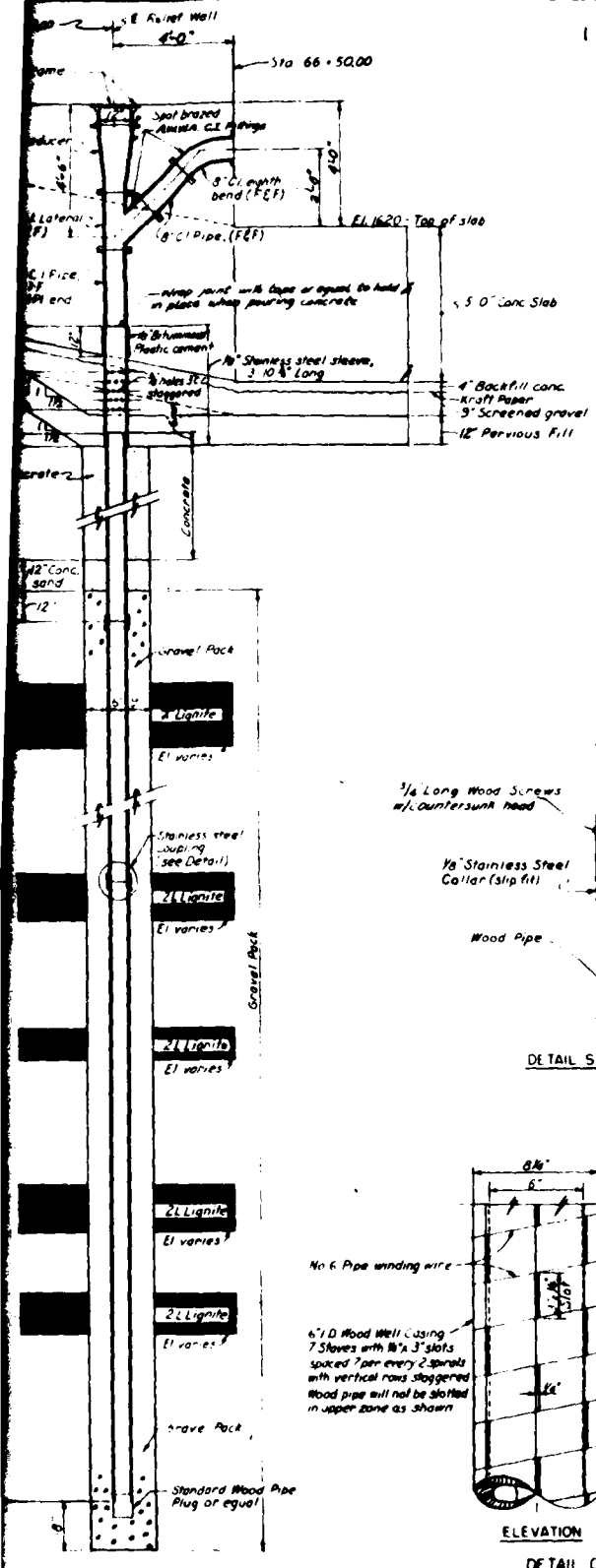
U S ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SPILLWAY STILLING BASIN
TENTATIVE DRAINAGE DETAILS

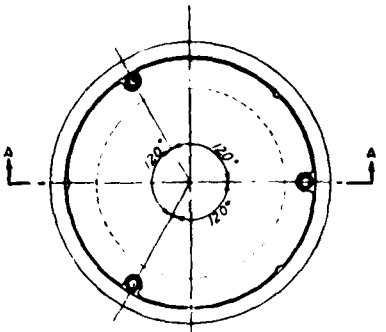
MARCH 1952

GSX - 3766


℄ Relief Well
10'x10' Access Shaft
8" I.D. C.I. Pipe
Cap, threaded
2'x2' sump
8" I.D. C.I. Pipe
8" I.D. CEP
½" Bituminous plastic cement
Wrap joint with tape or equal to hold in place when pouring concrete
Bott. Wall Footing
Stainless steel sleeve
4" W.I. Riser Pipe (threaded couplings)
Wood pipe 6" I.D.
Concrete
Riser pipe
Access Shaft, 1E & 1W 41'-3" Lg
Access Shaft, 2E & 2W 23'-2" Lg
Access Shaft, 3E & 3W 8'-0" Lg
12" Cond. sand
Stainless steel coupling (see Detail)
El 1593
Gravel Pack
Max elev. Top of "X" Lignite bed - 1591
"X" Lignite
2E Lignite
2E Lignite
2E Lignite
2E Lignite
42" Screen Sector (Slotted Wood Pipe)
Gravel Pack
El 1553
Standard Wood Pipe Plug or equal
TYPICAL DETAIL
RELIEF WELL - ACCESS SHAFT
SCALE ½" = 1'-0"
Sta 66+46.00
℄ Relief Well
4'-0"
Sta 66+50.00
Std. cover and Frame (see detail)
Spot brazed AMWA C.I. fittings
12"x8" Reducer (F.E.F.)
Top concrete slab
8" C.I. eighth bend (F.E.F.)
4'-10"
8" C.I. Pipe (F.E.F.)
El. 1620 - Top of slab
Kraft Paper
Wrap joint with tape or equal to hold in place when pouring concrete
½" Bituminous Plastic cement
½" Stainless steel sleeve, 3 1/2" Long
8 holes ½" ø staggered
Concrete
Gravel Pack
"X" Lignite
El varies
Stainless steel coupling (see Detail)
2E Lignite
El varies
2E Lignite
El varies
2E Lignite
El varies
Gravel Pack
No 6 Pipe winding wire
6" I.D. Wood Well Casing 7 Staves with ½"x 3" slots spaced 7 per every 2 spirals with vertical rows staggered. Wood pipe will not be slotted in upper zone as shown
Standard Wood Pipe Plug or equal
TYPICAL DETAIL
RELIEF WELL - SPILLWAY FLOOR SLAB
SCALE ½" = 1'-0"

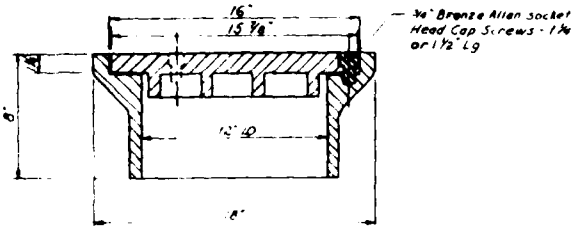


TYPICAL DETAIL
OF WELL - SPILLWAY FLOOR SLAB
SCALE 3" = 1'-0"



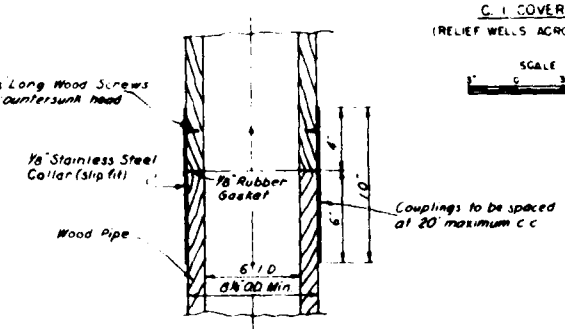
PLAN

FLOCKHART FOUNDRY CO OR EQUAL
12" I.D. CODE NO 62014 - TYPE 600-CD

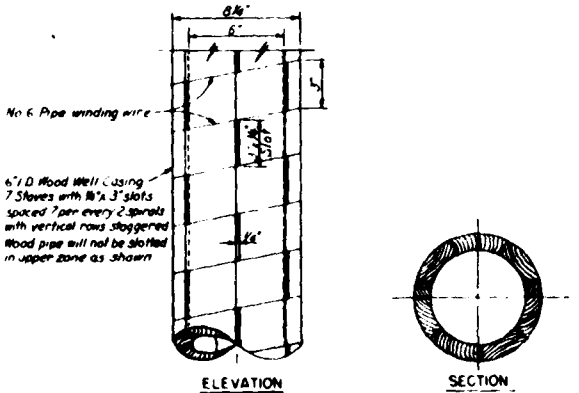


SECTION A-A
C. I. COVER AND FRAME
(RELIEF WELLS ACROSS SPILLWAY SLAB)

SCALE 3" = 1'-0"



DETAIL STAINLESS STEEL COUPLING
SCALE 3" = 1'-0"



ELEVATION

SECTION

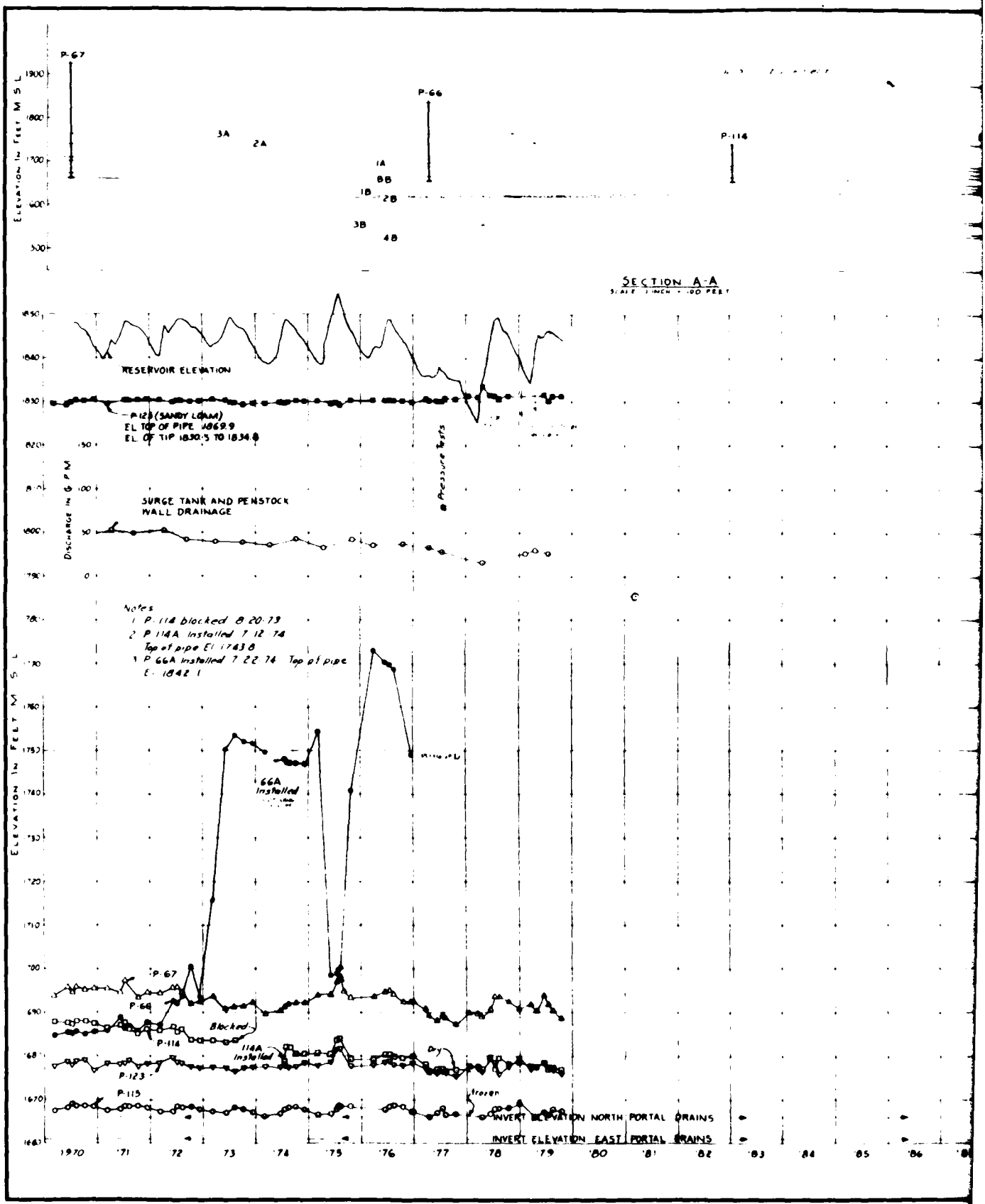
DETAIL OF SLOTTED WOOD PIPE
SCALE 3" = 1'-0"

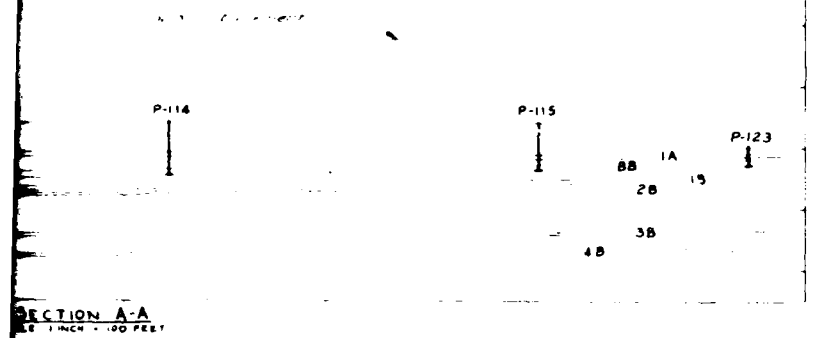
U. S. ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEB.

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SPILLWAY STILLING BASIN
DRAINAGE
RELIEF WELLS

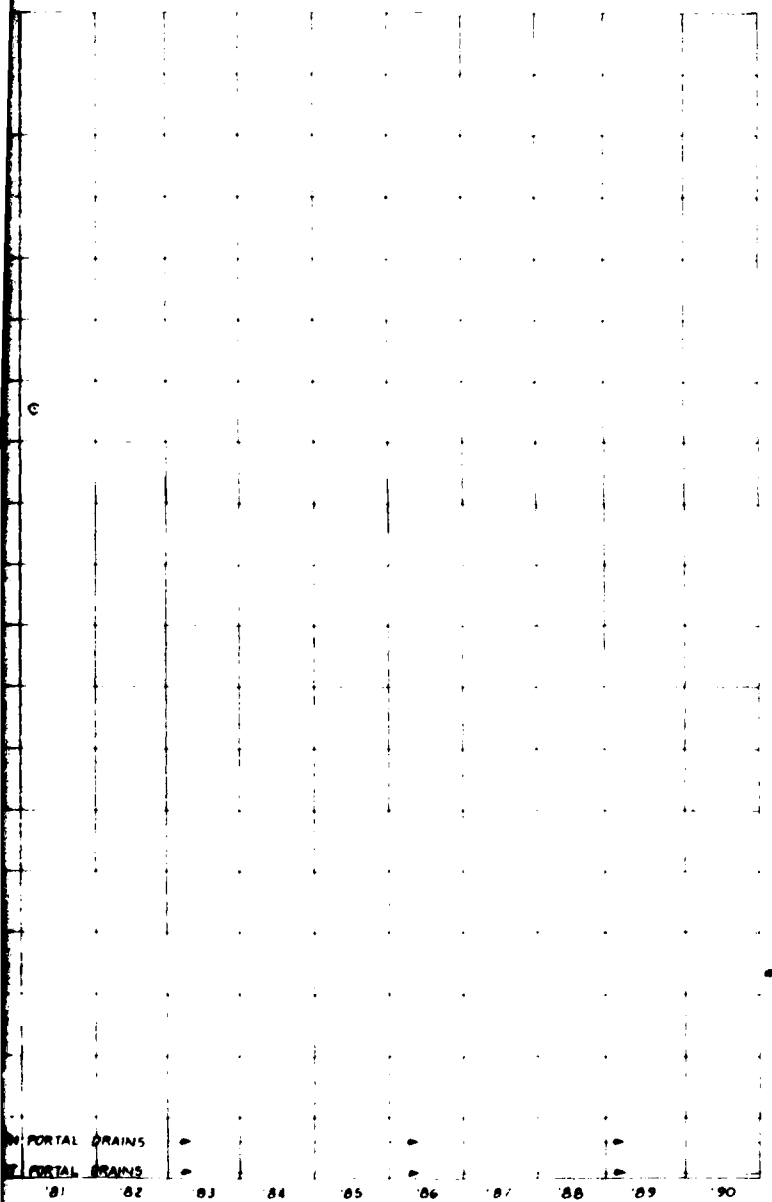
AUGUST 1954

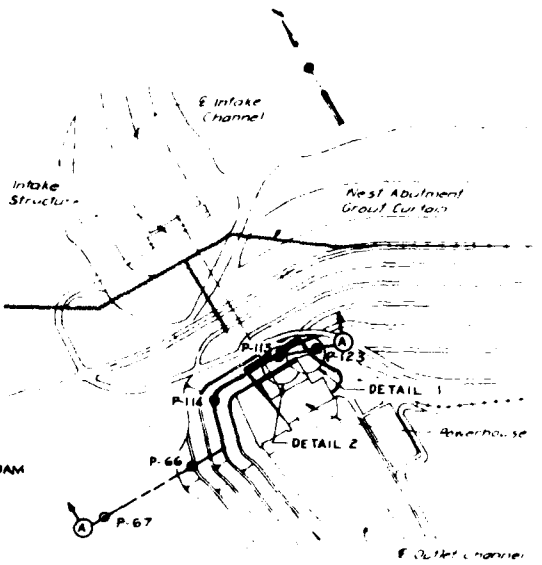
GS4-6/15


P-67
P-66
P-114
3A
2A
1A
BB
1B
2B
3B
4B
SECTION A-A
SCALE 1 INCH = 100 FEET
ELEVATION IN FEET M S L
RESERVOIR ELEVATION
P-123 (SANDY LOAM)
EL TOP OF PIPE 1869.9
EL OF TIP 1830.5 TO 1834.8
DISCHARGE IN G P M
SURGE TANK AND PENSTOCK WALL DRAINAGE
Pressure Tests
Notes
1 P-114 blocked 8 20 73
2 P 114A Installed 7 12 74
Top of pipe El 1743.8
3 P 66A Installed 7 22 74 Top of pipe
E. 1842.1
66A Installed
P-67
P-66
Blocked
P-114
114A Installed
Dry
P-123
P-115
frozen
INVERT ELEVATION NORTH PORTAL DRAINS
INVERT ELEVATION EAST PORTAL DRAINS
1970
'71
'72
'73
'74
'75
'76
'77
'78
'79
'80
'81
'82
'83
'84
'85
'86

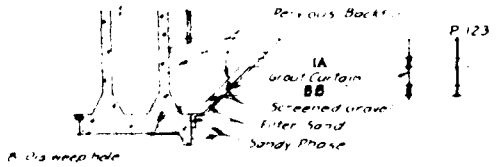


SECTION A-A
SCALE 1 INCH = 100 FEET

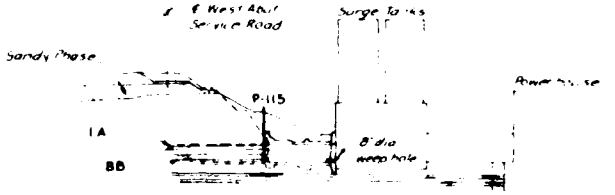




KEY PLAN
NO SCALE



DETAIL 1
SCALE 1 INCH = 40 FEET



DETAIL 2
SCALE 1 INCH = 100 FEET

Note.
For data prior to 1970 see the following plates in the 1969 Periodic Inspection Report
Plate B 56 for P-114, P-115, P-123 & Well Discharge
Plate B 58 for P-66 & P-67
Plate B 62 for P-125

● Pressure tests were conducted in June [illegible] and August 19[illegible] and all pipes responded well. Pipe [illegible] is being replaced

THIS DRAWING WAS REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE

DATE	DESCRIPTION	PAGE	APPD

REVISIONS

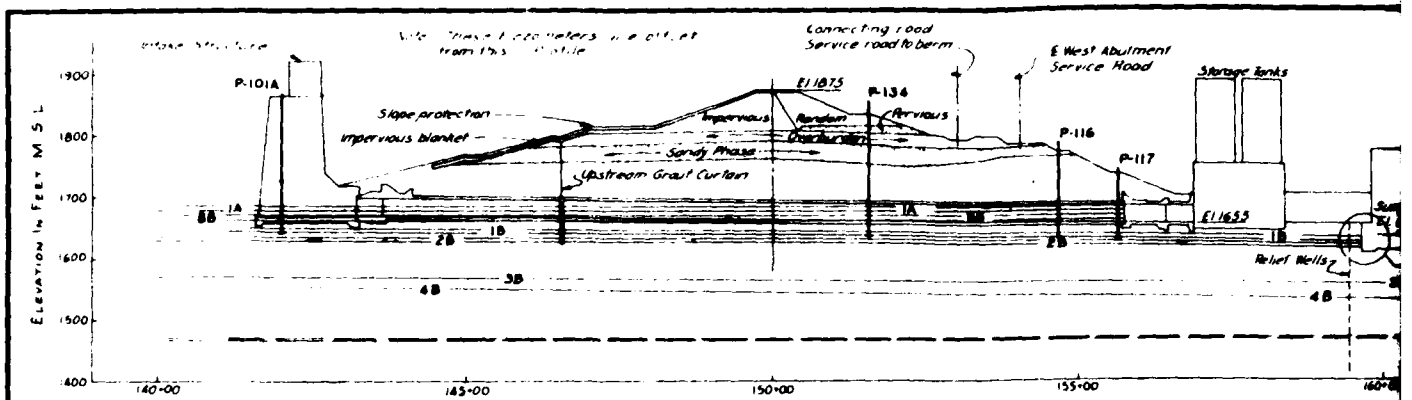
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
UNDERSEEPAGE STUDIES
WEST ABUTMENT PIEZOMETERS
SANDY LOAM & 1A AND BB LIGNITES
SURGE TANK AND PENSTOCK WELL DRAINS

DESIGNED BY
DRAWN BY
CHECKED BY
SUBMITTED BY
DATE
CONTRACT
APPROVED
DATE
SCALE AS SHOWN
DRG. NO.
APPROVED
CHIEF, ENGINEERING DIVISION
CHIEF, U.S. ARMY ENGINEER DIVISION
SHEET

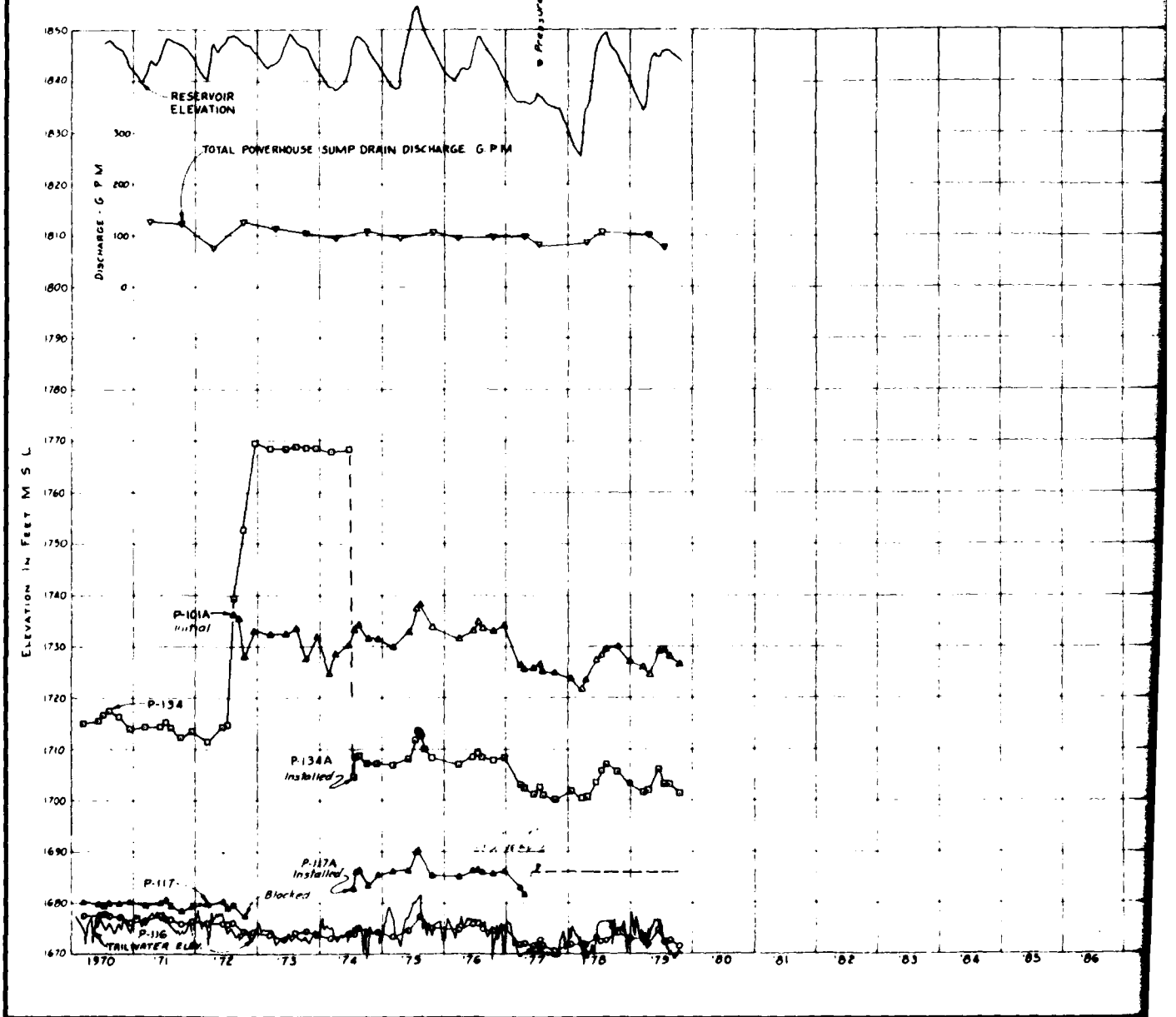
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MODIFICATION NO.

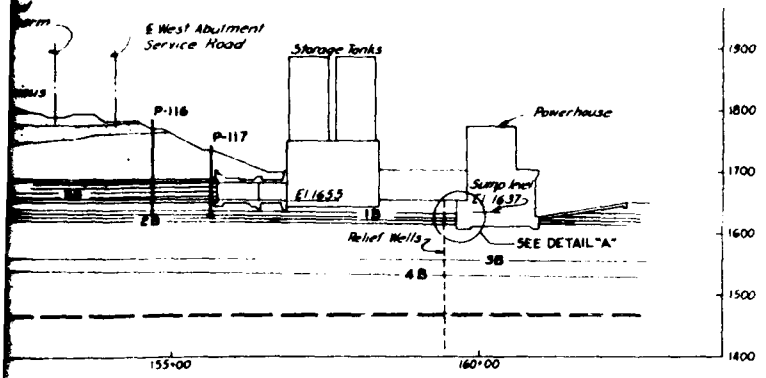
SAFETY DAYS

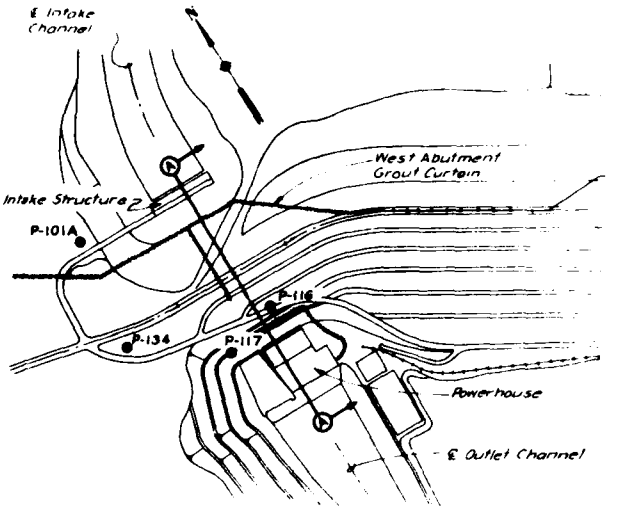


PROFILE A-A

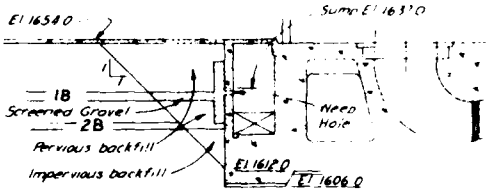
SCALE HORIZ 1 INCH = 100 FEET
VERT 1 INCH = 100 FEET







KEY PLAN
NO SCALE



DETAIL "A"
SCALE 1 INCH = 20 FEET

81 82 83 84 85 86 87 88 89

* Pressure Tests were conducted in June July and August 1977 and all piezometers responded well.

Notes:
1 P-101 Plugged 6-4-71
2 P-101A initial reading 8-17-73
3 P-117 Plugged 12-7-72
4 P-117A installed 7-12-74 Top of pipe El 1743.9
5 P-134A installed 7-12-74 Top of pipe El 1855.0

Note
For data prior to 1970 see the following plates in the 1969 Periodic Inspection Report
Plate B-52 for P-101, P-117 & P-134
Plate B-54 for P-116 & Total Powerhouse Sump Drain Discharge

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

DATE	DESCRIPTION	MADE	APPVD
	REVISIONS		

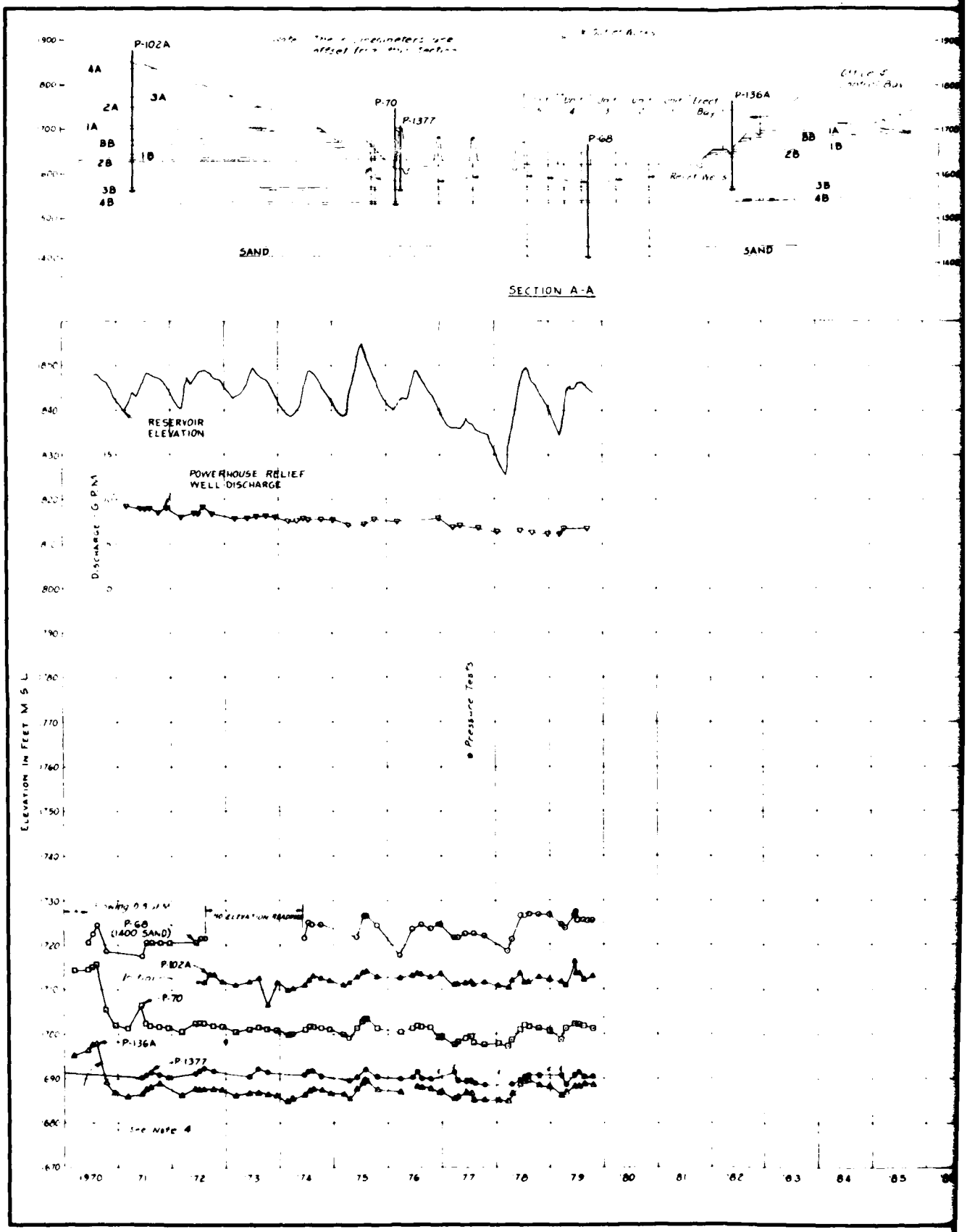
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

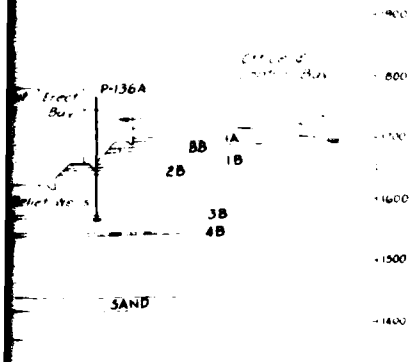
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
UNDERSEEPAGE STUDIES
WEST ABUTMENT PIEZOMETERS
1B LIGNITE AND POWERHOUSE
SUMP DRAIN OBSERVATIONS

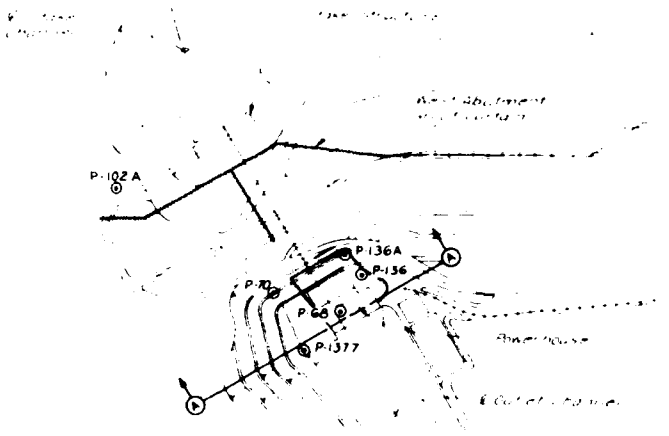
DESIGNED BY:
DRAWN BY:
CHECKED BY:
SUBMITTED BY:
CHIEF, DESIGN BRANCH
CHECKED:
CHIEF, ENGINEERING DIVISION
APPROVED:
CHIEF, ENGINEERING DIVISION
APPROVED:
CHIEF, DESIGN BRANCH
DATE:
SCALE AS SHOWN
DRWG. NO.
ENGINEER
SHEET

THIS PLAN ACCOMPANIES CONTRACT NO.
MODIFICATION NO.

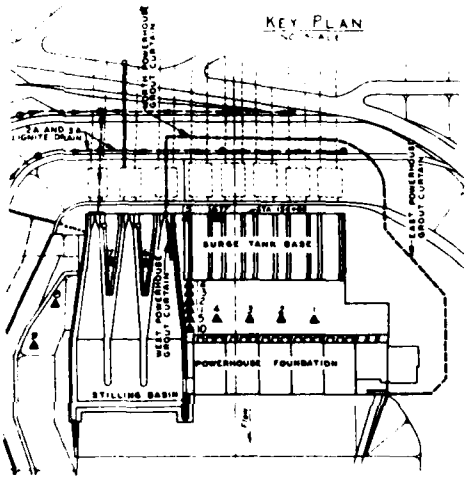
SAFETY PAYS


P-102A
4A
3A
2A
1A
BB
2B
1B
3B
4B
SAND
P-70
P-1377
P-68
P-136A
SAND
SECTION A-A
RESERVOIR ELEVATION
POWERHOUSE RELIEF WELL DISCHARGE
DISCHARGE - G.P.M.
ELEVATION IN FEET M.S.L.
* Pressure Tests
P-68 (1400 SAND)
P-102A
P-70
P-136A
P-1377
See Note 4
1970
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85





KEY PLAN



POWERHOUSE RELIEF WELL PLAN

Notes
1. Piezometer 102 was plugged 4-13-72
2. Piezometer 102A initial reading 8-17-72
3. Piezometer 136 flowing at .004 GPM or less
4. Relief wells 10 thru 17 installed Sept thru Oct 1970

Note
For data prior to 1972 see Plate B-50 1969 Periodic Inspection Report

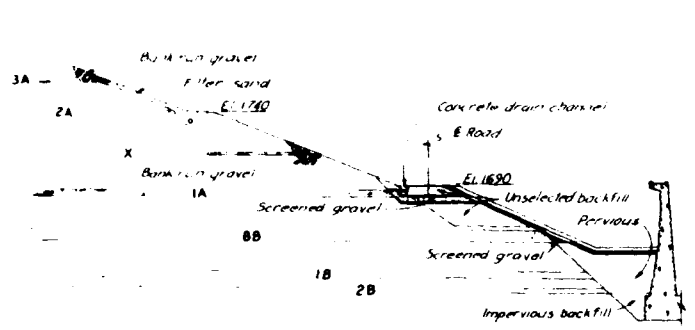
* Pressure tests were conducted in June July and August 1972 and all piezometers reported wet

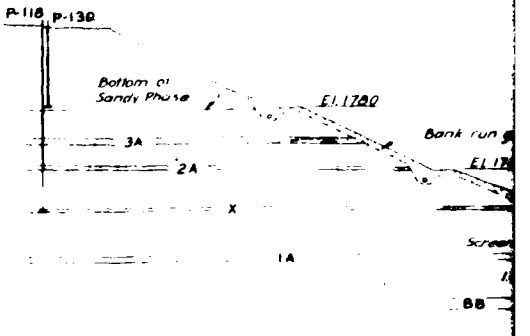
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

GARRISON DAM AND RESERVOIR
UNDERSEEPAGE STUDIES
WEST ABUTMENT PIEZOMETERS
1400 SAND, 3B & 4B LIGNITE
AND POWERHOUSE RELIEF WELL DISCHARGE

SAFETY PAYS

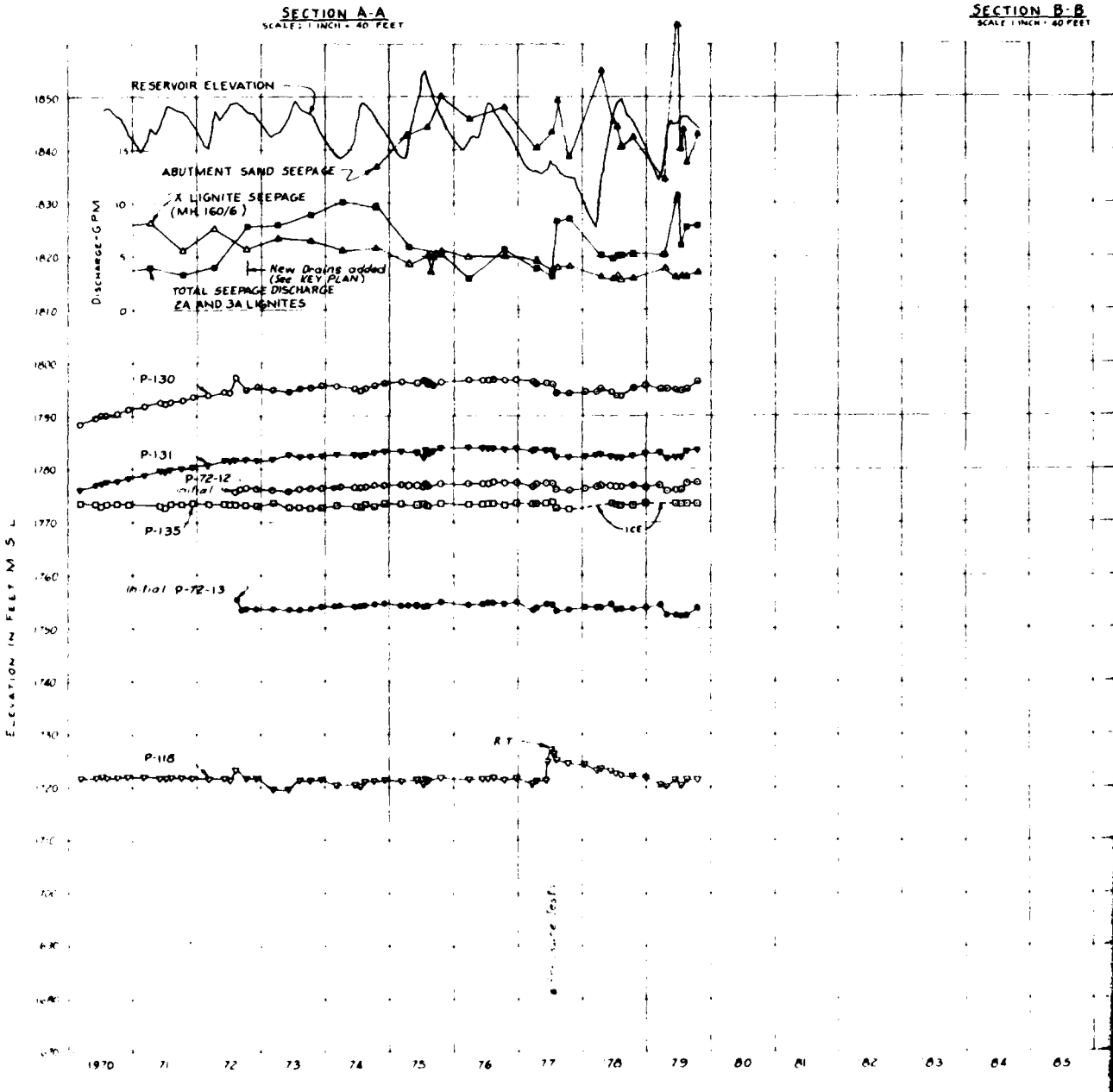
THIS PLAN ACCOMPANIES CONTRACT NO.
MODIFICATION NO.

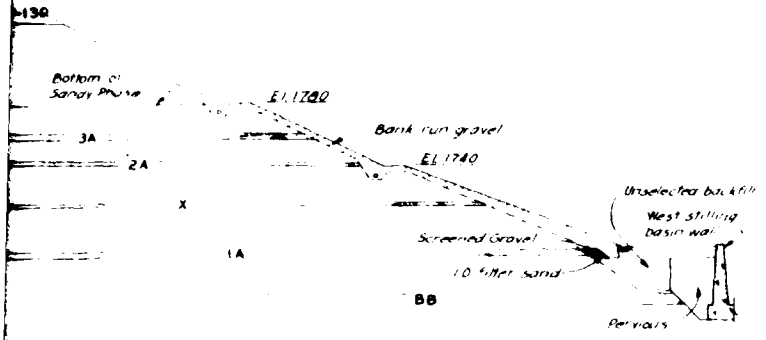


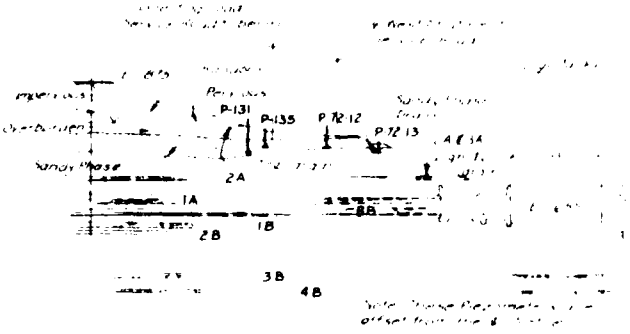


SECTION A-A
SCALE: 1 INCH = 40 FEET

SECTION B-B
SCALE: 1 INCH = 40 FEET

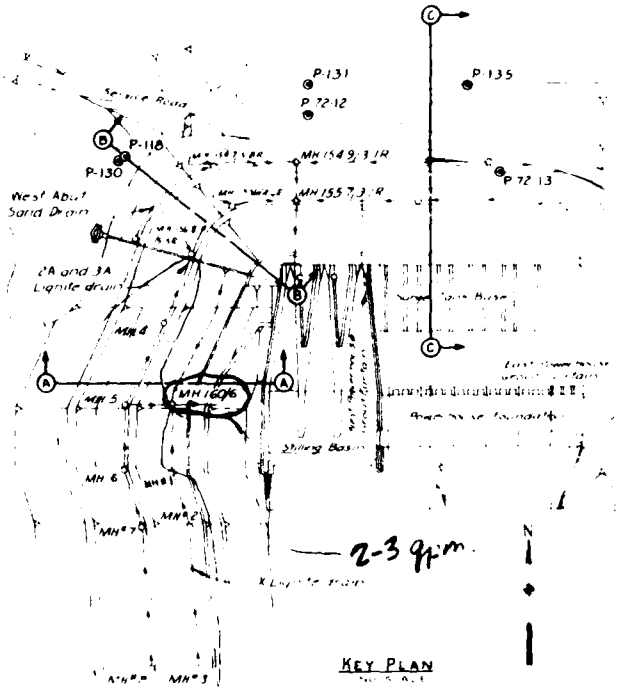






SECTION B-B
SCALE 1 INCH = 40 FEET

OUTLET WORKS & PROFILE C-C
SCALE VERT 1 INCH = 10 FEET
HORIZ 1 INCH = 10 FEET



KEY PLAN

Drains added

Notes

Note
For data pr or to 1970 see the following plates in the 1969 Periodic Inspection Report
Plate B-60 for P-118 & Seepage Discharges
Plate B-62 for P-130, P-131 & P-135

SAFETY PAYS

THIS PLAN ACCOMPANIES CONTRACT No.
MODIFICATION No.

DATE	DESCRIPTION	MADE	APPR'D
	REVISIONS		

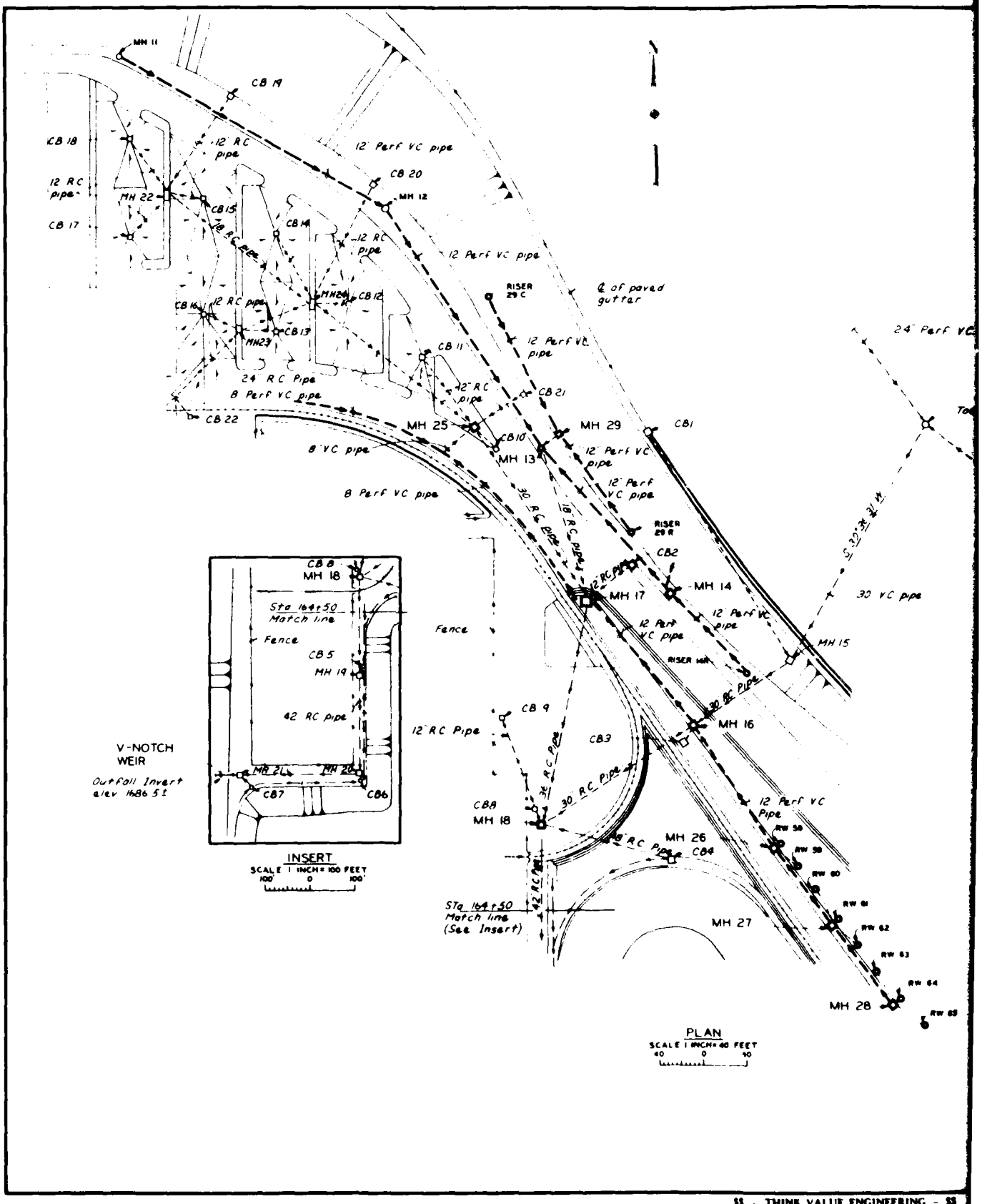
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
UNDERSEEPAGE STUDIES
PIEZOMETERS AND DRAINS
FOR THE WEST ABUTMENT SAND
AND THE 3A, 2A AND X LIGNITES

DESIGNED BY
DRAWN BY
TRACED BY
SUBMITTED BY
SURVEY SECTION
COMPARED
APPROVED
CHIEF, ENGINEERING DIVISION
DATE
SCALE AS SHOWN
DATE
APPROVED
CHIEF, ENGINEERING DIVISION
DRAWING NUMBER
SHEET

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 122

2


MH 11
CB 19
CB 18
12 RC pipe
12 Perf VC pipe
CB 20
MH 12
MH 22
CB 15
CB 14
CB 17
MH24
CB 16
CB 12
CB 13
MH23
RISER 29 C
℄ of paved gutter
24" Perf VC
CB 11
24" RC Pipe
8" Perf VC pipe
CB 21
CB 22
MH 25
MH 29
CB1
CB 10
MH 13
8" VC pipe
30" RC pipe
18" RC pipe
RISER 29 R
CB2
MH 17
MH 14
30" VC pipe
Fence
MH 15
CB 8
MH 18
Sta 164+50 Match line
CB 5
MH 19
42" RC pipe
CB 9
12" RC Pipe
CB3
V-NOTCH WEIR
Outfall Invert elev 1686.51
MH 21
MH 20
CB7
CB6
MH 16
CB4
MH 26
MH 27
Sta 164+50 Match line (See Insert)
RW 58
RW 59
RW 60
RW 61
RW 62
RW 63
RW 64
RW 65
MH 28
INSERT
SCALE 1 INCH = 100 FEET
PLAN
SCALE 1 INCH = 40 FEET

MANHOLES ROUTINELY MONITORED

MH 25	SW LEG
MH 13	NW LEG
	NE LEG
	SE LEG
MH 17	NW LEG (18 R C P)
	SE LEG
MH 16	SE LEG
MH 15	NE LEG

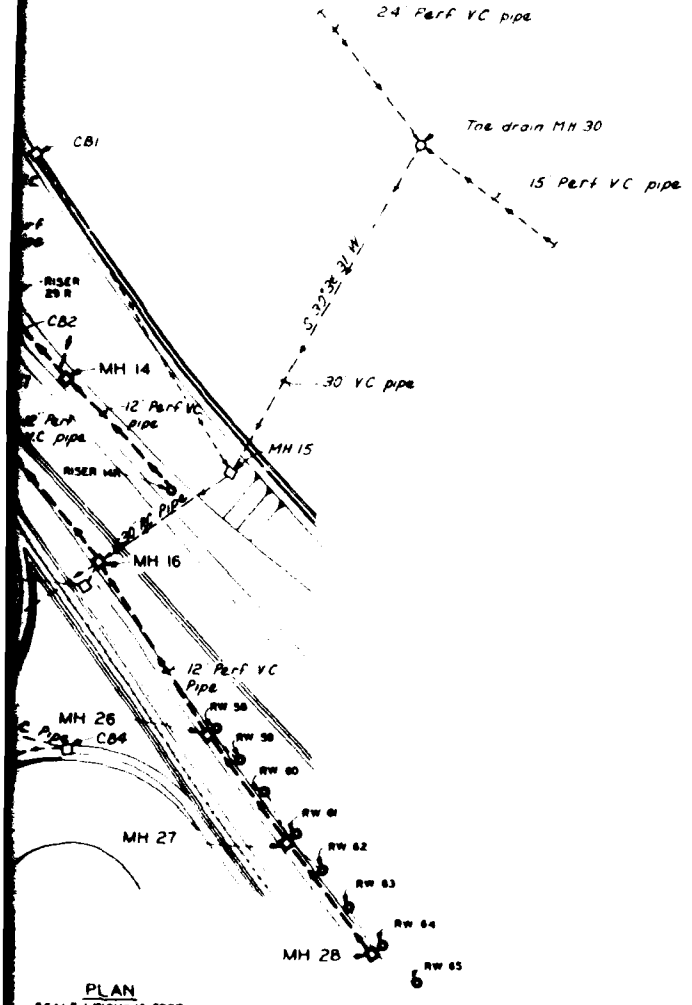
TOTAL FLOW EQUATION

TF = Total seepage flow from switchyard drainage system

TF = (MH 25 SW LEG) + (MH 17 SE LEG) + (MH 17 NW LEG) + (MH 16 SE LEG) - (MH 15 NE LEG)

LEGEND

R C = Reinforced Concrete
V C = Vitrified Clay
MH = Manhole
RW = Relief Well
CB = Catch Basin

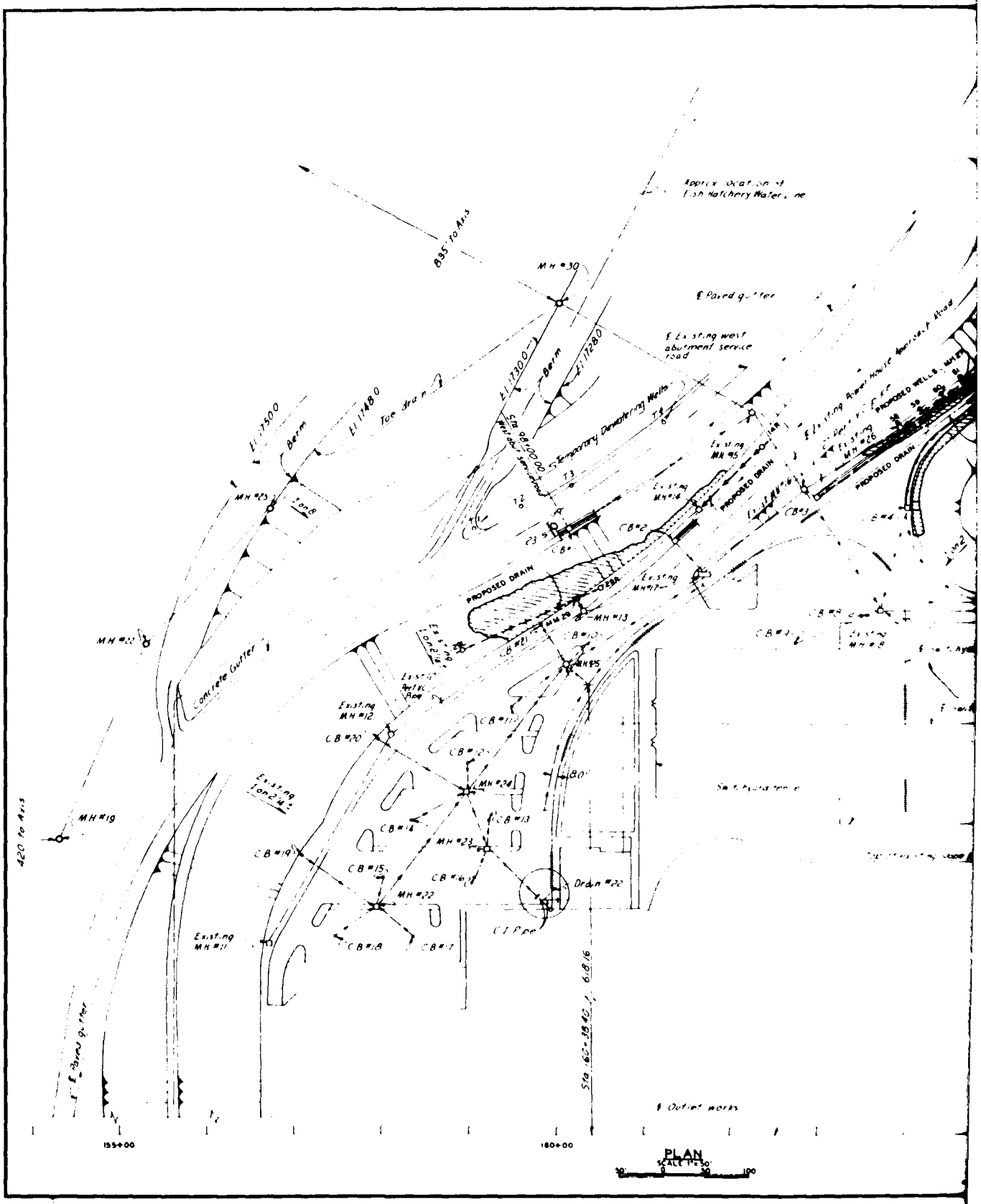


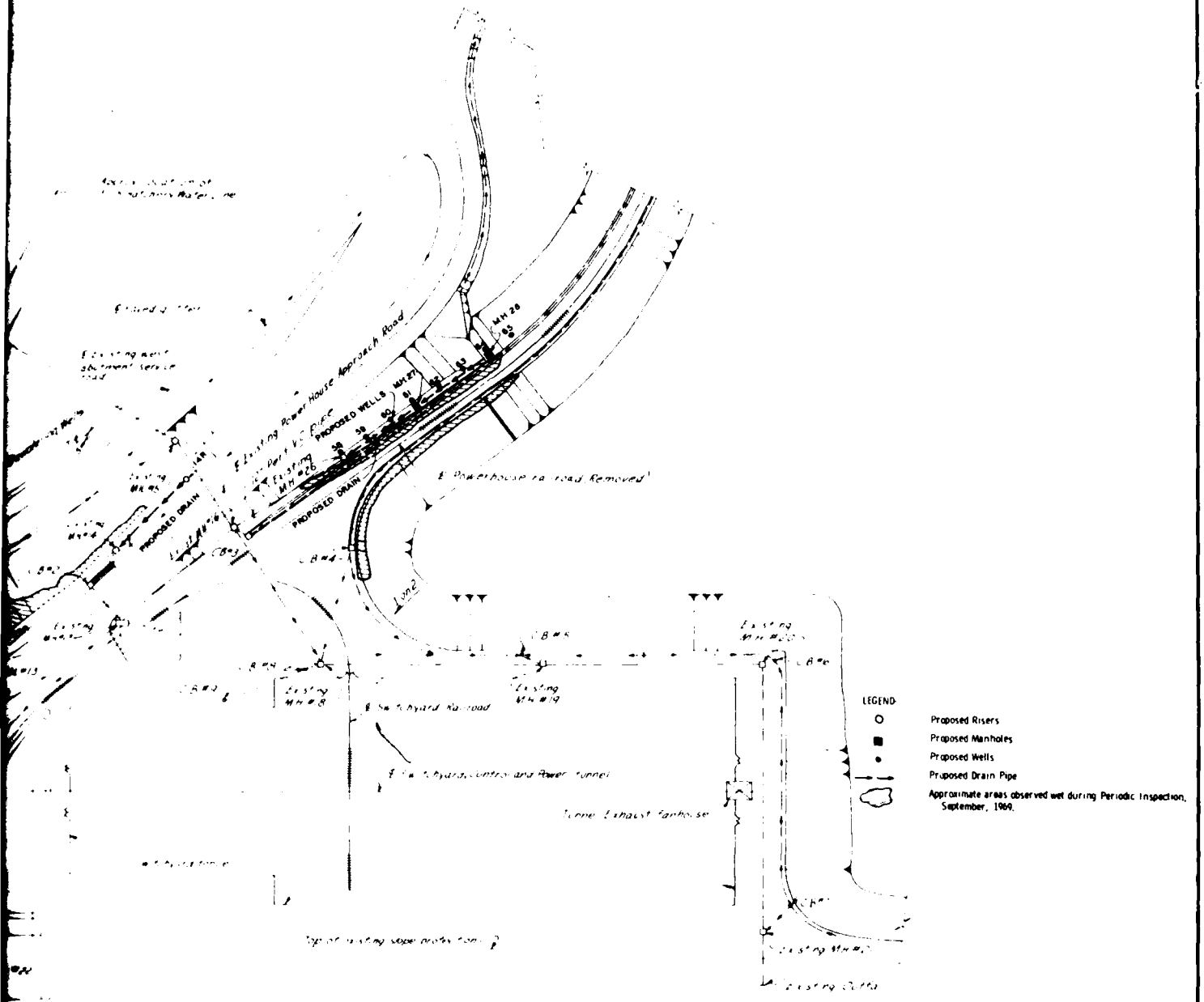
PLAN
SCALE: 1 INCH = 60 FEET
60 0 60

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

POWERHOUSE SWITCHYARD DRAINAGE SYSTEM UNDERSEEPAGE STUDIES

THIS PLAN ACCOMPANIES CONTRACT NO. DACA45 MODIFICATION NO


Approx location of Fish Hatchery Water Line
835' to Axis
MH #30
E Paved gutter
E Ex st.ng west abutment service road
El 1728.0
El 1730.0
Berm
El 1750.0
El 1748.0
Toe drain
Sta 98+00.00 Temporary Dewatering Wells
Existing MH #25
Existing Armory Access Road
PROPOSED WELLS
PROPOSED DRAIN
Existing MH #26
Existing MH #24
Existing MH #7
Existing MH #8
CB #2
CB #3
CB #1
CB #4
CB #5
CB #6
CB #7
CB #8
CB #9
CB #10
CB #11
CB #12
CB #13
CB #14
CB #15
CB #16
CB #17
CB #18
CB #19
CB #20
CB #21
MH #13
MH #25
MH #23
MH #22
MH #20
MH #19
Existing MH #12
Existing MH #11
Existing 10" CMP
Existing Armory Road
Concrete Gutter
Drain #22
C.I.P. pipe
Sta 162+39.62 L.T. 6.8.16
E Outlet works
420' to Axis
155+00
180+00
PLAN
SCALE 1"=50'
0
50
100



PLAN

185+00

THIS PLAN ACCOMPANIES CONTRACT No.
MODIFICATION No.

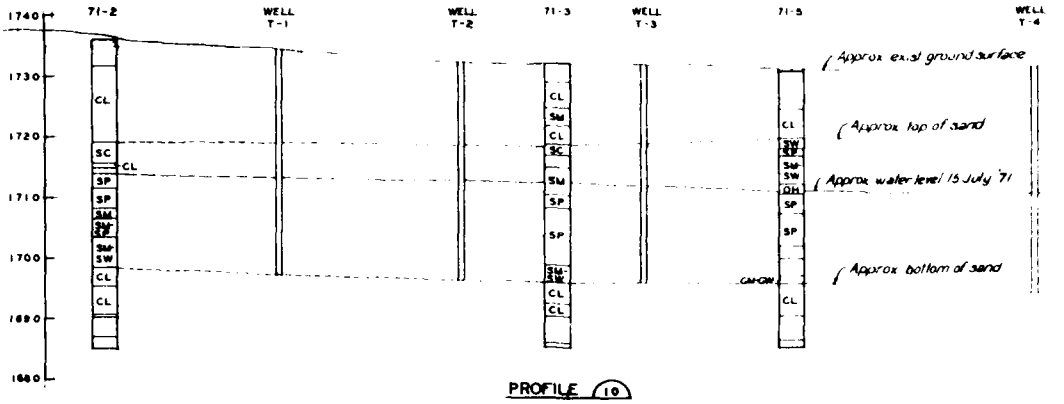
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

MISSOURI RIVER
GARRISON DAM-LAKE SAKAKAWEA
WEST TERRACE
GRAVEL UNDERSEEPAGE
DRAINAGE PLAN

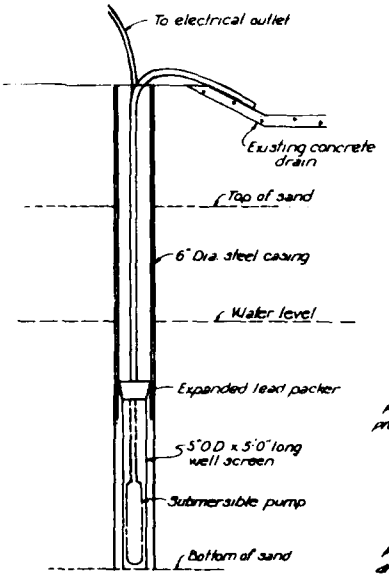
JAN 1972

SAFETY PAYS

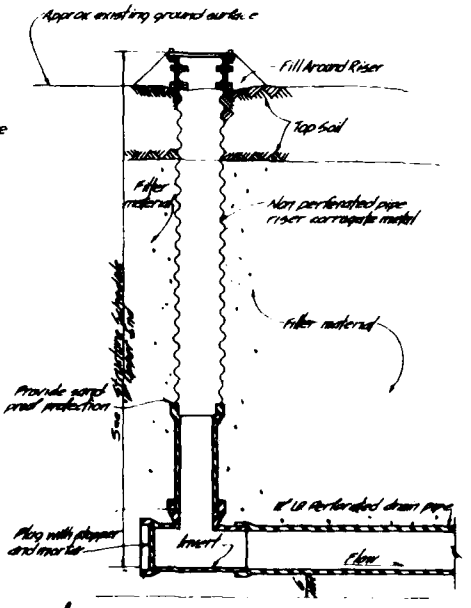
CONSTRUCTION FOUNDATION REPORT (1982) PLATE 124



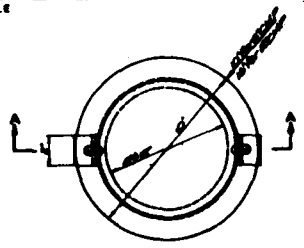
PROFILE (10)



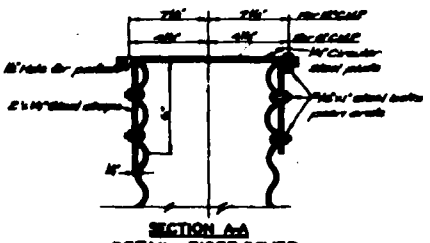
TEMPORARY WELL DETAIL
NO SCALE



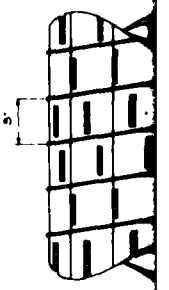
OBSERVATION RISER
NO SCALE



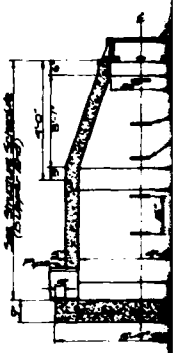
TOP PLAN



SECTION A-A
DETAIL - RISER COVER
NO SCALE



WOOD PIPE WE
NO SCALE



STANDARD PRECAST O

SCALE 1/2 INCH

RELIEF WELL SCHEDULE

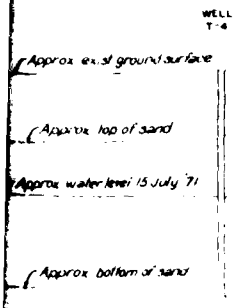
LOCATION			ELEVATIONS			LENGTH		
WELL NO.	STA.	RANGE	BOTTOM SCREEN	TOP SCREEN	TOP RISER	OUTFALL INVERT	WELL SCREEN	RISER PIPE
58	*0+00	5' LT.	1668.5	1698.65	1709.0	1697.40	28.15	10.
59	0+30	3' LT.	1666.5	1698.65	1709.0	1697.40	30.15	10.
60	0+60	3' LT.	1664.5	1698.95	1709.0	1697.70	32.45	10.
61	0+90	5' LT.	1662.5	1698.95	1709.0	1697.70	34.45	10.
62	1+20	3' LT.	1660.5	1698.95	1709.0	1697.70	36.45	10.
63	1+50	3' LT.	1658.5	1697.25	1710.0	1698.00	38.75	10.
64	1+80	5' LT.	1657.0	1697.25	1713.0	1698.00	40.25	13.
65	2+10	3' LT.	1655.0	1697.25	1713.0	1698.00	42.25	13.

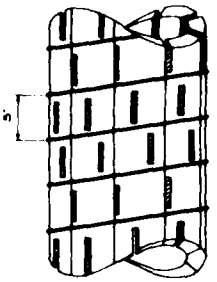
* ℄ RIM #28 + STA. 0+00

MANHOLE STRUCTURE SCHEDULE

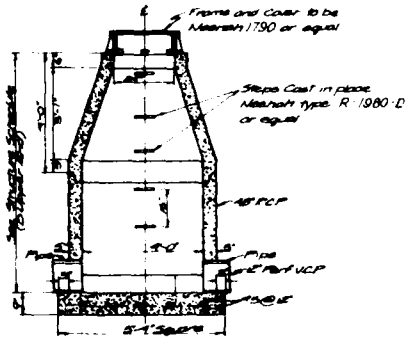
FROM		TO		RIM ELEV.	INV. ELEV		SLOPE
TYPE	NO.	TYPE	NO.	UPPER END	FROM	TO	FT. PER
M. H.	26	M. H.	27	-----	1698.48	1698.70	.022
M. H.	27	M. H.	28	1705.0	1698.70	1697.00	022
M. H.	28	---	---	1707.0	1697.00	---	---
OR	29R	M. H.	29	1711.0	1706.60	1697.00	.057
M. H.	29	OR	29R	1706.0	1697.0	1699.15	033
OR	29R	---	---	1704.0	1697.15	---	---
M. H.	29	M. H.	13	1705.0	1697.0	1693.64	
M. H.	14	OR	14R	-----	1688.47	1701.97	.033
OR	14R	---	---	1711.0	1701.97	---	---

* NON PERFORATED PIPE

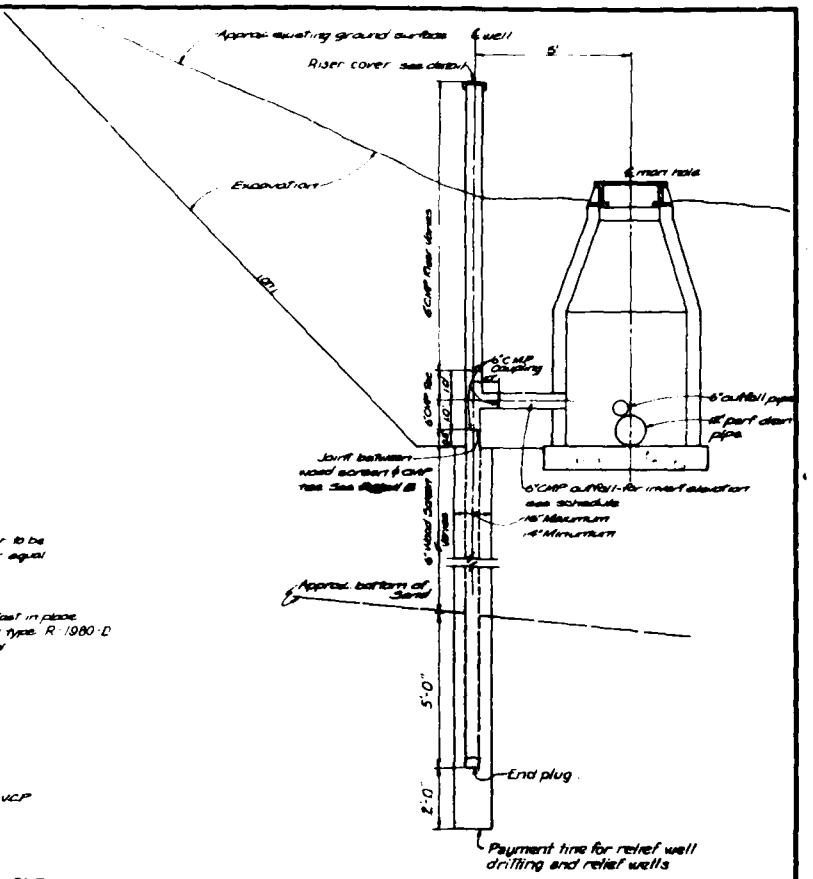




WOOD PIPE WELL SCREEN
NO SCALE



STANDARD PRECAST CONCRETE MANHOLE
SCALE: 1/2 INCH = 1 FOOT



RELIEF WELL DETAIL
SCALE: 1/2 INCH = 1 FOOT

RELIEF WELL SCHEDULE

LOCATION			ELEVATIONS			LENGTH		C.M.P. DISCHARGE OUTFALL		
WELL NO.	STA.	RANGE	BOTTOM SCREEN	TOP SCREEN	TOP RISER	OUTFALL INVERT	WELL SCREEN	RISER PIPE	LENGTH	SIZE
58	*0+00	5' LT.	1668.5	1698.65	1709.0	1697.40	28.15	10.35'	2.17'	6"
59	0+30	3' LT.	1666.5	1698.65	1709.0	1697.40	30.15	10.35'	27.32'	6"
60	0+60	3' LT.	1664.5	1698.95	1709.0	1697.70	32.45	10.05'	27.32'	6"
61	0+90	5' LT.	1662.5	1698.95	1709.0	1697.70	34.45	10.05'	2.17'	6"
62	1+20	3' LT.	1660.5	1698.95	1709.0	1697.70	36.45	10.05'	27.32'	6"
63	1+50	3' LT.	1658.5	1697.25	1710.0	1698.00	38.75	10.75'	27.32'	6"
64	1+80	5' LT.	1657.0	1697.25	1713.0	1698.00	40.25	13.75'	2.17'	6"
65	2+10	3' LT.	1655.0	1697.25	1713.0	1698.00	42.25	13.75'	27.32'	6"

* ℄ RIM 65 - STA. 0+00

MANHOLE STRUCTURE SCHEDULE

FROM		TO		RIM ELEV.	INV. ELEV.		SLOPE	℄ TO ℄	D. UPPER
TYPE	NO.	TYPE	NO.	UPPER END	FROM	TO	FT./FT.	DIST.	END
MH	26	MH	27	-----	1696.40	1696.70	.003	90'	----
MH	27	MH	28	1705.0	1696.70	1697.00	.003	90'	8.30'
MH	28	---	---	1707.0	1697.00	-----	----	---	10.00'
OR	29R	MH	29	1711.0	1706.60	1697.00	.067	143'	4.40'
MH	29	OR	29R	1706.0	1697.0	1697.15	.005	30'	----
OR	29R	---	---	1704.0	1697.15	----	----	---	6.85'
MH	29	MH	13	1706.0	1697.0	1693.44		*161.5	9.00'
MH	14	OR	14R	-----	1701.97	1701.97	.000	109'	----
OR	14R	---	---	1711.0	1701.97	----	----	---	9.03'

* RDM PERFORATED PIPE

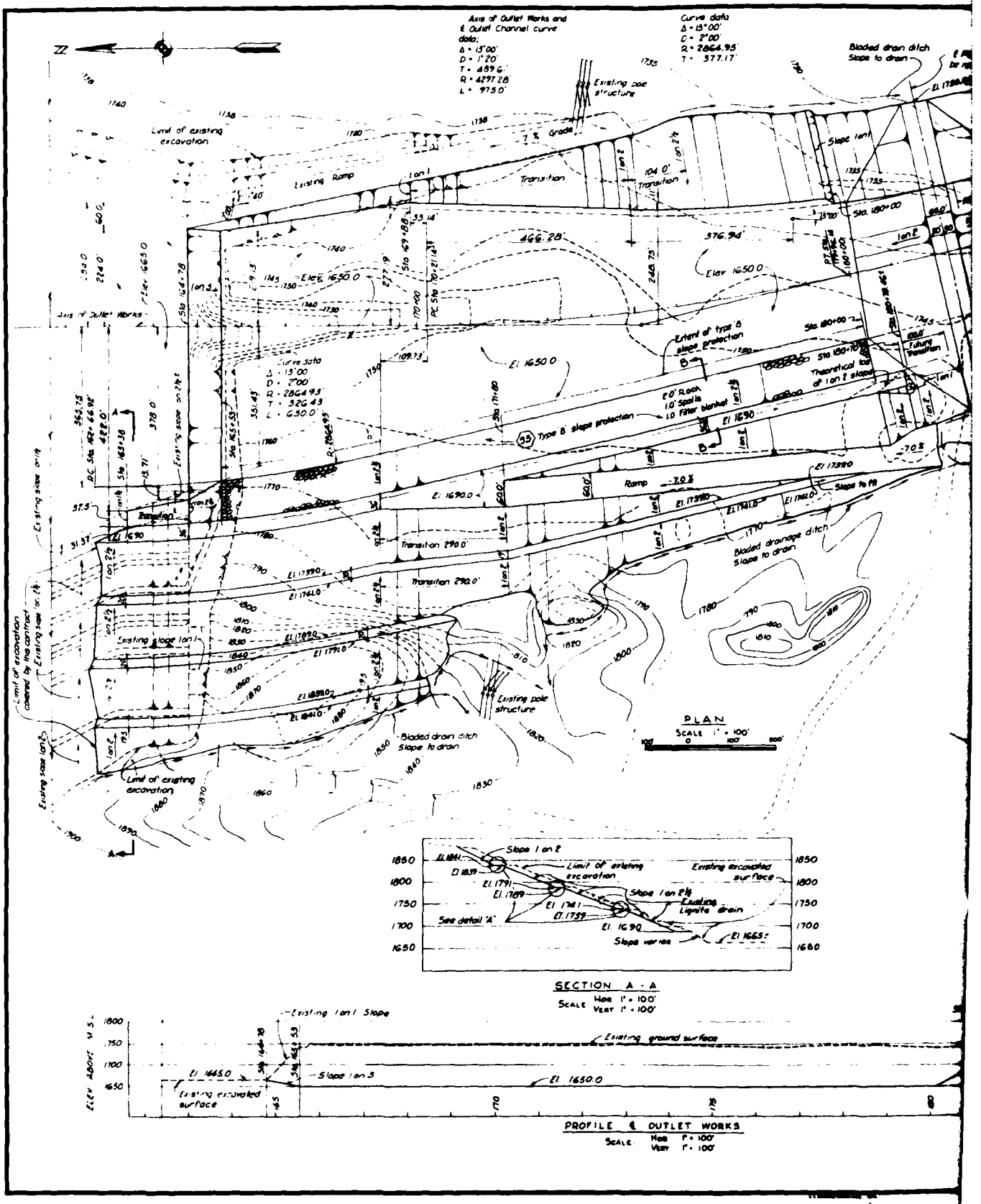
SAFETY PAYS

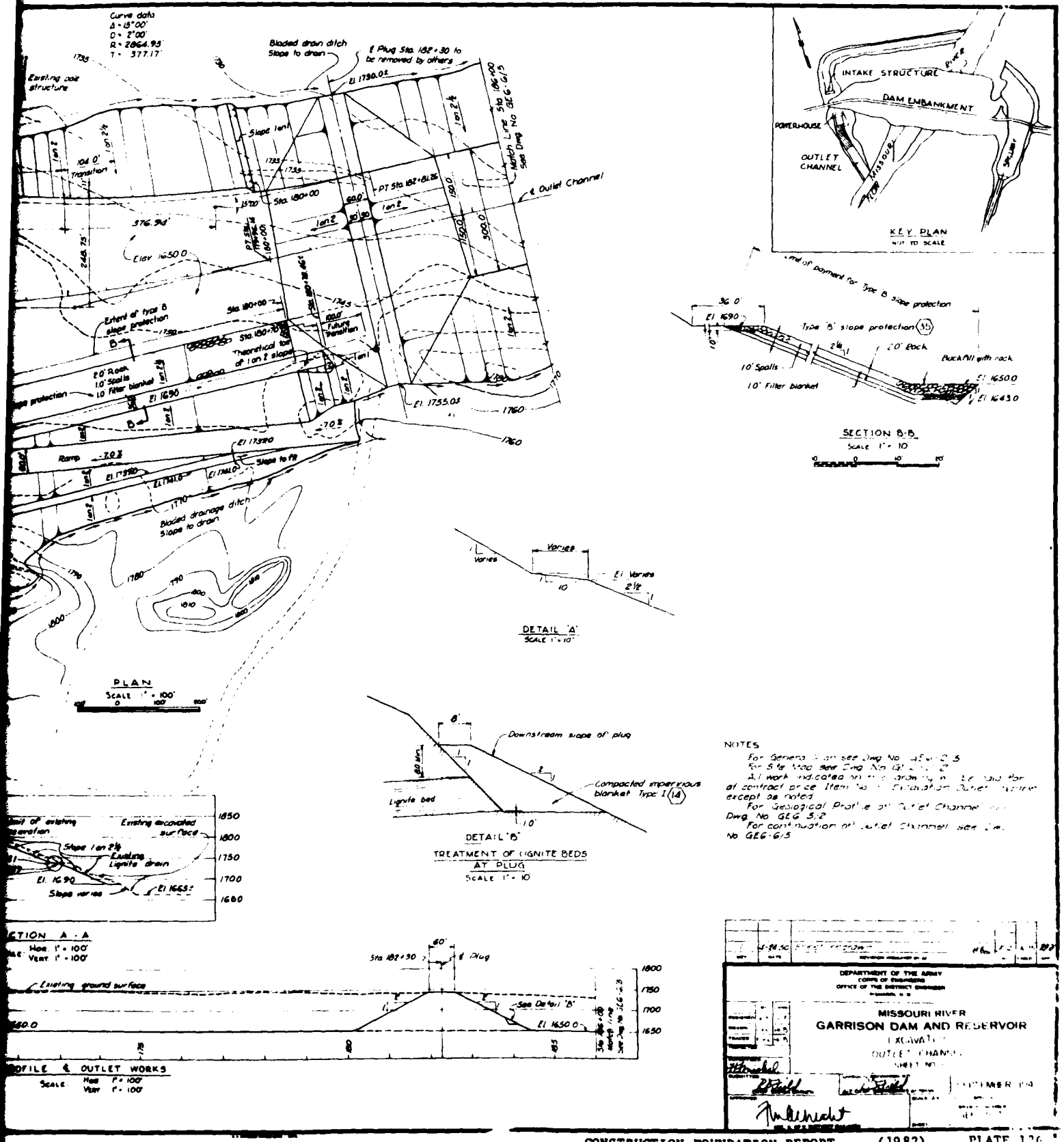
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

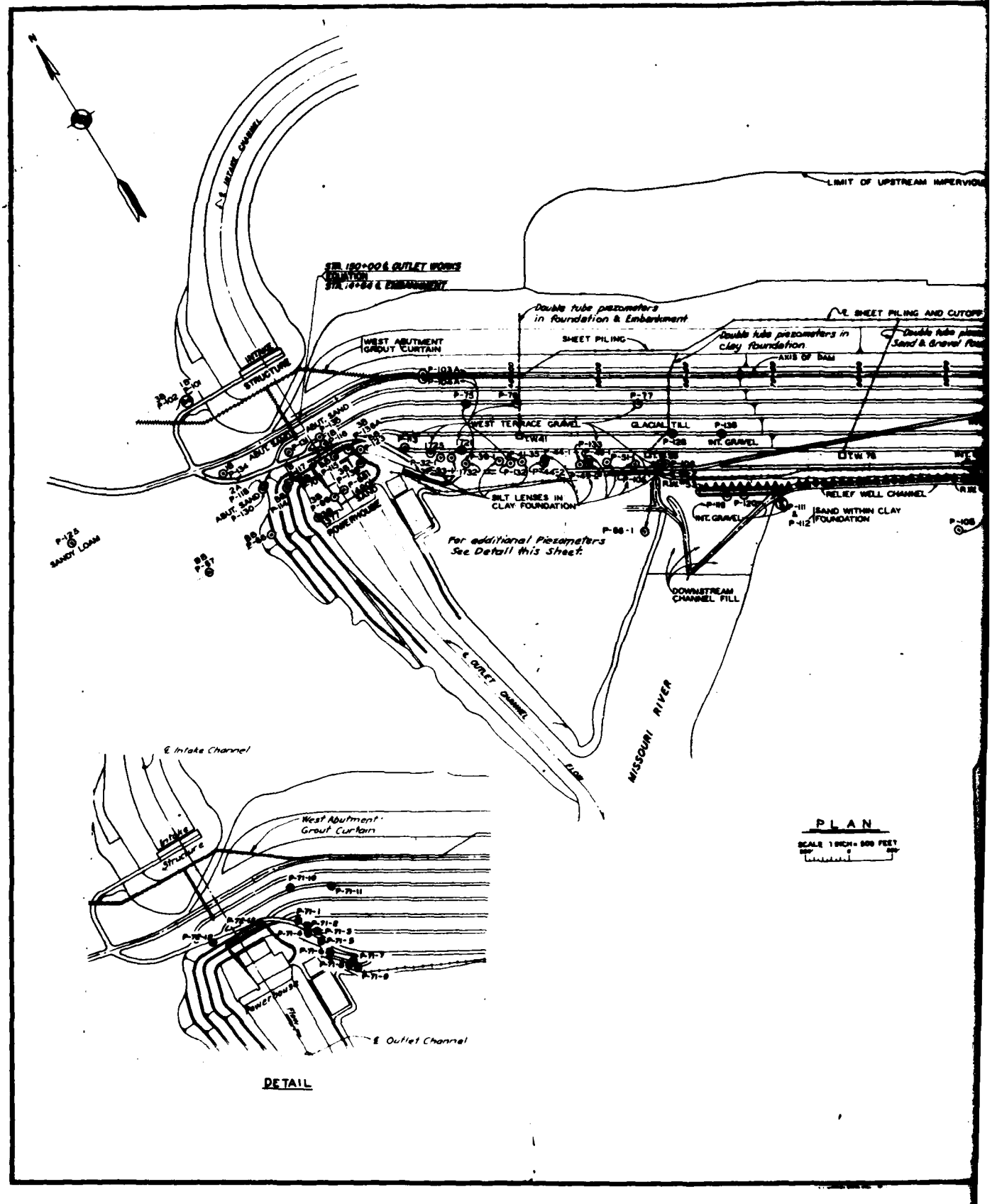
MISSOURI RIVER
GARRISON DAM-LAKE SAKAKAWEA
WEST TERRACE GRAVEL UNDERSEEPAGE
MANHOLE, RISER AND WELL DETAILS

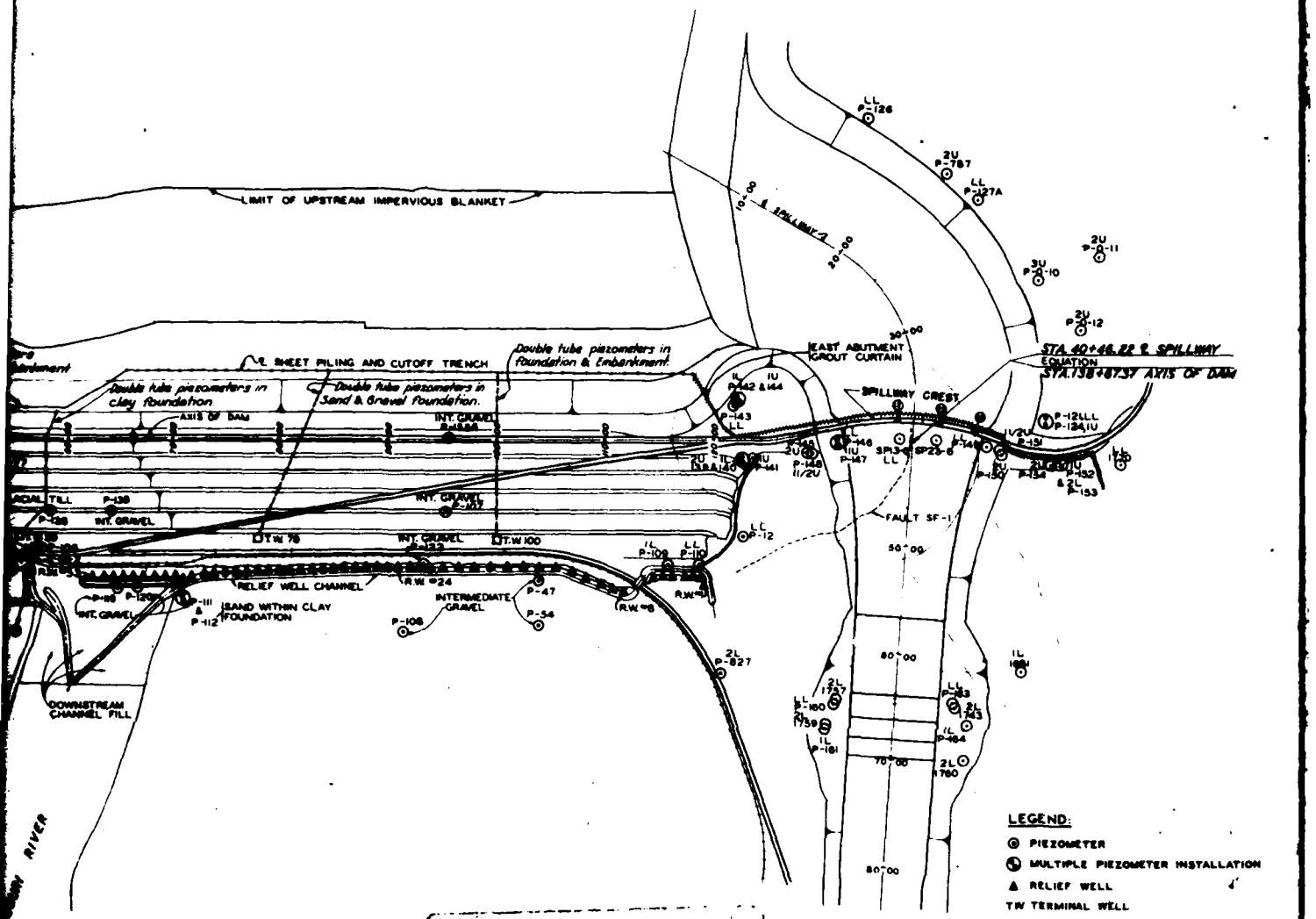
DESIGNED BY: R.J.H.
DRAWN BY: M.O.S.
TRACED BY: C.V.J.
SUBMITTED: [illegible]
RECOMMENDED: [illegible]
APPROVED: 61 Vandergraaf
DATE: JAN 1972

THIS PLAN ARE ENGINEER CONTRACT No.
MODIFICATION No.


Axis of Outlet Works and ℄ Outlet Channel curve data;
Δ = 15°00'
D = 1°20'
T = 489.6'
R = 4297.28
L = 975.0'
Curve data
Δ = 15°00'
D = 2°00'
R = 2864.93'
T = 377.17'
Existing pole structure
Bladed drain ditch
Slope to drain
Limit of existing excavation
7 % Grade
Existing Ramp
1 on 1
Transition
104.0'
1 on 2
Slope 1 on 1
Sta. 1+80.00
466.28'
376.94'
Elev 1650.0
Axis of Outlet Works
Curve data
Δ = 15°00'
D = 2°00'
R = 2864.93'
T = 329.43'
L = 650.0'
Extent of type B slope protection
Sta 1+80.00
Sta 1+00.00
Future transition
Theoretical toe of 1 on 2 slope
Type B slope protection
6.0' Rock
1.0' Spalls
1.0 Filter blanket
El 1690
Ramp -7.0 %
El 1799.0
El 1741.0
Slope to fill
Transition 290.0'
Bladed drainage ditch
Slope to drain
Existing slope 1on1
Existing slope 1on2
Limit of excavation covered by this contract
Existing slope 1on1/2
Existing slope 1on2
Limit of existing excavation
Bladed drain ditch
Slope to drain
Existing pole structure
PLAN
SCALE 1" = 100'
SECTION A - A
SCALE Horz 1" = 100'
Vert 1" = 100'
Slope 1 on 2
Limit of existing excavation
Existing excavated surface
Slope 1 on 2½
Existing Lignite drain
See detail 'A'
Slope varies
El 1665±
El 1650.0
PROFILE ℄ OUTLET WORKS
SCALE Horz 1" = 100'
Vert 1" = 100'
ELEV ABOVE M.S.L.
Existing 1 on 1 Slope
Existing ground surface
Slope 1 on 3
Existing excavated surface


Curve data
Δ = 15°00'
D = 2°00'
R = 2864.93'
T = 377.17'
Bladed drain ditch
Slope to drain
℄ Plug Sta. 182+30 to be removed by others
El. 1730.0±
Existing core structure
Slope 1on1
1on2
1on2½
104.0' Transition
376.94'
245.73'
Elev 1650.0
Match Line Sta 186+00 See Dwg No GEG-6/5
PT Sta 182+81.25
Sta. 180+00
60.0
30
90
1on2
℄ Outlet Channel
150.0
750.0
900.0
PT Sta 180+00
180.00
Extent of type B slope protection
Sta. 180+00
Sta. 180+10
Theoretical toe of 1on2 slope
100.0' Future Transition
1on1
B
B
20' Rock
10' Spalls
10' Filter blanket
El. 1690
El. 1755.03
El. 1730
Ramp -7.0%
El. 1739.0
El. 1741.0
Slope to fill
Bladed drainage ditch
Slope to drain
1760
1770
1780
1790
1800
1810
1820
1600
PLAN
SCALE 1" = 100'
0
100
200
INTAKE STRUCTURE
DAM EMBANKMENT
POWERHOUSE
OUTLET CHANNEL
MISSOURI
SPILLWAY
KEY PLAN
NOT TO SCALE
End of payment for Type B slope protection
36.0'
El. 1690
Type 'B' slope protection (33)
10.0'
2½:1
20' Rock
Backfill with rock
10' Spalls
10' Filter blanket
El. 1650.0
El. 1643.0
SECTION B-B
SCALE 1" = 10'
0
10
20
Varies
Varies
El. Varies
2½:1
10
DETAIL 'A'
SCALE 1" = 10'
8'
Downstream slope of plug
60 min.
Lignite bed
Compacted impervious blanket Type I (14)
10'
DETAIL 'B'
TREATMENT OF LIGNITE BEDS AT PLUG
SCALE 1" = 10'
NOTES
For General Plan see Dwg No. GEG-6/5
For Site Map see Dwg No. GEG-6/2
All work indicated on this drawing is to be paid for at contract price Item No. 1 Excavation Outlet Works except as noted
For Geological Profile of Outlet Channel see Dwg No GEG 5/2
For continuation of Outlet Channel see Dwg No GEG-6/5
Limit of existing excavation
Existing excavated surface
Slope 1on2½
Existing Lignite drain
El. 1690
Slope varies
El. 1663±
1850
1800
1750
1700
1650
SECTION A-A
Hor. 1" = 100'
Vert 1" = 100'
60'
Sta 182+30
℄ Plug
Existing ground surface
See Detail 'B'
El. 1650.0
1800
1750
1700
1650
1650.0
PROFILE & OUTLET WORKS
Scale Hor. 1" = 100'
Vert 1" = 100'
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
EXCAVATION
OUTLET CHANNEL
SHEET NO.
SEPTEMBER 19


LIMIT OF UPSTREAM IMPERVIOUS
Double tube piezometers in Foundation & Embankment
SHEET PILING
Double tube piezometers in Clay foundation
AXIS OF DAM
WEST ABUTMENT GROUT CURTAIN
INTAKE STRUCTURE
WEST TERRACE GRAVEL
GLACIAL TILL
INT. GRAVEL
SILT LENSES IN CLAY FOUNDATION
RELIEF WELL CHANNEL
SAND WITHIN CLAY FOUNDATION
DOWNSTREAM CHANNEL FILL
POWERHOUSE
For additional Piezometers See Detail this Sheet
MISSOURI RIVER
SANDY LOAM
PLAN
SCALE 1 INCH = 500 FEET
West Abutment Grout Curtain
Intake Structure
Powerhouse
DETAIL



PLAN

SCALE 1 INCH = 500 FEET

SPILLWAY CREST STRUCTURE FOUNDATION PIEZOMETERS

PIEZ. NO.	TIP CONTACTS
SP13-1	Screened gravel pocket
SP13-2	Screened gravel pocket
SP13-3	Screened gravel pocket
SP13-4	I U Lignite
SP13-5	Screened gravel pocket
SP13-7	1½ U Lignite
SP23-1	Screened gravel pocket
SP23-2	Screened gravel pocket
SP23-3	Screened gravel pocket
SP23-4	I U Lignite
SP23-5	Screened gravel pocket
SP29-1	Screened gravel pocket
SP29-2	Screened gravel pocket
SP29-3	Screened gravel pocket
SP29-4	I U Lignite
Sp29-5	Lignite Stringer (El.1760)

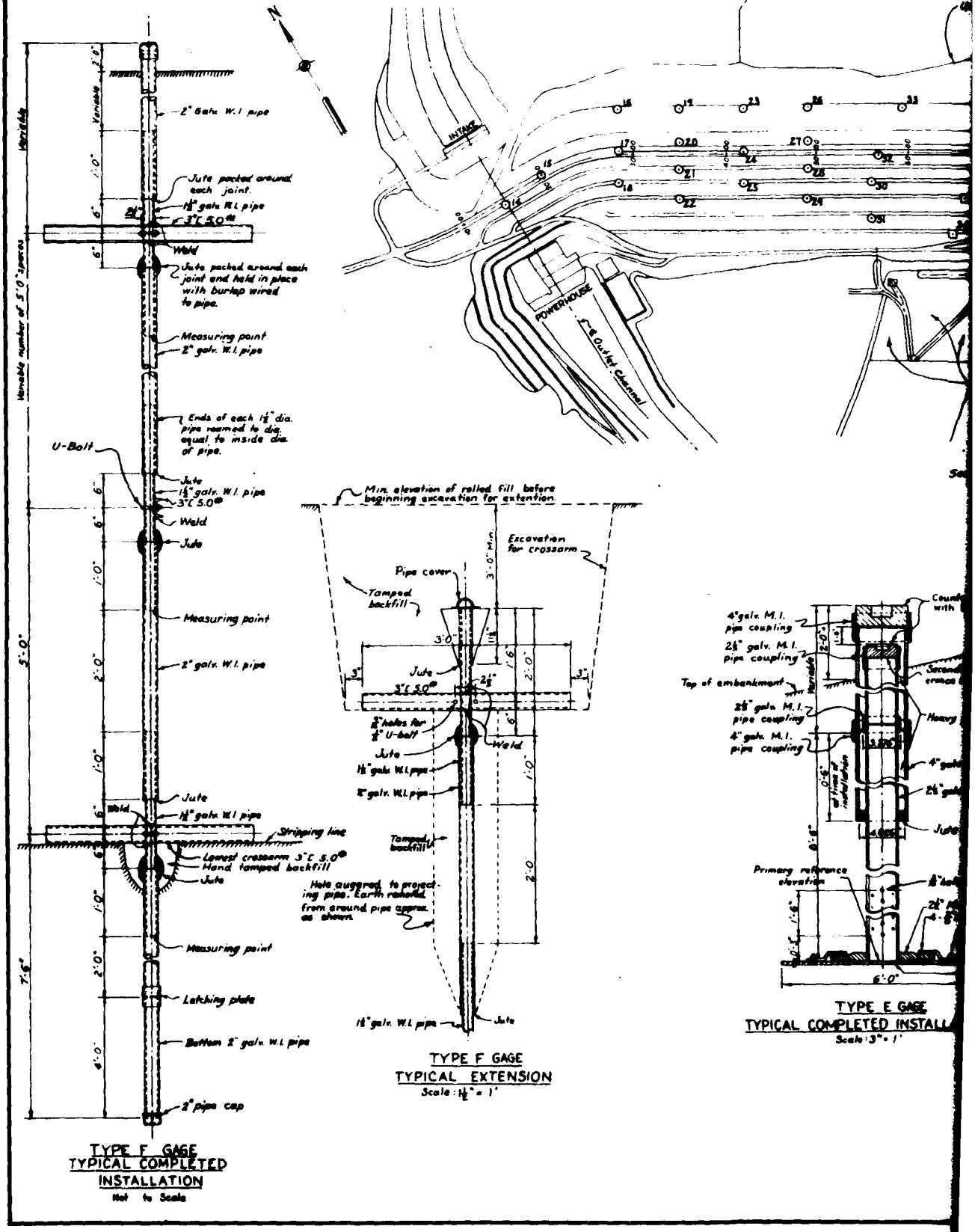
Note: Indicates Pier 13

THIS DRAWING HAS BEEN REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE.

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

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
UNDERSEEPAGE STUDIES
GARRISON DAM PIEZOMETERS
PLAN

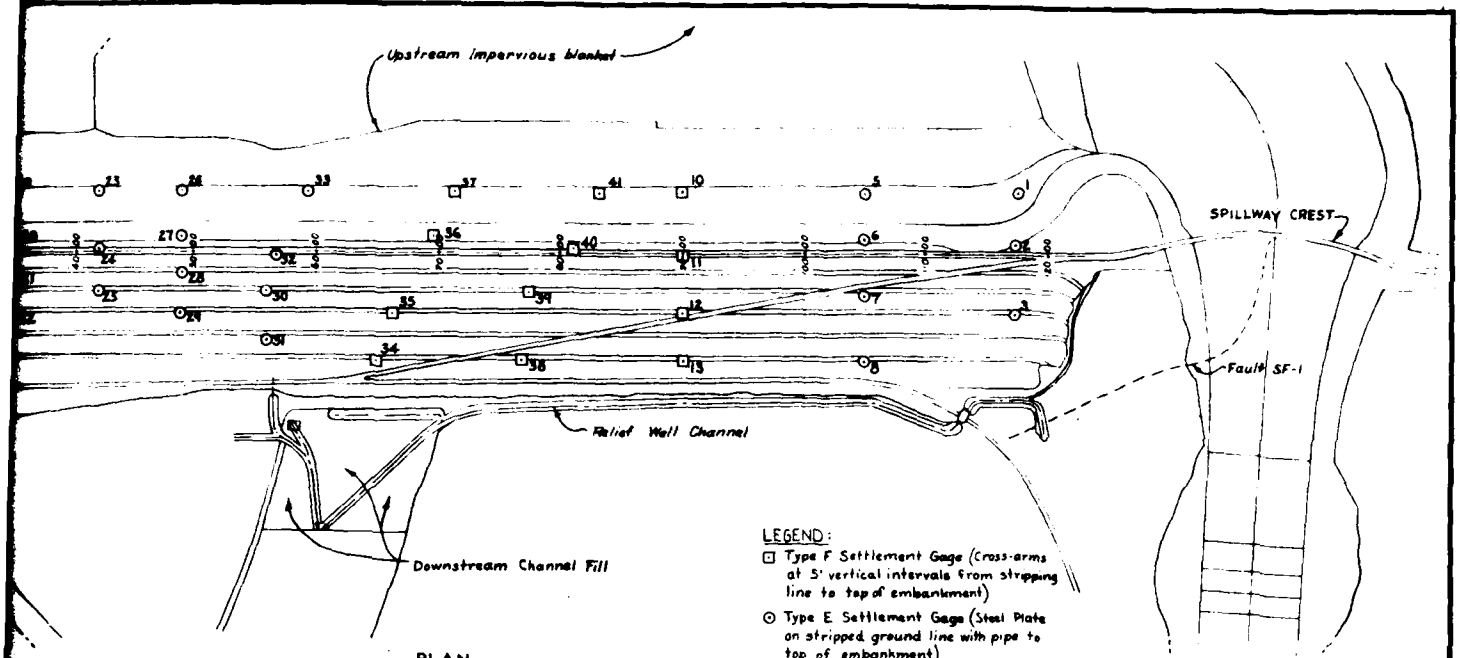
MAY 1964



TYPE F GAGE
TYPICAL COMPLETED INSTALLATION
Not to Scale

TYPE F GAGE
TYPICAL EXTENSION
Scale: 1½" = 1'

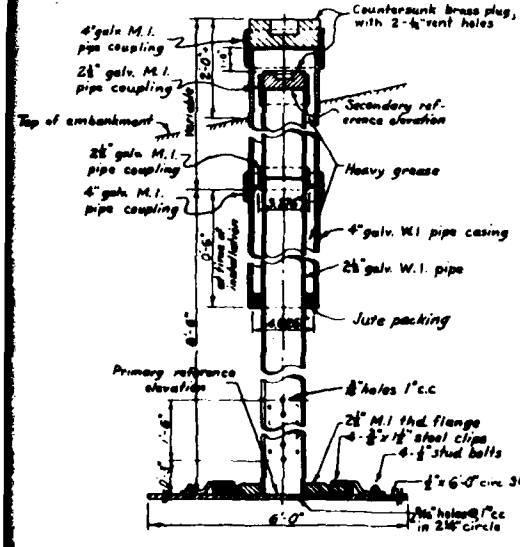
TYPE E GAGE
TYPICAL COMPLETED INSTALL
Scale: 3" = 1'



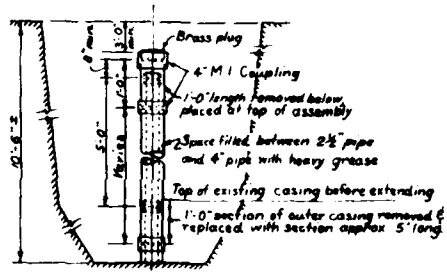
PLAN
Scale: 1" = 500'

LEGEND:
- ⊡ Type F Settlement Gage (Cross-arms at 5' vertical intervals from stripping line to top of embankment)
- ⊙ Type E Settlement Gage (Steel Plate on stripped ground line with pipe to top of embankment)

From "Excavation and Main Embankment, Stage II - Contract," Dwg. GE10-718



TYPE E GAGE
TYPICAL COMPLETED INSTALLATION
Scale: 3" = 1'



TYPE E GAGE
TYPICAL EXTENSION
Not to Scale

THIS DRAWING HAS BEEN REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE.

DATE	DESCRIPTION	BY	APPVD

REVISIONS

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

MISSOURI RIVER
GARRISON DAM - LAKE SAKAKAWEA
EMBANKMENT-FOUNDATION STUDIES
SETTLEMENT GAGES
TYPE E & F
PLAN AND DETAILS

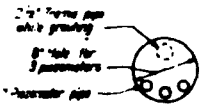
DESIGNED BY: O.D.K.
DRAWN BY:
CHECKED BY: C.F.J.
QUANTITIES BY: A.H.K.
TRACED BY:
CHECKED BY: E.R.K.
APPROVED: [signature] CHIEF, ENGR. DIV.
DATE: SEP 1975
APPROVED: [signature] COL., CE, DISTRICT ENGINEER
DRAWING NO. OMA 10-1-1128
CONTRACT NUMBER
DATE

SAFETY PAYS

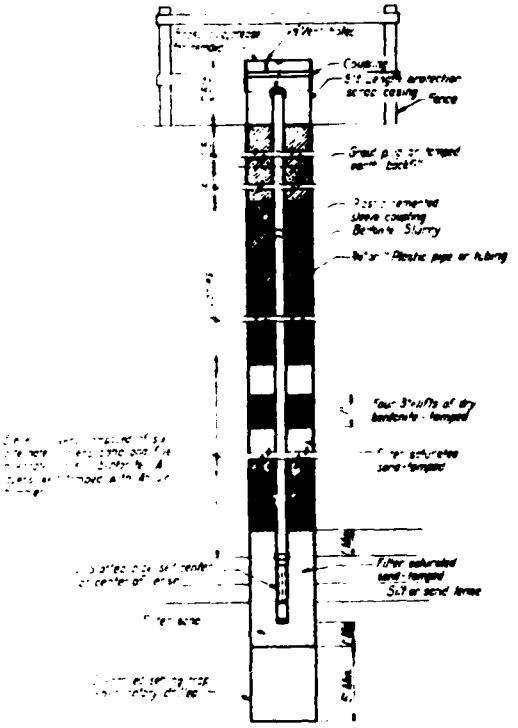
THIS PLAN ACCOMPANIES CONTRACT NO. MODIFICATION NO.
U.S.A.E. DISTRICT, OMAHA



PLAN



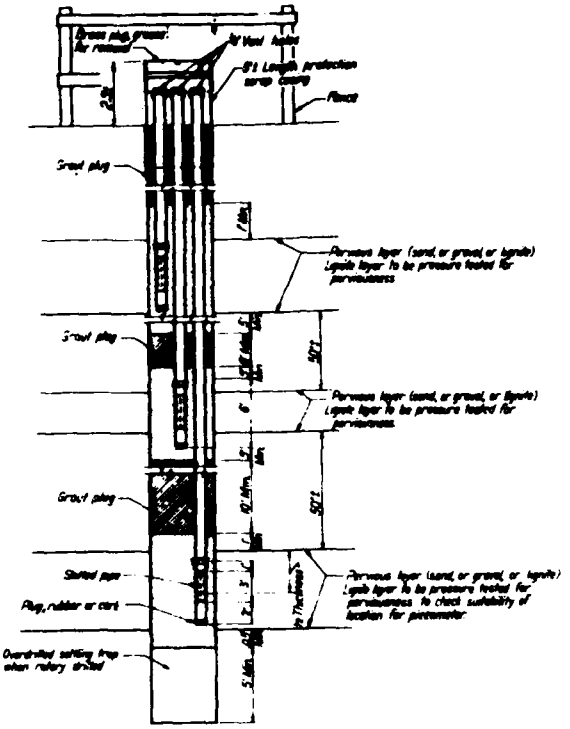
PLAN



PIEZOMETER INSTALLATION FOR IMPERVIOUS MATERIAL ONLY

NOT TO SCALE

TYPE J-2

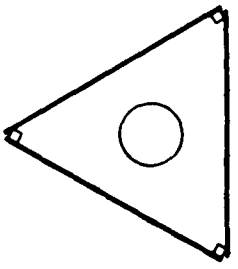


PIEZOMETERS IN MULTIPLE INSTALLATION PERVIOUS LAYERS ONLY

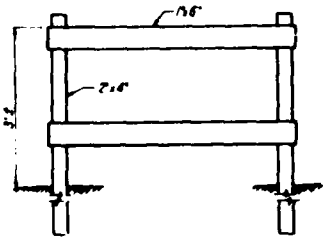
NOT TO SCALE

TYPE L

Note: Multiple installation not over 3 piezometers per hole when distance between pervious layers around 50' and stratification such as to permit sealing between tips of adjacent piezometers, otherwise install only 1 piezometer in hole.



PLAN

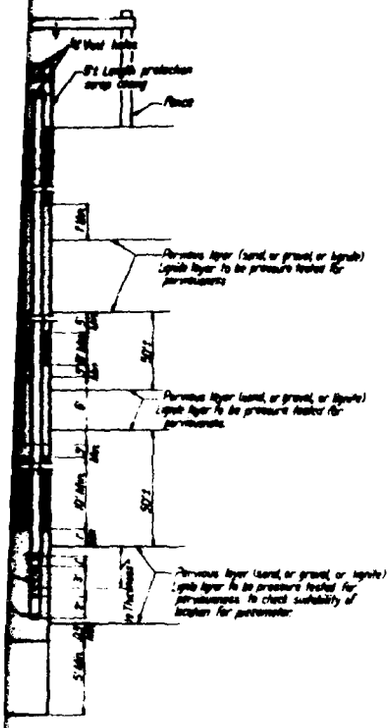


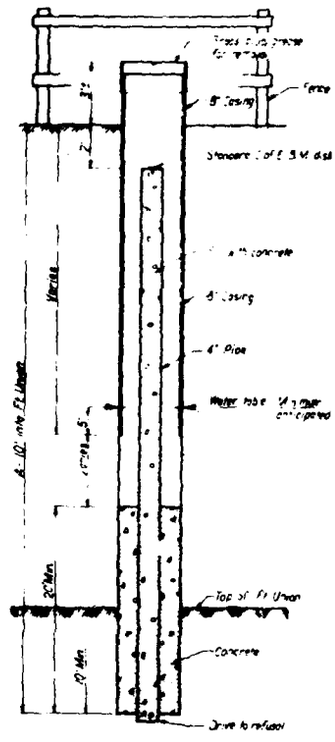
ELEVATION

FENCE DETAILS

NOT TO SCALE

PLAN

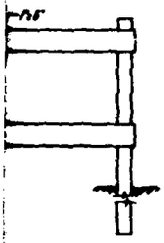




UNDERGROUND BENCH MARK
NOT TO SCALE

TIPLE INSTALLATION
IVERS ONLY
SCALE
YPE L

Note: Multiple installation not over 3 piezometers per hole when distance between pervious layers around 50' and stratification such as to permit sealing between tips of adjacent piezometers, otherwise install only 1 piezometer in hole



NOTES

- Plastic pipe to be Carlon "Flexible pipe" or equivalent, SDR type 26
- Filter sand to be clean and medium
- 3 Slots are to be 3" long by 1/8" wide, 120° apart, and located midway between the couplings

THIS DRAWING WAS WITH REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE

U. S. ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
Omaha, Nebr.

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
OPERATION & MAINTENANCE MANUAL
PIEZOMETERS AND UNDERGROUND BENCH MARK DETAILS

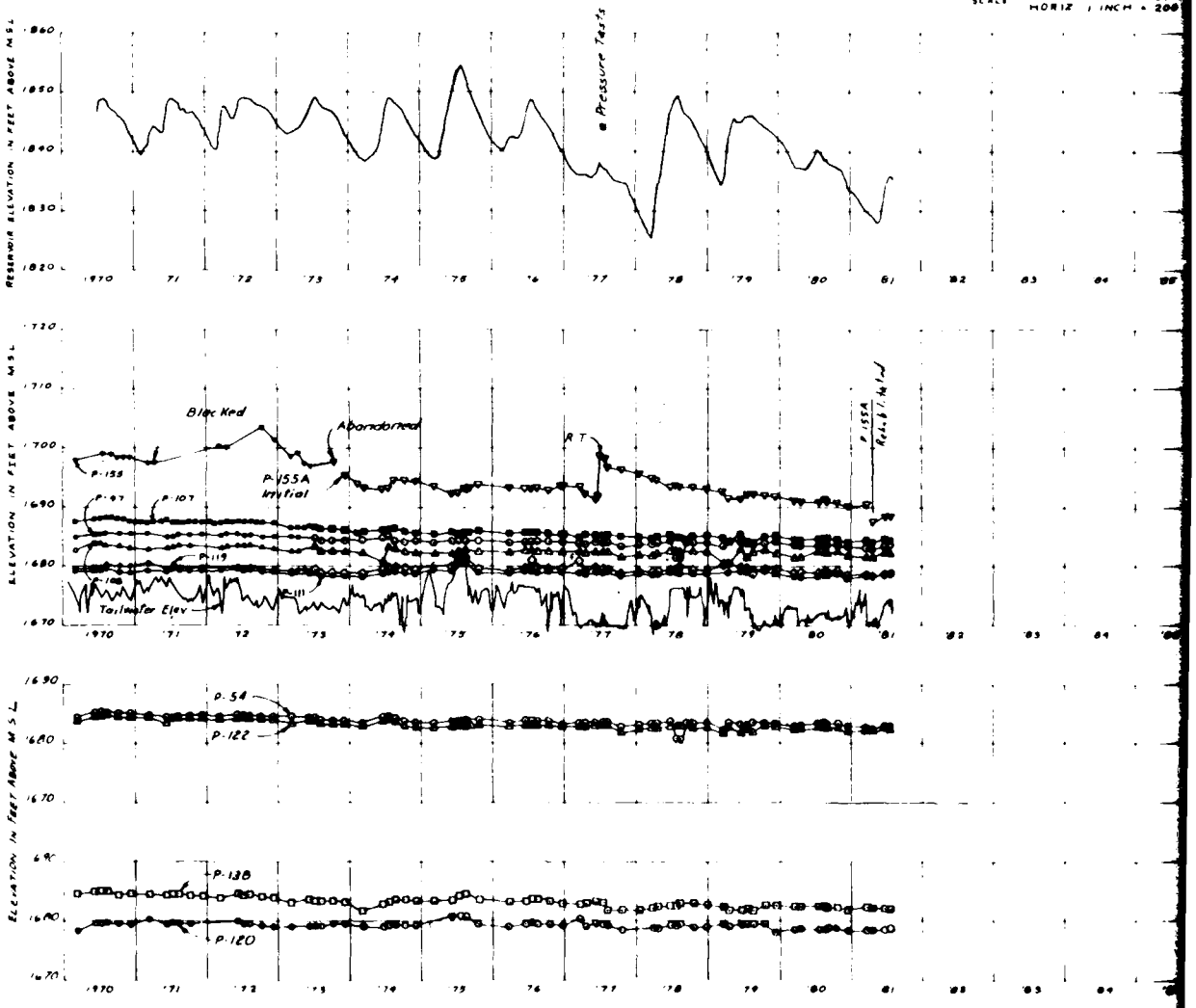
OCTOBER 1953

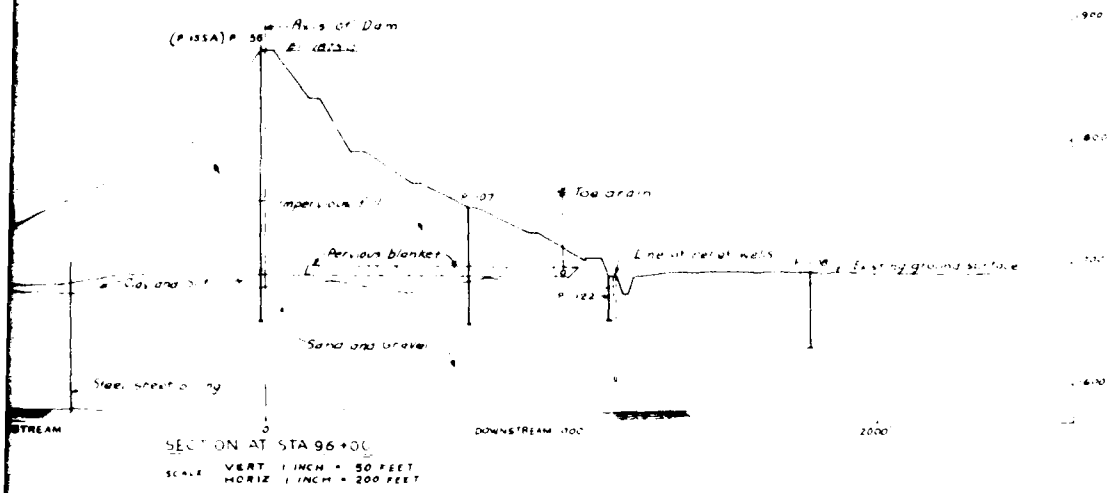
SHEET 9 OF 14



SECTION AT STA 96+00

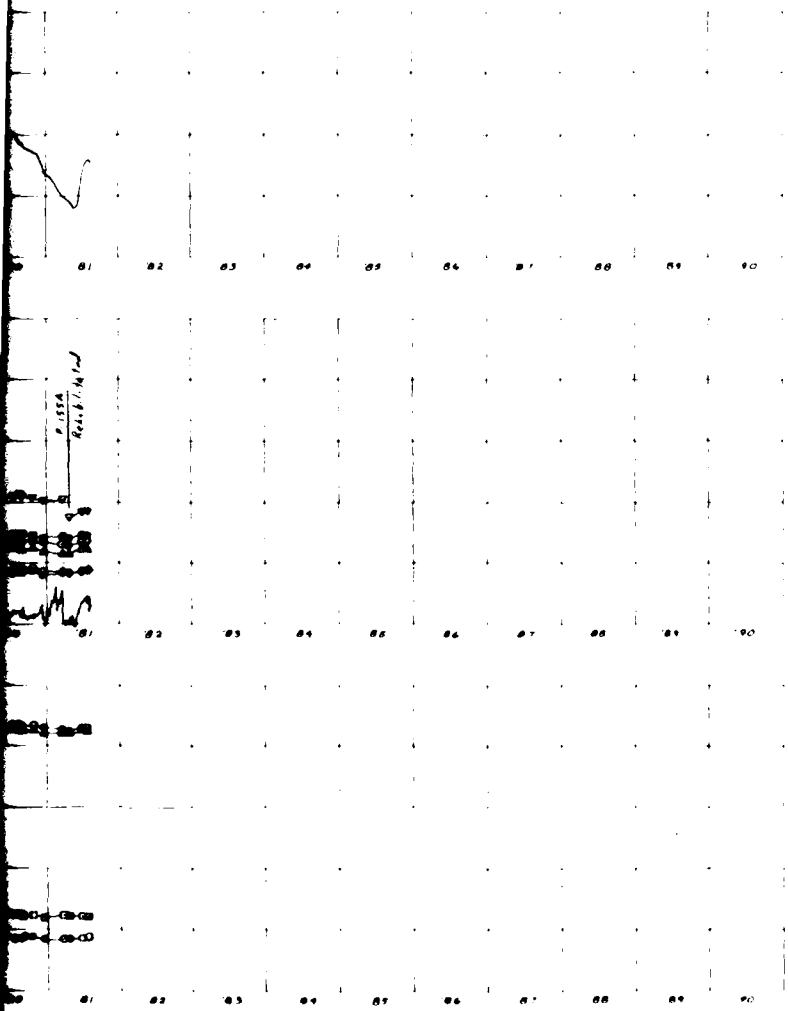
SCALE VERT 1 INCH = 50
HORIZ 1 INCH = 200

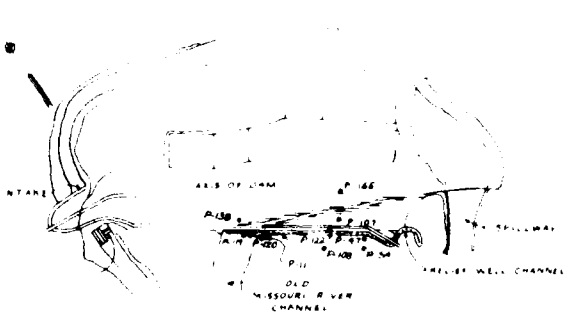




SECTION AT STA 96+00

SCALE VERT 1 INCH = 50 FEET
HORIZ 1 INCH = 200 FEET





KEY PLAN
NO SCALE

* Pressure tests were conducted in the [illegible] and the [illegible] piezometers were tested for [illegible] response to [illegible] of the [illegible]

Note
1. P 155 is replaced by 155A at Sta 95+73 Top of pipe elev 1875.0
2. [illegible] free at Elev [illegible]
3. R.T. = Response Test

Note
For data prior to 1970 see the following plates in the 1969 Periodic Inspection Report
Plate B-10 for Relief Well Discharge
Plate B-12 for P 155, P 107, P 108 & P 122

THIS DRAWING HAS BEEN REDUCED TO THREE-FOURTHS OF ORIGINAL SCALE

DATE	DESCRIPTION	ISSUE	APPVD
	REVISIONS		

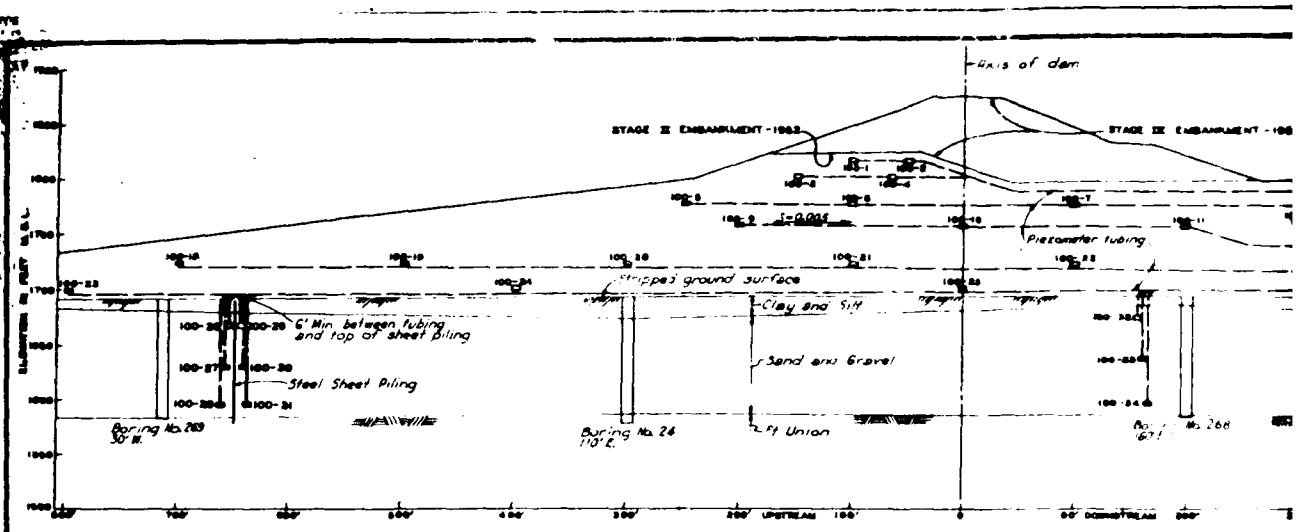
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

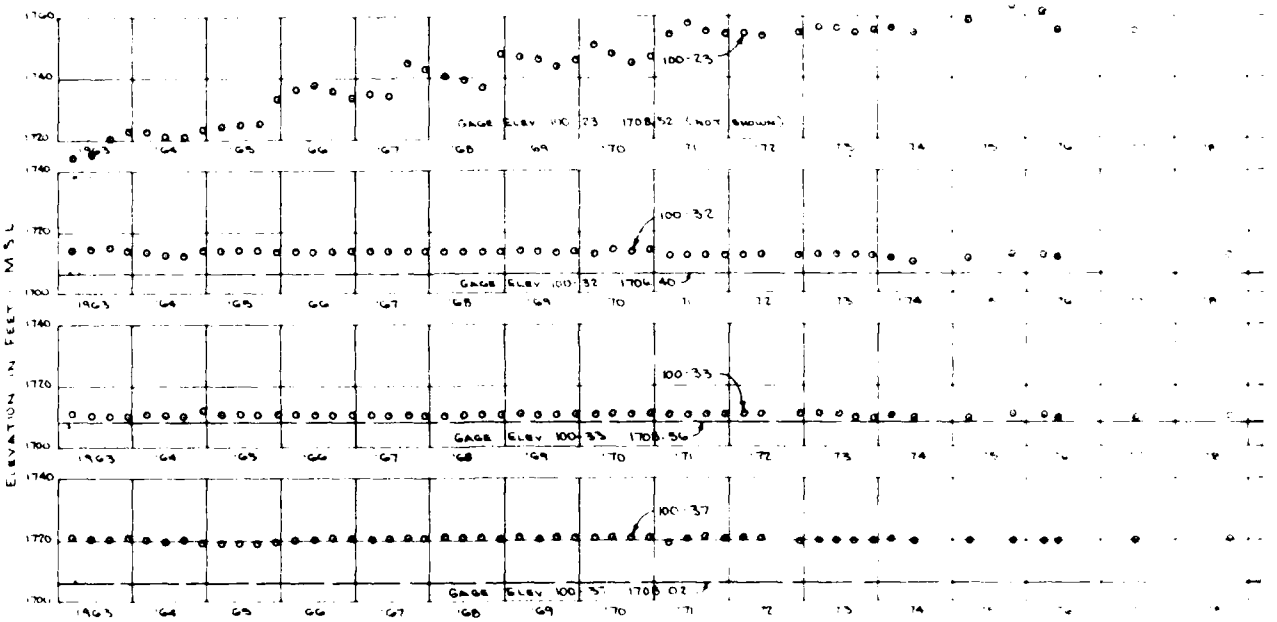
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
UNDERSEEPAGE STUDIES
VALLEY PIEZOMETERS
INTERMEDIATE GRAVEL PIEZOMETERS

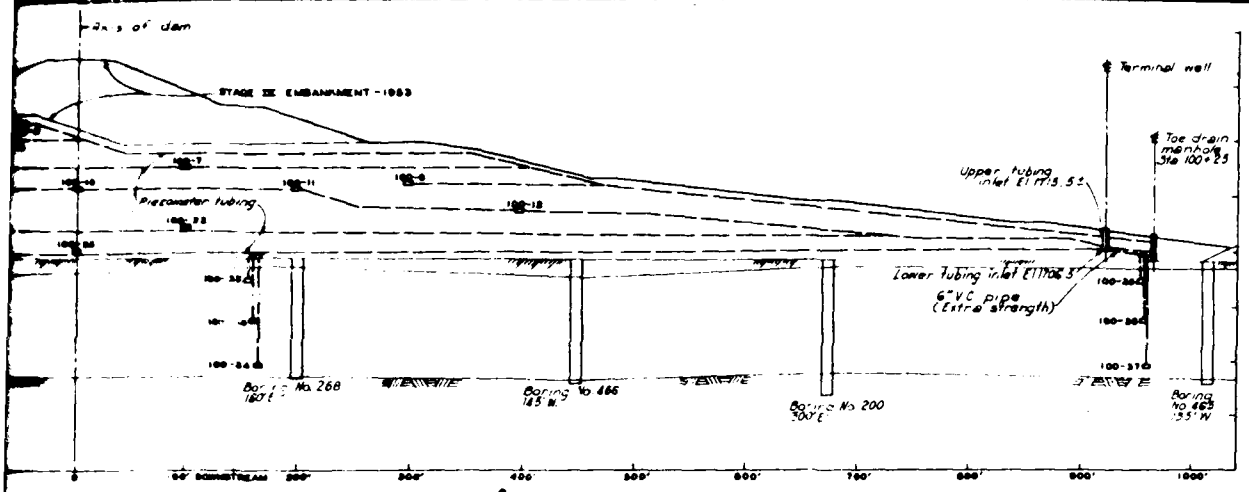
SUBMITTED BY
DRAWN BY
CHECKED BY
SUBMITTED BY
CHIEF, DESIGN
CHECKED
CHIEF, CONST.
APPROVED
DATE
CHIEF, ENGINEERING DIVISION
SCALE AS SHOWN
DRWG. NO.
APPROVED
CHIEF, U.S. ARMY DISTRICT, OMAHA
ASSISTANT ENGINEER
SHEET

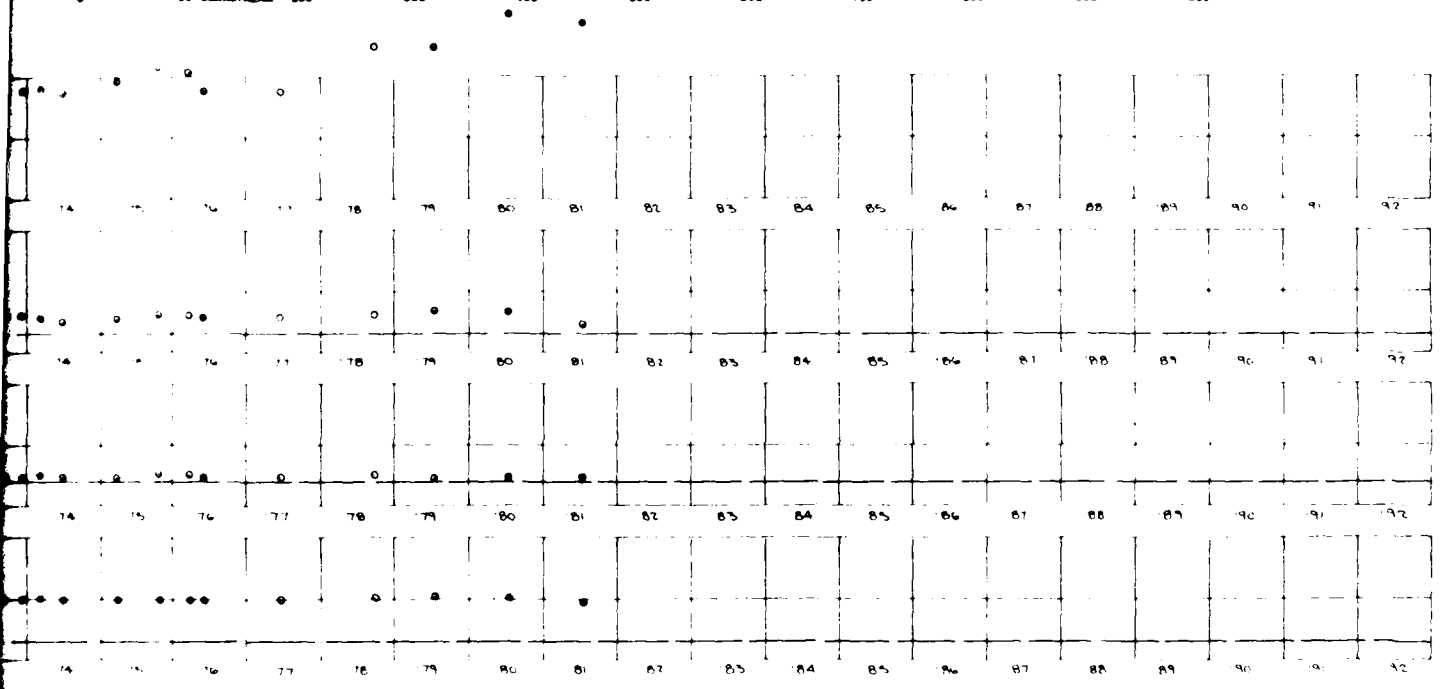
SAFETY PAYS

THIS PLAN ACCOMPANIES CONTRACT No.
MODIFICATION No.


Axis of dam
STAGE II EMBANKMENT - 1963
STAGE III EMBANKMENT - 196
i=0.005
Piezometer tubing
Stripped ground surface
Clay and Silt
Sand and Gravel
6' Min. between tubing and top of sheet piling
Steel Sheet Piling
Boring No. 269
30' W.
Boring No. 24
110' E.
2 Ft Union
No. 268
UPSTREAM
DOWNSTREAM


ELEVATION IN FEET M.S.L.
100-23
GAGE ELEV 100-23 1708.52 (NOT SHOWN)
100-32
GAGE ELEV 100-32 1706.40
100-33
GAGE ELEV 100-33 1708.56
100-37
GAGE ELEV 100-37 1708.02
1963
64
65
66
67
68
69
70
71
72
73
74





THIS DRAWING WAS REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE.

DATE	DESCRIPTION	BY	APPD
	REVISIONS		

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

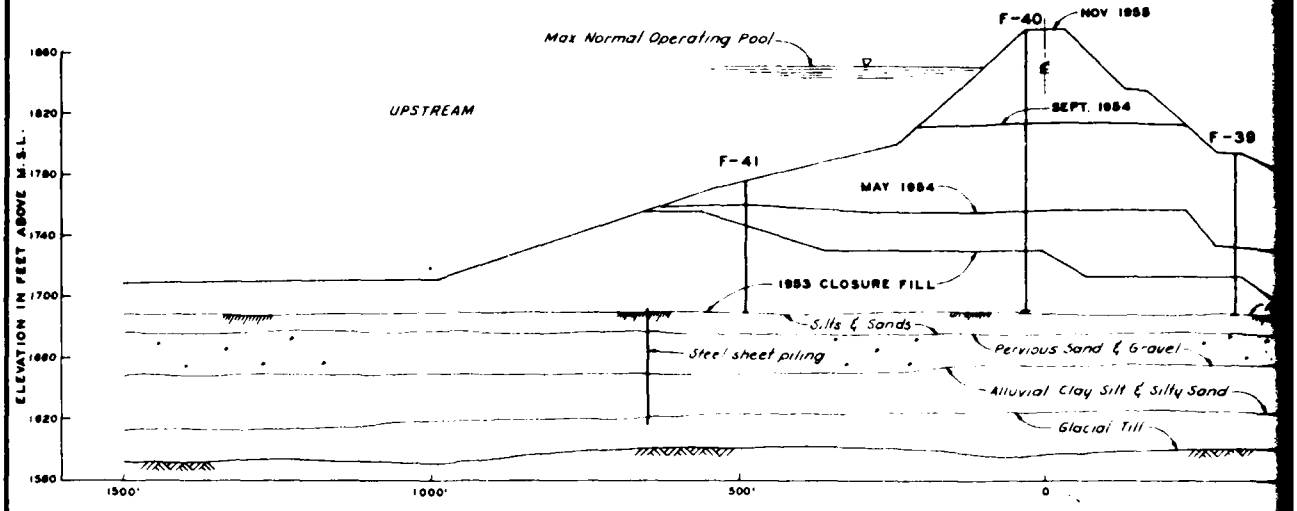
MISSOURI RIVER
GARRISON DAM LAKE SAKAKAWEA
UNDERSEEPAGE STUDIES
EMBANKMENT PORE PRESSURE
OBSERVATIONS - STATION 100+00

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SUBMITTED BY:
DATE
TRACED
APPROVED
DATE
SCALE AS SHOWN
SPEC. NO.
DRAWING NUMBER
SUBMITTED
DATE

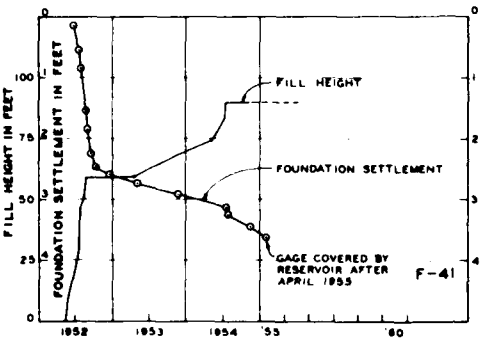
SAFETY PAYS

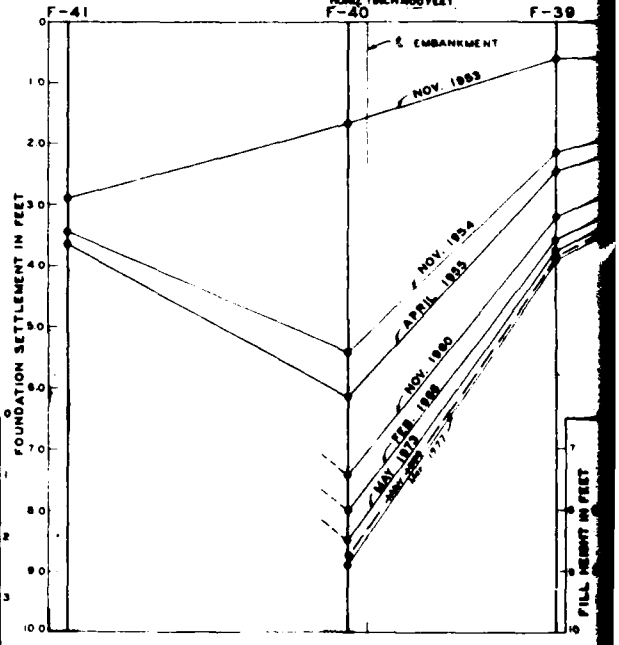
THIS PLAN ACCOMPANIES CONTRACT No.
MODIFICATION No.

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 131

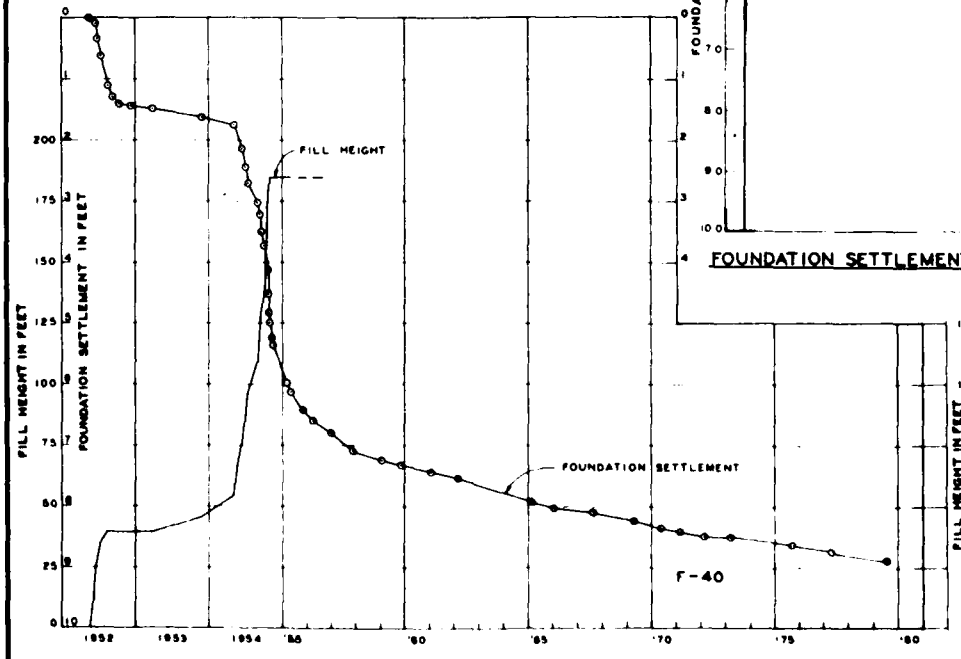


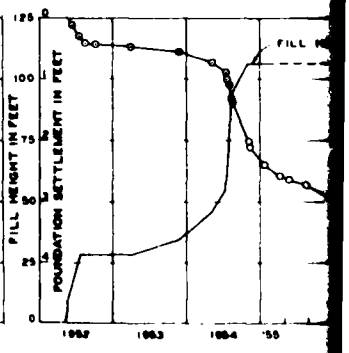
DIAGONAL SECTION-STATION 76+90 TO 83+2

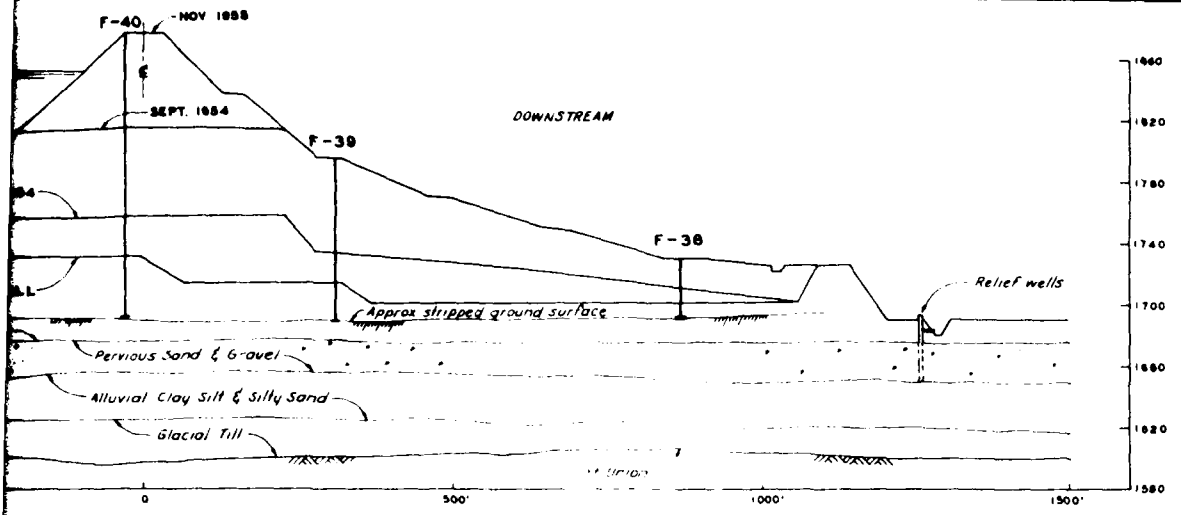




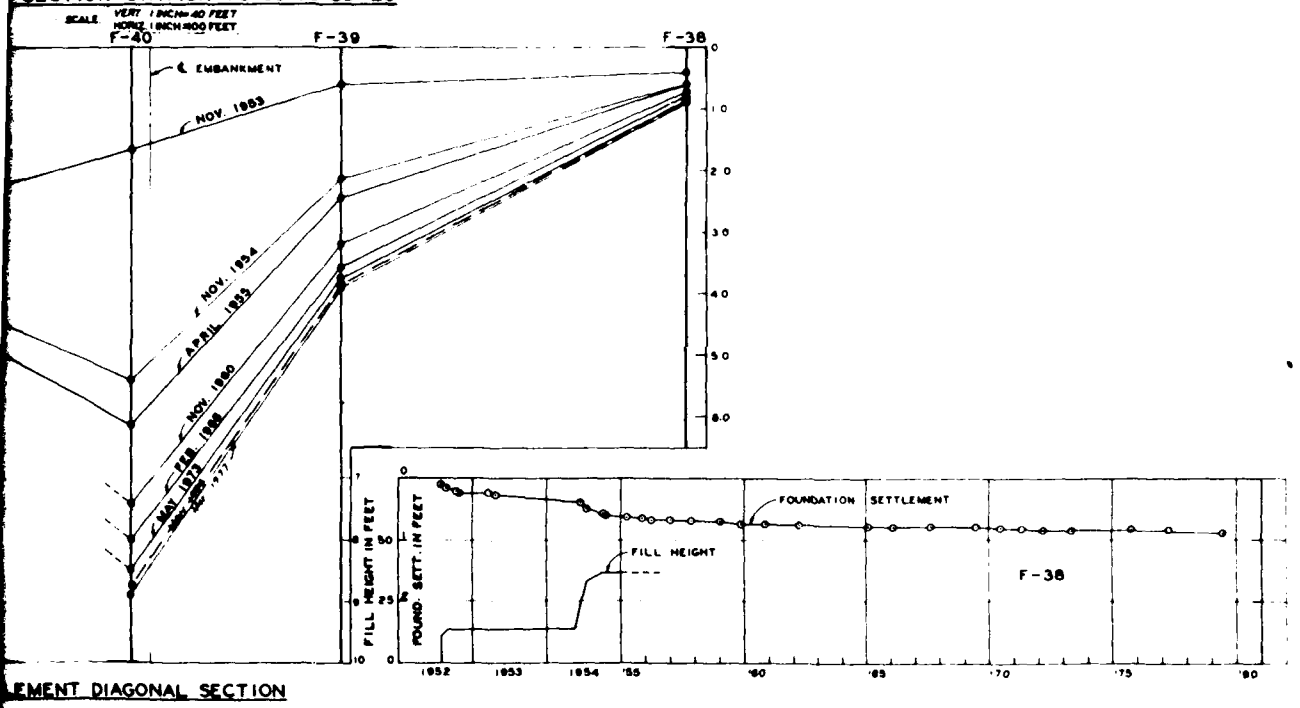
FOUNDATION SETTLEMENT DIAGONAL SECTION



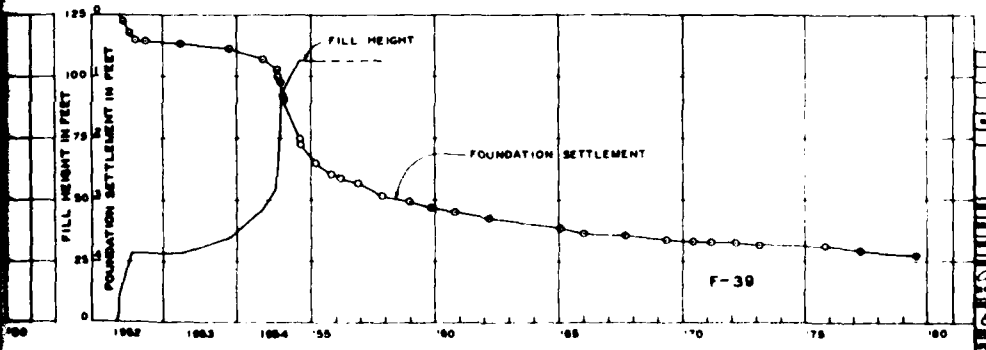




SECTION-STATION 76+90 TO 83+25



EMENT DIAGONAL SECTION



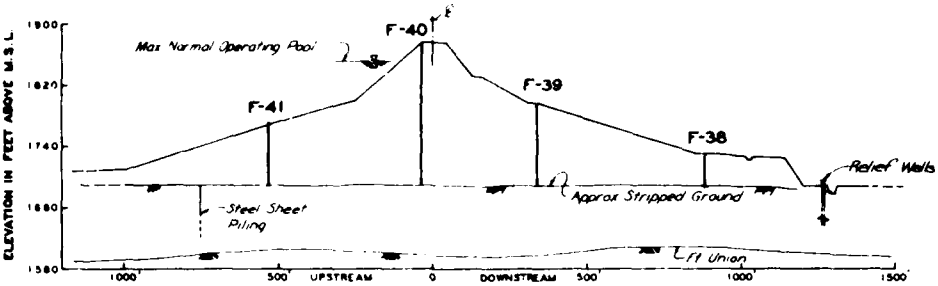
THIS DRAWING HAS BEEN REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE

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

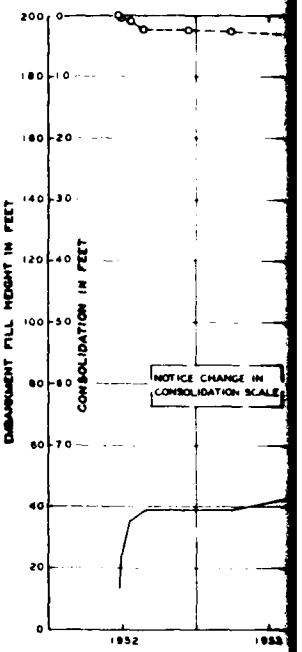
MISSOURI RIVER
GARRISON DAM - LAKE SAKAKAWEA
SETTLEMENT AND CONSOLIDATION STUDIES
FILL HEIGHT AND FOUNDATION SETTLEMENT DIAGONAL SECTION STA. 76+90 TO 83+25

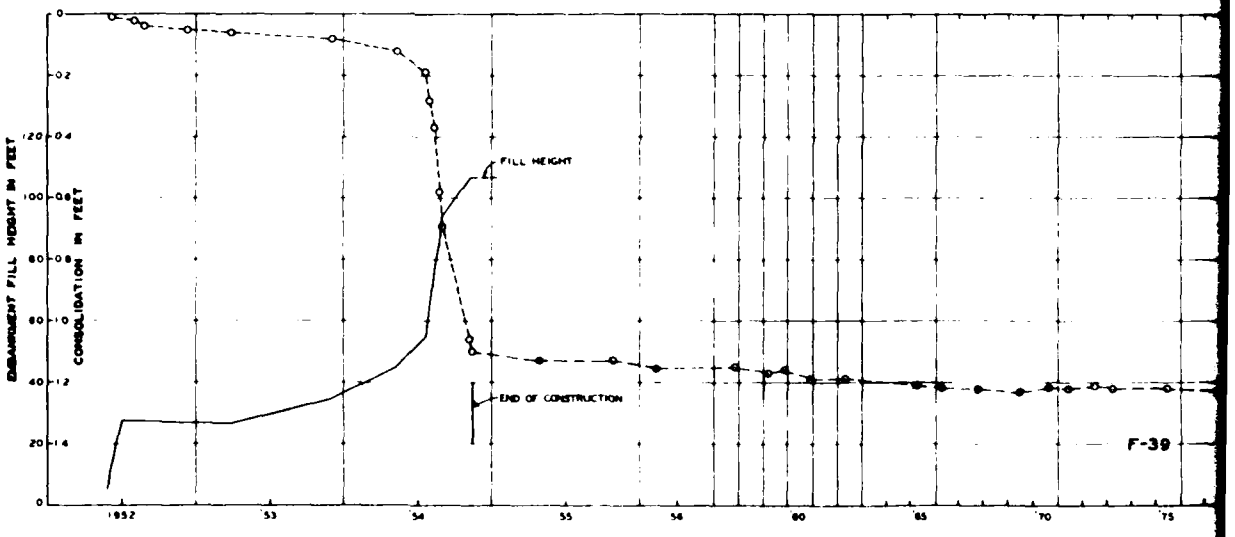
DRAWN: Art Baum
CHECKED: C.R. Brunner
APPROVED: Russell K. Hahn
DATE: SEP 1975
ERA AS SHOWN

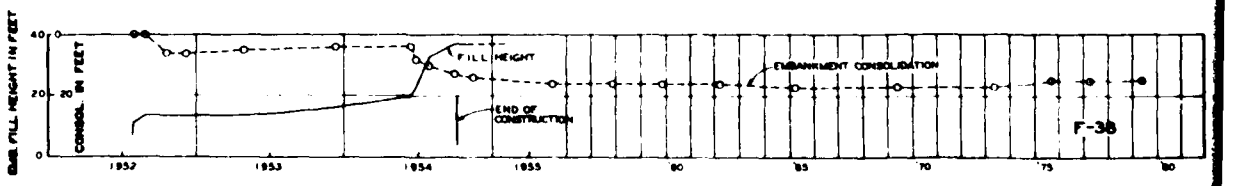
THIS PLAN ACCOMPANIES CONTRACT NO.
MODIFICATION NO.

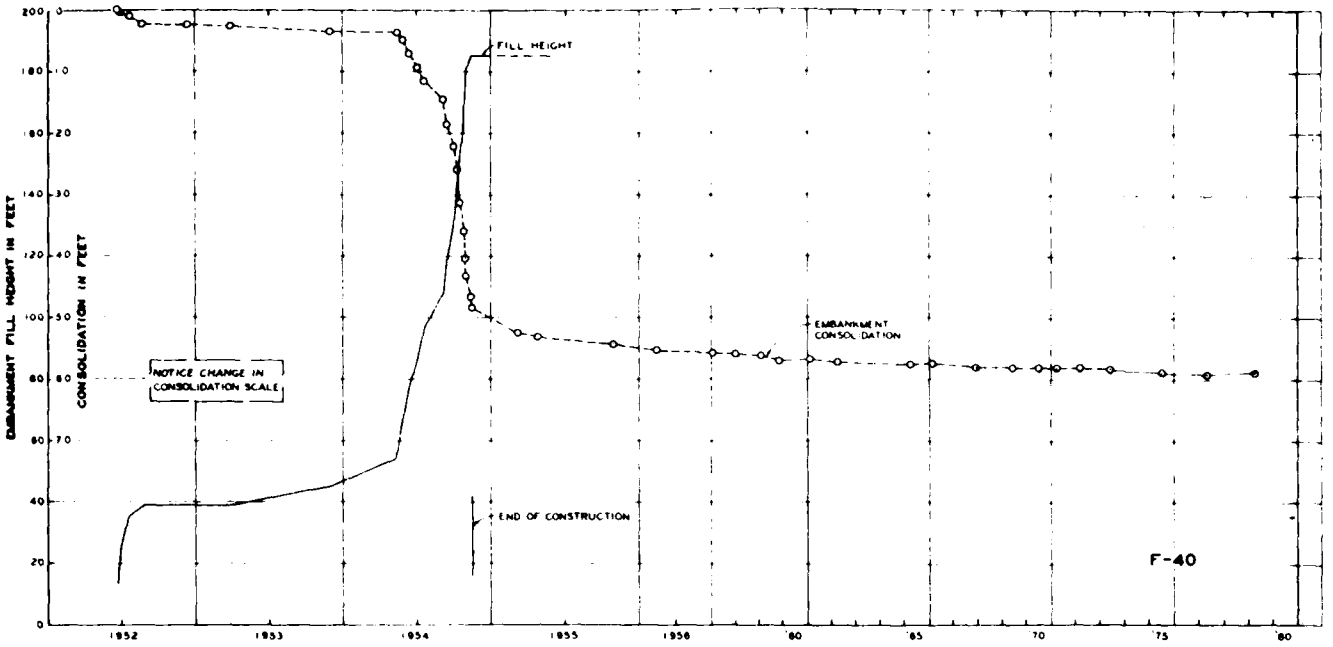


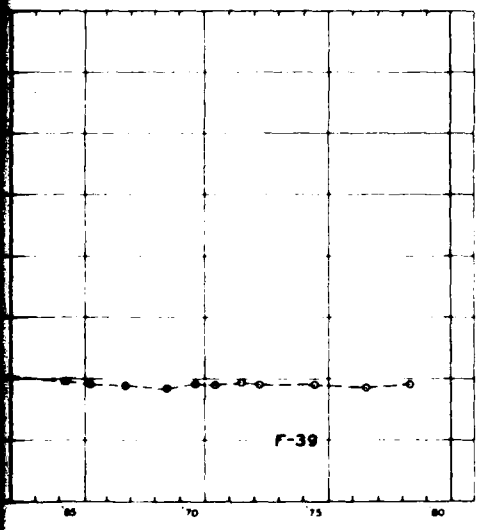
DIAGONAL SECTION - STA. 76+90 TO STA. 83+25

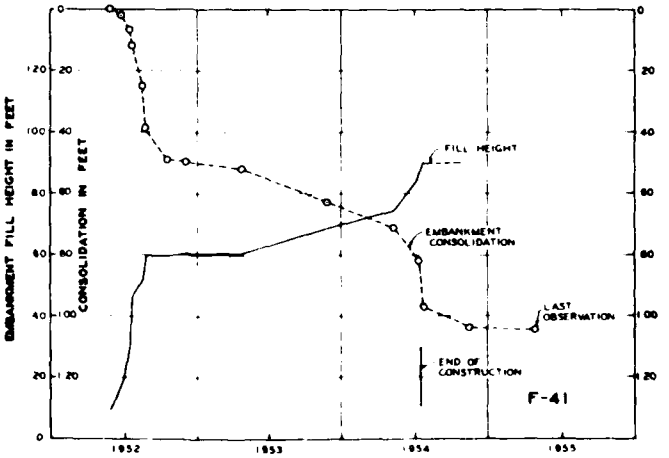


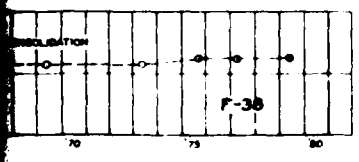


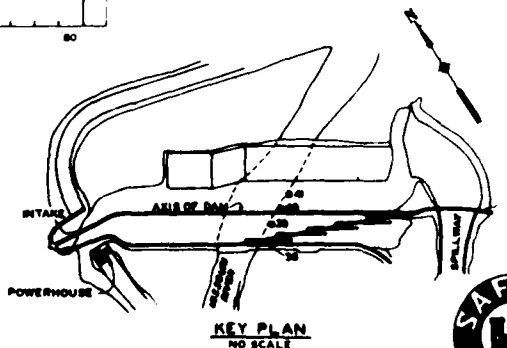












KEY PLAN
NO SCALE

SAFETY PAYS

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

MISSOURI RIVER

GARRISON DAM - LAKE SAKAKAWEA

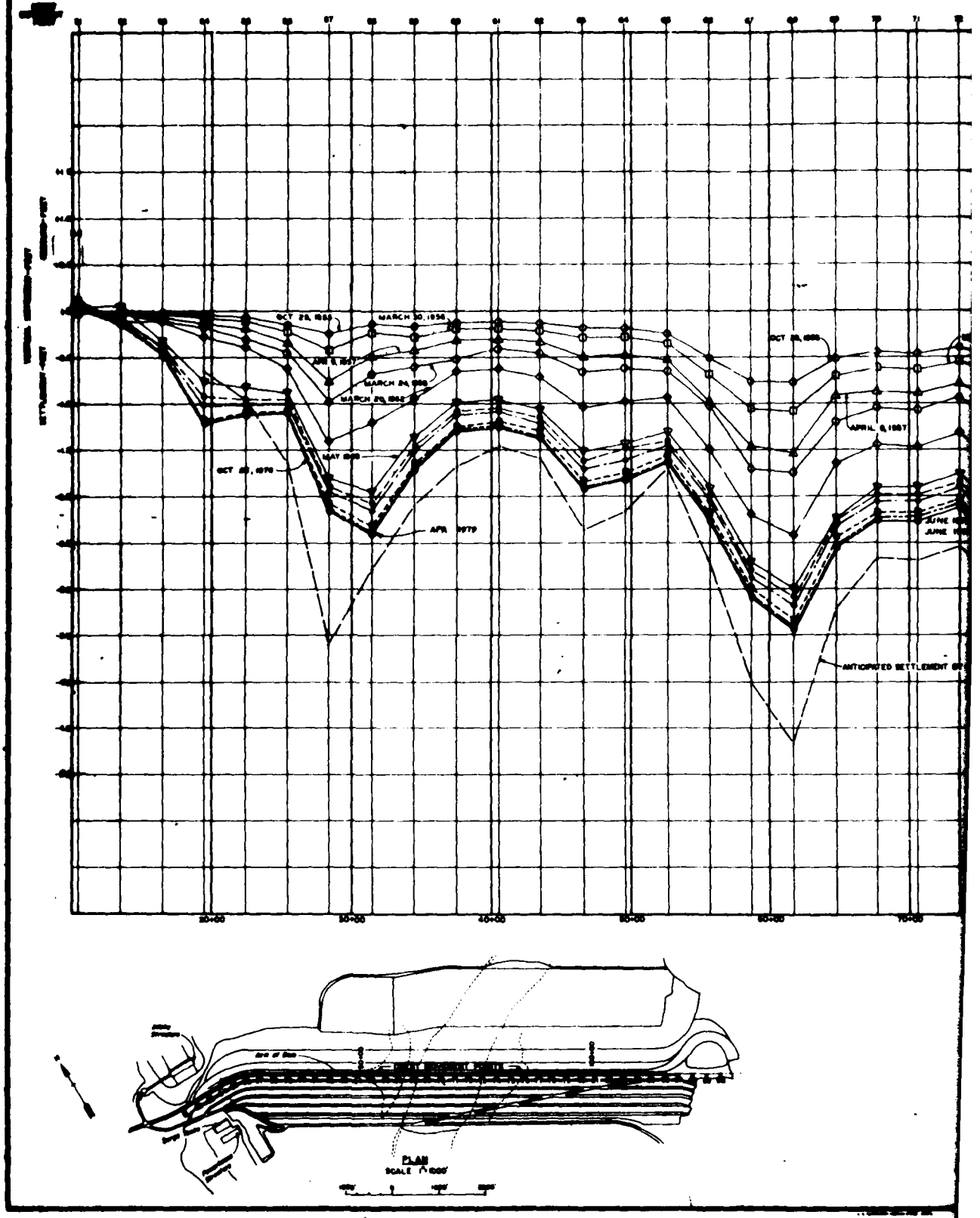
SETTLEMENT AND CONSOLIDATION STUDIES

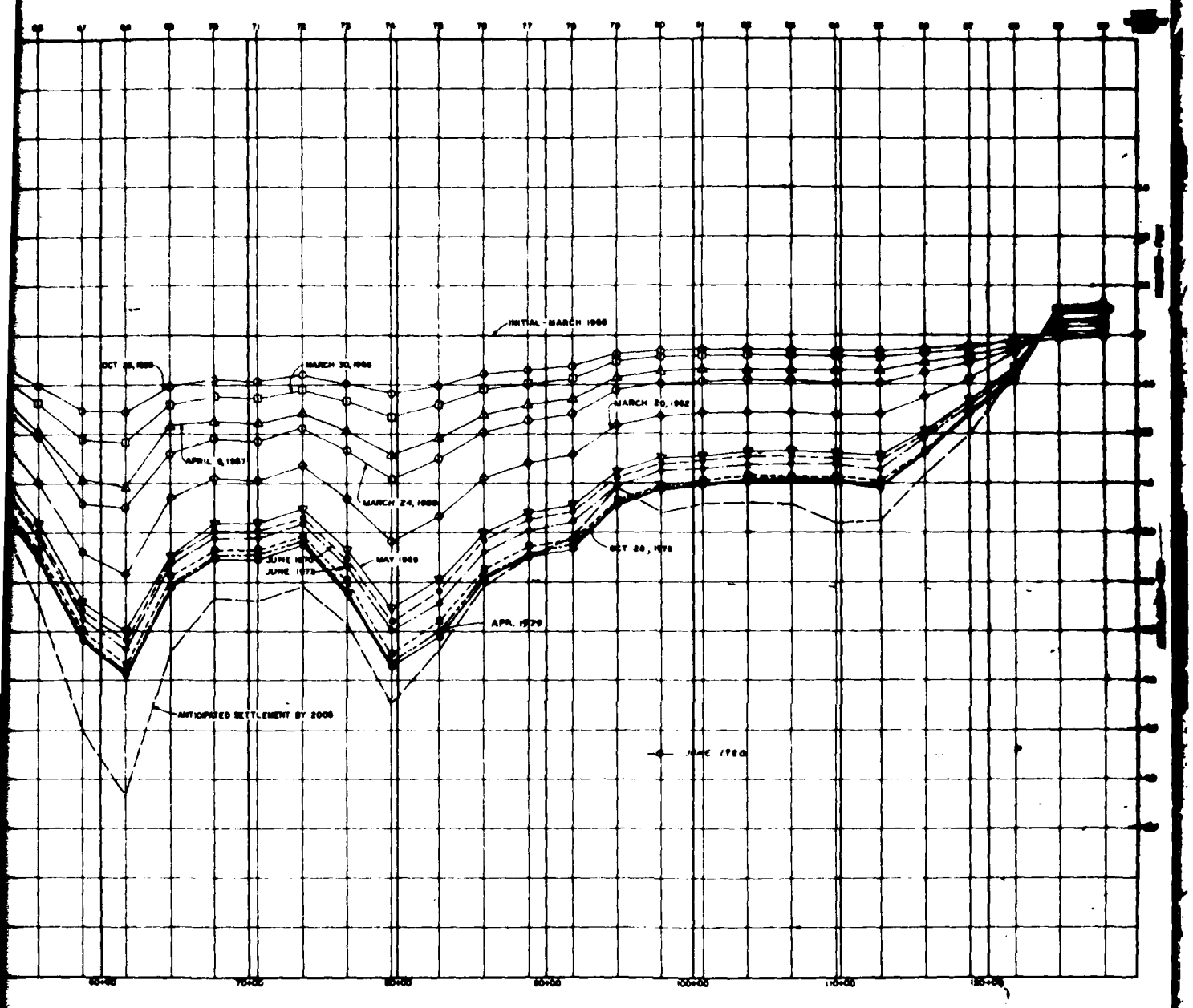
FILL HEIGHT & EMB. CONSOLIDATION
DIAGONAL SECTION - STA. 70+00 TO 83+25

SEPT 1975

THIS PLAN ACCOMPANIES CONTRACT NO.
MODIFICATION NO.

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 133


OCT 28, 1955
MARCH 30, 1956
JUNE 6, 1957
MARCH 24, 1958
MARCH 20, 1962
MAY 1968
OCT 28, 1970
APR 1979
OCT 28, 1955
APRIL 6, 1967
ANTICIPATED SETTLEMENT
PLAN
SCALE



NOTES

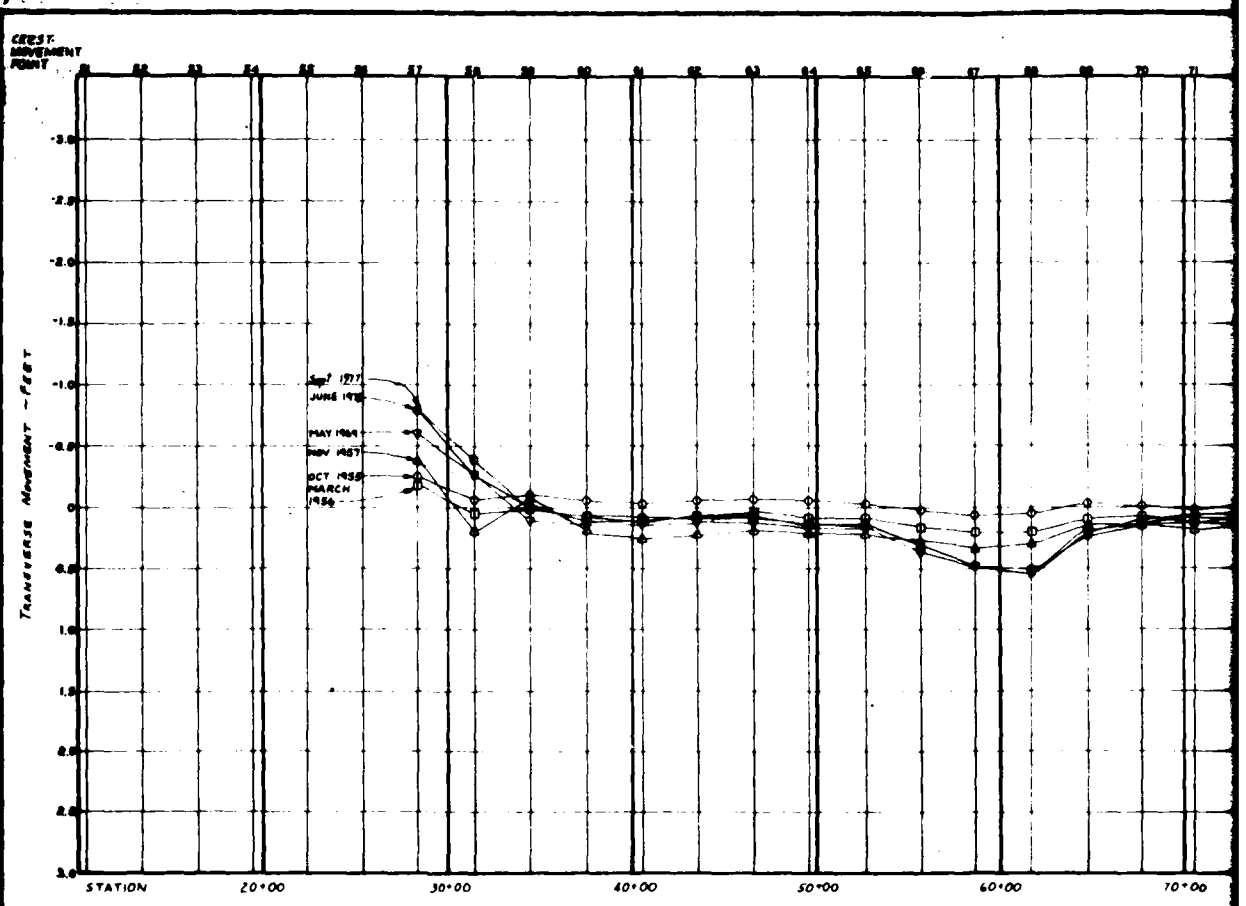
1. The above plotted data is derived from observations taken after March 1953, (the date the embankment was completed and before the paved roadway was constructed).
2. The anticipated settlement at the year 2005 is extrapolated from semi-log plots of each individual Crest Movement Point.
3. The April '77 survey shows negligible change from the Oct '76 survey, and therefore is not shown on the graph.

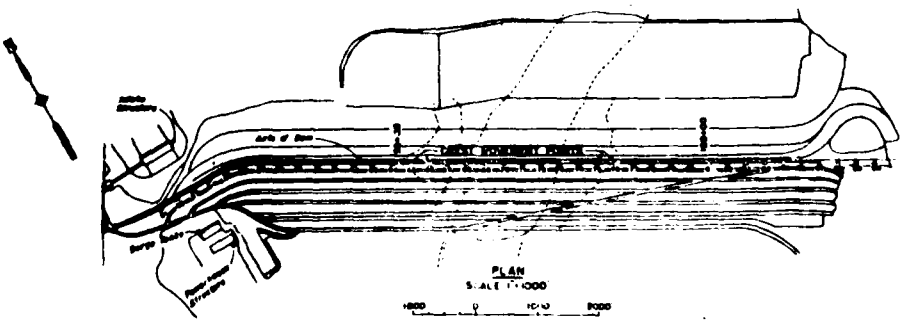
THIS DRAWING HAS BEEN REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE.

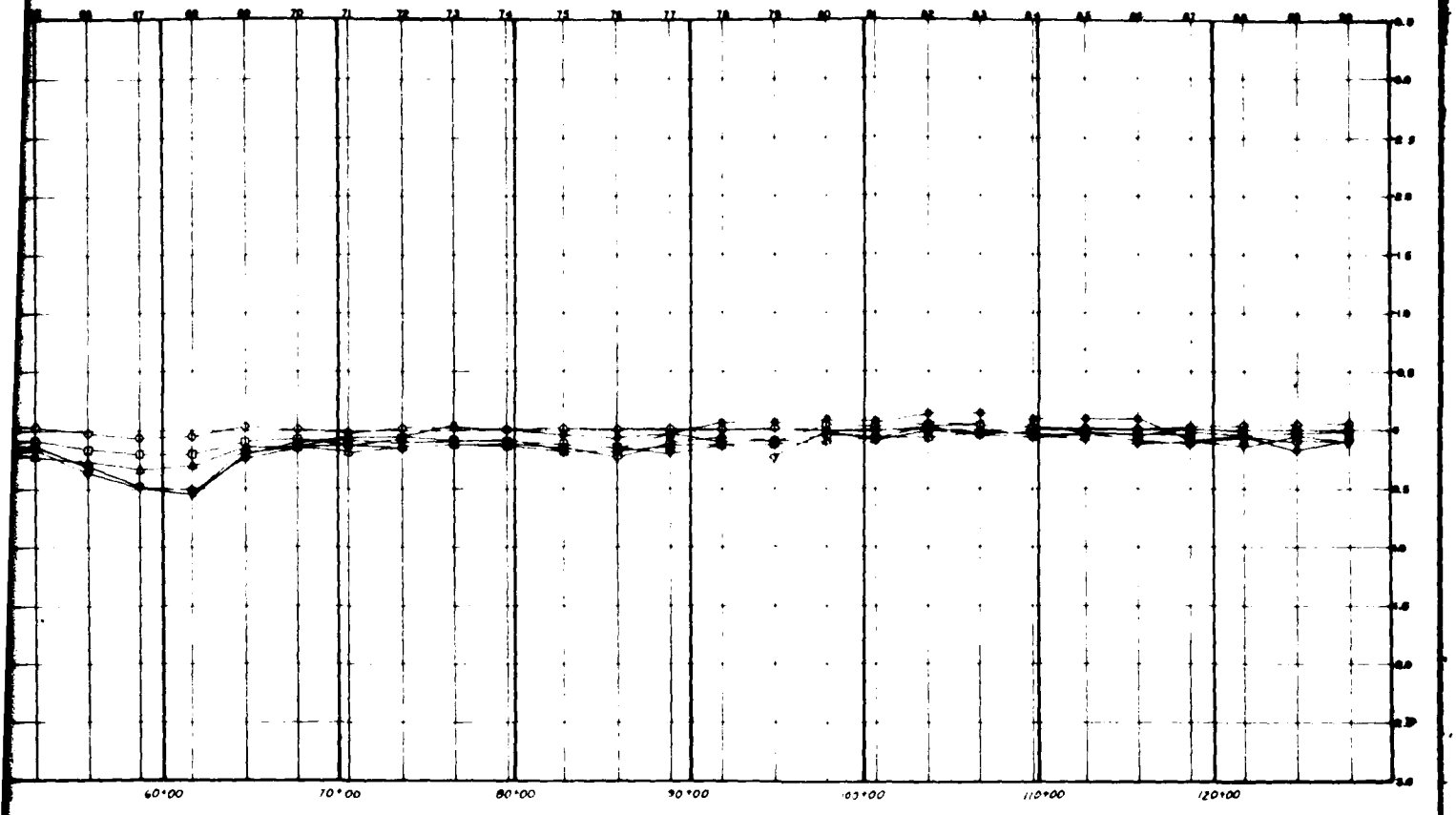
U. S. ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEBRASKA

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
CREST MOVEMENT OBSERVATIONS
VERTICAL MOVEMENT
PROFILE

SM 10-[illegible]

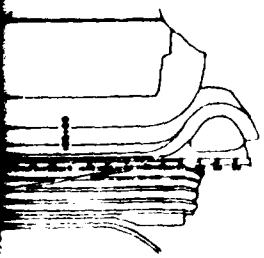

CREST MOVEMENT POINT
TRANSVERSE MOVEMENT - FEET
JUNE 1958
MAY 1956
NOV 1957
OCT 1958
MARCH 1956
STATION
20+00
30+00
40+00
50+00
60+00
70+00


PLAN



Notes

1. Movement in a plus (+) direction indicates downstream movement
2. Movement in a negative (-) direction indicates upstream movement
3. The July 1979 survey closely resembles the [illegible] 1977 survey

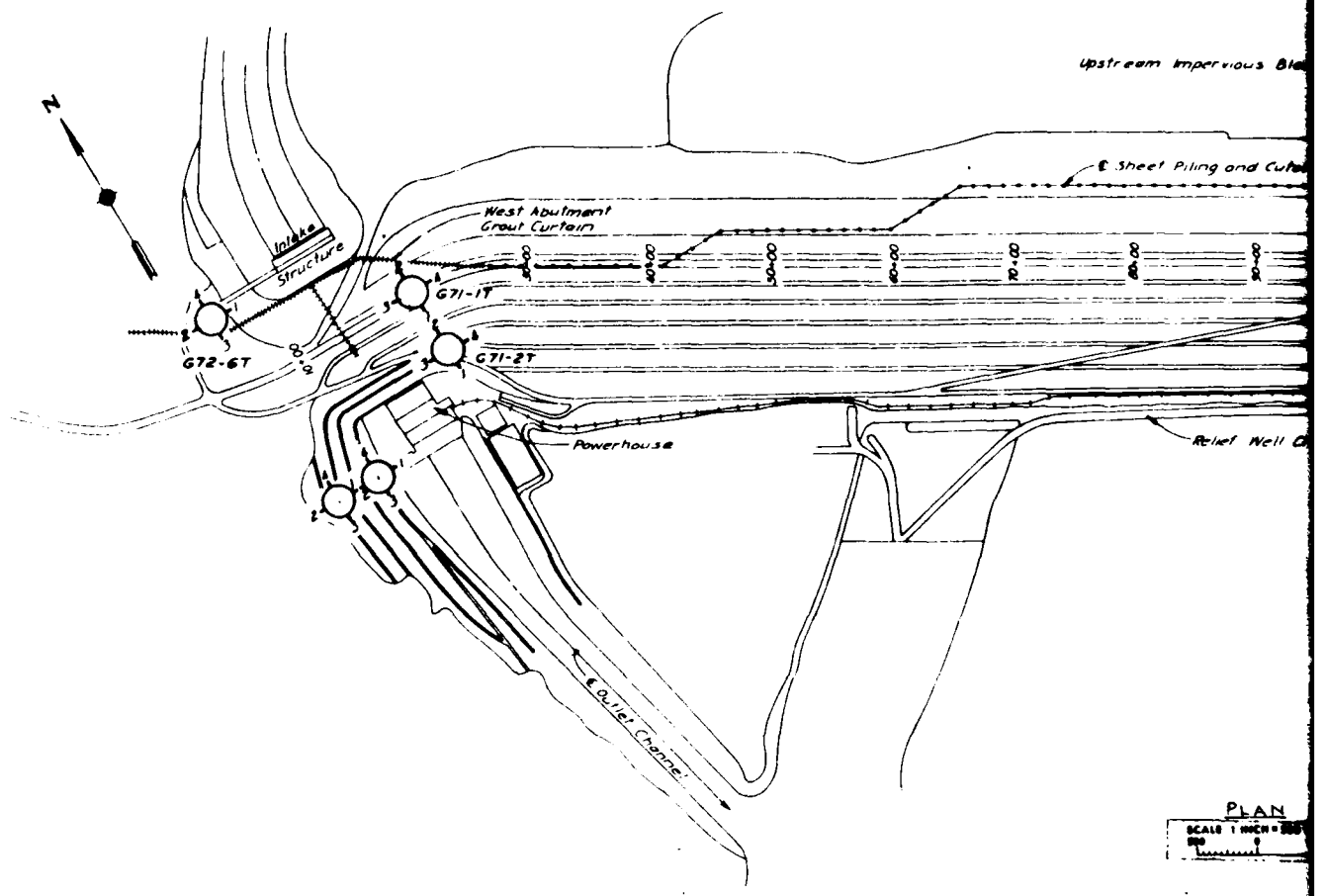


U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

MISSOURI RIVER
GARRISON DAM AND RESEVOIR
CREST MOVEMENT OBSERVATIONS
TRANSVERSE MOVEMENT

SAFETY DAYS

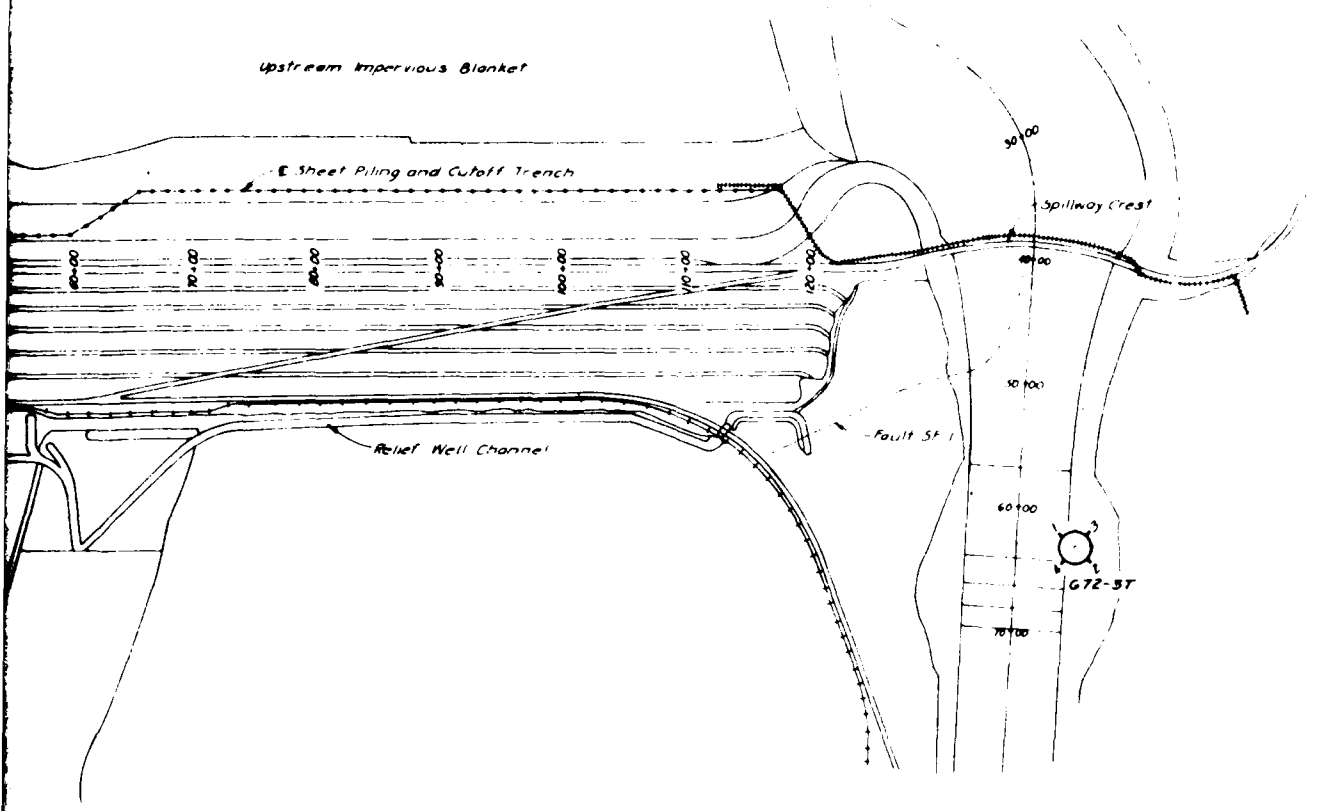
THIS PLAN ACCOMPANIES CONTRACT NO.
MODIFICATION NO.



PLAN

SCALE 1 INCH = 200

Tiltmeter No	Location	Sta	Range	Bottom Depth	Elev TOP
G71-1T	Crest	20+00	30' U S	207.0	1875.8
G71-2T	Emb Berm	20+09	320 D S	211.0	1759.6
G72-3T	P H Slope	161+30	8+10 Rt	165.8	1793.4
G71-4T	P H Slope (Base)	161+30	4+85 Rt	160.0	1693.8
G72-5T	Spillway	63+00	4+70 Lt	161.6	1718.0
G72-6T	Intake Bridge			101.3	1765.4



PLAN

SCALE 1 INCH = 200 FEET

Sta	Range	Bottom Depth	Elev TOP
20+00	30' U.S	207.0	1875.8
20+09	320 D.S	211.0	1759.6
161+30	8+10 Rt	165.8	1793.4
161+30	4+85 Rt	160.0	1693.8
63+00	4+70 Lt	161.6	1718.0
		101.5	1765.4

THIS DRAWING WAS REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE

DATE	DESCRIPTION	MADE	APPRD

REVISIONS

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

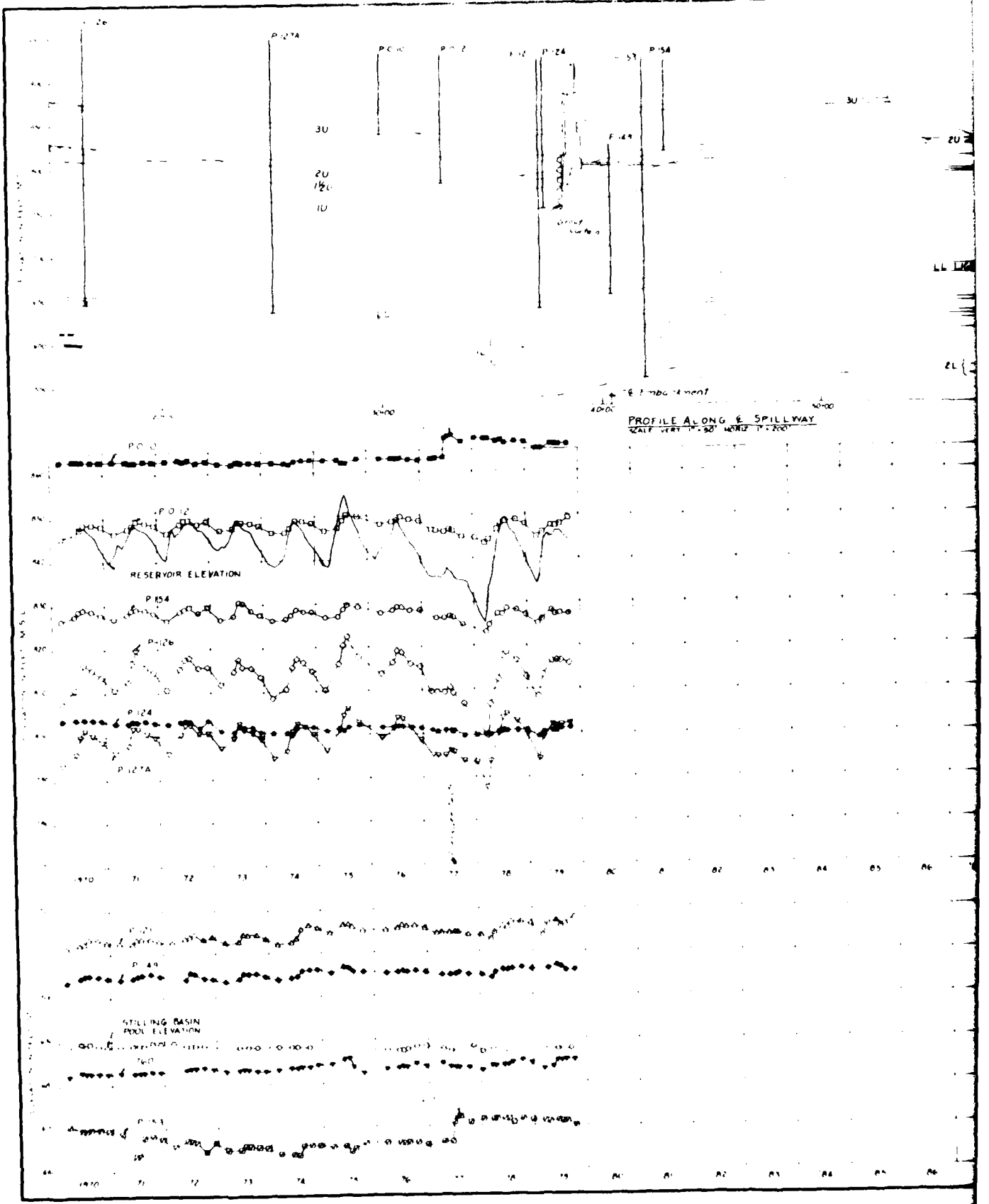
MISSOURI RIVER

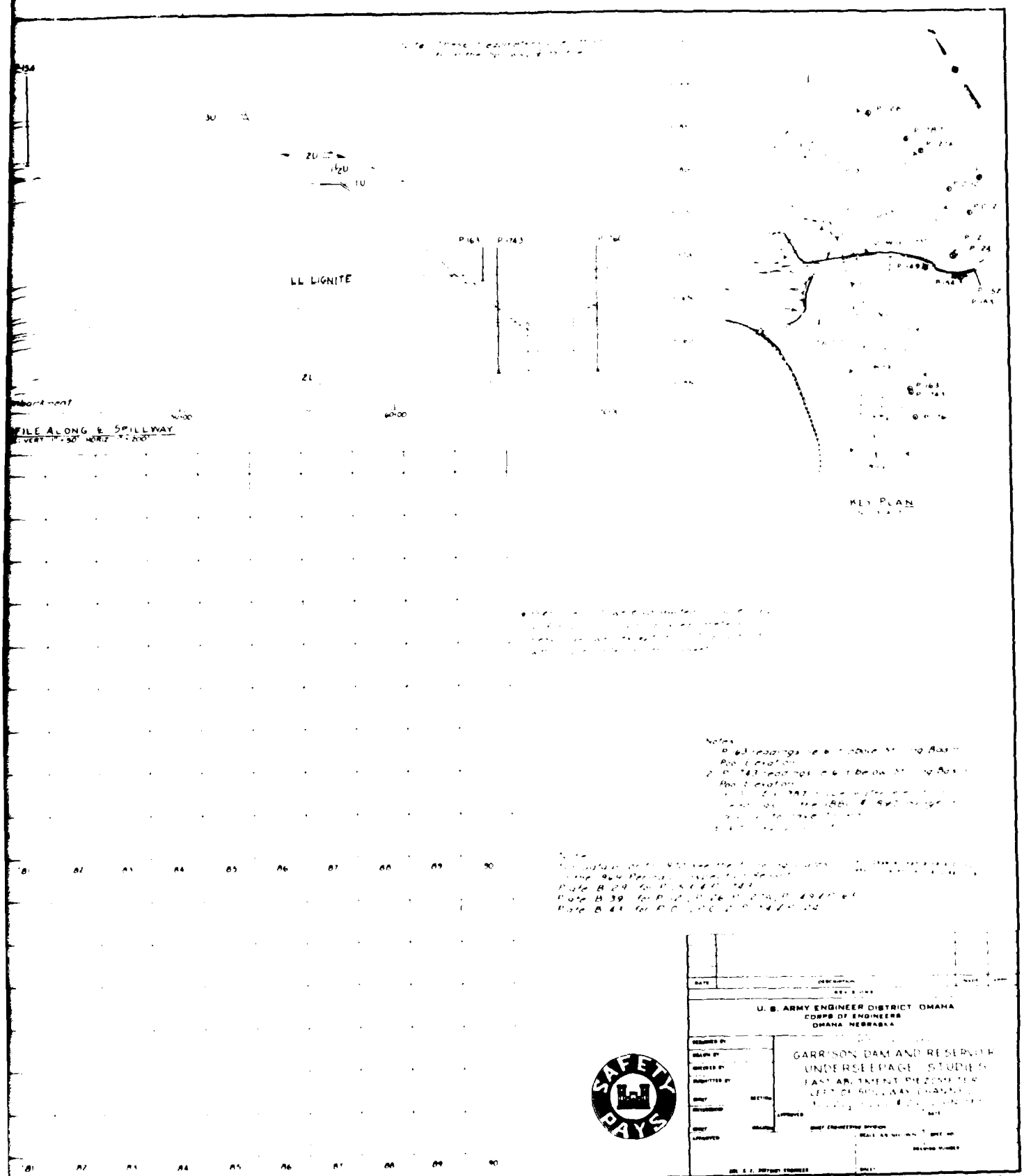
GARRISON DAM AND RESERVOIR
SLOPE INDICATORS
LOCATION PLAN

DESIGNED BY
DRAWN BY
CHECKED BY
QUANTITIES BY
APPROVED
DATE
SCALE AS SHOWN
DWG NO.

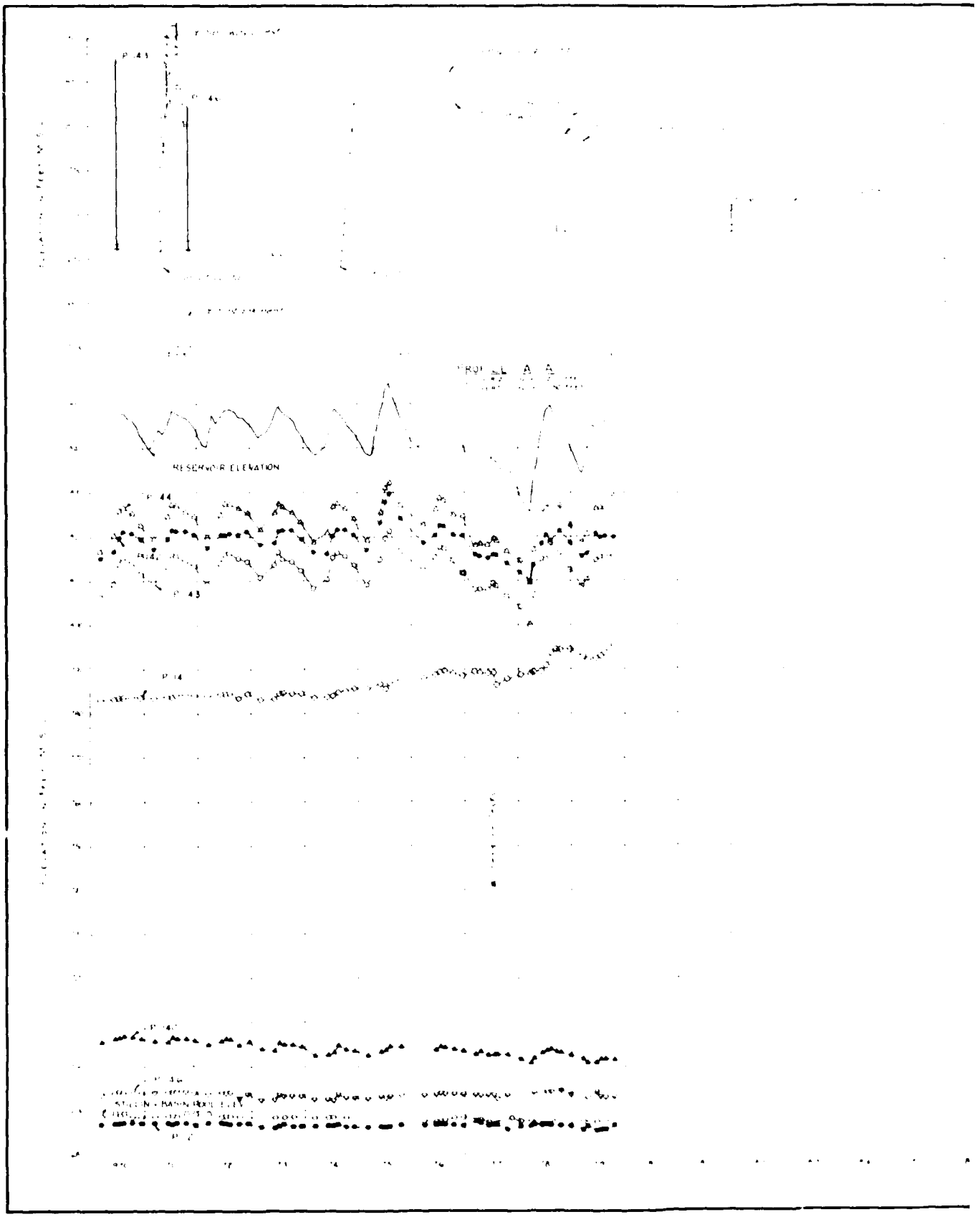
SAFETY PAYS

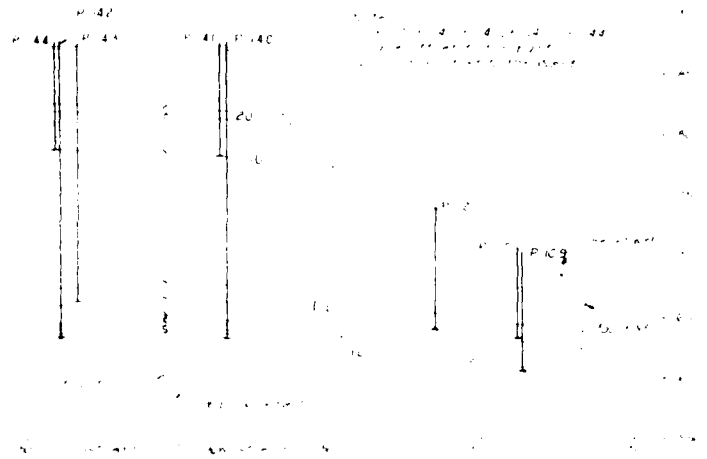
THIS PLAN ACCOMPANIES CONTRACT NO.
MODIFICATION NO.


P-127A
P-124
P-154
P-49
RESERVOIR ELEVATION
P-154
P-126
P-124
P-127A
STILLING BASIN
POOL ELEVATION
PROFILE ALONG ℄ SPILLWAY

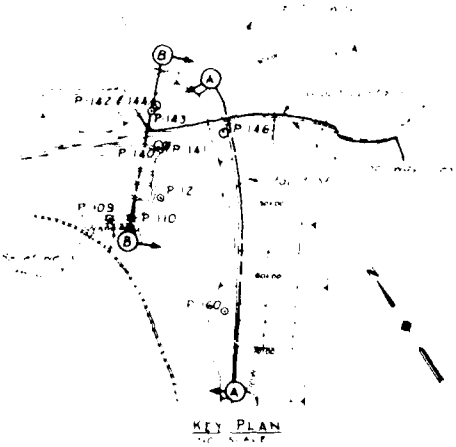


CONSTRUCTION FOUNDATION REPORT (1982) PLATE 137


RESERVOIR ELEVATION



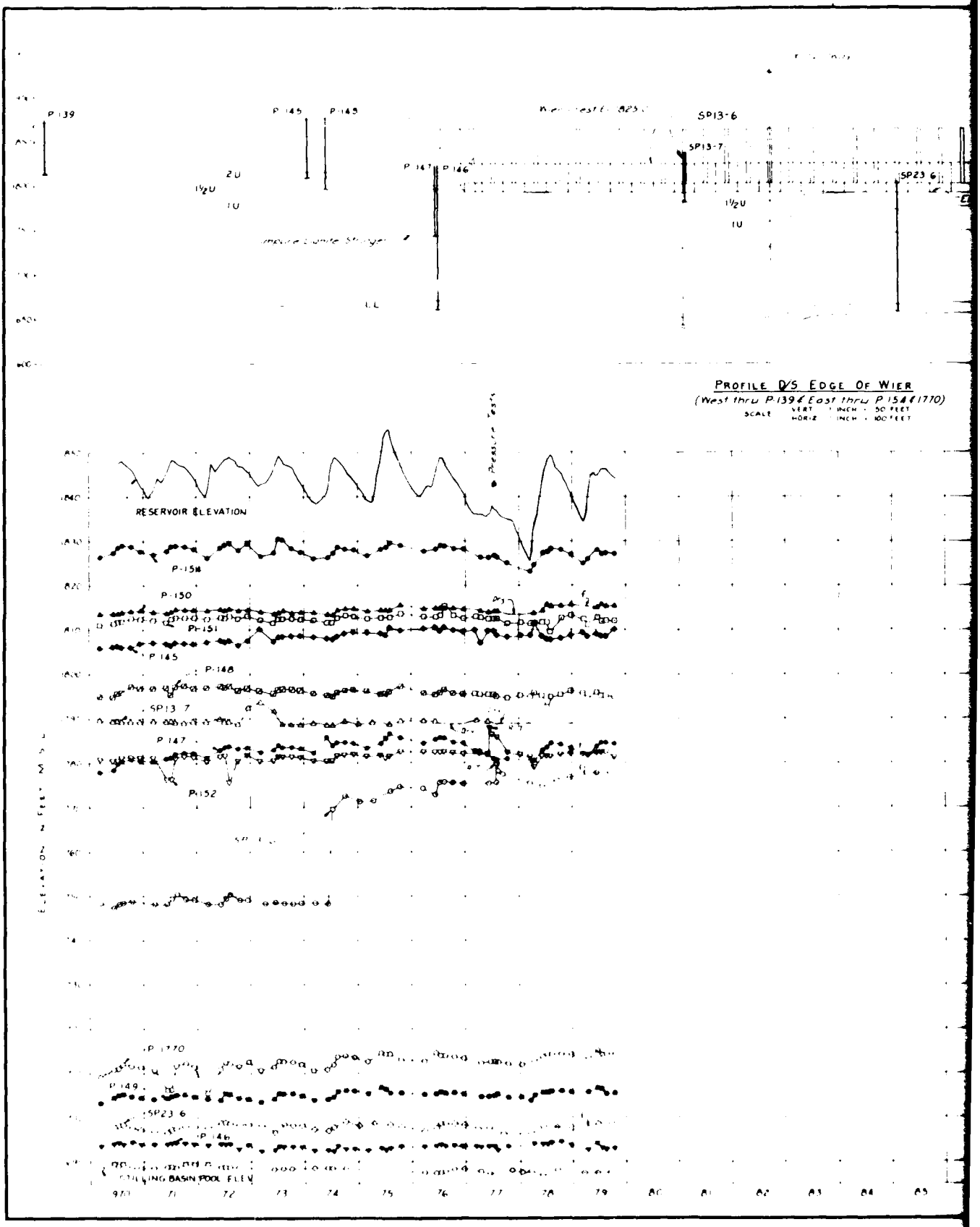
PROFILE B-B

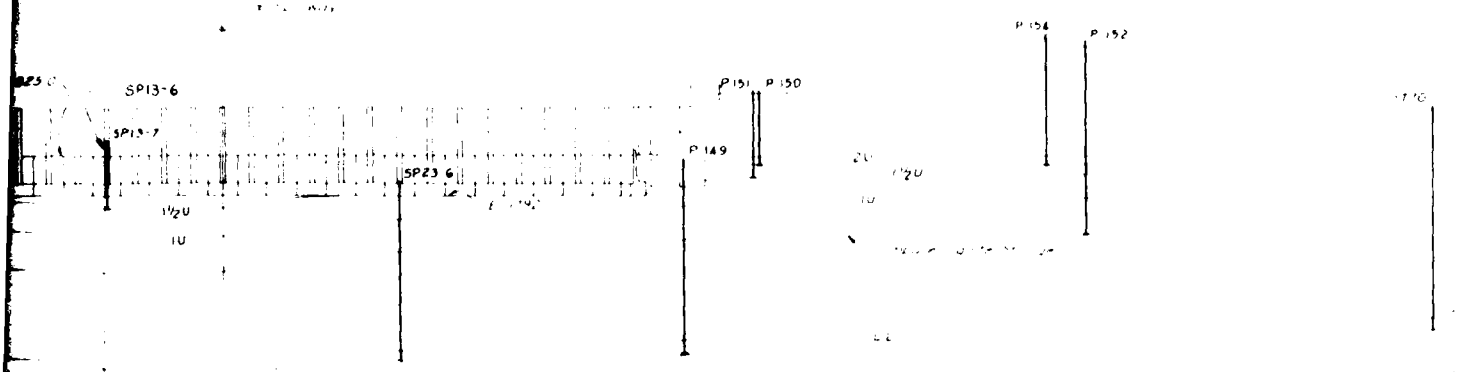


U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA NEBRASKA

GARRISON DAM AND RESERVOIR
EAST APPROACH CHANNEL
RIGHT SPILLWAY CHANNEL

THIS PLAN ACCOMPANIES CONTRACT NO.
MODIFICATION NO.

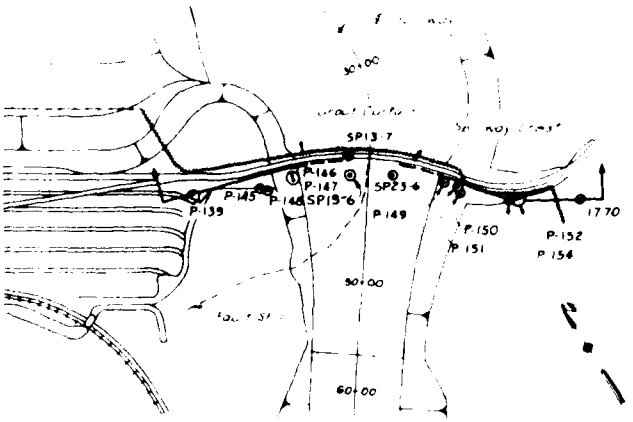

P 139
P 145
P 143
SP13-6
SP13-7
P 147
P 146
SP23 6
2U
1½U
1U
PROFILE D/S EDGE OF WIER
(West thru P 139 & East thru P 154 & 1770)
SCALE VERT 1 INCH = 50 FEET
HORIZ 1 INCH = 100 FEET
RESERVOIR ELEVATION
P-154
P-150
P-151
P 145
P-148
SP13 7
P 147
P-152
P 1770
P 149
SP23 6
P 146
CULVING BASIN POOL ELEV
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85



PROFILE D/S EDGE OF WIER

(West thru P 139 & East thru P 154 & 1770)

SCALE VERT. 1 INCH = 30 FEET
HORIZ. 1 INCH = 100 FEET



KEY PLAN

Note

For [illegible] see the following plates in the [illegible] Report

Plate B 37 for P 146
Plate B 39 for P 149, SP23-6
Plate B 41 for SP 13-7
Plate B 43 for P 150, P 151 & P 154
Plate B 45 for P 139, P 145 & P 148

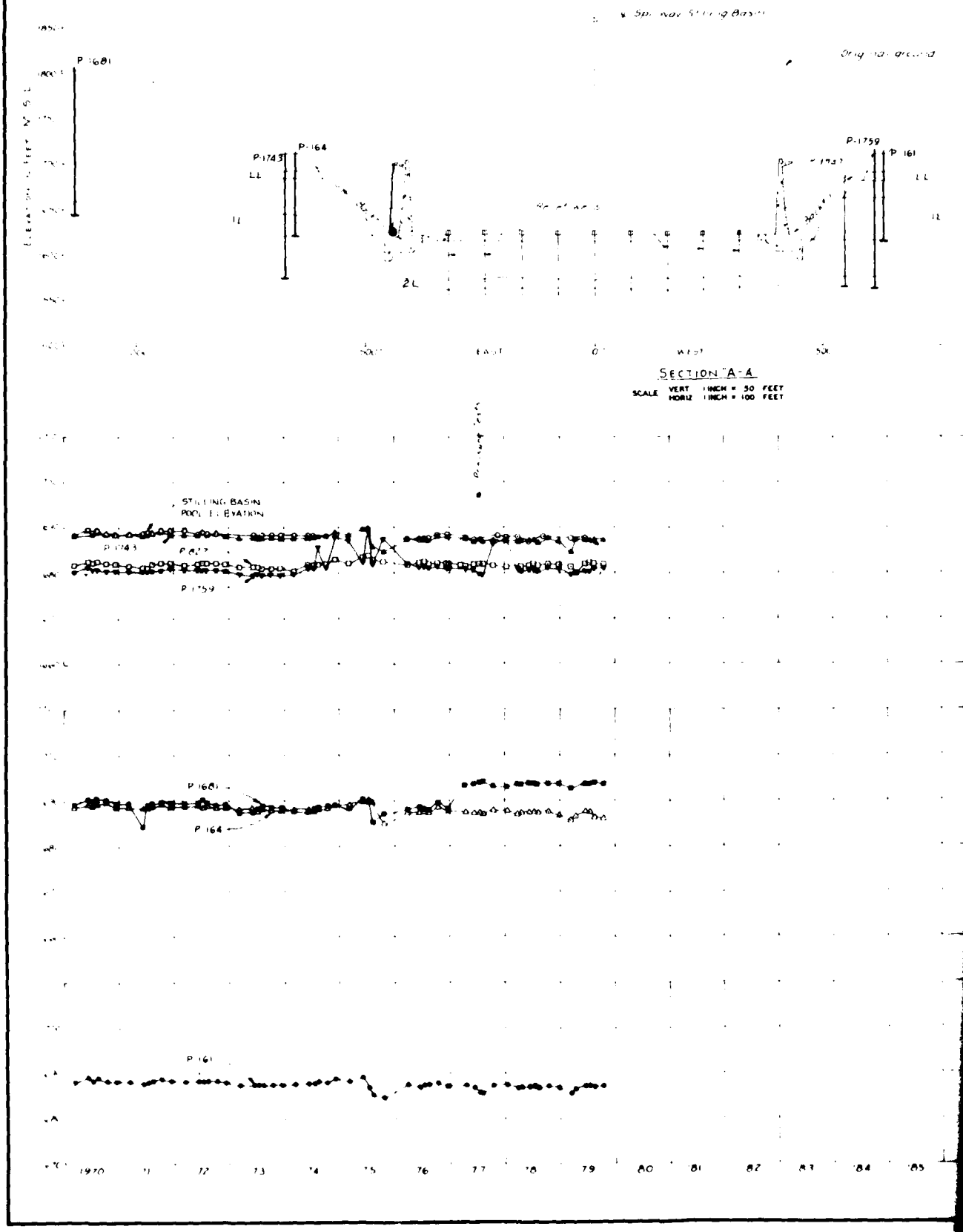
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

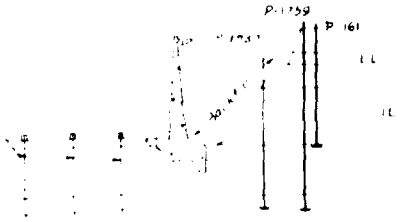
MISSOURI RIVER

GARRISON DAM AND RESERVOIR
EAST ABUTMENT PIEZOMETERS
PIEZOMETERS ACROSS SPILLWAY CREST
2U, 1½U & LL LIGNITES &
LIGNITE STRINGER

80 81 82 83 84 85 86 87 88 89

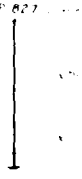
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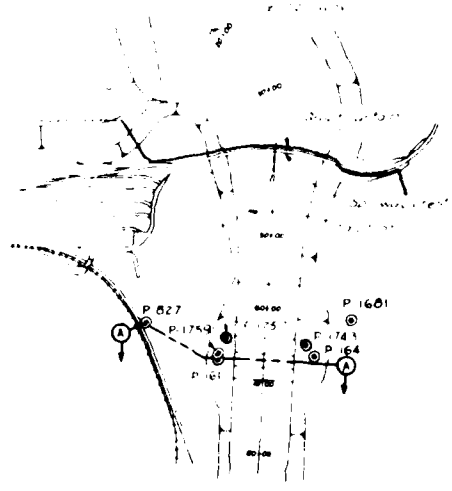

P-1681
P-1743
P-164
P-1759
P 161
LL
EAST
WEST
SECTION "A-A"
SCALE VERT 1 INCH = 50 FEET
HORIZ 1 INCH = 100 FEET
STILLING BASIN
POOL ELEVATION
P-1743
P-827
P-1759
P-1681
P 164
P 161
1970
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85



SECTION A-A

SCALE VERT 1 INCH = 50 FEET
HORIZ 1 INCH = 100 FEET





KEY PLAN
NO SCALE

Note
For data prior to 1970 see the following plates
in the 1969 Annual Report
Plate B 21 for P 827 & P 759
Plate B 29 for P 161
Plate B 33 for P 161 & P 164 & P 68

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

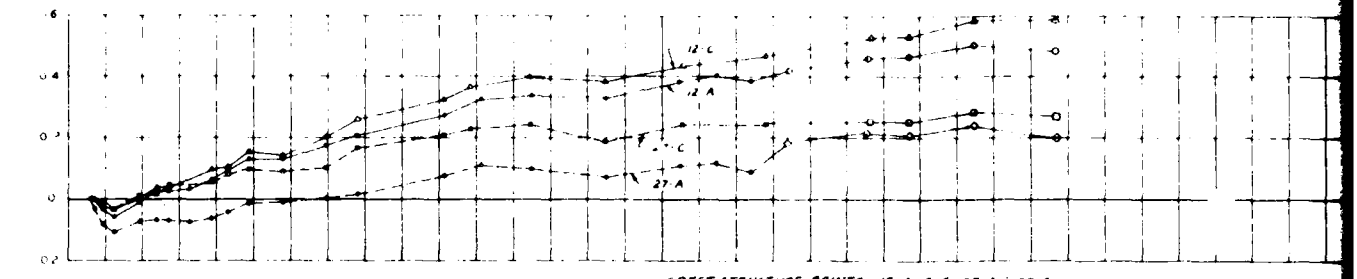
GARRISON DAM AND RESERVOIR
UNDERSEEPAGE STUDIES
EAST ABUTMENT
STILLING BASIN PIEZOMETERS
1L & 2L LIGNITES

THIS PLAN ACCOMPANIES CONTRACT NO
MODIFICATION NO

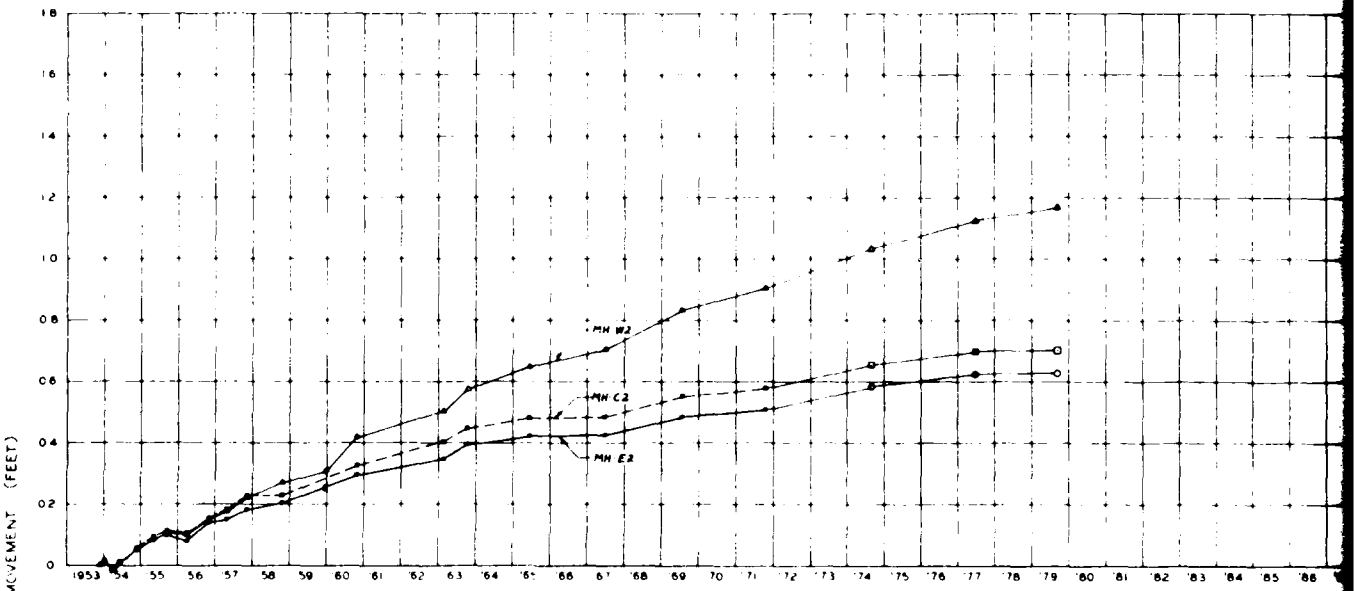
SAFETY PAYS

80 81 82 83 84 85 86 87 88 89

CONSTRUCTION FOUNDATION REPORT (1982) PLATF 140

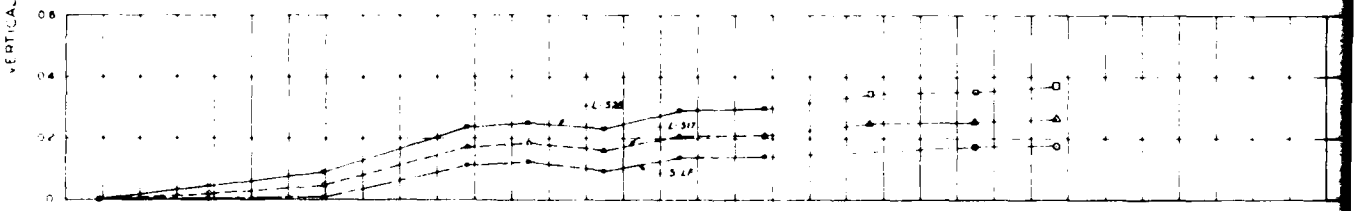


CREST STRUCTURE POINTS 12-A, 12-C, 27-A & 27-C



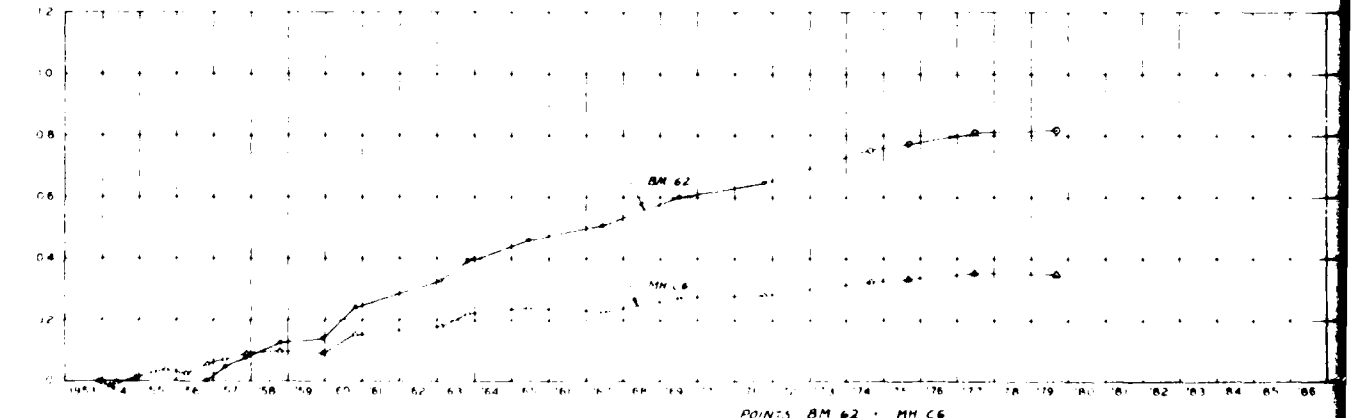
POINTS MH-E2 MH-C2 & MH W2

VERTICAL MOVEMENT (FEET)

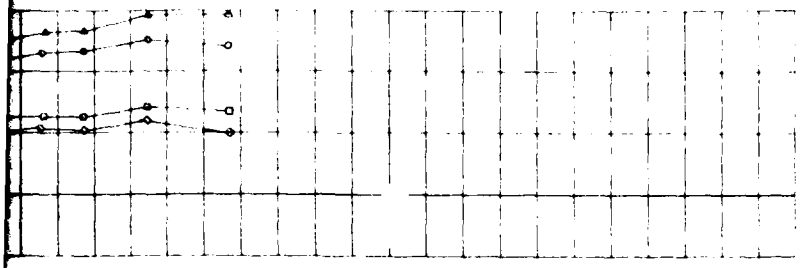


POINTS 5-LF, L-517 & L-525

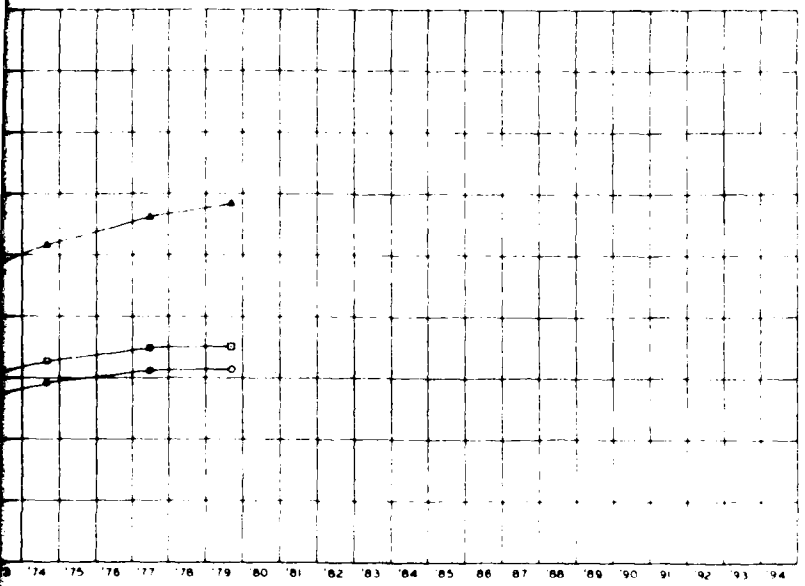
(From scribing hole slabs Line 5)



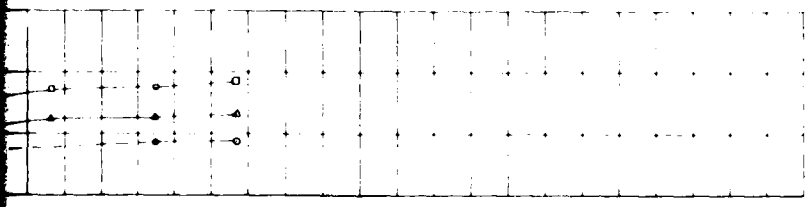
POINTS BM 62 & MH C6



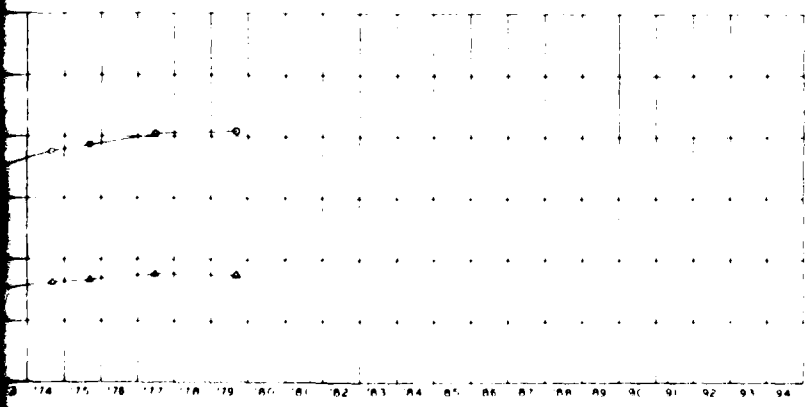
NTS 12-A, 12-C, 27-A & 27-C



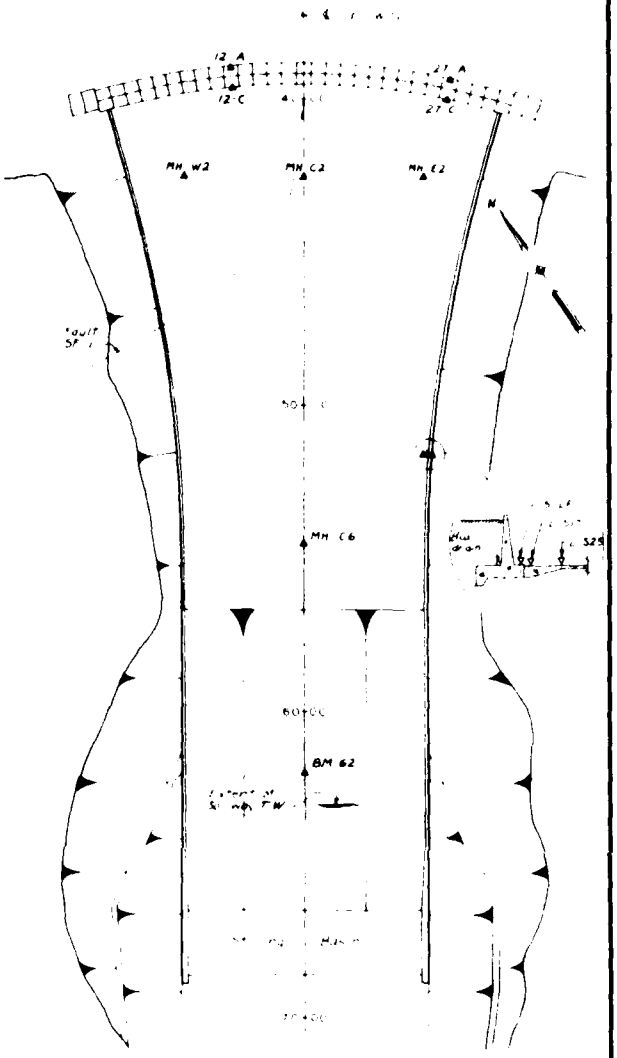
82 MH C2 & MH W2



L-517 & L-535
Globe Line 5")



62 & MH C6



THIS PLAN ACCOMPANIES CONTRACT No.
MODIFICATION No.

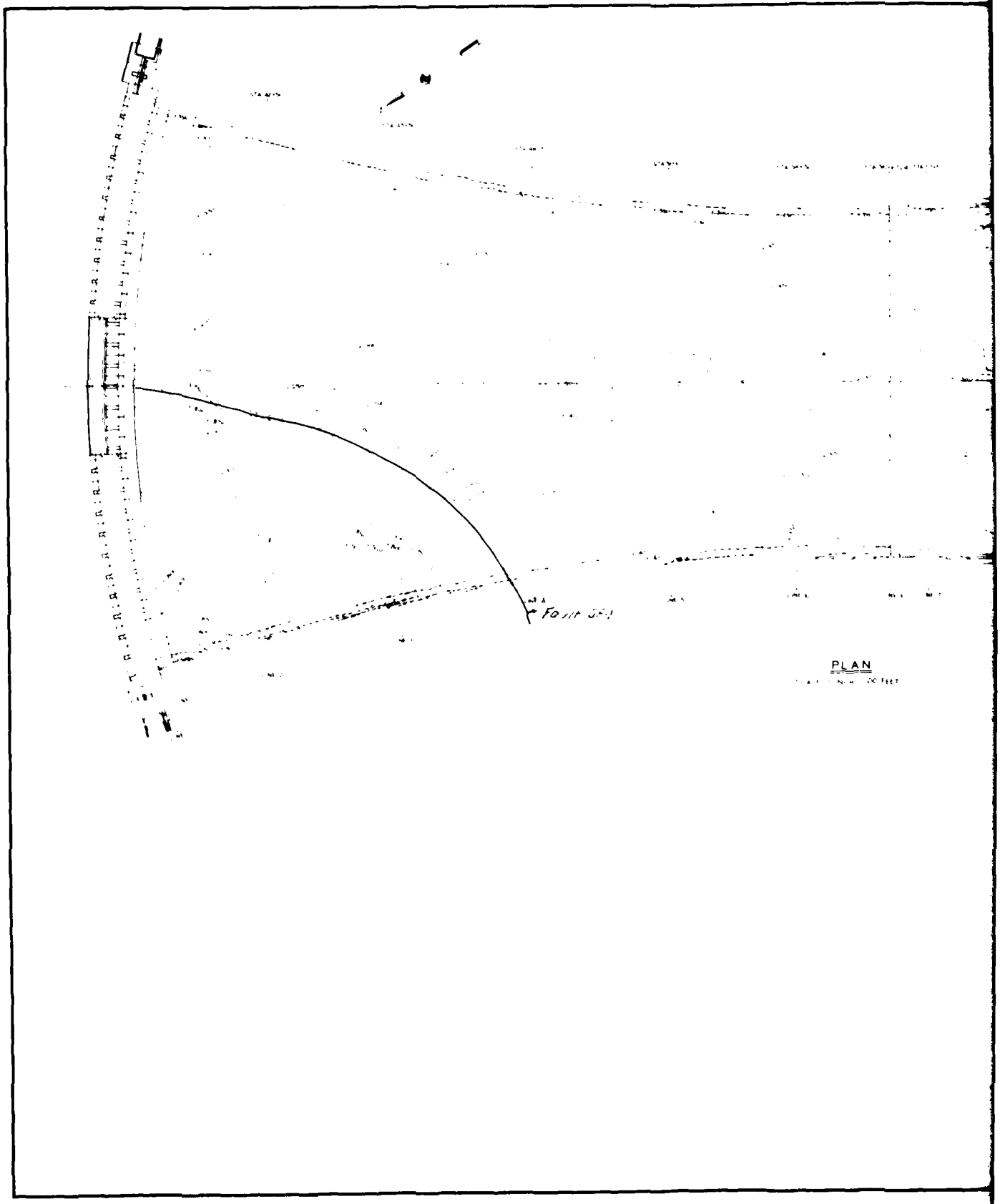
DATE	DESCRIPTION	MADE	APPD
	REVISIONS		

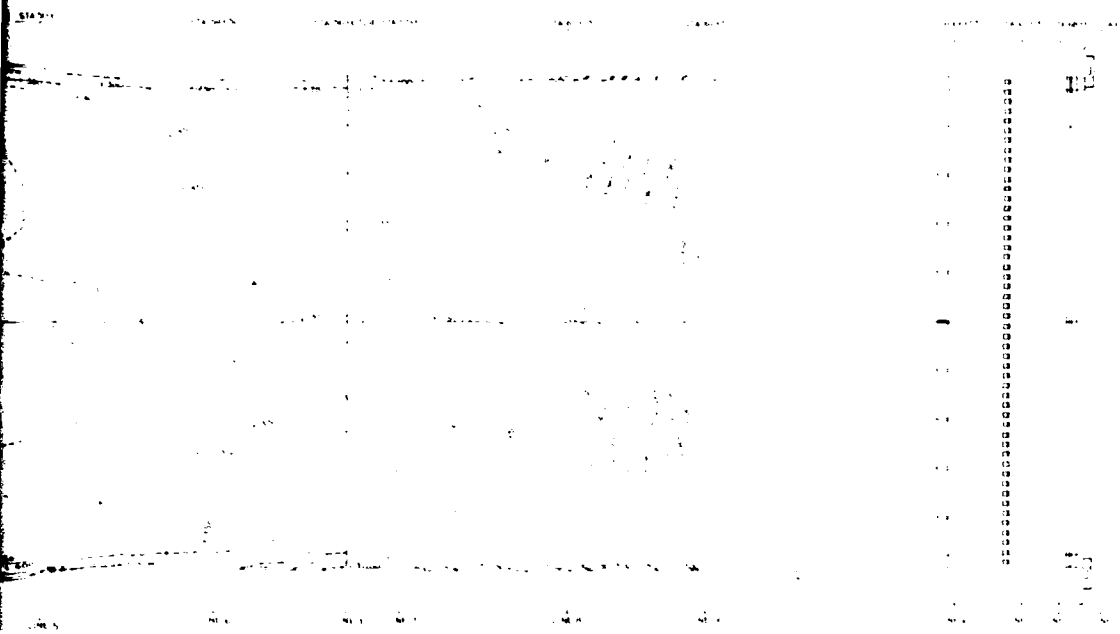
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

SPILLWAY
VERTICAL MOVEMENT
TYPICAL MOVEMENT POINT HISTORIES

SAFETY PAYS

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 141


PLAN



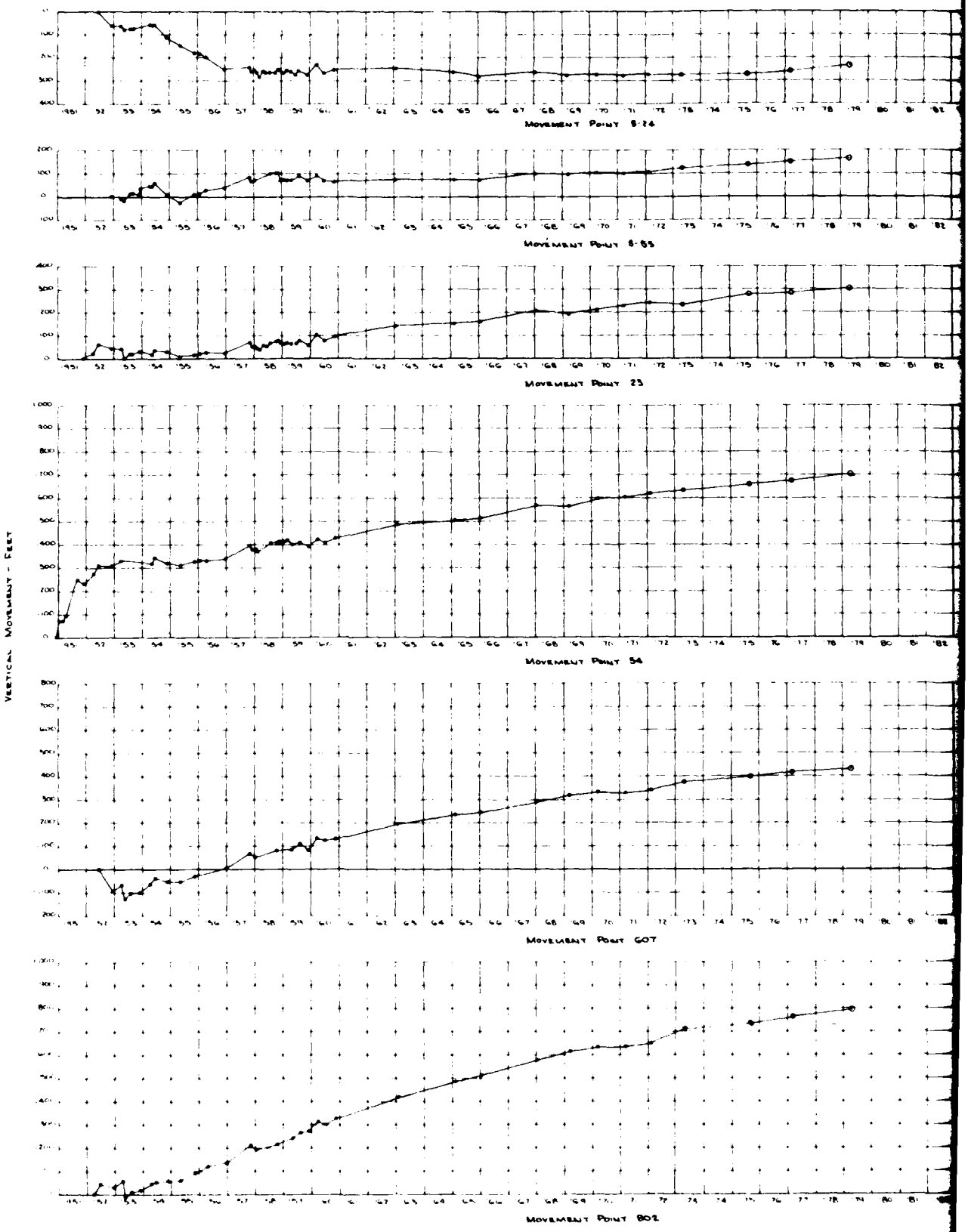
LEGEND

PLAN

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

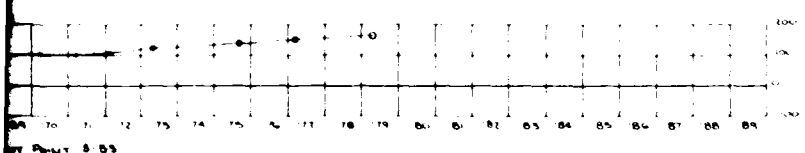
GARRISON DAM, LAKE SAKAKAWEA
SPILLWAY MOVEMENT STUDIES
REBOUND CONTOURS CHANNEL SLAB

THIS PLAN ACCOMPANIES CONTRACT NO
DACA 45-7-CO MODIFICATION NO

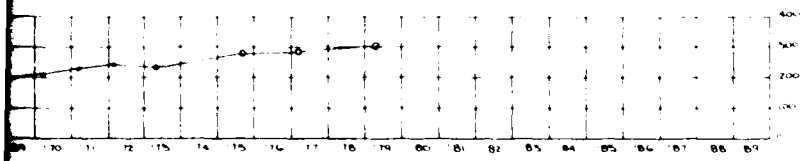

VERTICAL MOVEMENT - FEET
MOVEMENT POINT 8-24
MOVEMENT POINT 8-85
MOVEMENT POINT 23
MOVEMENT POINT 54
MOVEMENT POINT 607
MOVEMENT POINT 802



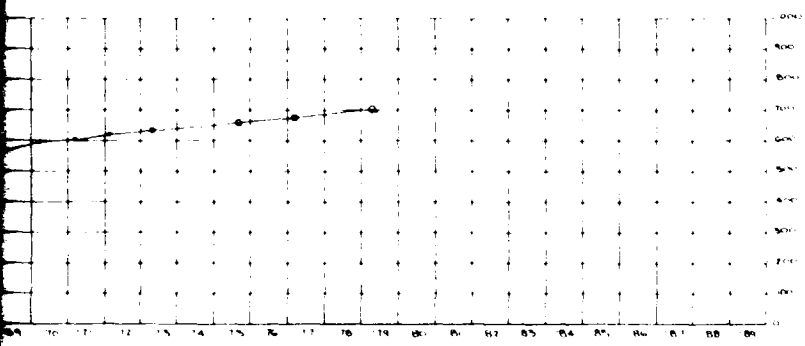
Point B 24



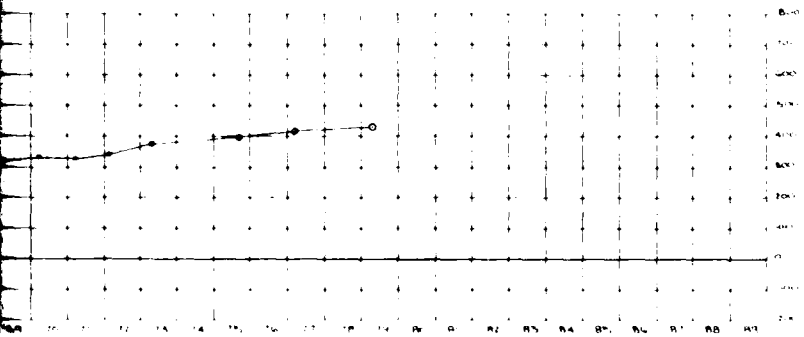
Point B 83



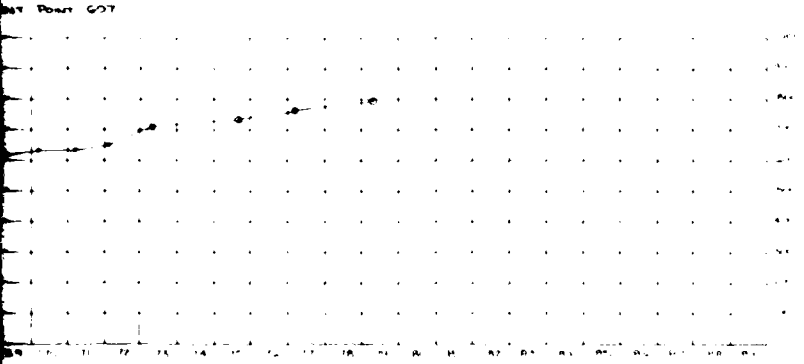
Point 23



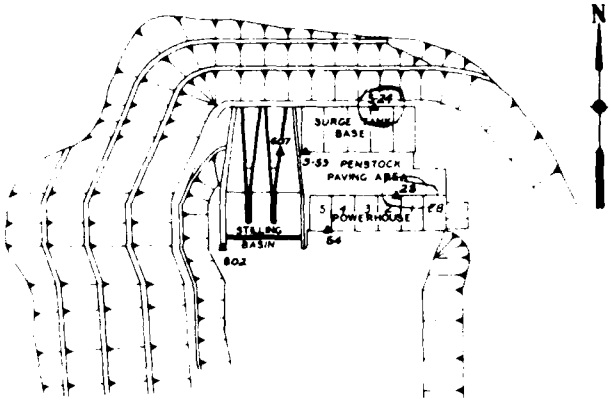
Point 54



Point 607



Point 802

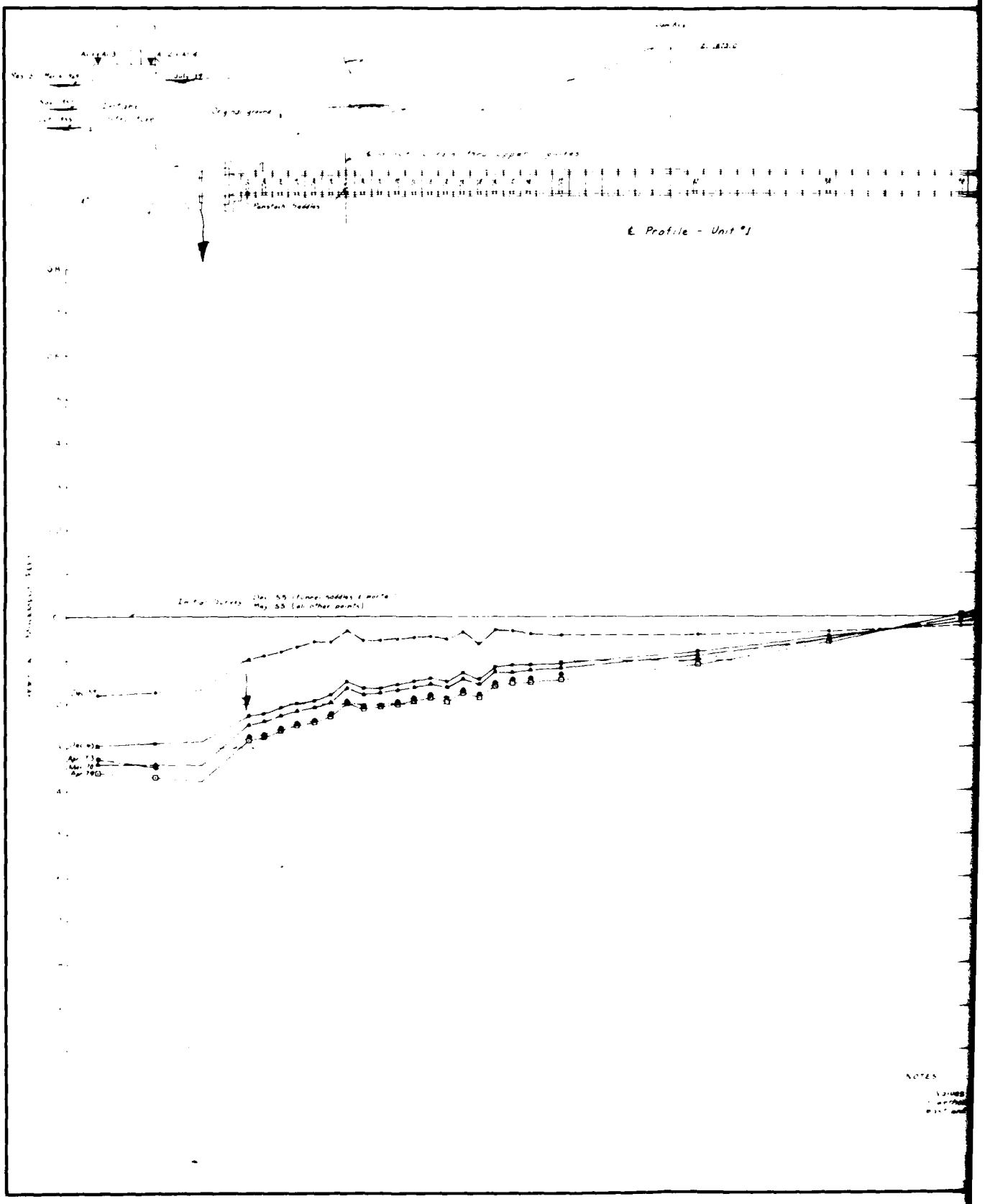


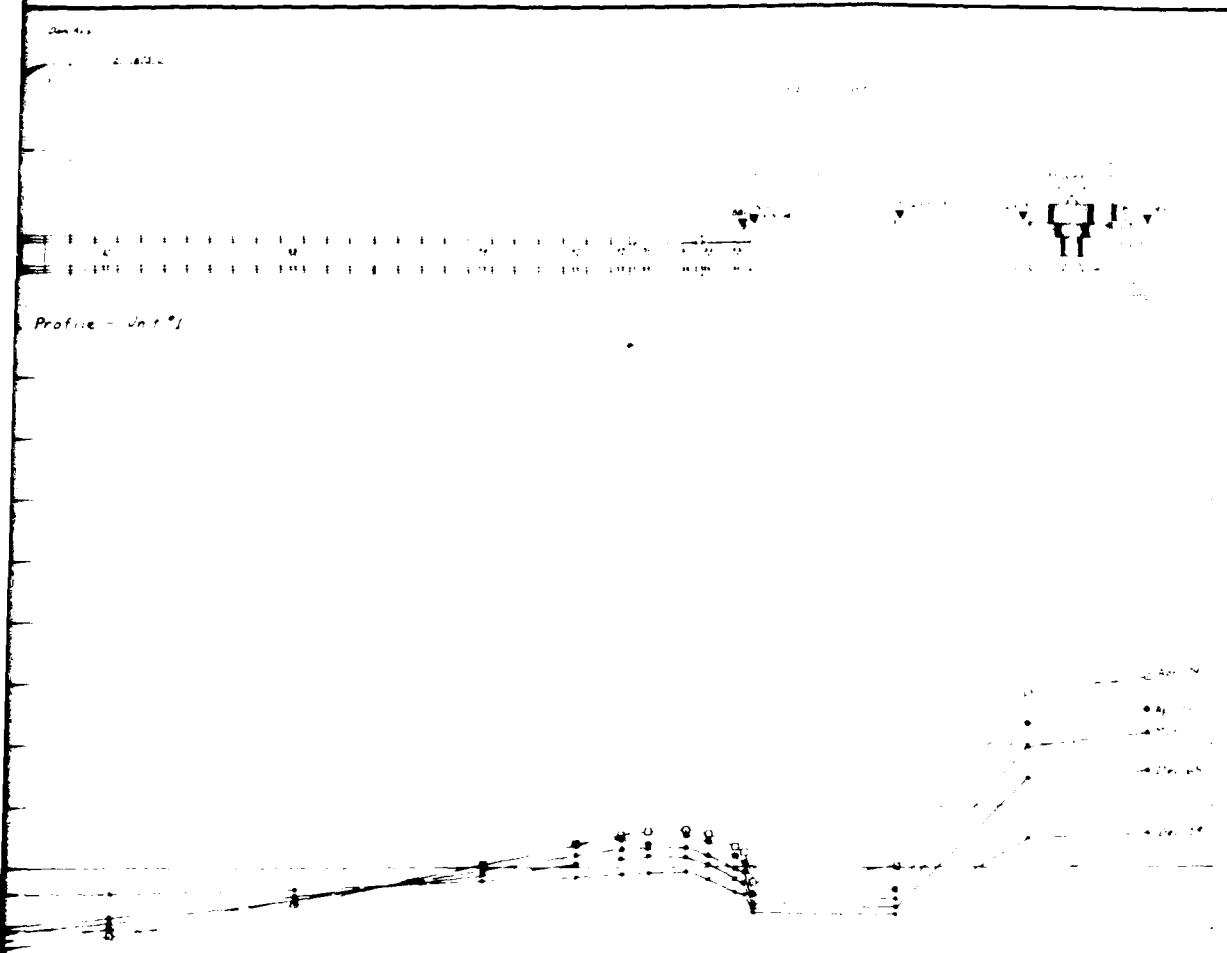
KEY PLAN

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

Pathfinder Dam Area
Vertical Movement
Typical Monument Point Histories

THIS PLAN ACCOMPANIES CONTRACT NO
MODIFICATION NO


E Profile - Unit "J"

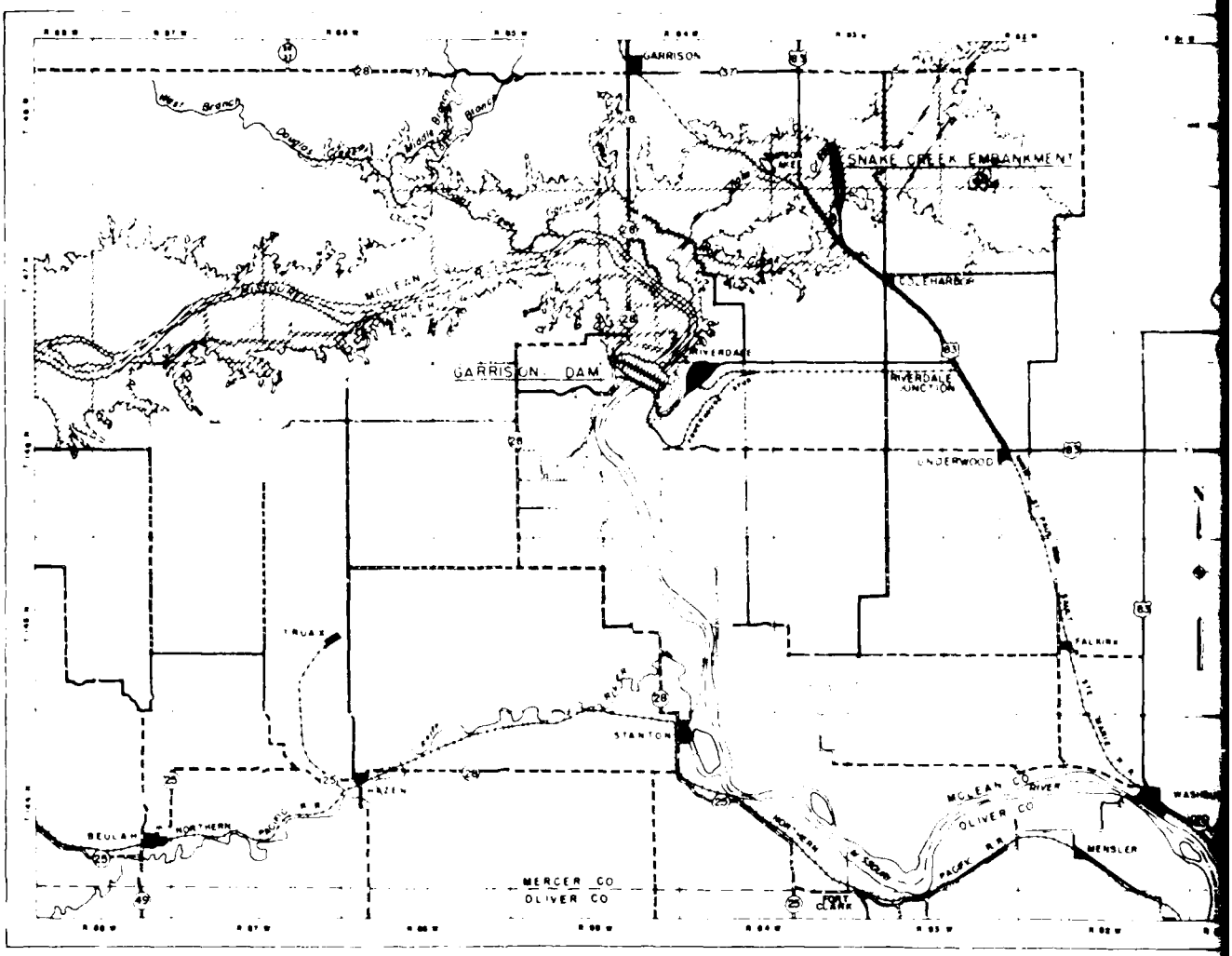


U. S. ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS
OMAHA NEBRASKA

SAFETY PAYS

THIS PLAN ACCOMPANIES CONTRACT No
MODIFICATION No

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 144



VICINITY MAP

SCALE IN MILES

0 1 2 3 4

INDEX TO DRAWINGS

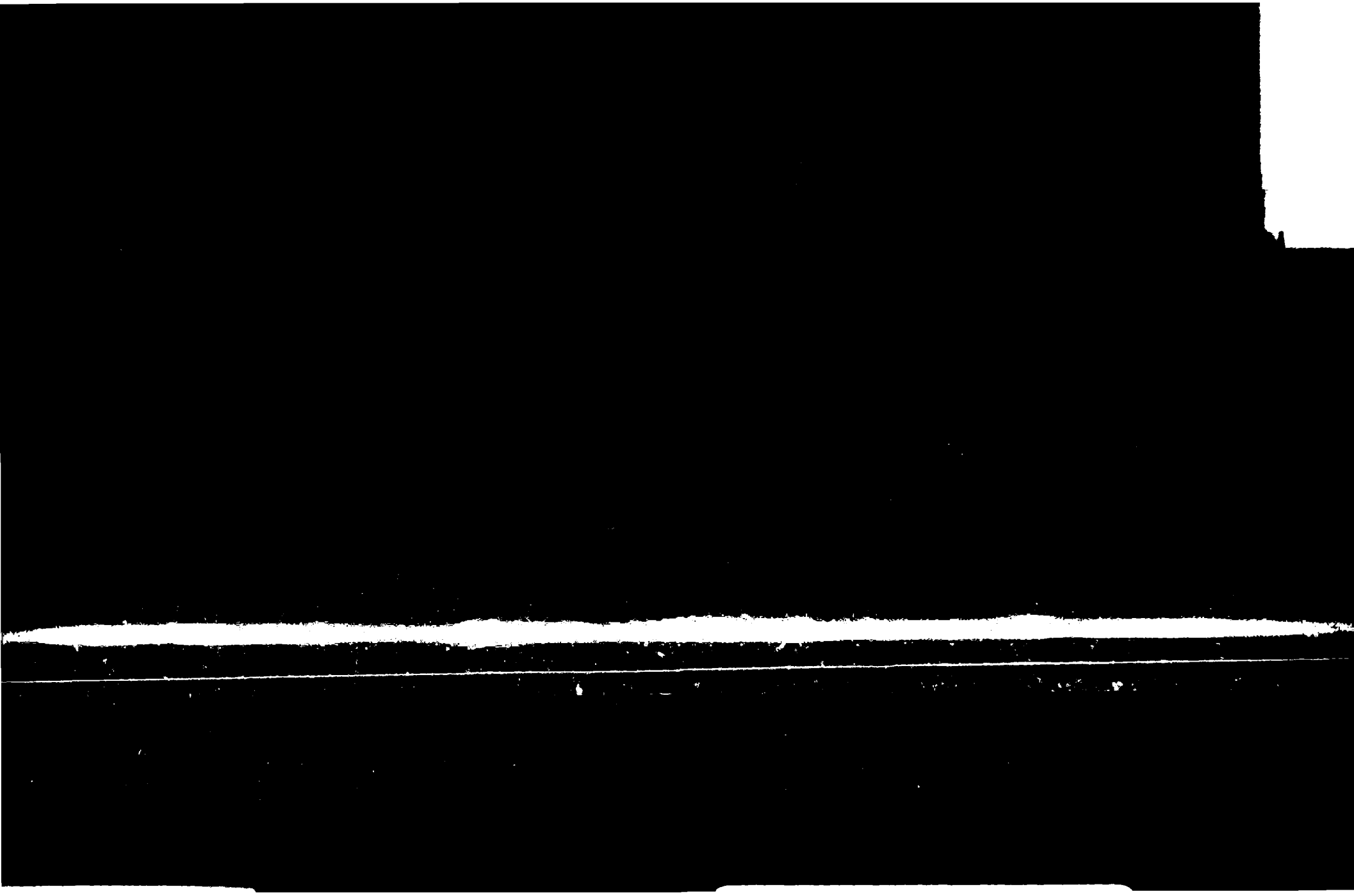
	PROJECT LOCATION AND INDEX	GR 21 - 1/1
2	GENERAL PLAN - SHEET NO. 1	GR 21 - 2/1
3	GENERAL PLAN - SHEET NO. 2	GR 21 - 2/2
4	MAIN EMBANKMENT - PLAN AND PROFILE - SHEET NO. 1	GR 21 - 7/1
5	MAIN EMBANKMENT - PLAN AND PROFILE - SHEET NO. 2	GR 21 - 7/2
6	MAIN EMBANKMENT - PLAN AND PROFILE - SHEET NO. 3	GR 21 - 7/3
7	MAIN EMBANKMENT - SECTIONS	GR 21 - 7/4
8	MAIN EMBANKMENT - DETAILS	GR 21 - 7/5
9	MAIN EMBANKMENT - HIGHWAY DRAINAGE STRUCTURES	GR 21 - 7/6
10	EXCAVATION - FUTURE PUMPING CHANNEL - PLAN PROFILE AND SECTIONS	GR 21 - 6/1
11	EXCAVATION - REGULATING CONDUIT - PLAN AND PROFILE	GR 21 - 6/2
12	EXCAVATION - REGULATING CONDUIT - SECTIONS - SHEET NO. 1	GR 21 - 6/3
13	EXCAVATION - REGULATING CONDUIT - SECTIONS - SHEET NO. 2	GR 21 - 6/4
14	CONCRETE - REGULATING CONDUIT - GATE STRUCTURE ELEVATIONS AND SECTIONS	GR 21 - 10/1
15	CONCRETE - REGULATING CONDUIT - GATE STRUCTURE - SECTIONS	GR 21 - 10/2
16	CONCRETE - REGULATING CONDUIT - GATE STRUCTURE - DETAILS	GR 21 - 10/3
17	REINFORCEMENT - REGULATING CONDUIT - GATE STRUCTURE SHEET NO. 1	GR 21 - 10/4
18	REINFORCEMENT - REGULATING CONDUIT - GATE STRUCTURE SHEET NO. 2	GR 21 - 10/5
18A	REINFORCEMENT - REGULATING CONDUIT - GATE STRUCTURE SHEET NO. 3	GR 21 - 10/5A
19	CONCRETE - REGULATING CONDUIT - PLAN AND ELEVATION	GR 21 - 10/6
20	CONCRETE AND REINFORCEMENT - REGULATING CONDUIT 7 & 10 CONDUIT	GR 21 - 10/7
21	CONCRETE REGULATING CONDUIT - TRANSITION	GR 21 - 10/8
22	REINFORCEMENT REGULATING CONDUIT - TRANSITION	GR 21 - 10/9
23	CONCRETE REGULATING CONDUIT - WINGWALLS	GR 21 - 10/10
24	REINFORCEMENT REGULATING CONDUIT - WINGWALLS	GR 21 - 10/11
25	CONCRETE - REGULATING CONDUIT - STILLING BASIN PLAN AND ELEVATION	GR 21 - 10/12
26	CONCRETE - REGULATING CONDUIT - STILLING BASIN - SECTIONS	GR 21 - 10/13
27	REINFORCEMENT - REGULATING CONDUIT - STILLING BASIN	GR 21 - 10/14
28	MISCELLAN	
29	HIGHWAY R	
30	HIGHWAY R	
31	HIGHWAY R	
32	LOCATION	
33	BORING PR SHEET NO	
34	BORING PR	
35	BORING PR	
36	BORING PR PUMPING C	
38	BORING PR	
39	BORING PR	
40	BORING PR	
41	BORING PR	
42	BORING PR	
43	BORING PR	
44	RECORD	
45	RECORD	
46	RECORD	
47	RECORD	
48	RECORD	
49	RECORD	
50	RECORD	

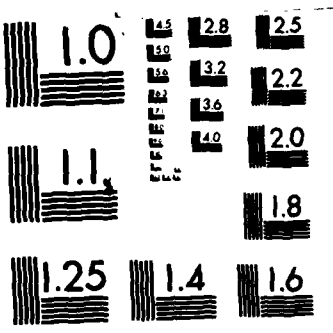
AD-A140 035 CONSTRUCTION FOUNDATION REPORT MISSOURI RIVER GARRISON DAM LAKE SAKAKAWEA VOLUME 2 DRAWINGS(U) ARMY ENGINEER DISTRICT OMAHA NE NOV 83 4/4

UNCLASSIFIED F/G 13/13 NL

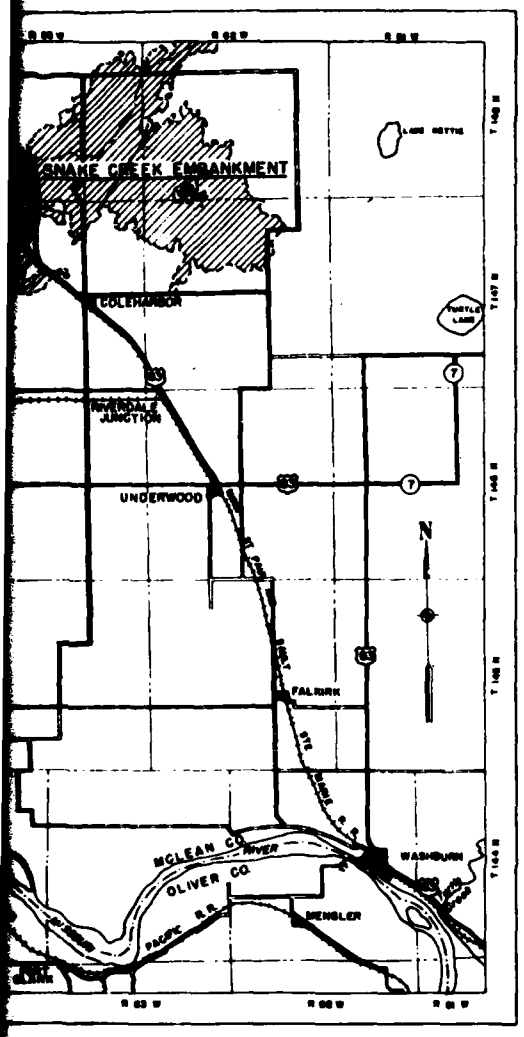


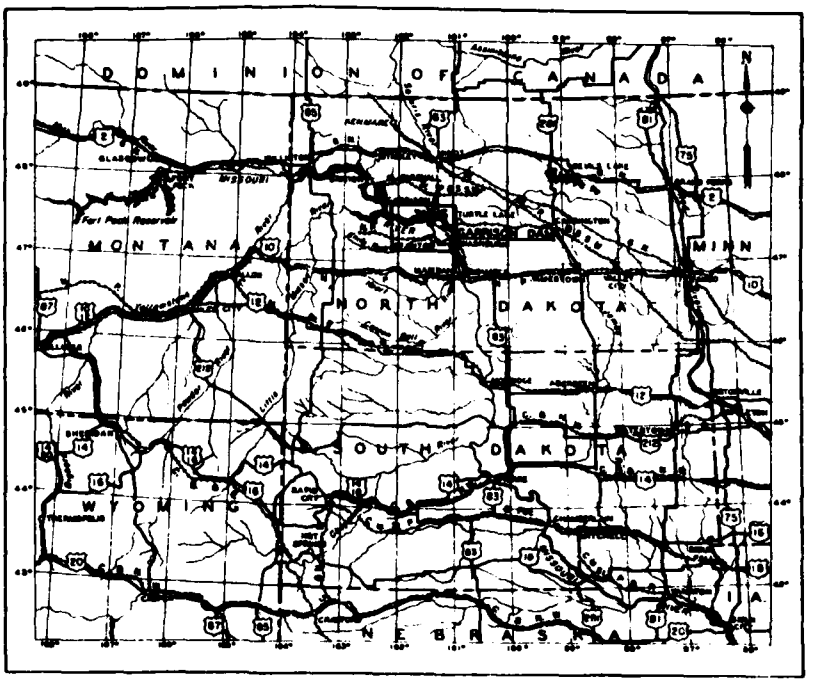
END
DATE FILMED
5-84
DTIC





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





LOCATION MAP

SCALE IN MILES
20 0 20 40 60 80 100

LEGEND

- HARD SURFACED HIGHWAY
- GRAVELED HIGHWAY
- IMPROVED ROAD
- UNIMPROVED ROAD
- FEDERAL HIGHWAY SYMBOL
- STATE HIGHWAY SYMBOL
- TOLL FERRY

DRAWINGS

ATE STRUCTURE	GR 21 - 10/1	28	MISCELLANEOUS METAL - REGULATING CONDUIT - GATE STRUCTURE	GR 21 - 11/1
RE STRUCTURE - SECTIONS	GR 21 - 10/2	29	HIGHWAY AND RAILROAD - PLAN AND PROFILE - SHEET NO 1	GR 21 - 32/1
ATE STRUCTURE - DETAILS	GR 21 - 10/3	30	HIGHWAY AND RAILROAD - PLAN AND PROFILE - SHEET NO 2	GR 21 - 32/2
NT - GATE STRUCTURE	GR 21 - 10/4	31	HIGHWAY AND RAILROAD - DETAILS	GR 21 - 32/3
T - GATE STRUCTURE	GR 21 - 10/5	32	LOCATION OF BORINGS - MAIN EMBANKMENT	GR 21 - 5/1
UIT - GATE STRUCTURE	GR 21 - 10/6A	33	BORING PROFILES - CENTERLINE MAIN EMBANKMENT - LEGEND SHEET NO 1	GR 21 - 5/2
LAN AND ELEVATION	GR 21 - 10/6	34	BORING PROFILES - CENTERLINE MAIN EMBANKMENT - SHEET NO. 2	GR 21 - 5/3
ULATING CONDUIT	GR 21 - 10/7	35	BORING PROFILES - CENTERLINE MAIN EMBANKMENT - SHEET NO 3	GR 21 - 5/4
NSITION	GR 21 - 10/8	36	BORING PROFILES - REGULATING CONDUIT AND FUTURE PUMPING CHANNEL	GR 21 5/5
TRANSITION	GR 21 - 10/9	38	BORING PROFILES - BORROW AREA A - SHEET NO 1	GR 21 - 5/7
LLS	GR 21 - 10/10	39	BORING PROFILES - BORROW AREA A - SHEET NO. 2	GR 21 - 5/8
- SHINGLES	GR 21 - 10/11	40	BORING PROFILES - BORROW AREA D - SHEET NO. 1	GR 21 - 5/9
LING BASIN	GR 21 - 10/12 -	41	BORING PROFILES - BORROW AREA D - SHEET NO 2	GR 21 - 5/10
		42	BORING PROFILES - BORROW AREA F - SHEET NO	GR 21 5/11
STILLING BASIN - SECTIONS	GR 21 - 10/13	43	BORING PROFILES - BORROW AREA H & J	GR 21 5/12
NT - STILLING BASIN	GR 21 - 10/14	44	RECORD OF BORINGS - SHEET NO. 1	GR 21 - 5/13
		45	RECORD OF BORINGS - SHEET NO. 2	GR 21 - 5/14
		46	RECORD OF BORINGS - SHEET NO. 3	GR 21 5/15
		47	RECORD OF BORINGS - SHEET NO. 4	GR 21 - 5/16
		48	RECORD OF BORINGS - SHEET NO. 5	GR 21 - 5/17
		49	RECORD OF BORINGS - SHEET NO. 6	GR 21 - 5/18
		50	RECORD OF BORINGS - SHEET NO. 7	GR 21 - 5/19

1	3 29 54	Revised Prior to Advertising	

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OFFICE OF THE DISTRICT ENGINEER

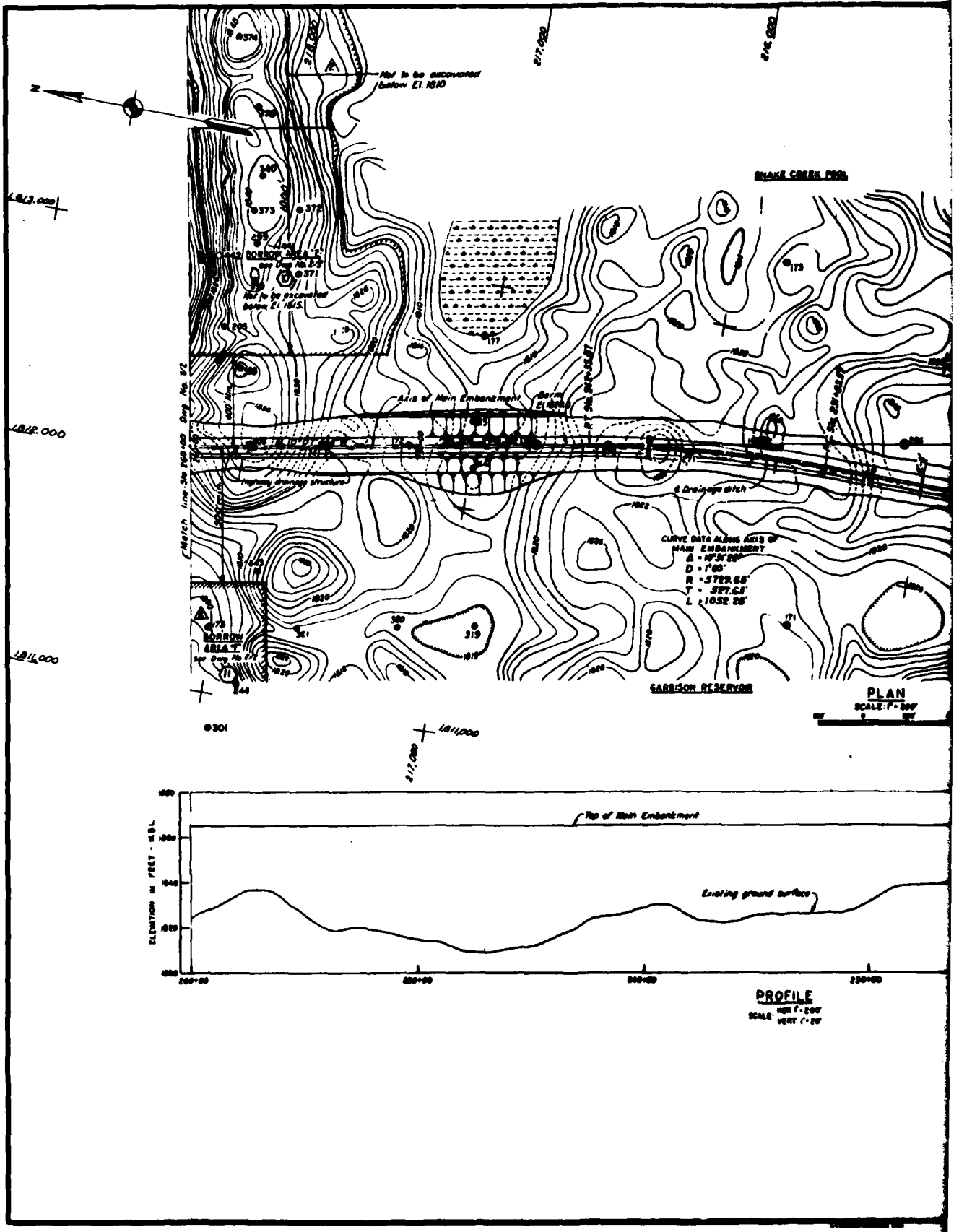
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SNAKE CREEK EMBANKMENT
PROJECT LOCATION AND INDEX

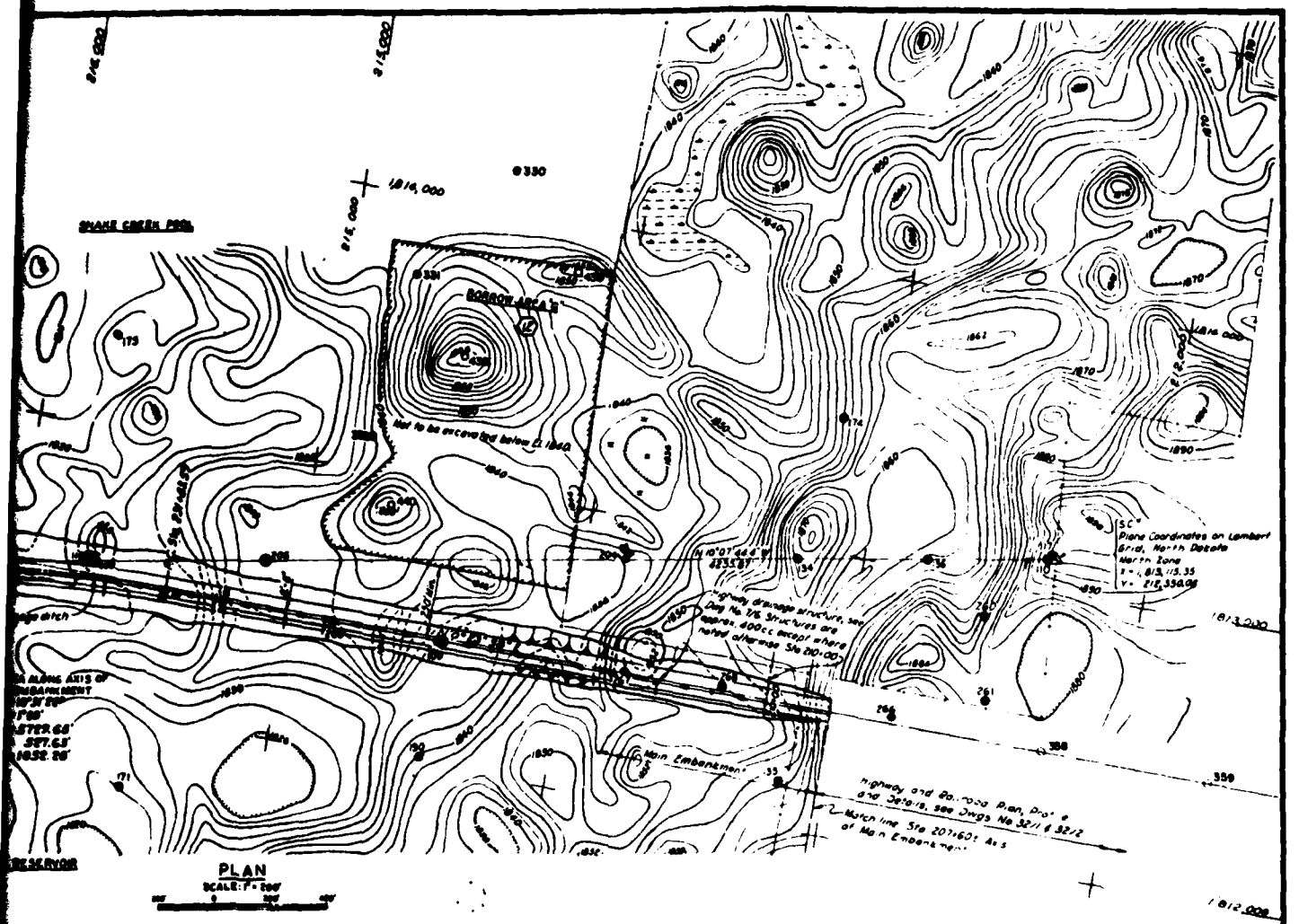
FEBRUARY 1951

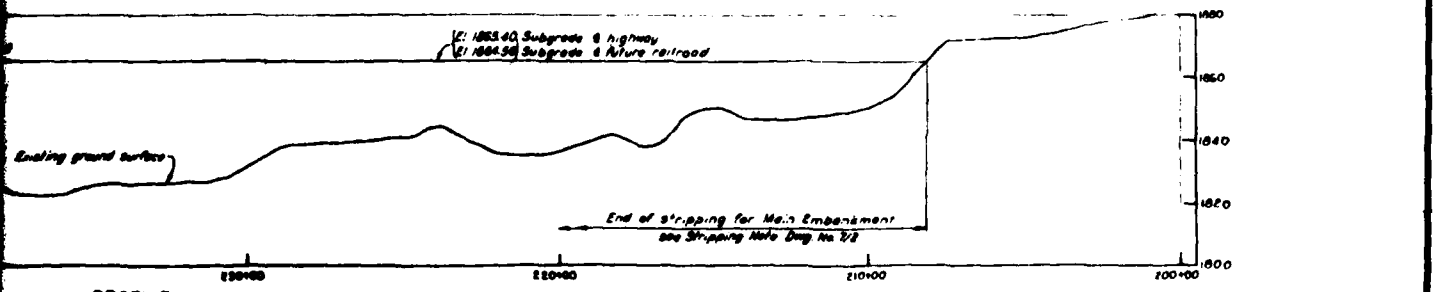
GR 21 - 1/1

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 145

2


Not to be excavated below El. 1810
SNAKE CREEK POOL
BORROW AREA 'E'
See Dwg. No. 2-2
Not to be excavated below El. 1815
Axis of Main Embankment
Match line Sta 260+00 Dwg. No. V2
Highway drainage structure
Drainage ditch
CURVE DATA ALONG AXIS OF MAIN EMBANKMENT
Δ = 10°31' 00"
D = 1°00'
R = 5729.65'
T = 527.65'
L = 1052.20'
BORROW AREA 'F'
See Dwg. No. 2-1
GARRISON RESERVOIR
PLAN
SCALE: 1" = 200'
Top of Main Embankment
Existing ground surface
ELEVATION IN FEET - M.S.L.
PROFILE
SCALE: HOR. 1" = 200'
VERT. 1" = 20'





PROFILE
SCALE: HOR 1" = 200' VERT 1" = 20'

NOTES

Figures in hexagons indicate item numbers under which payment will be made.
For construction of Main Embankment, Plan and Profile, see Dwgs No. 7/2 & 7/3.
For Main Embankment, Sections, see Dwg No 7/4.
For Main Embankment, Details, see Dwg No 7/5.
For General Plan, Sheets No 1 and 2, see Dwgs No 2/1 and 2/2.
For Highway Drainage Structures, see Dwg No 7/6.
Arrows shown on & Drainage ditch indicate direction that ditch shall be graded to drain.
For Record of Borings and Profiles, see Dwgs No 5/1 to 5/22 incl.

1	1-22-51	Revised prior to advertising			
NO.	DATE	REVISIONS			

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OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEBR

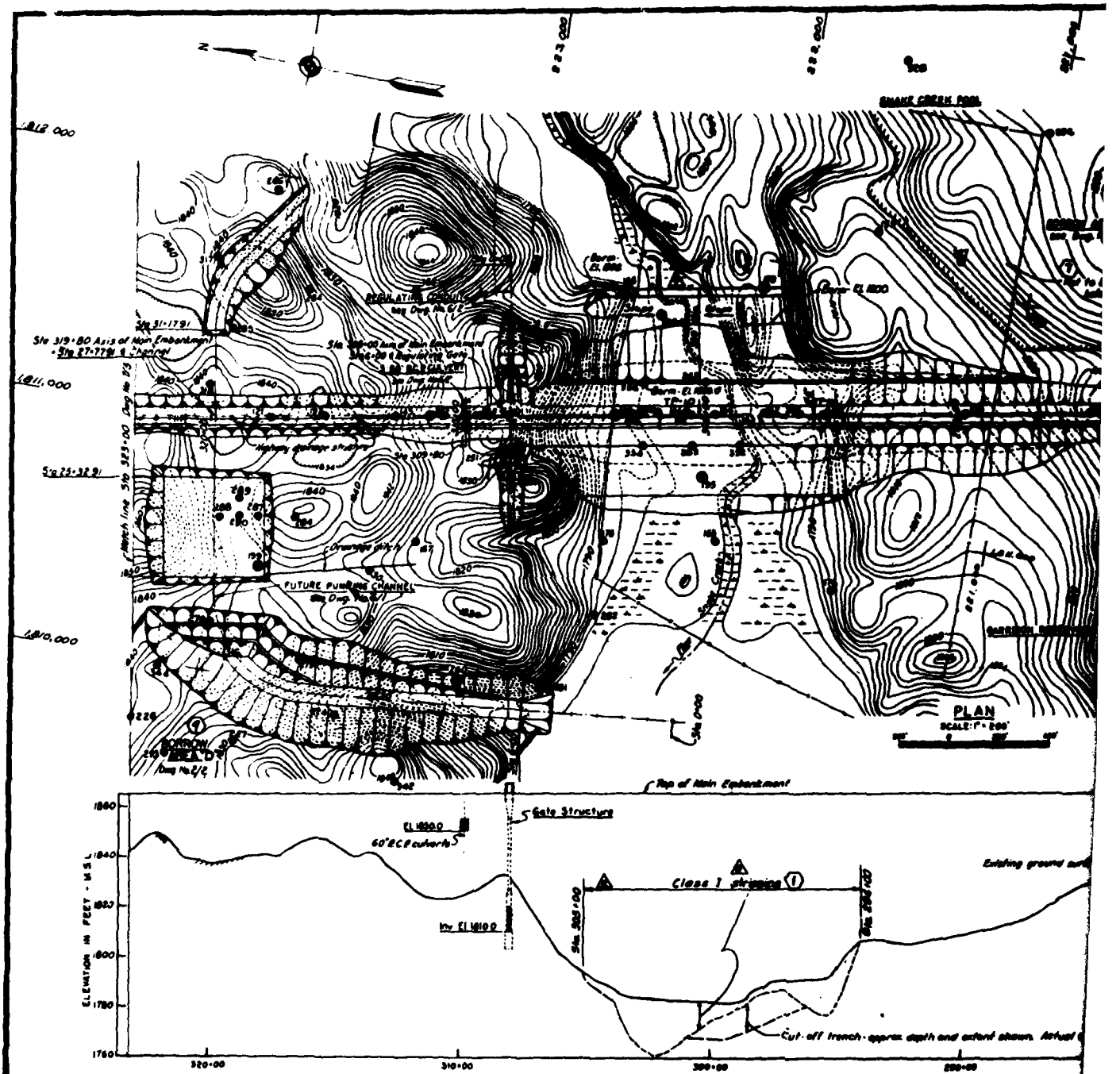
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SNAKE CREEK EMBANKMENT
MAIN EMBANKMENT
PLAN AND PROFILE
SHEET NO 1

FEBRUARY 1951

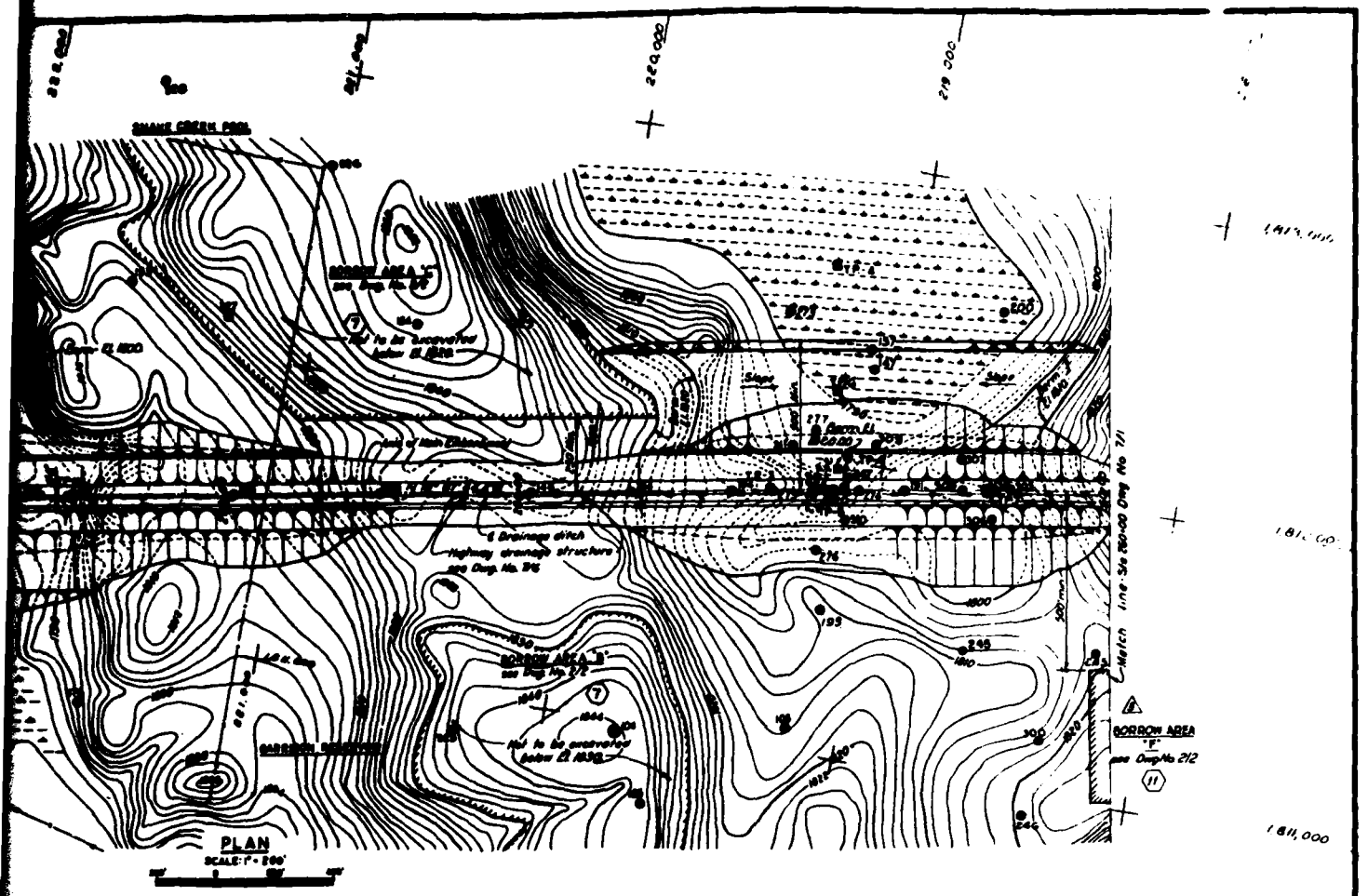
DRAWING NO. GRD-7/1

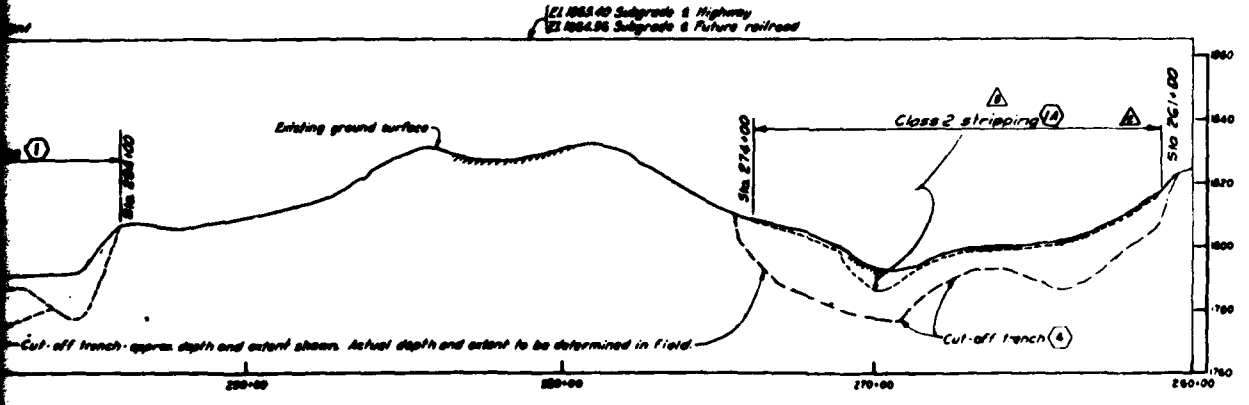
CONSTRUCTION FOUNDATION REPORT (1982) PLATE 146

2



STRIPPING NOTE:
Stripping of main embankment area, except where shown as Class 1 or Class 2, shall be Class 3 stripping paid for under Item No. 18.





PROFILE
SCALE: HOR. 1" = 200'
VERT. 1" = 20'

NOTES

Figures in hexagons indicate item numbers under which payment will be made.

For continuation of Main Embankment, Plan and Profile see Dwgs. No. 7/1 and 7/3

For General Plan, Sheets No. 1 and 2, see Dwgs. No. 2/1 and 2/2
For Highway Drainage Structures, see Dwg. No. 7/5
For Main Embankment, Details, see Dwg. No. 7/5.
For Main Embankment, Sections, see Dwg. No. 7/4

4	7-5-51	Blanket changes made	GR	
3	4-27-51	Stripping Note Area F - Addendum No. 2		
2	4-19-51	Addendum No. 1		
1	3-23-51	Revised prior to advertising		

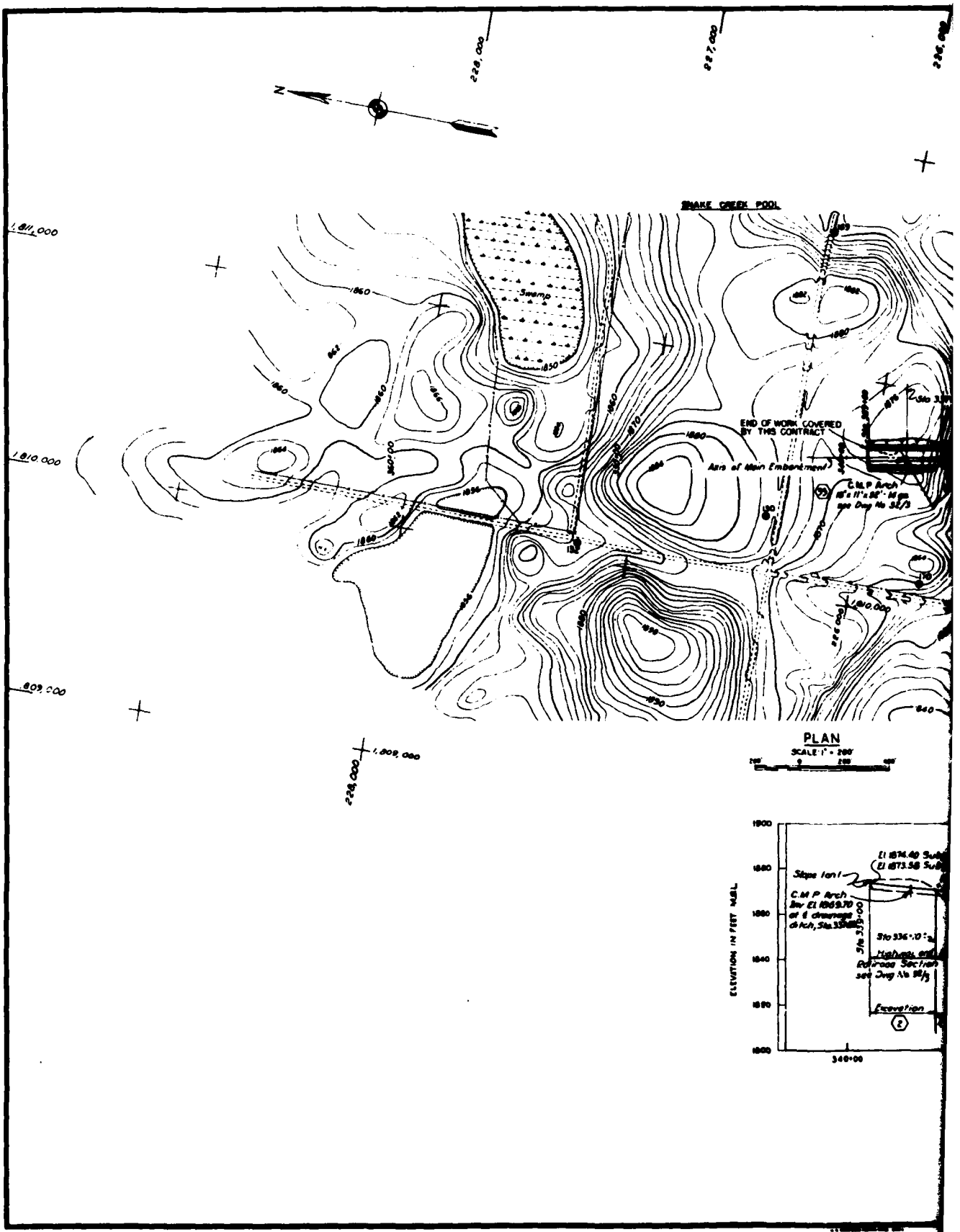
U. S. ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEBR.

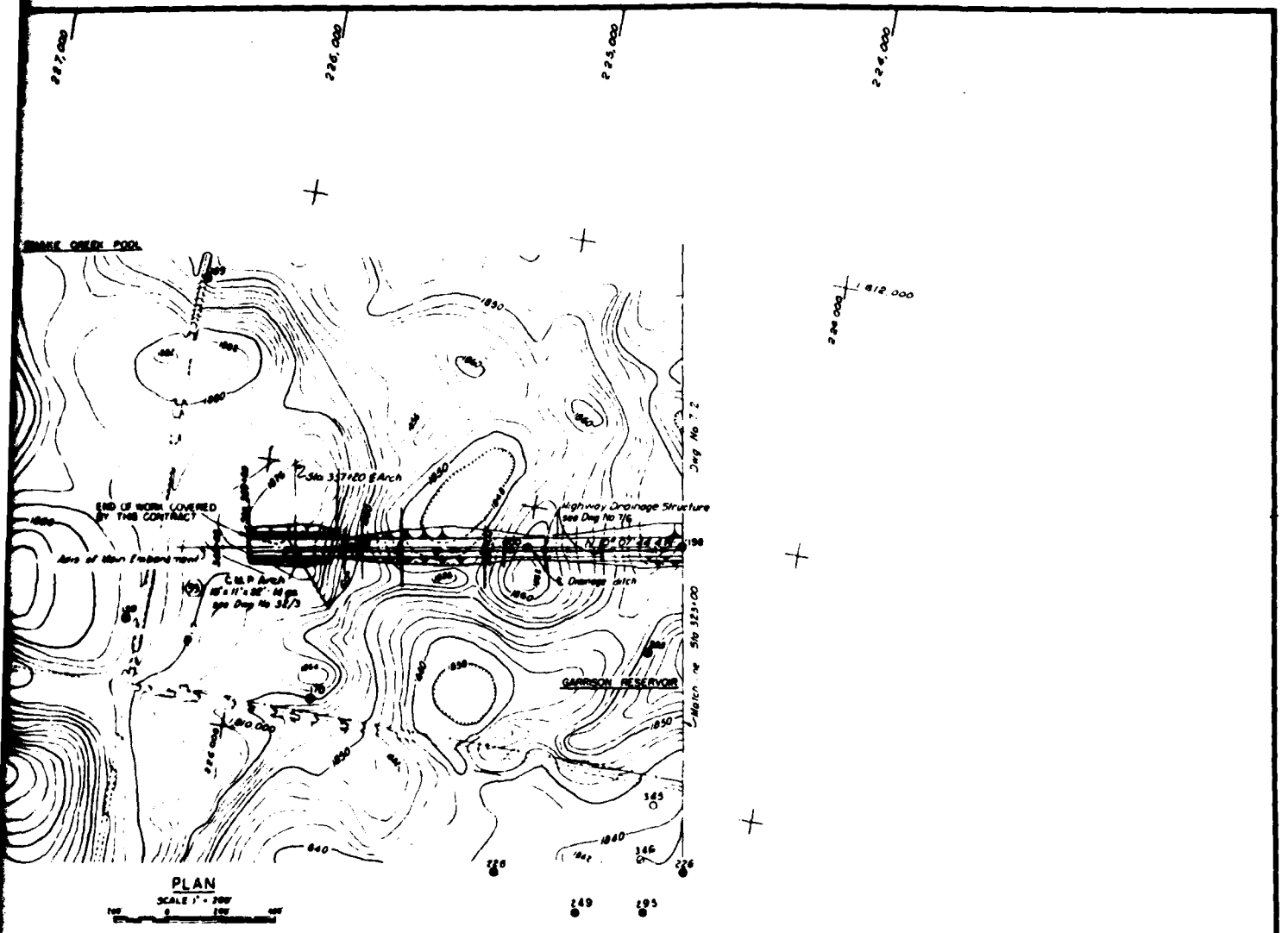
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SNAKE CREEK EMBANKMENT
MAIN EMBANKMENT
PLAN AND PROFILE
SHEET NO. 2

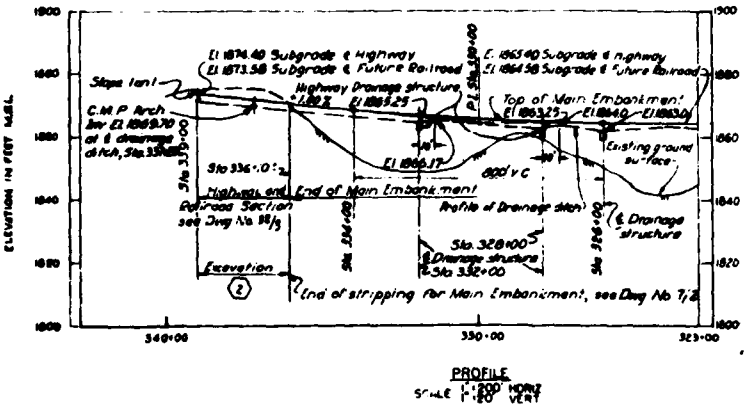
FEBRUARY 1951

GR21-7/2

2


N
SNAKE CREEK POOL
Swamp
END OF WORK COVERED BY THIS CONTRACT
Axis of Main Embankment
C.M.P. Arch
PLAN
SCALE 1" = 200'
ELEVATION IN FEET M.S.L.
Slope 1on1
Excavation
340+00





NOTES
Figures in hexagons indicate the sheets under which copyment will be taken
For continuation of Main Embankment plan and profile, see Dwgs No 7/1 and 7/2
For Main Embankment, Sections, see Dwg No 7/8
For Main Embankment, Details, see Dwg No 7/5
For General Plan Sheet, No 1 and 2, see Dwgs No 2/1 and 2/2
For Highway Drainage Structure, see Dwg No 7/6
Arrows shown on ℄ Drainage ditch indicates direction that ditch shall be graded to drain
For Records of Borings and Profiles, see Dwgs No 5/1 to 5/19 inclusive

1	3-29-51	Revised prior to advertising	

U. S. ARMY
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OFFICE OF THE DISTRICT ENGINEER

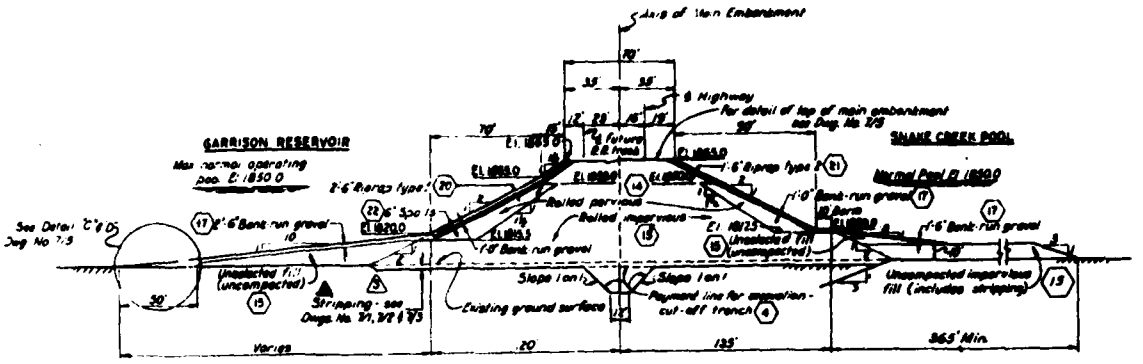
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SNAKE CREEK EMBANKMENT
MAIN EMBANKMENT
PLAN AND PROFILE
SHEET NO 3

FEBRUARY 1951

GR21-7/3

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 148

2

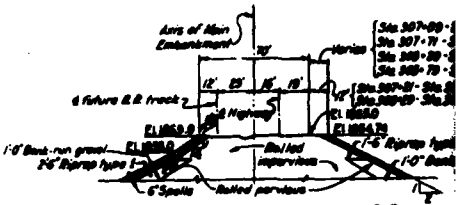


TYPICAL SECTION NO. 1

SCALE: 1" = 40'

STA. 243+10 - STA. 251+00
STA. 260+60 - STA. 276+00

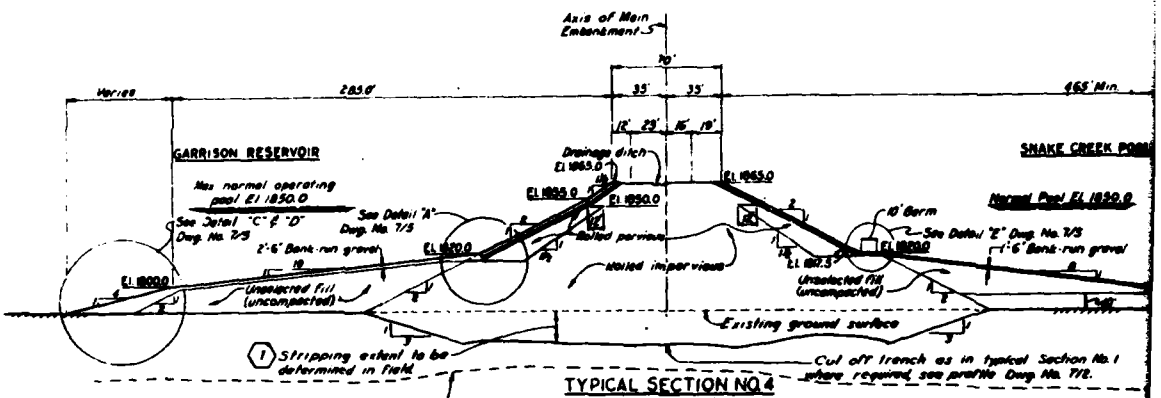
STA. 294+50 - STA. 294+00
STA. 305+00 - STA. 307+50 (See Part Typical Section No. 3)



PART TYPICAL SECTION NO. 3

SCALE 1" = 40'

STA. 307+09 - STA. 308+91



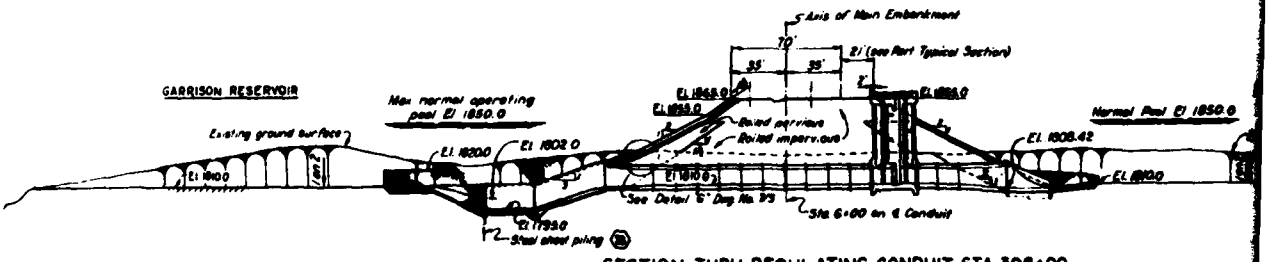
Approximate top of foundation sand and gravel at Sta. 302+00, for variation at other stations see boring drawings.

For data on artesian pressure, see piezometer observations on boring Dwg. No. 5/1.

TYPICAL SECTION NO. 4

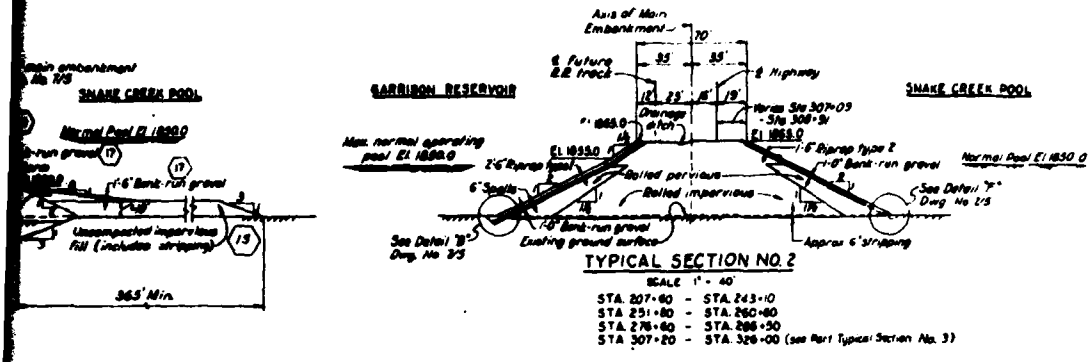
SCALE: 1" = 40'

Section at Sta. 302+00
Typical for Sta. 294+00 to Sta. 305+00



SECTION THRU REGULATING CONDUIT STA. 306+00

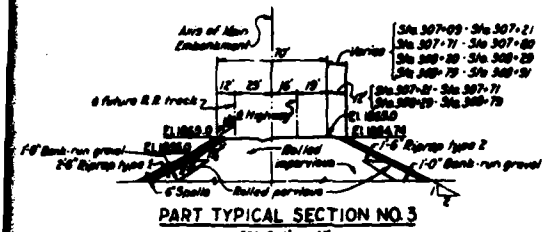
SCALE: 1" = 40'



TYPICAL SECTION NO. 2

SCALE 1" = 40'

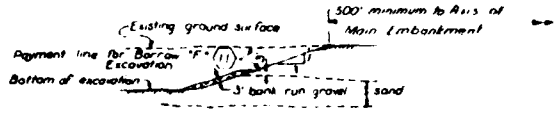
STA. 207+60 - STA. 243+10
STA 251+80 - STA. 260+80
STA 278+60 - STA. 286+50
STA 307+20 - STA. 326+00 (see Part Typical Section No. 3)



PART TYPICAL SECTION NO. 3

SCALE 1" = 40'

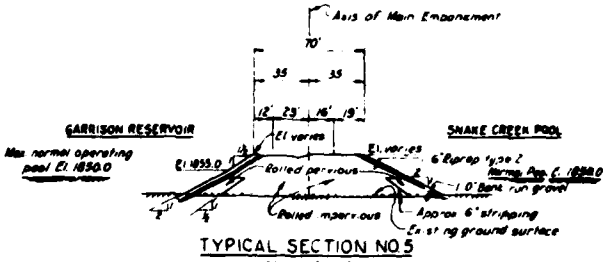
STA. 307+09 - STA. 308+91



BORROW AREA F

EAST SIDE OF FINISHED EXCAVATION

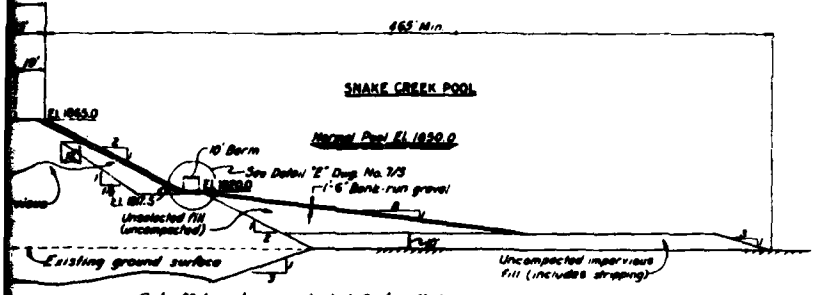
Scale 1" = 40'



TYPICAL SECTION NO. 5

SCALE 1" = 40'

STA 326+00 - STA 336+10



TION NO. 4

NOTES

Figures in hexagons indicate item number under which payment will be made

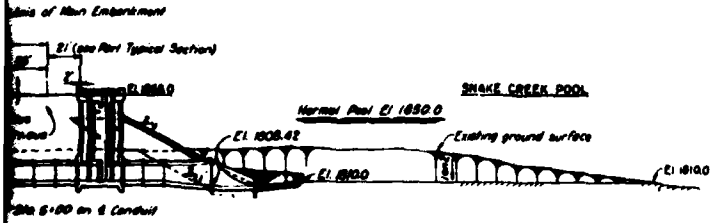
For General Plans see Dwgs No. 2/1 & 2/2

For Main Embankment, Plan and Profile, see Dwgs No. 7/1, 7/2 and 7/3

For Highway Drainage Structures, see Dwg No. 7/6

For Excavation, Regulating Conduit, Plan, Profile and Sections, see Dwgs. No. 6/2, 6/3 & 6/4

For Regulating Conduit, Concrete, see Dwgs No. 10/1 thru 10/14



ATING CONDUIT STA 308+00

NO.	DATE	REVISIONS INDICATED BY △	BY	CHKD
3	4-27-51	Section No 1 & 4 Addendum No 2	CES	RLB
2	4-19-51	Addendum No 1	do	RLB
1	3-28-51	Revised prior to advertising	do	L.H.

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CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEBR.

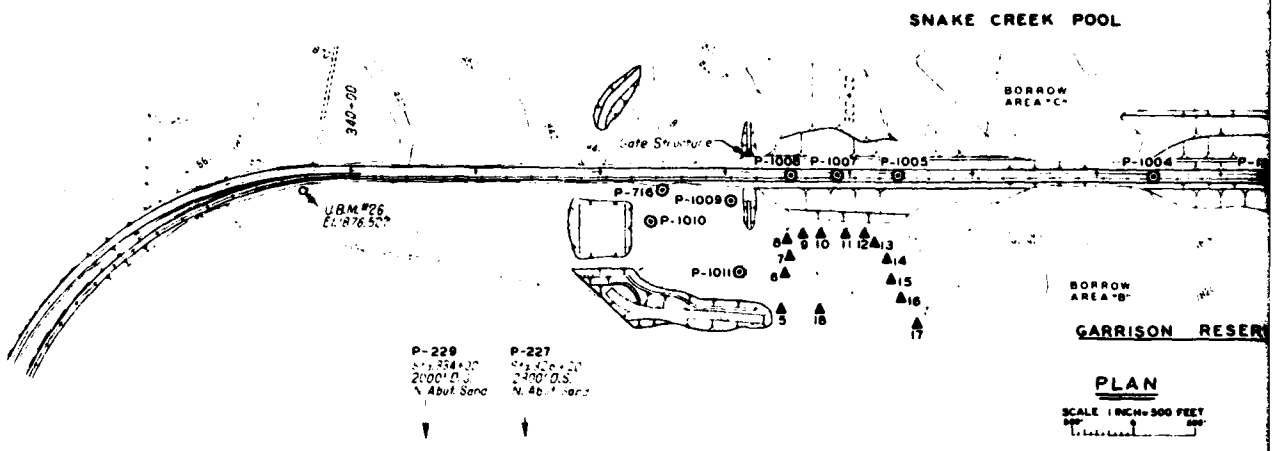
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
SNAKE CREEK EMBANKMENT
MAIN EMBANKMENT
SECTIONS

FEBRUARY 1951

GR21-7/4

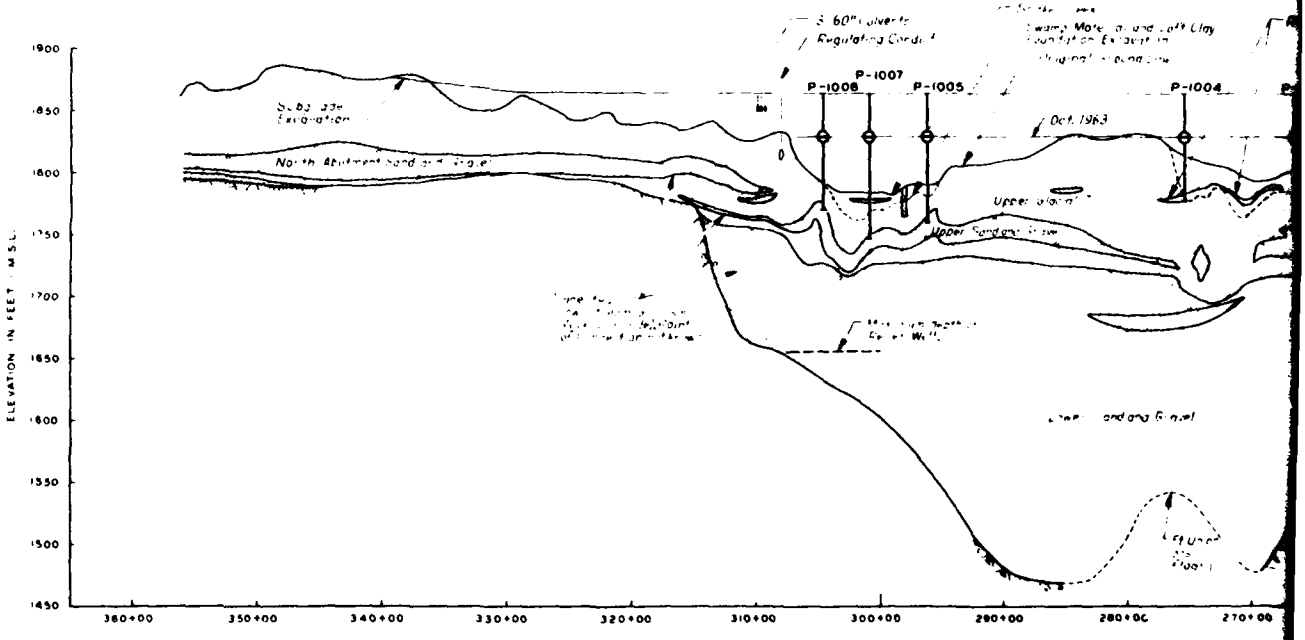
2

CORPS OF ENGINEERS



PLAN

SCALE 1 INCH = 500 FEET

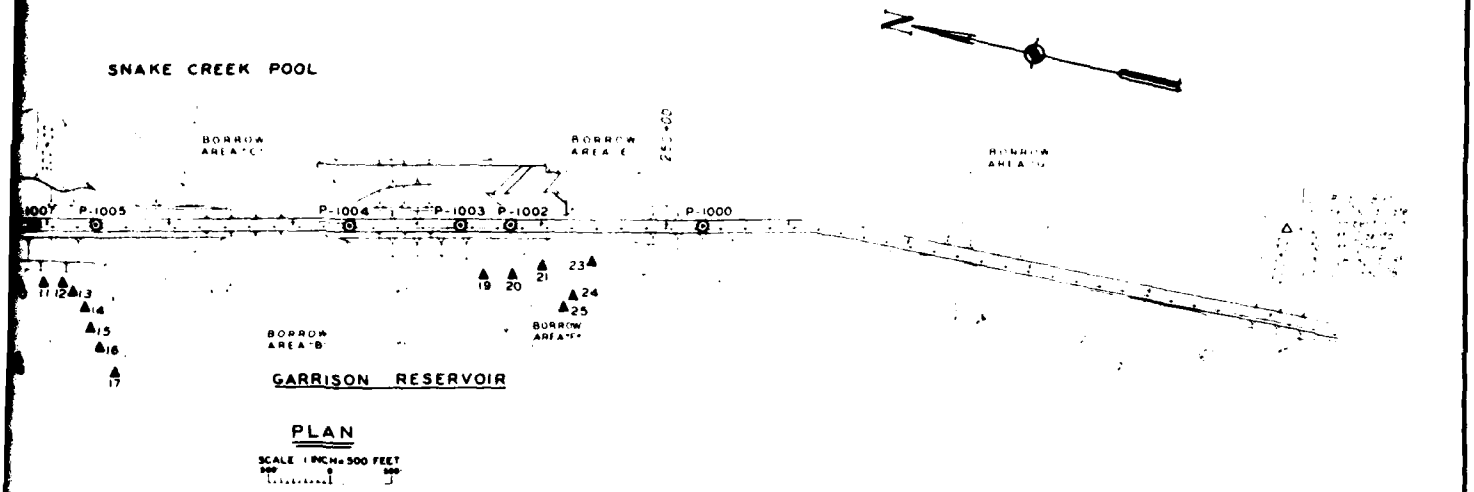


PROFILE - CENTER

SCALE: VERT 1 INCH = 50 FEET
HORIZ 1 INCH = 500 FEET

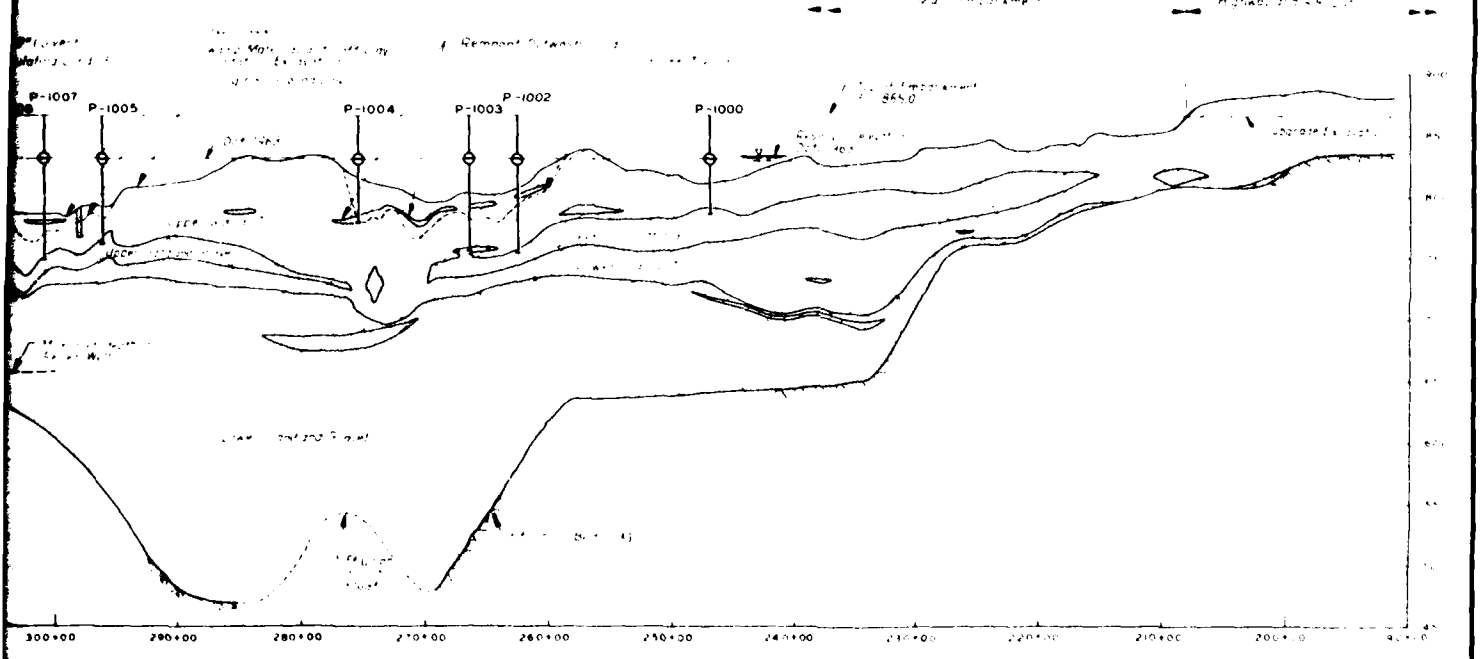
Copy Must Be Made Before Entry Addendum and/or Modification

ADDENDA NO.	
DATE	
MODIFICATION	
DATE	



PLAN

SCALE 1 INCH = 500 FEET



PROFILE - CENTER LINE

SCALE VERT 1 INCH = 50 FEET
HORIZ 1 INCH = 500 FEET

LEGEND

- ZONE OF GYPSUM FILLED CRACKS
- GLACIAL TILL
- ALLUVIUM (SAND & GRAVEL WITH THIN SILT & CLAY LENSES)
- FT UNION (BEDROCK)
- PIEZOMETERS
- RELIEF WELLS

SAFETY PAYS

DATE	DESCRIPTION	MADE	APPVD

REVISIONS

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

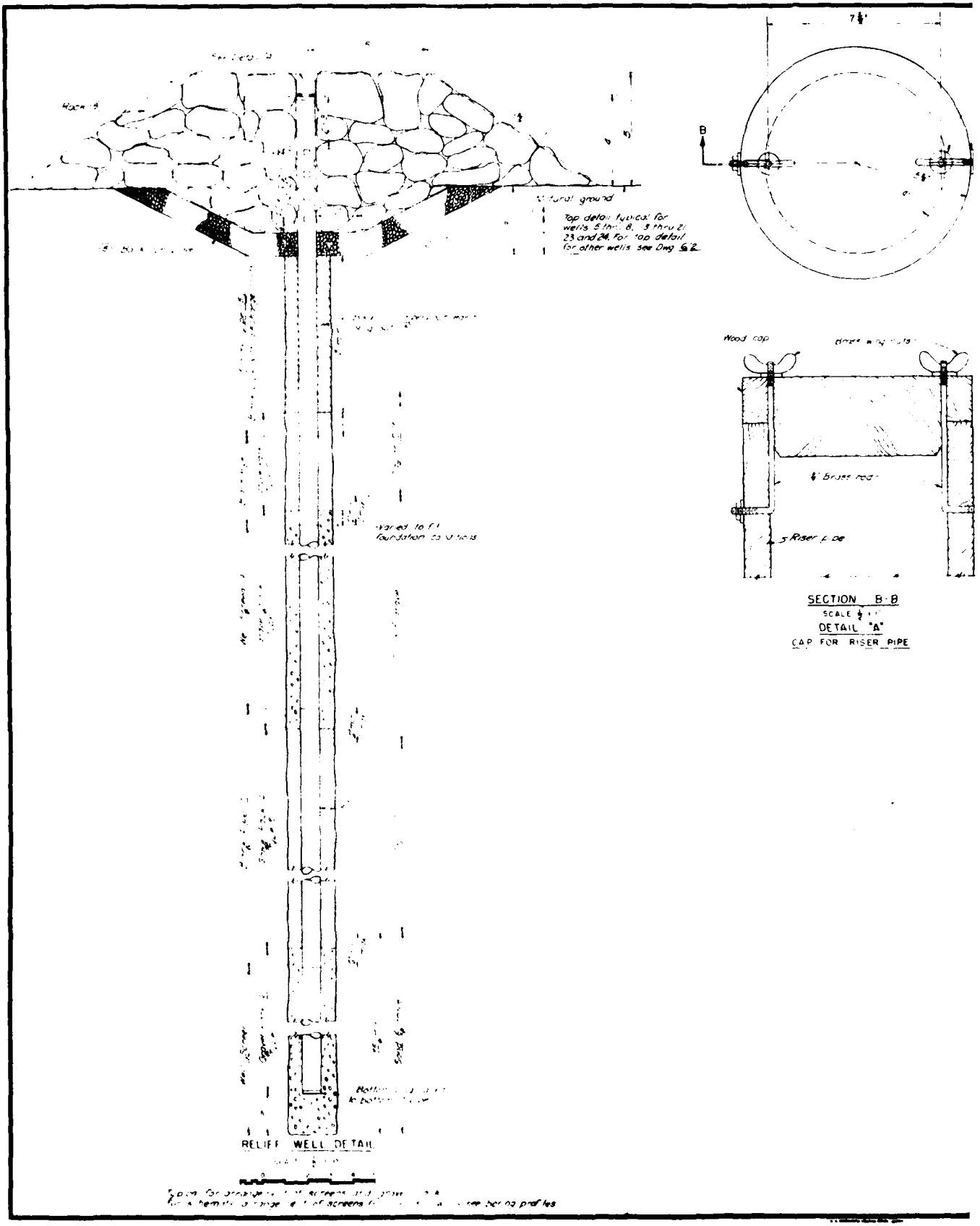
MISSOURI RIVER

GARRISON DAM AND RESERVOIR
UNDERSEEPAGE STUDIES
SNAKE CREEK EMBANKMENT
PLAN AND PROFILE

THIS PLAN ACCOMPANIES CONTRACT No. DA-25-066-eng MODIFICATION No.

CONSTRUCTION FOUNDATION REPORT (1982) PLATE 150

2

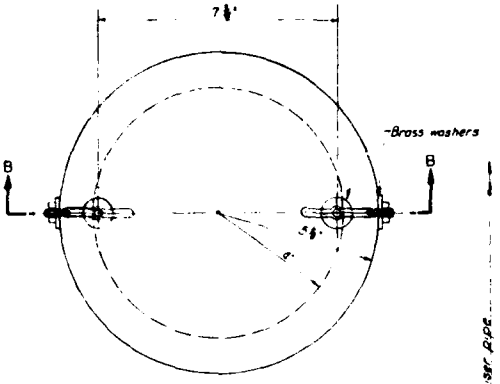


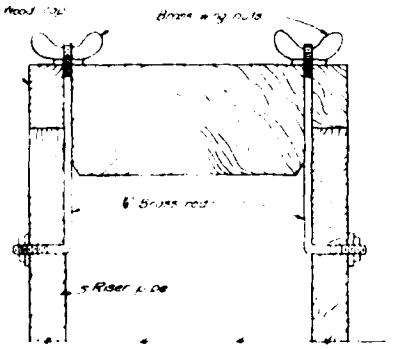
SECTION B-B

SCALE 1/2"

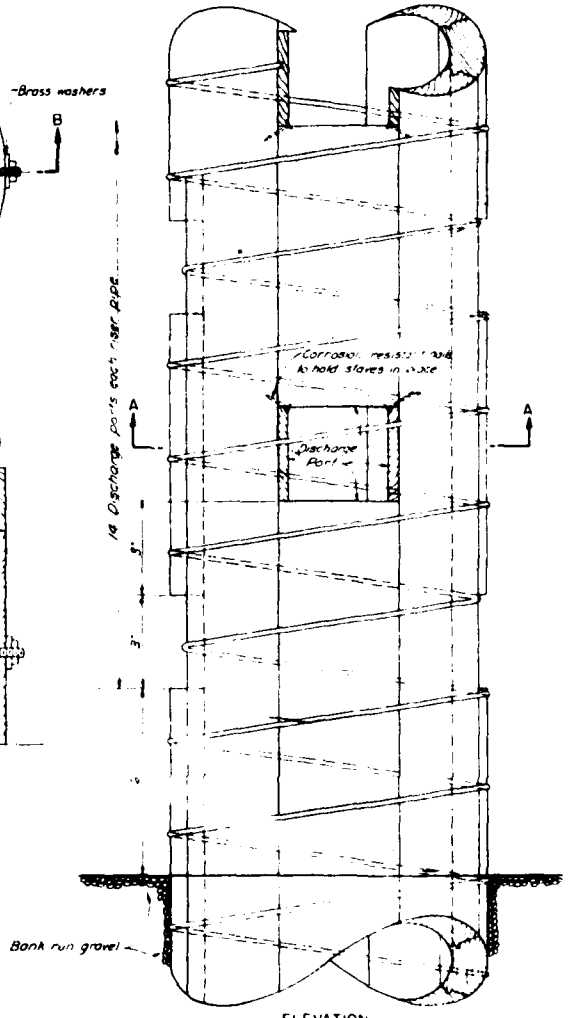
DETAIL "A"

CAP FOR RISER PIPE



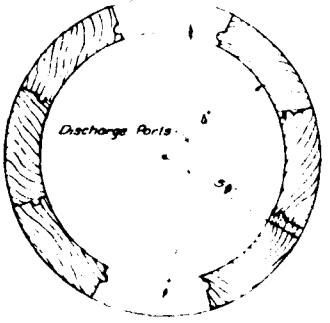


SECTION B-B
SCALE 1/2"
DETAIL "A"
CAP FOR RISER PIPE



ELEVATION
SCALE 1/2"

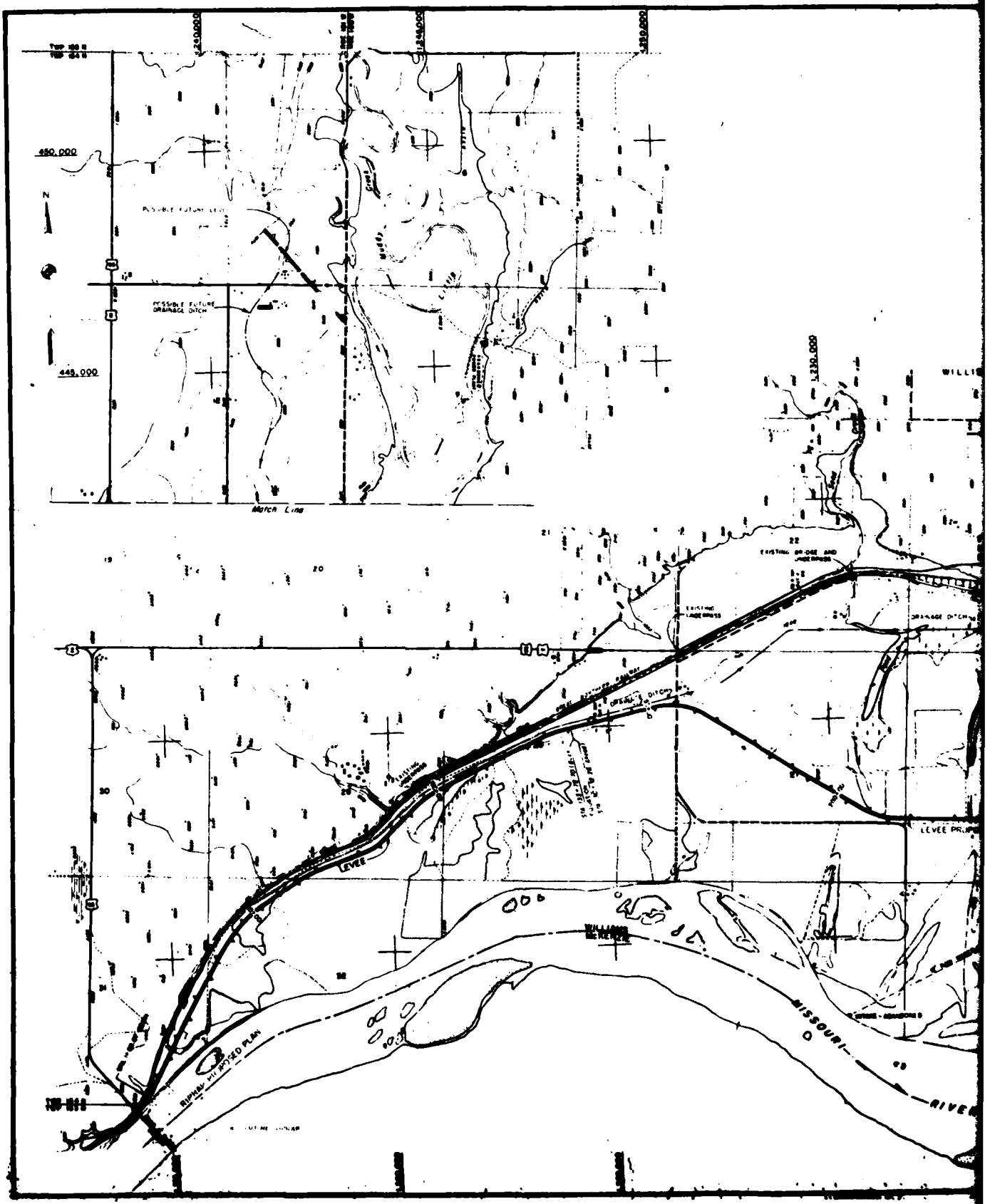


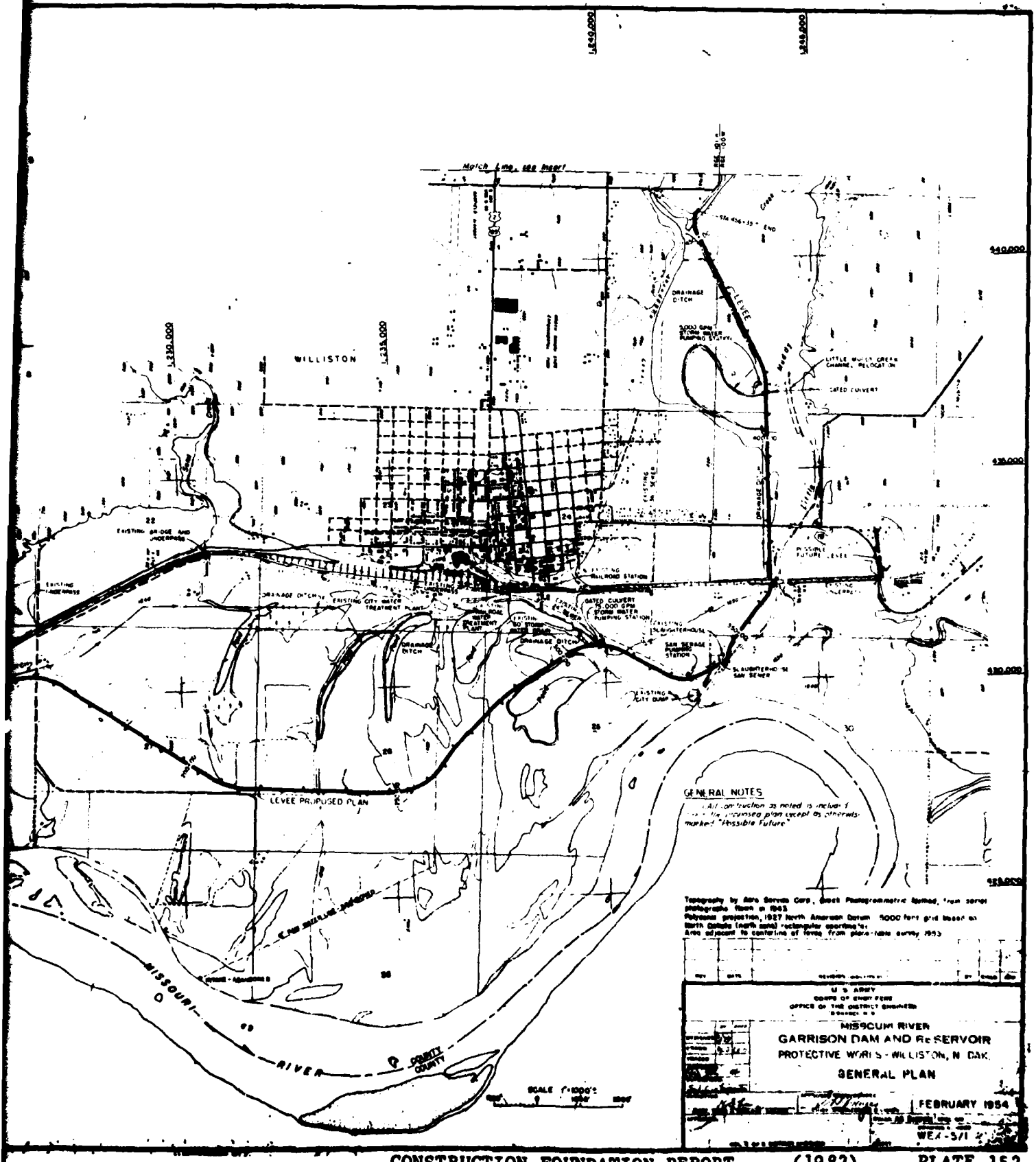


SECTION A-A
SCALE 1/2"
RISER PIPE

GARRISO
SNAKE

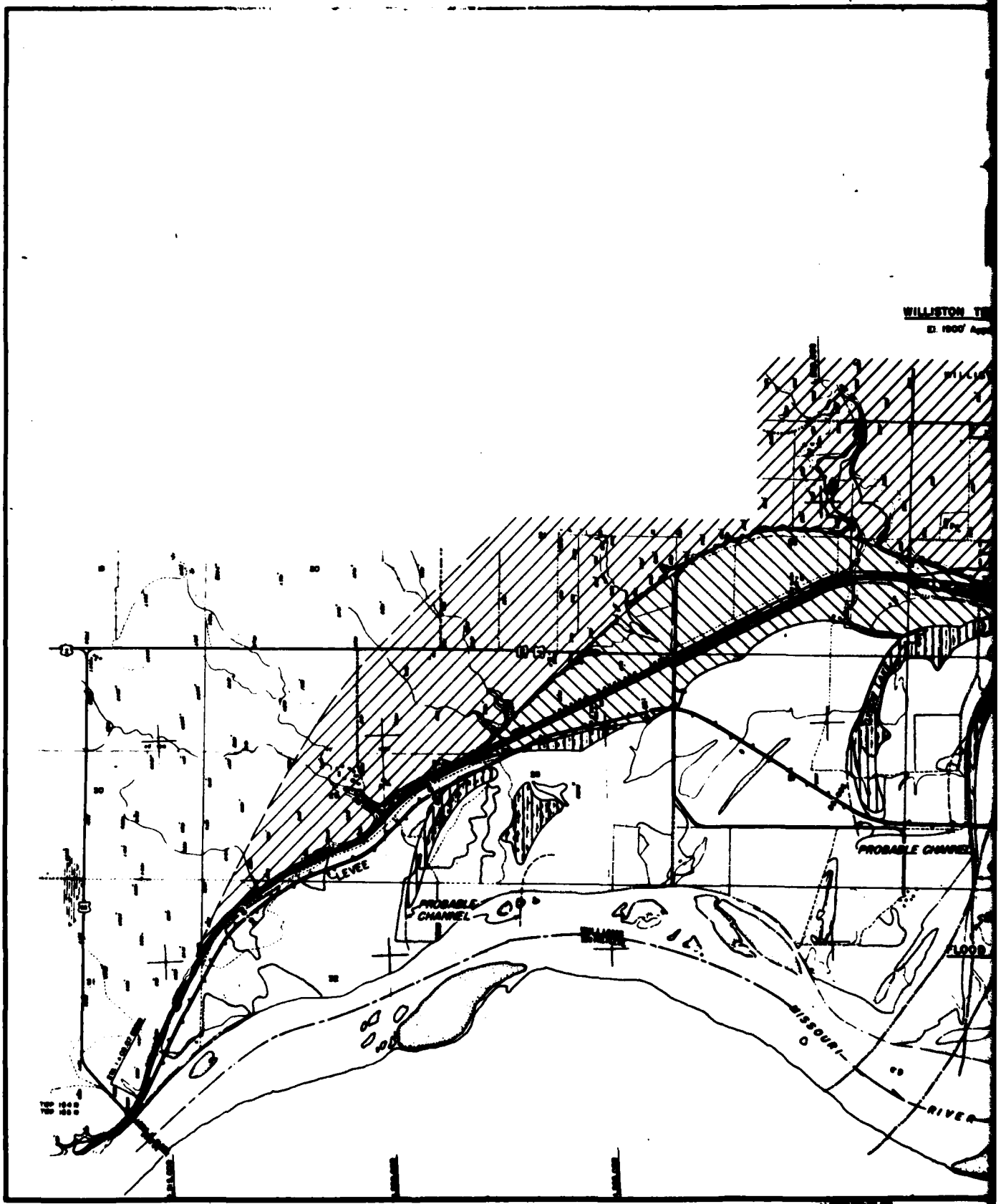
CONSTRUCTION FOUNDATION REPORT (1982

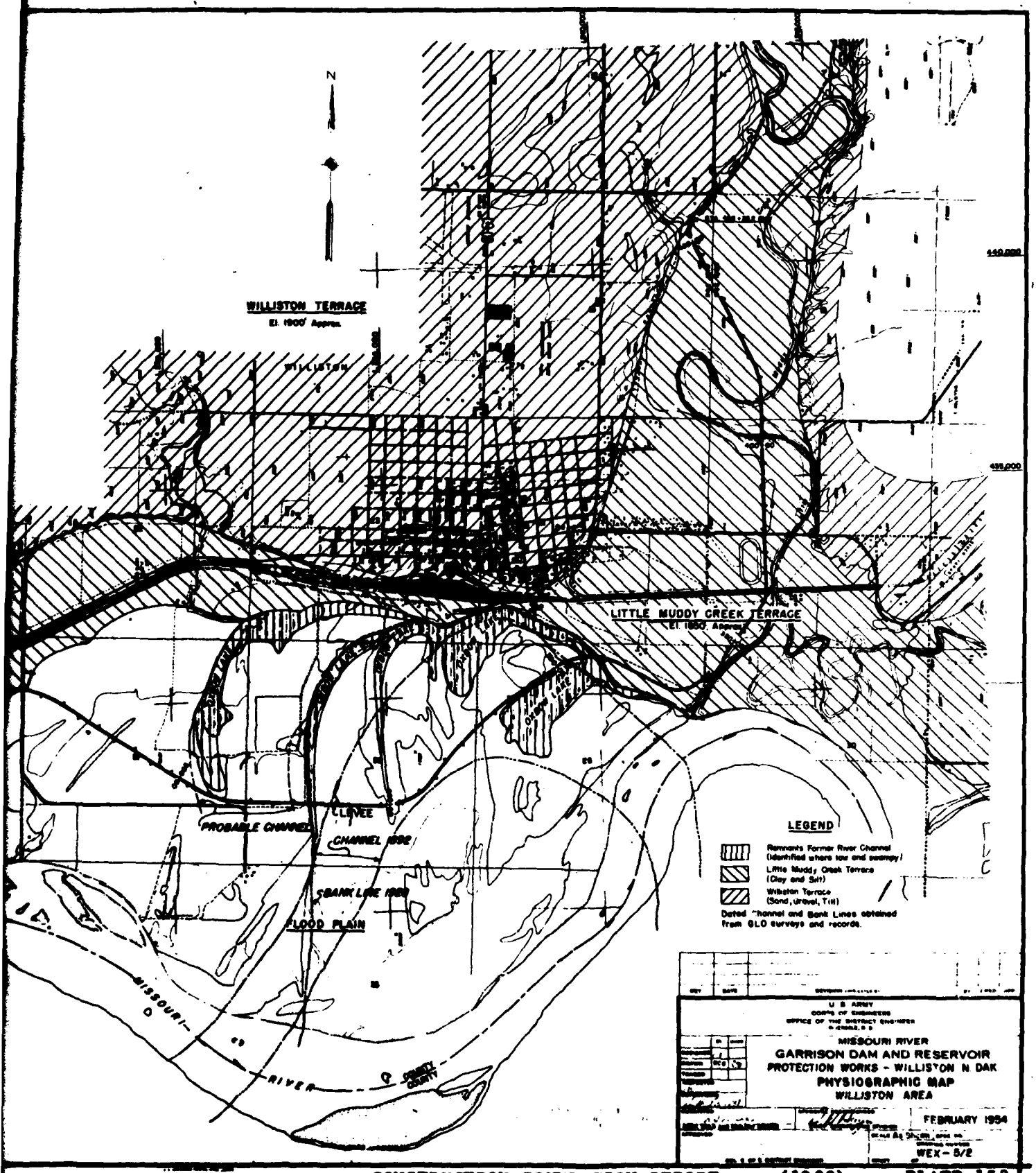

450,000
440,000
N
LEVEE
MISSOURI
RIVER



CONSTRUCTION FOUNDATION REPORT (1982) PLATE 152

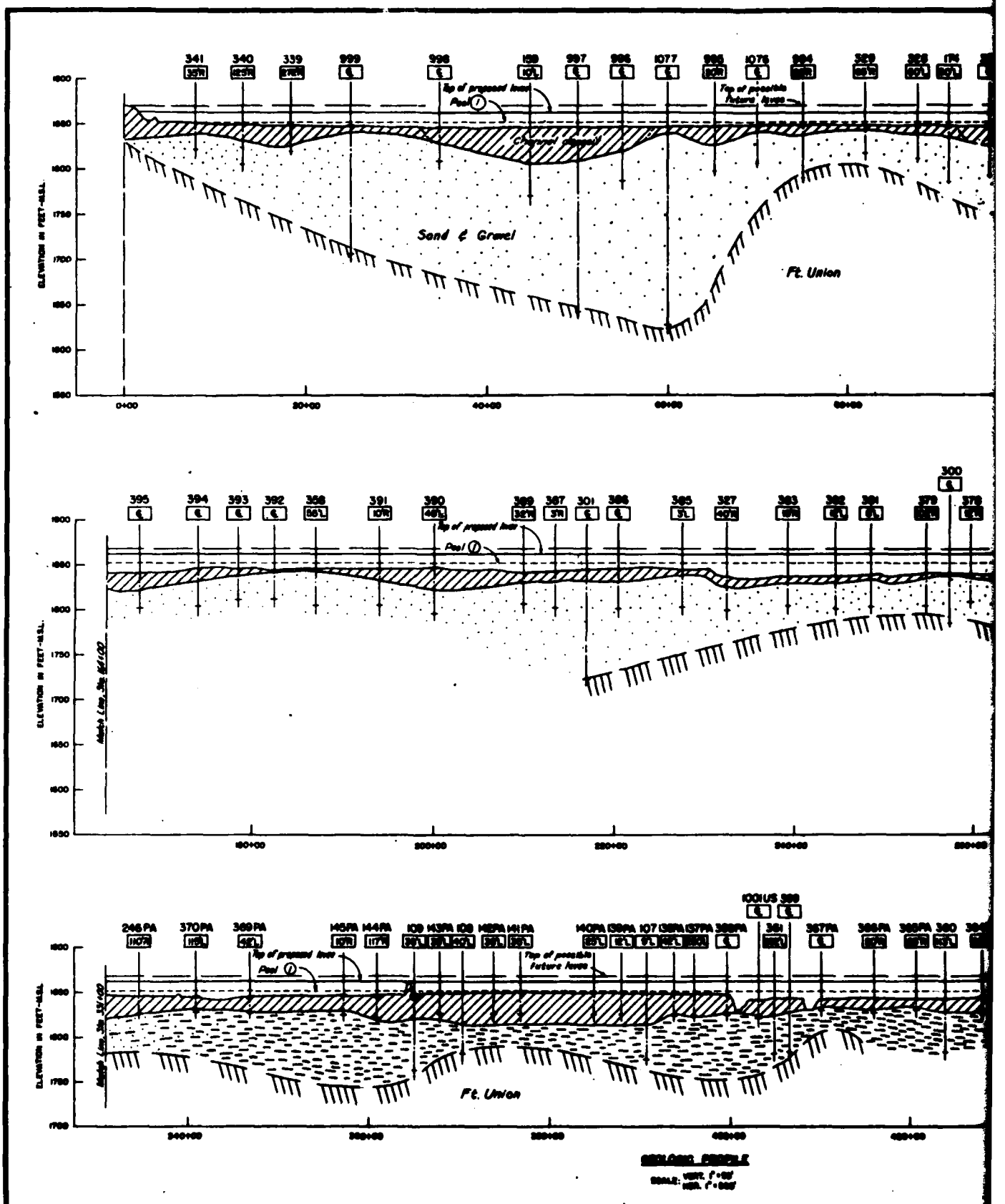
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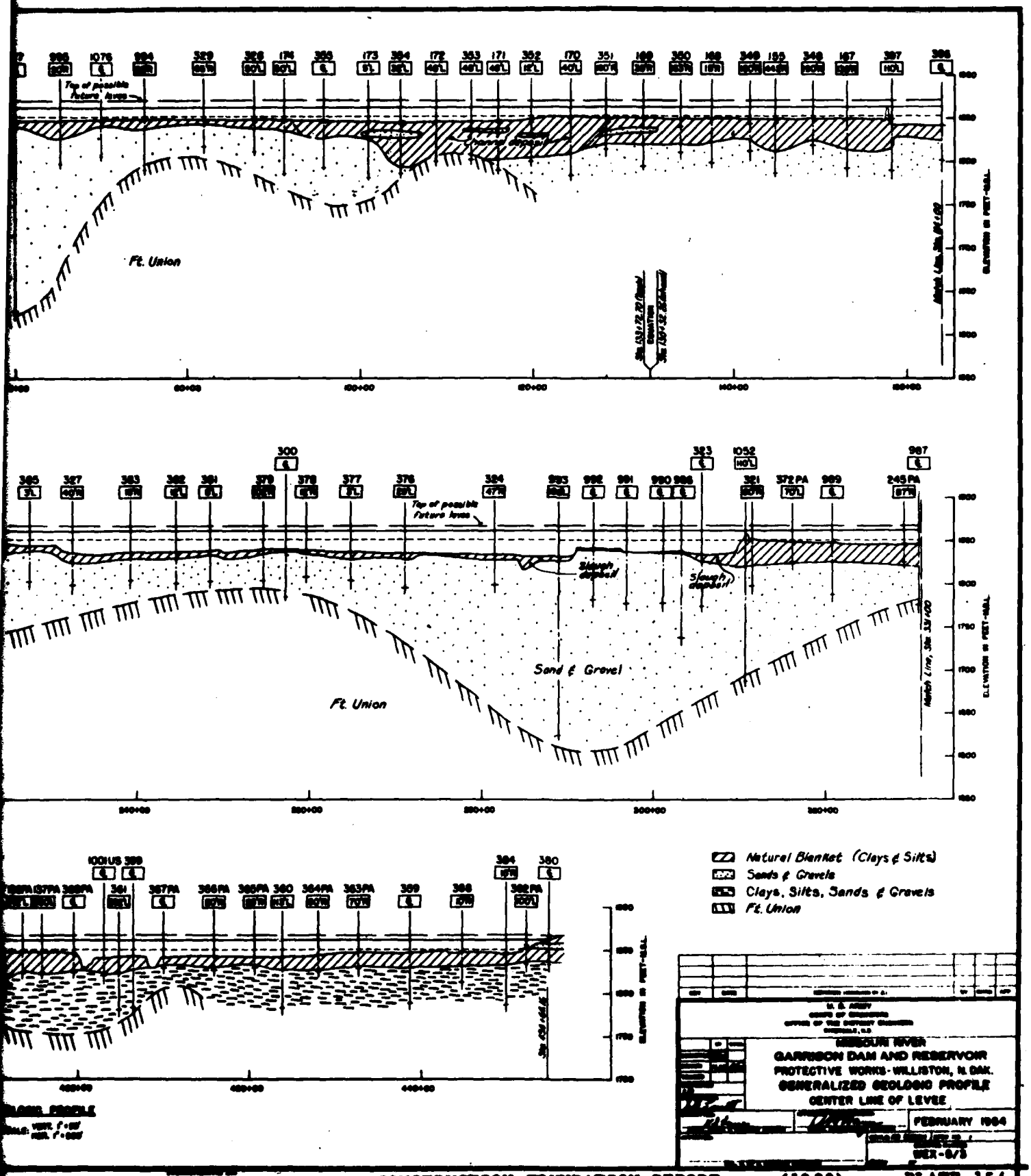

LEVEE
PROBABLE CHANNEL
PROBABLE CHANNEL
MISSOURI
RIVER

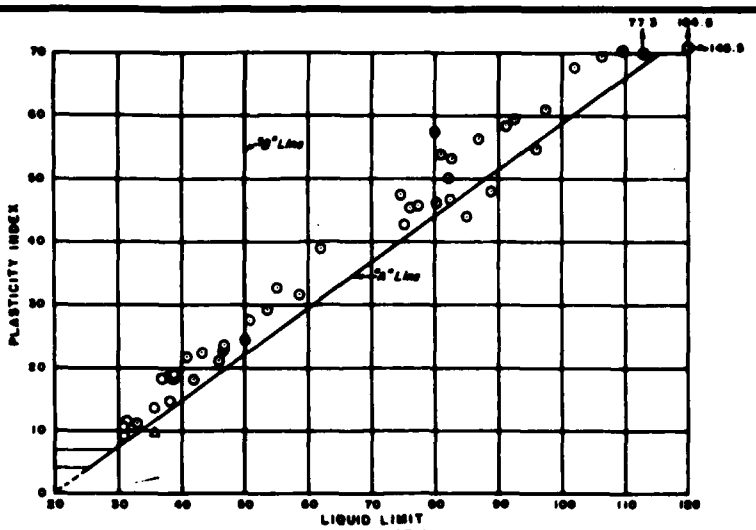


CONSTRUCTION FOUNDATION REPORT (1982) PLATE 153

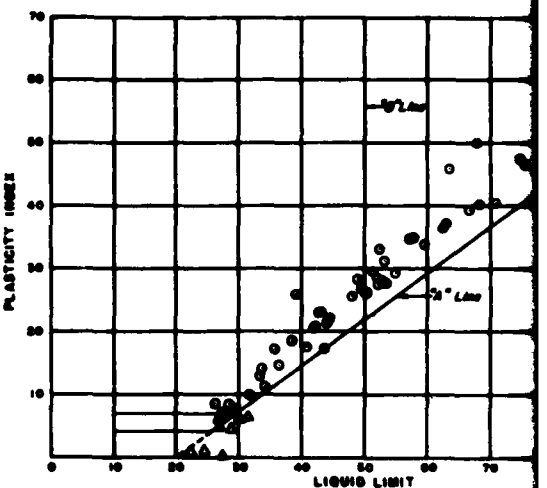
2


Sand & Gravel
Ft. Union
Top of proposed liner
Pool
Top of possible future liner
ELEVATION IN FEET - M.S.L.

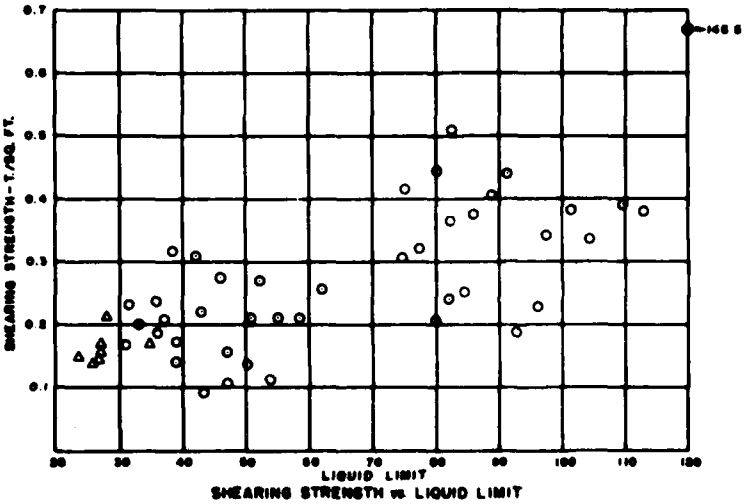

Top of possible future levee
Ft. Union
Sand & Gravel
Slough deposit
Natural Blanket (Clays & Silts)
Sands & Gravels
Clays, Silts, Sands & Gravels
Ft. Union
MISSOURI RIVER
GARRISON DAM AND RESERVOIR
PROTECTIVE WORKS - WILLISTON, N. DAK.
GENERALIZED GEOLOGIC PROFILE
CENTER LINE OF LEVEE
FEBRUARY 1964



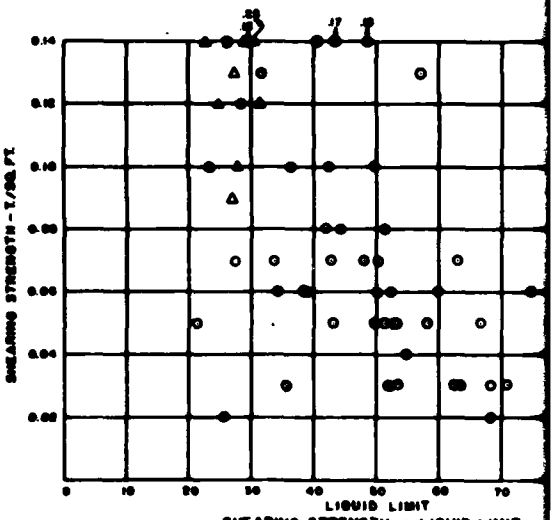
LIQUID LIMIT vs PLASTICITY INDEX
FIG. 1



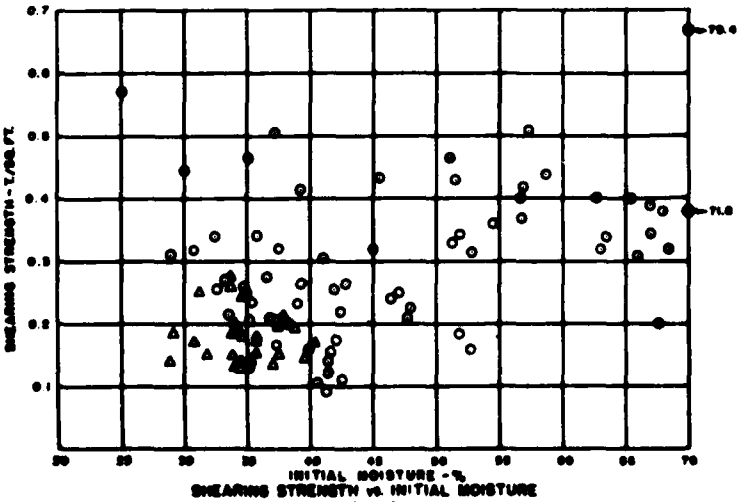
LIQUID LIMIT vs. PLASTICITY INDEX
FIG. 4



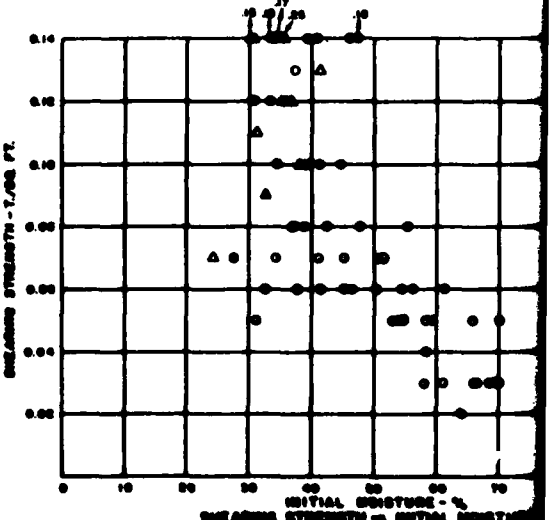
SHEARING STRENGTH vs LIQUID LIMIT
FIG. 2



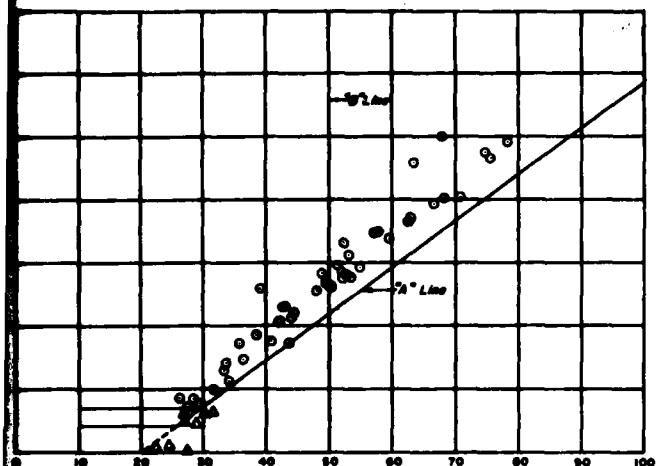
SHEARING STRENGTH vs LIQUID LIMIT
FIG. 5



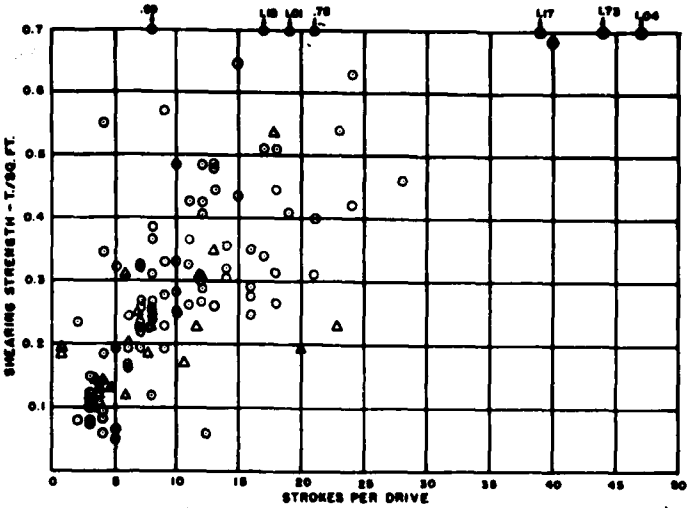
SHEARING STRENGTH vs. INITIAL MOISTURE
FIG. 3
MARSH AREAS AND CLAY FILLED CHANNELS



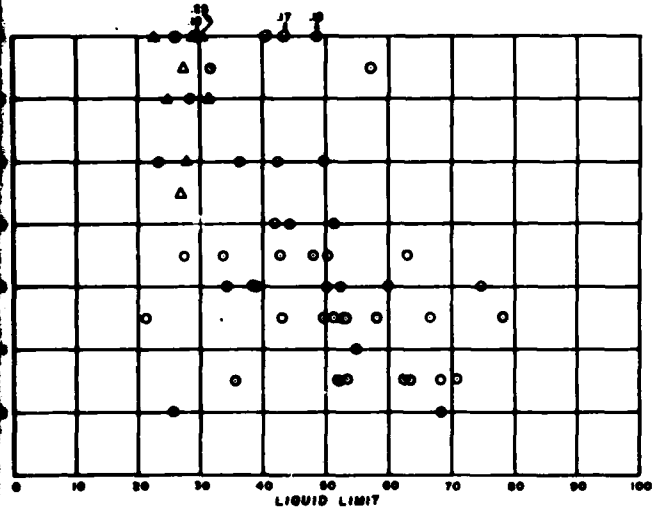
SHEARING STRENGTH vs. INITIAL MOISTURE
FIG. 6



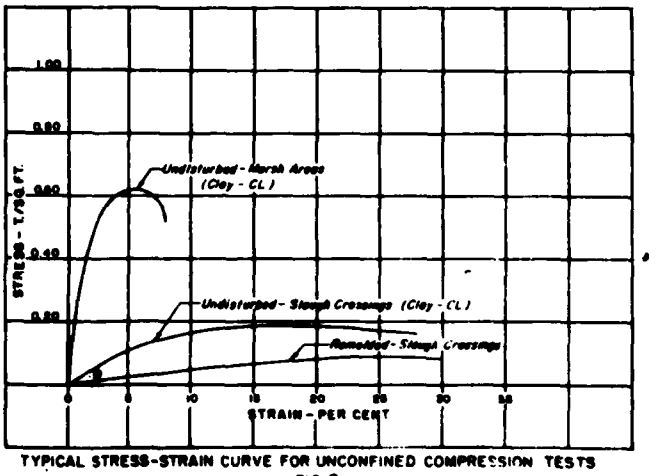
LIQUID LIMIT vs. PLASTICITY INDEX
FIG. 4



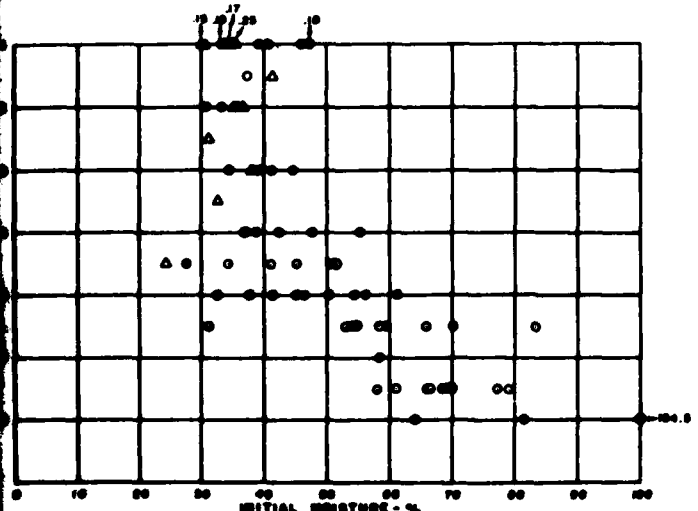
SHEARING STRENGTH vs. STROKES PER DRIVE
FIG. 7



SHEARING STRENGTH vs LIQUID LIMIT
FIG. 5



TYPICAL STRESS-STRAIN CURVE FOR UNCONFINED COMPRESSION TESTS
FIG. 8



SHEARING STRENGTH vs. INITIAL MOISTURE
FIG. 6

NOTES

Strokes per drive obtained from churn drilling - 3 11 drive using a 6" sampling tube and a 2' drop of drilling tools weighing approximately 1500 pounds

○ Denotes clay samples

△ Denotes silt samples

Shearing strength computed as one half the unconfined compressive strength of undisturbed samples. Data taken from C.W.S. Corp Rpts. 5-24 & 5-25, not including test results marked as questionable

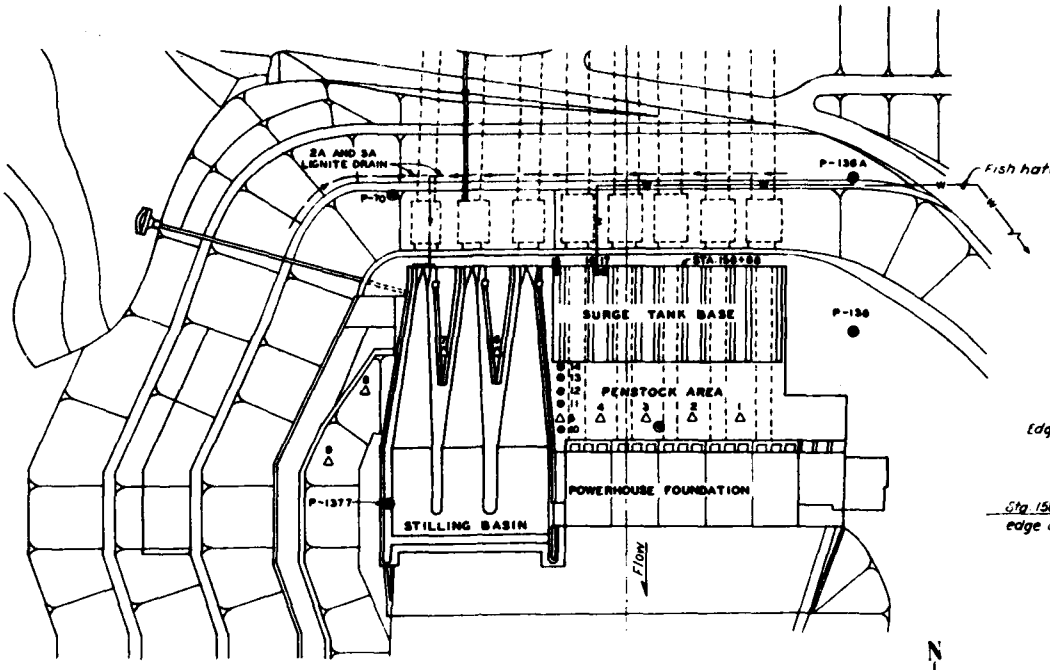
U. S. ARMY
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEBR.

MISSOURI RIVER
GARRISON DAM AND RESERVOIR
PROTECTIVE WORKS - WILLISTON, N. DAK.
SOILS TEST DATA
FOUNDATION SUMMARY

FEBRUARY, 1964

WER - 5/26

2



PLAN

SCALE 1 INCH = 100 FEET

100 0 100

Sta 156+88 Portal wall

E2 C4

R.W. 15

28" Pipe

Edge of stilling basin East wall

Sta 158+58.17 Downstream edge of surge tank base

Invert El 1646.22

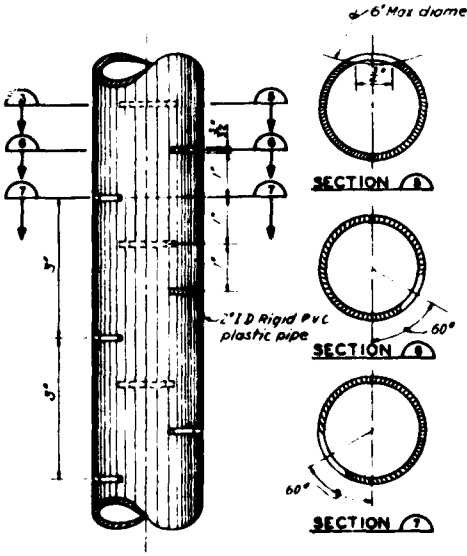
Invert El 1645.20

E2 C3

Existing relief well manhole No 5

Sta 159+63.17 Upstream edge of Powerhouse foundation

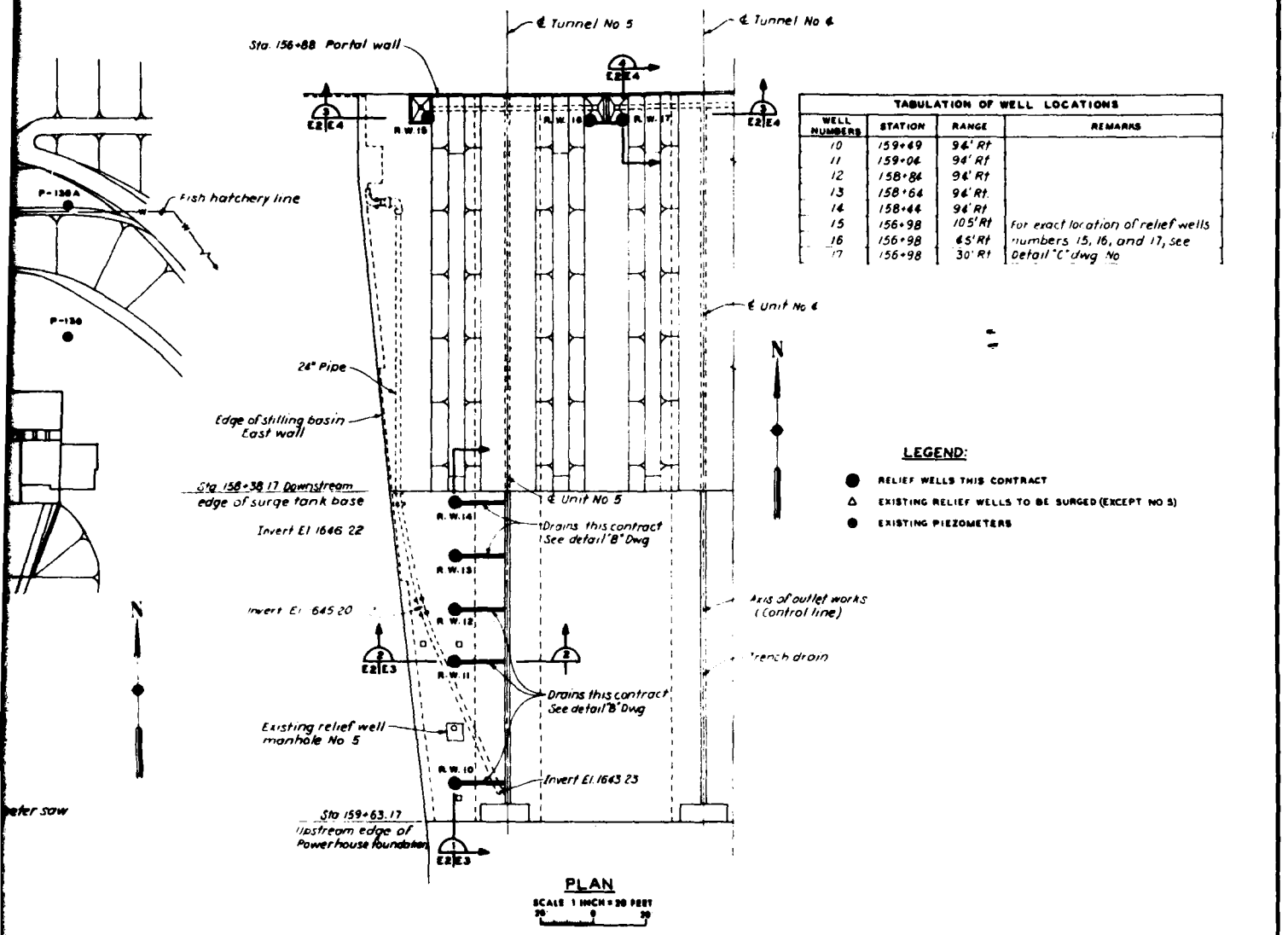
N



DETAIL

SLOT ARRANGEMENT FOR PLASTIC SCREEN

SCALE



TABULATION OF WELL LOCATIONS			
WELL NUMBERS	STATION	RANGE	REMARKS
10	159+49	94' Rt	
11	159+06	94' Rt	
12	158+84	94' Rt	
13	158+64	94' Rt.	
14	158+44	94' Rt	
15	156+98	105' Rt	For exact location of relief wells numbers 15, 16, and 17, see detail "C" dwg No
16	156+98	65' Rt	
17	156+98	30' Rt	

LEGEND:

- ● RELIEF WELLS THIS CONTRACT
- △ EXISTING RELIEF WELLS TO BE SURGED (EXCEPT NO 5)
- ● EXISTING PIEZOMETERS

SECTION NUMBER

DRAWING NUMBER ON WHICH SECTION IS DETAILED

DRAWING NUMBER ON WHICH SECTION IS CUT

Q DENT DRAWING NUMBERS IF SECTION IS CUT AND DETAILED ON SAME DRAWING.

SECTION IDENTIFICATION

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

DATE	DESCRIPTION	INITIALS	APPVD
	REVISIONS		

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

MISSOURI RIVER
GARRISON DAM - LAKE SAKAKAWEA
POWERHOUSE RELIEF WELLS
PLANS AND DETAIL

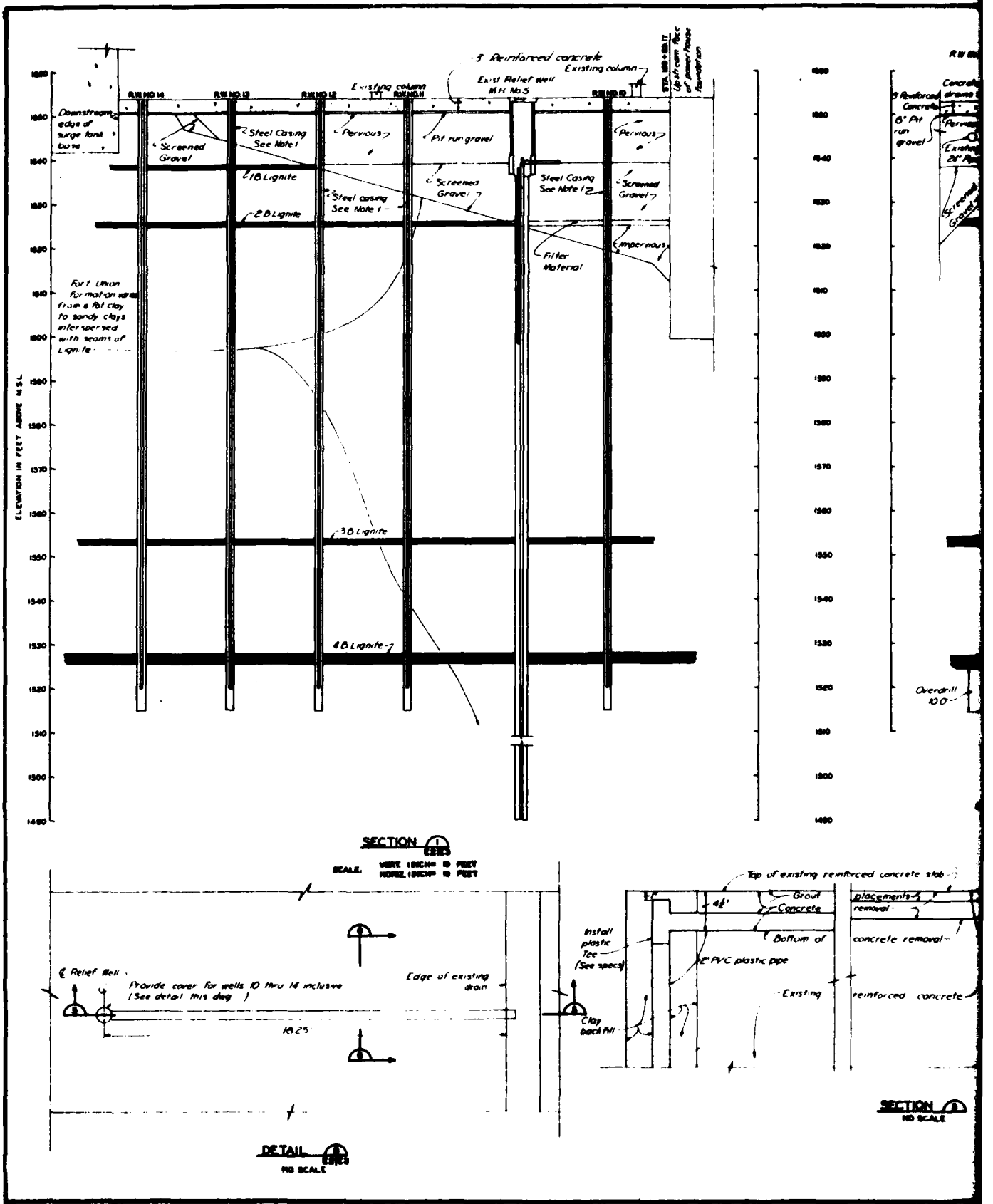
DESIGNED BY: V. E. G.
DRAWN BY: D. A.
TRACED BY:
CHECKED BY: C. V. J.
SUBMITTED:
APPROVED: B. P. Sondergaard
COL., C. E., DISTRICT ENGINEER

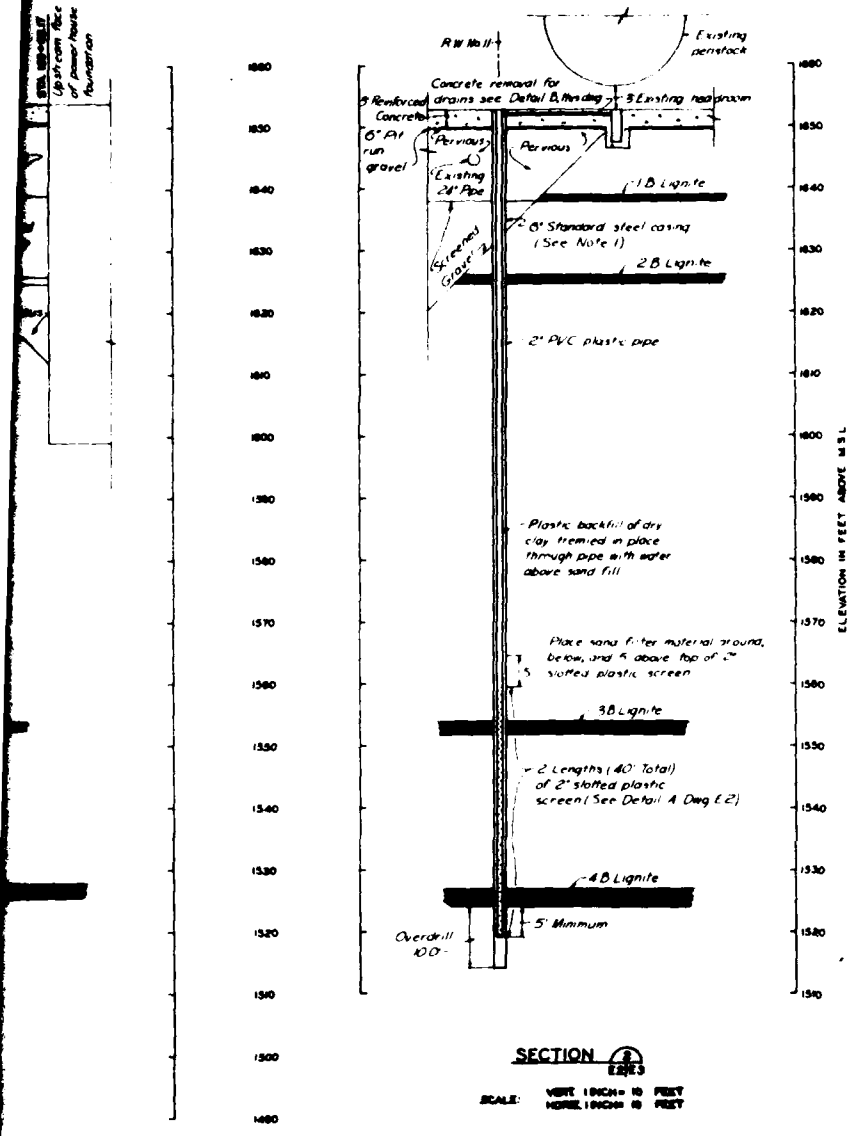
DATE: MAY 1970
SCALE AS SHOWN
DRG. NO.
CONTRACT NUMBER
MGR72-80E2

THIS PLAN ASSEMBLED CONTRACT NO.
MODIFICATION NO.

SAFETY PAYS

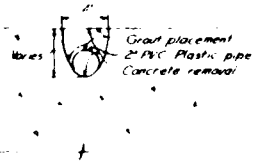
2


R.W. NO. 14
R.W. NO. 13
R.W. NO. 12
R.W. NO. 11
R.W. NO. 10
Existing column
Existing column
Exist Relief Well M.H. No. 5
3' Reinforced concrete
Downstream edge of surge tank base
Screened Gravel
Steel Casing See Note 1
Pervious
Pit run gravel
Steel Casing See Note 1
Screened Gravel
Pervious
Steel Casing See Note 1
Screened Gravel
Impervious
Filter Material
1B Lignite
2B Lignite
3B Lignite
4B Lignite
For Union Formation varies from a fat clay to sandy clays interspersed with seams of Lignite
ELEVATION IN FEET ABOVE M.S.L.
1650
1640
1630
1620
1610
1600
1590
1580
1570
1560
1550
1540
1530
1520
1510
1500
1490
SECTION
SCALE: VERT. 1 INCH = 10 FEET
HORIZ. 1 INCH = 10 FEET
℄ Relief Well
Provide cover for wells 10 thru 14 inclusive (See detail this dwg.)
Edge of existing drain
18.25'
DETAIL
NO SCALE
Top of existing reinforced concrete slab
48"
Grout
Concrete
placements
removal
Bottom of
concrete removal
Install plastic Tee (See specs)
8" PVC plastic pipe
Existing
reinforced concrete
Clay backfill
SECTION
NO SCALE

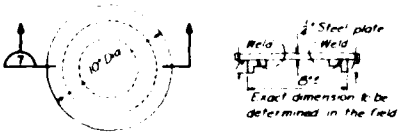


SECTION 8
ES/E3

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



SECTION 6
NO SCALE

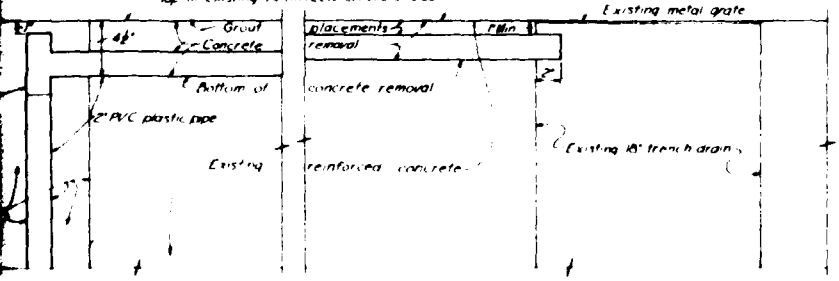


TOP VIEW

SECTION 7

COVER DETAIL
NO SCALE

NOTE
1. Use 8" standard steel casing through pervious material and 5' into Fort Union Formation on wells numbered 10, 11, 12, and 19.



SECTION 8
NO SCALE

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

DATE	DESCRIPTION	NAME	APPVD
	REVISIONS		

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

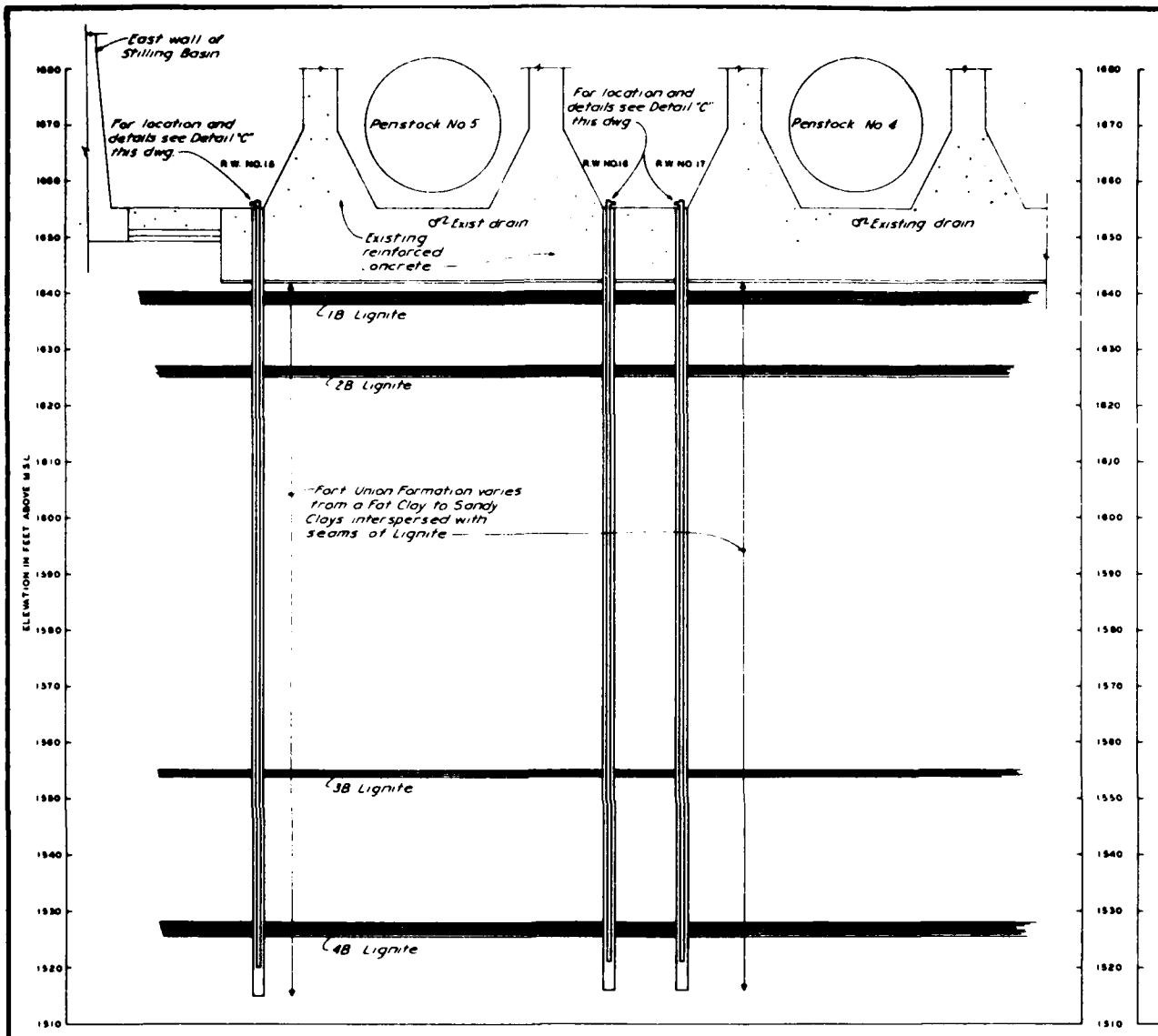
MISSOURI RIVER
GARRISON DAM-LAKE SAKAKAWEA
POWERHOUSE RELIEF WELLS
SECTIONS AND DETAILS
SHEET 1

DESIGNED BY: V.E.G.
DRAWN BY: M.B.H.
TRACED BY:
CHECKED BY: C.V.J.
SUBMITTED: Charles L. Hopp
APPROVED: B. F. Sandegren
DATE: MAY 1970
SCALE: AS SHOWN
SPEC. NO.
CONTRACT NO.
DRAWING NO. MGR72-80E3

SAFETY PAYS

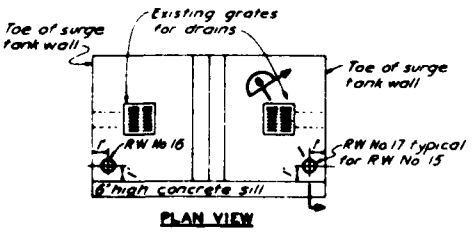
THIS PLAN ACCOMPANIES CONTRACT NO. ____ MODIFICATION NO. ____

2



SECTION 3 E2|E4

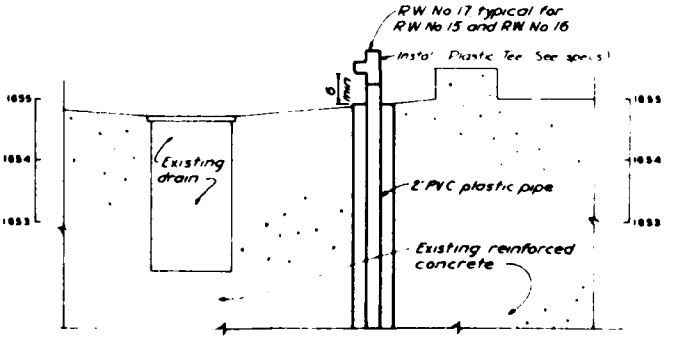
TYPICI



PLAN VIEW

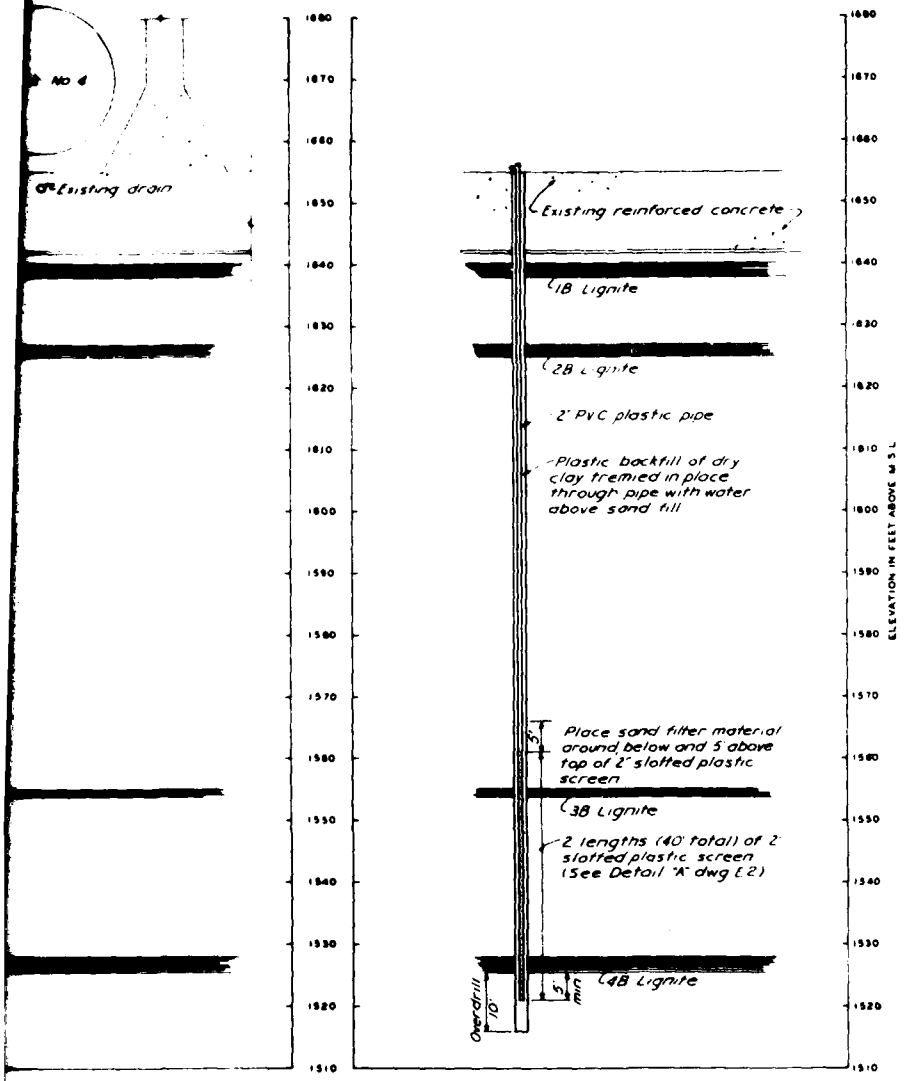
DETAIL "C"

NO SCALE



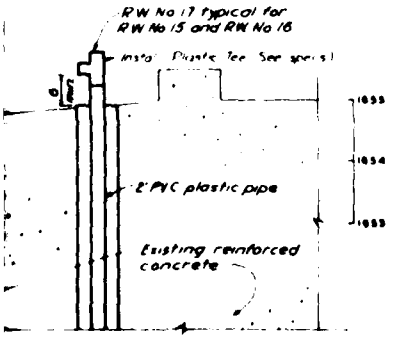
SECTION A

NO SCALE



SECTION 4 E2/E4

RELIEF WELL NO.17
TYPICAL FOR RELIEF WELLS NO.15 AND NO.16



TION 1

SCALE

SAFETY PAYS

U. S. ARMY ENGINEER
CORPS OF E
OMAHA, NE

GARRISON
POWERHO
SECT

B. P. Lindgren

THIS PLAN ACCOMPANIES CONTRACT NO.
MODIFICATION NO.

CONSTRUCTION FOUNDATION REPORT (1982)


DA
FILM

existing reinforced concrete

CTION 1

NO SCALE

