FOUNDATION CONSOLIDATION UNDER EARTH DAMS

DURING AND IMMEDIATELY FOLLOWING CONSTRUCTION OPERATIONS

By

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PREFACE

The experiments discussed in this thesis are the first part of a series of such tests to be conducted by construction personnel of the Upstream Flood Prevention Section of the United States Department of Agriculture, Soil Conservation Service. Material and personnel services were furnished by the Soil Conservation Service.

The author is grateful to Messrs. Charlie M. Moore, Head, Design Section, Engineering and Watershed Planning Unit, Soil Conservation Service, Fort Worth, Texas, and Glenn A. Beecham, Construction Engineer, Soil Conservation Service, Clinton, Oklahoma, for making available the facilities and the assisting personnel for the tests. The author is especially grateful to Mr. Frank Gordon, Supervising Engineering Aide, for his valuable and tireless assistance throughout the testing period.

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I. INTRODUCTION

General

The design of earth dams in the Barnitz Creek subwatershed of the Washita River in Oklahoma (Figure 1) presented the Design Section of the Engineering and Watershed Planning Unit of the Soil Conservation Service with several difficult problems. First, it was quite obvious from the site borings that it would be impractical to design positive cut-off cores through the alluvium which extends to depths of as much as seventy feet. Second, the analysis of the borings showed that nearly every dam site had some gypsum dispersed in the foundation and borrow material. There were, also, layers of very hard gypsum, alabaster, to be reckoned with in the abutments of many of the sites. There were, in addition to the special problems, the usual design problems presented by relatively small earth dams, constructed from non-uniform borrow materials, and built on narrow valley floors and steep abutments.

The first of the problems was handled by designing shallow cutoffs and providing for control of the seepage through the alluvium through the use of lateral toe drains within the embankment foundations and/or relief wells at the downstream toe of the dam. The toe drains were also designed to control the phreatic line in the embankment and the relief wells were designed to relieve the hydrostatic pressure on the dam.

Exhaustive laboratory testing and analyses indicated that the alluvial material containing gypsum had sufficient shear strength to support

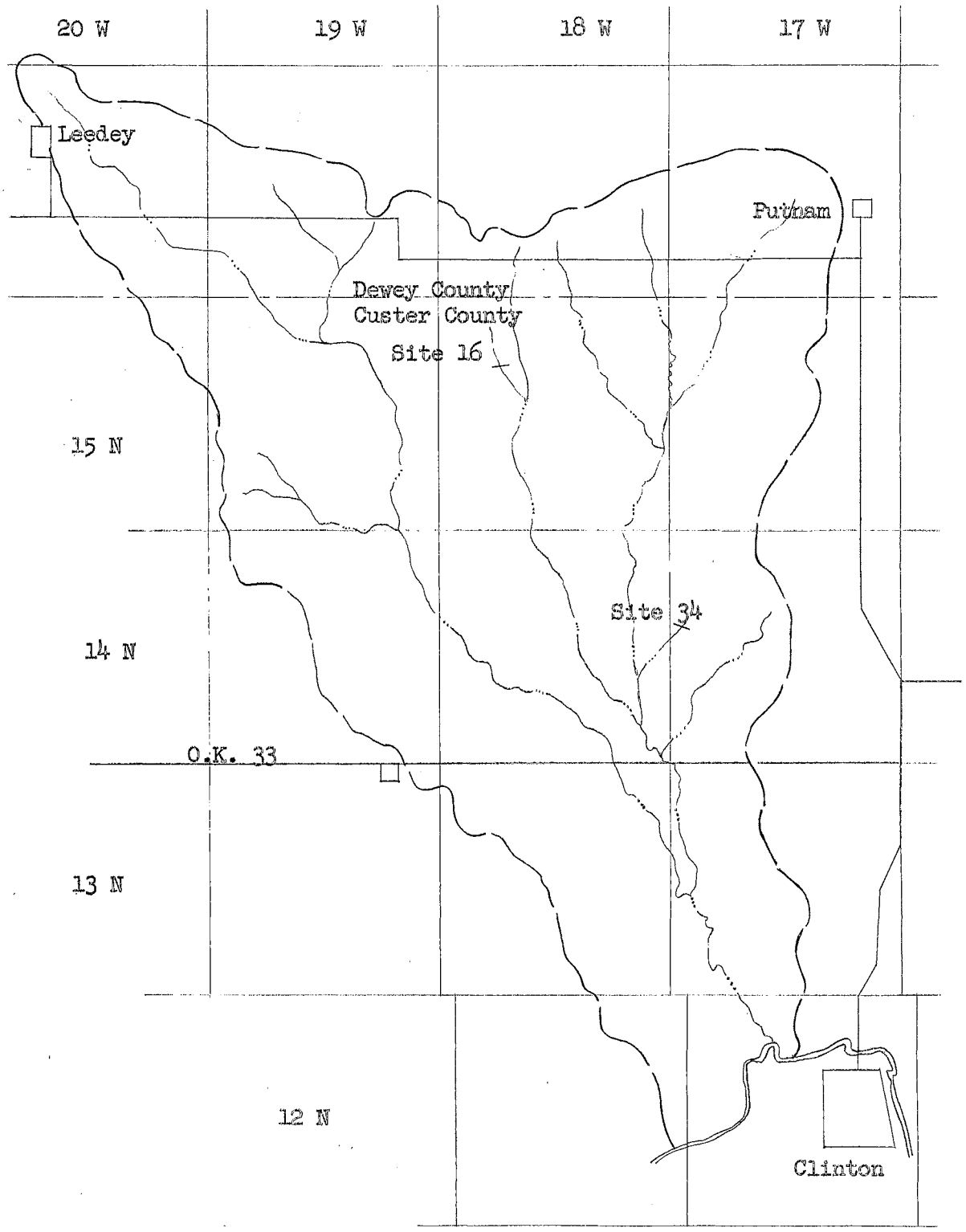

Figure 1. Barnitz Creek Watershed Map; Sites 34 & 16 shown

the thirty to fifty feet of earth which was to be placed upon it. Consolidation tests indicated that the foundations would not settle sufficiently to cause failure of the structure and compaction testing showed that the borrow materials would make satisfactory fills if selective borrowing schedules were followed. All cutoffs were designed to extend through the gypsum layers in the abutments.

A comprehensive plan of field testing to supplement the laboratory findings was drawn up early in 1954 by the various responsible authorities of the Soil Conservation Service. The purpose of these tests was to correlate the laboratory analyses with actual field conditions and thereby improve the designs for the earthen structures.

The author was directed to ascertain the relationship between the foundation consolidation under the earth fills as estimated from laboratory tests and that which occurred in the field. The tests were to begin with construction operations and continue through the construction period and for a time afterward. The method of testing was to be set up by the author, and all work and results were to be his responsibility.

Two dam sites were selected from the contracts that were being supervised by the author at that time (May, 1955). They were chosen because they both were to have shallow cores, relief wells and other characteristics that made them representative of the sites of the Barnitz Creek watershed. Of the two sites, Site No. 16 is in the north central part of the watershed and Site No. 34 is in the east central portion.

Description of Dam Site No. 34

Site 34 (Figure 2) is located in Section 18, Township 14 North,

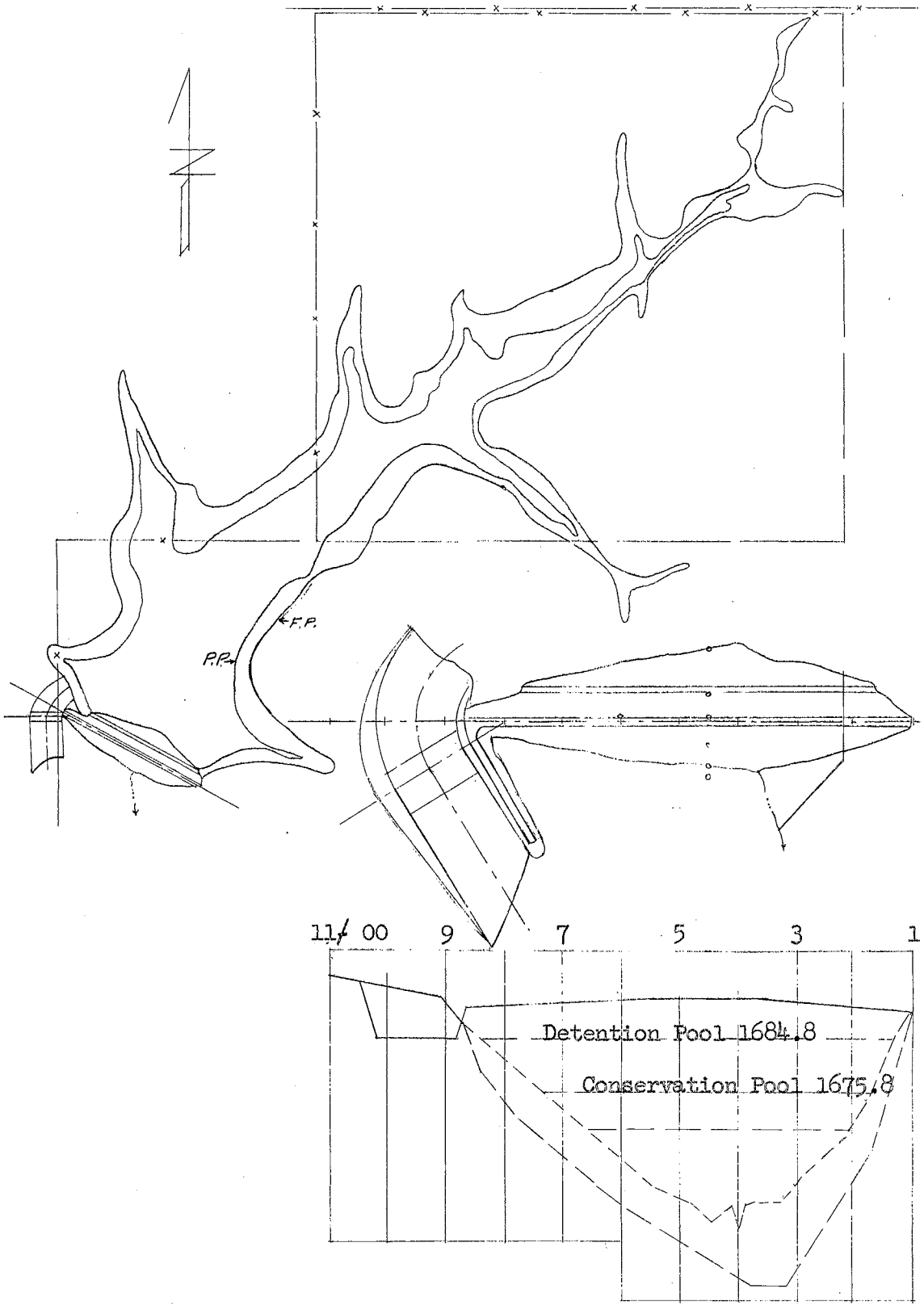

Figure 2. Plan and Profile of Site No. 34, Barnitz

Range 17 WIM, approximately twelve miles north and three miles west of Clinton, Oklahoma in Custer County. The dam is approximately eight hundred feet long and the maximum fill height is forty feet. The slopes of the dam are 3:1 upstream and 2:1 downstream. The upstream slope is broken by a ten foot berm one foot below the sediment pool elevation and the crest of the dam is fourteen feet wide. The embankment, which contains approximately sixty-eight thousand, five hundred cubic yards of earth, is a homogeneous earth fill.

The principal spillway consists of a thirty-inch square concrete drop inlet with uncontrolled orifice. The water is carried through the embankment by a reinforced concrete conduit twenty-two inches in diameter. The auxiliary spillway is an excavated earth channel one hundred forty feet wide.

The dam site is underlain by Rush Springs Sandstone of the Permian Age. On both abutments the parent material is covered by residual soils formed by the decomposition of the bedrock. The parent material of the upper slopes is Cloud Chief Gypsum of the Permian Age. The overburden is shallow (two to five feet) on the east abutment and the extreme west abutment. It reaches depths of fifteen feet or more on the lower west abutment and has a higher silt content than the areas noted above. There is an average of one per cent of gypsum by volume in the abutment materials.

The three hundred feet of valley floor is overlain by a mantle of very fine to coarse, silty sand. This sand becomes coarser with depth. It is reddish brown in color and extends to depths greater than thirty feet at the stream channel. There is a water-bearing stratum five feet in thickness at a depth of nineteen feet below the surface. The water

carried by this aquifer is intercepted by two relief wells equipped with screens and carried to the stream channel in the well collector lines. These wells are set approximately fifteen feet from the downstream toe of the dam on each side of the stream channel. The core of the dam extends to parent material on the abutments and to a depth of fifteen feet into the alluvium.

The abutment materials have an average unit weight of 1.50 gm/cc (93.6 pcf) in situs. They are composed of fifty-six per cent sand, thirty-two per cent silt and twelve per cent clay. Standard Proctor tests on these soils result in a dry unit weight of 114.0 pcf. at an optimum moisture content of thirteen per cent.

The alluvial materials have an average volume weight of 1.60 gm/cc (99.8 pcf) in situs. These soils consist of an average of fifty-five per cent sand, thirty-one per cent silt and fourteen per cent clay. The compacted unit weight averages 114.0 pcf. at optimum moisture (thirteen per cent) under Standard Proctor conditions.

Description of Dam Site No. 16

Site 16 (Figure 3) is located in Section 8, Township 15 North, Range 18 WIM, approximately eighteen miles north and nine miles west of Clinton, Oklahoma in Custer County. The dam is approximately seven hundred seventy feet in length and has a maximum fill height of thirty-seven feet. The slopes of the dam are 3:1 upstream and 2:1 downstream. The upstream slope has a ten-foot berm one foot below the sediment pool elevation. The crest width of the dam is fourteen feet. The dam is a homogeneous earth fill and contains approximately sixty-two thousand cubic yards of soil.

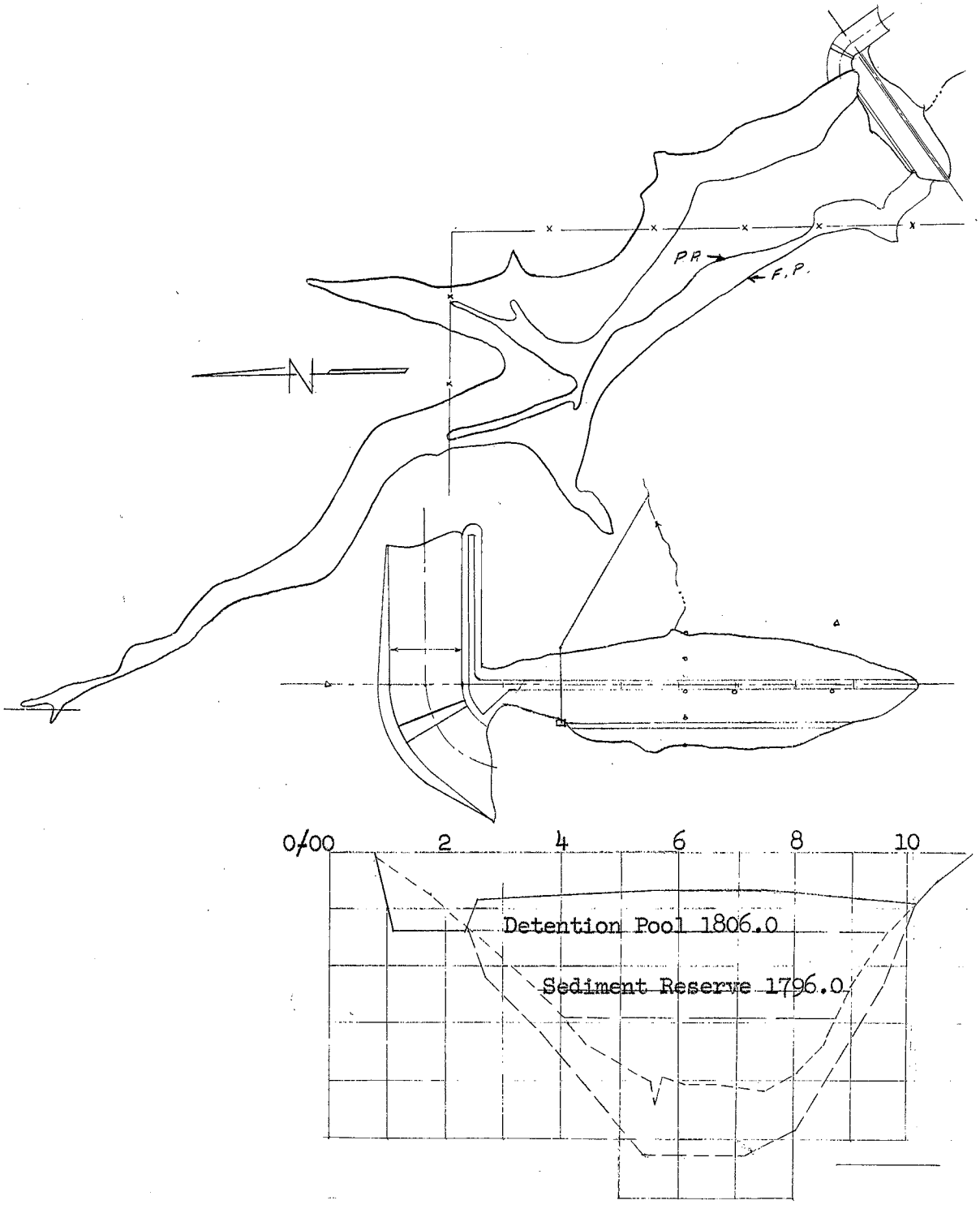

Figure 3. Plan and Profile of Site No. 16, Barnitz

The principal spillway is a thirty-inch square, concrete, drop inlet with uncontrolled discharge. The water is carried under the dam by a reinforced concrete conduit fourteen inches in diameter. There is a fifteen-inch gate valve in the bottom of the drop inlet to further control the water surface. The auxiliary spillway is an excavated earth channel one hundred twenty-five feet in width.

The dam site is underlain by Rush Springs sandstone and siltstone. The colluvial soils consist of unconsolidated, very fine sand and silty sandbeds. These beds occur at a shallow depth beneath a friable soil mantle two to three feet in thickness. These colluvial soils are from two to fifteen feet in depth. They have a gypsum content of one to two per cent.

The three hundred feet of valley section overlain by alluvial beds to an average depth of twenty feet with a much greater depth at the stream channel (thirty-five feet or over). These soils are very fine, silty sands and silts at the surface and grade downward into medium to coarse sands containing some clay at depths of fourteen to twenty feet. The clay occurs in one-inch layers and is followed by two-inch bands of coarse sand. The water carried by these coarse sand aquifers is intercepted by two relief wells placed west of the stream channel near the downstream toe of the embankment.

Laboratory analyses indicate that the abutment materials have an average volume weight of 1.65 gm/cc (103.0 pcf.) in original position. They consist of the following average proportions of sand, silt and clay: Fifty-four per cent sand, twenty-one per cent clay and twenty-five per cent silt. Standard Proctor Compaction Tests on these soils indicate that a maximum dry unit weight of one hundred twelve pounds

per cubic foot can be attained at an optimum moisture content of fourteen per cent.

The alluvial materials have an average unit weight of 1.60 gm/cc (99.8 pcf.) in situs. These soils average forty-eight per cent sand, thirty-one per cent silt and twenty-one per cent clay. Standard Proctor Compaction Tests on these soils resulted in a maximum dry unit weight of one hundred ten pounds per cubic foot at an optimum moisture content of fourteen and one-half per cent. The gypsum content of these soils varies from one-half per cent to over four per cent.

II. OBJECTIVES

The general objectives of this study were to determine the foundation consolidation under earth dams through field investigations and to correlate these findings with those obtained by laboratory testing.

To accomplish these general objectives, the test program was designed with the following specific objectives:

1. To measure the foundation consolidation (settlement) of the dams at various points in typical embankment cross-sections in the alluvial areas of the foundations.
2. To measure the foundation consolidation at points of maximum load in the colluvial sections of the foundation.
3. To correlate the alluvial settlements with the colluvial settlements and thereby obtain results useful in estimating the differential settlements under structures to be built in the future.
4. To correlate the field data with those from the laboratory.

III. REVIEW OF LITERATURE

The compression of a soil occurs mainly as a function of a decrease of the volume of the voids. By comparison, the component of compression produced by a decrease of the volume of the grains of the solid skeleton is negligible. If the voids of a soil are entirely filled with water, measurable compression can occur only as a result of the escape of excess water from the voids. Gradual compression of a soil under such conditions, when induced by static forces of gravity, such as the weight of the soil itself or of structures erected upon it, is termed "consolidation." It should not be confused with "compaction," which is the artificial compression of a soil by mechanical means.

If a saturated soil is quite pervious, e.g., a clean sand, its consolidation under newly applied static loads will be almost instantaneous, since excess water has no difficulty in escaping from the voids. On the other hand, if the saturated soil is a clay with low permeability, its consolidation will be quite slow, since any excess water in the voids will take time to be squeezed out toward pervious boundaries of the clay layer.

When a load is applied to a fully saturated cohesive soil in its plastic range of consistency, the entire compressive stress "p" created by the load is at first carried by the water in the voids. It is then said that $p = u$, where "u" is the stress in the water which resulted from the application of the pressure "p". The stress "u" is termed "neutral stress." Other terms frequently used to designate the stress

"u" are "hydrostatic excess pressure" or "excess pore pressure."

As time goes by, some water is squeezed out of the clay and escapes through the pervious boundaries of the clay mass where such pervious boundaries are available. The decrease of the volume of the voids of a fully saturated clay corresponds to the amount of water squeezed out. As a result of this process, the solid grains of the soil skeleton are brought into closer contact with each other and, therefore, take up some of the newly applied load. The stresses thus created in the soil skeleton are called effective stresses "f_e". Any decrease of the neutral stresses of the water in the voids must correspond to an equal increase of the effective stresses in the solid skeleton, and vice versa. The sum of the effective stresses "f_e" and the neutral stresses "u" at any point and at all times must remain constant and equal to the applied pressure "p".

$$p = u + f_e$$

When all the pressure has been transferred to the soil skeleton so that $p = f_e$, the neutral stress or excess pore pressure "u" becomes equal to zero. Flow of water from the voids and further compression of the clay will then cease. The consolidation has reached 100 per cent of its final value. Intermediate states in this process can be defined by the "percentage of consolidation."

$$U = S/S_2 \times 100$$

where S = linear change of length of a soil specimen or settlement of a layer during one-dimensional vertical consolidation at the consolidation stage to be defined.

S_2 = linear compression or settlement at the final stage of consolidation.

The rate at which the volume change, or consolidation, occurs in a soil is directly related to the permeability of the soil because the permeability controls the speed at which the pore water can escape. The permeability of most sands is so high that the time required for consolidation after a load application can be considered negligible, except for cases where a large mass of sand is subjected to a rapid shear or shock. On the other hand, the low permeability of clay makes the rate of volume change after a load application, a factor which must be considered. Laboratory consolidation studies, therefore, are almost entirely limited to soils of low permeability.

In nature all sands are more or less stratified. The compressibility of a stratified deposit in the direction of the bedding planes is somewhat smaller than that in the direction at right angles to them. In addition, most natural sands contain at least traces of cementing material, and above the water table they also contain some soil moisture. Both ingredients produce cohesion. Furthermore, some sands in the natural state have a relative density greater than that which can be obtained by any artificial means other than vibrations. Other sands in a natural state have a much more unstable structure than that of the loosest sand specimens which can be prepared in the laboratory. These facts suggest that the structure of sands in their natural state may be slightly different from that of the same sands in samples made in the laboratory. Sands in natural state often have a honeycomb structure that is the result of their being deposited by water. However, if the void ratios of the sands are the same in both states, the compressibilities are also likely to be approximately equal.

In connection with practical problems, the compressibility of confined strata of dense sand can usually be disregarded. As a consequence, the compressibility of sand has not been extensively investigated. A dense sand expands when it is acted upon by vibrations or has a load that changes (alternately increases and decreases). The volume of a loose sand is reduced when the sand is deformed by the application of loads. These changes in volume may happen suddenly because of the fact that practically all of the strength of sands is made up of the frictional resistance between the soil grains.

If the soil beneath a structure contains layers of sand or stiff clay alternating with layers of soft clay, the compressibility of the sand and stiff-clay strata can be disregarded.

Settlement Analysis

Settlement analysis is the investigation and the detailed study of all factors which affect settlements. Of particular importance for foundation design is the knowledge of: (a) the distribution in plan of settlements; (b) the final value of the settlements; and (c) the rate of the settlements.

The settlements themselves may be caused by the combined effects of vertical consolidation and lateral and upward displacement due to lateral pressures and to shearing stresses. The settlement component due to lateral and vertical displacement is of practical importance mainly in the case of soils with little shearing strength, such as very soft clays which can be easily displaced like a viscous fluid. In all other soils the effects of the settlement component due to vertical consolidation usually predominate. For that reason, settlement analyses

are, as a rule, limited to the study of this latter component. (They are in this report).

The final value of the settlement of a certain point of the foundation is obtained as follows: The increment of vertical pressure caused by the foundation loads at several elevations of the underlying compressible layers is computed. The corresponding values of the moduli of volume change (m_v') are determined from laboratory consolidation tests on undisturbed samples. The settlements for each layer are then computed and totaled to give the final value of the surface settlement. The soil layer within which 75 per cent of the surface settlement originates is called the "seat of settlement."

It should be realized that soil samples are subject to many types of disturbance, and that the verification of settlement forecasts by systematic regional field observations on actual structures is essential. Most observations carried out so far indicate that the observed settlements, as a rule, are somewhat smaller than the ones forecast on the strength of laboratory consolidation tests, in spite of the fact that the latter take into account only one of the two theoretically possible settlement components.

There are three main types of time-settlement curves of actual structures. In the first type, most of the settlement occurs during construction. This is the case of foundations resting on compact pervious soils. In the case of structures supported by clay and silt soils, the shape of the time-settlement curve varies, depending on whether primary or secondary time effects predominate. If the soil follows the laws of Terzaghi's theory of consolidation, the settlements will decrease progressively and will stop entirely after a certain

period of time following the end of construction. The time-settlement curve will have a parabolic shape. This is the second type of curve. In the third type, the time-settlement curve may have the shape of a straight line, either from the very start or as a tangent to the initial parabola. This may indicate one of two things: Either the settlements are caused by possible dangerous shearing deformations of the entire soil mass, or the structure of the soil is such that the slippage of grain upon grain delays the consolidation. Such so-called secondary time effects will, however, also show up during a laboratory consolidation test. (1), (2), (3), (4) and (5).

IV. APPARATUS AND METHODS OF PROCEDURE

Description of Gages

The settlement gages used in the field studies consisted of the following elements (Figures 4, 5 and 6):

1. A circular steel plate three-eights of an inch thick and two feet in diameter. The plate was so designed to assure that it would not buckle under load and would cover a relatively large area of the foundation.
2. A one-inch steel pipe coupler which was welded to the center of the steel plate. This coupler joined the plate and the first joint of the one-inch gage pipe. Great care was exercised during the welding operations to assure that no warping of the plates would occur.
3. A joint of one-inch galvanized pipe was threaded into the plate coupler forming a solid unit with the plate. Additional joints of one-inch pipe were added as the work progressed. These joints were cut in various lengths to conform with the fill slopes and construction progress. Most of the joints were six feet in length.
4. A joint of two-inch pipe was placed outside the one-inch gage pipe. This pipe served to protect the one-inch gage pipe from the placed fill so as to assure free movement of the internal pipe with the gage plate. The first two-inch pipe joint was cut one foot shorter than the gage pipe joint to allow for

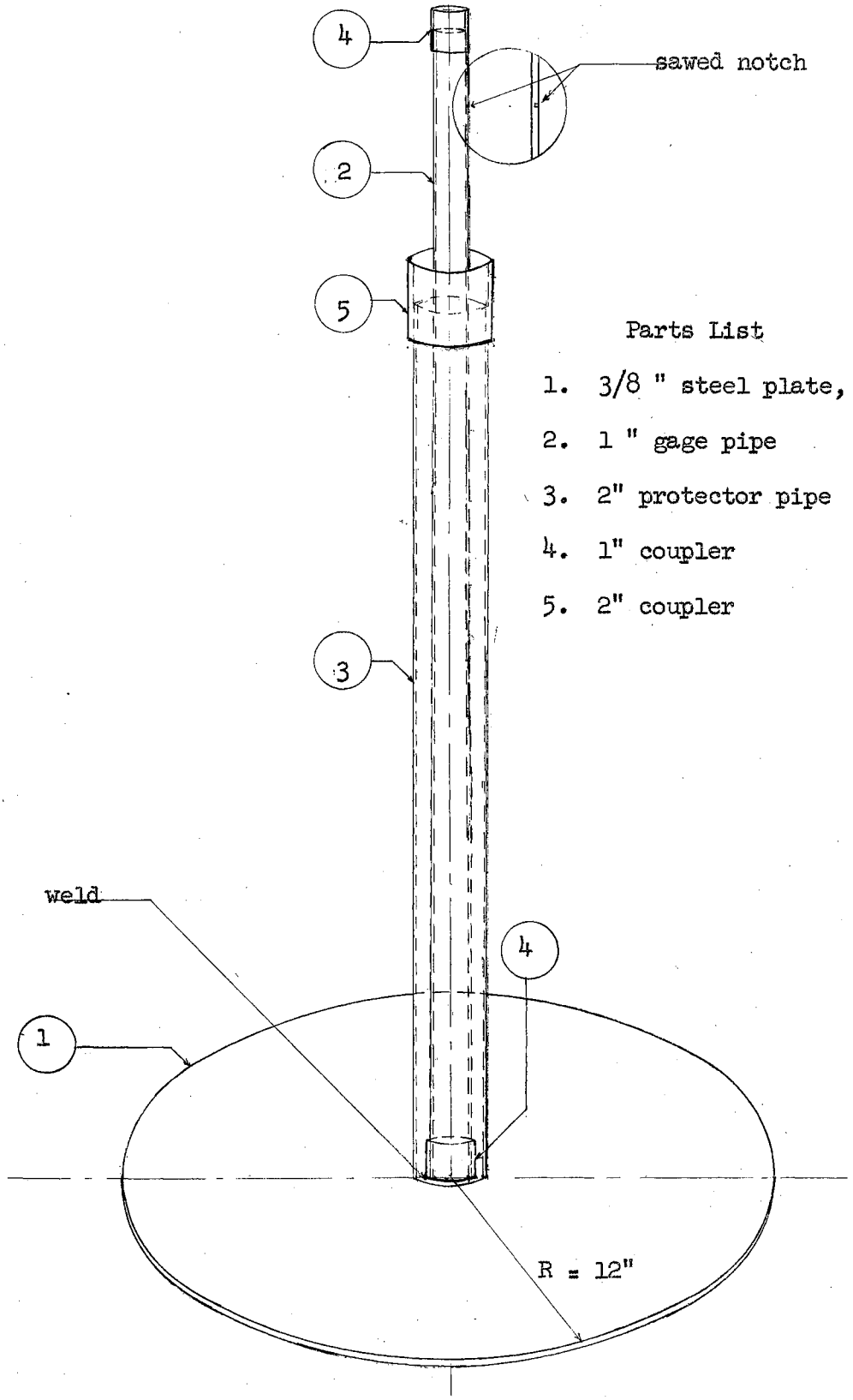

Figure 4. Drawing of Consolidation Gage

Figure 5. Basic elements of consolidation gages showing 24" plate, 1" union, 1" gage pipe and 2" protecting pipe

Figure 6. Basic elements of consolidation gages showing relative location of pipes.

Figure 7. Relief Well No. 1 - Site 34. Remaining steps: Installing well cover and covering collector line with earth.

Figure 8. Relative location of Relief Well outfall lines, Relief Well No. 2 and gages in 2:1 slope of Site 16.

marking and checking the one-inch pipe. Each succeeding joint was the same length as the joint of the one-inch pipe; therefore, the one-inch pipe extended one foot above the protective two-inch pipe at all times.

These gages are very similar to those employed by Frank Bell in his Georgia experiments. (6)

Location of Gages

The gages were located in an alluvial section opposite one of the relief wells (Figures 7 and 8). They were installed in the approximate centers of gravity of the front (3:1) and back (2:1) sections of the embankments. An additional gage was placed in the core backfill material. This gage was offset toward the 3:1 toe far enough from the center of the dam to allow free movement of construction equipment in the core and on the crest of the dam during finishing operations.

A study of the temporary bench marks on Site 34 in the early stages of construction indicated that the bench marks in the lower sections of the valley floor were settling. Settlement gages were added at the toes of the front and back slopes to determine the extent of the settling at these points. This procedure was followed from the beginning of the study on Site 16. The addition of the two gages made a total of five in the alluvial cross sections. The gages were numbered consecutively from the 3:1 toe to the 2:1 toe; e.g., the 3:1 toe gage was number one.

The gaged alluvial section on Site 34 was perpendicular to dam centerline station 4 + 50. This station was only a short distance from the base of the west abutment of the site; so, only one additional gage

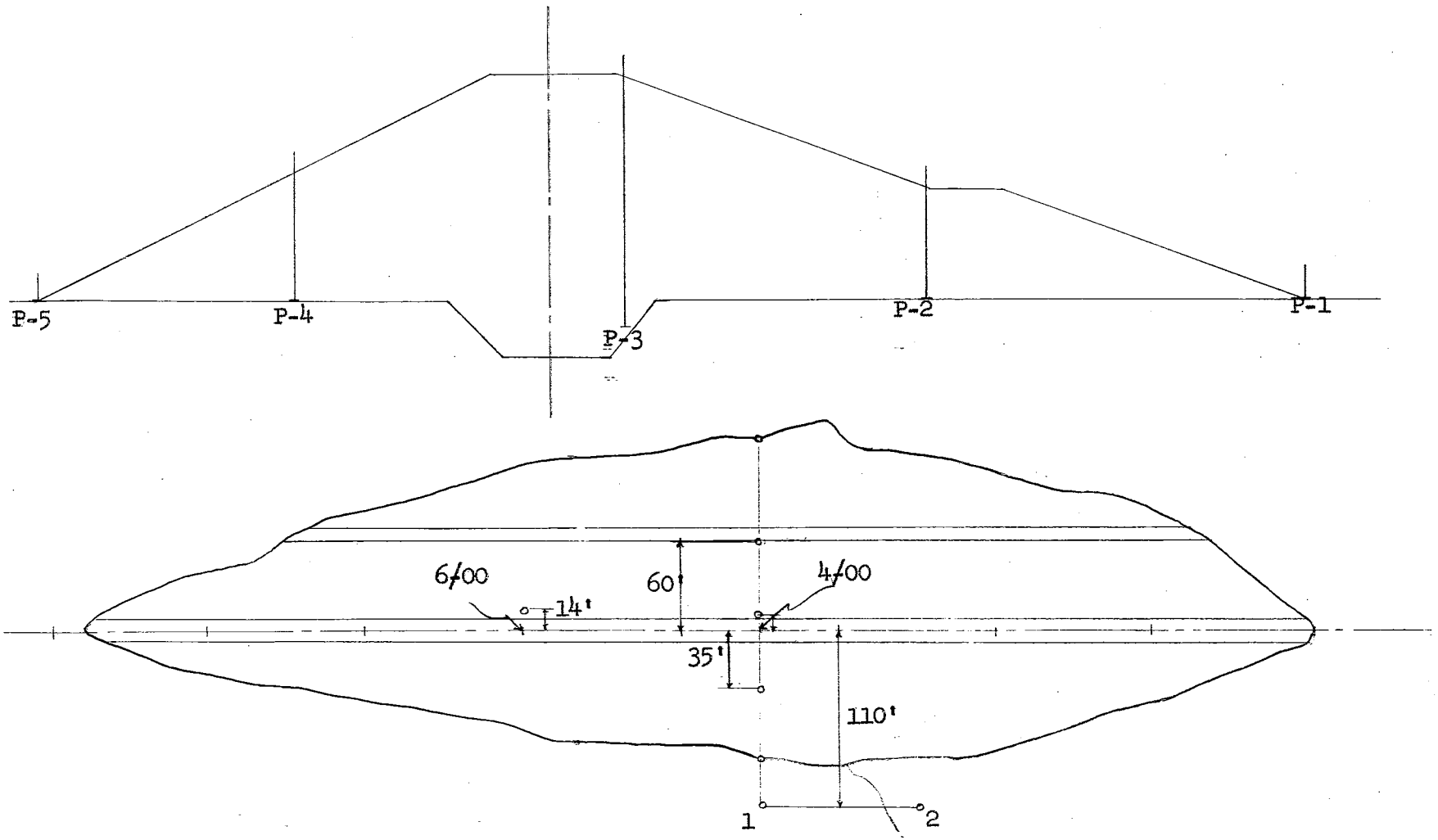

Figure 9. Gage Location - Site 34

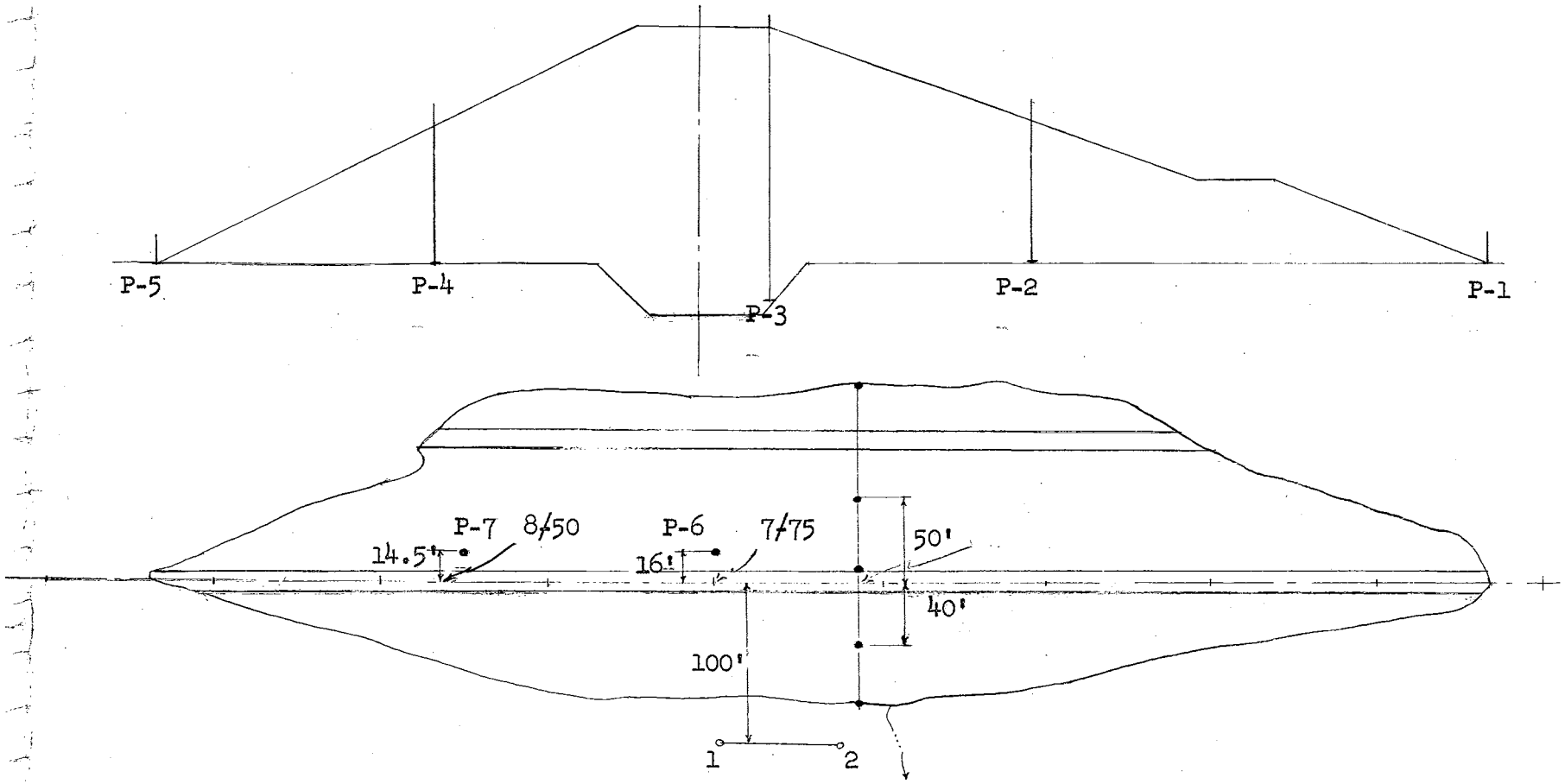

Figure 10. Gage Location - Site 16

was required to produce comparative data between alluvial and colluvial foundation consolidation. This gage was located fourteen feet to the right (forward) of dam centerline station 6 + 00.

The gaged alluvial section on Site 16, dam centerline station 6 + 15, was over two hundred feet from the toe of the abutment on the west side of the stream channel; so, it was considered necessary that two gages be added in order to obtain the best comparison of colluvial and alluvial settling. A gage was installed sixteen feet forward of the dam centerline at station 7 + 75 in the alluvium and another was set on the west abutment fourteen and one-half feet forward of the centerline of the dam at station 8 + 50.

A total of thirteen gages was installed at both sites; six at Site 34 and seven at Site 16 (Figures 9 and 10). It was necessary that gages 2 and 4 be located so that they would not interfere with the normal construction operations as the dams were being built. The gages were shifted slightly from the centers of gravity of the dam sections, but not enough to materially affect the test results.

Installation of Gages

The locations of the gages were staked by a survey party on the day that they were installed. These points were staked on the sites after the embankment area had been stripped of all foreign material, the upper foot of the foundation compacted using a sheep's foot roller, and the first one or two feet of embankment had been placed and compacted. The gages were installed by:

1. Digging a hole slightly larger than the plate through the placed fill to a point within the first six-inch lift above

the foundation. The hole was very carefully levelled and compacted, and the plate with the one-inch union welded to it was lowered into the hole.

2. The plate was levelled using an Abney Hand Level. Differential Levels were run to determine the plate elevation (Figures 13 and 14).

3. A joint of one-inch galvanized pipe was threaded into the one-inch coupler on the plate. A distance was measured up the pipe. This measurement was in even feet or so gaged that the mark on the pipe would be at approximately an even foot above Mean Sea Level.

4. A notch was cut into the one-inch pipe using a regular hack saw. The Mean Sea Level Elevation of the notch and the plate were checked and noted (Figure 15).

5. Earth was placed upon the plate and compacted in two to four inch lifts. When this earth reached a depth of two inches, the joint of two-inch protective pipe was placed over the one-inch pipe and upon the soil. The soil was placed around the gage as above until the elevation of the fill was reached (approximately one foot).

6. The elevation of the mark on the gage pipe was again checked and any variation from the previous determination noted. If the soil was properly compacted under the plate and the ensuing operations carried out with the proper care, there was little change in the plate elevation. If the variation was great, the plate was removed and installed properly.

Figure 11. Gage pipes on Site 34 showing relative location of Gages Nos. 3 and 6. (No. 6 is by the open door of the car.)

Figure 12. Gage pipws 3 and 6 on Site 34 shown two days before the embankment was completed.

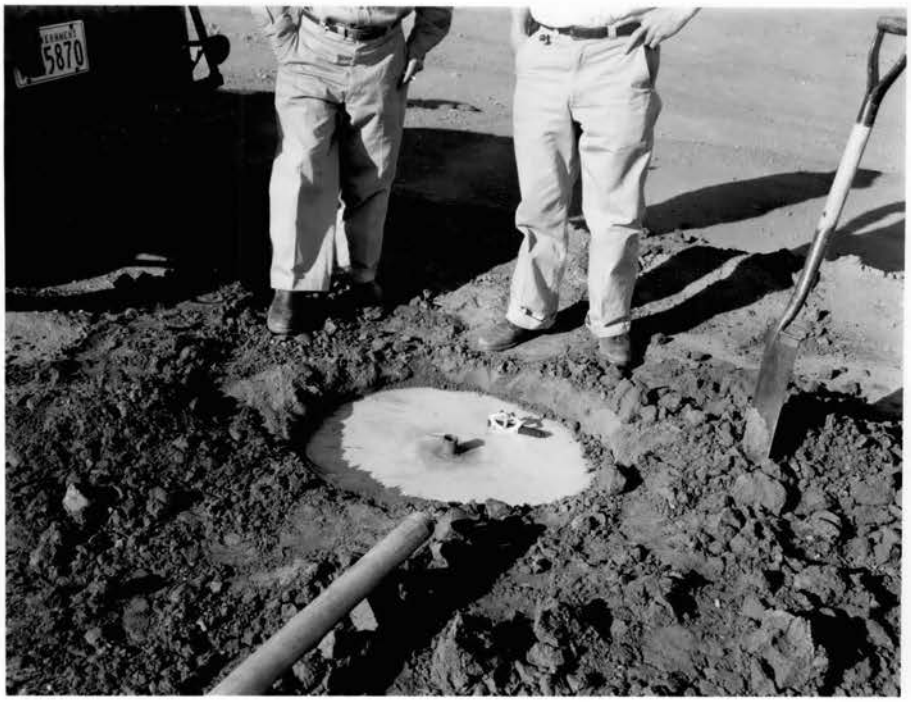

Figure 13. Gage plate in place and levelled.

Figure 14. Determining the elevation of the installed plate.

Figure 15. Determining the elevation of the notch in the 1" gage pipe.

Figure 16. The complete gage with first joints of gage (1") pipe and protecting (2") pipe installed.

All gages were set as outlined above except those that were set in the core trenches, including gages Nos. 5 and 6 on Site 34 and Nos. 5, 6 and 7 on Site 16. It was very difficult to place the backfill material in the core with the pipes extending up in the way of the heavy equipment. To remedy this, the plates were installed as outlined in Step No. 1, after about two or three feet of backfill were placed in the core. The elevation of the plates was noted and the plates were covered and compacted by hand to a depth of one and one-half feet. The backfilling of the cores then proceeded just as if the plates were not in place. The core trenches were then backfilled to a level with the rest of the embankment. During the backfilling of the cores personnel were standing by and when the backfilling was complete, they immediately dug holes through the backfill material down to the plates. The elevation of the plates was checked, and the gage and protecting pipes were installed and marked and noted as before. The earth was tamped around the protecting pipe and additional joints of pipe were added if needed. This entire operation was carried out in two to three hours.

Elevation Controls and Checks

A concrete marker was installed at each of the embankments during the initial layout of the dams. At the bench mark location a hole, approximately six inches in diameter, was excavated to bed rock and a one-half inch reinforcing rod was driven into the rock. A bronze cap with a curved surface was welded to the rod. Next, a mold of asphalt-treated paper was set over the hole. A mixture of "Class A" concrete was then poured into the hole. Special care was taken to insure a proper bond between the concrete and reinforcing rod.

The concrete bench marks were tied to Mean Sea Level elevation by levels from the nearest first or second order Mean Sea Level Marker.

The bench mark set on the east end of Site 34 was close enough to the consolidation gages to be used as a reference. (Satisfactory bench marks could not be established in the valley floor and the spillway operations would interfere with the use of the west permanent bench mark). There was a sandstone hill jutting out into the flood plain below Site 16; so, an additional bench mark was installed there (Figure 3). This marker was used as a reference for all levels run of Site 16.

The checks on the gages were made at one or two day intervals during the time that construction operations were in progress on the two sites. After the completion of the dams, the period between checks was lengthened to two weeks; the period was increased to one month in December, 1955, and checks have been made each month since that time. The testing will continue indefinitely.

The only checking difficulties encountered resulted from the high winds common to western Oklahoma.

The elevation of the water in the relief wells was checked each time that the gages were checked (Tables XVI and XVII).

Compaction of Fill Material and Compaction Testing

At the beginning of the tests it was felt that, in order to obtain results that would be applicable to all areas of the foundations, the fill material placed above the gage plates should be compacted in the same manner as the rest of the embankment. During the installation of the plates, the first fill over them was compacted using an air-driven mechanical tamper. The sheep's foot rollers that were used in

Figure 17. Supplementary compaction of soil around protecting pipe.

Figure 18. Compacting the soil around the gages using an air-driven tamper.

compacting the embankment fill were operated as closely to the protector pipes as possible. Very careful checks were made in the immediate area around the gages as fill was placed, and all uncompacted earth was compacted to approximately the same density as that of the adjacent soil. The compacting was accomplished using hand tampers and air-driven tampers (Figures 17 and 18).

The compaction procedure employed proved to be very satisfactory. There was slight damage to the protecting pipes at various times, but the gages' usefulness was never impaired. This lack of difficulty is attributable to the caution and efforts of the contractors' employees.

The earth around the protecting pipes was carefully compacted and dressed to conform with the embankment slopes as the last fill was placed over the gages. This operation precluded the necessity for finishing equipment to be operated close to the gage pipes.

Regular compaction tests were made on each dam as the embankments were being built. The sand-cone method of compaction testing was used. (5) The results of these tests are summarized in Tables XIV and XV of the Appendix.

History of the Gages on Site 34

The relief wells were installed on Site 34 on April 26, 1955. Construction operations were also started at that time. Relief wells are always installed before the work on the dam begins or at the same time that the contractor begins work. The early installation is essential so that the wells can provide for the collection of outflowing water from the consolidating foundation throughout the construction period. The core drill crew took undisturbed samples from the

foundation at points near the proposed consolidation gage locations at the same time that the wells were installed. These samples were promptly dispatched to the Soil Mechanics Laboratory in Albuquerque, New Mexico for analysis.

Gages Nos. 2 and 4 were installed on Site 34 on May 7, 1955. Gages Nos. 1 and 5 were not planned at this time but were added later as a result of bench mark studies discussed previously in this section. Fill material was placed on Site 34 from the borrows and core excavation from May 6 through May 12, when all operations were abandoned because of heavy rains. At the time that the earth-moving equipment was moved to another dam site, the core trench was full of water and sediment and the entire area was saturated from the four inches of rain received the preceding week. The plates were covered by 3.5 feet of fill when the work was stopped.

The contractor did not have the proper equipment for readying the site for further operations; so, he centered his operations on another dam. The embankment area was not in proper condition for further fill placement until the first week in July. At that time the core trench was clean and the embankment was reworked and recompacted to sufficient depths to secure proper bonding with the previously placed fill. At this time plates Nos. 1 and 5 were installed. Gage No. 2 was destroyed and was replaced July 6, 1955.

The work progressed very rapidly in early July. Gages Nos. 3 and 6 were installed in the core trench and the embankment was brought up to an elevation approximately fourteen feet above the original ground level at Station 4 + 50, the test control section.

The hauling of fill material was discontinued between August 19

and August 24 while the earth-moving equipment was being utilized in the removal of large boulders from the spillway. Blasting in the spillway area started at this time and continued until shortly after the embankment was completed.

Work on the embankment resumed August 25 and proceeded at a rapid rate until it was completed September 16. Dressing, cleanup operations, fencing and removal of soil and rock from the earth spillway continued until the dam was accepted as complete October 1, 1955.

History of the Gages on Site 16

The relief wells were installed on Site 16 early in the spring of 1955. Test cores were drilled from the dam foundation near the scheduled gage locations during the first week of May, 1955.

Clearing and grubbing operations were begun on Site 16 on June 21, 1955. All operations progressed satisfactorily, and the dam site was stripped and prepared for fill placement by the last of June.

Embankment placing was started July 1, 1955 and the first four gages (Nos. 1, 2, 4 and 5) were installed the following day. Gage No. 3 was installed July 5 and Gages Nos. 6 and 7 were installed July 6.

The work progressed very rapidly on Site 16; so rapidly, in fact, that it was very difficult for the checks and addition of pipe extensions to keep pace with the embankment placing. The second joints of the gage pipe and protector pipe were damaged on Gage No. 7 during construction operations; however, a careful examination showed that the plate and first pipe joints were still intact. The replacement of the pipe sections was the only repair work required.

All work, except fencing and routine cleanup, was completed on

Site 16, August 13, 1955 and all equipment was removed from the site. The dam and appendages were accepted as complete August 24, 1955.

Figures 19, 20, 21 and 22 show the gages during construction and after completion of the sites.

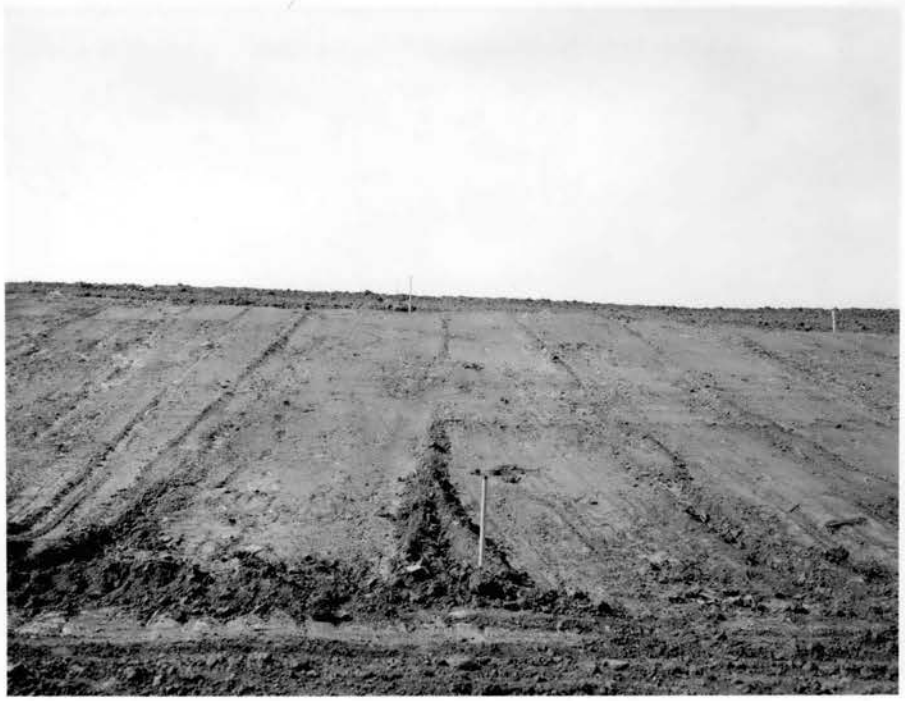

Figure 19. Gages on Site 34 showing Gages Nos. 1, 2 and 3 during construction of the dam.

Figure 20. Gages Nos. 1, 2 and 3 on Site 34 shown after the completion of the embankment.

Figure 21. Site 34. View showing Gages Nos. 4 and 5 during construction of dam. The man is standing by Relief Well No. 1.

Figure 22. Back (2:1) slope of Site 34 after completion of the embankment showing the relative location of Gages Nos. 4 and 5 and Relief Wells Nos. 1 and 2.

V. PRESENTATION AND ANALYSIS OF DATA

Site No. 34 Data

Gage No. 1 (3:1 toe) was installed July 9, 1955, with one foot of earth compacted over it. (fig. 23) The overburden was increased to 1.9 feet the thirteenth of July; the fill over the plate remained almost unchanged during the period of July 14 through August 28, 1955. During this first period the plate moved erratically up and down with a net resultant of 0.048 feet of settling. The erratic movement of the plate was caused by the alternate wetting and drying of the soil by the heavy rains during the summer. The embankment was saturated most of the month of May and much of June and July. The plate was under water from August 10 through August 28. All of the water in the borrow area was used in wetting the fill material in the embankment. There was practically no change in plate elevation while the gage plate was immersed in water. There was no fill placed on the dam from May 12 to July 5 because of the heavy rains; the water table under the dam rose sharply during this time.

The fill over the plot was increased to 2.9 feet during the last week in August. Additional load was placed on the plate until it was covered by 3.5 feet of earth September 12, 1955; the load remained constant throughout the rest of the testing period. The plate moved erratically until the embankment was completed on September 16; it then began to settle gradually. The final check on the gage (March 16, 1956) showed that the plate had settled 0.117 feet. The settlement during construction was 0.038 feet.

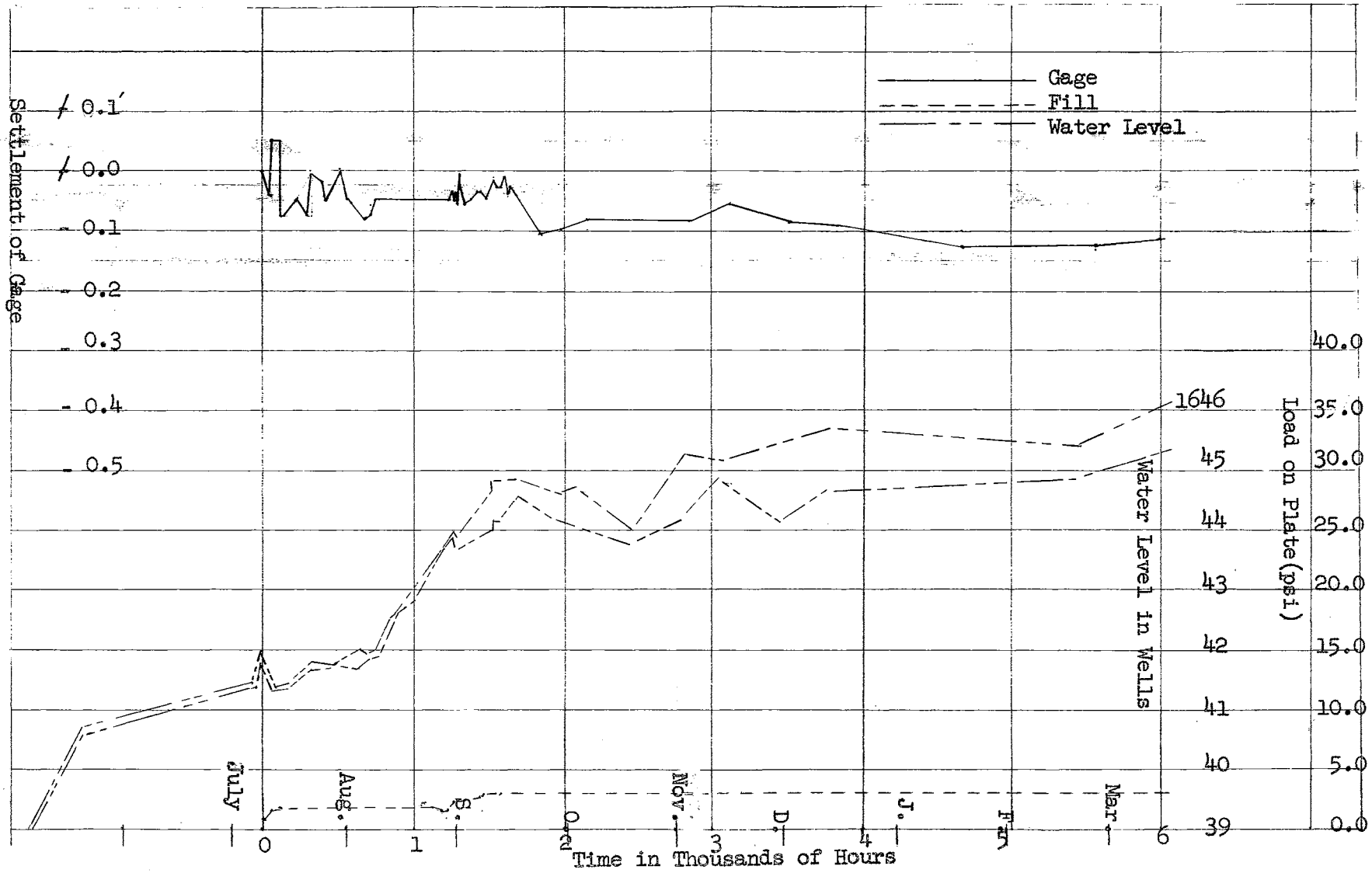

Figure 23. Presentation of Data for Gage No. 1 - Site 34

Gage No. 2 (60 feet right of ℄ Station, 4 + 50) was installed May 7, 1955, with an initial cover of 1.4 feet. (fig. 24) The fill over the plate was increased to 3.6 feet and remained constant until July 6. The area was saturated during most of this time and the plate was raised 0.6 feet by the heaving and swelling of the embankment foundation. This movement was parallel to the rise in the water table of the area.

A gage was destroyed while the contractor was readying the site for the resumption of operations, July 6, 1955. The gage was promptly replaced and the readings were continued as before.

The gage continued to rise sharply under the influence of the swelling foundation until July 11; the plate was then under 6.7 feet of fill and had risen a total of 0.689 feet (both plates). The following day a trend of settling (lowering) was begun; the plate settled 0.09 feet while the fill was being increased to 7.9 feet. The fill remained constant until August 24; the water table continued to rise under the embankment; and the plate rose and fell with no net change.

The plate started down sharply August 24 and continued the trend until September 30. The last fill over the plate was placed September 16; the load on the plate had been increased at a constant rate to a peak of 22.1 feet (19.436 psi)[1]. The dam was topped September 16, 1955; the settlement at that time was 0.305 feet.

The plate settled gradually through the remaining test period; the settlement through March 16, 1956, was 0.445 feet.

Plate No. 3 (9 feet to right of ℄) was installed July 8, 1955, with

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[1] Computed loads are the products of the average bearing pressure of the moist fill material (Appendix Table XIV and XV) and the heights of fill over the gage plates.

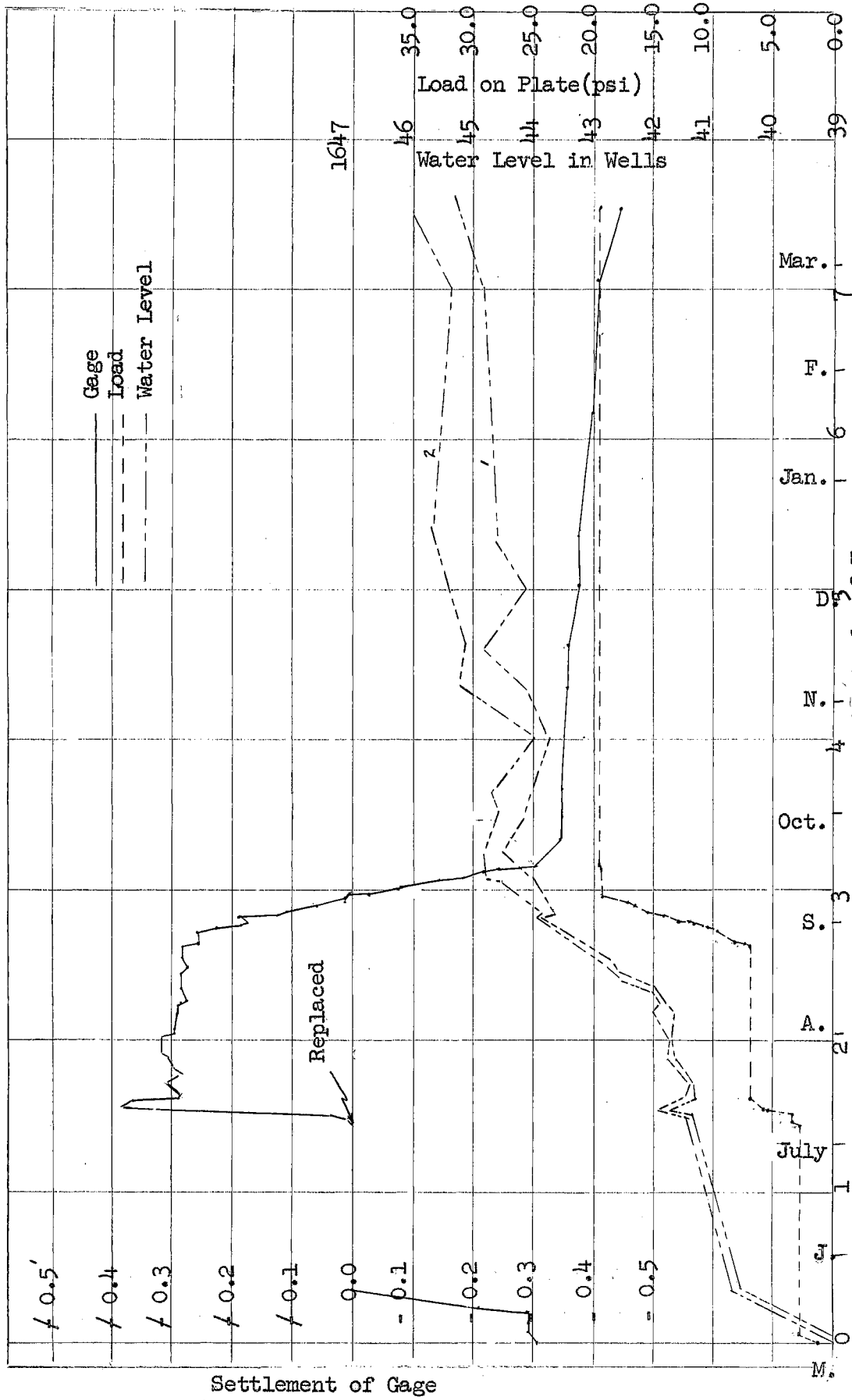


Figure 24 Presentation of Data for Gage No. 2 - Site 34

an initial cover of 1.5 feet of earth. (fig. 25) The fill over the plate was increased to 4.5 feet the following day and was increased to 8.9 feet by July 13. The plate began settling almost immediately because of the rather rapid increase in load and the fact that the foundation had reached its peak in heaving.

The settling rate of the gage decreased on July 14. There was no fill placed over the gage between July 14 and August 24 and there was only a slight drop in the plate elevation.

The placing of fill over the gage plate was resumed August 25 and was continued at a rapid rate. The plate started settling at a rapid rate on this date and continued to do so until September 23, one week after the final fill was placed over the plate. The decrease in plate elevation during this period was 0.860 feet and the load increased to 41.2 feet (36.233 psi).

The gage settled at a slow rate during the rest of the time; the total settlement of the gage was 1.13 feet. The settlement during construction was 0.775 feet.

Plate No. 4 (35 feet left of ℄ station, 4 + 50) was installed May 7, 1955. (fig. 26) The original load of 1 foot of fill (0.879 psi) was increased to 3.5 feet May 10 and remained at that level until construction operations were resumed July 6. The plate rose rapidly during the first week just as plate No. 2 did; there was a net increase of 0.002 feet in plate elevation during the shut-down period.

The plate rose as the placing of fill was resumed on July 6; when fill placement stopped on July 14 the gage started settling gradually (net - 0.0002 feet/day). Loading over the plate was started again on August 25; the plate started settling very rapidly the following day.

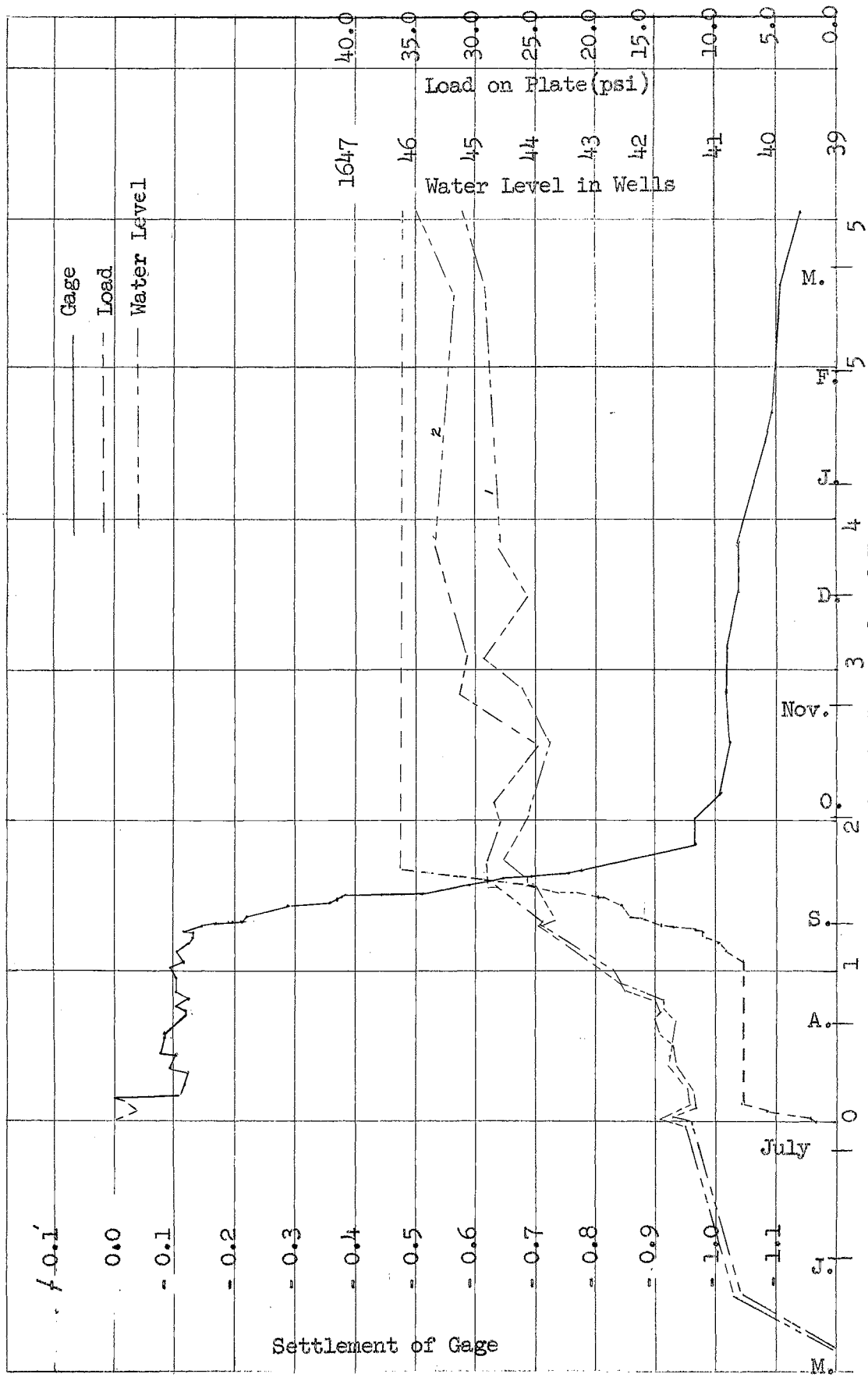


Figure 25. Presentation of Data for Gage No. 3.- Site 34

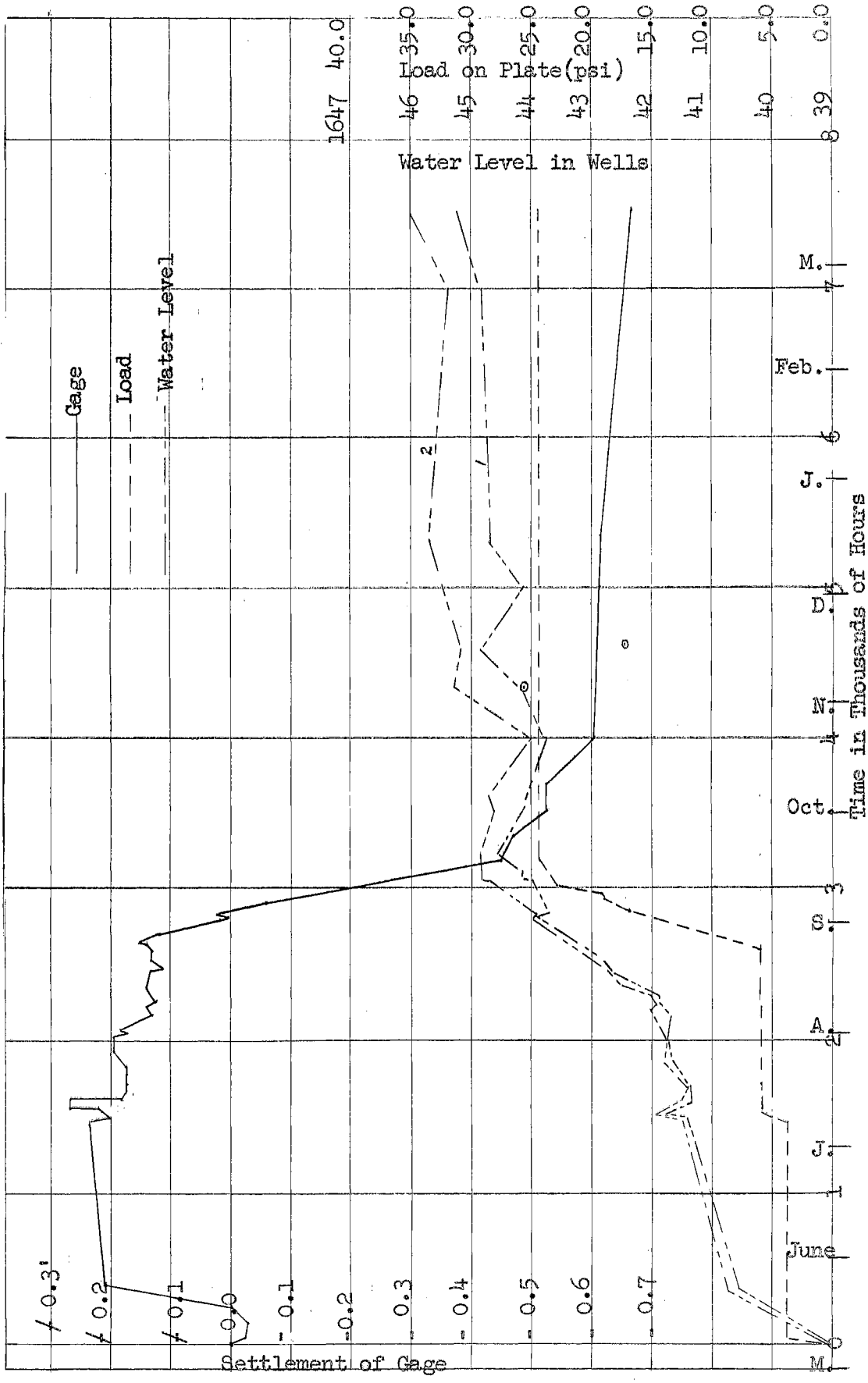


Figure 26. Presentation of Data for Gage No. 4 - Site 34

The settling continued at the rate of approximately 0.03 feet per day until September 17; the day after the last fill was placed over the gage. The rate of settling began decreasing at that time and became lower and lower as time passed. The total settlement through March 16, 1956, was 0.665 feet under a maximum fill of 27.5 feet. The settlement during construction was 0.455 feet.

Gage No. 5 (2:1 toe) was installed July 7, 1955. (fig. 27) The initial load of 1 foot was increased to 1.2 feet July 21 and was unchanged throughout the testing time.

The plate settled 0.03 feet during the first week after it was set; however, the net resultant was a rise of 0.001 feet at the end of July. The plate settled 0.08 feet during the first ten days in August and then remained practically unchanged throughout the rest of the time that readings were taken. Almost all of the oscillation of the plate ceased during the week following the completion of the dam. The net distance that the plate settled through March 16, 1956, was 0.100 feet. The settlement during construction was 0.070 feet.

The first units of gage No. 6 (9 feet right of ℄ station, 6 + 00) were set July 8, 1955. (fig. 28) The plate fell, then rose 0.15 feet the first five days after the load was applied; the load was increased from 3.5 feet of fill to 10.6 feet of fill (9.322 psi) during these five days. No fill was added over the plate from July 14 to August 24; the plate first settled 0.06 feet and then rose 0.07 feet to a new peak on July 26. The plate settled rapidly between July 26 and August 10 to an elevation 0.06 feet below the installation elevation. The plate moved up and down during the last part of this period.

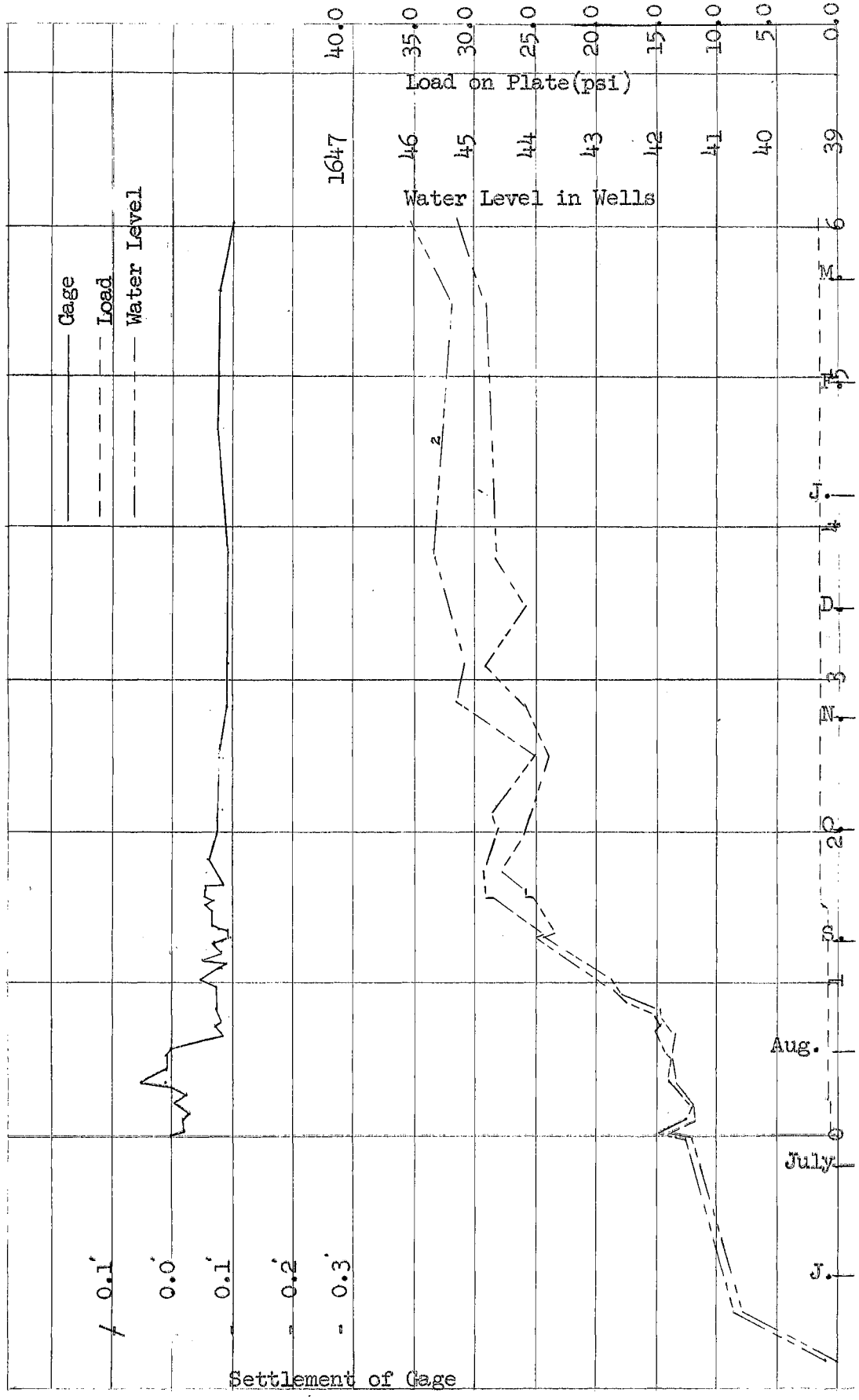


Figure 27. Presentation of Data for Gage No. 5 - Site 34

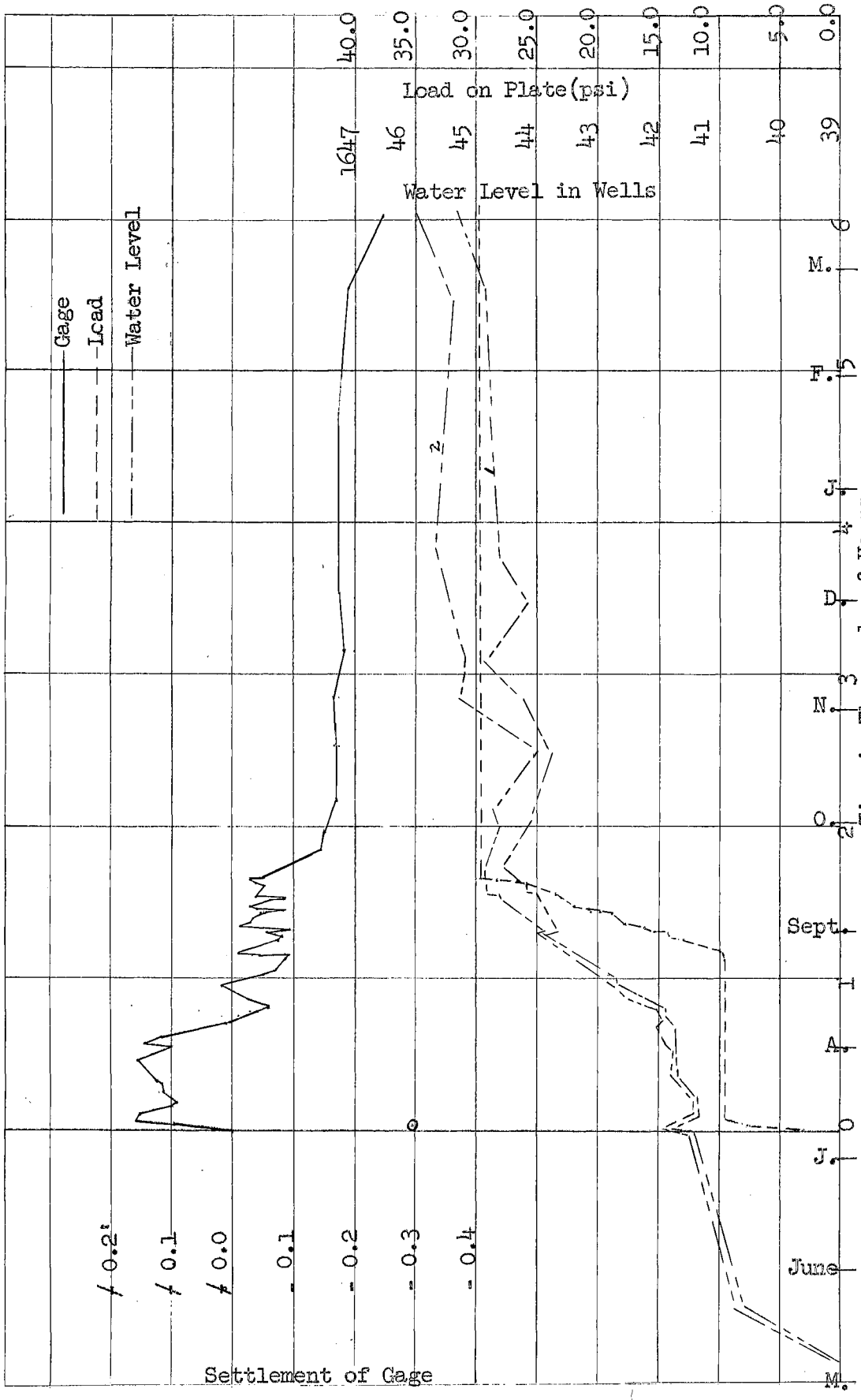


Figure 28. Presentation of Data for Gage No. 6 - Site 34

Increased loads were added to the plate (foundation) from August 25 until the final cover was placed September 16; the maximum load on the plate was 33.7 feet of fill material (29.637 psi). The plate settled and rose in continuation of the pattern started in late August until the day the last fill was placed over it. The plate settled 0.12 feet between September 16 and October 7; the settling continued at the rate of 0.002 feet per day. The total net settlement of the plate was 0.248 feet. The settlement during construction was 0.050 feet.

Site No. 16 Data

Consolidation gage No. 1 (3:1 toe ℄ station, 6 ⁄ 15) was set on Site 16 July 2, 1955. (fig. 29) The plate gage was installed with one foot of soil compacted over it; this load was increased only one tenth of a foot while the construction of the dam was in progress.

The plate first settled 0.16 foot and then rose to an elevation only 0.03 foot below its original position; the rise was parallel to an 0.8 foot rise in the static water table under the foundation.

The equipment was moved from the area July 13 and no fill was placed in the embankment until July 26. The foundation under the gage alternately settled and heaved in stages of 0.05 foot during that time.

The gage plate rose sharply (0.11 foot) with the resumption of fill placing on July 26 and remained high until the entire foundation of the dam began to consolidate rapidly during the first week in August. Gage No. 1 dropped 0.3 foot between August 1 and August 5; the water table rose steadily during that period.

Plate No. 1 oscillated up and down during the rest of the construction period; this was caused by the activity on the dam. The foundation

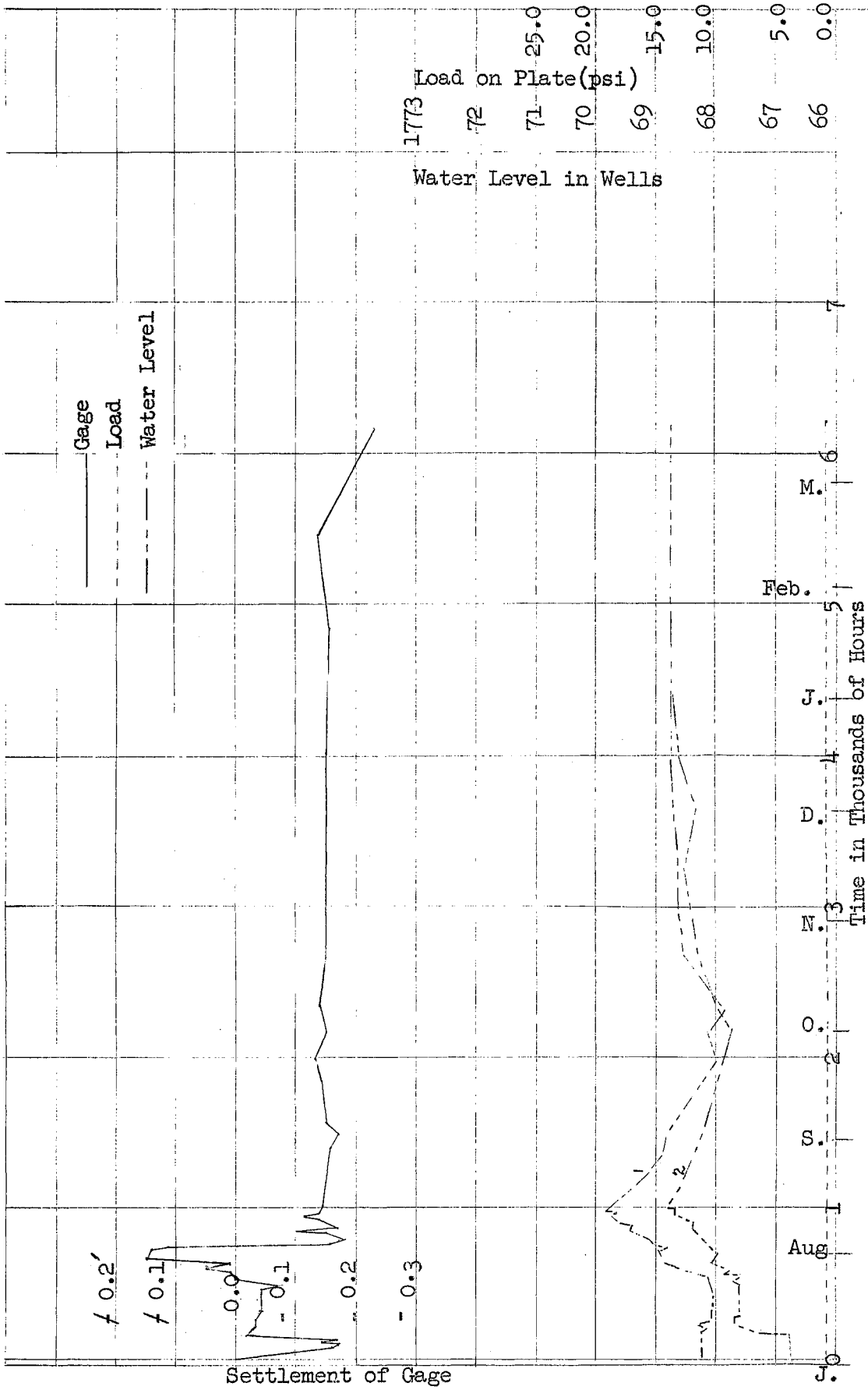


Figure 29. Presentation of Data for Gage No. 1 - Site 16

under the plate moved very little after the dam was completed; the net movement of the plate was 0.140 foot during the construction period; the total settlement was 0.228 foot.

Gage No. 2 (50 feet right of ℄ station, 6 + 15) was installed July 2, 1955. (fig. 30) The original load of 1 foot of fill (0.863 psi) was increased to 4.6 feet, to 5.0 feet between the installation date and July 13; the loading was stopped for a period of twelve days. The plate settled over a 0.1 foot during the first four days after it was set; it then rose sharply to an elevation above its original position. The gage moved at approximately the original elevation until August 2, two days before the last significant increment of fill was placed over it. The foundation settled very rapidly between August 2 and August 13; it settled over 0.4 foot during that eleven day period. The plate settled at successively decreasing rates during the test period after the dam was completed, August 13. The settlement during construction was a net lowering of the plate of 0.515 foot. The plate settled 0.381 foot during the eight month observation period following construction. The total settlement of the plate was 0.896 foot.

The water table rose generally during the construction of the dam; then lowered slightly and levelled off 1.8 feet above the level at which it stood at the time the dam was started.

Gage No. 3 (7 feet right of ℄ station) was installed July 5, 1955. The initial overburden of six feet of fill coupled with the fact that the gage was installed very close to the water table (3 feet above) resulted in a very rapid settling of the plate during the forty-eight hours following its installation. The plate settled over 0.60 foot by July 7. The plate rose to an elevation 0.37 foot below its original position by July 11

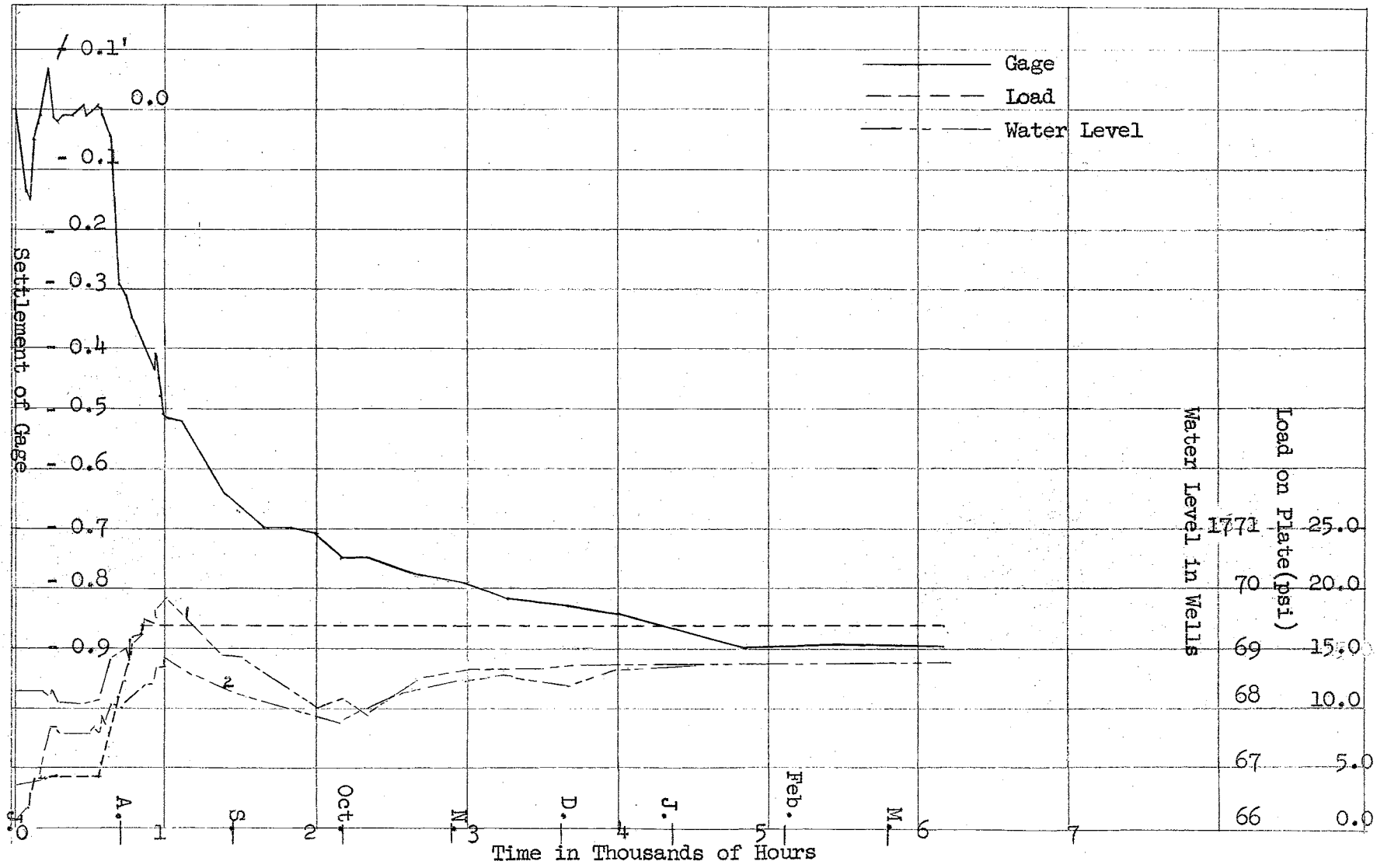


Figure 30. Presentation of Data for Gage No. 2 - Site 16

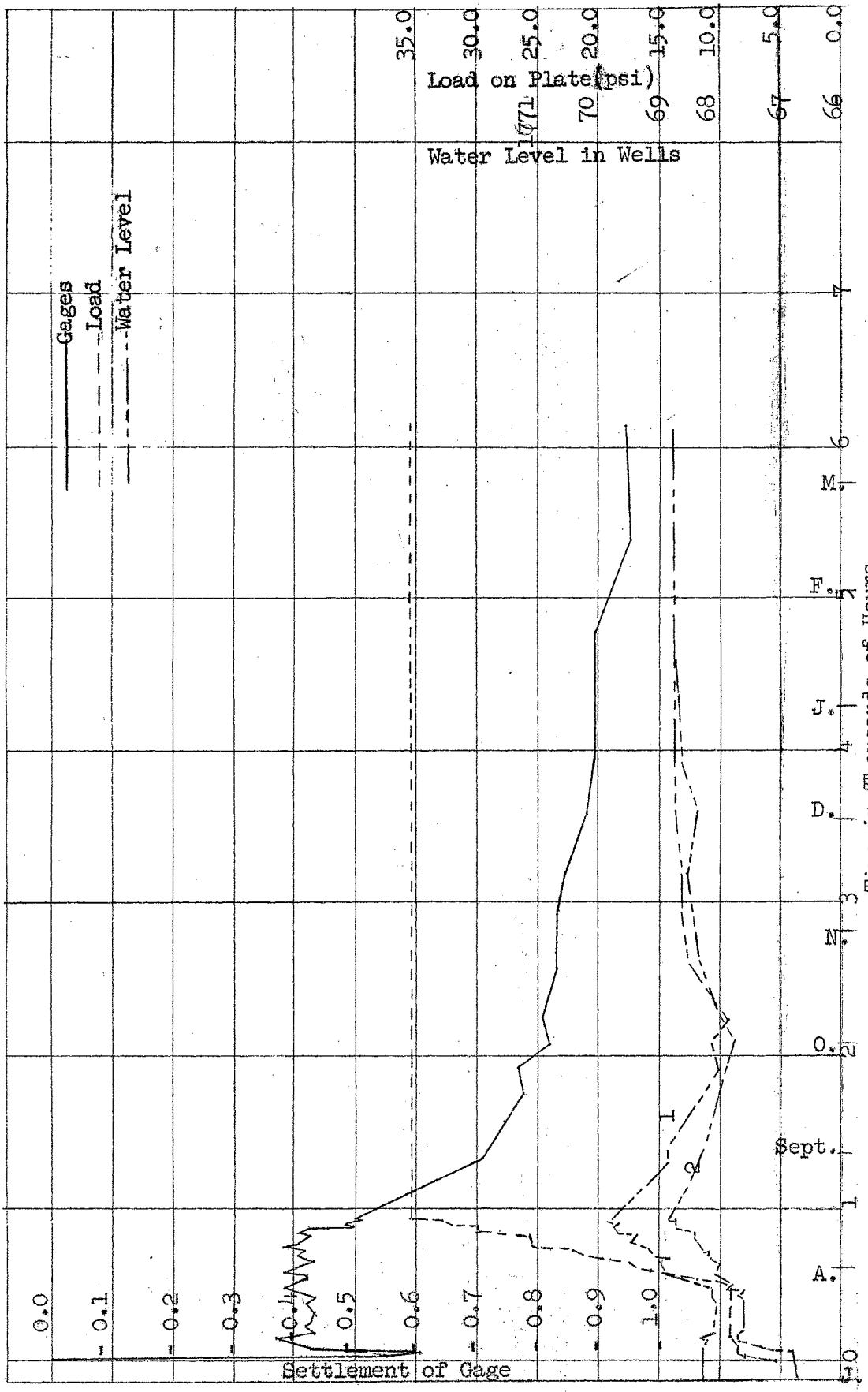


Figure 52. Presentation of Data for Gage No. 3 - Site 16

and oscillated above and below that level until August 11. The foundation consolidation proceeded at a very rapid rate between August 11 and August 13; over 0.1 foot of settlement was observed in that two-day period. Rapid settlement (0.01 foot/day) continued until August 29. That period was followed by a gradual decline in the rate of consolidation; this decline continued until November 15. The plate elevation changed very little during the rest of the testing time. The net settlement during construction was 0.550 foot; the settlement between the time that the dam was completed and November 15 was 0.345 foot; the total settlement of the plate was 0.954 foot.

The movement of the water table was generally upward during the construction of the dam; it then fell for a time; and levelled off.

Gage No. 4 (40 feet left of ℄ station) was set July 2, 1955. (fig. 32) The original overburden was 1.0 foot; this load was increased to 3.9 feet of soil during the eleven days immediately following the gage installation. The gage plate settled 0.04 foot the first six days of the period and rose to 0.1 foot above the original position during the following five days.

There was no load added between August 11 and August 25; the foundation oscillated up and down in much the same manner as in the other areas during that time.

The gage rose slightly with the resumption of loading July 26; this general rising continued until July 30. The elevation of the gage plate lowered 0.4 foot between July 30 and August 13. The last fill was placed over the gage plate August 9. The foundation settled 0.14 foot between August 13 and October 9; the rate of settling decreased progressively from that time to the end of the testing period.

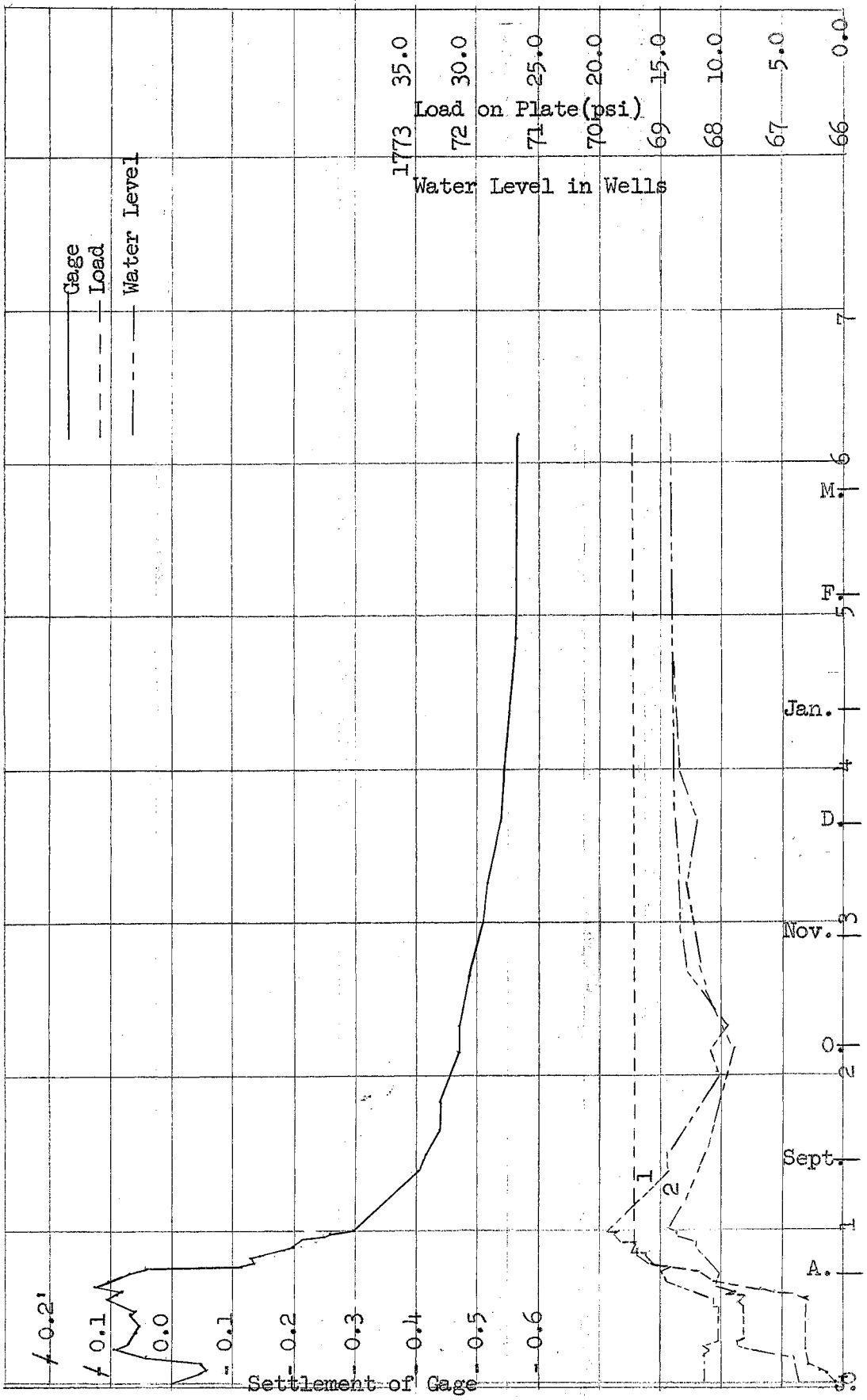


Figure 32. Presentation of Data for Gage No. 4 - Site 16

The net settlement of the gage plate during construction was 0.297 foot; the total settlement of the plate was 0.569 foot.

Gage No. 5 (2:1 toe) was installed with a load of 1 foot of fill. (fig. 33) The load remained unchanged until August 8; 0.9 foot of fill was added August 8 and 9. The load remained unchanged after August 9.

The gage settled 0.22 foot during the first six days after it was installed and then started to rise steadily under the heaving influence of the newly loaded foundation. The rising of the plate continued until July 30; at that time all of the foundation at test section 6 ∠ 15 started settling. The plate settled rapidly between July 30 and August 3; the plate lowered 0.26 foot during that period. The plate moved up and down under the influence of the vibrating load of the equipment until the dam was completed. The foundation rebounded 0.03 foot when construction operations ceased and remained practically unchanged during the rest of the test period. The net movement of the plate was 0.007 foot upward.

Gage No. 6 (16 feet right of dam ℄ station, 7 ∠ 75) was installed July 6, 1955. (fig. 34) The initial load on the plate of 1.0 foot of earth fill was increased to 2.6 feet July 11; the load remained at 2.6 feet of fill until July 26. The plate settled 0.10 foot the first day and then moved up and down with a general movement upward until July 30.

Loading was resumed July 26 and progressed at the rate of 1.5 feet (1.295 psi) per day until the last earth was placed over the gage August 13. The foundation settled 0.265 foot between July 30, when a downward trend was begun, and August 13, the date that the dam was completed. After the dam was finished the rate of settling of the foundation continued at successively decreasing rates. The net settlement during construction was 0.315 foot; the net settlement during the gaging period was 0.473 foot.

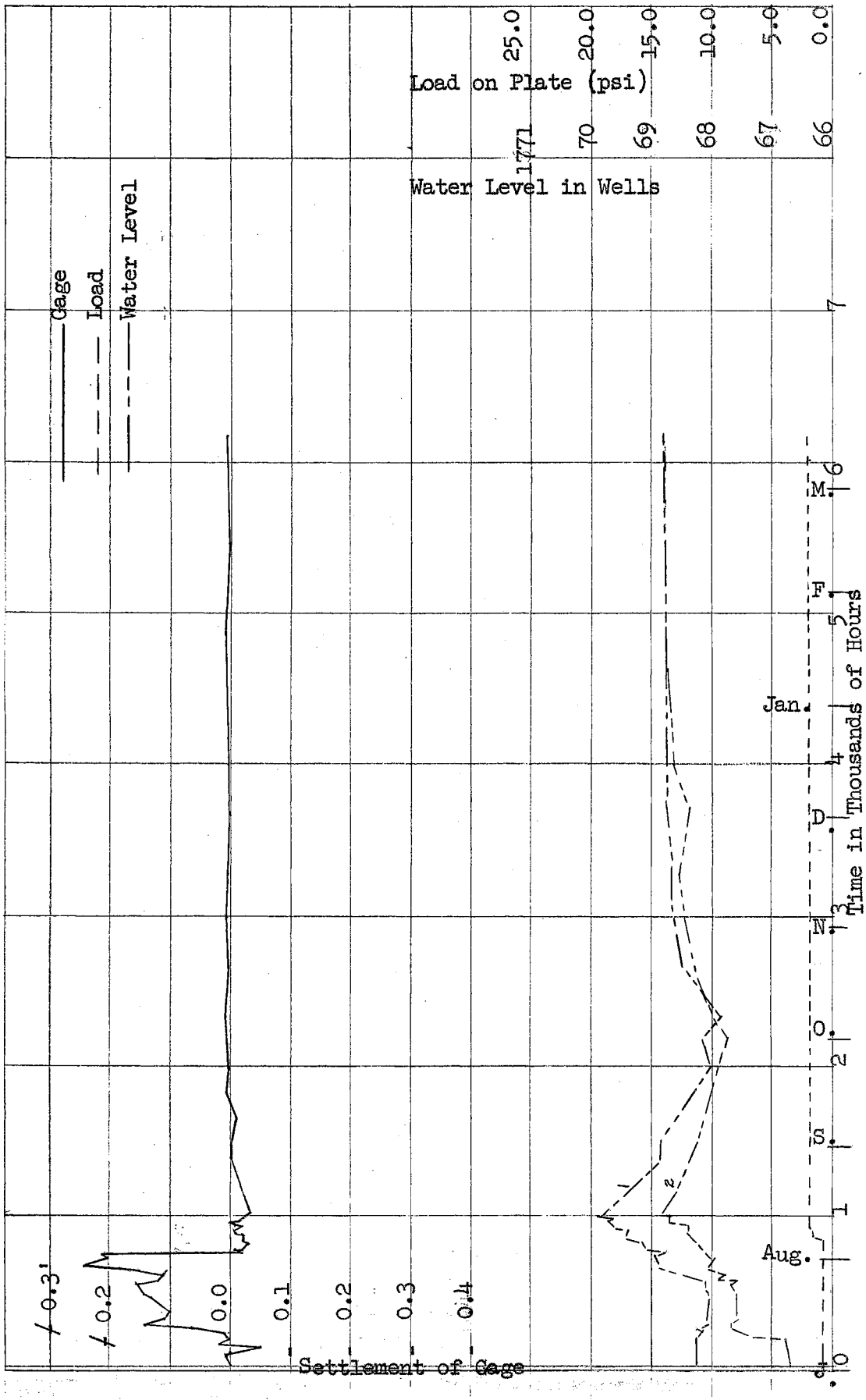


Figure 33. Presentation of Data for Gage No. 5 - Site 16

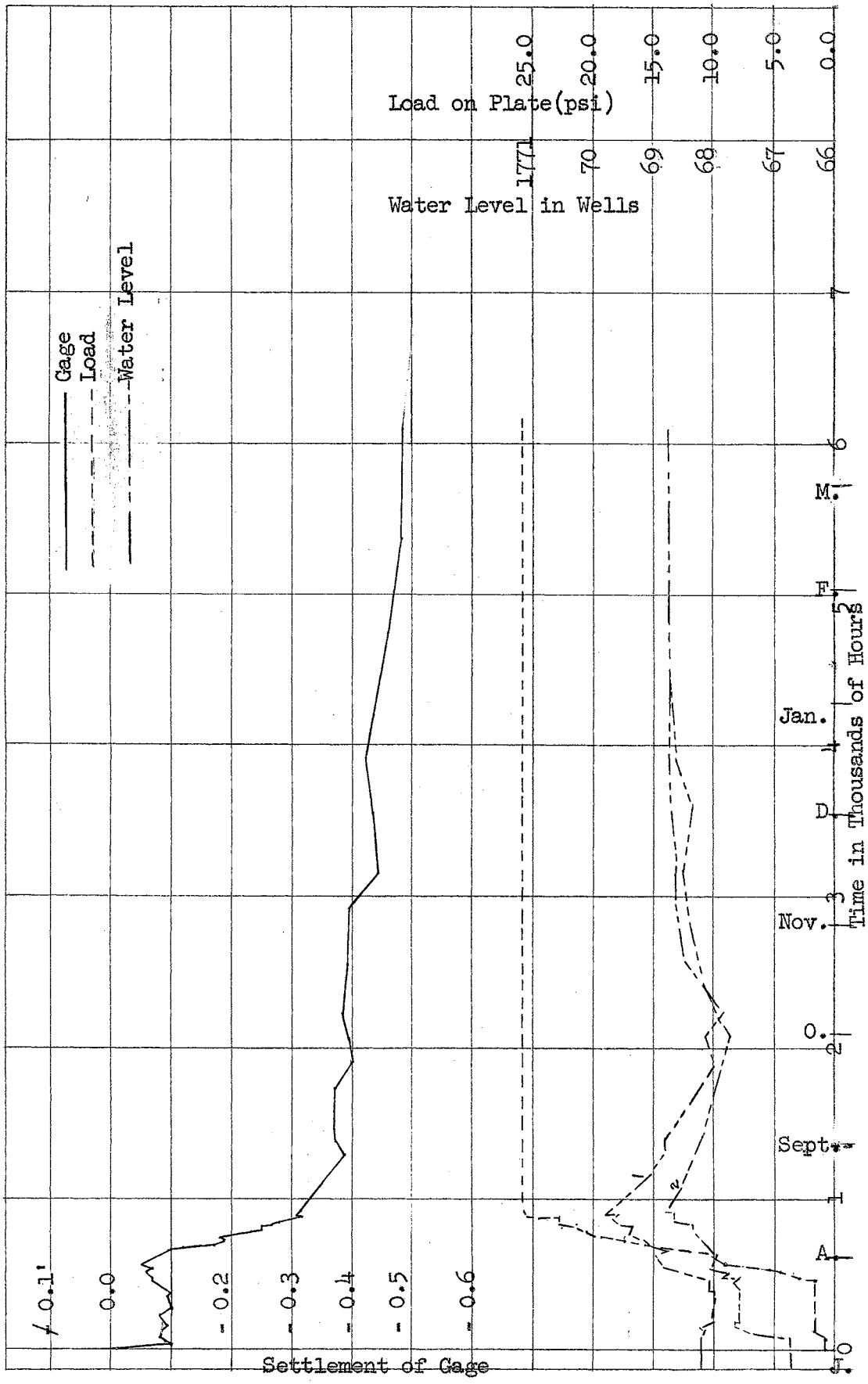


Figure 34. Presentation of Data for Gage No. 6 - Site 16

Gage No. 7 (14.5 feet right of ℄ station, 8 + 50) was installed July 6, 1955. (fig. 35) There was only 1.0 foot of fill over the gage plate during the twenty days immediately following the installation date. The plate moved up and down during that time with a net change of 0.015 foot downward.

The addition of fill over the gage plate was begun July 27 and continued at a rapid rate until the last earth was placed August 13. The fill over the plate at that time was 25.5 feet. The plate rose approximately 0.08 foot when loading was begun; it lowered to 0.04 foot below its original position. The plate rose to a new peak of 0.095 foot above the original elevation August 6. The load at that time was 18.5 feet of fill. The plate started settling August 6 and settled 0.050 foot by August 13. The plate settled at a slow rate after the construction operations ceased. The net elevation change of the plate during construction was a rise of 0.015 foot. The net change of the plate during the observation period was 0.051 foot.

General Summary of the Test Results from Site No. 34

The three gages within the embankment in the alluvial test section of Site No. 34 followed the same general pattern of settling; that is, during the time that all of them were functioning. The three gages settled approximately one-tenth foot as fill was placed upon them in early July; and then levelled off into a general downward trend during the time that the earth moving equipment was wasting the rock from the earth spillway. They began their major settling period two days after placing of fill was again resumed and continued to settle at a fairly

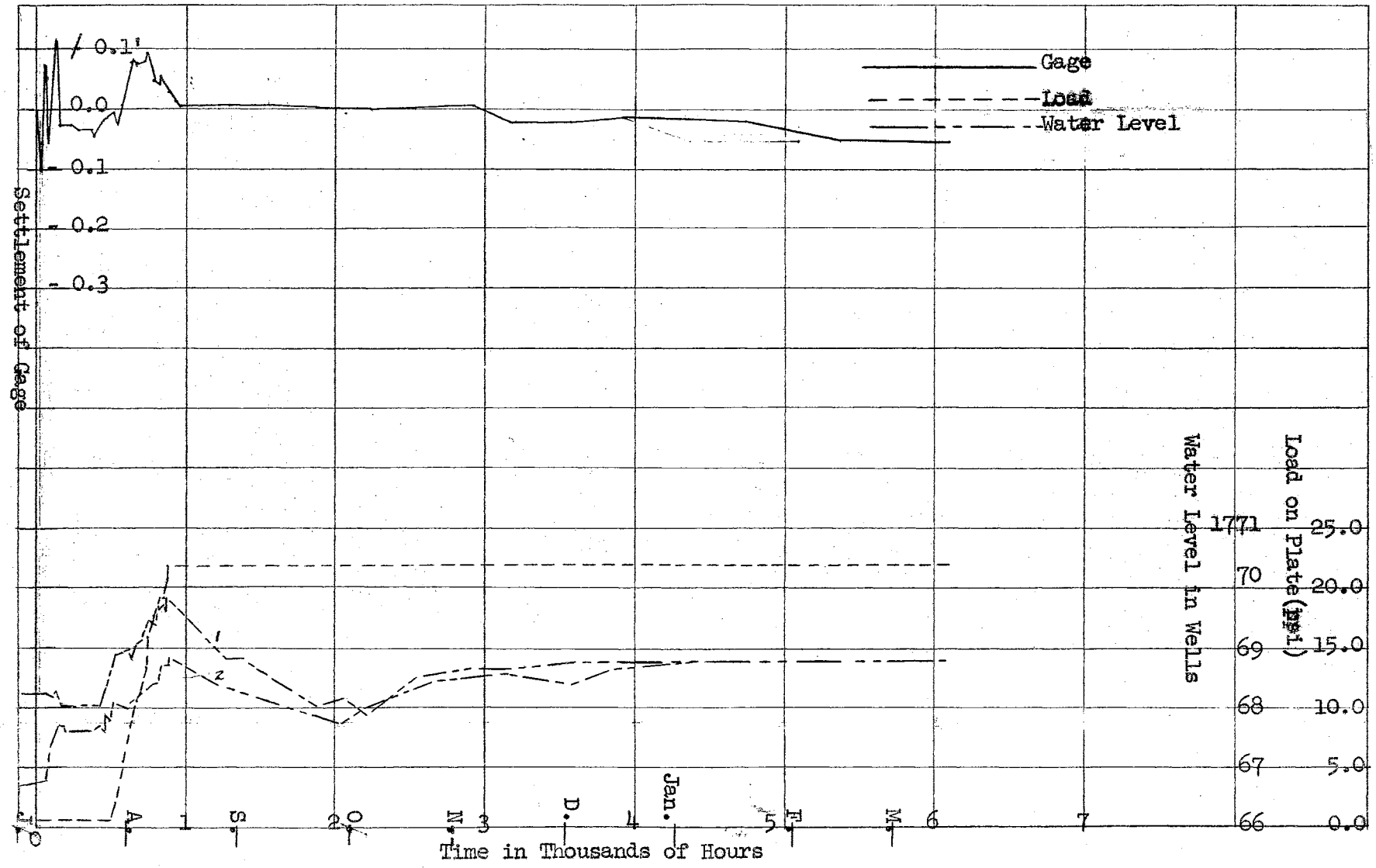


Figure 35. Presentation of Data for Gage No. 7 - Site 16

rapid rate until two days after the embankment was completed. The settling generally lagged the load placement two days throughout the period. With the end of construction operations the gages began to settle at a much slower rate and continued to do so during the remaining time of testing. Gages that were in place during the period of heavy rainfall rose with the rise in water table.

The movements of the two gages at the toes of the slopes were very similar. They settled with a very general trend downward; the settling was erratic during construction operations and uniform during periods of relative inactivity. Both gages settled approximately the same distance.

Gage No. 6 settled little in comparison to the load over it; this was caused by the fact that the plate rested on a relatively thin (7.0 feet) layer of soil over parent material. The over burden extended to depths of 35 feet or more at the other gage points. The general movement of the plate was similar to that of the other plates.

There was no water impounded at Site No. 34 during the testing period.

The dam was thoroughly inspected at the end of the test period; no evidence of fissuring or other indications of possible failure were found.

General Summary of the Test Results from Site No. 16

The patterns of settling of all at the points gaged at Station 6 + 15 on Site No. 16 were remarkably alike. All gages settled for the first few days after their installation; they then rebounded to a point of equilibrium between the loads and bearing strengths of the foundation

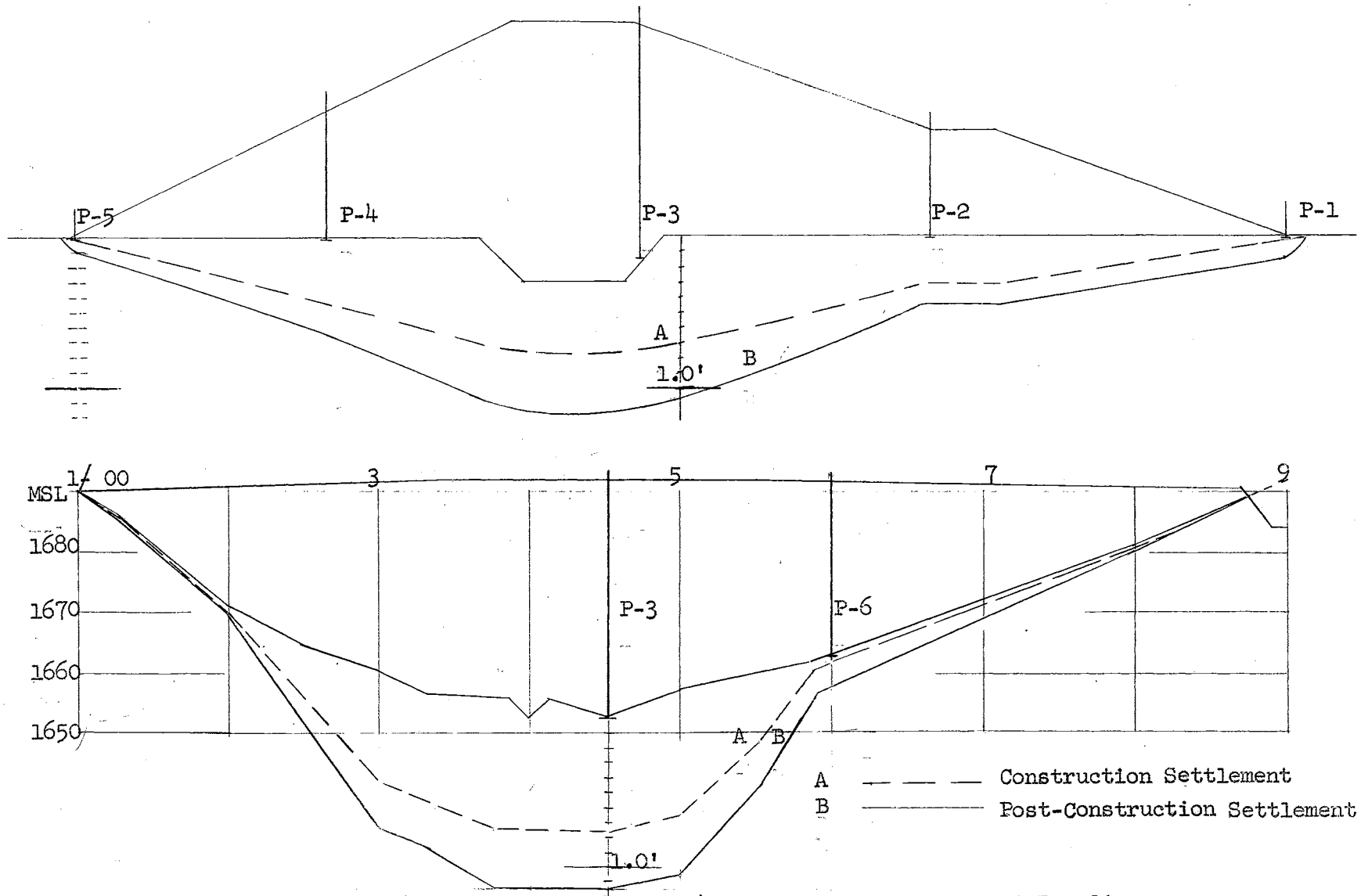


Figure 36. Settlement of Site 34 Foundation Based on Test Results

areas. This rebound was due largely to a rising water table. The foundation generally settled little during the time that the fill material was being placed until approximately ninety per cent of load was in place (based on No. 3). At this point in the loading all of the gages began settling rapidly; indicating that the foundation was consolidating at a high rate. The settlement of the gages was generally in proportion to the loading at that point.

Gage No. 6 followed the pattern of the other gages in the alluvium very closely. There was a greater space of time between the beginning of consolidation and completion of the fill because of the very rapid rate at which the area was loaded.

The movements of Gage No. 7 were different from those of the other gages; the abrupt settling was much less in relation to the load and the total settling was much less in relation to the load. The low settlements at this gage are attributable to the fact that the foundation of the dam at that point rests upon parent material approximately six feet below the surface. The surface of the earth in the alluvial areas was thirty-five to forty feet above the parent material; all but the last fourteen to sixteen feet of the alluvium was saturated.

There was no water impounded at Site No. 16 during the testing period.

The surface of the dam was thoroughly inspected at the end of the testing period; no evidence of fissuring or other indications of possible failure were found.

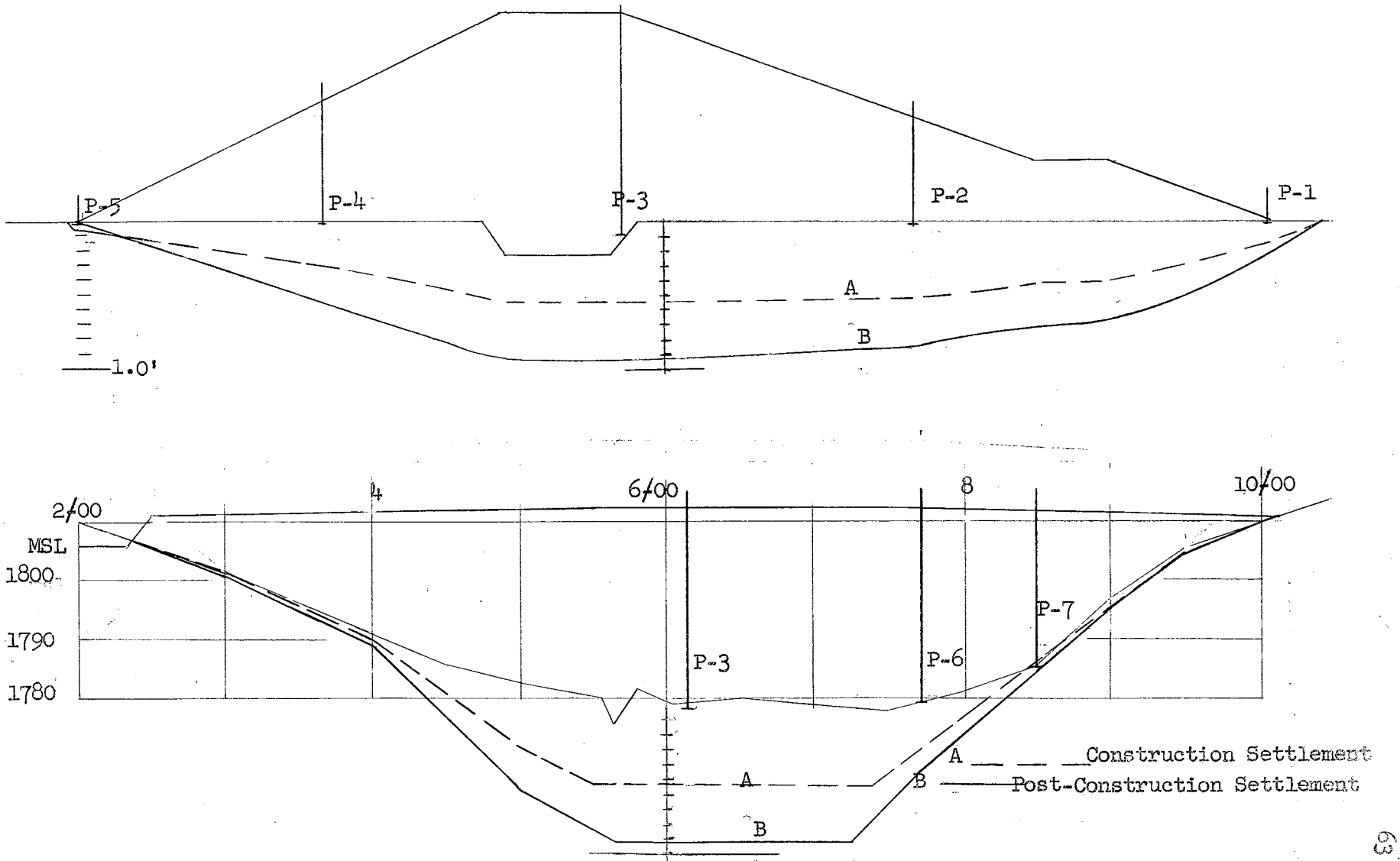


Figure 37. Settlement of Site 16 Foundation Based on Test Results

Discussion of Laboratory Methods and Results

Consolidation tests were run in the Albuquerque Soils Mechanics Laboratory of the Soil Conservation Service. The data from the tests were analyzed using the "square root fitting method" (4). The follow- steps are involved in the analysis:

1. Plot compression dial reading against the square root of elapsed time on arithmetic scales.

2. Extend the straight-line portion of the curve back to intersect zero time and obtain the corrected zero point "d_s".

3. Through "d_s" draw a straight line having an inverse slope 1:15 times the tangent. This straight line cuts the compression-time curve at 90% compression.

4. Compute the primary compression ratio "r" using the following equation: $r = 1.111 (d_s - d_{90}) / (d_o - d_f)$

in which d_s is the corrected zero point,

d_{90} is the compression dial reading at 90% primary compression,

d_o is the compression dial reading at zero time, and

d_f is the final dial reading.

5. Compute the coefficient of consolidation "c_v" from the following equation: $c_v = 0.848 H^2/t_{90}$ (1)

6. Plot computed void ratios "e" vs. log of pressure "p". The slope of this curve is called the compression index "C_c";

$$C_c = de/d(\log_{10} p)$$

7. Plot pressure vs. void ratio; the slope of this curve is called the coefficient of compressibility "a_v"; a_v can be found from C_c by

$$a_v = 0.435\ C_c/p$$

in which "p" is the average pressure for the increment.

The total settlement for any given load can be found by

$$dH = H \frac{C_c}{1+e_1} \text{ Log } \frac{P_2}{P_1}$$

p_1 is the original overburden load,

p_2 is the original load plus the added load,

and e_1 is the void ratio corresponding to p_1

The settlement at any time after the application of a load can be found by the following formula when the time to reach 100% consolidation and the total settlement of the sample are known:

$$\frac{U_1^2}{U_2^2} = \frac{c_v \, t_1/H_1^2}{c_v \, t_2/H_2^2}$$

in which U_1 is the percentage of consolidation sought; U_2 corresponds to 100% consolidation; t_1 and t_2 are the respective times of the new consolidation and 100% consolidation; and H_1 and H_2 are the corresponding sample heights.

In the case of computing consolidation of the laboratory sample, c_v is the same at all times and H_1 and H_2 are the same value. The formula then is resolved to $U_1^2 / U_2^2 = t_1 / t_2$.

In the laboratory computations of consolidation were made using a consolidating depth of sixteen feet (the depth of the well screen below the surface). The construction time was estimated to be two months. The relation of the construction consolidation to the laboratory consolidation was estimated using the following relations:

$t_1 = t_2 H_1^2 / H_2^2$

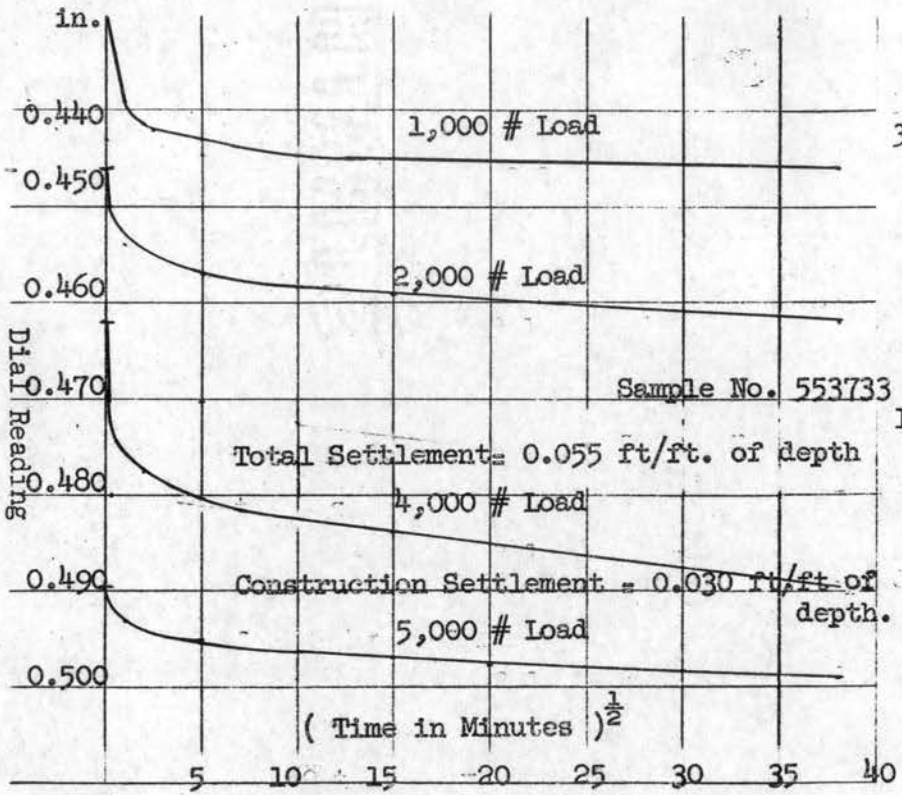
t_2 = 2 months/2 = 43,200 minutes

H_1^2 = 1.25"^{2}(sample size) = 1.56 in.^{2}

$H_2^2 = (16 \times 12)^2$ = /36864 in.^{2}

t_1 = 43,200 x 1.56 / 36864; t_1 = 1.8 min. in the lab. $1.8^{\frac{1}{2}} = 1.34$

The maximum load was estimated to be 5000 psf (34.7 psi) which is very close to that actually placed on the foundation at the ℄ of the test sections. (Figure 38 shows a sample and results of the testing on the site).



Typical Set of Laboratory Consolidation Curves.

The method involved in the analysis of these curves is explained in the preceding text.

Gage No.	Field Test Results Constr.	Total	Laboratory Estimates Constr.	Total	Constr./Total x 100 Field	Lab.
34- 1	0.038'	0.117'	no estimate		32.5%	--
2	0.305'	0.445'	0.378'	0.758'	68.6%	49.5%
3	0.775'	1.141'	0.442'	0.798'	68.5%	55.4%
4	0.455'	0.665'	0.450'	0.890'	68.5%	50.6%
5	0.070'	0.100'	no estimate		70.0%	--
6	0.050'	0.248'	0.112'	0.192'	20.2%	58.4%
16- 1	0.145'	0.228'	no estimate		63.5%	--
2	0.515'	0.896'	0.455'	0.800'	57.4%	56.9%
3	0.550'	0.945'	0.350'	0.795'	58.2%	56.0%
4	0.297'	0.569'	0.350'	0.700'	52.2%	50.0%
5	Plate No. 5 rose 0.007' total--no lab. est.					
6	0.315'	0.479'	0.376'	0.304'	65.9%	55.4%
7	0.015'	0.051'	0.108'	0.183'	00.0%	59.0%

Comparison of the findings of the laboratory personnel and the results of the field tests. These results are discussed at length in the text of the report. The laboratory data are the results of thorough testing and analysis of each of the soil layers within the foundations of the two structures

Figure 38. Laboratory Test Results Compared to The Results of the Field Research

VI. SUMMARY AND CONCLUSIONS

1. Settlement of the alluvial foundations generally occurred in direct proportion to the added loads. There was, however, some settling that occurred in areas contiguous to the areas upon which the load rested directly. The amount of the settling that occurred at the toes of the embankments was measured in this study. The distance that settling extended beyond the loaded areas was not measured.

2. The settlement in proportion to load in the foundations of the two dams tested reached its maximum at the point of greatest load in the alluvial areas. The settlement in proportion to load decreased as the overburden over the parent material decreased in thickness. There was very little consolidation of the foundations in the abutments of the sites where the parent material lay only a few feet below the surface. There were, of course, different amounts of settling with different soil types. The sandier soils (higher unit weight) consolidated smaller amounts.

3. Fluctuations in the rates of foundation consolidation occurred at approximately the same time at all points of the foundations. This was not always true during the heaving and swelling processes that followed the first loading of the foundations; however, all areas of each foundation began their primary consolidation at the same time. The fluctuations that followed the beginning of primary consolidation occurred at approximately the same time at all points.

4. The foundations generally heaved during the early stages of construction. This was caused by the rise in water table that accompanied the covering of the original surface. The foundation soils swelled with rises in water table caused by heavy rains. There was no water impounded at either site during the testing period. The impounding of water should result in some rise in water table and some heaving of the foundations.

5. The estimates made by laboratory personnel concerning the percentages of the total settlement that would occur during the construction and post-construction periods were very accurate. This was especially true for Site 16. The length of the construction period of the dam was very close to the two-month period estimated by the Soil Mechanics Engineers. A greater percentage of the total settlement occurred during the construction period, and a correspondingly smaller percentage occurred during the post-construction period as the construction time lengthened.

6. The observed settlements were generally larger than estimated by the laboratory engineers--the opposite is generally true. (2) It is noteworthy, however, that all estimated amounts of settling were well within the range of accuracy generally expected from laboratory investigations. A variation of one hundred per cent is usually considered sufficiently accurate. (5)

7. The settlement of both foundations over the points of maximum loading (41 feet of fill or 35.5 psi. average) averaged 0.016 feet per foot of fill during construction. Those points settled an average of 0.026 feet per foot of fill (two per cent) during the testing period. Designs based on a foundation settlement of two per cent after the

completion of structures should be sufficiently safe for dams constructed under the same conditions as those tested.

8. There was no evidence that the differential settling between the abutments and the alluvial areas were great enough to impair the efficiency of the dams as flood prevention structures.

VII. RECOMMENDATIONS FOR FURTHER STUDY

The scope of studies of the type presented in this report are unlimited. All facets of the problem could not be studied in the brief period covered by this study. The following list includes some of the factors that should be studied further:

1. The tests should be repeated on structures of all sizes with many different foundation conditions so that data useful in designing any future structures may be obtained.

2. The studies started should be continued indefinitely so that a complete picture of the movement of the foundations under all conditions may be had. The studying of the effects of water impoundment is especially important.

3. A study of the effect of the structure upon the foundations of adjacent areas and structures should be studied.

The methods and equipment employed in these studies proved to be very effective and could be used without appreciable revision or redesigning in future tests.

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APPENDIX

TABLE I
SETTLEMENT RECORDS FOR PLATE NO. 1 - SITE 34

Location: Toe of 3:1 Slope ℄ Station 4 + 50
Original Elevation: 1655.048

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
7-9-55		0.000	1.0	0.879	11:00 AM	0.00
7-11-55	55.006	-0.042	1.0	0.879	11:00 AM	48.00
7-11-55	55.053	+0.005	1.7	1.495	4:15 PM	53.25
7-13-55	55.053	+0.005	1.9	1.671	4:00 PM	101.00
7-14-55	54.970	-0.078	1.9	1.671	12:00 AM	121.00
7-15-55	54.970	-0.078	1.9	1.671	9:45 AM	142.75
7-18-55	54.995	-0.053	1.9	1.671	9:30 AM	214.50
7-21-55	54.975	-0.073	1.9	1.671	9:30 AM	286.50
7-22-55	55.040	-0.008	1.9	1.671	10:00 AM	311.00
7-25-55	55.030	-0.018	1.9	1.671	10:00 AM	383.00
7-26-55	55.000	-0.048	1.9	1.671	3:15 PM	412.25
7-30-55	55.045	+0.003	1.9	1.671	11:00 AM	504.00
8-1-55	55.000	-0.048	1.9	1.671	9:30 AM	551.50
8-2-55	54.990	-0.058	1.9	1.671	9:45 AM	574.75
8-6-55	54.970	-0.078	1.9	1.671	5:00 PM	678.00
8-8-55	54.980	-0.068	1.9	1.671	1:45 PM	722.75
8-9-55	55.000	-0.048	1.9	1.671	12:00 AM	745.00
8-10-55	55.000	-0.048	1.9	1.671	1:30 PM	770.50
8-13-55	55.000	-0.048	1.9	1.671	4:30 PM	845.50
8-17-55	55.000	-0.048	1.9	1.671	9:30 AM	934.50
8-19-55	55.000	-0.048	1.9	1.671	1:45 PM	986.75
8-21-55	55.000	-0.048	1.9	1.671	1:30 PM	1034.50
8-24-55	55.000	-0.048	1.9	2.281	8:45 AM	1101.75
8-25-55	55.000	-0.048	1.9	1.848	3:00 PM	1132.00
8-26-55	55.000	-0.048	1.9	1.631	10:00 AM	1151.00
8-28-55	55.000	-0.048	1.9	1.414	5:00 PM	1206.00
8-29-55	55.000	-0.048	2.7	2.374	4:15 PM	1229.25
8-30-55	55.010	-0.038	2.8	2.462	8.45 AM	1245.75
8-30-55	55.000	-0.048	2.9	2.550	4:00 PM	1253.00
8-31-55	55.010	-0.038	2.9	2.550	8:30 AM	1269.50
8-31-55	54.990	-0.058	2.9	2.550	4:15 PM	1277.25
9-1-55	55.040	-0.008	2.9	2.550	10:15 AM	1295.25
9-2-55	55.020	-0.028	2.9	2.550	9:45 AM	1318.75
9-3-55	54.990	-0.058	2.9	2.550	9:30 AM	1342.50
9-5-55	55.000	-0.048	2.9	2.550	9:30 AM	1390.50
9-6-55	55.010	-0.038	2.9	2.550	8:30 AM	1413.50
9-7-55	55.010	-0.038	3.0	2.638	8:30 AM	1437.50
9-8-55	55.015	-0.033	3.3	2.902	8:30 AM	1461.50
9-9-55	55.000	-0.048	3.3	2.902	8:45 AM	1485.75
9-10-55	55.030	-0.018	3.3	2.902	1:30 PM	1514.50
9-12-55	55.020	-0.028	3.5	3.078	9:00 AM	1558.00
9-13-55	55.020	-0.028	3.5	3.078	8:45 AM	1581.75
9-14-55	55.010	-0.010	3.5	3.078	9:00 AM	1606.00
9-15-55	55.010	-0.038	3.5	3.078	8:30 AM	1629.50

TABLE I (Continued)

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
9-16-55	55.020	-0.028	3.5	3.078	9:30 AM	1654.50
9-23-55	54.940	-0.108	3.5	3.078	9:30 AM	1822.50
9-30-55	54.950	-0.098	3.5	3.078	9:30 AM	1990.50
10-7-55	54.970	-0.078	3.5	3.078	9:30 AM	2158.50
10-21-55	54.970	-0.078	3.5	3.078	10:00 AM	2495.00
11-4-55	54.970	-0.078	3.5	3.078	10:00 AM	2831.00
11-16-55	54.990	-0.058	3.5	3.078	10:00 AM	3119.00
12-2-55	54.970	-0.078	3.5	3.078	11:00 AM	3504.00
12-16-55	54.960	-0.088	3.5	3.078	12:00 AM	3841.00
1-20-56	54.920	-0.128	3.5	3.078	9:00 AM	4678.00
2-25-56	54.926	-0.122	3.5	3.078	9:00 AM	5542.00
3-16-56	54.931	-0.117	3.5	3.078	9:00 AM	6022.00

TABLE II
SETTLEMENT RECORDS FOR PLATE NO. 2 - SITE 34

Location: 60 Feet Right of ℄ Station 4 + 50
Original Elevation: 1653.270 Replaced: 7-6-55 Elevation 1653.475

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
5-7-55		0.000	1.4	1.231	4:00 PM	0.00
5-10-55	53.255	-0.015	3.6	3.166	4:00 PM	72.00
5-13-55	53.255	-0.015	3.6	3.166	4:00 PM	144.00
5-16-55	53.255	-0.015	3.6	3.166	4:00 PM	216.00
5-18-55	53.370	+0.100	3.6	3.166	11:00 AM	259.00
5-23-55	53.580	+0.310	3.6	3.166	2:30 PM	382.50
7-2-55	53.580	+0.310	3.6	3.166	4:00 PM	1344.00
7-6-55	53.475	0.000	3.6	3.166	5:00 PM	1441.00
7-7-55	53.475	0.000	3.6	3.166	12:00 AM	1460.00
7-8-55	53.480	+0.005	4.5	3.957	2:00 PM	1486.00
7-9-55	53.517	+0.042	4.5	3.957	11:00 AM	1507.00
7-11-55	53.806	+0.331	6.0	5.277	11:00 AM	1555.00
7-11-55	53.853	+0.379	6.7	5.892	4:15 PM	1560.25
7-13-55	53.843	+0.369	7.9	6.948	4:00 PM	1608.00
7-14-55	53.760	+0.285	7.9	6.948	12:00 AM	1627.00
7-15-55	53.760	+0.285	7.9	6.948	9:45 AM	1649.75
7-18-55	53.785	+0.310	7.9	6.948	9:30 AM	1721.50
7-21-55	53.755	+0.280	7.9	6.948	9:30 AM	1793.50
7-22-55	53.770	+0.295	7.9	6.948	10:00 AM	1818.00
7-25-55	53.780	+0.305	7.9	6.948	10:00 AM	1890.00
7-26-55	53.790	+0.315	7.9	6.948	3:15 PM	1919.25
7-30-55	53.790	+0.315	7.9	6.948	11:00 AM	2011.00
8-1-55	53.770	+0.295	7.9	6.948	9:30 AM	2058.50
8-2-55	53.770	+0.295	7.9	6.948	9:45 AM	2081.75
8-6-55	53.765	+0.290	7.9	6.948	5:00 PM	2185.00
8-8-55	53.765	+0.290	7.9	6.948	1:45 PM	2229.75
8-9-55	53.760	+0.285	7.9	6.948	12:00 AM	2252.00
8-10-55	53.750	+0.275	7.9	6.948	1:30 PM	2277.50
8-13-55	53.760	+0.285	7.9	6.948	4:30 PM	2352.50
8-17-55	53.760	+0.285	7.9	6.948	9:30 AM	2441.50
8-19-55	53.750	+0.275	7.9	6.948	1:45 PM	2493.75
8-21-55	53.760	+0.285	7.9	6.948	1:30 PM	2541.50
8-24-55	53.760	+0.285	7.9	6.948	8:45 AM	2608.75
8-25-55	53.730	+0.255	8.6	7.563	3:00 PM	2639.00
8-26-55	53.730	+0.255	9.9	8.706	10:00 AM	2658.00
8-28-55	53.735	+0.260	11.1	9.762	5:00 PM	2713.00
8-29-55	53.700	+0.225	12.0	10.553	4:15 PM	2736.25
8-30-55	53.700	+0.225	12.5	10.993	8:45 AM	2752.75
8-30-55	53.700	+0.225	13.3	11.697	4:00 PM	2760.00
8-31-55	53.660	+0.185	13.6	11.960	8:30 AM	2776.50
8-31-55	53.650	+0.175	14.9	13.104	4:15 PM	2784.25
9-31-55	53.665	+0.190	14.9	13.104	10:15 AM	2802.25
9-2-55	53.600	+0.125	16.2	14.247	9:45 AM	2825.75
9-3-55	53.585	+0.110	17.6	15.478	9:30 AM	2849.50

TABLE II (Continued)

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
9-5-55	53.535	∱0.060	18.7	16.446	9:30 AM	2897.50
9-6-55	53.490	∱0.015	19.7	17.325	8:30 AM	2920.50
9-7-55	53.490	∱0.015	21.8	19.172	8:30 AM	2944.50
9-8-55	53.480	∱0.005	21.8	19.172	8:30 AM	2968.50
9-9-55	53.425	-0.030	21.8	19.172	8:45 AM	2992.75
9-10-55	53.390	-0.085	21.8	19.172	1:30 PM	3021.50
9-12-55	53.330	-0.145	21.8	19.172	9:00 AM	3065.00
9-13-55	53.290	-0.185	21.8	19.172	8:45 AM	3088.75
9-14-55	53.260	-0.215	21.8	19.172	9:00 AM	3113.00
9-15-55	53.230	-0.245	21.8	19.172	8:30 AM	3136.50
9-16-55	53.170	-0.305	22.1	19.436	9:30 AM	3161.50
9-23-55	53.130	-0.345	22.1	19.436	9:30 AM	3329.50
9-30-55	53.130	-0.345	22.1	19.436	9:30 AM	3497.50
10-7-55	53.130	-0.345	22.1	19.436	9:30 AM	3665.50
10-21-55	53.090	-0.385	22.1	19.436	10:00 AM	4002.00
11-4-55	53.120	-0.355	22.1	19.436	10:00 AM	4338.00
11-16-55	53.120	-0.355	22.1	19.436	10:00 AM	4626.00
12-2-55	53.100	-0.375	22.1	19.436	11:00 AM	5011.00
12-16-55	53.100	-0.375	22.1	19.436	12:00 AM	5348.00
1-20-56	53.075	-0.400	22.1	19.436	9:00 AM	6185.00
2-25-56	53.066	-0.409	22.1	19.436	9:00 AM	7049.00
3-16-56	53.030	-0.445	22.1	19.436	9:00 AM	7529.00

TABLE III
SETTLEMENT RECORDS FOR PLATE NO. 3 - SITE 34

Location: 7 Feet Right of ℄ Station 4 + 50
Original Elevation: 1651.815

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
7-8-55		0.000	1.5	1.319	2:00 PM	0.00
7-9-55	51.808	-0.007	4.5	3.957	11:00 AM	21.00
7-11-55	51.776	-0.039	6.7	5.892	11:00 AM	69.00
7-11-55	51.833	-0.039	6.7	5.892	4:15 PM	74.25
7-13-55	51.793	-0.022	8.9	7.827	4:00 PM	122.00
7-14-55	51.710	-0.105	8.9	7.827	12:00 AM	142.00
7-15-55	51.710	-0.105	8.9	7.827	9:45 AM	163.75
7-18-55	51.705	-0.110	8.9	7.827	9:30 AM	235.50
7-21-55	51.690	-0.120	8.9	7.827	9:30 AM	307.50
7-22-55	51.720	-0.095	8.9	7.827	10:00 AM	332.00
7-25-55	51.710	-0.105	8.9	7.827	10:00 AM	404.00
7-26-55	51.740	-0.075	8.9	7.827	3:15 PM	433.25
7-30-55	51.730	-0.085	8.9	7.827	11:00 AM	525.00
8-1-55	51.730	-0.085	8.9	7.827	9:30 AM	572.50
8-2-55	51.720	-0.095	8.9	7.827	9:45 AM	595.75
8-6-55	51.700	-0.115	8.9	7.827	5:00 PM	699.00
8-8-55	51.700	-0.115	8.9	7.827	1:45 PM	743.75
8-9-55	51.710	-0.105	8.9	7.827	12:00 AM	766.00
8-10-55	51.690	-0.125	8.9	7.827	1:30 PM	791.50
8-13-55	51.710	-0.105	8.9	7.827	4:30 PM	866.50
8-17-55	51.700	-0.105	8.9	7.827	9:30 AM	955.50
8-19-55	51.720	-0.095	8.9	7.827	1:45 PM	1007.75
8-21-55	51.700	-0.115	8.9	7.827	1:30 PM	1055.50
8-24-55	51.710	-0.105	8.9	7.827	8:45 AM	1122.75
8-25-55	51.700	-0.115	10.6	9.322	3:00 PM	1153.00
8-26-55	51.650	-0.125	11.1	9.762	10:00 AM	1172.00
8-28-55	51.685	-0.130	12.6	11.081	5:00 PM	1227.00
8-29-55	51.685	-0.130	12.6	11.081	4:15 PM	1250.25
8-30-55	51.700	-0.115	12.9	11.345	8:45 AM	1266.75
8-30-55	51.670	-0.145	13.3	11.697	4:00 PM	1274.00
8-31-55	51.650	-0.165	15.4	13.543	8:30 AM	1290.50
8-31-55	51.630	-0.185	16.6	14.599	4:15 PM	1298.25
9-1-55	51.620	-0.195	16.7	14.687	10:15 AM	1316.25
9-2-55	51.600	-0.215	18.1	15.918	9:45 AM	1339.75
9-3-55	51.595	-0.220	19.3	16.973	9:30 AM	1363.50
9-5-55	51.526	-0.289	20.7	18.204	9:30 AM	1411.50
9-6-55	51.460	-0.355	21.9	19.260	8:30 AM	1434.50
9-7-55	51.450	-0.365	22.6	19.875	8:30 AM	1458.50
9-8-55	51.440	-0.375	24.6	21.634	8:30 AM	1482.50
9-9-55	51.375	-0.440	25.9	22.778	8:45 AM	1506.75
9-10-55	51.305	-0.510	29.5	25.944	1:30 PM	1535.50
9-12-55	51.230	-0.585	31.4	27.615	9:00 AM	1579.00
9-13-55	51.170	-0.645	33.7	29.637	8:45 AM	1602.75
9-14-55	51.120	-0.695	36.0	31.660	9:00 AM	1627.00

TABLE III (Continued)

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
9-15-55	51.060	-0.755	38.6	33.947	8:30 AM	1650.50
9-16-55	51.040	-0.775	41.2	36.233	9:30 AM	1675.50
9-23-55	50.850	-0.965	41.2	36.233	9:30 AM	1843.50
9-30-55	50.850	-0.965	41.2	36.233	9:30 AM	2011.50
10-7-55	50.810	-1.005	41.2	36.233	9:30 AM	2179.50
10-21-55	50.780	-1.025	41.2	36.233	10:00 AM	2516.00
11-4-55	50.800	-1.015	41.2	36.233	10:00 AM	2852.00
11-16-55	50.800	-1.015	41.2	36.233	10:00 AM	3140.00
12-2-55	50.780	-1.035	41.2	36.233	11:00 AM	3525.00
12-16-55	50.780	-1.035	41.2	36.233	12:00 AM	3862.00
1-20-56	50.720	-1.095	41.2	36.233	9:00 AM	4699.00
2-25-56	50.709	-1.106	41.2	36.233	9:00 AM	5563.00
3-16-56	50.674	-1.141	41.2	36.233	9:00 AM	6043.00

TABLE IV
SETTLEMENT RECORDS FOR PLATE NO. 4 - SITE 34

Location: 35 Feet Left of Dam ℄ Station 4 + 50
Original Elevation: 1652.035

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
5-7-55		0.000	1.0	0.879	4:00 PM	0.00
5-10-55	52.010	-0.025	3.5	3.078	4:00 PM	72.00
5-13-55	51.998	-0.037	3.5	3.078	4:00 PM	144.00
5-16-55	51.991	-0.044	3.5	3.078	4:00 PM	216.00
5-18-55	52.035	-0.000	3.5	3.078	11:00 AM	259.00
5-23-55	52.250	+0.215	3.5	3.078	2:30 PM	382.50
7-6-55	52.270	+0.235	3.5	3.078	5:00 PM	1441.00
7-7-55	52.255	+0.220	3.5	3.078	12:00 AM	1460.00
7-8-55	52.240	+0.205	3.5	3.078	2:00 PM	1486.00
7-9-55	52.243	+0.208	3.5	3.078	11:00 AM	1507.00
7-11-55	52.256	+0.221	6.1	5.365	11:00 AM	1555.00
7-11-55	52.303	+0.268	6.7	5.892	4:15 PM	1560.25
7-13-55	52.303	+0.268	6.8	5.980	4:00 PM	1608.00
7-14-55	52.220	+0.185	7.9	6.948	12:00 AM	1627.00
7-15-55	52.210	+0.175	7.9	6.948	9:45 AM	1649.75
7-18-55	52.205	+0.170	7.9	6.948	9:30 AM	1721.50
7-21-55	52.205	+0.170	8.0	7.036	9:30 AM	1793.50
7-22-55	52.210	+0.175	8.0	7.036	10:00 AM	1818.00
7-26-55	52.230	+0.195	8.0	7.036	3:15 PM	1919.25
7-30-55	52.230	+0.195	8.0	7.036	11:00 AM	2011.00
8-1-55	52.210	+0.175	8.0	7.036	9:30 AM	2058.50
8-2-55	52.220	+0.185	8.0	7.036	9:45 AM	2081.75
8-6-55	52.165	+0.130	8.0	7.036	5:00 AM	2185.00
8-8-55	52.175	+0.140	8.0	7.036	1:45 PM	2229.75
8-9-55	52.180	+0.145	8.0	7.036	12:00 AM	2252.00
8-10-55	52.160	+0.125	8.2	7.211	1:30 PM	2277.50
8-13-55	52.180	+0.145	8.2	7.211	4:30 PM	2352.50
8-17-55	52.170	+0.135	8.2	7.211	9:30 AM	2441.50
8-19-55	52.150	+0.115	8.2	7.211	1:45 PM	2493.75
8-21-55	52.170	+0.135	8.2	7.211	1:30 PM	2541.50
8-24-55	52.170	+0.135	8.2	7.211	8:45 AM	2608.75
8-25-55	52.180	+0.145	9.4	8.267	3:00 PM	2639.00
8-26-55	52.190	+0.155	9.6	8.443	10:00 AM	2658.00
8-28-55	52.155	+0.120	12.4	10.905	5:00 PM	2713.00
8-29-55	52.145	+0.110	13.0	11.433	4:15 PM	2736.25
8-30-55	52.125	+0.090	13.5	11.872	8:45 AM	2752.75
8-30-55	52.110	+0.075	14.0	12.312	4:00 PM	2760.00
8-31-55	52.090	+0.055	14.7	12.928	8:30 AM	2776.50
8-31-55	52.080	+0.045	15.5	13.631	4:15 PM	2784.25
9-1-55	52.050	+0.015	15.7	13.807	10:15 AM	2802.25
9-2-55	52.040	+0.005	17.4	15.302	9:45 AM	2825.75
9-3-55	52.055	+0.020	19.3	16.973	9:30 AM	2849.50
9-5-55	51.975	-0.060	20.7	18.204	9:30 AM	2897.50
9-6-55	51.940	-0.095	21.2	18.644	8:30 AM	2920.50

TABLE IV (Continued)

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
9-7-55	51.930	-0.105	21.6	18.996	8:30 AM	2944.50
9-8-55	51.920	-0.115	23.5	20.667	8:30 AM	2968.50
9-9-55	51.885	-0.150	25.0	21.986	8:45 AM	2992.75
9-10-55	51.840	-0.195	26.2	23.041	1:30 PM	3021.50
9-12-55	51.790	-0.245	27.0	23.745	9:00 AM	3065.00
9-13-55	51.740	-0.295	27.2	23.920	8:45 AM	3088.75
9-14-55	51.720	-0.315	27.3	24.009	9:00 AM	3113.00
9-15-55	51.680	-0.355	27.5	24.185	8:30 AM	3136.50
9-16-55	51.580	-0.455	27.5	24.185	9:30 AM	3161.50
9-23-55	51.570	-0.465	27.5	24.185	9:30 AM	3329 50
9-30-55	51.510	-0.525	27.5	24.185	9:30 AM	3497.50
10-7-55	51.510	-0.525	27.5	24.185	9:30 AM	3665.50
10-21-55	51.430	-0.605	27.5	24.185	10:00 AM	4002.00
11-4-55	51.450	-0.585	27.5	24.185	10:00 AM	4338.00
11-16-55	51.380	-0.655	27.5	24.185	10:00 AM	4626.00
12-2-55	51.420	-0.615	27.5	24.185	11:00 AM	5011.00
12-16-55	51.420	-0.615	27.5	24.185	12:00 AM	5348.00
3-16-56	51.370	-0.665	27.5	24.185	9:00 AM	7529.00

TABLE V
SETTLEMENT RECORDS FOR PLATE NO. 5 - SITE 34

Location: Toe of 2:1 Slope ℄ Station 4 + 50
Original Elevation: 1654.760

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
7-9-55		0.000	1.0	0.879	11:00 AM	0.00
7-11-55	54.756	0.004	1.0	0.879	11·00 AM	48.00
7-11-55	54.743	-0.017	1.0	0.879	4:15 PM	53.25
7-13-55	54.743	-0.017	1.0	0.879	4:00 PM	101.00
7-14-55	54.740	-0.020	1.0	0.879	12:00 AM	121.00
7-15-55	54.730	-0.030	1.0	0.879	9:45 AM	142.75
7-18-55	54.755	-0.005	1.0	0.879	9:30 AM	214.50
7-21-55	54.740	-0.020	1.2	1.055	9:30 AM	286.50
7-22-55	54.760	-0.000	1.2	1.055	10:00 AM	311.00
7-25-55	54.810	+0.050	1.2	1.055	10:00 AM	383.00
7-26-55	54.770	+0.010	1.2	1.055	3:15 PM	412.00
7-30-55	54.770	+0.010	1.2	1.055	11:00 AM	504.00
8-1-55	54.760	+0.000	1.2	1.055	9:30 AM	551.50
8-2-55	54.760	+0.000	1.2	1.055	9:45 AM	574.75
8-6-55	54.680	-0.080	1.2	1.055	5:00 PM	678.00
8-8-55	54.700	-0.060	1.2	1.055	1:45 PM	722.75
8-9-55	54.690	-0.070	1.2	1.055	12:00 AM	745.00
8-10-55	54.690	-0.070	1.2	1.055	1:30 PM	770.50
8-13-55	54.700	-0.060	1.2	1.055	4:30 PM	845.50
8-17-55	54.700	-0.060	1.2	1.055	9:30 AM	934.50
8-19-55	54.700	-0.060	1.2	1.055	1:45 PM	986.75
8-21-55	54.710	-0.050	1.2	1.055	1:30 PM	1034.50
8-24-55	54.690	-0.070	1.2	1.055	8:45 AM	1101.75
8-25-55	54.680	-0.080	1.2	1.055	3:00 PM	1132.00
8-26-55	54.710	-0.050	1.2	1.055	10:00 AM	1151.00
8-28-55	54.690	-0.070	1.2	1.055	5:00 PM	1206.00
8-29-55	54.690	-0.070	1.2	1.055	4:15 PM	1229.25
8-30-55	54.700	-0.060	1.2	1.055	8:45 AM	1245.75
8-30-55	54.690	-0.700	1.2	1.055	4:00 PM	1253.00
8-31-55	54.700	-0.060	1.2	1.055	8:30 AM	1269.50
8-31-55	54.690	-0.070	1.2	1.055	4:15 PM	1277.25
9-1-55	54.680	-0.080	1.2	1.055	10:15 AM	1295.25
9-2-55	54.680	-0.080	1.2	1.055	9:45 AM	1318.75
9-3-55	54.680	-0.080	1.2	1.055	9:30 AM	1342.50
9-5-55	54.690	-0.070	1.2	1.055	9:30 AM	1390.50
9-6-55	54.700	-0.060	1.2	1.055	8:30 AM	1413.50
9-7-55	54.700	-0.060	1.2	1.055	8:30 AM	1437.50
9-8-55	54.700	-0.060	1.2	1.055	8:30 AM	1461.50
9-9-55	54.700	-0.060	1.7	1.495	8:45 AM	1485.75
9-10-55	54.710	-0.050	1.8	1.583	1:30 PM	1514.50
9-12-55	54.700	-0.060	1.8	1.583	9:00 AM	1558.00
9-13-55	54.710	-0.050	1.8	1.583	8:45 AM	1581.75
9-14-55	54.710	-0.050	1.8	1.583	9:00 AM	1606.00
9-15-55	54.710	-0.050	1.8	1.583	8:30 AM	1629.50

TABLE V (Continued)

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
9-16-55	54.690	-0.070	1.8	1.583	9:30 AM	1654.50
9-23-55	54.710	-0.050	1.8	1.583	9:30 AM	1822.50
9-30-55	54.700	-0.060	1.8	1.583	9:30 AM	1990.50
10-7-55	54.690	-0.070	1.8	1.583	9:30 AM	2158.50
10-21-55	54.690	-0.070	1.8	1.583	10:00 AM	2495.00
11-4-55	54.680	-0.080	1.8	1.583	10:00 AM	2831.00
11-16-55	54.680	-0.080	1.8	1.583	10:00 AM	3119.00
12-2-55	54.680	-0.080	1.8	1.583	11:00 AM	3504.00
12-16-55	54.680	-0.080	1.8	1.583	12:00 AM	3841.00
1-20-56	54.685	-0.075	1.8	1.583	9:00 AM	4678.00
2-25-56	54.681	⁄0.079	1.8	1.583	9:00 AM	5542.00
1-16-56	54.660	-0.100	1.8	1.583	9:00 AM	6022.00

TABLE VI
SETTLEMENT RECORDS FOR PLATE NO. 6 - SITE 34

Location: 9 Feet Right of ℄ Station 6 + 00
Original Elevation: 1657.980

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
7-8-55		0.000	3.5	3.078	2:00 PM	0.00
7-9-55	57.688	-0.292	3.7	3.254	11:00 AM	21.00
7-11-55	58.076	+0.096	8.5	7.475	11:00 AM	69.00
7-11-55	58.143	+0.163	9.5	8.355	4:15 PM	74.25
7-13-55	58.133	+0.153	10.6	9.322	4:00 PM	122.00
7-14-55	58.080	+0.100	10.8	9.498	12:00 AM	142.00
7-15-55	58.070	+0.090	10.8	9.498	9:45 AM	163.75
7-18-55	58.095	+0.115	10.8	9.498	9:30 AM	235.50
7-21-55	58.100	+0.120	10.9	9.586	9:30 AM	307.50
7-22-55	58.105	+0.125	10.9	9.586	10:00 AM	332.00
7-26-55	58.140	+0.160	10.9	9.586	3:15 PM	433.25
7-30-55	58.080	+0.100	10.9	9.586	11:00 AM	525.00
8-1-55	58.120	+0.140	10.9	9.586	9:30 AM	572.50
8-2-55	58.110	+0.120	10.9	9.586	9:45 AM	595.75
8-6-55	57.990	+0.010	10.9	9.586	5:00 PM	699.00
8-8-55	57.960	-0.020	10.9	9.586	1:45 PM	743.75
8-9-55	57.940	-0.040	10.9	9.586	12:00 AM	766.00
8-10-55	57.920	-0.060	10.9	9.586	1:30 PM	791.50
8-13-55	57.950	-0.030	10.9	9.586	4:30 PM	866.50
8-17-55	58.010	+0.020	10.9	9.586	9:30 AM	955.50
8-19-55	57.930	-0.050	10.9	9.586	1:45 PM	1007.75
8-21-55	57.910	-0.070	10.9	9.586	1:30 PM	1055.50
8-24-55	57.900	-0.080	10.9	9.586	8:45 AM	1122.75
8-25-55	57.940	-0.040	11.3	9.938	3:00 PM	1153.00
8-26-55	57.970	-0.010	12.3	10.817	10:00 AM	1172.00
8-28-55	57.905	-0.075	13.5	11.872	5:00 PM	1227.00
8-29-55	57.900	-0.080	15.0	13.192	4:15 PM	1250.25
8-30-55	57.910	-0.070	15.5	14.423	8:45 AM	1266.75
8-30-55	57.920	-0.060	16.4	14.423	4:00 PM	1274.00
8-31-55	57.900	-0.080	16.4	14.423	8:30 AM	1290.50
8-31-55	57.890	-0.090	17.5	15.390	4:15 PM	1298.25
9-1-55	57.960	-0.020	18.5	16.270	10:15 AM	1316.25
9-2-55	57.950	-0.030	19.2	16.885	9:45 AM	1339.75
9-3-55	57.945	-0.035	20.0	17.589	9:30 AM	1363.50
9-5-55	57.925	-0.055	21.4	18.820	9:30 AM	1411.50
9-6-55	57.910	-0.070	22.5	19.787	8:30 AM	1434.50
9-7-55	57.940	-0.040	23.1	20.315	8:30 AM	1458.50
9-8-55	57.950	-0.030	23.4	20.579	8:30 AM	1482.50
9-9-55	57.915	-0.065	24.5	21.546	8:45 AM	1506.75
9-10-55	57.900	-0.080	25.9	22.778	1:30 PM	1535.50
9-12-55	57.940	-0.040	26.4	23.217	9:00 AM	1579.00
9-13-55	57.930	-0.050	29.5	25.944	8:45 AM	1602.75
9-14-55	57.940	-0.040	30.5	26.823	9:00 AM	1627.00
9-15-55	57.930	-0.030	32.5	28.582	8:30 AM	1650.50

TABLE VI (Continued)

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
9-16-55	57.920	-0.050	33.7	29.637	9:30 AM	1675.50
9-23-55	57.840	-0.140	33.7	29.637	9:30 AM	1843.50
9-30-55	57.830	-0.150	33.7	29.637	9:30 AM	1990.50
10-7-55	57.810	-0.170	33.7	29.637	9:30 AM	2179.50
10-21-55	57.810	-0.170	33.7	29.637	10:00 AM	2516.00
11-4-55	57.820	-0.160	33.7	29.637	10:00 AM	2852.00
11-16-55	57.800	-0.180	33.7	29.637	10:00 AM	3140.00
12-2-55	57.810	-0.170	33.7	29.637	11:00 AM	3525.00
1-20-56	57.810	-0.170	33.7	29.637	9:00 AM	4699.00
2-25-56	57.792	-0.188	33.7	29.637	9:00 AM	5563.00
3-16-56	57.732	-0.248	33.7	29.637	9:00 AM	6043.00

TABLE VII
SETTLEMENT RECORDS FOR PLATE NO. 1 - SITE 16

Location: Toe of 3:1 Embankment ℄ Station 6 / 15
Original Elevation: 1780.806

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
7-2-55	80.860	0.000	1.0	0.863	1:30 PM	0.00
7-5-55	80.696	-0.164	1.0	0.863	4:00 PM	74.50
7-6-55	80.690	-0.170	1.0	0.863	10:30 AM	93.00
7-7-55	80.720	-0.140	1.0	0.863	2:30 PM	121.00
7-8-55	80.695	-0.165	1.0	0.863	4:00 PM	146.50
7-9-55	80.841	-0.019	1.0	0.863	3:45 PM	170.25
7-11-55	80.830	-0.030	1.0	0.863	2:00 PM	216.50
7-13-55	80.830	-0.030	1.0	0.863	2:30 PM	265.00
7-14-55	80.830	-0.030	1.0	0.863	10:45 AM	285.25
7-15-55	80.820	-0.040	1.0	0.863	4:00 PM	314.50
7-18-55	80.820	-0.040	1.0	0.863	3:30 PM	386.00
7-21-55	80.820	-0.040	1.0	0.863	1:30 PM	456.00
7-22-55	80.790	-0.040	1.0	0.863	2:30 PM	481.00
7-25-55	80.860	-0.000	1.0	0.863	11:30 AM	550.00
7-26-55	80.870	/0.010	1.0	0.863	1:45 PM	576.25
7-27-55	80.910	/0.050	1.0	0.863	2:00 PM	600.50
7-28-55	80.870	/0.010	1.0	0.863	11:00 AM	621.50
7-30-55	81.010	/0.150	1.0	0.863	1:00 PM	671.50
8-1-55	81.000	/0.140	1.0	0.863	10:30 AM	717.00
8-2-55	80.975	/0.115	1.0	0.863	10:45 AM	741.25
8-3-55	80.700	-0.160	1.0	0.863	1:30 PM	768.00
8-4-55	80.680	-0.180	1.0	0.863	10:30 AM	789.00
8-5-55	80.708	-0.152	1.0	0.863	2:30 PM	817.00
8-6-55	80.757	-0.103	1.0	0.863	11:00 AM	837.50
8-8-55	80.695	-0.165	1.0	0.863	10:00 AM	884.50
8-8-55	80.700	-0.160	1.0	0.863	3:15 PM	889.75
8-9-55	80.695	-0.165	1.0	0.863	9:30 AM	908.00
8-9-55	80.720	-0.140	1.0	0.863	3:30 PM	914.00
8-10-55	80.720	-0.140	1.0	0.863	11:30 AM	934.00
8-11-55	80.745	-0.115	1.0	0.863	9:30 AM	956.00
8-11-55	80.745	-0.115	1.0	0.863	3:30 PM	962.00
8-12-55	80.720	-0.140	1.0	0.863	10:00 AM	980.50
8-12-55	80.720	-0.140	1.0	0.863	3:30 PM	986.00
8-13-55	80.715	-0.145	1.0	0.863	9:45 AM	1004.25
8-29-55	80.705	-0.155	1.1	0.949	1:30 PM	1392.00
9-2-55	80.690	-0.170	1.1	0.949	11:30 AM	1486.00
9-9-55	80.710	-0.150	1.1	0.949	12:00 AM	1654.50
9-16-55	80.720	-0.140	1.1	0.949	11:30 AM	1822.00
9-23-55	80.730	-0.130	1.1	0.949	11:30 AM	1990.00
9-30-55	80.710	-0.150	1.1	0.949	11:30 AM	2158.00
10-7-55	80.720	-0.140	1.1	0.949	11:30 AM	2326.00
10-21-55	80.710	-0.150	1.1	0.949	11:30 AM	2662.00
11-4-55	80.710	-0.150	1.1	0.949	11:30 AM	2998.00
11-15-55	80.710	0.150	1.1	0.949	3:00 PM	3265.50

TABLE VII (Continued)

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
12-2-55	80.710	0.150	1.1	0.949	3:00 PM	3673.50
12-16-55	80.710	-0.150	1.1	0.949	3:00 PM	4009.50
1-20-56	80.705	-0.155	1.1	0.949	10:00 AM	4844.50
2-15-56	80.722	-0.138	1.1	0.949	10:00 AM	5468.50
3-16-56	80.632	-0.228	1.1	0.949	10:00 AM	6188.50

TABLE VIII
SETTLEMENT RECORDS FOR PLATE NO. 2 - SITE 16

Location: 50 Feet Right of Dam ℄ Station 6 + 15
Original Elevation: 1779.170

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
7-2-55	79.170	0.000	1.0	0.863	1:30 PM	0.00
7-5-55	79.036	-0.134	2.0	1.726	4:00 PM	74.50
7-6-55	79.020	-0.150	3.3	2.847	10:30 AM	93.00
7-7-55	79.110	-0.050	4.6	3.969	2:30 PM	121.00
7-8-55	79.145	-0.025	4.6	3.963	4:00 PM	146.50
7-9-55	79.161	-0.009	4.6	3.969	3:45 PM	170.25
7-11-55	79.235	+0.065	4.7	4.056	2:00 PM	216.50
7-13-55	79.185	+0.015	5.0	4.315	2:30 PM	265.00
7-14-55	79.150	-0.020	5.0	4.315	10:45 AM	285.25
7-15-55	79.160	-0.010	5.0	4.315	4:00 PM	314.50
7-18-55	79.160	-0.010	5.0	4.315	3:30 PM	386.00
7-21-55	79.175	+0.005	5.0	4.315	1:30 PM	456.00
7-22-55	79.160	-0.010	5.0	4.315	2:30 PM	481.00
7-25-55	79.190	+0.010	5.0	4.315	11:30 AM	550.00
7-26-55	79.170	0.000	6.0	5.178	1:45 PM	576.25
7-27-55	79.170	0.000	7.3	6.299	2:00 PM	600.50
7-28-55	79.170	0.000	9.0	7.767	11:00 AM	621.50
7-30-55	79.180	+0.010	12.7	10.959	1:00 PM	671.50
8-1-55	79.125	-0.045	14.3	12.314	10:30 AM	717.00
8-2-55	79.090	-0.080	15.9	13.721	10:45 AM	741.25
8-3-55	78.920	-0.250	18.1	1.620	1:30 PM	768.00
8-4-55	78.880	-0.290	18.7	16.137	10:30 AM	789.00
8-5-55	78.858	-0.312	18.8	16.224	2:30 PM	817.00
8-6-55	78.855	-0.315	18.9	16.320	11:00 AM	837.50
8-8-55	78.820	-0.350	19.2	16.569	10:00 AM	884.50
8-8-55	78.800	-0.370	19.2	16.569	3:15 PM	889.75
8-9-55	78.735	-0.435	19.2	16.569	9:30 AM	908.00
8-9-55	78.755	-0.415	19.2	16.569	3:30 PM	914.00
8-10-55	78.720	-0.450	19.2	16.569	11:30 AM	934.00
8-11-55	78.690	-0.480	19.2	16.569	9:30 AM	956.00
8-11-55	78.685	-0.485	19.2	16.569	3:30 PM	962.00
8-12-55	78.675	-0.495	19.2	16.569	10:00 AM	980.50
8-12-55	78.660	-0.510	19.2	16.569	3:30 PM	986.00
8-13-55	78.655	-0.515	19.2	16.569	9:45 AM	1004.25
8-29-55	78.530	-0.640	19.2	16.569	1:30 PM	1392.00
9-2-55	78.500	-0.670	19.2	16.569	11:30 AM	1486.00
9-9-55	78.470	-0.700	19.2	16.569	11:30 AM	1486.00
9-16-55	78.470	-0.700	19.2	16.569	12:00 AM	1654.50
9-23-55	78.460	-0.710	19.2	16.569	11:30 AM	1822.00
9-30-55	78.420	-0.750	19.2	16.569	11:30 AM	2158.00
10-7-55	78.420	-0.750	19.2	16.569	11:30 AM	2326.00
10-2-55	78.390	-0.780	19.2	16.569	11:30 AM	2662.00
11-4-55	78.380	-0.790	19.2	16.569	11:30 AM	2998.00
11-15-55	78.350	-0.820	19.2	16.569	3:00 PM	3265.50

TABLE VIII (Continued)

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
12-2-55	78.340	-0.830	19.2	16.569	3:00 PM	3673.50
12-16-55	78.330	-0.840	19.2	16.569	3:00 PM	4009.50
1-20-56	78.270	-0.900	19.2	16.569	10:00 AM	4844.50
2-15-56	78.280	-0.890	19.2	16.569	10:00 AM	5468.50
3-16-56	78.274	-0.896	19.2	16.569	10:00 AM	6188.50

TABLE IX
SETTLEMENT RECORDS FOR PLATE NO. 3 - SITE 16

Location: 7 Feet right of Dam ℄ Station 6 + 15
Original Elevation: 1773.255

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
7-5-55	73.255	0.00	6.0	5.178	4:00 PM	0.00
7-6-55	72.705	-0.550	9.0	7.767	10:30 AM	18.50
7-7-55	72.650	-0.605	10.1	8.716	2:30 PM	46.50
7-8-55	72.745	-0.510	10.1	8.716	4:00 PM	72.00
7-9-55	72.831	-0.424	10.1	8.716	3:45 PM	95.75
7-11-55	72.885	-0.370	10.6	9.147	2:00 PM	142.00
7-13-55	72.820	-0.435	10.7	9.233	2:30 PM	190.50
7-14-55	72.840	-0.415	10.7	9.233	10:45 AM	210.75
7-15-55	72.830	-0.425	10.7	9.233	4:00 PM	240.00
7-18-55	72.820	-0.435	10.7	9.233	3:30 PM	311.50
7-21-55	72.835	-0.420	10.7	9.233	1:30 PM	381.50
7-22-55	72.820	-0.435	10.7	9.233	2:30 PM	406.50
7-25-55	72.870	-0.385	10.7	9.233	11:30 AM	475.50
7-26-55	72.850	-0.405	11.8	10.182	1:45 PM	501.75
7-27-55	72.840	-0.415	13.8	11.908	2:00 PM	526.00
7-28-55	72.840	-0.415	15.1	13.031	11:00 AM	547.00
7-30-55	72.870	-0.385	18.5	15.965	1:00 PM	596.00
8-1-55	72.820	-0.435	20.3	17.518	10:30 AM	642.50
8-2-55	72.840	-0.415	22.1	19.071	10:45 AM	666.75
8-3-55	72.850	-0.405	24.1	20.797	1:30 PM	693.50
8-4-55	72.840	-0.415	25.7	22.178	10:30 AM	714.50
8-5-55	72.871	-0.384	28.6	24.681	2:30 PM	742.50
8-6-55	72.850	-0.405	29.5	25.458	11:00 AM	763.00
8-8-55	72.830	-0.425	30.0	25.889	10:00 AM	810.00
8-8-55	72.840	-0.415	31.1	26.838	3:15 PM	815.25
8-9-55	72.850	-0.405	32.9	28.392	9:30 AM	833.50
8-9-55	72.835	-0.420	34.7	29.945	3:30 PM	839.50
8-10-55	72.800	-0.455	34.7	29.945	11:30 AM	869.50
8-11-55	72.760	-0.495	35.1	30.290	9:30 AM	881.50
8-11-55	72.775	-0.480	36.7	31.671	3:30 PM	887.50
8-12-55	72.700	-0.555	37.8	32.620	10:00 AM	906.00
8-12-55	72.700	-0.555	40.7	35.123	3:30 PM	911.50
8-13-55	72.705	-0.550	40.9	35.305	9:45 AM	929.75
8-29-55	72.550	-0.705	40.9	35.305	1:30 PM	1317.50
9-2-55	72.530	-0.725	40.9	35.305	11:30 AM	1411.50
9-9-55	72.510	-0.745	40.9	35.305	12:00noon	1580.00
9-16-55	72.480	-0.775	40.9	35.305	11:30 AM	1747.50
9-23-55	72.490	-0.765	40.9	35.305	11:30 AM	1915.50
9-30-55	72.440	-0.815	40.9	35.305	11:30 AM	2083.50
10-7-55	72.450	-0.805	40.9	35.305	11:30 AM	2251.50
10-21-55	72.420	-0.835	40.9	35.305	11:30 AM	2587.50
11-4-55	72.420	-0.835	40.9	35.305	11:30 AM	2923.50
11-15-55	72.410	-0.845	40.9	35.305	3:00 PM	3131.00
12-2-55	72.370	-0.885	40.9	35.305	3:00 PM	3599.00
12-16-55	72.360	-0.895	40.9	35.305	3:00 PM	3935.00
1-20-56	72.360	-0.895	40.9	35.305	10:00 AM	4770.00
2-15-56	72.303	-0.952	40.9	35.305	10:00 AM	5394.00
3-16-56	72.310	-0.945	40.9	35.305	10:00 AM	6114.00

TABLE X
SETTLEMENT RECORDS FOR PLATE NO. 4 - SITE 16

Location: 40 Feet Left of Dam ℄ Station 6 + 15
Original Elevation: 1778.637

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
7-2-55	78.637	0.000	1.0	0.863	1:30 PM	0.00
7-5-55	78.596	-0.041	1.5	1.294	4:00 PM	74.50
7-6-55	78.580	-0.057	2.5	2.157	10:30 AM	93.00
7-7-55	78.590	-0.047	3.5	3.020	2:30 PM	121.00
7-8-55	78.595	-0.042	3.5	3.020	4:00 PM	146.50
7-9-55	78.681	+0.044	3.5	3.020	3:45 PM	170.25
7-11-55	78.735	+0.098	3.8	3.280	2:00 PM	216.50
7-13-55	78.710	+0.073	3.9	3.366	2:30 PM	265.00
7-14-55	78.710	+0.073	3.9	3.366	10:45 AM	285.25
7-15-55	78.700	+0.063	3.9	3.366	4:00 PM	314.50
7-18-55	78.690	+0.053	3.9	3.366	3:30 PM	386.00
7-21-55	78.710	+0.073	3.9	3.366	1:30 PM	456.00
7-22-55	78.700	+0.063	3.9	3.366	2:30 PM	481.00
7-25-55	78.740	+0.103	3.9	3.366	11:30 AM	550.00
7-26-55	78.730	+0.093	4.5	3.883	1:45 PM	576.25
7-27-55	78.720	+0.083	6.8	5.868	2:00 PM	600.50
7-28-55	78.750	+0.113	7.8	6.731	11:00 AM	621.50
7-30-55	78.740	+0.103	12.4	10.701	1:00 PM	671.50
8-1-55	78.710	+0.073	14.1	12.168	10:30 AM	717.00
8-2-55	78.680	+0.043	15.6	13.462	10:45 AM	741.25
8-3-55	78.520	-0.117	18.7	16.137	1:30 PM	768.00
8-4-55	78.500	-0.137	18.9	16.310	10:30 AM	789.00
8-5-55	78.510	-0.127	19.0	16.396	2:30 PM	817.00
8-6-55	78.495	-0.142	19.2	16.569	11:00 AM	837.50
8-8-55	78.450	-0.187	19.7	17.000	10:00 AM	884.50
8-8-55	78.440	-0.197	19.7	17.000	3:15 PM	889.75
8-9-55	78.400	-0.237	19.9	17.173	9:30 AM	908.00
8-9-55	78.425	-0.212	19.9	17.173	3:30 PM	914.00
8-10-55	78.390	-0.247	19.9	17.173	11:30 AM	934.00
8-11-55	78.390	-0.247	19.9	17.173	9:30 AM	956.00
8-11-55	78.385	-0.252	19.9	17.173	3:30 PM	962.00
8-12-55	78.375	-0.262	19.9	17.173	10:00 AM	980.50
8-12-55	78.375	-0.262	19.9	17.173	3:30 PM	986.55
8-13-55	78.340	-0.297	19.9	17.173	9:45 AM	1004.25
8-29-55	78.235	-0.402	19.9	17.173	1:30 PM	1392.00
9-2-55	78.220	-0.417	19.9	17.173	11:30 AM	1486.00
9-9-55	78.200	0.437	19.9	17.173	12:00noon	1654.50
9-16-55	78.200	-0.437	19.9	17.173	11:30 AM	1822.00
9-23-55	78.190	-0.447	19.9	17.173	11:30 AM	1990.00
9-30-55	78.170	-0.467	19.9	17.173	11:30 AM	2158.00
10-7-55	78.170	-0.467	19.9	17.173	11:30 AM	2326.00
10-21-55	78.150	-0.487	19.9	17.173	11:30 AM	2662.00
11-4-55	78.130	-0.507	19.9	17.173	11:30 AM	2998.00
11-15-55	78.120	-0.517	19.9	17.173	3:00 PM	3265.50

TABLE X (Continued)

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
12-2-55	78.100	-0.537	19.9	17.173	3:00 PM	3673.50
12-16-55	78.090	-0.547	19.9	17.173	3:00 PM	4009.50
1-20-56	78.085	-0.562	19.9	17.173	10:00 AM	4844.50
2-15-56	78.070	-0.567	19.9	17.173	10:00 AM	5468.50
3-16-56	78.068	-0.569	19.9	17.173	10:00 AM	6188.50

TABLE XI
SETTLEMENT RECORDS FOR PLATE NO. 5 - SITE 16

Location: 2:1 Toe of the Embankment ℄ Station 6 + 15
Original Elevation: 1778.800

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
7-2-55	78.800	0.000	1.0	0.863	1:30 PM	0.00
7-5-55	78.806	+0.006	1.0	0.863	4:00 PM	74.50
7-6-55	78.800	+0.000	1.0	0.863	10:30 AM	93.00
7-7-55	78.780	-0.020	1.0	0.863	2:30 PM	121.00
7-8-55	78.815	+0.015	1.0	0.863	4:00 PM	146.50
7-9-55	78.801	+0.001	1.0	0.863	3:45 PM	170.25
7-11-55	78.810	+0.010	1.0	0.863	2:00 PM	216.50
7-13-55	78.865	+0.065	1.0	0.863	2:30 PM	265.00
7-14-55	78.940	+0.140	1.0	0.863	10:45 AM	285.25
7-15-55	78.910	+0.110	1.0	0.863	4:00 PM	314.50
7-18-55	78.900	+0.100	1.0	0.863	3:30 PM	386.00
7-21-55	78.930	+0.130	1.0	0.863	1:30 PM	456.00
7-22-55	78.940	+0.140	1.0	0.863	2:30 PM	481.00
7-25-55	78.960	+0.160	1.0	0.863	11:30 AM	550.00
7-26-55	78.920	+0.120	1.0	0.863	1:45 PM	576.25
7-27-55	78.910	+0.110	1.0	0.863	2:00 PM	600.50
7-28-55	78.970	+0.170	1.0	0.863	11:00 AM	621.50
7-30-55	79.040	+0.240	1.0	0.863	1:00 PM	671.50
8-1-55	79.000	+0.200	1.0	0.863	10:30 AM	717.00
8-2-55	79.010	+0.210	1.0	0.863	10:45 AM	741.25
8-3-55	78.778	-0.022	1.0	0.863	1:30 PM	768.00
8-4-55	78.790	-0.010	1.0	0.863	10:30 AM	789.00
8-5-55	78.782	-0.028	1.0	0.863	2:30 PM	817.00
8-6-55	78.780	-0.020	1.0	0.863	11:00 AM	837.50
8-8-55	78.780	-0.020	1.6	1.381	10:00 AM	884.50
8-8-55	78.785	-0.015	1.6	1.381	3:15 PM	889.75
8-9-55	78.790	-0.010	1.8	1.553	9:30 AM	908.00
8-9-55	78.780	-0.020	1.9	1.640	3:30 PM	914.00
8-10-55	78.790	-0.010	1.9	1.640	11:30 AM	934.00
8-11-55	78.800	0.000	1.9	1.640	9:30 AM	956.00
8-11-55	78.785	-0.015	1.9	1.640	3:30 PM	962.00
8-12-55	78.785	-0.015	1.9	1.640	10:00 AM	980.50
8-12-55	78.785	-0.015	1.9	1.640	3:30 PM	986.00
8-13-55	78.770	-0.303	1.9	1.640	9:45 AM	1004.25
8-29-55	78.800	-0.000	1.9	1.640	1:30 PM	1392.00
9-2-55	78.800	-0.000	1.9	1.640	11:30 AM	1486.00
9-9-55	78.790	-0.010	1.9	1.640	12:00noon	1654.50
9-16-55	78.810	+0.010	1.9	1.640	11:30 AM	1822.00
9-23-55	78.800	+0.000	1.9	1.640	11:30 AM	1990.00
9-30-55	78.800	+0.000	1.9	1.640	11:30 AM	2158.00
10-7-55	78.810	+0.010	1.9	1.640	11:30 AM	2326.00
10-21-55	78.805	+0.005	1.9	1.640	11:30 AM	2662.00
11-4-55	78.810	+0.010	1.9	1.640	11:30 AM	2998.00
11-15-55	78.810	+0.010	1.9	1.640	3:00 PM	3265.50
12-2-55	78.800	-0.000	1.9	1.640	3:00 PM	3673.50
12-16-55	78.810	+0.010	1.9	1.640	3:00 PM	4009.50
1-20-56	78.810	+0.010	1.9	1.640	10:00 AM	4844.50
2-15-56	78.802	+0.002	1.9	1.640	10:00 AM	5468.50
3-16-56	78.807	+0.007	1.9	1.640	10:00 AM	6188.50

TABLE XII
SETTLEMENT RECORDS FOR PLATE NO. 6 - SITE 16

Location: 16 Feet right of Dam ℄ Station 7 + 00
Original Elevation: 1780.730

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
7-6-55	80.730	0.000	1.0	0.863	10:30 AM	0.00
7-7-55	80.630	-0.100	1.0	0.863	2:30 PM	28.00
7-8-55	80.640	-0.090	1.0	0.863	4:00 PM	53.50
7-9-55	80.651	-0.079	1.0	0.863	3:45 PM	77.25
7-11-55	80.645	-0.085	2.6	1.641	2:00 PM	123.50
7-13-55	80.640	-0.090	2.6	1.641	2:30 PM	173.00
7-14-55	80.640	-0.090	2.6	1.641	10:45 AM	192.25
7-15-55	80.650	-0.080	2.6	1.641	4:00 PM	221.50
7-18-55	80.640	-0.100	2.6	1.641	3:30 PM	293.00
7-21-55	80.640	-0.090	2.6	1.641	1:30 PM	363.00
7-22-55	80.630	-0.100	2.6	1.641	2:30 PM	388.00
7-25-55	80.660	-0.070	2.6	1.641	11:30 AM	457.00
7-26-55	80.800	-0.070	3.4	2.934	1:45 PM	483.25
7-27-55	80.670	-0.060	5.3	4.573	2:00 PM	507.50
7-28-55	80.660	-0.070	6.1	5.264	11:00 AM	528.50
7-30-55	80.680	-0.050	10.5	9.061	1:00 PM	578.50
8-1-55	80.645	-0.085	12.5	10.787	10:30 AM	624.00
8-2-55	80.635	-0.095	14.3	12.341	10:45 AM	648.25
8-3-55	80.610	-0.120	16.9	14.583	1:30 PM	675.00
8-4-55	80.560	-0.170	18.4	15.879	10:30 AM	696.00
8-5-55	80.543	-0.187	20.3	17.518	2:30 PM	724.00
8-6-55	80.550	-0.180	22.2	19.156	11:00 AM	744.50
8-8-55	80.500	-0.230	24.0	20.711	10:00 AM	791.50
8-8-55	80.485	-0.245	24.7	21.315	3:15 PM	796.75
8-9-55	80.480	-0.250	26.2	22.609	9:30 AM	815.00
8-9-55	80.465	-0.265	26.3	22.697	3:30 PM	821.00
8-10-55	80.450	-0.280	26.3	22.697	11:30 AM	841.00
8-11-55	80.440	-0.290	26.3	22.697	9:30 AM	863.00
8-11-55	80.440	-0.290	28.4	24.509	3:30 PM	869.00
8-12-55	80.415	-0.315	29.7	25.630	10:00 AM	887.50
8-12-55	80.420	-0.310	29.9	25.803	3:30 PM	893.00
8-13-55	80.415	-0.315	30.0	25.890	9:45 AM	911.25
8-29-55	80.345	-0.385	30.0	25.890	1:30 PM	1299.00
9-2-55	80.360	-0.370	30.0	25.890	11:30 AM	1393.00
9-9-55	80.360	-0.370	30.0	25.890	12:00 noon	1561.50
9-16-55	80.360	-0.370	30.0	25.890	11:30 AM	1729.00
9-23-55	80.330	-0.400	30.0	25.890	11:30 AM	1897.00
9-30-55	80.340	-0.390	30.0	25.890	11:30 AM	2065.00
10-7-55	80.350	-0.380	30.0	25.890	11:30 AM	2233.00
10-21-55	80.340	-0.390	30.0	25.890	11:30 AM	2569.00
11-4-55	80.340	-0.390	30.0	25.890	11:30 AM	2905.00
11-15-55	80.290	-0.440	30.0	25.890	3:00 PM	3172.50
12-2-55	80.300	-0.430	30.0	25.890	3:00 PM	3580.50
12-16-55	80.310	-0.420	30.0	25.890	3:00 PM	3916.50
1-20-56	80.275	-0.455	30.0	25.890	10:00 AM	4751.50
2-15-56	80.251	-0.479	30.0	25.890	10:00 AM	5375.50
3-16-56	80.261	-0.479	30.0	25.890	10:00 AM	6095.50

TABLE XIII
SETTLEMENT RECORDS FOR PLATE NO. 7 - SITE 16

Location: 14.5 Feet Right of Dam ℄ Station 8 + 50
Original Elevation: 1785.030

Date	Elevation	Elevation Change	Fill Over Plate(ft)	Load on Plate(psi)	Observation Time	Total Time Hours
7-6-55	85.030	0.000	1.0	0.863	10:30 AM	0.00
7-7-55	84.930	-0.100	1.0	0.863	2:30 PM	28.00
7-8-55	85.105	+0.075	1.0	0.863	4:00 PM	53.50
7-9-55	84.971	-0.057	1.0	0.863	3:45 PM	77.25
7-11-55	85.145	+0.115	1.0	0.863	2:00 PM	123.50
7-13-55	85.005	-0.025	1.0	0.863	2:30 PM	172.00
7-14-55	85.005	-0.025	1.0	0.863	10:45 AM	192.25
7-15-55	85.005	-0.025	1.0	0.863	4:00 PM	221.50
7-18-55	85.000	-0.030	1.0	0.863	3:30 PM	293.00
7-21-55	85.000	-0.030	1.0	0.863	1:30 PM	363.00
7-22-55	84.990	-0.040	1.0	0.863	2:30 PM	388.00
7-25-55	85.010	-0.020	1.0	0.863	11:30 AM	457.00
7-26-55	85.015	-0.015	1.0	0.863	1:45 PM	483.25
7-27-55	85.020	-0.010	2.0	1.726	2:00 PM	507.50
7-28-55	85.101	-0.020	2.3	1.985	11:00 AM	528.50
7-30-55	85.040	+0.010	6.5	5.609	1:00 PM	578.50
8-1-55	85.110	+0.080	10.1	8.716	10:30 AM	624.00
8-2-55	85.114	+0.084	10.2	8.802	10:45 AM	648.25
8-3-55	85.110	+0.080	12.6	10.873	1:30 PM	675.00
8-4-55	85.110	+0.080	13.1	11.305	10:30 AM	696.00
8-5-55	85.108	+0.078	15.8	13.635	2:30 PM	724.00
8-6-55	85.125	+0.095	18.5	15.965	11:00 AM	744.50
8-8-55	85.080	+0.050	20.1	17.346	10:00 AM	791.50
8-8-55	85.080	+0.050	20.7	17.863	3:15 PM	796.75
8-9-55	85.080	+0.050	21.5	18.554	9:30 AM	815.00
8-9-55	85.075	+0.045	22.1	19.071	3:30 PM	821.00
8-10-55	85.090	+0.060	22.2	19.168	11:30 AM	841.00
8-11-55	85.075	+0.045	22.3	19.244	9:30 AM	863.00
8-11-55	85.075	+0.045	23.2	20.021	3:30 PM	869.00
8-12-55	85.060	+0.030	24.2	20.883	10:00 AM	887.50
8-12-55	85.075	+0.045		21.955	3:30 PM	893.00
8-13-55	85.045	+0.015	25.5	22.006	3:30 PM	911.25
8-29-55	85.040	+0.010		22.006	1:30 PM	1299.00
9-2-55	85.040	+0.010	25.5	22.006	11:30 AM	1393.00
9-9-55	85.040	+0.010	25.5	22.006	12:00 noon	1561.50
9-16-55	85.040	+0.010	25.5	22.006	11:30 AM	1729.00
9-23-55	85.030	+0.000	25.5	22.006	11:30 AM	1897.00
9-30-55	85.020	-0.010	25.5	22.006	11:30 AM	2065.00
10-7-55	85.030	-0.000	25.5	22.006	11:30 AM	2233.00
10-21-55	85.030	-0.000	25.5	22.006	11:30 AM	2569.00
11-4-55	85.040	+0.010	25.5	22.006	11:30 AM	2905.00
11-15-55	85.010	-0.020	25.5	22.006	3:00 PM	3172.50
12-2-55	85.010	-0.020	25.5	22.006	3:00 PM	3580.50
12-16-55	85.020	-0.010	25.5	22.006	3:00 PM	3916.50
1-20-56	85.010	-0.020	25.5	22.006	10:00 AM	4751.50
2-15-56	84.981	-0.049	25.5	22.006	10:00 AM	5375.50
3-16-56	84.973	-0.051	25.5	22.006	10:00 AM	6095.50

TABLE XIV

COMPACTION TESTS SITE NO. 34 - BARNITZ CREEK

Test No.	Test Date	Location of Test*	MSL	% H_2O	Dry Unit Weight (pcf)	Wet Unit Weight (pcf)
1	5-7-55	Dam Fill 35' R. of 3/90	1650.0	12.7	106.05	120.25
2	5-8-55	Dam Fill 60' R. of 6/00	1663.5	12.4	113.64	127.73
3	5-8-55	Dam Fill 45' L. of 5/50	1660.0	12.9	114.50	129.27
4	7-6-55	Core 2/25	1663.0	13.72	106.46	121.07
5	7-7-55	Dam Fill 50' R. of 5/00	1660.5	12.21	119.53	134.12
6	7-8-55	Core 3/50	1646.0	13.43	108.41	122.97
7	7-9-55	Core 6/00	1658.0	12.98	106.77	120.63
8	7-10-55	Core 8/00	1677.0	12.0	109.25	122.36
9	7-12-55	Dam Fill 30' L. of 7/00	1673.5	12.48	110.01	123.74
10	8-25-55	Dam Fill 50' R. of 7/00	1676.0	9.5	108.57	118.80
11	8-27-55	Dam Fill 50' L. of 6/00	1674.0	12.2	107.91	121.08
12	8-29-55	Dam Fill 25' L. of 5/50	1665.8	12.3	114.21	128.26
13	8-30-55	Dam Fill 10' R. of 5/00	1670.0	12.2	110.56	124.05
14	9-1-55	Dam Fill 4/00	1666.0	12.6	104.51	117.68
15	9-2-55	Dam Fill 50' L. of 4/00	1669.0	12.3	128.35	144.14
16	9-3-55	Dam Fill 3/00	1665.5	12.1	112.44	126.05
17	9-5-55	Dam Fill 50' L. of 4/50	1673.0	12.5	122.38	137.68
18	9-6-55	Dam Fill 60' R. of 3/50	1673.0	13.9	119.37	135.96
19	9-7-55	Dam Fill 3/00	1675.0	11.98	113.32	126.90
20	9-8-55	Dam Fill 15' L. of 5/00	1676.0	12.67	118.77	133.82
21	9-9-55	Dam Fill 10' L. of 3/00	1677.0	11.16	102.97	114.46
22	9-10-55	Dam Fill 25' R. of 6/50	1681.0	11.44	116.61	129.95
23	9-12-55	Dam Fill 30' R. of 6/00	1682.0	12.67	111.96	126.15
24	9-13-55	Dam Fill 20' R. of 4/00	1683.0	12.53	112.34	126.42
25	9-14-55	Dam Fill 10' R. of 3/00	1684.0	11.70	118.61	132.49

Average Wet Unit Weight = 126.64 pcf.

Average Wet Unit Weight = 0.879 psi.

Density = 2.029

* Location as Right (R) or Left (L) of Centerline Station.

TABLE XV

COMPACTION TESTS SITE NO. 16 - BARNITZ CREEK

Test No.	Test Date	Location of Test*	MSL	% H_2O	Dry Unit Weight (pcf)	Wet Unit Weight (pcf)
1	7-1-55	Found. 60' L. of 5+50	1778.0	14.3	120.28	137.48
2	7-2-55	Found. 50' R. of 6+50	1781.3	13.7	106.94	121.59
3	7-4-55	Core 6+00	1772.1	13.9	105.20	119.82
4	7-4-55	Core 7+50	1778.2	12.7	103.21	116.32
5	7-5-55	Str. 5' R. of 1+15	1786.5	14.8	102.78	117.99
6	7-5-55	Dam 30' L. of 6+50	1779.0	14.9	114.09	131.09
7	7-6-55	Dam 30' L. of 5+25	1779.5	13.7	107.50	122.22
8	7-7-55	Dam 65' R. of 6+00	1783.0	14.8	110.05	126.34
9	7-7-55	Dam 30' L. of 4+50	1791.5	12.1	104.79	117.47
10	7-27-55	Dam 25' R. of 6+50	1785.0	11.23	113.34	126.07
11	7-27-55	Dam 30' L. or 5+50	1787.5	12.7	113.27	127.66
12	7-28-55	Dam 50' R. of 4+50	1794.0	11.34	121.91	135.73
13	7-28-55	Dam 25' L. of 7+50	1787.0	12.75	111.64	125.87
14	7-29-55	Dam 30' R. of 6+00	1789.0	13.89	105.32	119.95
15	7-29-55	Dam 30' L of 4+75	1795.0	13.8	101.82	115.87
16	7-30-55	Dam 60' R. of 7+00	1790.0	14.22	119.75	136.78
17	7-30-55	Dam 50' R. of 8+00	1792.0	14.11	109.98	125.50
18	8-1-55	Dam 6+50	1791.0	10.8	100.04	110.84
19	8-1-55	Dam 20' R. of 7+50	1792.0	12.67	129.04	145.39
20	8-3-55	Dam 15' R. of 7+00	1795.0	13.63	117.26	133.24
21	8-3-55	Dam 20' L. of 3+50	1798.0	12.11	111.37	124.86
22	8-4-55	Dam 50' R. of 5+50	1794.0	13.89	116.26	132.41
23	8-5-55	Dam 20' L. of 6+00	1800.0	11.9	103.92	116.29
24	8-5-55	Dam 20' R. of 7+00	1801.5	10.83	98.04	108.71
25	8-6-55	Dam 20' L. of 3+50	1801.5	12.3	108.56	121.92
26	8-6-55	Dam 10' R. of 5+00	1803.0	13.9	112.88	128.57
27	8-8-55	Dam 20' R. of 6+75	1804.0	13.4	107.42	121.81
28	8-8-55	Dam 15' L. of 8+50	1804.0	10.64	103.39	114.39
29	8-9-55	Dam 10' R. of 4+00	1804.5	11.3	105.42	117.33
30	8-9-55	Dam 19' L. of 7+00	1805.5	14.6	107.28	122.94
31	8-11-55	Dam 10' L. of 4+50	1807.0	10.9	110.52	122.57
32	8-11-55	Dam 10' R. of 6+50	1808.5	11.9	120.74	135.11

Average Wet Unit Weight = 124.38 pcf.

Average Wet Unit Weight = 0.863 psi.

Density = 1.993

* Location as Right (R) of Left (L) of Centerline Station.

TABLE XVI
WATER LEVELS IN RELIEF WELLS ON SITE NO. 34

Location: 110 Feet Left of Dam ℄ Station

Date of Observation	Well No. 1 (Sta. 4 + 50)	Well No. 2 (Sta. 3 + 50)
5-7-55	1639.0	1639.2
5-18-55	1640.6	1640.7
7-8-55	1641.3	1641.4
7-9-55	1641.3	1641.5
7-11-55	1641.9	1641.8
7-13-55	1641.6	1641.6
7-14-55	1641.5	1641.4
7-15-55	1641.5	1641.5
7-18-55	1641.5	1641.6
7-21-55	1641.6	1641.7
7-22-55	1641.6	1641.7
7-25-55	1641.7	1641.8
7-26-55	1641.8	1641.5
7-30-55	1641.7	1641.7
8-1-55	1641.8	1641.8
8-2-55	1641.8	1641.8
8-6-55	1642.0	1641.7
8-8-55	1641.9	1641.8
8-9-55	1642.0	1641.9
8-10-55	1642.0	1641.9
8-12-55	1642.2	1642.2
8-13-55	1642.5	1642.3
8-17-55	1642.6	1642.6
8-19-55	1642.7	1642.8
8-21-55	1642.9	1642.8
8-24-55	1643.1	1643.1
8-25-55	1643.1	1643.2
8-26-55	1643.2	1643.3
8-28-55	1643.4	1643.4
8-29-55	1643.5	1643.6
8-30-55	1643.5	1643.6
8-30-55	1643.5	1643.6
8-31-55	1643.6	1643.8
8-31-55	1643.6	1643.8
9-1-55	1643.9	1644.0
9-2-55	1643.8	1643.9
9-3-55	1643.7	1644.0
9-5-55	1643.8	1644.1
9-6-55	1643.8	1644.2
9-7-55	1643.8	1644.2
9-8-55	1643.9	1644.3
9-9-55	1643.9	1644.4
9-12-55	1644.0	1644.5
9-13-55	1644.2	1644.7
9-14-55	1644.2	1644.8
9-15-55	1644.2	1644.8
9-23-55	1643.9	1644.6
9-30-55	1644.2	1644.7

TABLE XVI (Continued)

Date of Observation	Well No. 1 (Sta. 4 + 50)	Well No. 2 (Sta. 3 + 50)
10-7-55	1644.0	1644.8
10-21-55	1643.8	1644.0
11-4-55	1644.2	1645.3
11-16-55	1644.9	1645.2
12-2-55	1644.2	1645.5
12-16-55	1644.7	1645.7
2-25-56	1644.9	1645.4
3-16-56	1645.2	1646.0

TABLE XVII
WATER LEVELS IN RELIEF WELLS ON SITE NO. 16

Location: 100 Feet Left of Dam ℄ Station

Date of Observation	Well No. 1 (Sta. 6 + 98)	Well No. 2 (Sta. 6 + 25)
7-8-55	1768.4	1766.8
7-9-55	1768.3	1767.3
7-11-55	1768.4	1767.7
7-13-55	1768.3	1767.7
7-14-55	1768.2	1767.6
7-15-55	1768.2	1767.6
7-18-55	1768.1	1767.6
7-21-55	1768.1	1767.6
7-22-55	1768.1	1767.6
7-25-55	1768.2	1767.7
7-26-55	1768.2	1767.6
7-27-55	1768.5	1767.9
7-28-55	1768.6	1767.8
7-30-55	1768.9	1768.1
8-1-55	1769.0	1768.0
8-2-55	1768.8	1768.1
8-3-55	1769.1	1768.2
8-4-55	1769.2	1768.2
8-5-55	1769.3	1768.3
8-6-55	1769.5	1768.4
8-8-55	1769.4	1768.4
8-8-55	1769.4	1768.4
8-9-55	1769.6	1768.5
8-9-55	1769.6	1768.5
8-10-55	1769.7	1768.7
8-11-55	1769.6	1768.7
8-11-55	1769.6	1768.7
8-12-55	1769.8	1768.7
8-12-55	1769.8	1768.7
8-13-55	1769.8	1768.8
8-20-55	1769.3	1768.6
8-29-55	1768.9	1768.4
9-2-55	1768.9	1768.3
9-9-55	1768.6	1768.2
9-16-55	1768.4	1768.2
9-23-55	1768.0	1767.9
9-30-55	1768.2	1767.8
10-7-55	1767.9	1768.0
10-21-55	1768.5	1768.3
11-4-55	1768.7	1768.5
11-15-55	1768.7	1768.6
12-2-55	1768.8	1768.4
12-16-55	1768.8	1768.7
1-20-56	1768.8	1768.8
2-15-56	1768.8	1768.8
3-16-56	1768.8	1768.8

TABLE XVIII

RAINFALL DATA*

Date	Rainfall (inches)
5-9-55	1.20
5-10-55	0.50
5-11-55	1.00
5-16-55	1.50
5-18-55	0.60
5-19-55	2.30
5-20-55	0.50
5-25-55	0.50
6-2-55	0.60
6-5-55	1.00
6-8-55	3.50
6-10-55	0.50
6-15-55	2.00
7-5-55	0.50
7-19-55	2.00
8-10-55	2.50
8-30-55	0.50
9-26-55	1.60
9-28-55	0.66
9-29-55	0.12
10-1-55 - 10-4-55	5.00 (Site 34*)
10-1-55 - 10-4-55	3.50 (Site 16*)

*All rainfall was substantially the same at both sites except for the period of October 1 through October 4, 1955.

VITA

James Sidney Matthews
candidate for the degree of
Master of Science

Thesis: FOUNDATION CONSOLIDATION UNDER EARTH DAMS DURING AND IMMEDIATELY FOLLOWING CONSTRUCTION OPERATIONS

Major: Agricultural Engineering

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Date of Final Examination: May, 1956.

FOUNDATION CONSOLIDATION UNDER EARTH DAMS
DURING AND IMMEDIATELY FOLLOWING CONSTRUCTION OPERATIONS

AUTHOR: James S. Matthews

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