TRILBY WASH DETENTION BASIN

LOWER AGUA FRIA RIVER

MARICOPA COUNTY, ARIZONA

DRAFT

U. S. ARMY ENGINEER DISTRICT, LOS ANGELES

CORPS OF ENGINEERS

JANUARY 1973

TRILBY WASH DETENTION BASIN
LOWER AGUA FRIA RIVER
MARICOPA COUNTY, ARIZONA

CONTENTS

FIGURES

APPENDIX

TRILBY WASH DETENTION BASIN

LOWER AGUA FRIA RIVER

MARICOPA COUNTY, ARIZONA

GENERAL

1. Inspections of the Trilby Wash Detention Basin embankment conducted in 1964, 1966, 1969 and 1971 have indicated surficial irregularities of the crest. The irregularities were reported to be in the forms of surface erosion and small holes and tunnels. A subsequent investigation, conducted in March 1972, included a limited amount of trenching which exposed transverse cracks within the embankment. The cracks were extensive enough to warrent further investigations, as the safety of the embankment appeared to be effected.

PURPOSE

2. The purpose of this report is to present information pertinent to the embankment cracking and to recommend remedial treatment. Results of recent investigations are presented as well as test results obtained during the design and construction of the project.

PROJECT DESCRIPTION

3. The project was constructed under one contract beginning in July 1955 and finishing in July 1956. The project is located on Trilby Wash and adjacent streams about 4 miles from Beardsley, Arizona and 10 miles northeast of Luke Air Force Base.

The project consists of a compacted random earthfill dam, approximately 10 miles long; a detention reservoir with a gross capacity of 19,300 acre-feet; an ungated concrete channel outlet works; an outlet channel which carries discharges from the dam to a point about 2 miles west of the Agua Fria River and an uncontrolled spillway located at the left abutment.

GEOLOGY

4. The embankment is located on a broad, southeast sloping alluvial plain with a surface that is cut by numerous shallow ephemeral stream channels. The unconsolidated alluvium are sediments derived primarily from igneous and metamorphic rocks. The coarser materials (gravels, cobbles and boulders) were derived from the metamorphic rocks of the White Tank Mountains located to the west of the project. The sands are predominantly quartz with admixtures of unweathered feldspar. Much of the fines are low plasticity silts, but clays derived from the decomposition of feldspars and mafic constituents of rocks also occur. Caliche is found impregnating, to some extent, all soil types with especially marked concentrations in those soils that consist chiefly of porous sand. The thickness of alluvium is known to exceed 200 feet along the alignment of the embankment.

DESIGN INVESTIGATIONS AND CONSTRUCTION DATA

5. Foundation explorations. The original design exploration consisted of drilling thirty-eight power auger holes in 1952 and twenty-four power auger holes in 1953 along the axis of the embankment. Ten in-place densities were obtained from along the axis of the embankment and undisturbed samples of the foundation materials were obtained from test pits. For a detail description of the exploration, testing and selection of design values, see Design Memorandum No. 2 entitled "Design Analysis for Trilby Wash Detention Basin and Outlet Channel," dated March 1953. The location of exploration holes are shown on plate 1 and the logs of the exploration holes are shown on plates 2 and 3.

a. Density testing. The results of the ten in-place density tests conducted on the foundation material, prior to construction of the embankment, are shown on figure 1 and 2.

b. Consolidation testing. Consolidation tests were conducted on an undisturbed sample of the foundation material and on an undisturbed sample of the existing berm fill which existed prior to the 1956 construction. The results of the consolidation tests are shown on figure 3. Both samples had higher densities than similar materials tested in-place. In addition, consolidation tests on two samples of undisturbed embankment materials were conducted for the construction record testing. The results of consolidation testing of the two record samples of the embankment material are shown on figure 4.

c. Construction testing. A summary of the moisture and density testing of the embankment materials is shown on plate 4.

RECENT INVESTIGATION

6. Explorations. In September 1971 a detailed survey of all surface erosion, holes and cracks was made by Corps of Engineers personnel. The results of the survey are on file in the Los Angeles District, Foundation and Materials Branch. The location of the holes or cracks are shown on plates 5 and 6. Subsequently, in March 1972, five excavations along the crest of the embankment were made using a backhoe at Stations 467+60, 459+90, 451+48, 305+00, and 283+28 (excavations numbered 1, 2, 3, 4 and 5, respectively). The excavations were made in areas where holes were observed during the September 1971 survey. Cracks of significant widths were encountered in four of the excavations. Excavation number 4 was made on a rodent hole which had a maximum depth of 2.5 feet. The maximum depths of transverse cracking observed in excavations 1, 2, 3 and 5 were 6.5 feet, greater than 12 feet, greater than 14.5 feet and 9 feet, respectively. Disturbed samples of representative materials were obtained for laboratory testing. A detailed description of the excavations is included as Appendix A.

During June 1972 an exploration consisting of 40 shallow backhoe test trenches (TT 72-1 through 40) was conducted on the embankment crest. The purpose of the trenching was to determine if the embankment cracking occurred in localized areas or along the entire length of embankment. The trenches were all approximately 2 feet wide, 20 feet long and 3 feet deep. In cases where a crack extended to a three-foot depth the trench was increased in depth to 5 feet. The location of the trenches along the crest are shown on plates 5 and 6. A profile of the trenches in which cracks were encountered and the results of the mechanical analysis are shown on plate 7. Cracks greater than 1/8-inch in width and continuously extending to a depth greater than three feet, were encountered in the test trenches located at Stations 356+75, 394+00, 419+32, 455+57, 482+00 and 497+20. A detailed description of the excavations, logs, photographs and the mechanical analysis results are on file in the Los Angeles District Office, Foundation and Materials Branch.

During July 1972, twelve bucket auger test holes were drilled between Stations 435+00 and 460+00. The purpose of the drilling was to establish soil profiles normal to the embankment in an area of extensive cracking and in adjacent areas. Four lines of three test holes were drilled at Stations 460+00, 451+48, 443+85 and 435+00. The standard penetration test was conducted for the full depth of the test holes. The materials encountered were visually classified and disturbed samples of representative materials were obtained for moisture content, Atterberg limits and gradation testing. The locations and logs of the test holes are shown on plates 8 and 9. Cross sections drawn at each of the four stations and a profile along the centerline of the embankment showing the distribution of soil type in the foundation and embankment are shown on plates 10 through 12.

During August 1972, five undisturbed samples of foundation materials were obtained for consolidation testing. The samples were taken in the streambed in areas of extensive cracking and non-cracking both upstream and downstream of the embankment. The locations of the areas sampled are shown on plate 10.

a. Laboratory testing. The laboratory testing in this investigation consisted of mechanical analysis, Atterberg limits,shrinkage limits and consolidation testing.

(1) Mechanical analysis and Atterberg limits tests. The mechanical analysis and determination of Atterberg limits were conducted on disturbed and undisturbed samples. The results of these tests are presented throughout the report whenever applicable.

(2) Shrinkage limit tests. Four shrinkage limit tests were conducted on disturbed samples of the embankment materials obtained from areas of extensive cracking. The results of these tests are shown in figure 5.

(3) Consolidation tests. Nine consolidation tests were conducted on the undisturbed samples obtained in August 1972. The purpose of the testing was to evaluate the collapsibility of the foundation material under saturated conditions and embankment loading as shown in plate 13. The results of these tests are shown in figures 6 through 15.

GROUND WATER

7. Recent water well depths in the vicinity of the embankment are not available. Water well depths obtained in 1964 are contained in Water Resources Report No. Twenty-seven, by the Arizona State Land Department, entitled "Basic Ground Water Data for Western Salt River Valley, Maricopa County, Arizona," dated June 1966. The change in ground water depth for the period from 1952 to 1964 is shown in figure 16.

AREA SUBSIDENCE

8. An undated report prepared by the Department of the Interior, Geological Survey, entitled "Investigation of Vertical Displacement of Ground Surface, Phoenix-Mesa Area, Arizona," contains survey data in the area of the project. The amount of subsidence for the period 1948 to 1967 is shown on plates 14 and 15.

ANALYSIS OF DATA

9. Foundation materials. The explorations revealed considerable variation in the distribution of the various soil types and a lack of continuity of the soil strata. Caliche is found impregnating all soil types with the greater amount being found in the sandy soils. Numerous small washes crossed the axis of the embankment and contained shallow surface deposits of sand and gravelly soils. These pervious zones were designated to be removed during construction.

In general, fine-grained soils consisting of sandy clay, sandy silt and clayey and silty sand comprise the upper portion of the foundation. These relatively impervious soils vary in thickness from 2.5 to 16.5 feet with an average thickness of approximately 7.0 feet. In areas of the foundation coarser materials consisting principally of silty and clayey gravelly sands underlie the fine-grained surface soil.

The foundation materials encountered between Stations 435+00 and 460+00 consist of irregular deposition of various soil type. No discernible difference in distribution of soil type is noticeable either in a transverse or longitudinal section (see plates 10 through 12). The moisture contents of the foundation materials located under the embankment are approximately 2 percent lower than those upstream and downstream of the embankment. This may be an indication that the materials under the embankment have not been saturated in the past. The standard penetration tests do indicate the materials in the upper 15 feet of the foundation could have widely varying resistance to penetration and therefore, differences in consolidation characteristics.

a. Density tests. The results of the in-place density tests on the foundation materials indicated a range of dry densities between 74 and 115 pounds per cubic foot with an average of 90 pounds per cubic foot. The percent compaction ranged from 63 to 90 with an average of 73. The dry density and relative compaction is lower for the fine grained materials (the sandy clays and sandy silts), see figure 2.

b. Consolidation testing. The two undisturbed samples obtained in 1953 during the design phase of the project, show the foundation and existing berm samples would collapse when saturated under pressure consistent with their in-situ pressure, see figure 3.

Extrapolation of the consolidation data for foundation sample (a), a sandy silt, indicates a 30% reduction in void ratio when subjected to embankment loading and saturation. This sample had an initial void ratio of 0.96, see figure 3.

Extrapolation of the consolidation data for existing berm sample (b), a sandy clay, under same conditions as above, indicates a 25% reduction in void ratio. This sample had an initial void ratio of 0.77, see figure 3.

Consolidation tests conducted in the recent investigation gave similar results to those discussed above.

Three undisturbed samples were obtained near the downstream toe area of the embankment and two undisturbed samples were obtained near the upstream toe area. The samples were sandy clays with LL's ranging from 25 to 36 and PI's from 8 to 16, and clayey sand with LL's ranging from 22 to 30 and PI's from 7 to 12. The locations where the samples were obtained are shown on plate 10.

All of the downstream samples loaded to their in-situ pressure, collapsed when saturated. The three samples had dry densities ranging from 84.5 pcf to 89.8 pcf. These samples exhibited a change in void ratio of 34%, 26% and 12%, varying directly with density, when subjected to embankment load, see figure 7 through 11.

The two upstream samples, loaded to their in-situ pressure, showed no collapse when saturated. These two samples had dry densities ranging from 91.5 to 100.3 pcf. When these samples were subjected to embankment loading under saturated conditions they experienced a change in void ratio of 8 and 9 percent, see figure 12 through 15.

The test results indicate that the upstream materials have experienced saturation and collapse of structure, whereas, the downstream materials have not. The test results of the downstream samples compare very well in gradation, density and behavior with the test results of the samples obtained from the foundation during the design phase of the project. The degree of saturation which has occurred beneath the embankment is unknown but may be assumed minimal based on the available pool and standard penetration data.

c. Construction control testing. There were no foundation tests conducted during the foundation preparation stage of the embankment construction.

10. Embankment conditions. The investigations indicate a predominance of transverse cracking between Stations 475+00 to 445+00 and between Stations 295+00 to 265+00. Cracking occurs in other areas of the embankment but not with the same frequency or having the depths encountered in the above mentioned reaches.

a. <u>Construction testing</u>. The results of the consolidation tests conducted on record samples of the embankment materials obtained at two locations, Stations 117+00 and 481+65 indicate that: Sample (a), a clayey gravelly sand, collapsed when saturated under a loading of 400 psf, Sample (b), a silty gravelly sand, did not collapse. Sample (a) had an initial dry density of 109 pcf and sample (b) had an initial dry density of 118 pcf, see figure 4.

The results of the construction control testing of density and moisture contents of the embankment material are shown on plate 4. Fifty-five percent of the embankment materials had moisture contents below optimum moisture content and 31 percent had moisture contents of less than one percent below optimum moisture content. The majority of the embankment materials were compacted to at least 95% of maximum density and 18 percent were compacted to less than 93 percent of maximum density. The record sample that indicated collapse had a dry density of 109 pcf and a moisture content of 6.7 percent. It is estimated that approximately 18 percent of the embankment materials were placed at densities or moisture contents low enough to have collapsible behavior upon saturation.

Calculations of settlements of the embankment using the consolidation test results discussed above are shown on plate 16. The calculations reflect the collapse of material at Station 117+00 below the theoretical phreatic line. Although the collapse accounts for a significant part of the settlements, recent data and the ponding history of the structure would indicate that saturation of the embankment has not occurred.

b. <u>Shrinkage limit tests</u>. Results of shrinkage limit tests, figure 5, indicate that the embankment materials undergo no further change in volume below a moisture content of 16%. The shrinkage test results and the information gained from the construction control record, plate 4, which show 90% of the embankment materials were placed at a moisture content of less than 16%, would indicate major cracking due to shrinkage is very improbable.

c. <u>Embankment materials</u>. The embankment materials encountered between Stations 435+00 and 460+00 consist mainly of sandy clays and clays with plasticity index ranging from 7 to 23 and liquid limit ranging from 26 to 44, and non-plastic silty sands and sand. The embankment materials exhibited various amounts of caliche cementation. The average moisture content of the embankment materials is 11 percent, with lower moisture contents in the upper 5 feet of embankment, indicating a slight amount of desiccation. The upper 15 feet of embankment materials had very high standard penetration test blow counts ranging from 27 to 60 plus, and the lower embankment materials had blow counts between 12 and 35. Based on the construction testing results and using Sherard's classification of susceptibility to cracking, see table 1, the embankment materials having low moisture contents, high densities and being silts, silty clays, clays and sandy clays with the above mentioned range in Atterberg limits would have a degree of susceptibility between 1 and 3. In Sherard's classification 1 is the greatest and 6 is the least degree of susceptibility to cracking.

11. Ground water and area subsidence. Data obtained from the referenced ground water publication indicates that for the period from 1952 to 1964 the ground water depth increased 160 feet at the north end of the embankment and 120 feet at the south end of the embankment. The ground water contour was approximately at elevation 920 along the embankment alignment in 1964. Well records indicated the ground water was declining at a rate of approximately 12 feet per year during the period. The amount of increase in the ground water depth occurring after the embankment construction is estimated to be between 150 and 200 feet.

Data obtained from the referenced report on vertical ground displacement indicates for the period from 1948 to 1967 the subsidence along the embankment alignment varied between 1.2 and 1.9 feet. The amount of subsidence occurring after the embankment construction is estimated to be between 0.8 and 1.3 feet.

Figure 17 shows the estimated decline of the ground water surface and the estimated ground subsidence along the embankment alignment. Total and effective pressures were determined based on the estimated decline of the water table since construction. The effective pressure, the pressure that causes consolidation and shear deformations, increased about 100 times the drained unit weight of alluvium (about 6 tons per square foot) at an elevation of 800 feet (550 feet below the ground surface). The typical change in vertical pressure with depth is shown in figure 18. Since construction the change in effective pressure shows an increase from zero at a depth of 300 feet to approximately 6 tons per square foot at a depth of 500 feet. Below this elevation the effective pressure increase is 6 tons per square foot. As the depths involved are great, deformations can be significant with the large pressure changes. For example assuming the alluvium is about 1000 feet deep and the foundation materials have an elastic modulus of 50,000 psi, the computed shorting would be about 1 foot for a change in vertical stress as shown in figure 18. Unexplainable with the available data is the lesser magnitude of ground subsidence at the north end of the embankment. This may be due to geologic conditions or differences in properties of the deeper foundation materials, however, no data of this type is available.

Associated with the ground water decline and subsidence is the development of surface fissures and evidence of ground cracking on a regional basis. A limited inspection of the area in the vicinity of the embankment resulted in observation of cracking evidence on cultural features such as paved road, ditches and canals. This data is shown in figure 19 along with earth fissures 4 to 9 miles distant from the embankment reported by others. The cracking evidenced in the vicinity of the embankment is in the form of displacements and patching of pavements, ditches and canal linings and is not as pronounced as the distant earth fissures which are over a foot in size. The embankment cracks diminished in width with depth below the embankment crest and are larger than the cracks observed adjacent to the embankment.

The apparent non extension of the embankment cracking into the foundation may be due to the embankment being constructed after a significant amount of regional subsidence had already occurred. It is felt the larger embankment cracks are due to the embankment soils being much more brittle than the foundation soils as they are denser. It appears the embankment cracking could be attributed to the regional subsidence.

CONCLUSIONS

12. The results of field exploration indicate a high frequency of transverse cracking between Stations 475+00 to 445+00 and 295+00 to 265+00.

13. Continuing ground water decline and resulting surface subsidence apparently has and will continue to influence the embankment.

14. The embankment materials are brittle and highly susceptible to cracking.

15. The foundation and embankment materials have not yet been saturated.

16. Some of the foundation and embankment materials will collapse when saturated. This collapse may be as great as 1 foot at several locations along the embankment.

17. Collapse of foundation materials can not be economically prevented and damage to the embankment will have to be repaired should it occur.

18. Treatment to increase the embankment integrity between Stations 475+00 to 445+00 and 295+00 to 265+00 is required.

19. Areas outside those designated may require treatment in the future.

20. Field observations and instrumentation will be required to monitor the behavior of the embankment and foundation.

RECOMMENDATIONS

21. Four methods of treatment were considered for the upstream slope of the embankment between Stations 445+00 to 475+00 and 265+00 to 295+00. The methods consisted of (1) removal and recompaction of the outer 6 feet of material, (2) an overlay with 6 feet of compacted fill, (3) installation of a buried membrane and (4) paving with asphaltic concrete. Comparative cost estimates are shown on table 2. The recommended treatment would be the asphaltic concrete paving. The treatment was selected as additional settlements of the embankment and foundation are expected. The soil treatment methods would experience cracking that would not lend itself to detection or easy maintenance. The selected treatment provides a desirable degree of flexibility, is visible for easy detection of cracking and can be readily maintained. In addition, the asphaltic concrete paving may be easily extended in the future.

The crest should be raised to elevation 1361 to re-establish the design freeboard. Between 0.5 to 2.0 feet of compacted fill would be required along the length of the embankment.

Settlement monuments should be established at approximately 500 foot intervals along the embankment crest and at approximately 1000 foot intervals along the upstream and downstream toes of the embankment for future monitoring of vertical embankment and foundation movement. Vertical movement of the monuments should be obtained on a yearly basis. The elevations of the existing U.S.G.S. section corner monuments shown on plates 14 and 15 should be determined concurrently.

Future condition surveys should denote the occurrence of holes along the crest by stationing.

TABLE 1.—CLASSIFICATION OF EMBANKMENT MATERIALS

Group number	Soil type	A casagrande's airfield classification system symbols	Approximate Ranges of Soil Properties: Median grain-size D_{50} (mm)	Plasticity index[c]	Liquid limit	Per-cent clay sizes (0.005 mm)	Number of dams in each soil group	Piping[a]: Degree of resistance (1) greatest to (6) least	Piping resistance	Cracking[b]: Degree of susceptibility (1) greatest to (6) least	Susceptibility to cracking when compacted dry	Relative Importance of Moisture-Density Control: Degree of importance of control (1) greatest to (6) least	Consequence of inadequate moisture control
I	Sands and gravels with plastic fines	SC SF GC GF	0.15-5.0	8-15	20-50	5-30	6	(3)	Intermediate resistance. Heavier conpaction and higher plasticity index increase resistance.	(3)	Intermediate susceptibility may crack only under extreme combinations of conditions.	(5)	May fail by cracking or piping only under severe combination of detrimental conditions.
II	Sands and gravels with nonplastic fines	GF SF	0.15-5.0	0-8	10-30	0-15	6	(5)	Low to intermediate resistance. Heavier conpaction and higher plasticity index increase the resistance.	(4)	Intermediate susceptibility.	(3)	Most likely to fail by piping. May possibly fail by cracking.
III	Inorganic silts of low conpressibility and fine silty sands	ML ML-CL ML-SC ML-SF	0.03-0.15	0-10	10-45	0-25	12	(6)	Uniform sand with P.I. < 6 has lowest resistance. Well-graded material with P.I. > 6 has intermediate resistance.	(2)	High susceptibility. The finer and more uniform the soil, the greater the susceptibility.	(1)	High probability of failure by piping and cracking.
IV	Inorganic silts and clays of low medium plasticity	CL ML	0.10	10-25	20-50	10-40	30	(4)	P.I. < 15—intermediate resistance.	(1)	Material with $D_{50} > 0.02$ mm and P.I. < 15 has highest susceptibility.	(2)	Most likely to fail by cracking. May fail by piping.
								(2)	P.I. > 15—high resistance.	(5)	Material with $D_{50} < 0.02$ mm and P.I. > 20 has high post-construction settlement but sufficient deformability to follow without cracking.	(4)	May fail by cracking or piping only under severe combinations of detrimental conditions.
V	Inorganic clays of high plasticity	CH CL-CH	0.02	25-40	40	30	6	(1)	High piping. Resistance not severely lowered by very poor compaction.	(6)	Unlikely to crack. High post-construction settlement but high deformability.	(6)	Least likely to fail by either piping or cracking.

[a] In general, the coarser the soil and the less the plasticity, the greater the increase in piping resistance due to increased compactive effort.
[b] Susceptibility to cracking was not observed to be decreased appreciably by increase in compactive effort. Rapidly disintegrating residual soils may be especially susceptible to cracking.
[c] No dams constructed of soils with plasticity index greater than 40 were included in the investigation. (After Sherard)

Table 2

Comparative Cost Estimate

1. Upstream slope treatment.

   a. Remove and recompact outer 6 feet of embankment.

      Remove 88,000 CY @ 0.50 — $ 44,000

      Replace and compact 88,000 CY @ 1.25 — 110,000

      $154,000

   b. Overlay with 6 feet of compacted fill.

      Compacted fill 88,000 CY @ 1.50 — $132,000

   c. Buried membrane (Poly propylene).

      Prepare subgrade 48,000 SY @ 0.15 — 7,200

      Installation of membrane 48,000 SY @ 1.35 — 64,800

      2' of soil cover 32,000 CY @ 3.00 — 96,000

      $168,000

   d. Asphaltic concrete.

      Prepare subgrade 48,000 SY @ 0.15 — 7,200

      A.C. 48,000 SY @ 2.50 — 138,000

      $145,200

2. Restore crest elevation.

   a. 12,000 CY @ 2.50 — $30,000

3. Install settlement monuments.

   a. 250 monuments 25,000 LS

   b. Survey (initial) 15,000 LS — $40,000

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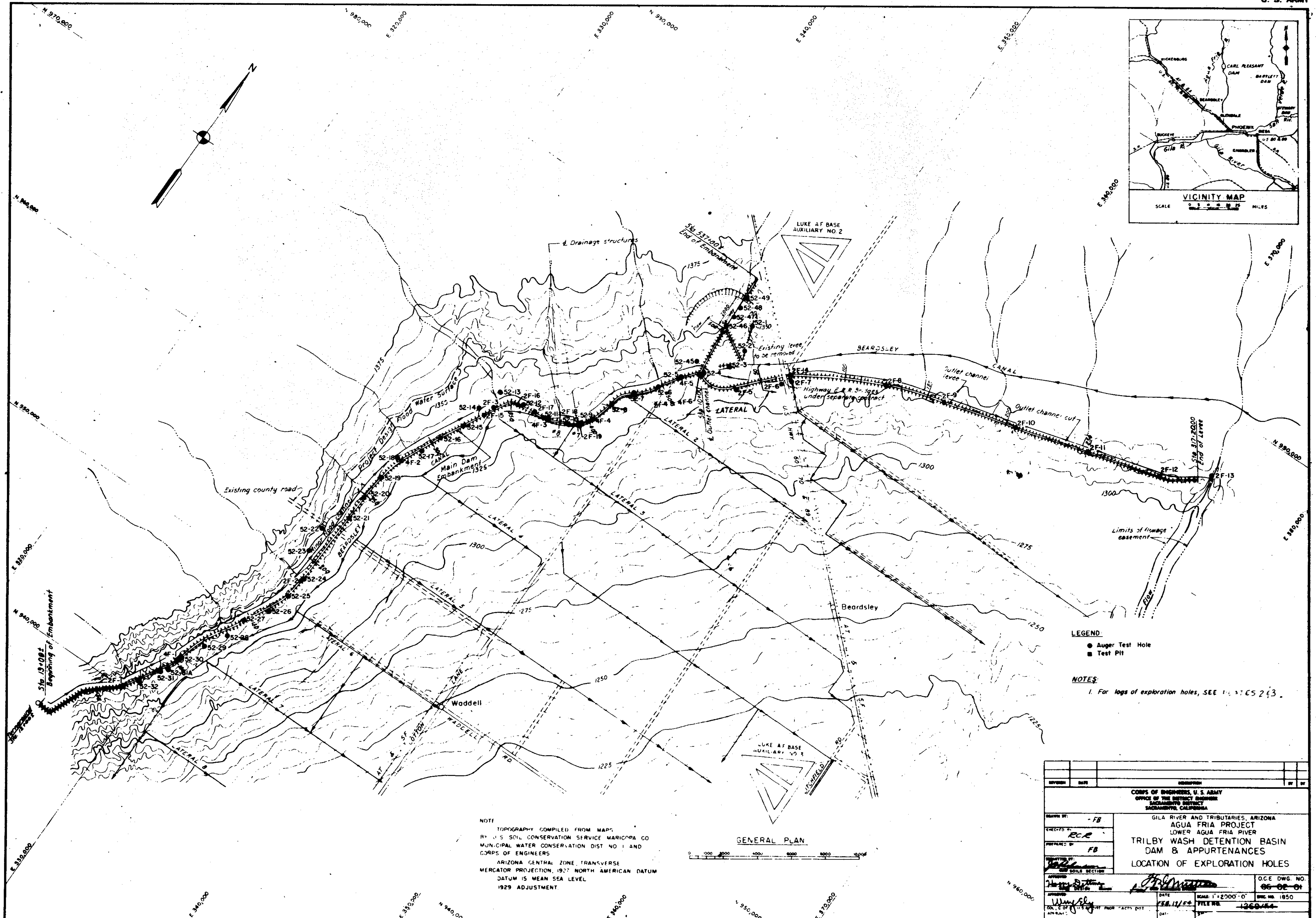

PLATE 1

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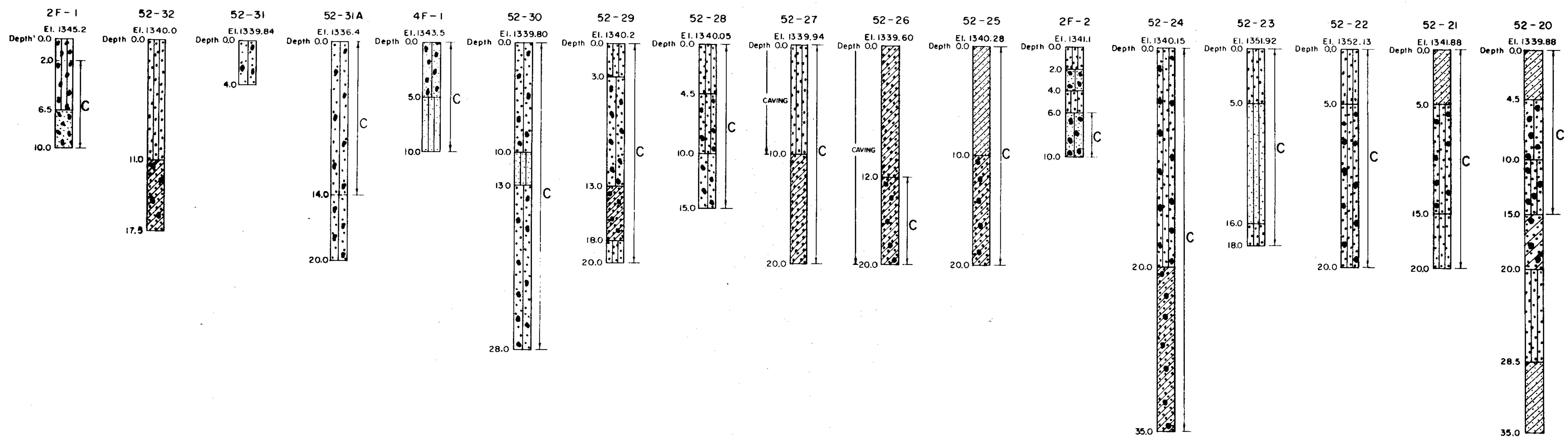

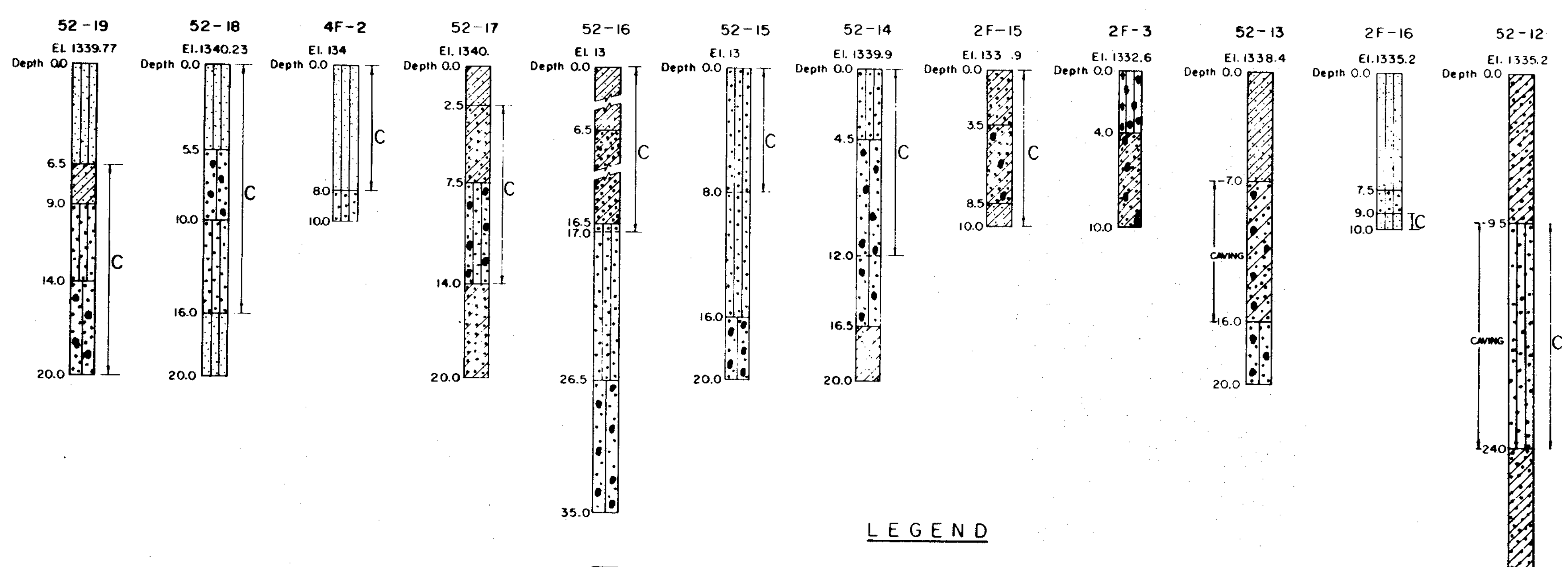

NOTES:

1. *All classifications are in accordance with the Corps of Engineers "Unified Soil Classification System," dated March 1953.*
2. *All logs with the prefix "4F" are test pits; all others are power auger holes.*
3. *For location of exploration holes, see*

VERTICAL SCALE

4 0 4 8 12 FEET

LEGEND

- Sandy Gravel (GP)
- Silty Sandy Gravel (GM)
- Silty Gravel (GM)
- Silty Gravelly Sand (SM)
- Grav. Silty Sand (SM)
- Silty Sand (SM)
- Clayey Gravelly Sand (SC)
- Gravelly Clayey Sand (SC)
- Clayey Sand (SC)
- Sandy Silt (ML)
- Sandy Clay (CL)

"C" indicates the presence of caliche which is found in varying amounts and degrees of cementation.

REVISION	DATE	DESCRIPTION	BY	BY

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER
SACRAMENTO DISTRICT
SACRAMENTO, CALIFORNIA

DRAWN BY: M. A.
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SUBMITTED BY: [signature] SOILS SECTION

GILA RIVER AND TRIBUTARIES, ARIZONA
AGUA FRIA PROJECT
LOWER AGUA FRIA RIVER

TRILBY WASH DETENTION BASIN
DAM AND APPURTENANCES
LOGS OF EXPLORATION HOLES

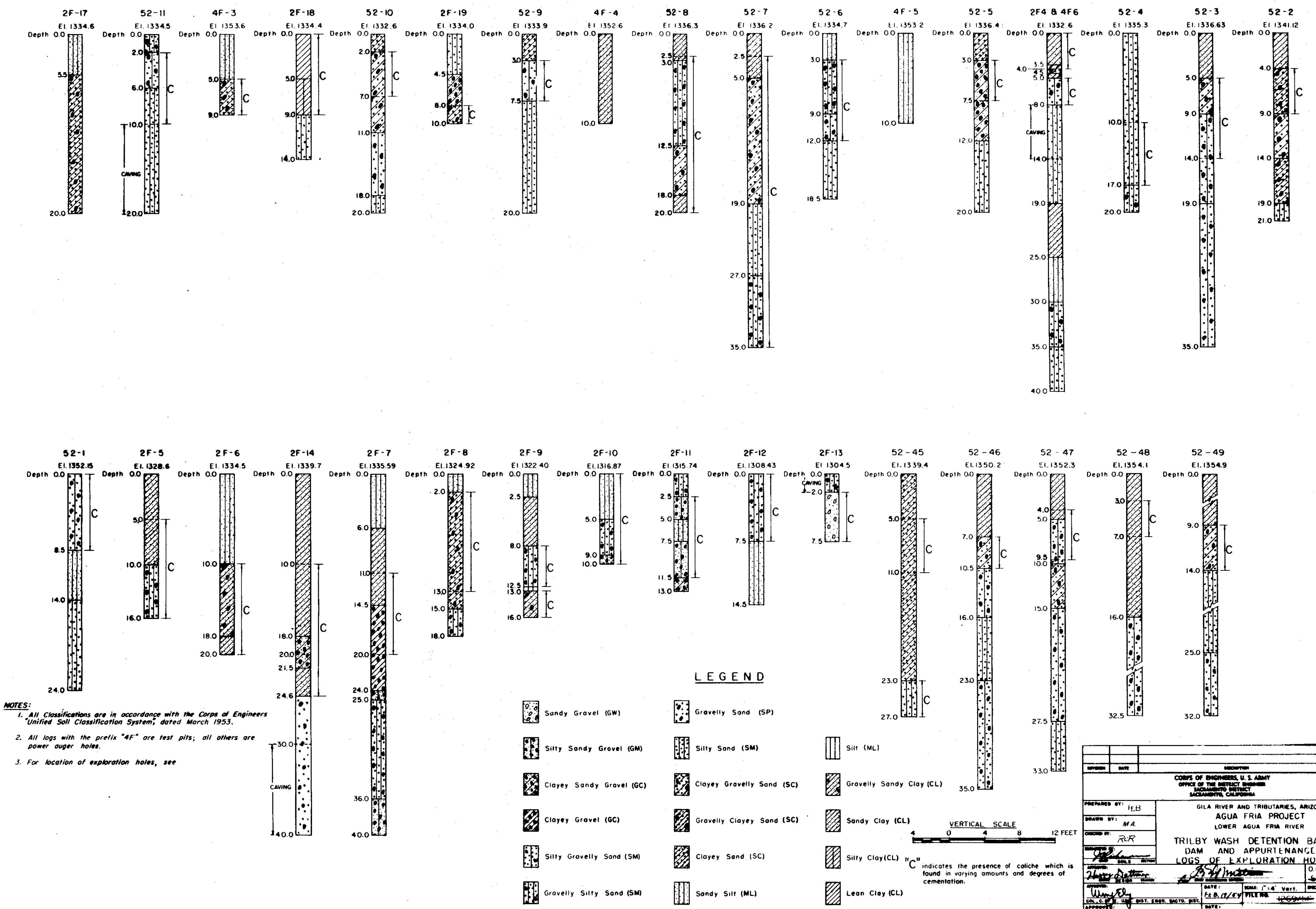
APPROVED: Harry Dittmer, DESIGN; for [signature]

APPROVED: [signature] COL., C. OF E. U.S.A. DIST. ENGR. SACTO. DIST.
DATE: FEB. 19, 54

APPROVED: COL., C. OF E. U.S.A. DIST. ENGR. L. A. DIST.
DATE:

O.C.E. DWG. NO. ~~86-02-01~~
SCALE: 1" : 4' Vert.
SPEC. NO. 1850
FILE NO. ~~1269/55~~
SHEETS
SHEET NO

PLATE 2



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2. All logs with the prefix "4F" are test pits; all others are power auger holes.
3. For location of exploration holes, see

REVISION | DATE | DESCRIPTION | BY | BY

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER
SACRAMENTO DISTRICT
SACRAMENTO, CALIFORNIA

PREPARED BY: F.E.B.
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GILA RIVER AND TRIBUTARIES, ARIZONA
AGUA FRIA PROJECT
LOWER AGUA FRIA RIVER

TRILBY WASH DETENTION BASIN
DAM AND APPURTENANCES
LOGS OF EXPLORATION HOLES

APPROVED: [signature] DESIGN BRANCH
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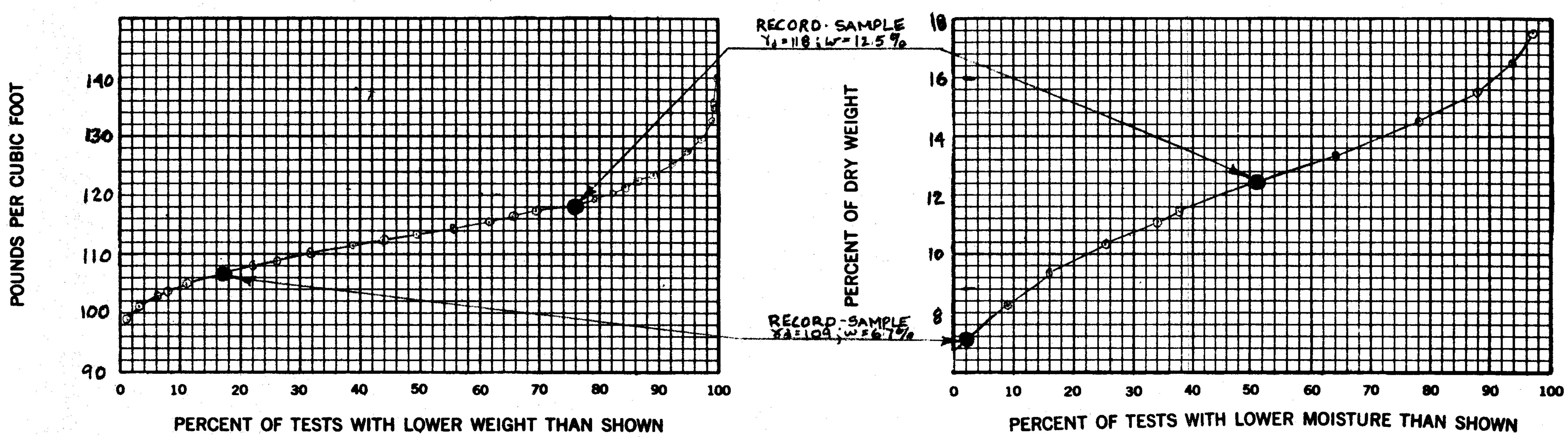
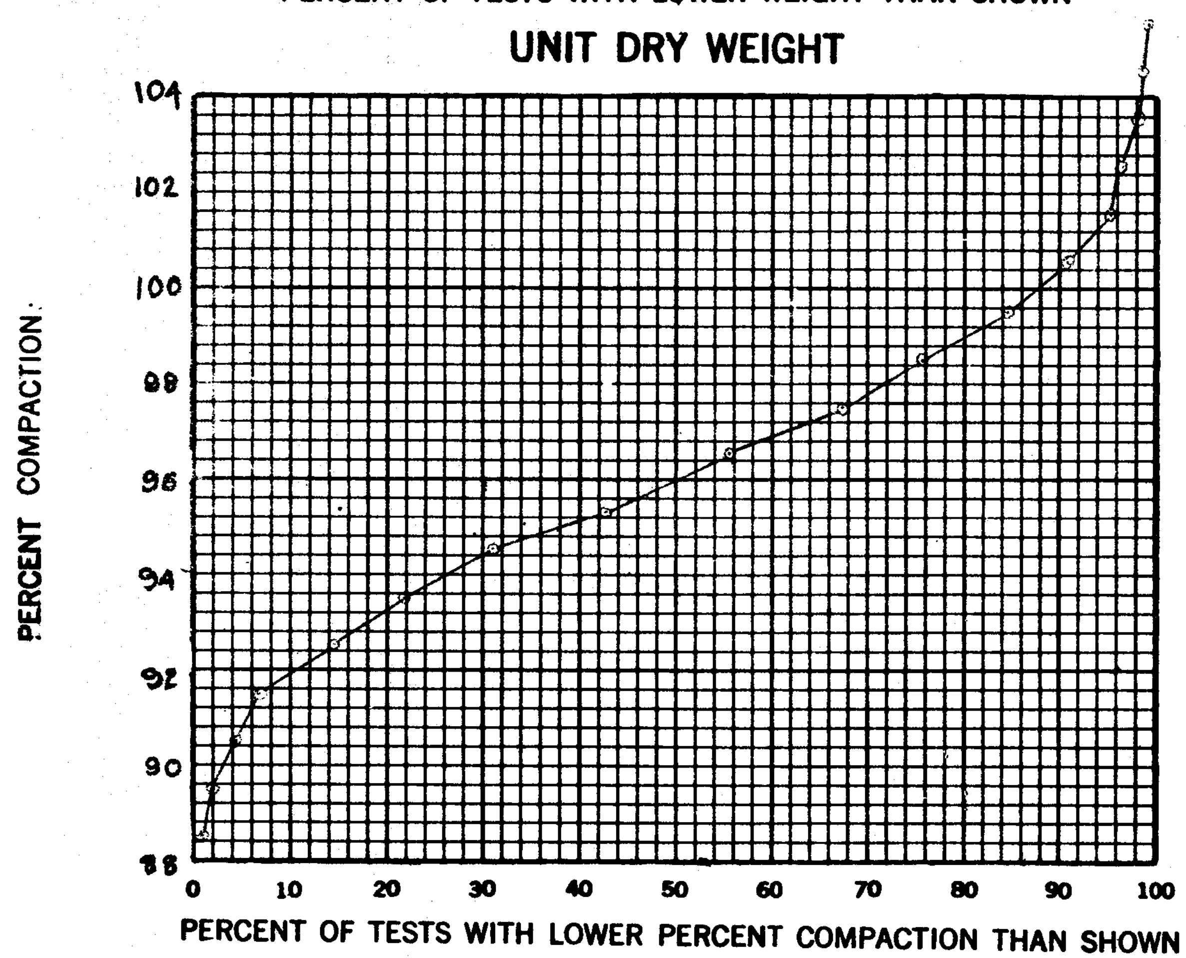
APPROVED: [signature] COL., C. OF E. USA DIST. ENGR. SACTO. DIST.
APPROVED: COL., C. OF E. USA DIST. ENGR. L.A. DIST.
DATE: FEB. 19/54
DATE:
SCALE: 1" = 4' Vert.
O.C.E. DWG. NO. ~~56-02-01~~
SPEC. NO. 1950
FILE NO. ~~126046~~

PLATE 3

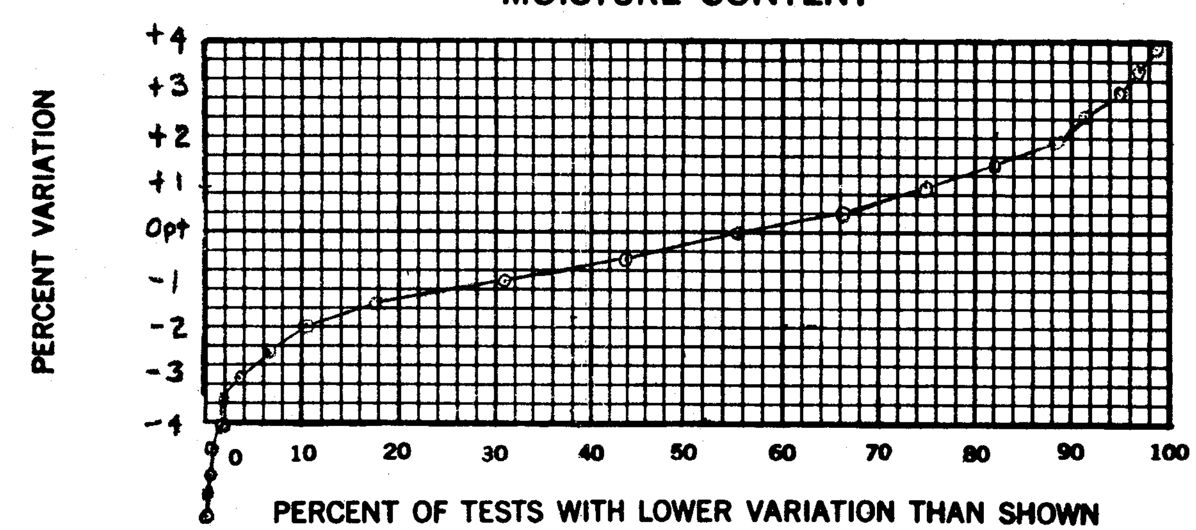


UNIT DRY WEIGHT

MOISTURE CONTENT



COMPACTION



MOISTURE CONTENT VARIATION FROM LABORATORY OPTIMUM

LEGEND

—— TESTS THIS REPORT - 963

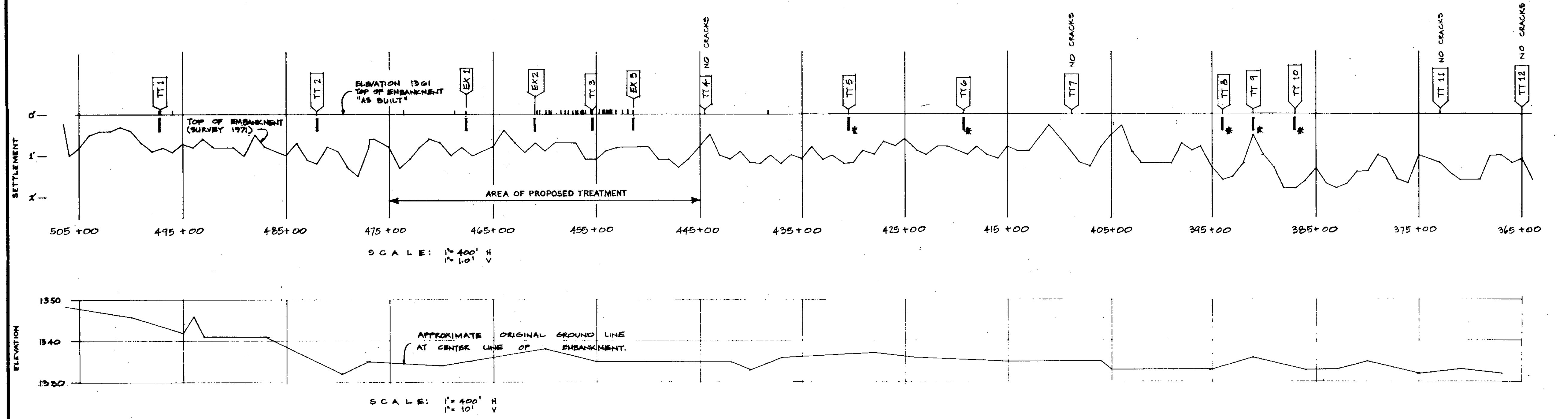
--- TESTS TO DATE

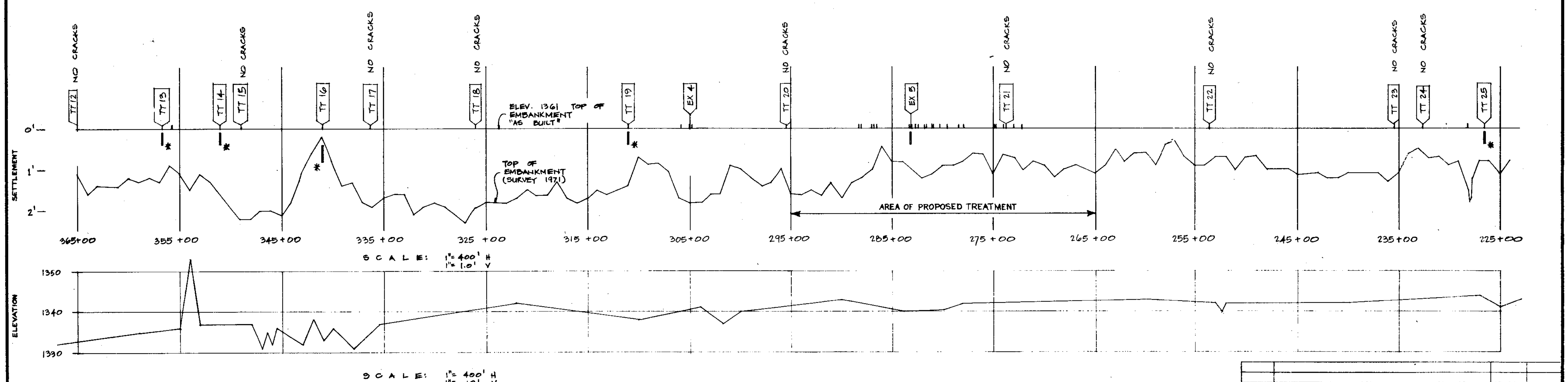
NOTE: Results based on standard A.A.S.H.O. compaction tests.

TRILBY WASH
EMBANKMENT - APRIL 1956
CONSTRUCTION CONTROL RECORD
FOR IMPERVIOUS OR SEMIPERVIOUS SOILS

DENSITY AND MOISTURE CONTROL TESTS REPORT

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:





LEGEND

- APPROXIMATE LOCATION AND NUMBER OF TEST TRENCHS (JUNE 1972)
- APPROXIMATE LOCATION AND NUMBER OF EXCAVATIONS (MARCH 1972)
- CRACK ENCOUNTERED IN TEST TRENCH OR EXCAVATION
- * INDICATES INSIGNIFICANT CRACKS
- SURFACE IRREGULARITIES "HOLES" (SEPT 1971)

GENERAL NOTES:

1. SEE PLATE 7 FOR PROFILES OF TEST TRENCHES (JUNE 1972).
2. SEE APPENDIX A FOR A DESCRIPTION OF EXCAVATIONS (MARCH 1972).

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

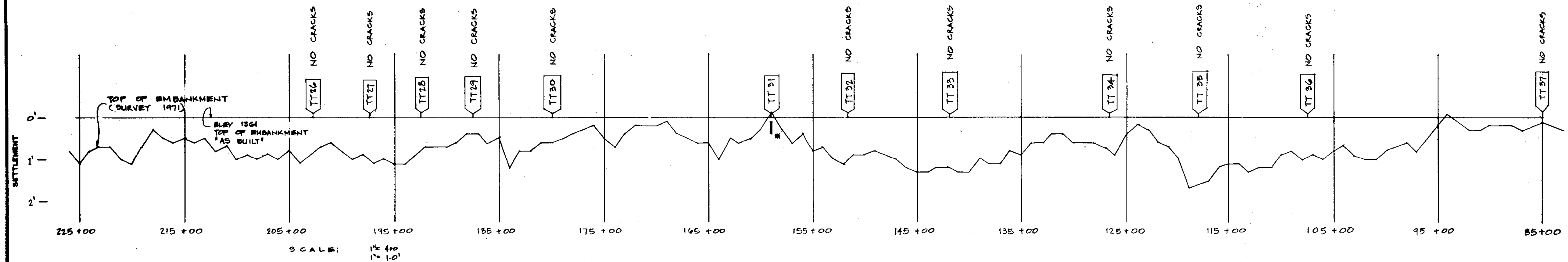
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

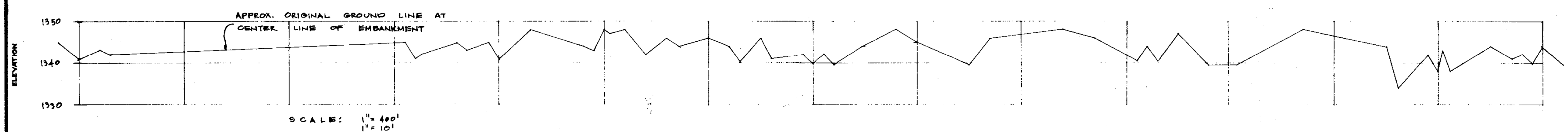
DESIGNED BY:
DRAWN BY: LSH
CHECKED BY: MPC
SUBMITTED BY:
DATE:

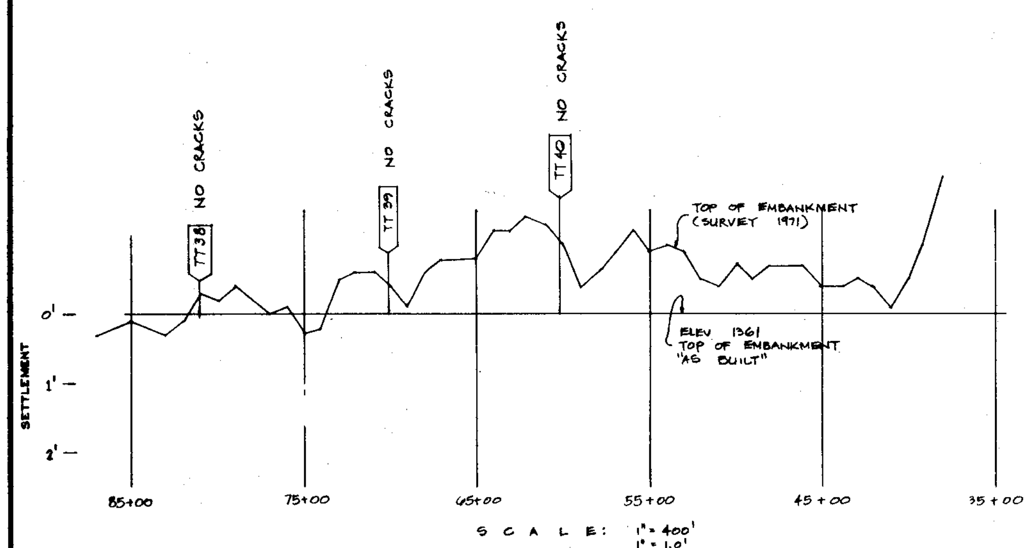
TRILBY WASH DETENTION BASIN

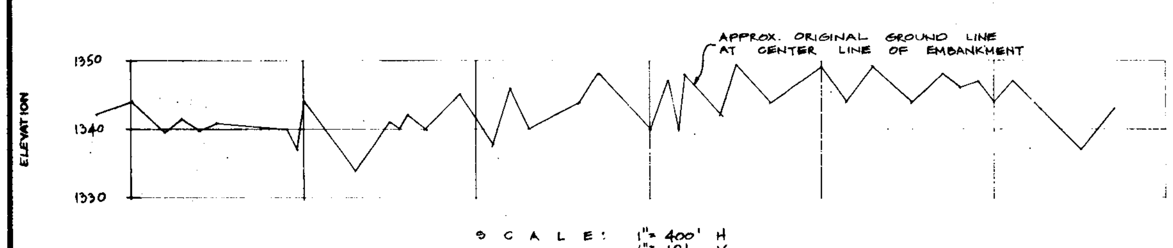
LOCATION OF TEST TRENCHES, EXCAVATIONS AND SURFACE IRREGULARITIES

SPEC. NO.
DRAWING NUMBER
DISTRICT FILE NO
SHEET









NOTES:

1. SEE PLATE 5 FOR LEGEND AND GENERAL NOTES.

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:

DRAWN BY: LSH

CHECKED BY: MPC

TRILBY WASH DETENTION BASIN

LOCATION OF TEST TRENCHES, EXCAVATIONS AND SURFACE IRREGULARITIES

SUBMITTED BY:

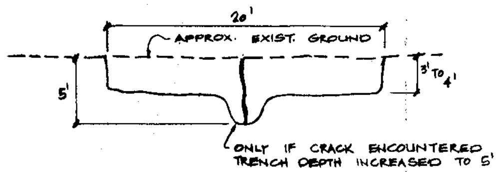
SPEC. NO.

SHEET

DRAWING NUMBER

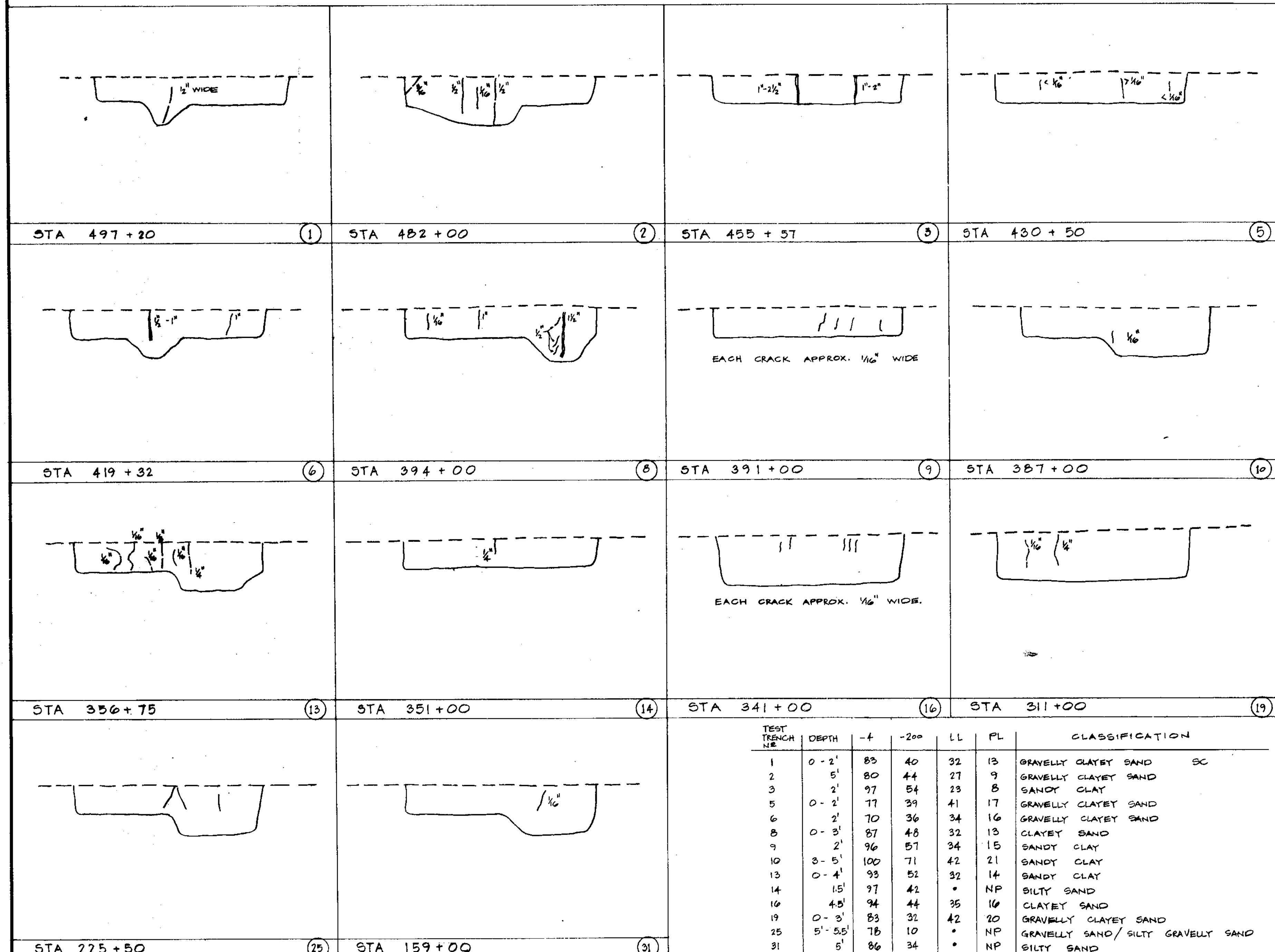
DISTRICT FILE NO.

DATE:



TYPICAL TRENCH

(3) NUMBER OF TEST TRENCH



UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS More than half of material is larger than no. 200 sieve size.	GRAVELS More than half of coarse fraction is larger than no. 4 sieve size.	Clean gravels	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS More than half of coarse fraction is smaller than no. 4 sieve size.	Clean sands	SW	Well-graded sands, gravelly sands, little or no fines.
			SP	Poorly-graded sands, gravelly sands, little or no fines.
		Sands with fines	SM	Silty sands, sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS More than half of material is smaller than no. 200 sieve size.	SILTS AND CLAYS	Low liquid limit.	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts, with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
		High liquid limit.	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
Highly organic soils			Pt	Peat and other highly organic soils.

NOTES:

1. Boundary Classification: Soils possessing characteristics of two groups are designated by combinations of group symbols. For example, GW-GC, well-graded gravel-sand mixture with clay binder.

2. All sieve sizes on this chart are U. S. Standard.

3. The terms "silt" and "clay" are used respectively to distinguish materials exhibiting lower plasticity from those with higher plasticity. The minus no. 200 sieve material is silt if the liquid limit and plasticity index plot below the "A" line on the plasticity chart (Table VI, Military Standard 619A), and is clay if the liquid limit and plasticity index plot above the "A" line on the chart.

4. For a complete description of the Unified Soil Classification System, see "Military Standard 619A" dated 20 March 1962

LEGEND

T.H. ●	LOCATION AND NUMBER OF TEST HOLE.
MC	FIELD MOISTURE CONTENT IN PERCENT OF DRY WEIGHT.
LL	LIQUID LIMIT.
PI	PLASTICITY INDEX (LIQUID LIMIT MINUS PLASTIC LIMIT).
NP	NONPLASTIC
-4	PERCENT OF MATERIAL BY WEIGHT PASSING NO. 4 SIEVE.
-200	PERCENT OF MATERIAL BY WEIGHT PASSING NO. 200 SIEVE.
N	NUMBER OF BLOWS OF A 140-POUND DROPHAMMER FALLING 30 INCHES REQUIRED TO DRIVE A SAMPLING SPOON ONE FOOT. OUTSIDE DIAMETER OF SPOON IS 2 INCHES; INSIDE DIAMETER IS 1-3/8 INCHES. PROCEDURE IS CALLED STANDARD PENETRATION TEST.
W	DEPTH TO WATER

NOTE:

1. TRENCHES NOT SHOWN DIDN'T ENCOUNTER ANY CRACKS.

TEST TRENCH №	DEPTH	-4	-200	LL	PL	CLASSIFICATION
1	0 - 2'	83	40	32	13	GRAVELLY CLAYEY SAND SC
2	5'	80	44	27	9	GRAVELLY CLAYEY SAND
3	2'	97	54	23	8	SANDY CLAY
5	0 - 2'	77	39	41	17	GRAVELLY CLAYEY SAND
6	2'	70	36	34	16	GRAVELLY CLAYEY SAND
8	0 - 3'	87	48	32	13	CLAYEY SAND
9	2'	96	57	34	15	SANDY CLAY
10	3 - 5'	100	71	42	21	SANDY CLAY
13	0 - 4'	93	52	32	14	SANDY CLAY
14	1.5'	97	42	•	NP	SILTY SAND
16	4.5'	94	44	35	16	CLAYEY SAND
19	0 - 3'	83	32	42	20	GRAVELLY CLAYEY SAND
25	5' - 5.5'	78	10	•	NP	GRAVELLY SAND / SILTY GRAVELLY SAND
31	5'	86	34	•	NP	SILTY SAND

• TESTED

NP NON PLASTIC

TABULATION OF SOIL SAMPLE TESTS

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

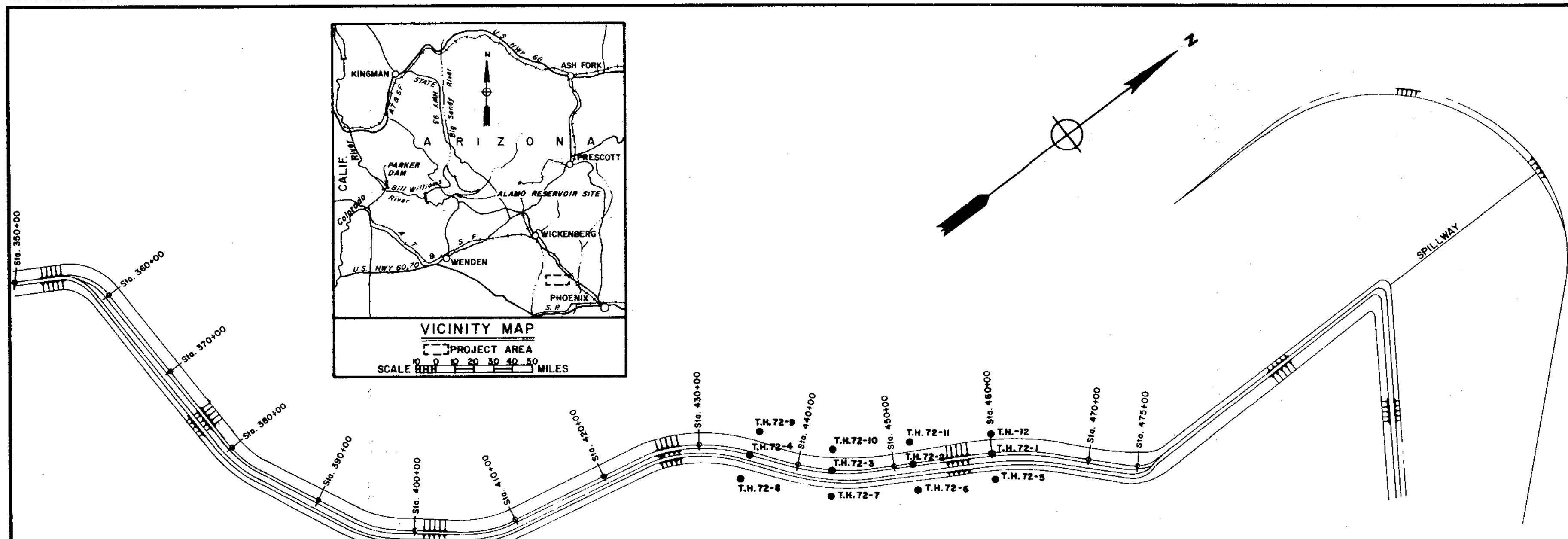
DESIGNED BY: LSH
DRAWN BY: LSH
CHECKED BY: MPC

TRILBY WASH DETENTION BASIN

TEST TRENCH PROFILES

SUBMITTED BY:
DATE:
SPEC. NO.
DRAWING NUMBER
DISTRICT FILE NO.
SHEET

D. O. SERIES



PLAN

SCALE 500 0 500 1000 1500 FEET

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS More than half of material is larger than no. 200 sieve size.	GRAVELS More than half of coarse fraction is larger than no. 4 sieve size.	Clean gravels	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS More than half of coarse fraction is smaller than no. 4 sieve size.	Clean sands	SW	Well-graded sands, gravelly sands, little or no fines.
			SP	Poorly-graded sands, gravelly sands, little or no fines.
		Sands with fines	SM	Silty sands, sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS More than half of material is smaller than no. 200 sieve size.	SILTS AND CLAYS	Low liquid limit.	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts, with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
		High liquid limit.	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
Highly organic soils			Pt	Peat and other highly organic soils.

NOTES:

1. Boundary Classification: Soils possessing characteristics of two groups are designated by combinations of group symbols. For example, GW-GC, well-graded gravel-sand mixture with clay binder.
2. All sieve sizes on this chart are U. S. Standard.
3. The terms "silt" and "clay" are used respectively to distinguish materials exhibiting lower plasticity from those with higher plasticity. The minus no. 200 sieve material is silt if the liquid limit and plasticity index plot below the "A" line on the plasticity chart (Table VI, Military Standard 619A), and is clay if the liquid limit and plasticity index plot above the "A" line on the chart.
4. For a complete description of the Unified Soil Classification System, see "Military Standard 619A" dated 20 March 1962

LEGEND

T.H. ●	LOCATION AND NUMBER OF TEST HOLE (SEE PLATE 10).
MC	FIELD MOISTURE CONTENT IN PERCENT OF DRY WEIGHT.
LL	LIQUID LIMIT.
PI	PLASTICITY INDEX (LIQUID LIMIT MINUS PLASTIC LIMIT).
NP	NONPLASTIC
-4	PERCENT OF MATERIAL BY WEIGHT PASSING NO. 4 SIEVE.
-200	PERCENT OF MATERIAL BY WEIGHT PASSING NO. 200 SIEVE.
N	NUMBER OF BLOWS OF A 140-POUND DROPHAMMER FALLING 30 INCHES REQUIRED TO DRIVE A SAMPLING SPOON ONE FOOT. OUTSIDE DIAMETER OF SPOON IS 2 INCHES; INSIDE DIAMETER IS 1-3/8 INCHES. PROCEDURE IS CALLED STANDARD PENETRATION TEST.
W	DEPTH TO WATER

LOGS

VERT SCALE 5 0 5 10 15 FEET

T.H. 72-1

EMBANKMENT (0 to 26.0')

Depth	Symbol	MC	LL	PI	-4	-200	N	Description
4.0'	SC	6	38	17	89	40	6	CLAYEY SAND, light brown, medium dense, gravel & cobbles to 5" max.
7.0'	CL	10	36	16	90	51	36	SANDY CLAY, brown w/white caliche streaks, hard, gravel to 1" max.
11.0'	SC	11	35	14	89	50	27	CLAYEY SAND, light brown, caliche streaks, gravel to 2" max.
14.0'	CL	15	29	11	97	66		SANDY CLAY, brown, caliche streaks, very stiff.
18.0'	SC	11	38	14	79	29	41	GRAVELLY CLAYEY SAND, light brown, dense, gravel to 2" max.
21.0'	SC	16	44	23	86	44	35	CLAYEY SAND, brown, dense, gravel to 2" max.
24.0'	SC	14	37	17	83	40	12	GRAVELLY CLAYEY SAND, brown, medium dense, gravel to 2" max.
26.0'	ML-CL	9	24	6	95	52	32	SANDY SILT-SANDY CLAY, brown, dense, gravel to 1" max.
	CL	13	36	18	92	64	27, 37	SANDY CLAY, light brown to tan, some caliche, gravel to 2" max.
31.0'	CL	17	46	20	93	70	46, 44	
34.0'	SC	14	38	19	96	48	60+, 60+	CLAYEY SAND, brown with tan caliche, gravel to 2" max.
37.0'	CL	14	38	16	96	59	60+, 60+	SANDY CLAY, light brown w/dark brown lenses, gravel to 1" max.
41.0'	SM	9		NP	100	28	60+, 60+	SILTY SAND, light brown, cemented, 2-4" cobbles.
45.0'	SW-SM	5		NP	65	6	44, 58, 60	GRAVELLY SAND-SILTY GRAVELLY SAND, light brown, dense, gravel to 2" max.
47.0'	SM	8		NP	78	32	X	GRAVELLY SILTY SAND, tan, cemented with caliche, gravel & cobbles to 4" max.
	SM	8		NP	100	43	X, X, X	SILTY SAND, light brown w/brown & black streaks, very hard, gravel to 2 1/2" max.
	SM	7		NP	99	40	X, X, X	
	SM	6		NP	98	47	X, X	
61.0'	SM	6		NP	91	30	X, X	
65.5'	SW-SM	3			93	12	60+, 60+	SAND-SILTY SAND, tan, gravel & cobbles to 4" max., caving.
69.0'	SC	14	34	15	100	50	60, 60+, 60+	CLAYEY SAND, light brown, very hard.
72.0'	SM	7		NP	100	40	60+, 60+	SILTY SAND, light brown, cemented, very dense.

T.H. 72-2

EMBANKMENT (0 to 27.0')

Depth	Symbol	MC	LL	PI	-4	-200	N	Description
3.0'	SC	6	35	14	91	45	X	CLAYEY SAND, light brown, caliche cemented, gravel to 1 1/2" max.
	CL	9	35	16	94	56	60	SANDY CLAY, light brown to brown w/gray streaks, very hard, gravel to 1 1/2" max.
11.0'	CL	12	26	7	98	64		
14.0'	SM	10		NP	94	47	60+	SILTY SAND, brown, very dense, gravel to 1" max.
18.0'	SC	13	41	20	83	34	37	GRAVELLY CLAYEY SAND, brown w/white streaks, dense, gravel to 1" max.
21.0'	CL	15	33	16	98	59	17	SANDY CLAY, brown, very stiff.
23.0'	SC	12	33	16	92	47		CLAYEY SAND, tan & light brown, medium dense, gravel to 2" max.
27.0'	ML	9		NP	95	59	16, 14, 17	SANDY SILT, brown, medium dense, gravel to 1 1/2" max.
31.0'	SM	10		NP	91	41	16, 15, 19	SILTY SAND, brown, medium dense, gravel to 1 1/2" max.
33.0'	SM	8		NP	78	28	25	GRAVELLY SILTY SAND, brown, medium dense, gravel to 2" max.
35.5'	SW-SM	3		NP	65	10	26, 26	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, medium dense, gravel & cobbles to 4" max.
38.0'	CL	5	35	15	95	56	29	SANDY CLAY, light brown, very stiff, gravel to 1 1/2" max.
41.0'	ML	16		NP	100	65	60+, 60+	SANDY SILT, tan, very dense, cemented.
	SM	11		NP	96	47	60+, 60+	SILTY SAND, tan to brown, very dense, gravel to 2" max.
46.0'	SM	3			92	13	60+	
48.5'	SW-SM	3			93	7	60, 60+	SAND-SILTY SAND, light brown, very dense, gravel to 2" max.
52.0'	SM	16		NP	94	47	60+, 60+, 60+	SILTY SAND, tan, cemented, hard to drill, gravel to 3" max.
55.0'	SW-SM	4		NP	68	9	60, 60+	GRAVELLY SAND-SILTY GRAVELLY SAND, light brown, dense, gravel to 3" max., caving.
59.0'	SC	9	39	18	92	38	60+, 60+	CLAYEY SAND, tan w/white and black streaks, very hard, gravel to 2" max.
	SM	7		NP	95	26	X, X	SILTY SAND, light brown, cemented, very dense, gravel & cobbles to 6" max.
66.0'	SM	6			89	13	X, 60+, X	
69.0'	CL	12	36	18	98	56	X, X	SANDY CLAY, light tan w/brown & white streaks, very hard drilling.

T.H. 72-3

EMBANKMENT (0 to 27.0')

Depth	Symbol	MC	LL	PI	-4	-200	N	Description
2.0'	SM	2		NP	93	41		SILTY SAND, tan, dense, gravel to 1/2" max., 1-5" cobble.
5.0'	ML	6		NP	97	55	60+	SANDY SILT, brown, dense and cemented, gravel to 2" max.
	CL	10	38	17	85	56		SANDY CLAY, brown, very dense & cemented, gravel to 3" max.
10.0'	CL	14	35	17	94	57	60+	
14.0'	SC	11	40	20	89	38	39	CLAYEY SAND, brown, dense, gravel to 2" max.
17.0'	SC	10	44	21	73	35		GRAVELLY CLAYEY SAND, tan, medium dense, gravel to 2" max.
	SC	13	39	19	89	47	26	CLAYEY SAND, tan, medium dense, gravel to 1" max., several cobbles to 6" max.
	SC	15	43	23	89	45	26	
25.0'	SC	15	40	18	88	48	21	
27.0'	CL	11	32	12	97	67	17, 24	SANDY CLAY, light brown, very stiff.
30.0'	ML-CL	10	24	5	94	53	14, 25	SANDY SILT-SANDY CLAY, brown, stiff to very stiff.
32.0'	CL	11	35	15	91	51	35	SANDY CLAY, tan w/white caliche streaks, gravel to 2" max.
34.0'	SC	8	39	14	65	27	45	CLAYEY GRAVELLY SAND, tan, dense, gravel to 2" max.
36.0'	SM	6		NP	63	13	35, 60+	SILTY GRAVELLY SAND, tan, dense, gravel & cobbles to 4" max.
39.0'	SM	6		NP	89	16	28, 36	SILTY SAND, light brown, medium to dense, gravel to 1" max.
41.0'	SP-SM	4		NP	68	8	50	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, dense, gravel to 3" max.
	SM	12		NP	98	48	60+, 41	SILTY SAND, tan to light brown, dense to very dense & highly cemented, gravel to 2" max.,
	SM	11		NP	97	38	60+, 60+	
	SM	11		NP	96	49	60+, X	
	SM	12	34	5	94	36	X, X, X	
58.0'	SM	8		NP	89	20	48, 39	dense, gravel to 1 1/2" max.
61.0'	SM	7		NP	79	16	31, 60+, 60+	SILTY GRAVELLY SAND, light brown & gray, very dense, gravel to 3" max.
64.0'	SP-SM	5		NP	62	9	X, X	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, very dense, gravel & cobbles to 5" max.
	SM	6		NP	90	14	60+, 60+	SILTY SAND, brown, very dense, gravel to 3" max.
71.0'	SM	6		NP	92	13	51, 60	
75.0'	CL	14	36	14	96	53	60+, X, X	SANDY CLAY, tan, very hard, slow drilling.

T.H. 72-4

EMBANKMENT (0 to approx. 27')

Depth	Symbol	MC	LL	PI	-4	-200	N	Description
3.0'	SC	3	35	16	82	36	X	GRAVELLY CLAYEY SAND, tan, caliche cemented, gravel to 2" max.
5.0'	SC	8	38	20	89	41		CLAYEY SAND, brown, slight cemntation, gravel to 1" max.
8.0'	CL	8	33	14	92	51	X	SANDY CLAY, tan w/white cementation, gravel to 2" max.
11.0'	SC	10	41	19	85	40	60	CLAYEY SAND, tan w/white cementation, gravel to 2" max.
15.0'	CL	12	43	23	91	58	45	SANDY CLAY, brown, hard, gravel to 2" max.
	SC	14	39	18	85	47		CLAYEY SAND, dark brown, slightly cemented, gravel to 3" max.
22.0'	SC	10	37	17	89	48	28	
	CL	10	38	14	91	58	26, 16, 24	SANDY CLAY, brown to tan, cemented zones, gravel to 2" max.
25.0'	CL	8	40	17	92	56	29, 32	
30.0'	CL	12	44	18	94	51	52	
32.0'	SW-SM	3		NP	69	11	49	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, dense, gravel to 2" max.
35.0'	SW-SM	2		NP	89	11	60+, 24	SAND-SILTY SAND, brown, dense to medium dense, gravel to 2" max., caving.
36.5'	CL	11	31	12	98	53	19	SANDY CLAY, brown, very stiff.
40.0'	SM	10		NP	98	48	60+, 60+	SILTY SAND, brown, cemented, gravel to 1/2" max.
42.0'	SW-SM	4		NP	76	12	60+, 60+	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, very dense, gravel to 1 1/2" max.
	SM	10		NP	100	43	60+, 60+	SILTY SAND, tan w/white caliche cementation, gravel to 1" max.
48.0'	SM	9		NP	100	46	60+, 60+	
52.0'	ML	12		NP	100	51	60+, 60+	SANDY SILT, tan, cemented, gravel to 1" max.
	SM	12		NP	100	46	X, X, X	SILTY SAND, light brown, highly cemented, gravel to 2" max.
59.0'	SM	9		NP	94	22	X, X	
63.0'	SW-SM	10			88	11	X, 60+, 60+	SAND-SILTY SAND, brown & gray, very dense, gravel to 2" max.
67.0'	SP-SM	5			97	8	60+, 60+, 60+	
	SW-SM	3			75	6	60+, 60+	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, very dense, gravel to 3" max.
75.0'	SW-SM	3			82	9	60+, 60+, 60+	

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
REVISIONS			

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: LAK
DRAWN BY: L.L.W.
CHECKED BY: MPC

TRILBY WASH DETENTION BASIN

LOCATIONS AND LOGS OF TEST HOLES

SUBMITTED BY:
DATE:
SPEC. NO.
DRAWING NUMBER
DISTRICT FILE NO.
SHEET

T.H. 72-5

Depth	Symbol	MC	LL	PI	-4	-200	N	Description
4.0'	SM	3		NP	90	27	[illegible]	SILTY SAND, tan, loose, gravel to 3" max.
6.0'		7	35	12	88	46	[illegible]	CLAYEY SAND, tan, loose to medium dense, gravel to 1/2" max.
8.0'	SC	6	34	13	84	42	[illegible]	GRAVELLY CLAYEY SAND, tan, caliche cemented, gravel to 3" max.
10.0'		5	35	13	88	29	[illegible]	CLAYEY SAND, tan, dense to medium dense, gravel to 2" max., 1-5" cobble.
12.5'	ML	9		NP	95	52	[illegible]	SANDY SILT, tan, medium dense.
16.0'	CL	12	32	10	100	62	[illegible]	SANDY CLAY, tan, caliche cemented.
	SM	12			100	40	[illegible]	SILTY SAND, brown, dense to medium dense.
		6			100	27	[illegible]	
24.0'		7			98	13	[illegible]	
27.0'	SW-SM	3			87	9	[illegible]	SAND-SILTY SAND, brown & gray, dense, gravel & cobbles to 4" max., caving.
31.0'	SC	10	39	17	100	46	[illegible]	CLAYEY SAND, tan w/black streaks, very hard drilling.
	SM	10		NP	100	35	[illegible]	SILTY SAND, tan to brown, highly cemented, a few gravels to 2" max.
		10		NP	100	35	[illegible]	
41.0'		12		NP	100	40	[illegible]	
	SW-SM	10			84	10	[illegible]	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, very dense, gravel to 3" max.
47.0'		4			74	9	[illegible]	
51.0'	SC	27	38	18	95	39	[illegible]	CLAYEY SAND, brown, stiff to very hard, gravel to 1 1/2" max., very wet at 47 feet.
54.0'	SW-SM	14			91	12	[illegible]	SAND-SILTY SAND, brown, very dense, wet, gravel to 2" max.

T.H. 72-6

Depth	Symbol	MC	LL	PI	-4	-200	N	Description
	SM	3		NP	84	42	[illegible]	GRAVELLY SILTY SAND, tan, dense to medium dense, gravel & cobbles to 4" max.
7.0'		4		NP	79	22	[illegible]	
11.0'		4		NP	72	20	[illegible]	SILTY GRAVELLY SAND, tan, medium dense, gravel to 3" max.
14.0'	SM	6		NP	88	34	[illegible]	SILTY SAND, light brown, dense to medium dense, gravel to 2" max.
16.5'	CL	17	33	13	100	71	[illegible]	SANDY CLAY, tan w/white caliche streaks, gravel to 2" max.
18.0'	ML	17		NP	100	62	[illegible]	SANDY SILT, light brown, cemented.
22.0'	SM	9		NP	100	32	[illegible]	SILTY SAND, light brown, very dense & cemented.
25.5'	SW-SM	5		NP	82	9	[illegible]	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, dense, gravel to 3" max.
29.0'		12		NP	84	38	[illegible]	GRAVELLY SILTY SAND, light brown, cemented, gravel to 1" max.
	SM	12	43	16	100	47	[illegible]	SILTY SAND, tan, highly cemented, very hard
		12	36	9	100	45	[illegible]	
40.0'		15		NP	95	31	[illegible]	gravel to 2" max.
42.0'		16		NP	65	19	[illegible]	SILTY GRAVELLY SAND, light brown, very dense, gravel to 3" max.
43.5'	SW-SM	20		NP	88	9	[illegible]	SAND-SILTY SAND, brown, very dense, very wet.
45.0'	CL	20	38	16	100	55	[illegible]	SANDY CLAY, tan w/white, very hard.

T.H. 72-7

Depth	Symbol	MC	LL	PI	-4	-200	N	Description
	SM	4		NP	90	47	[illegible]	SILTY SAND, tan, loose, gravel & cobbles to 5" max.
7.0'		4		NP	90	40	[illegible]	
10.0'	CL	5	35	12	89	51	[illegible]	SANDY CLAY, tan, cemented, gravel to 1 1/2" max.
11.0'	SC	6	36	14	60	20	[illegible]	CLAYEY GRAVELLY SAND, tan, dense, gravel & cobbles to 6" max.
	SW-SM	4		NP	76	12	[illegible]	GRAVELLY SAND-SILTY GRAVELLY SAND, light brown, dense, gravel & cobbles to 5" max., caving.
		3		NP	65	11	[illegible]	
19.5'		3		NP	78	11	[illegible]	
21.0'	SC	6	28	8	89	35	[illegible]	CLAYEY SAND, brown, hard, gravel to 1" max.
25.0'	SM	10		NP	100	35	[illegible]	SILTY SAND, brown, cemented.
29.0'	CL	17	44	18	97	55	[illegible]	SANDY CLAY, tan w/white streaks, cemented.
	SM	13		NP	91	38	[illegible]	SILTY SAND, tan to brown, cemented, gravel to 2" max.
		8		NP	90	24	[illegible]	
39.0'		5			92	16	[illegible]	
42.0'	SW-SM	4			76	7	[illegible]	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, very dense, gravel to 2 1/2" max.
46.0'	SW-SM	5			92	8	[illegible]	SAND-SILTY SAND, brown, very dense, gravel & cobbles to 5" max.
49.0'					83	10	[illegible]	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, very dense, gravel & cobbles to 5" max.
51.0'	SW-SM	19			86	12	[illegible]	SAND-SILTY SAND, brown, very dense, wet, gravel & cobbles to 5" max.
54.0'	SC	16	35	15	96	46	[illegible]	CLAYEY SAND, brown, cemented, moist.

T.H. 72-8

Depth	Symbol	MC	LL	PI	-4	-200	N	Description
3.0'	SC	2	34	12	85	33	[illegible]	CLAYEY SAND, tan, loose, gravel to 1 1/2" max.
5.5'	CL	10	33	11	96	65	[illegible]	SANDY CLAY, brown, stiff.
8.5'	SC	8	38	14	88	48	[illegible]	CLAYEY SAND, tan, dense, gravel to 1 1/2" max.
11.0'		5	39	20	68	15	[illegible]	CLAYEY GRAVELLY SAND, brown, dense to medium dense, gravel to 2 1/2" max.
14.5'	SW-SC	5	42	24	82	12	[illegible]	GRAVELLY SAND-CLAYEY GRAVELLY SAND, red-brown, medium dense, gravel to 1 1/2" max.
16.0'	CL	13	29	11	88	56	[illegible]	SANDY CLAY, brown, hard, gravel to 2" max.
	SM	11		NP	93	38	[illegible]	SILTY SAND, brown to light brown, very dense, gravel to 2" max.
24.0'		10		NP	92	38	[illegible]	
28.0'	ML	11		NP	94	56	[illegible]	SANDY SILT, light brown, cemented, gravel to 1 1/2" max.
31.0'	CL	22	39	14	100	68	[illegible]	SANDY CLAY, light brown, cemented.
34.0'	ML	15	47	16	100	52	[illegible]	SANDY SILT, tan, highly cemented.
37.0'	SM	11		NP	86	24	[illegible]	SILTY SAND, light brown, very hard, gravel & cobbles to 5" max.
	SW-SM	11		NP	86	11	[illegible]	SAND-SILTY SAND, brown, very dense, gravel & cobbles to 6" max., caving.
		5					[illegible]	
44.0'		4			96	9	[illegible]	
46.0'	SM	12		NP	92	29	[illegible]	SILTY SAND, brown, cemented, gravel to 2" max.
	SW-SM	7			77	11	[illegible]	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, very dense, gravel to 3" max.
52.0'		3			84	8	[illegible]	
54.0'	SM	17		NP	100	27	[illegible]	SILTY SAND, brown, cemented lenses.

T.H. 72-9

Depth	Symbol	MC	LL	PI	-4	-200	N	Description
2.0'	ML	8	37	11	93	63	38	SANDY SILT, red-brown, dense, gravel & cobbles to 4" max.
5.0'	SM	10	41	15	92	48	47, 60+	SILTY SAND, tan w/white cementation, gravel to 1/2" max.
8.8'	SW-SM	6		NP	84	10	48, 54, 60+	GRAVELLY SAND-SILTY GRAVELLY SAND, red-brown, dense, gravel to 3" max.
	CL	15	33	13	97	52	60+	SANDY CLAY, brown, very hard, gravel & cobbles to 5" max.
11.0'		10	35	15	90	52		
14.0'	SC	16	35	15	88	36	60+, 60+	CLAYEY SAND, light brown, very dense & cemented, gravel to 1/2" max.
17.0'		7	37	16	69	16	60+, X	CLAYEY GRAVELLY SAND, brown, very dense & cemented, gravel & cobbles to 4" max.
	SM	11		NP	100	36	60+, 60+, 60+	SILTY SAND, tan, very dense & cemented.
23.0'		17		NP	100	42	60+	
	ML	16	48	16	100	53	60+, 60+, 60+	SANDY SILT, tan w/brown cementation, hard to drill.
31.0'		14	45	14	100	52	60+, 60+, 60+	
33.0'	SC	10	46	26	91	29	X	CLAYEY SAND, tan, highly cemented, gravel to 1" max.
36.0'	SW-SM	8			71	11	X, X	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, very dense, gravel & cobbles to 5" max., caving.
	SW-SM	6			97	6	60+, 60+	SAND-SILTY SAND, very dense, gravel & cobbles to 8" max., caving.
42.0'		3			99	8	60+, 60+	
	SW-SM	7			84	10	60+, 60+	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, very dense, gravel to 3" max.
48.0'		5			80	12	60+, 60+	
50.0'	SM	8		NP	96	37	60+	SILTY SAND, brown, cemented.

T.H. 72-10

Depth	Symbol	MC	LL	PI	-4	-200	N	Description
	CL	4	26	8	94	52	25	SANDY CLAY, tan, caliche cementation, gravel to 1 1/2" max.
5.0'		7	30	14	96	58	17, 14	
	SC	8	41	19	74	26	36, 52	CLAYEY GRAVELLY SAND, tan, medium to very dense, gravel & cobbles to 6" max.
9.0'		6	38	15	61	17	50	
11.0'	SW-SC	5	38	18	73	12	54	GRAVELLY SAND-CLAYEY GRAVELLY SAND, brown, very dense, gravel to 3" max.
13.0'	CL	12	34	16	97	52	60+	SANDY CLAY, tan, caliche cemented.
15.0'	SC	12	30	11	93	33	55, 60+	CLAYEY SAND, brown, very dense.
19.0'	ML	14		NP	98	58	60+, 60+	SANDY SILT, light brown, highly cemented & hard to drill.
23.0'	CL	14	42	22	100	55	60+, 60+, 60+	SANDY CLAY, light brown, highly cemented, hard to drill.
27.0'	SC	11	42	17	95	45	60+, 60+, 60+	CLAYEY SAND, tan, highly cemented, hard drilling.
	SM	14		NP	100	49	60+, 60+	SILTY SAND, light brown, highly cemented, gravel to 1" max.
32.0'		9		NP	95	16	50	
	SW-SM	4			79	6	60, 56	GRAVELLY SAND-SILTY GRAVELLY SAND, brown to light brown, very dense, gravel to 3" max.
		5			67	8	49, X	
42.0'		5			74	7	60+, X, X	
45.0'	SW-SM	4			86	9	60+, 60+	SAND-SILTY SAND, brown, very dense, gravel to 2" max.
49.0'	SP-SM	5			86	6	60+, 60+	
51.0'	SC	8	31	11	94	32	60+, X	SILTY SAND, brown, very dense, hard to drill.

T.H. 72-11

Depth	Symbol	MC	LL	PI	-4	-200	N	Description
3.0'	ML	5		NP	98	67	38, 41	SANDY SILT, tan, dense, gravel to 1 1/2" max.
5.0'	SM	5		NP	96	41	30	SILTY SAND, tan, dense, 1-4" cobble.
7.0'		3		NP	78	17	22, 11	SILTY GRAVELLY SAND, light brown, medium dense, gravel to 3" max.
11.0'	SM-SC	4	21	5	77	13	8, 7	SILTY GRAVELLY SAND-CLAYEY GRAVELLY SAND, brown, loose, gravel to 2" max.
14.0'	SP-SM	5	20	2	77	12	19, 45	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, medium to dense, gravel to 3" max.
16.0'	CL	20	30	9	100	60	20	SANDY CLAY, brown, dense.
18.0'	SM	7			95	16	53, 55	SILTY SAND, brown, dense, gravel to 1" max.
22.0'	SW-SM	4			95	10	36, 35	SAND-SILTY SAND, light brown, gravel to 2" max.
	SM	17	37	12	95	42	30, 60+, 60+	SILTY SAND, light brown, very dense, gravel to 2" max.
28.0'		12		NP	88	35	60+, 60+	
30.0'	SC	11	38	14	80	19	X	CLAYEY GRAVELLY SAND, tan, caliche cemented, gravel to 2 1/2" max.
31.5'	SM	9		NP	74	16	X	SILTY GRAVELLY SAND, light brown, dense, gravel & cobbles to 5" max.
35.0'		12		NP	90	27	X, 60+	SILTY SAND, light brown, highly cemented.
37.0'	SC	10	27	9	88	26	60+	CLAYEY SAND, light brown, cemented, gravel to 2 1/2" max.
38.0'	SW-SM	7			96	8	60+	SAND-SILTY SAND, light brown, dense.
40.0'	SW-SM	4			70	7	60+	GRAVELLY SAND-SILTY GRAVELLY SAND, light brown, very dense, gravel to 3" max.
43.0'	SM	10		NP	100	36	X, X, X	SILTY SAND, brown, highly cemented, hard drilling.
46.0'	CL	19	36	14	100	68	60+, 60+	SANDY CLAY, brown, very hard drilling.
49.0'	GC	14	31	12	55	24	60+	CLAYEY SANDY GRAVEL, brown, very hard, gravels are caliche clods.
51.0'	SC	14	26	7	62	19	X, X	CLAYEY GRAVELLY SAND, brown, cemented, gravels are caliche clods.

T.H. 72-12

Depth	Symbol	MC	LL	PI	-4	-200	N	Description
2.0'	CL	6	33	13	95	51	60+	SANDY CLAY, brown, cemented, gravel to 1 1/2" max.
4.0'	SC	6	38	12	91	47	42, 60+	CLAYEY SAND, tan, caliche cemented, gravel to 1" max.
7.0'		5	36	15	64	20	X, 60+	CLAYEY GRAVELLY SAND, tan, highly cemented, gravel to 3" max.
11.0'		15	43	18	85	44	60+, 60+	CLAYEY SAND, tan, highly cemented, gravel to 2" max.
13.0'	SM	12		NP	100	46	52	SILTY SAND, light brown, dense.
17.0'	SW-SM	6		NP	83	12	34, 35, 46	GRAVELLY SAND-SILTY GRAVELLY SAND, light brown, dense, gravel to 2 1/2" max., 2-5" cobbles.
20.0'	SW-SM	4		NP	95	7	37, 41	SAND-SILTY SAND, light brown, dense, gravel & cobbles to 5" max.
24.0'	SM	10	39	13	90	46	60+, X, X	SILTY SAND, tan, very hard drilling, cemented.
28.0'	GM	11	42	14	50	20	X, X	SILTY SANDY GRAVEL, light brown, highly cemented. +40 material is cemented particles.
32.0'	SC	9	31	9	100	41	X, X, X	CLAYEY SAND, tan, highly cemented.
36.0'		11	33	10	75	33	60+, 60+, 60+	GRAVELLY CLAYEY SAND, brown, highly cemented. +40 material is cemented particles.
38.0'	SM	12			97	22	60+	SILTY SAND, brown, very dense gravel to 2" max.
42.5'	SW-SM	5			90	10	60+, 60+, 60+	SAND-SILTY SAND, light brown, very dense, gravel & cobbles to 4" max.
45.0'	CL	13	34	15	100	52	60+, X	SANDY CLAY, tan w/white caliche streaks.
48.0'	SC	11	30	10	68	24	X, X	CLAYEY GRAVELLY SAND, brown w/black streaks, highly cemented. +40 is cemented particles.
51.0'		10	33	11	100	49	60+, 60+	CLAYEY SAND, brown w/black streaks, highly cemented.

VERT. SCALE 0 5 10 15 FEET

NOTES:
1. See Sheet 8 for Locations of Test Holes.
2. See Sheet 8 for General Notes, Legend and Basis For Classification.

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: LAK

DRAWN BY: L.L.W.

CHECKED BY: MPC

TRILBY WASH DETENTION BASIN

LOGS OF TEST HOLES

SUBMITTED BY:

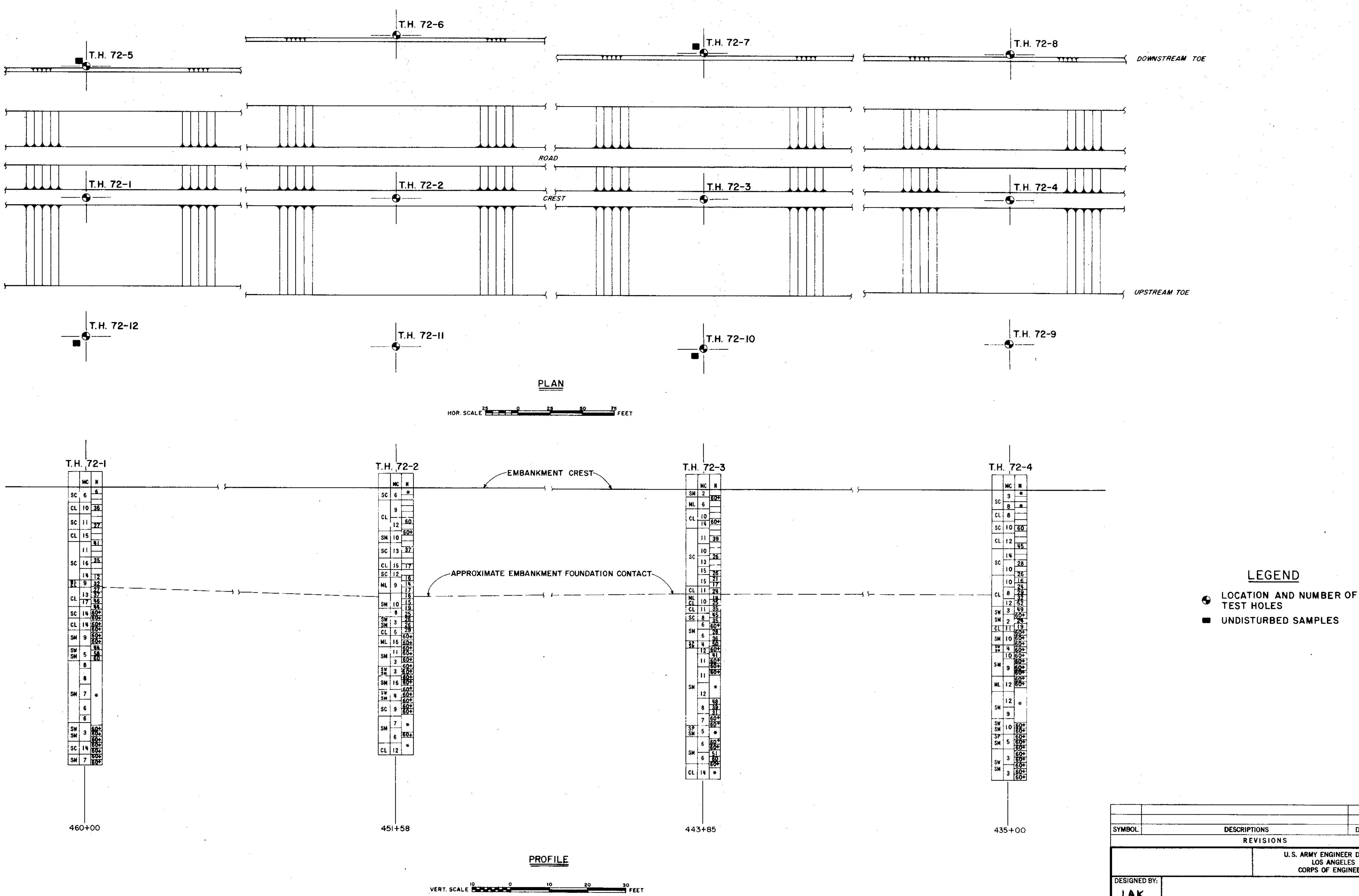
DATE:

SPEC. NO.

DRAWING NUMBER

DISTRICT FILE NO.

SHEET



SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: LAK

DRAWN BY: L.L.W.

CHECKED BY: MPC

TRILBY WASH DETENTION BASIN

SOIL PROFILES

SUBMITTED BY:

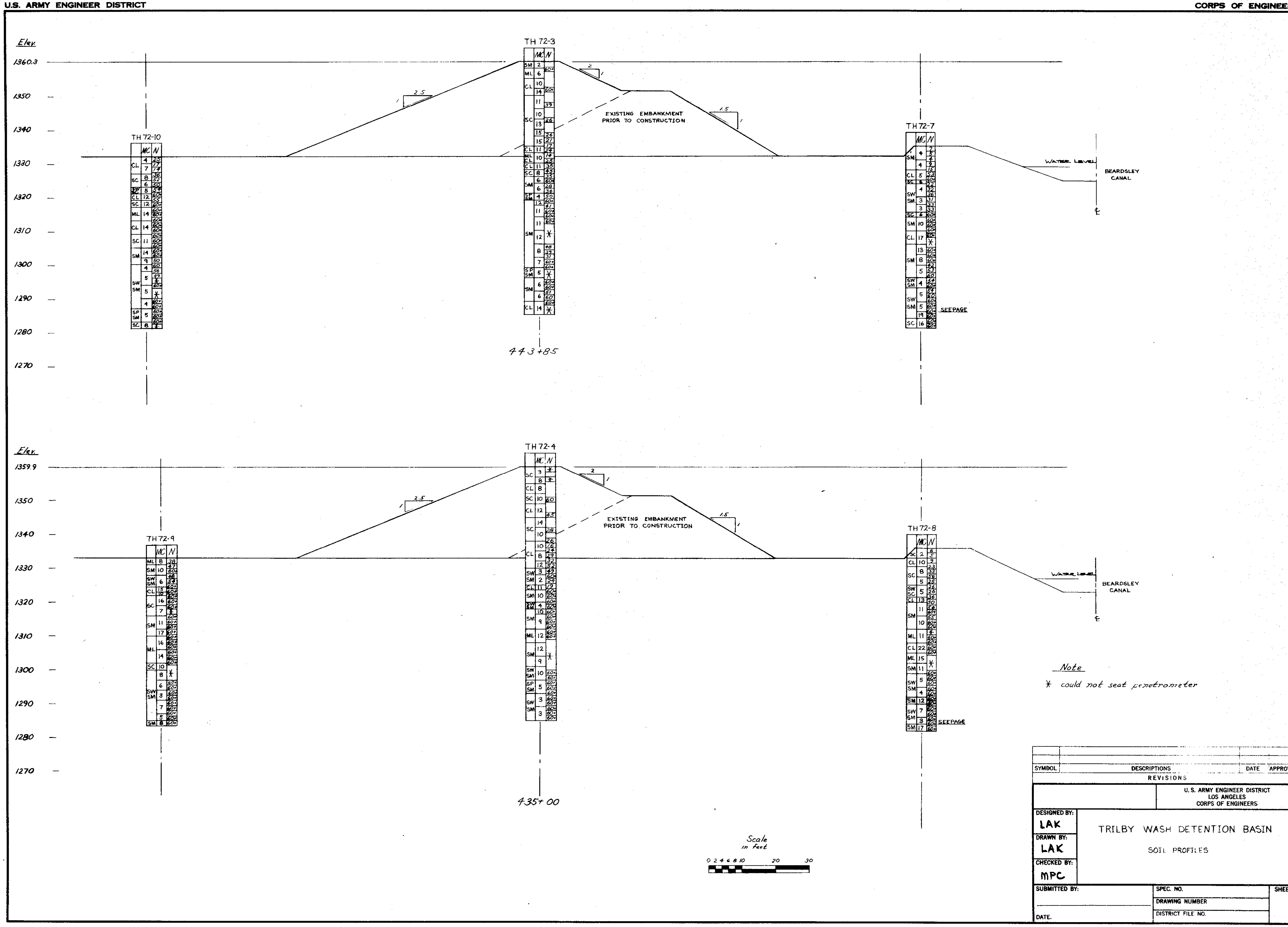
DATE:

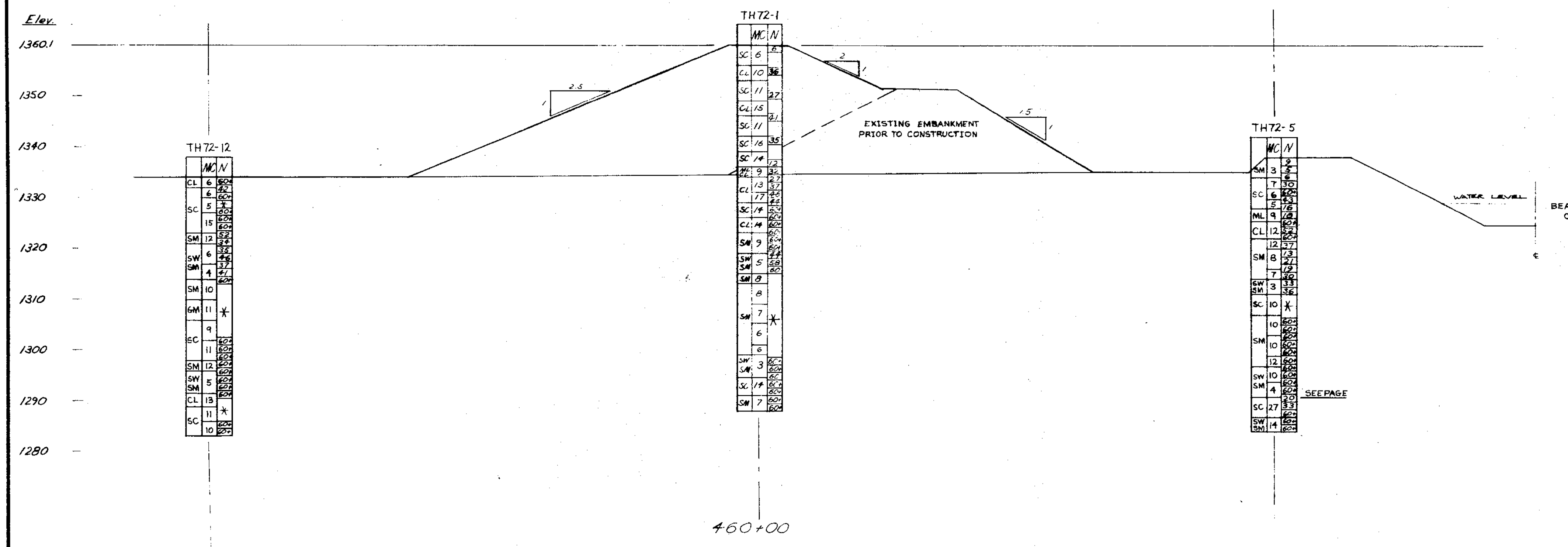
SPEC. NO.

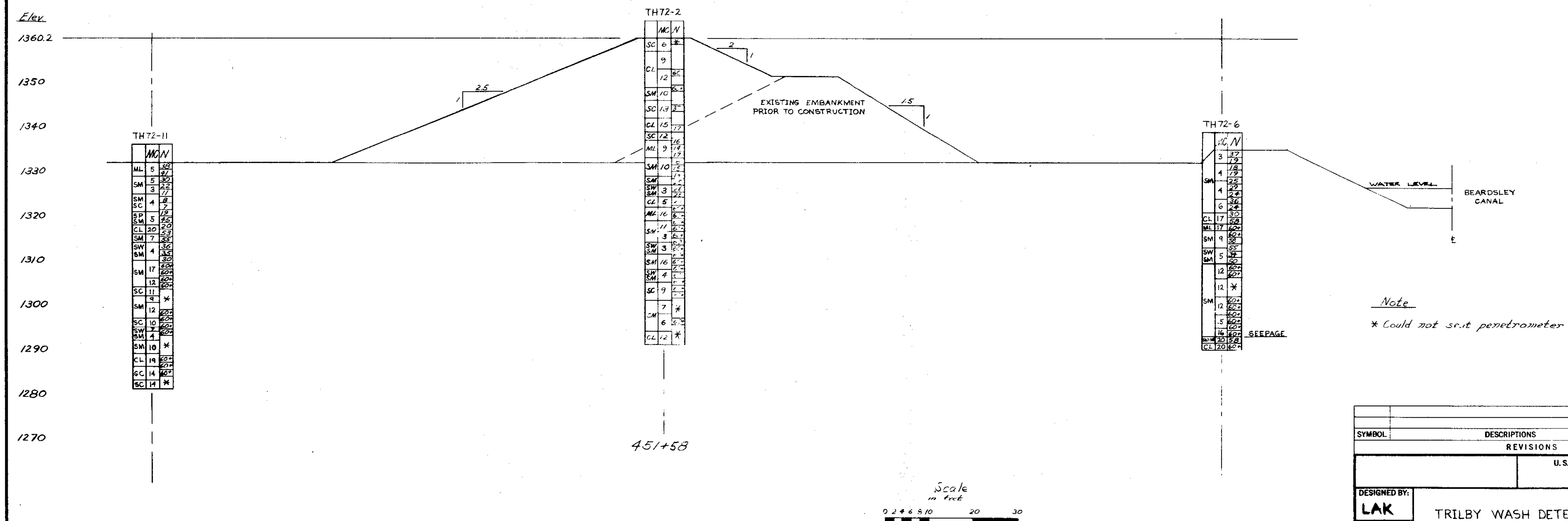
DRAWING NUMBER

DISTRICT FILE NO.

SHEET


Elev.
TH 72-3
TH 72-10
TH 72-7
EXISTING EMBANKMENT PRIOR TO CONSTRUCTION
WATER LEVEL
BEARDSLEY CANAL
SEEPAGE
443+85
TH 72-4
TH 72-9
TH 72-8
435+00
Note
* could not seat penetrometer
Scale in feet
SYMBOL
DESCRIPTIONS
DATE
APPROVAL
REVISIONS
U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS
DESIGNED BY: LAK
DRAWN BY: LAK
CHECKED BY: MPC
TRILBY WASH DETENTION BASIN
SOIL PROFILES
SUBMITTED BY:
DATE.
SPEC. NO.
DRAWING NUMBER
DISTRICT FILE NO.
SHEET





Note

* Could not seat penetrometer

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: LAK

DRAWN BY: LAK

CHECKED BY: MPC

TRILBY WASH DETENTION BASIN

SOIL PROFILES

SUBMITTED BY:

DATE:

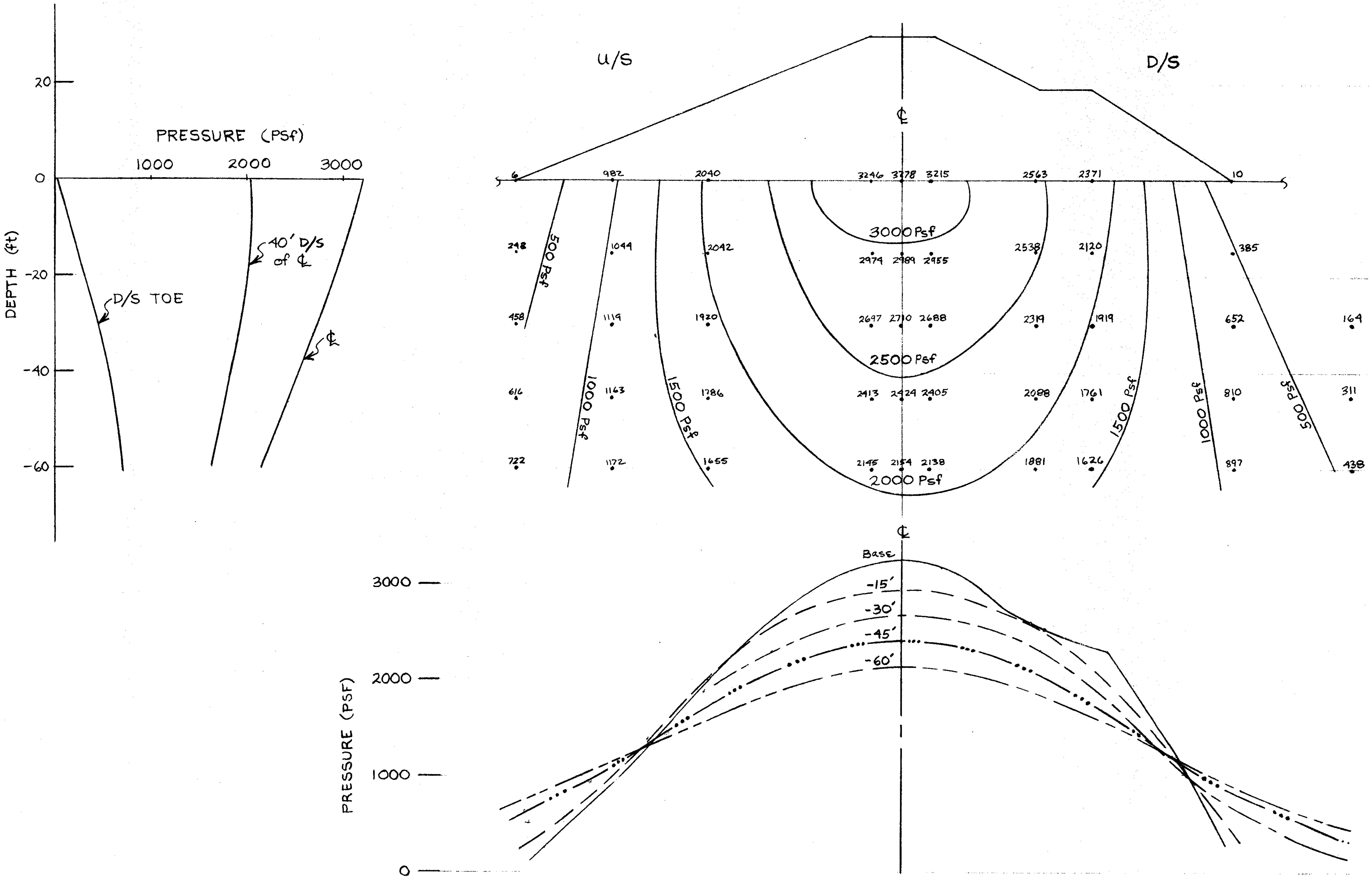
SPEC. NO.

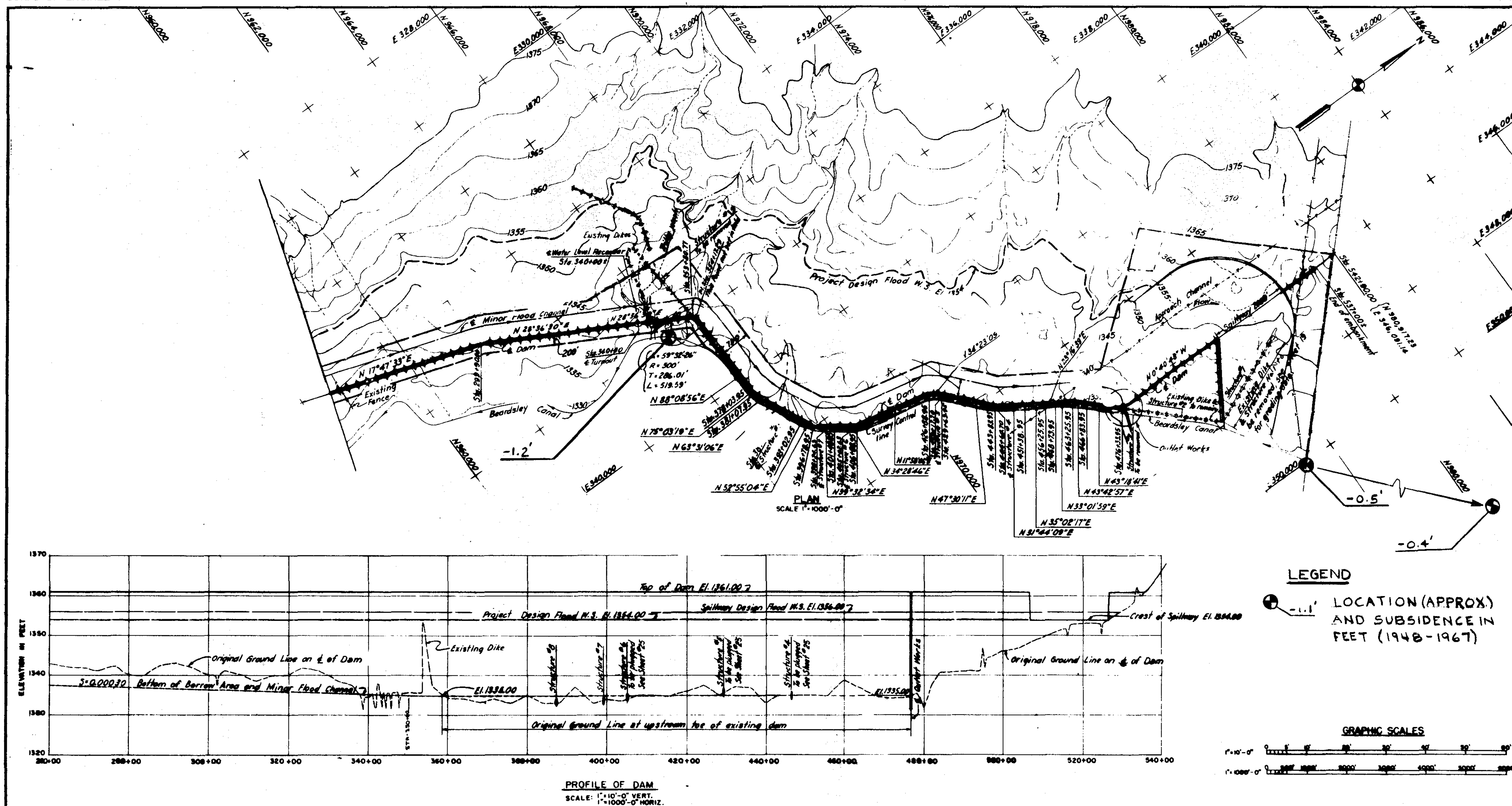
DRAWING NUMBER

DISTRICT FILE NO.

SHEET

EMBANKMENT INFLUENCE WITHIN THE FOUNDATION





GENERAL NOTES

1. Topography compiled from maps by U.S. Soils Conservation Service, and Corps of Engineers.
2. Datum is Mean Sea Level, 1929 General Adjustment
3. Contour interval 5 feet.
4. Arizona Central Zone, Transverse Mercator Projection, 1927 North American Datum.
5. U.S.C.E. Bench Marks, 1½" Brass Capped Pipe, intermittently available, approximately 200' landward of survey control line

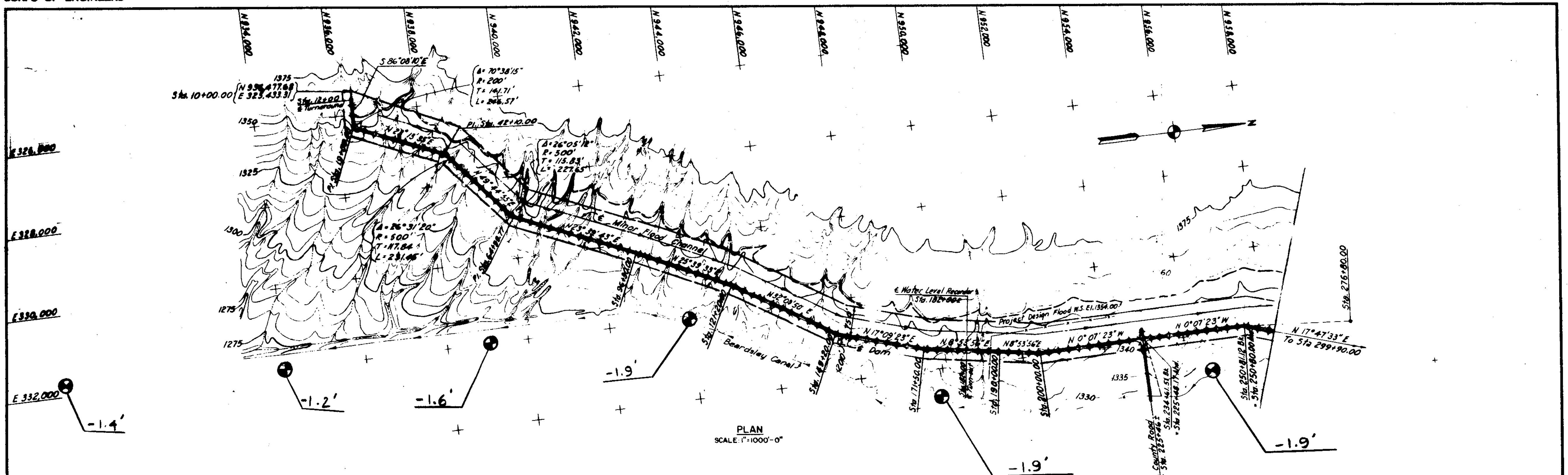
CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER
SACRAMENTO DISTRICT
SACRAMENTO, CALIFORNIA

DRAWN BY: R.K.J. & K.E.M.
CHECKED BY: F.L.T.

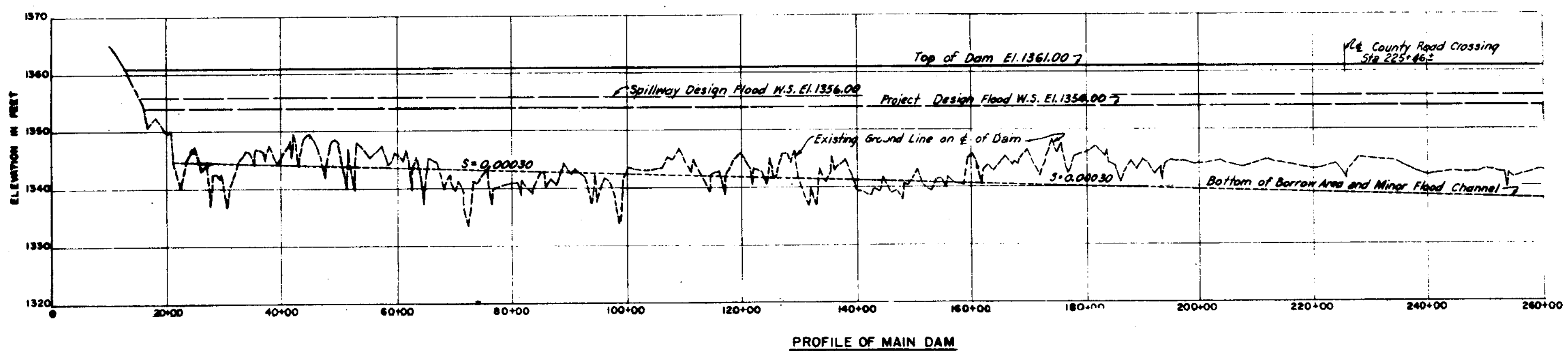
GILA RIVER AND TRIBUTARIES, ARIZONA
AGUA FRIA PROJECT
LOWER AGUA FRIA RIVER
TRILBY WASH DETENTION BASIN
DAM & APPURTENANCES
SUBSIDENCE MEASUREMENTS

DATE: 19 Feb.'54
SCALE: AS SHOWN
O.C.E. DWG. NO. ~~86-00-01~~
SPEC. NO. 1850

PLATE 14



PLAN
SCALE: 1"=1000'-0"



PROFILE OF MAIN DAM
SCALE: 1"= 10'-0" VERT.
1"= 1000'-0" HORIZ.

LEGEND

-1.1' LOCATION (APPROX.) AND SUBSIDENCE IN FEET (1948 - 1967)

GRAPHIC SCALES

1"=10'-0" 0 10' 20' 40' 60' 80' 100'

1"=100'-0" 0 50' 100' 200' 300' 400' 500' 600'

1"=1000'-0" 0 500' 1000' 2000' 3000' 4000' 5000' 6000'

GENERAL NOTES

1. Topography compiled from maps by U.S. Soils Conservation Service, and Corps of Engineers.
2. Datum is Mean Sea Level, 1929 General Adjustment
3. Contour Interval 5 Feet.
4. Arizona Central Zone, Transverse Mercator Projection, 1927 North American Datum.
5. U.S.C.E. Bench Marks, $1\frac{1}{2}$" Brass Capped Pipe, intermittently available, approximately 200' landward of survey control line.

REVISION	DATE	DESCRIPTION	BY	BY

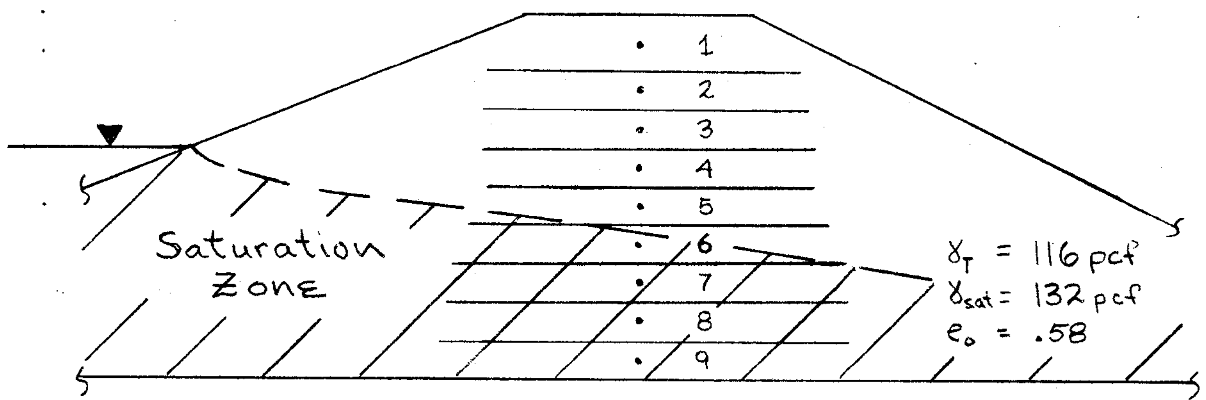
CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER
SACRAMENTO DISTRICT
SACRAMENTO, CALIFORNIA

DRAWN BY: R.K.J. & K.E.M.
CHECKED BY: F.L.T.

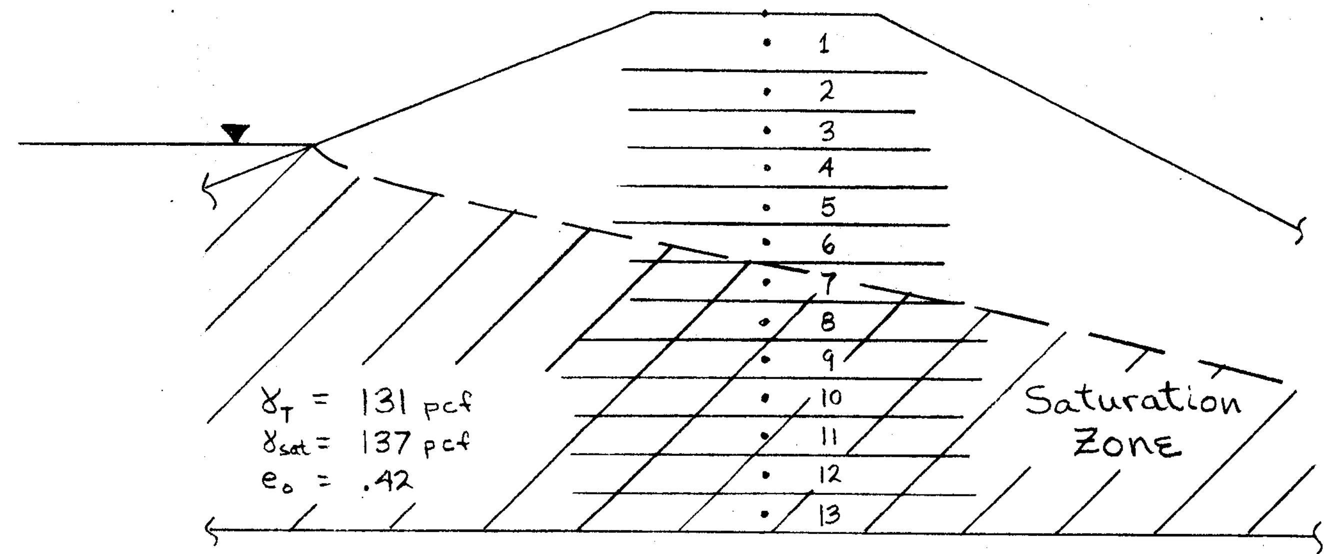
GILA RIVER AND TRIBUTARIES, ARIZONA
AGUA FRIA PROJECT
LOWER AGUA FRIA RIVER
TRILBY WASH DETENTION BASIN
DAM & APPURTENANCES
SUBSIDENCE MEASUREMENTS

DATE: 19 Feb.'54
SCALE: AS SHOWN
O.C.E. DWG. NO. ~~86-02-01~~
SPEC. NO. 1850
FILE NO. ~~1269/57~~

EMBANKMENT CONSOLIDATION



Sta. 117+00



Sta. 481+65

No.	γ	h	Wt(tons)	e_o	e_1	$e_o - e_1$	$[(e_o - e_1)/(1+e_o)] \cdot H$
1	116	1.5	0.09	.58	.572	0.008	0.015
2	116	4	0.23		.57	.01	.013
3	116	6	0.35		.568	.012	.015
4	116	8	0.46		.566	.014	.018
5	116	10	0.58		.565	.015	.019
6	132	12	0.71		.508	.072	.091
7	132	14	0.84		.50	.08	.101
8	132	16	0.98		.495	.085	.108
9	132	18	1.10		.49	.09	.114

$\Sigma = 0.494$ ft

Embankment Consolidation ≈ 6 in

No.	γ	h	Wt(tons)	e_o	e_1	$e_o - e_1$	$[(e_o - e_1)/(1+e_o)] \cdot h$
1	131	1.5	0.10	.42	.416	0.004	0.008
2	131	4	0.26		.413	0.007	.010
3	131	6	0.39		.412	0.008	.011
4	131	8	0.52		.41	0.01	.014
5	131	10	0.66		.408	0.012	.017
6	131	12	0.79		.405	0.015	.021
7	137	14	0.92		.402	0.018	.025
8	137	16	1.10		.40	0.02	.028
9	137	18	1.23		.399	0.021	.029
10	137	20	1.37		.397	0.023	.032
11	137	22	1.51		.395	0.025	.035
12	137	24	1.64		.393	0.027	.038
13	137	26	1.78		.39	0.03	.042

$\Sigma = 0.310$ ft

Embankment Consolidation ≈ 4 in

Note : H = height of each layer

CORPS OF ENGINEERS | U.S. ARMY

U.S. ARMY ENGINEER DIVISION LABORATORY — SOUTH PACIFIC

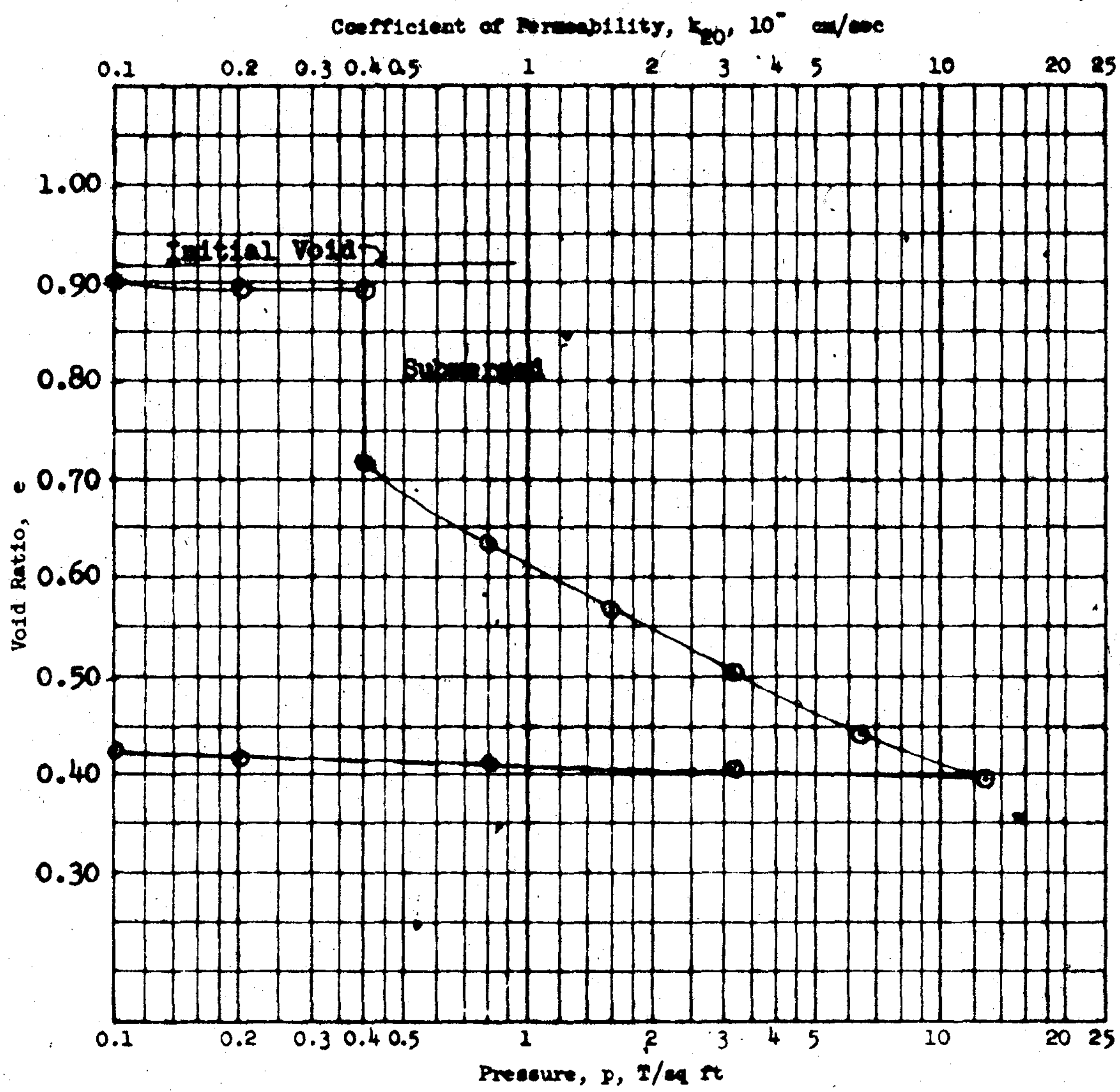
SOIL TEST RESULT SUMMARY

PROJECT: MC MICKEN DAM - TRILBY WASH | DATE: October 1972

DIVISION SERIAL NO.	HOLE NO.	CO-ORD. OR STA.	FIELD SAMPLE NO.	DEPTH OR ELEVATION FROM	DEPTH OR ELEVATION TO	LABORATORY DESCRIPTIVE CLASSIFICATION	MECHANICAL ANALYSIS - % FINER: GRAVEL 1"	GRAVEL 3/4	GRAVEL 1/2	SAND NO. 4	SAND NO. 10	SAND NO. 40	SAND NO. 80	FINES NO. 200	FINES	LIQUID LIMIT	PLASTICITY INDEX	SPECIFIC GRAVITY +4	SPECIFIC GRAVITY -4	FIELD DRY WT. LB/CF	FIELD % MOIST	RESULTS ON SEPARATE FORMS (U=UNDISTURBED, R=REMOLDED): COMPACTION AASHO LB/CF	COMPACTION AASHO % MOIST.	SHEAR STRENGTH DIRECT	SHEAR STRENGTH TRIAXIAL	CONSOLIDATION	PERMEABILITY	Remarks
61439	TTA			5.5'		Clayey Sand (SC-SM)			100	95	90	73	65	46		22	7		2.72							2U		CBR Mold.
61440	TTB			7.0'	8.0'	Sandy Clay (CL)	100	97	96	92	87	73	67	57		36	16		2.70							2U		Cubic Box
61441	TTC		1	2.0'		Sandy Clay (CL)					100	93	88	72		25	8		2.75							1U		CBR Mold
61442	TTD		1	1.2'		Clayey Sand (SC)	100	96	96	94	90	71	63	44		30	12		2.69							2U		"
61443	TTE		1	4.0'		Sandy Clay (CL)	100	97	96	91	86	71	64	52		34	15		2.70							2U		"

ENG FORM [illegible] (CIVIL) Edition of 1 July [illegible] is obsolete.

FIGURE 6



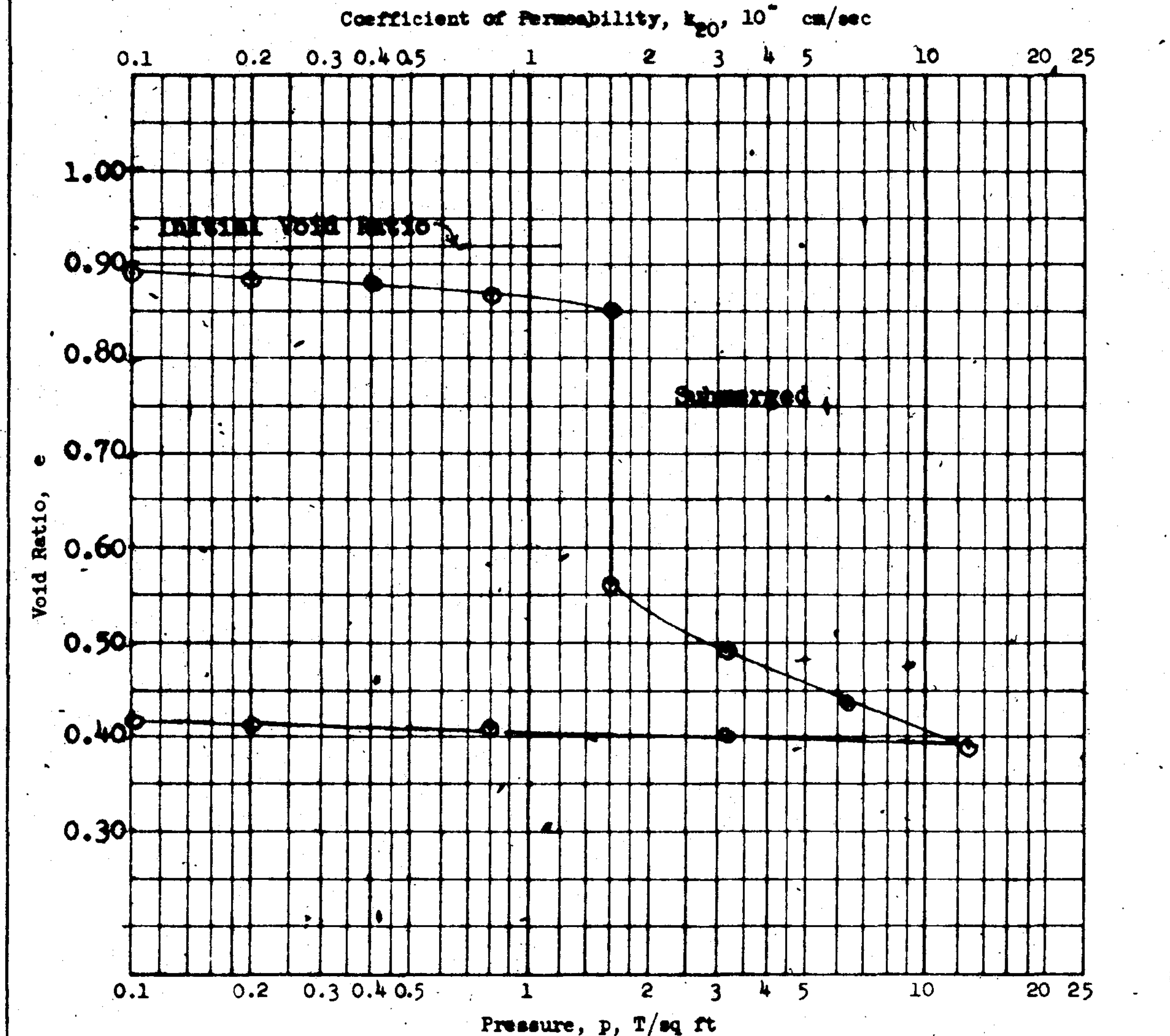
Type of Specimen Undisturbed		Before Test		After Test	
Diam 4.4 in.	Ht 1.0 in.	Water Content, w_o	5.2 %	w_f	14.8 %
Overburden Pressure, Po T/sq ft		Void Ratio, e_o	0.919	e_f	0.434
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	15 %	S_f	93 %
Compression Index, C_c		Dry Density, γ_d	88.4 lb/ft³		
Classification Clayey Sand (SC-SM)		k_{20} at e_o = × 10⁻ cm/sec			

LL 22	G_s 2.72	Project McMICKEN DAM	
PL 15	D_{10}	(Trilby Wash)	
Remarks Specimen submerged		Area	
at 0.4 tsf.		Boring No. TT A	Sample No. 61439
		Depth El 5.5'	Date
		CONSOLIDATION TEST REPORT	

ENG FORM 1 MAY 63 2090 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

0 8424

FIGURE 7

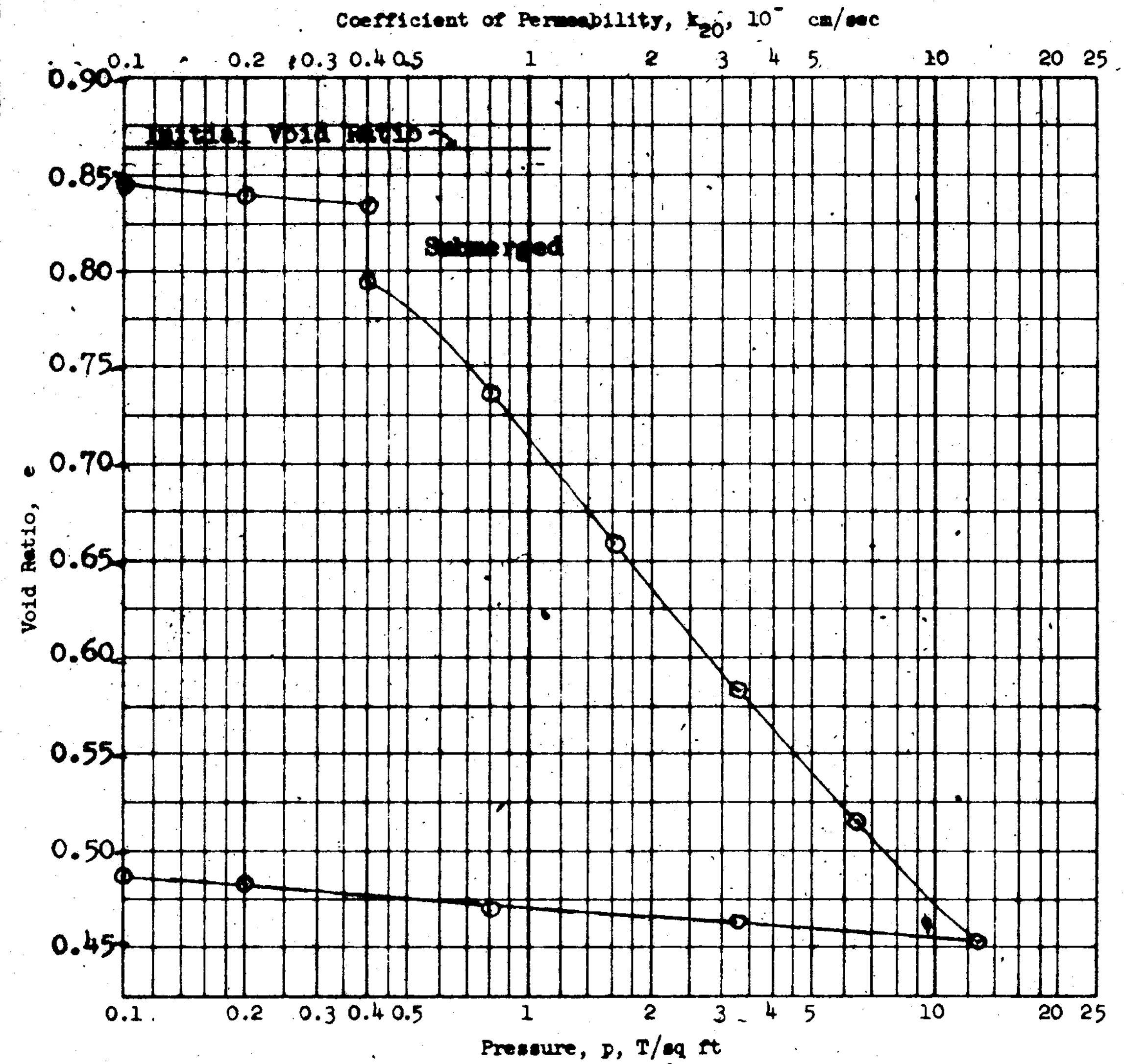


Type of Specimen Undisturbed		Before Test		After Test	
Diam 4.4 in.	Ht 1.0 in.	Water Content, w_o	5.1 %	w_f	14.7 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o	0.919	e_f	0.432
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	15 %	S_f	93 %
Compression Index, C_c		Dry Density, γ_d	88.4 lb/ft³		
Classification Clayey Sand (SC-SM)		k_{20} at e_o = × 10^{-} cm/sec			
LL 22	G_s 2.72	Project McMICKEN DAM (Trilby Wash)			
PL 15	D_{10}	Area			
Remarks Specimen submerged at 1.6 tsf.		Boring No. TT A		Sample No. 61439	
		Depth El 5.5'		Date	
		CONSOLIDATION TEST REPORT			

ENG FORM 1 MAY 63 2090 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

3424

FIGURE 8



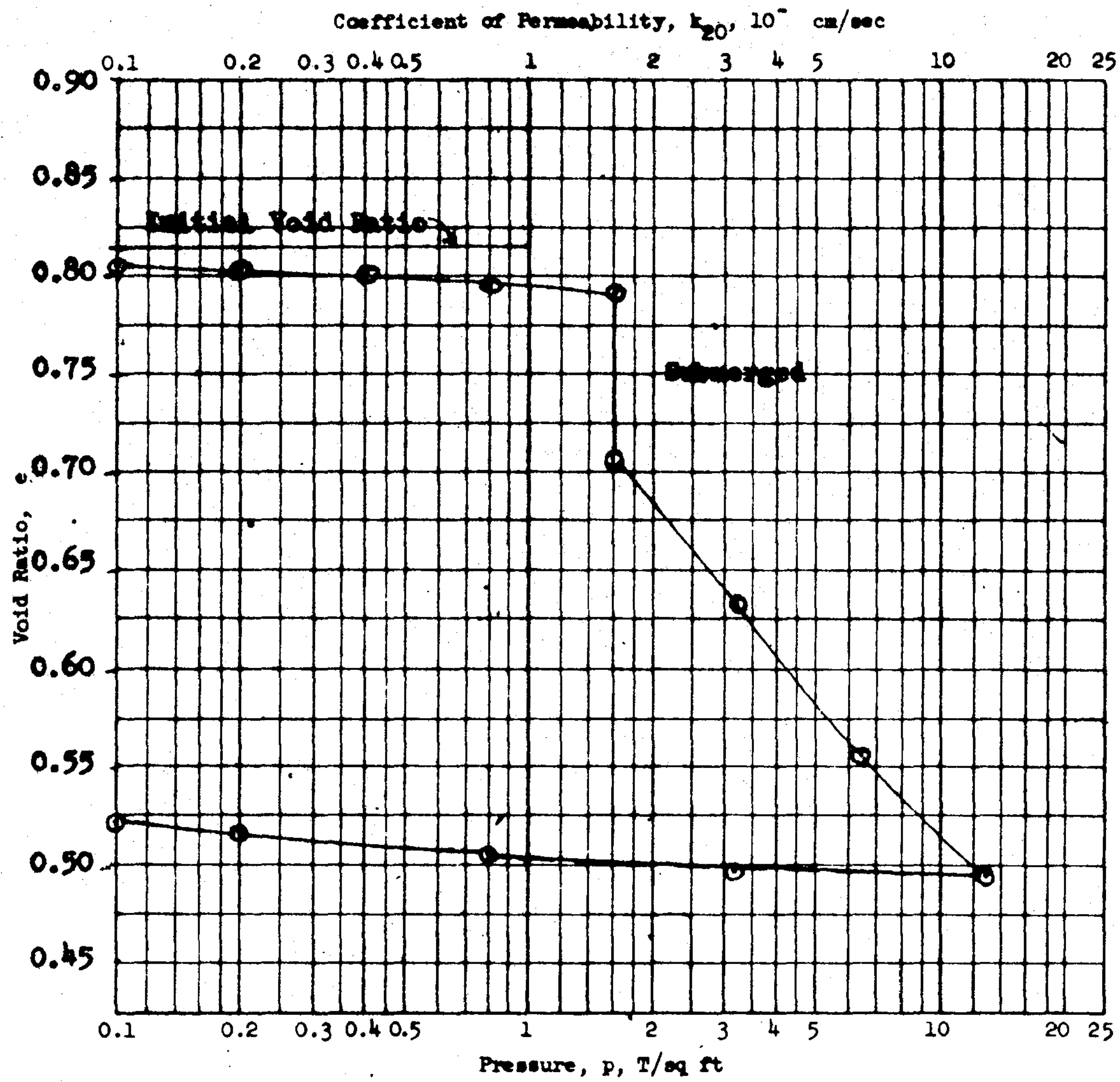
Type of Specimen Undisturbed		Before Test	After Test
Diam 4.4 in.	Ht 1.0 in.	Water Content, w_o 5.8 %	w_f 19.0 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o 0.862	e_f 0.510
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o 18 %	S_f 100 %
Compression Index, C_c		Dry Density, γ_d 89.8 lb/ft³	
Classification Sandy Clay (CL)		k_{20} at e_o = × 10⁻ cm/sec	
LL 36	G_s 2.70	Project McMICKEN DAM (Trilby Wash)	
PL 20	D_{10}	Area	
Remarks Specimen submerged at 0.4 tsf.		Boring No. TT B	Sample No. 61440
		Depth El 7.0' - 8.0'	Date

CONSOLIDATION TEST REPORT

ENG FORM 1 MAY 63 2090 PREVIOUS EDITIONS ARE OBSOLETE. *(TRANSLUCENT)*

3424

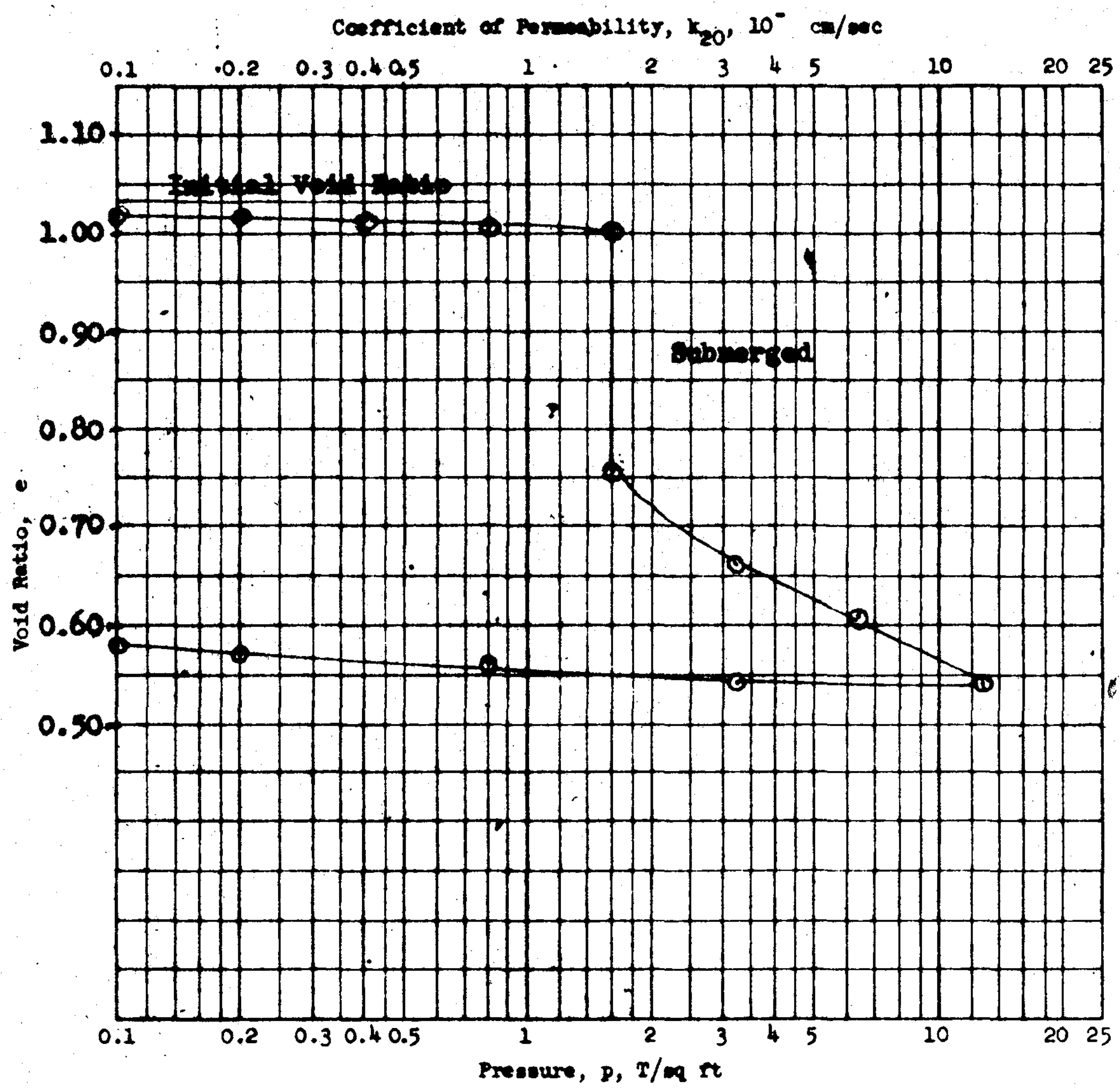
FIGURE 9



Type of Specimen Undisturbed		Before Test		After Test	
Diam 4.4 in.	Ht 1.0 in.	Water Content, w_o	5.8 %	w_f	19.0 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o	0.813	e_f	0.538
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	19 %	S_f	95 %
Compression Index, C_c		Dry Density, γ_d	92.9 lb/ft^3		
Classification Sandy Clay (CL)		k_{20} at e_o = × 10^{-} cm/sec			
LL 36	G_s 2.70	Project McMICKEN DAM			
PL 20	D_{10}	(Trilby Wash)			
Remarks Specimen submerged		Area			
at 1.6 tsf.		Boring No. TT B		Sample No. 61440	
		Depth El 7.0' - 8.0'		Date	
		CONSOLIDATION TEST REPORT			

ENG FORM 1 MAY 63 2090 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

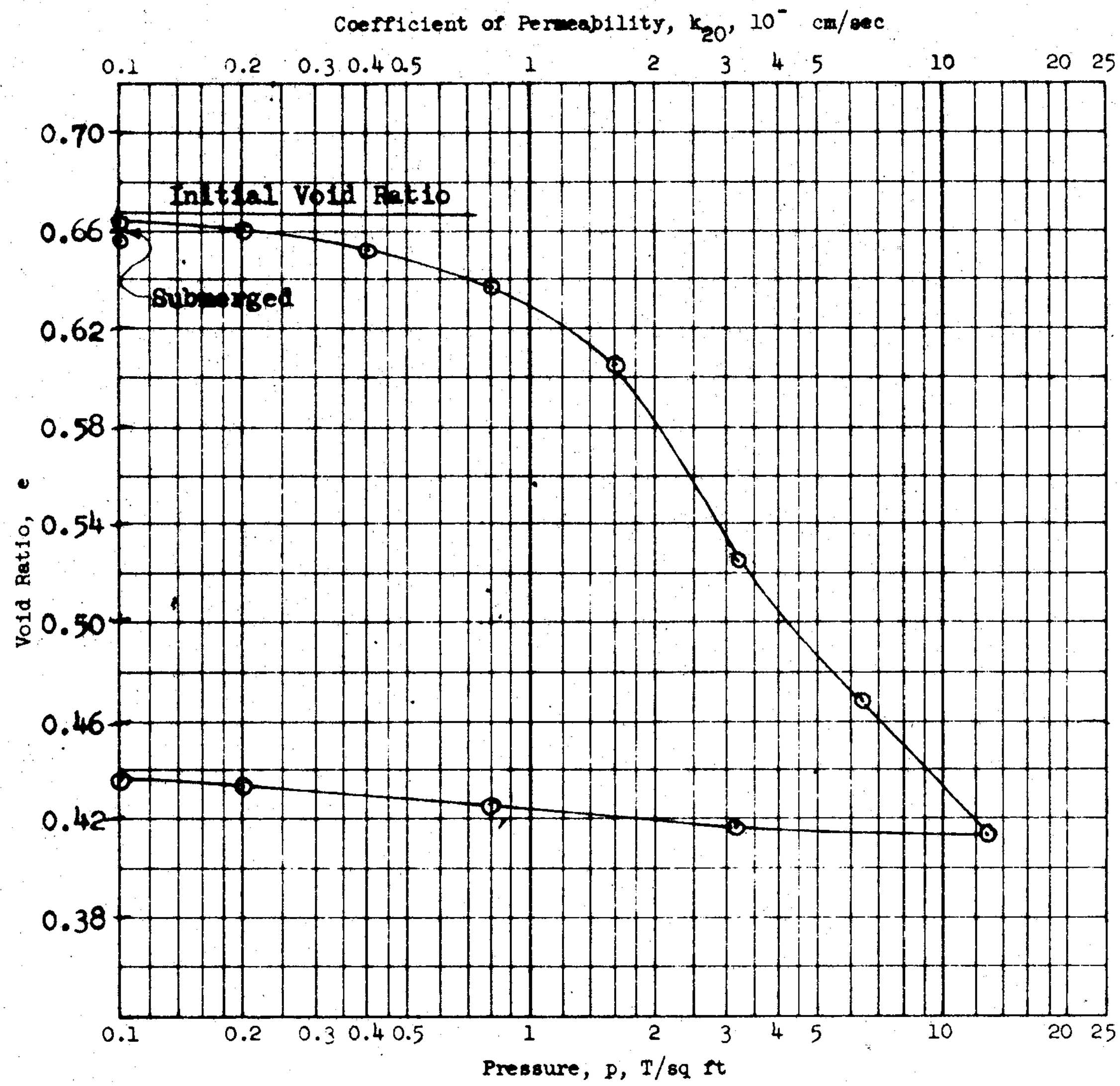
FIGURE 10



Type of Specimen Undisturbed		Before Test		After Test
Diam 4.4 in.	Ht 1.0 in.	Water Content, w_o	4.7 %	w_f 22.3 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o	1.030	e_f 0.617
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	13 %	S_f 99 %
Compression Index, C_c		Dry Density, γ_d	84.5 lb/ft^3	
Classification Sandy Clay (CL)		k_{20} at e_o = × 10^{-} cm/sec		
LL 25	G_s 2.75	Project McMICKEN DAM		
PL 17	D_{10}	(Trilby Wash)		
Remarks Specimen submerged at		Area		
1.6 tsf.		Boring No. TT C		Sample No. 61441
		Depth El 2.0'		Date
		CONSOLIDATION TEST REPORT		

ENG FORM 1 MAY 63 2090 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT) 3424

FIGURE 11



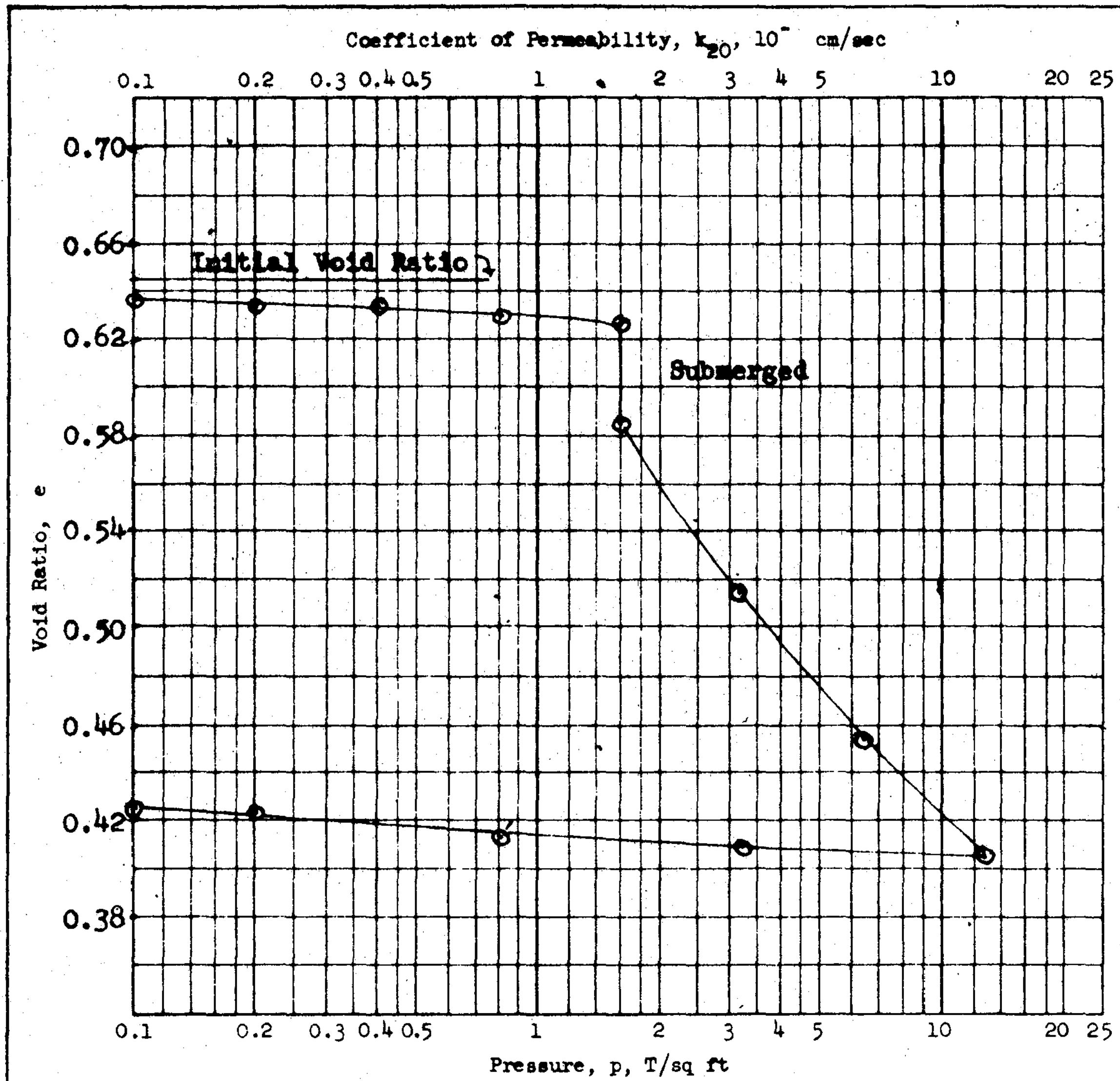
Type of Specimen **Undisturbed**		Before Test		After Test	
Diam 4.4 in.	Ht 1.0 in.	Water Content, w_o	5.6 %	w_f	15.9%
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o	0.667	e_f	0.460
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	23 %	S_f	93 %
Compression Index, C_c		Dry Density, γ_d	100.3 lb/ft^3		
Classification **Clayey Sand (SC)**		k_{20} at e_o = × 10^{-} cm/sec			
LL 30	G_s 2.69	Project **McMICKEN DAM (Trilby Wash)**			
PL 18	D_{10}				
Remarks **Specimen submerged at 0.1 tsf.**		Area			
		Boring No. TT D		Sample No. 61442	
		Depth El 1.2'		Date	

CONSOLIDATION TEST REPORT

ENG FORM 1 MAY 63 2090 PREVIOUS EDITIONS ARE OBSOLETE. *(TRANSLUCENT)*

G 3424

FIGURE 12

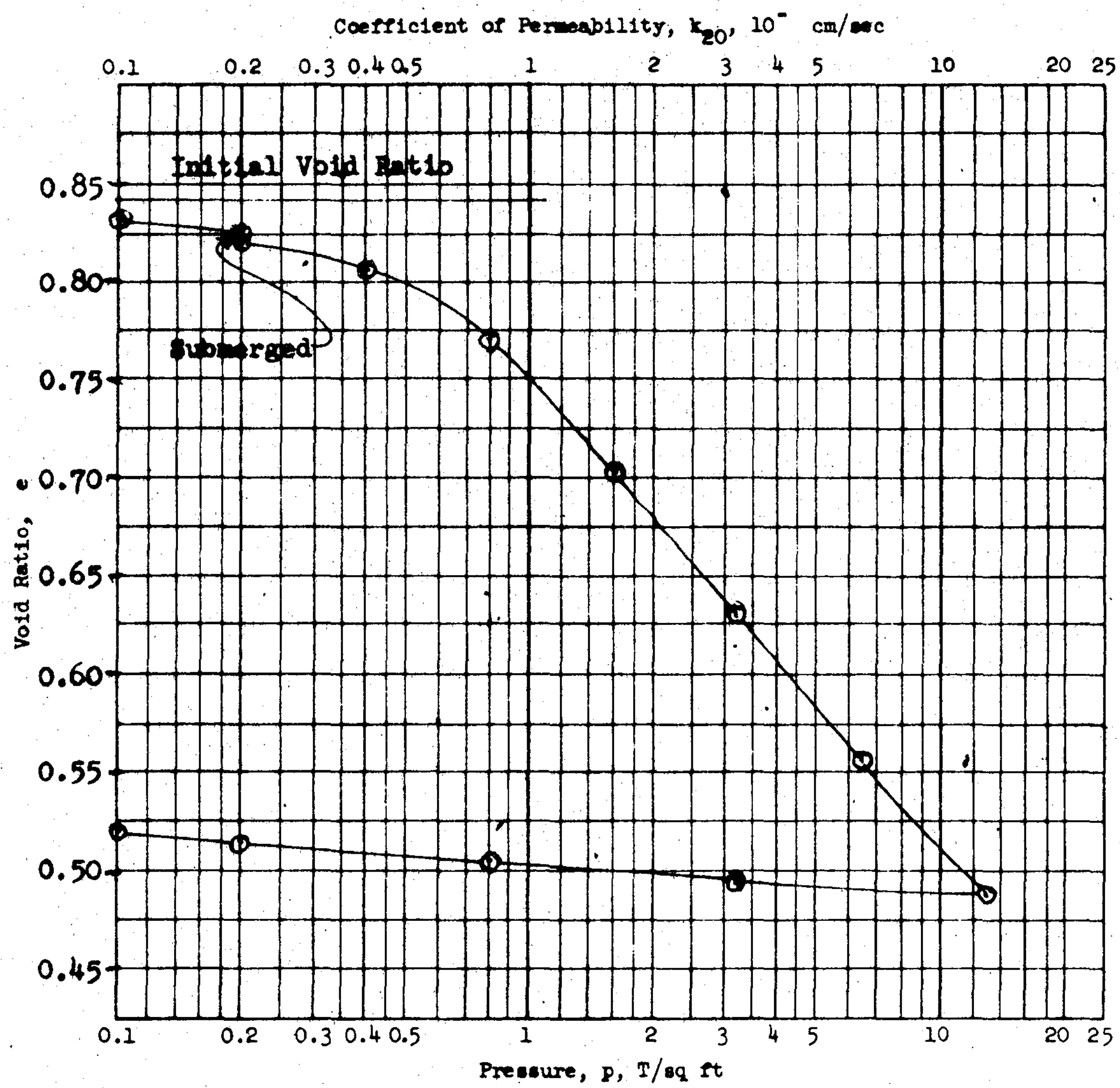


Type of Specimen Undisturbed		Before Test			After Test	
Diam 4.4 in.	Ht 1.0 in.	Water Content, w_o	5.3 %		w_f	15.1 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o	0.646		e_f	0.433
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	22 %		S_f	94 %
Compression Index, C_c		Dry Density, γ_d	102.0 lb/ft^3			
Classification Clayey Sand (SC)		k_{20} at e_o = × 10^{-} cm/sec				
LL 30	G_s 2.69	Project McMICKEN DAM				
PL 18	D_{10}	(Trilby Wash)				
Remarks Specimen submerged at		Area				
1.6 tsf.		Boring No. TT D		Sample No. 61442		
		Depth El 1.2'		Date		
		CONSOLIDATION TEST REPORT				

ENG FORM 1 MAY 63 2090 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

G 5424

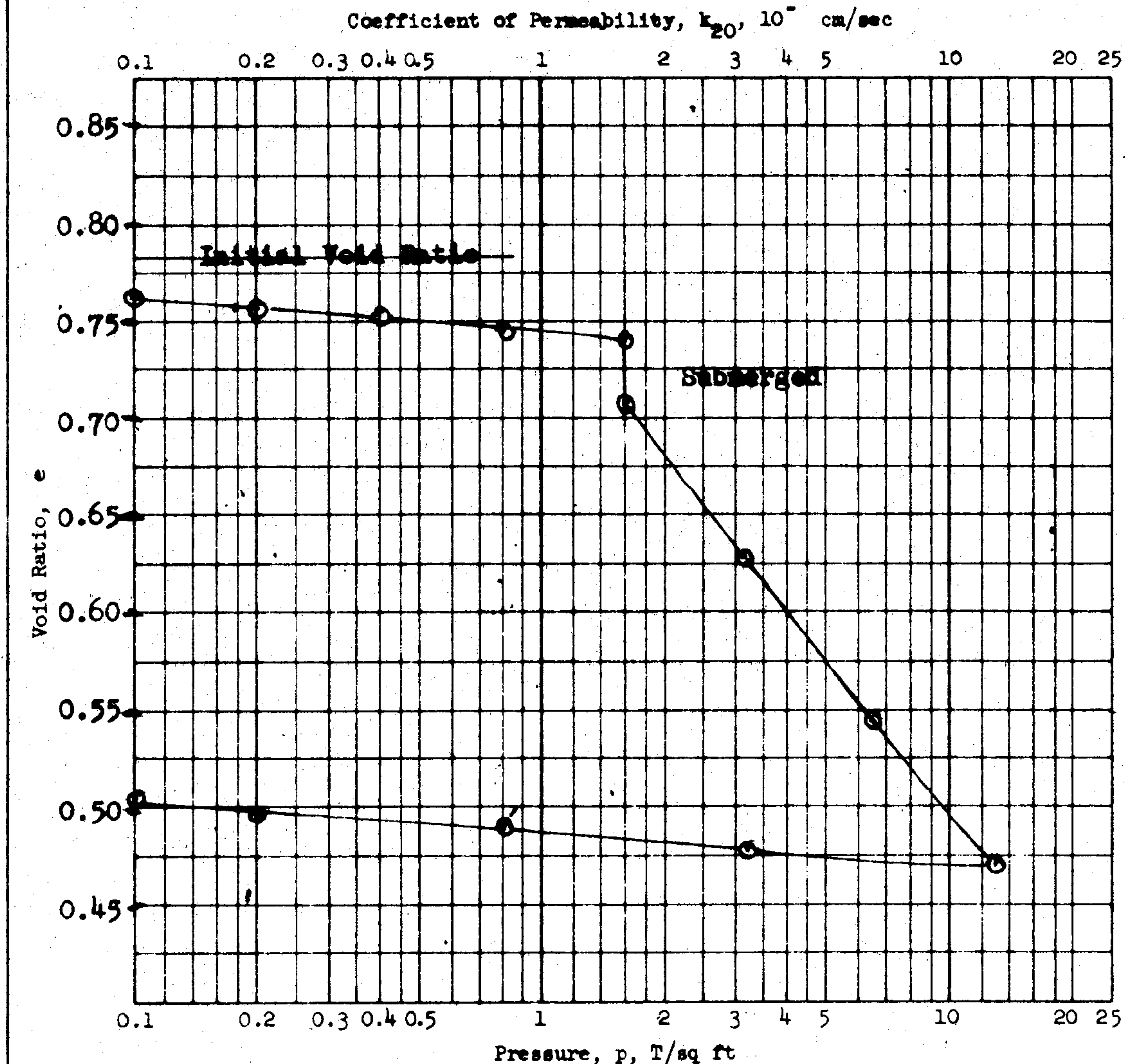
FIGURE 13



Type of Specimen Undisturbed		Before Test		After Test	
Diam 4.4 in.	Ht 1.0 in.	Water Content, w_o	9.5 %	w_f	18.8 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o	0.841	e_f	0.540
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	30 %	S_f	94 %
Compression Index, C_c		Dry Density, γ_d	91.5 lb/ft^3		
Classification Sandy Clay (CL)		k_{20} at e_o = × 10⁻ cm/sec			
LL 34	G_s 2.70	Project McMICKEN DAM			
PL 19	D_{10}	(Trilby Wash)			
Remarks Specimen submerged at		Area			
0.2 tsf.		Boring No. TT E		Sample No. 61443	
		Depth El 4.0'		Date	
		CONSOLIDATION TEST REPORT			

ENG FORM 1 MAY 63 2090 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

FIGURE 14



Type of Specimen Undisturbed		Before Test		After Test	
Diam 4.4 in.	Ht 1.0 in.	Water Content, w_o	9.5 %	w_f	18.7 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o	0.780	e_f	0.528
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	33 %	S_f	96 %
Compression Index, C_c		Dry Density, γ_d	94.7 lb/ft^3		
Classification Sandy Clay (CL)		k_{20} at e_o = × 10^{-} cm/sec			
LL 34	G_s 2.70	Project McMICKEN DAM			
PL 19	D_{10}	(Trilby Wash)			
Remarks Specimen submerged at 1.6 tsf.		Area			
		Boring No. TT E		Sample No. 61443	
		Depth El 4.0'		Date	
		CONSOLIDATION TEST REPORT			

ENG FORM 2090 1 MAY 63 PREVIOUS EDITIONS ARE OBSOLETE. *(TRANSLUCENT)*

0 3424

FIGURE 15

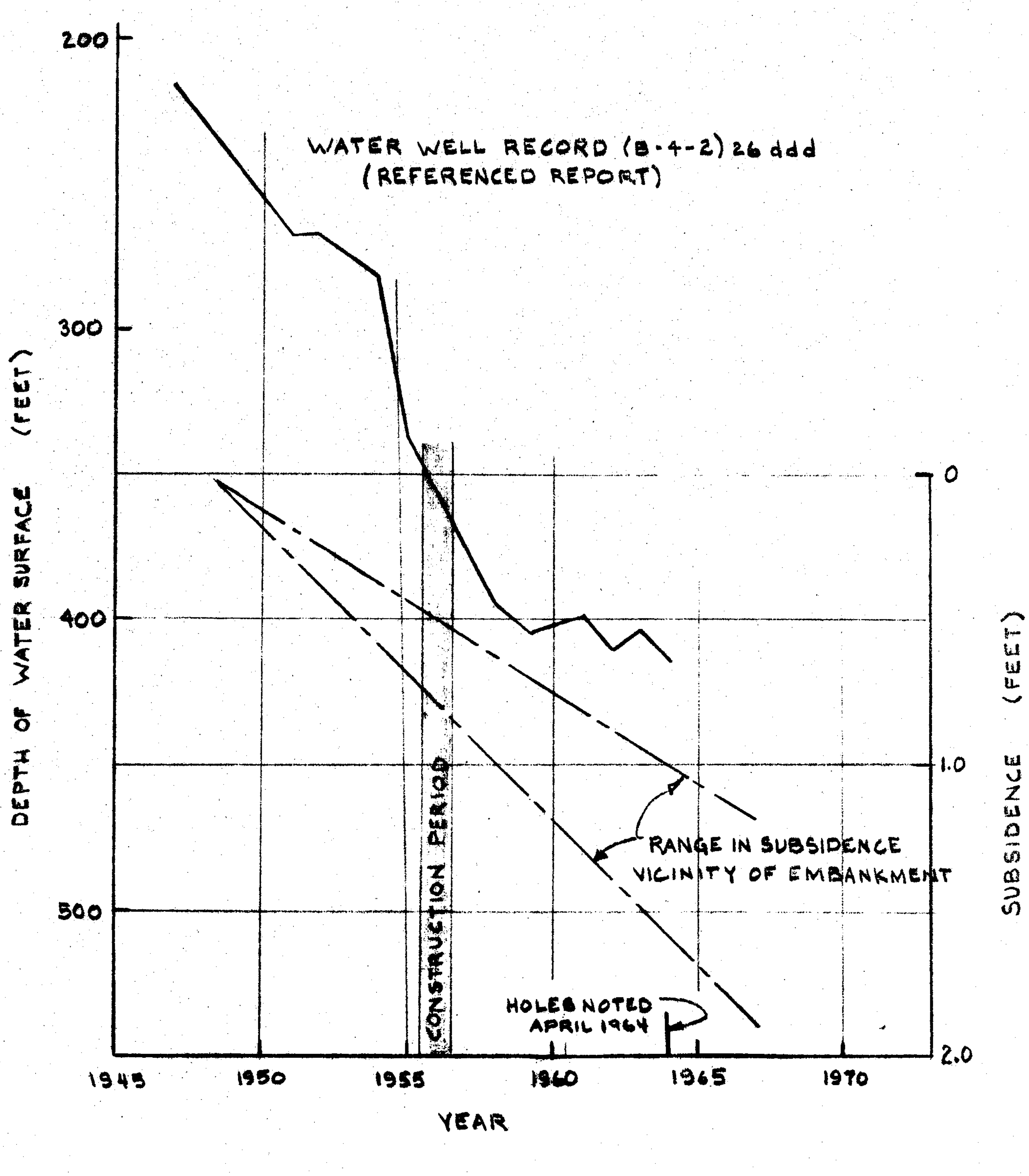
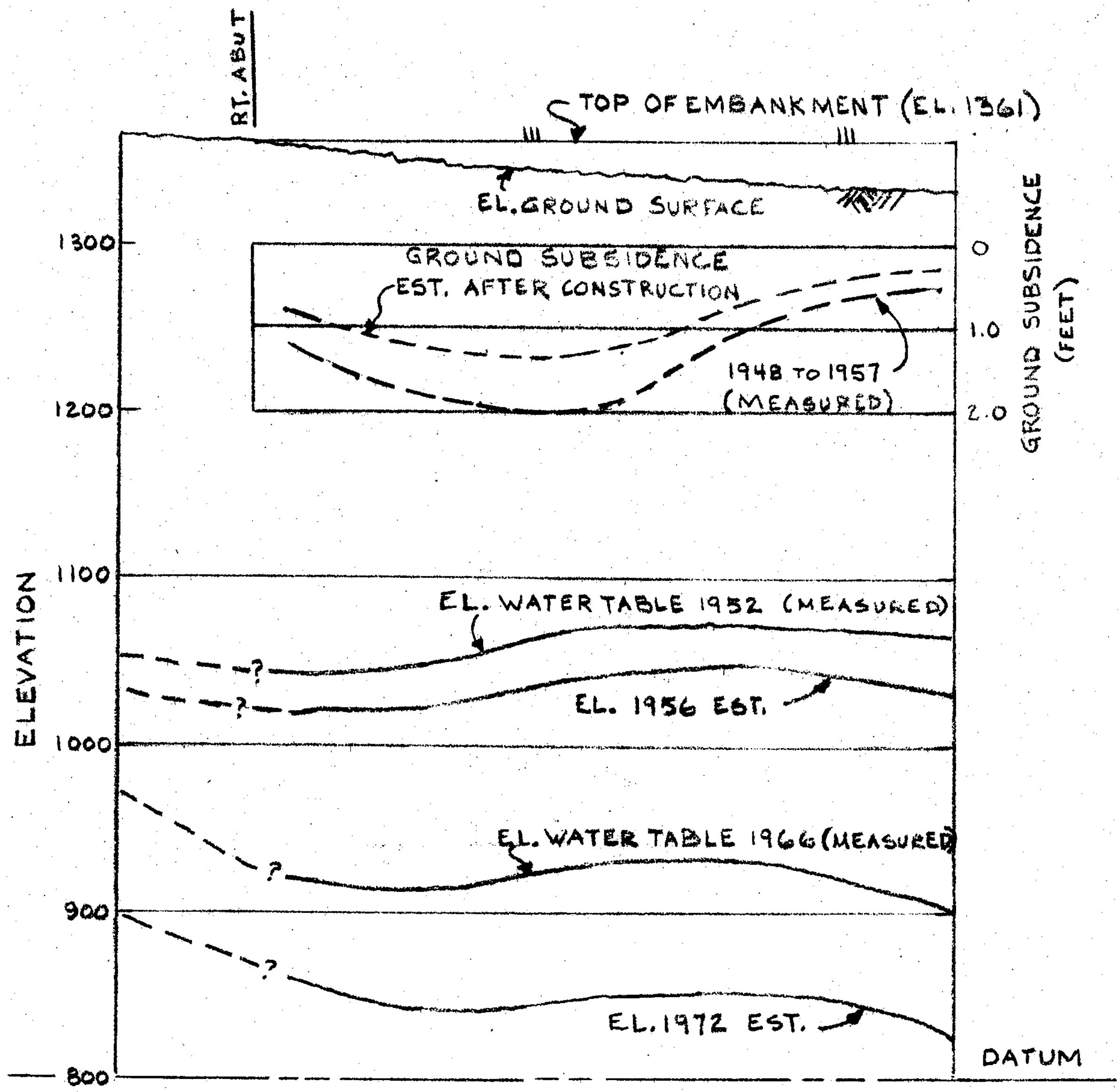
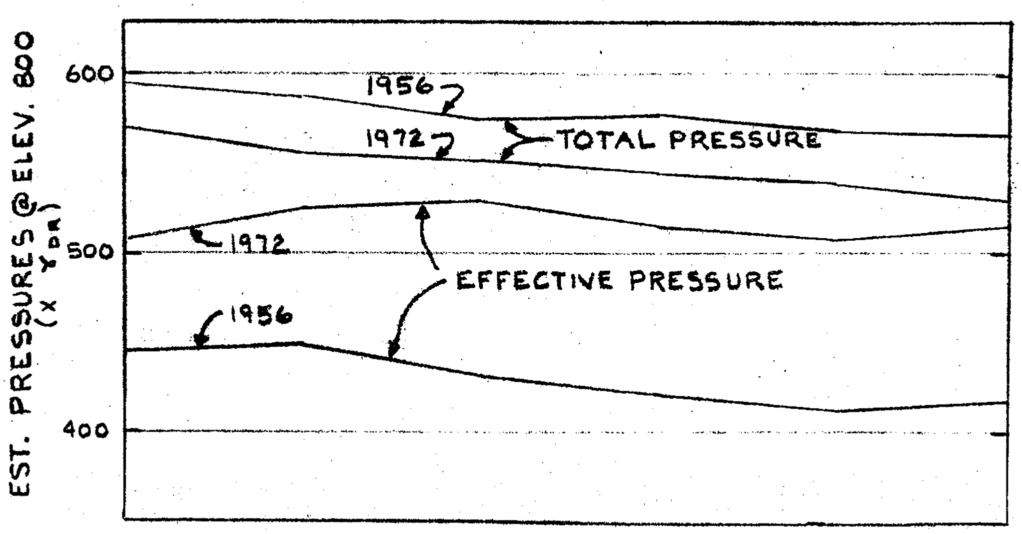

WATER WELL RECORD (B-4-2) 26 ddd
(REFERENCED REPORT)
DEPTH OF WATER SURFACE (FEET)
SUBSIDENCE (FEET)
200
300
400
500
0
1.0
2.0
CONSTRUCTION PERIOD
RANGE IN SUBSIDENCE
VICINITY OF EMBANKMENT
HOLES NOTED
APRIL 1964
1945
1950
1955
1960
1965
1970
YEAR

Figure 16

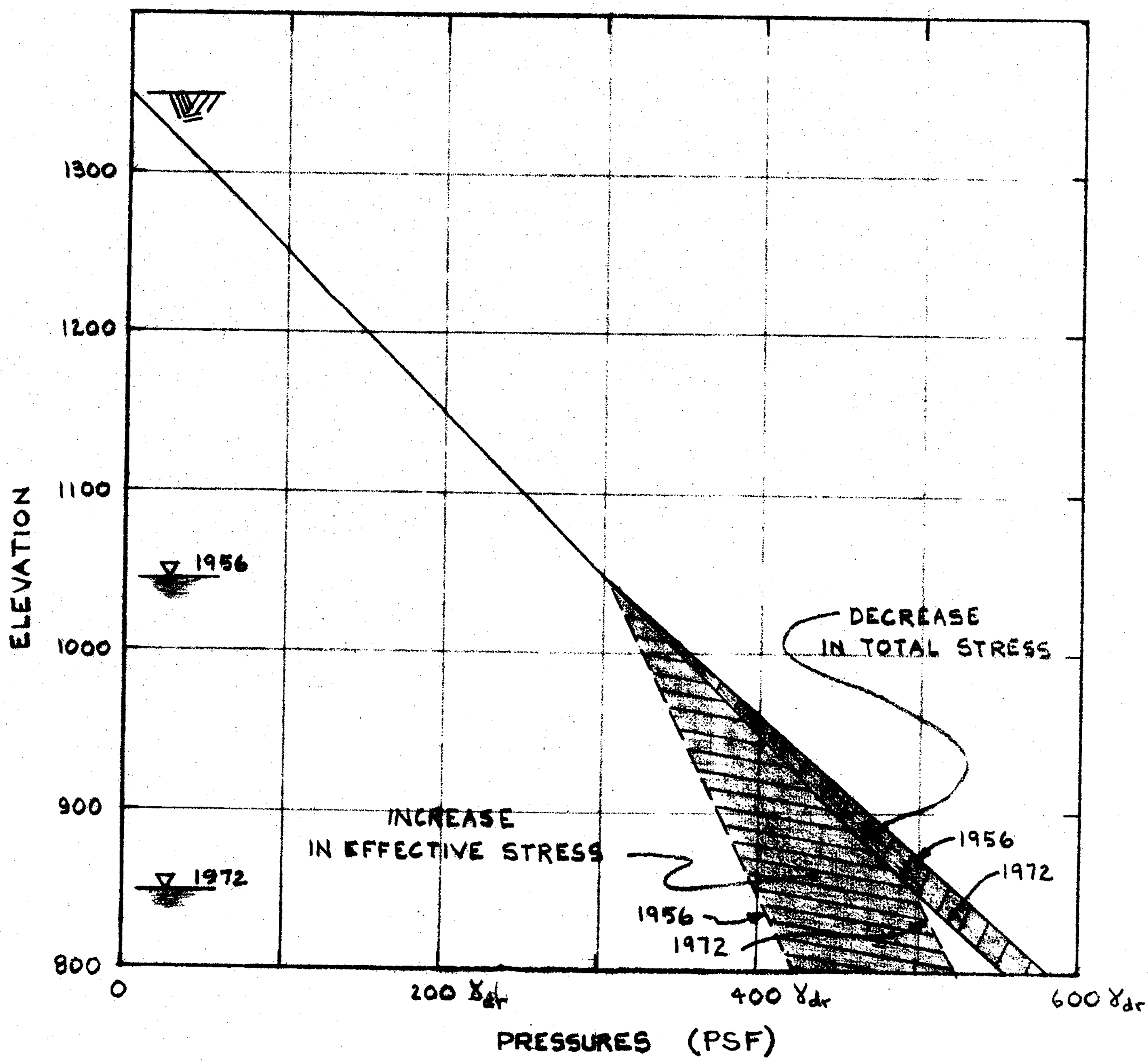


PROFILE ALONG EMBANKMENT



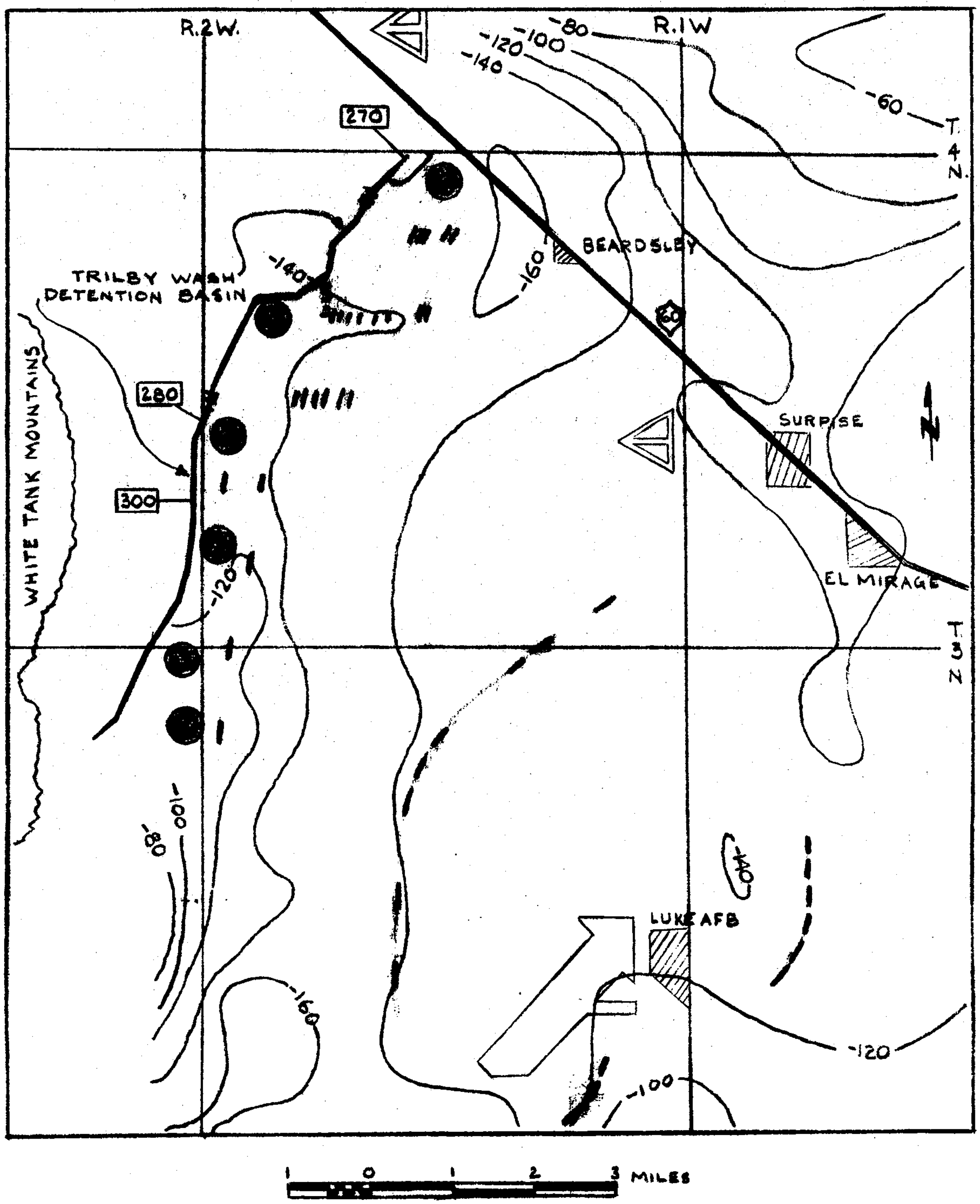
NOTE: PRESSURE EXPRESSED IN TERMS OF γ_{DR};
$\gamma_{SAT} = 1.15\ \gamma_{DR}$; $\gamma' = 0.5\ \gamma_{DR}$ (ASSUMED)

FIGURE 17



TYPICAL PRESSURE DIAGRAM

Figure 18



— — — — EVIDENCE OF SURFICIAL GROUND CRACKING

—80— CHANGES IN GROUND WATER LEVELS 1952 TO 1964 (FROM "BASIC GROUND WATER DATA FOR WESTERN SALT RIVER VALLEY, MARIPOCA COUNTY, ARIZONA." DATED JUNE 1966)

[300] DEPTH TO WATER TABLE, SPRING 1952

● SUBSIDENCE IN FEET (1948-1987)

FIGURE 19

APPENDIX A

TRILBY WASH DETENTION BASIN
LOWER AGUA FRIA RIVER
MARICOPA COUNTY, ARIZONA

REPORT ON PRELIMINARY INVESTIGATION

1. Purpose and scope. The purpose of this report is to present the results of the investigation of the embankment at Trilby Wash Detention Basin. The investigation was made on 7, 8 and 9 March 1972 in a few selected locations to determine the extent of the embankment irregularities.

2. Previous inspections and recommendations. An inspection of the embankment was made by personnel from this office in April 1964. Minor surface erosion in the form of shallow holes was observed on the slopes and the crest of the embankment. It was recommended that the extent and cause of the erosion be determined by means of shallow subsurface excavations.

A report that the holes in the levee were much more extensive than in April 1964 prompted a second inspection by this office in March 1966. The inspection revealed that the slopes and crest contained numerous small holes and tunnels. This condition extended over large sections of the embankment. Most holes were in the upper half of the channel slope and on the levee crest. The depth of the holes and tunnels were reported to be generally less than two feet. The inspection team concluded that the holes were made by burrowing animals and did not create any major problem at that time but that accelerated slope erosion might create serious problems if unattended. On 15 March 1966 the maintenance agency was appraised of the inspection findings and advised that action be taken to exterminate the burrowing animals and excavate the material containing the holes and backfill in accordance with the provisions of the Maintenance Manual.

Further inspection made by this office on 10 May 1966 showed the downstream slope of the dam to be eroded and the holes in the dam unrepaired. These findings were relayed to the maintenance agency on 8 June 1966.

The apparent delay in maintenance action prompted an August 1966 notification of the Maricopa County Board of Supervisors of the needed repairs. The maintenance agency reported to us in October 1966 that they had made a detailed inspection in September and had found the holes were voids resulting from shrinkage cracks and that necessary repair work would be initiated immediately.

The project was again inspected by this office in July 1969 and large voids were found at the locations of holes which previously had been inadequately repaired. It was suggested that a more permanent filler such as lean grout mix be used.

Inspection of the project by this office in May 1970 indicated that holes through the embankment starting at the crest were beginning to reappear. It was again felt that the holes were due originally to rodents and had been enlarged by erosion. The size of the hole could not be determined due to the relatively small crest openings. In September 1971 another inspection was carried out to determine whether the surface irregularities at the crest and the embankment, as indicated by the survey (May 1971) were caused by rodent holes, maintenance equipment, differential settlement or a combination of the above. The investigation was also planned to determine if these irregularities are extensive enough to affect the safety of the structure. It was recommended that the holes be enlarged with a backhoe for inspection and then adequately backfilled.

3. Recent investigation. The investigation was carried out to determine whether the surface irregularities were rodent holes and/or cracks and to determine their extent. The voids being investigated were first filled with a water dye solution in order to make tracing of the void easier. A backhoe was then used to excavate, where possible, the full depth of the void. In each case where a surface irregularity was excavated, pertinent information was recorded and photographs taken to show the extent of the damage. Soil samples, approximately 300 pounds, were taken from the excavations for detailed laboratory analysis. This data and photographs of the excavations are available in the Los Angeles District, Soils Design Section files.

Five excavations were made in the embankment and in all but one, the irregularity was a crack and not a rodent hole as previously thought. A detailed description of the excavations is stated below.

a. Excavation No. 1 was made in the crest of the embankment at Station 467+60, parallel with the centerline and perpendicular to the surface irregularity. Cracks were found to run transversely and longitudinally through the embankment ranging in depth from 6.5 feet to 4.5 feet, respectively. Desiccation was very prevalent for the entire depth of the cracks.

b. Excavation No. 2 was made in the crest of the embankment at Station 460+00 parallel with the centerline and perpendicular to the surface irregularity. A crack was found to run transversely through the embankment and was traced to a minimum depth of 12 feet with an average width of 3/4-inch. The excavation was continued on the downstream slope following the crack to the contact between the subject embankment and an old embankment that was incorporated as a downstream berm during the 1956 construction. A small trench was then excavated along this contact to a depth of four feet. It was observed that the crack continued into the old embankment as well as branching off and running parallel with the contact zone. This cracking had an average width of 1/4-inch and an undetermined depth. The material was desiccated to a depth of 8 or 9 feet, at which point there was a slight increase in moisture content.

c. Excavation No. 3 was made in the crest of the embankment parallel to the centerline at Station 451+48. This trench was perpendicular to a transverse crack which had a minimum depth of 14.5 feet. The width of the crack ranged from 1.5 inches at 6 feet to 1/4-inch at 13 feet. One crack in the end of the trench was observed to run parallel withthe centerline of the embankment and extended 10 feet below the crest. The material was desiccated to a depth of 9 feet at which point there appeared to be a slight increase in moisture content.

d. Excavation No. 4 was made in the crest of the embankment parallel to the centerline at Station 305+00. This trench was perpendicular to a rodent hole which extended down to a depth of 2.5 feet then ran toward the downstream slope where it had six apparent exits.

e. Excavation No. 5 was made in the crest of the embankment parallel to the centerline at Station 283+28. This trench was perpendicular to a transverse crack which extended down to a depth of 9 feet with an average width of 1 inch. The crack stopped abruptly with no tapering. The material was desiccated to a depth 2.5 feet at which point there appeared to be a slight increase in moisture content.

SPL FORM 436
OCT 63
(Replaces SPL 153, 153a & T-40 which may be used)

LABORATORY TEST DATA 1952

SERIAL NO	FLD SAMP NO	DEPTH FT	MECHANICAL ANALYSIS - % FINER											ATTERBERG LIMITS		CLASSIFICATION	DENSITY				
			GRAVEL (")					SAND (#)					FINES				FIELD		OPTIMUM		%
			MAX	3	1½	3/4	3/8	4	10	16	40	100	#200	LL	PI		MC	DENS	MC	DENS	OPT
	4							82	75				27		NP	SM Silty Gravelly Sand	7.1	97.6	8.6	127.0	77
	5							97	89				61	24	4	CL Sandy Clay	10.6	89.8	10.2	123.5	73
	6							96	92				65	42	19	CL Sandy Clay	12.8	86.3	14.4	109.5	79
	7							82	75				20	48	20	SC Clayey Gravelly Sand	11.1	90.8	13.1	117.3	77
	8							98	93				66	28	8	CL Sandy Clay	13.5	73.9	13.0	117.5	63
	9							46	40				8		NP	GW Sandy Gravel	6.9	115.0	9.2	128.5	90
	10							99	95				54		NP	ML Sandy Silt	8.5	85.3	10.2	119.8	71
	11							100	97				60		NP	ML Sandy Silt	9.9	75.7	10.8	121.3	62
	12							98	94				42	27	6	CL Sandy Clay	10.7	83.2	12.6	121.0	69
	13							82	73				27		NP	SC Silty Gravelly Sand	7.2	99.0	7.9	125.0	79

PROJECT & SECTION: TRILBY WASH DETENTION BASIN FOUNDATION DENSITY DATA 1952

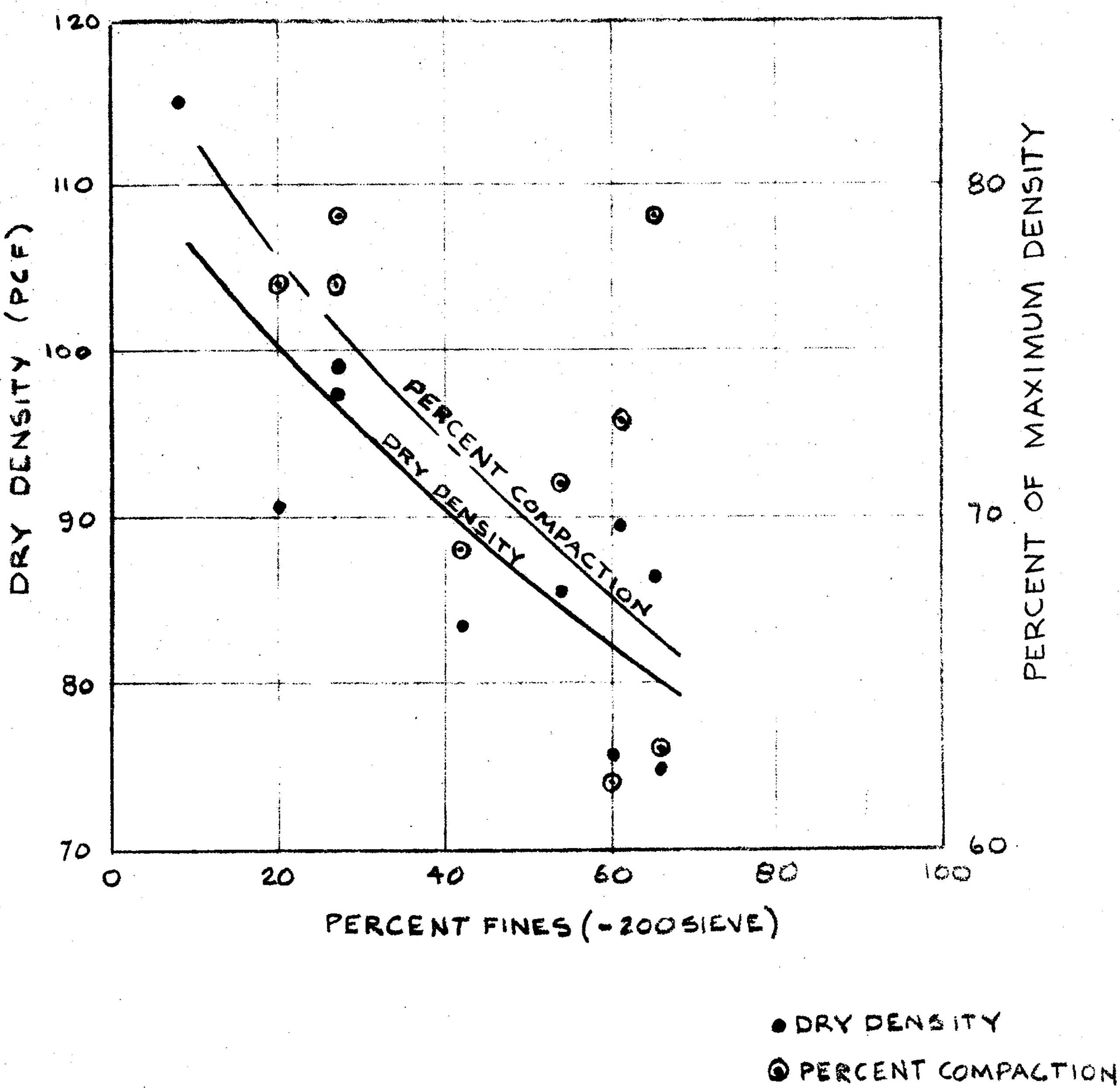
HOLE NO.

SUBMITTED BY

DATE SUBMITTED

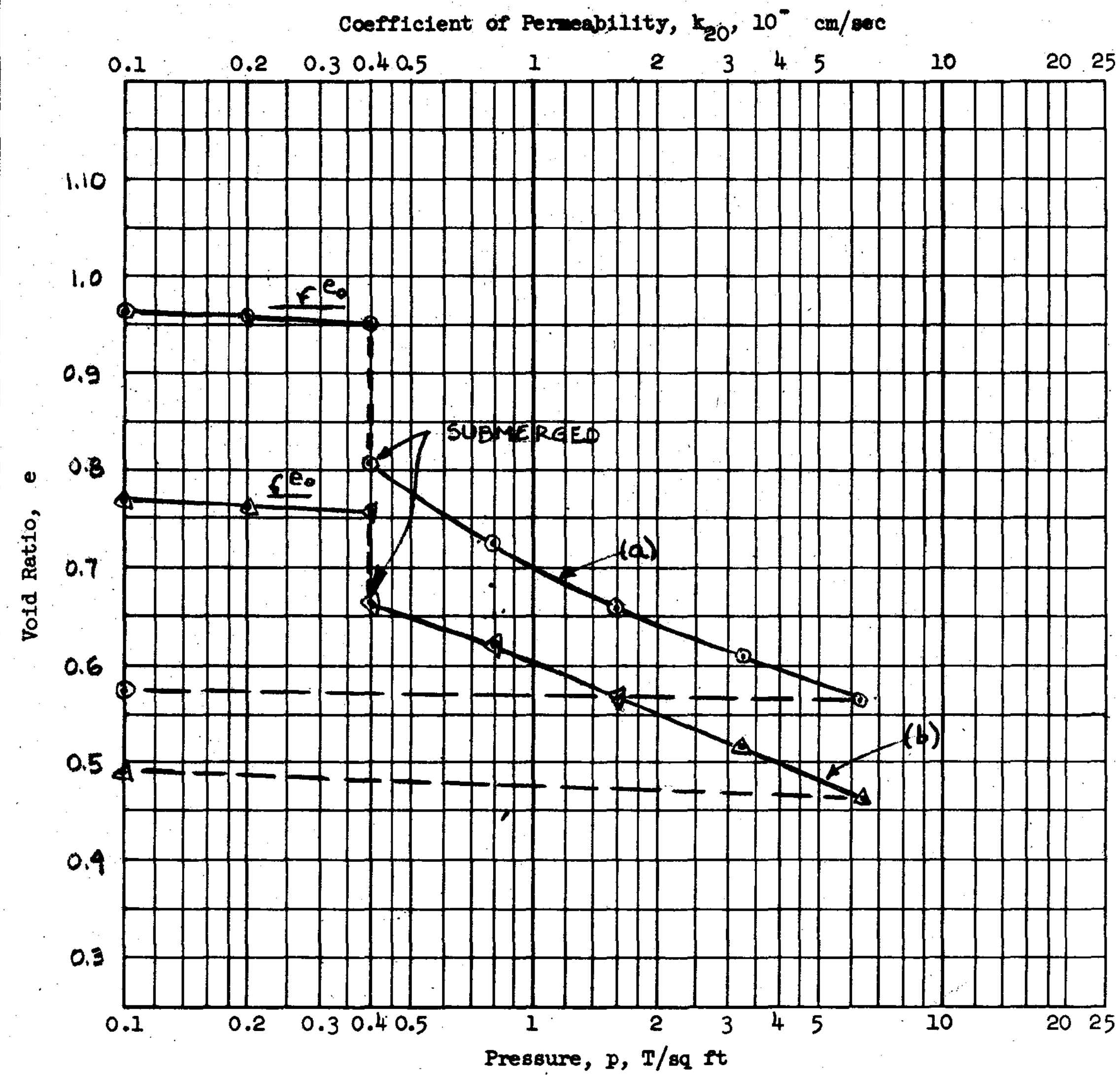
Figure 1

Figure 1



FOUNDATION DENSITY DATA

FIGURE 2



Type of Specimen UNDISTURBED		Before Test		After Test	
Diam 1.0 in.	Ht 4.4 in.	Water Content, w_o	7.1 (a) / 5.8 (b) %	w_f	%
Overburden Pressure, p_o 0.2 (a) / 0.4 (b) T/sq ft		Void Ratio, e_o	.96 (a) / .77 (b)	e_f	.58 (a) / .48 (b)
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	28 (a) / 23 (b) %	S_f	100 (a) / 100 (b) %
Compression Index, C_c		Dry Density, γ_d	99 (a) / 100 (b) lb/ft³		
Classification SANDY SILT (a) ML / SANDY CLAY (b) SC		k_{20} at e_o = × 10^{-} cm/sec			
LL 23 (a) / 40	G_s 2.66 (a) / 2.68	Project TRILBY WASH			
PL 20 (a) / 19	D_{10} 0.015 (a) / 0.004				
Remarks (a) FOUNDATION SAMPLE		Area			
(b) EXISTING LEVEE SAMPLE.		Boring No. 4F-2 (a) / 4F-5 (b)		Sample No. 3758-LA(a) / 3764-LA(b)	
		Depth / El 4-5' (a) / 8.5-9.5' (b)		Date DEC. 1953	
		CONSOLIDATION TEST REPORT			

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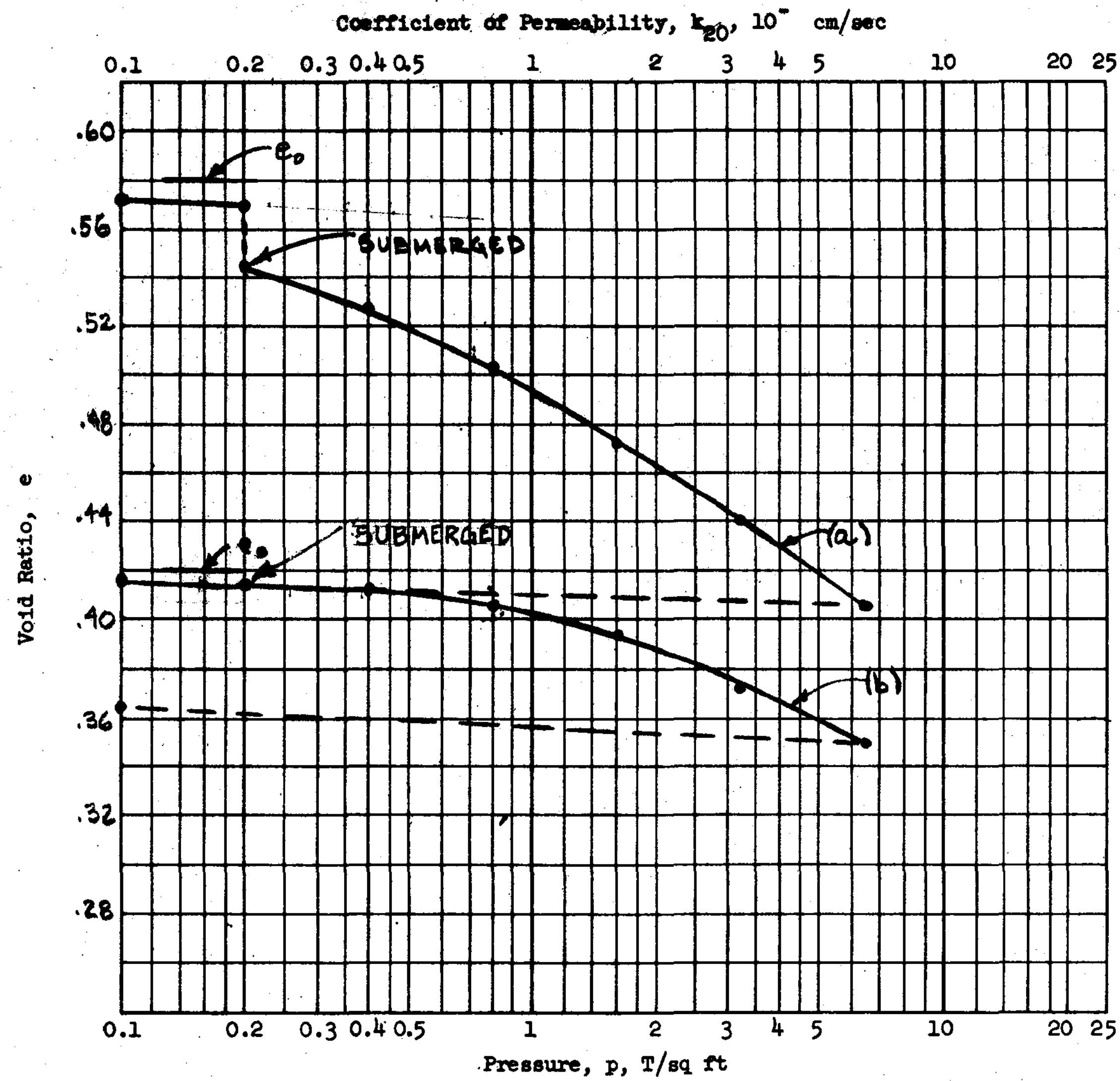
FIGURE 3



Type of Specimen		Before Test		After Test	
Diam 4.4 in.	Ht 1.0 in.	Water Content, w_o	6.7 (a) / 12.5 (b) %	w_f	%
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o	.58 (a) / .42 (b)	e_f	
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	32 (a) / 80 (b) %	S_f	90 (a) / 96 (b) %
Compression Index, C_c		Dry Density, γ_d	109 (a) / 118 (b) lb/ft³		
Classification CLAYEY GRAVELLY SAND SC/SM / SILTY GRAVELLY SAND SM		k_{20} at e_o = × 10⁻ cm/sec			
LL 26 (a) / 25 (b)	G_s 2.75 (a) / 2.70 (b)	Project TRILBY WASH			
PL 20 (a) / 29 (b)	D_{10}				
Remarks		Area STA. 117+00 (a) / STA 481+65 (b)			
		Boring No. TP 55-1 (a) / TP 56-1 (b)		Sample No. 10257 LA (a) / 11223 LA (b)	
		Depth 2-3' (a) / El 2-3' (b)		Date 1955 (a) / 1956 (b)	
		CONSOLIDATION TEST REPORT			

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FIGURE 4

SHRINKAGE LIMIT TEST

Date 26 May 1972

Project Trilby Wash

Embankment			TT-3		TT-5	
Depth			0-5'	5-10'	0-3'	6-9'
Sample No.			#1	#2	#3	#4
Weight in grams	Dish plus wet soil		47.08	39.09	48.27	41.47
	Dish plus dry soil		39.84	32.21	41.62	35.00
	Water	W_w	7.24	6.88	6.65	6.47
	Shrinkage dish		18.92	12.47	18.96	11.15
	Dry soil	W_s	20.92	19.74	22.66	23.85
	Displaced mercury + evaporating dish		336.8	327.9	353.7	357.8
	Evaporating dish		180.0	180.0	180.0	180.0
	Displaced mercury		156.80	147.9	173.7	177.8
Volume in cc	Shrinkage dish (wet soil pat)	V	15.47	14.29	15.31	15.25
	Volume of dry soil	V_s	11.59	10.56	12.83	13.14
	$V - V_s$		3.88	3.73	2.48	2.11
	$\frac{V - V_s}{W_s} \times 100$		18.55	18.9	10.94	8.85
Water content $= \frac{W_w}{W_s} \times 100$		w	34.61 %	34.85 %	29.35 %	27.13 %
Shrinkage limit		SL	16.06	15.95	18.41	18.28
Shrinkage ratio		R				

$$V_s = \frac{\text{weight of displaced mercury}}{\text{specific gravity of mercury (13.53 g/cc)}}$$

$$SL = \text{Water content of wet soil pat} - \left(\frac{\text{volume of wet soil pat} - \text{volume of oven-dry soil pat}}{\text{wt of oven-dry soil pat}}\right)$$

$$= w - \left(\frac{V - V_s}{W_s} \times 100\right)$$

$$R = \frac{\text{wt of oven-dry soil pat}}{\text{volume of oven-dry soil pat}} = \frac{W_s}{V_s}$$

Classification: ______

Remarks ______

Technician ______ Computed by LAK Checked by MPC

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