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RESPONSE TO ALLEGED VIOLATION OF OAC 3745-65-93(D)(4)(A
A REPORT TO THE OHIO EPA-SOUTHWEST DISTRICT OFFICE DIVISION OF HAZARDOUS WASTE MANAGEMENT APRIL 30, 1992

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REPORT

RESPONSE TO ALLEGED VIOLATION OF OAC 3745-65-93(D)(4)(a)
A REPORT TO THE OHIO EPA-SOUTHWEST DISTRICT OFFICE
DIVISION OF HAZARDOUS WASTE MANAGEMENT

3637

April 30, 1992

INTRODUCTION

In a letter dated February 4, 1992, from Mr. Phillip E. Harris, Ohio Environmental Protection Agency, Division of Hazardous Waste Management, to Mr. R. E. Tiller, Manager, Department of Energy, Fernald Field Office, it was requested that the Fernald Environmental Management Project (FEMP) provide "plans that incorporate procedures and schedules for the development of site specific hydrogeological data for the FMPC site." This report serves to respond to that request. This report also responds to an alleged violation of OAC 3745-65-93(D)(4)(a) and to 11 specific comments (A-K) made by the Ohio EPA to support the alleged violation.

SUMMARY OF THE ALLEGED VIOLATION

In the February 4, 1992 letter, the Ohio EPA stated that the "DOE-FEMP is in violation of OAC 3745-65-93(D)(4)(a), and has failed to determine the rate and extent of migration of hazardous waste or hazardous waste constituents in the groundwater." The Ohio EPA believes "that aquifer pump tests (or slug tests in the case of formations with low hydraulic conductivity) are needed to characterize the hydrogeological characteristics of all water bearing units found at the FMPC site." The Ohio EPA wants the tests to "be performed at a frequency so as to adequately represent the aquifer units throughout the site and affected off-site areas."

The Ohio EPA believes that "without this data, the DOE-FEMP cannot adequately define the rate and extent of hazardous waste or hazardous waste constituent migration in the ground water. As a result, DOE-FEMP cannot satisfy the requirements of OAC 3745-65-93(D)(4)(a)".

The Ohio EPA requested that within (90) days from the date of the February 4, 1992 letter, the "DOE-FEMP must submit to Ohio EPA, plans that incorporate procedures and schedules for the development of site specific hydrogeological data for the DOE-FEMP site."

FEMP RESPONSE TO ALLEGED VIOLATION OF OAC 3745-65-93(D)(4)(a)

The FEMP does not believe it failed to comply with the above requirement. Site specific pump test data was used in the 1989 RCRA assessment, to determine the rate and extent of hazardous constituents. The site specific pump test data was factored into the construction of a Swift III, finite-difference, numerical groundwater flow model for the FEMP site. Hydraulic conductivities predicted by the model are more conservative than the site specific pump test data.

In 1990 and 1991, the predicted hydraulic conductivities resulting from the model were used to determine the rate and extent of contamination in place of the site specific pump test data. The FEMP has already committed to perform an additional pump test in the South Plume area (south of the FEMP site), and the possibility of performing another pump test has not been ruled out. Results of the South Plume Pump test will be compared against the model to determine how well the model is predicting flow behavior. At this time though, any decision to commit to an additional test (i.e., in the waste pit area) is pending results from the upcoming test.

The enclosed report contains responses to the 11 specific comments which the Ohio EPA used to support the issue of the violation statement. Between April 1990 and February 1992, no additional information was requested by the RCRA reviewers on the RCRA reports prior to the issuance of the NOV letter on February 4, 1992.

The rate and extent of migration of hazardous constituents in the aquifer has been determined and documented in three yearly RCRA reports (1989 RCRA Report, 1990 RCRA Report, and the 1991 RCRA Report) [See FEMP responses to OEPA Specific Comments]. The 1991 RCRA Report was issued to the Ohio EPA on February 28, 1992.

A site specific pump test, located approximately 1,750 feet southeast of the center of waste pit 4, was conducted at the FEMP site (Spieker and Norris, 1962) and 34 slug tests have been conducted in the glacial till (formation of low hydraulic conductivity). Hydraulic conductivity values obtained from these tests have been used to determine flow rates and have been factored into the determinations made on the rate and extent of hazardous constituents for the RCRA program. A copy of the 1962 pump test report and field notes and calculations for the 34 slug tests are included as an appendix to this report.

PLANS FOR THE DEVELOPMENT OF ADDITIONAL SITE SPECIFIC HYDROGEOLOGICAL DATA FOR THE FEMP SITE

The FEMP has already committed to perform an additional pump test in the South Plume area (south of the FEMP site). Information collected from the 1962 pump test (Spieker and Norris, 1962) was used for the RI/FS Investigation and was used to help calibrate a site groundwater flow model. Calibrated model input for hydraulic conductivity was selected for use in assessing groundwater flow in the Waste Pit area in 1990 and 1991, because the model values are more conservative than the actual site specific pump test calculations.

If area specific pump test data for the South Plume reveals a problem in modeled values of hydraulic conductivity, then the groundwater flow model will need to be re-examined and re-calibrated. Sensitivity analyses of the Swift III flow model indicate that the model is sensitive to a large increase in hydraulic conductivity in the lower part of the aquifer. More detail can be found in the Draft FEMP Groundwater Report (DOE, 1990). A determination as to the need for conducting additional aquifer tests would be made pending how the results of the South Plume pump test compare to the modeled predictions.

In addition to using additional pump test data to evaluate the model, work is and will continue on validating modeled predictions of flow and solute transport through the use of field collected groundwater chemistry and water table elevation data. Water chemistry data is collected quarterly across the site and the South Plume area. Quarterly contour maps are constructed using this field data and compared to model predictions. Groundwater table elevation data is currently being collected every month across the site and the South Plume Area. To date, field observations and model predictions appear to agree fairly well.

PLANNED PUMP TEST FOR THE SOUTH PLUME AREA

As explained above, the results of the planned pump test for the South Plume Area will, in part, be used to verify flow modeling predictions in the RI/FS.

The FEMP project is currently using data collected during the RI/FS investigation to conduct a South Plume Removal Action. This Removal Action is being conducted through agreements made with the U.S. EPA. The Ohio EPA provides guidance and participates in the development and review of the Work Plans for this project.

The South Plume Removal Action is divided into five parts: Parts 2 and 3 addresses pumping at the leading edge of the plume; discharge to the Great Miami River (GMR); and the construction of the interim advanced wastewater treatment system to treat existing wastewater discharges, so that no increase to the uranium discharge to the GMR is realized, are all controlled through one Work Plan. The original Part 2 and Part 3 Work Plan was issued in December 1990. It is recorded on page 8 of the original plan that "Available data from the existing monitoring wells were sufficient to calibrate the groundwater model used to predict the location of the South Groundwater Contamination Plume in the EE/CA."...."The groundwater model will be used to predict how the aquifer may behave when the Pumping and Discharge System is operational."

The groundwater model was calibrated, in part, using hydraulic conductivity calculations made from pump test data collected slightly southeast of the Waste Pit Area in 1962. The concern exists that a pump test should be conducted in the area of the planned extraction field.

On February 3, 1992, Revision 1 of Part 2 and Part 3 Work Plan was submitted to both the U.S. EPA and Ohio EPA. The revision was made in part to include the pump test. One purpose of the pump test will be to adequately stress the aquifer to determine area specific aquifer parameters. Results of the pump test will then be used to calculate area specific hydraulic conductivity. The hydraulic conductivity value calculated from the pump test will be compared against the values used in the calibrated flow model (DOE, 1992). The Ohio EPA has conditionally approved Revision 1 of the Part 2 and Part 3 Work Plan in a letter dated March 6, 1992 (EPA, 1992). Data collected from the South Plume Removal Action Pump Test will provide insight into how heterogeneous and anisotropic the aquifer is across the FEMP site.

Revision 1 of the Part 2 and 3 Work Plan states that "Every effort is being exercised to expedite the completion of design, contract bid and award, procurement of equipment, acquisition of the necessary easements and rights-of-entry, and construction to achieve an operational date of.....January 29, 1993 for the pumping and discharge system." (DOE, 1992, Page 15). The results of the planned pump test will be factored into the evaluation of the success of the South Plume Pumping and Discharge System operation.

The FEMP provides updates to both the United States EPA and the Ohio EPA concerning the status of this project at routine Project Manager Update Meetings.

SUMMARY OF 11 SPECIFIC COMMENTS AND FEMP RESPONSES

In the February 4, 1992 letter, the Ohio EPA stated that the violation made against the DOE-FEMP was based upon 11 specific comments. Each of these specific comments is addressed below.

1. Ohio EPA Specific Comment (a)

"1989 Report 2, Page 13, para 2-This paragraph references Geotrans and Spieker for values of hydraulic conductivity. In order to properly calculate the rate and extent of migration of hazardous waste or hazardous waste constituents in the ground water, DOE-FEMP should obtain site specific data. Calculations based on regional values for hydrogeologic characteristics will not accurately represent site characteristics. In order to adequately determine the hydrogeologic characteristics found at the site, individual pumping tests (or slug tests in the case of units with low hydraulic conductivity) should be performed on a sufficient number of locations for each aquifer."

FEMP Response to OEPA Specific Comment (a)

A site specific pumping test in the regional aquifer and 34 slug tests in the glacial till have been performed at the FEMP, therefore site specific data does exist. The citation given in the 1989 RCRA report for the hydraulic conductivity value of 2000 gallons/day/foot^2 was calculated from a pump test which was site specific to the FEMP Waste Pit Area. The value given in the 1989 RCRA report is site specific data for the FEMP Waste Pit Area that was cited in a regional study.

It is reported in the 1989 RCRA report that a value of 2000 gallon/day/foot^2 or 267 feet/day was used to calculate a "bulk velocity" or specific discharge for the sand and gravel aquifer. The 1989 RCRA report states that this value was taken from a USGS study of the Great Miami Aquifer (Spieker, 1968a). Although the USGS study is regional, this datum actually originates from a site specific pump test which was performed by the USGS in 1962 for the Atomic Energy Commission using the FEMP number 2 production well (Spieker and Norris, 1962). This production well is located approximately 1,750 feet southeast of the center of Waste Pit 4. The citation in the 1989 RCRA report should have read "Spieker and Norris, 1962, pg. 7, as reported in Spieker, 1968a, pg. A15). There is a slight difference in how the value of hydraulic conductivity was determined in the 1962 report verses the 1968 report.

Speaker and Norris, 1962 report a transmissibility of about 140,000 gallons/day/foot. With a saturated thickness of approximately 70 feet, the aquifer has a coefficient of permeability of approximately 2,000 gallons/day/ft^2 (Spieker and Norris, 1962, pg. 7).

Spieker, 1968a, discusses the results of the 1962 pump test. The report states that, "The test indicated that the transmissibility of the lower half of the aquifer is 150,000 gpd per ft.; therefore, the transmissibility of the entire aquifer is estimated to be about 300,000 gpd per ft" (Spieker, 1968a, pg. A15). This was obviously derived by increasing the saturated thickness term from 70 feet to 150 feet to include the aquifer above the clay layer. Dividing 300,000 gallons/day/foot by 150 feet results in 2000 gallons/day/foot^2 also. A copy of the Norris and Spieker 1962 pump test is provided as an Appendix to this report.

The FEMP has conducted thirty four (34) slug tests in the glacial till. Three of these slug tests were conducted in the Waste Pit Area. Copies of all of the slug tests are provided as Appendix II to this report.

2. <u>Ohio EPA Specific Comment (b)</u>

"1990 Page 21, section 3.3.2, para 2- This paragraph states that the hydraulic conductivity in the upper aquifer (2000 and 3000 series level) is approximately 450 ft/day as determined through the RI/FS investigation. This information has not yet been released to the Ohio EPA and presently cannot be verified. The Department of Energy should submit this data to the Ohio EPA as soon as possible".

<u>FEMP Response to Ohio EPA Specific Comment (b)</u>

The information concerning the use of 450 ft/day and 600 ft/day for hydraulic conductivity of the upper and lower aquifer respectively is contained in section 13 of the DRAFT Groundwater Report, issued by ASI/IT in December of 1990, (DOE, 1990). This document was sent to the OEPA on September 03, 1991 (DOE, 1991).

The 1990 DRAFT Groundwater Report summarizes that the hydraulic conductivities used fall within the range of reported values. Ward et. al., 1987, working in the northern part of the city of Hamilton, used a saturated thickness of 180 feet to get a range of hydraulic conductivities from 20 to 520 ft/day, with most values being in the range of 75 to 225 ft/day. The highest hydraulic conductivity reported for the aquifer near Hamilton was 774 ft/day. Ward et. al., 1987, also reported that slug tests showed hydraulic conductivity increases with depth in the Great Miami Aquifer at Hamilton. Spieker and Norris, 1962, reported a hydraulic conductivity of 270 ft/day.

RI/FS investigators think that it was unlikely that the various analyses of the pumping tests reported for the Great Miami Aquifer adequately allowed for the combined effects of partial penetration and vertical anisotropy of the aquifer. Consequently the transmissivities and hydraulic conductivities reported are probably lower than the true values for these parameters.

A calibrated three dimensional flow model has been constructed. The SWIFT III finite difference numerical code was selected for the modeling work. The calibrated three-dimensional flow model values of 450 ft/day for the upper part of the aquifer and 600 ft/day for the lower part fall within the range of reported values. They are slightly higher than most of the values reported; however, the model-calibrated values are consistent with the observation that the reported values probably tend to be lower than true values. The hydraulic conductivities in the various model layers increase downward, which is a condition that has been observed near Hamilton, Ohio.

The hydraulic conductivities used in the RI/FS calibrated flow model are greater than the site specific hydraulic conductivity calculated from the 1962 pump test (Spieker and Norris, 1962). Based upon best professional judgement the conservative values of hydraulic conductivity generated from modeling efforts were applied to address flow in the Waste Pit Area.

The FEMP will continue validating modeled predictions of flow and solute transport through the use of field collected groundwater chemistry and water table elevation data. Water chemistry data is collected quarterly across the site and the South Plume area. Quarterly contour maps are constructed using this field data and compared to model predictions. Groundwater table elevations data is currently being collected every month across the site and the South Plume Area. To date, field observations and model predictions appear to agree fairly well.

3. <u>Ohio EPA Specific Comment (c)</u>

"1989 Report 2, Page 13, paragraph 3 - The velocity of ground water flow reported is not based upon site specific data. DOE should provide Ohio EPA with documentation reinforcing the given flow velocity."

<u>FEMP Response to OEPA Specific Comment (c)</u>

The FEMP does not believe that this comment is correct. The velocity of ground water flow reported in the 1989 RCRA report is based upon site specific data. The velocity reported is a calculated specific discharge. Hydraulic conductivity and hydraulic gradient are needed to calculate this parameter. As explained above in the FEMP response to the OEPA comment (a), the hydraulic conductivity value which was used was calculated from a 1962 pump test conducted at the FEMP in production well 2, and is site specific. The hydraulic gradient was determined from water table maps specific to the Waste Pit and Production areas of the FEMP site.

4. <u>Ohio EPA Specific Comment (d)</u>

"1990 Page 2 paragraph 4 - The rate of contaminant migration is based upon estimates of ground water flow rates. Site specific pump tests (or slug tests in units with low hydraulic conductivities) should be performed to verify estimates."

FEMP Response to Ohio EPA Specific Comment (d)

The FEMP has conducted a site specific pump test (Spieker and Norris, 1962). Page 2 of the 1990 RCRA Report is part of the executive summary. The calculations of average linear velocity are presented in section 3.3.2 of the 1990 RCRA report, pgs. 21 to 23. The Darcy equation was used to calculate the average linear velocity of groundwater, at both the 2000 and 3000 series depth.

An average hydraulic conductivity of 450 feet/day and 600 feet/day were used for the 2000 and 3000 series depths respectively. The source of these parameters is explained in the FEMP response to Ohio EPA Specific Comment (b). These flow calculations are conservative in that the hydraulic conductivity calculated from the site specific pump test in 1962 is only 270 ft/day.

5. Ohio EPA Specific Comment (e)

"1989 Report 2, Page 13, para 3- DOE did not provide any ground water flow velocities for the glacial till."

FEMP Response to OEPA Specific Comment (e)

The report failed to explain why flow velocities were not being reported for the glacial till. It was our understanding that Ohio EPA personnel reviewing the RCRA Report were also receiving and reviewing data collected by the CERCLA RI/FS and provided to OEPA. Water level data and drilling records produced through the RI/FS indicated that the glacial overburden contained areas of saturation. Although saturation had been documented in the field, flow paths had not. Therefore, flow velocities were not reported.

Fluid movement in the glacial till saturated areas can exist, but conventional means of monitoring saturated systems, with existing monitoring wells, are not as effective in the vadose zone as they are in the aquifer. The effectiveness of conventional monitoring is limited because of the lack of continuity in the saturated zones and the large differences in hydraulic conductivity between monitoring wells. Two additional reports have been submitted to the Ohio EPA since the 1989 RCRA Report that provide a better explanation than the 1989 Report of flow in the glacial till.

Page 10 of the 1990 RCRA report states that the "No flow systems within this unit have been identified yet by the RI/FS Investigation." Section 4.2.1 of the 1991 RCRA report provides a further discussion of flow in the vadose zone. The 1991 RCRA report points out that water elevations from wells completed in the vadose zone vary as much as 35 feet across the Waste Pit Area and that groundwater elevation fluctuations in monitoring wells do not follow any recognizable pattern.

An attempt was made in 1991 to calculate flow rates within a saturated zone of the glacial till. This information was reported in the 1991 RCRA Annual Report. The issue of groundwater flow within the glacial till continues to be evaluated as new data is generated through the RI/FS and the Engineered Waste Management Facility (EWMF) Project.

6. Ohio EPA Specific Comment (f)

"Upgradient water quality for monitoring wells 1052, 1024, 2066, 3066, 2043, 3043, were compared to all downgradient monitoring wells by Ohio EPA DDAGW. With the exception of 1038, 1004, 4001, 4008, 4010, and 2055, all downgradient monitoring wells indicated contamination. Additionally, upgradient monitoring wells 2066 and 3066 yielded questionable water quality when compared to 3043. These "upgradient" monitoring wells had high conductivity, high chloride, high iron, and high sulfate. As a result, monitoring wells 3043 was used by Ohio EPA DDAGW as the upgradient reference.

Based upon the geometric pattern of ground water contamination, DOE has failed to define the outermost perimeter of contamination; and has therefore, failed to determine the full extent of ground water contamination as per OAC 3745-65-93(D)(4)(a and b)."

FEMP Response to Ohio EPA Specific Comment (f)

Three flow systems within the Great Miami Aquifer converge in the vicinity of the FEMP. The Dry Fork and Shandon systems converge near the Waste Pit Area. Monitoring Wells 2066 and 3066 are completed in the Shandon Flow System. Monitoring wells 2043 and 3043 are completed in the Dry Fork Flow System. The chemistry of each flow system is different from that of the other flow system. If a direct comparison of water chemistry is made between the 0043 and 0066 monitoring wells without regard to the fact that they are completed in different flow streams, with different degrees of lithologic heterogeneity, one could conclude that the results are questionable. This issue was more thoroughly explained in a letter sent to the Ohio EPA on April 3, 1992 (DOE-1305-92).

The DOE feels that by defining the extent of elevated concentrations of sulfate, the extent of contamination has been determined. Isoconcentration maps contained in the annual RCRA Reports serve to illustrate the extent. Sulfate is the most widespread constituent emanating from the waste pit area. The plume was contoured to 100 ppm in the 2000 series, and 30 ppm in the 3000 series; concentrations that are below the maximum contaminant level (MCL) of 250 ppm. Elevated sulfate was detected at only one location in the 4000 series therefore an isoconcentration map was not created. The elimination of wells 2066 and 3066 from consideration as upgradient wells may result in different statistical test results (additional downgradient wells displaying statistically significant concentrations) but would not change the size and shape of the downgradient contamination illustrated by the isoconcentration maps.

7. Ohio EPA Specific Comment (g)

"1990 Page 2, para 2- This paragraph states that elevated levels of additional inorganic constituents have been detected in the plume, but are inconsistent and are not used to trace plume movement. DOE-FEMP needs to provide Ohio EPA with the supporting data and rational that they used to determine this."

FEMP Response to OEPA Specific Comment (g)

The term "inconsistent" as used in the 1990 RCRA report has caused confusion. It should have been stated that "additional statistically significant concentrations of some inorganics have been determined, however only inorganics confirmed at three or more locations are illustrated in the isoconcentration maps."

Page 31 of the 1990 RCRA report states that "The contour maps were constructed only for those parameters that indicated 3 or more Monitoring Wells with statistically significant concentrations in the same monitoring zone". All analytical data was factored into the downgradient assessment of the extent of contamination. The supporting data was summarized and presented in Tables 3.1 through 3.6 and the Appendices of the 1990 RCRA Report.

8. Ohio EPA Specific Comment (h)

"1990 Page 36, section 3.3.5.1- This section describes the method which DOE used to determine the rate of contaminant migration. This method assumes a linear relationship between contaminant concentration, distance, and time. This method does not take into account variability in hydraulic conductivity, transmissivity, storativity (specific yield), or recharge. The DOE should provide Ohio EPA the data which supports these assumptions.

FEMP Response to Ohio EPA Specific Comment (h)

The FEMP has employed the technique identified in the RCRA Groundwater Monitoring Technical Enforcement Guidance Document (OSWER-9950.1 September, 1986, Section 6.11, page 181) to determine the rate of contamination for the Waste Pit 4 Assessment. This technique utilizes monitoring wells installed at the same elevation and aligned in the direction of flow. Changes in contaminant concentrations can be observed in these monitoring wells to develop migration rates. Specific aquifer parameters are not used in this method, but field data used to trend changes over time represent the parameters empirically. Observed rates of migration between the monitoring wells is not being extrapolated to other areas of the site.

9. Ohio EPA Specific Comment (i)

"DOE-FEMP solely uses statistical analysis to verify the presence of contaminants in monitoring wells. Ohio EPA recommends the use of "best professional judgement" coupled with statistical analysis to determine contamination. Ohio EPA and DOE-FEMP need to clarify how contamination will be determined."

FEMP Response to Ohio EPA Specific Comment (i)

The FEMP uses involved statistical methods consistent with The Statistical Analysis of Groundwater Monitoring Data At RCRA Facilities (EPA/530-SW-89-026, April, 1989). These statistical procedures compare upgradient monitoring well data to downgradient monitoring well data for the glacial overburden and different aquifer zones. The statistics are designed to determine small

changes in groundwater quality that may not be detected through graphical methods. Despite the use of these statistics, the FEMP also performs spacial analysis of groundwater data to determine the extent of contamination. This spatial evaluation uses analytical results contoured on a site to map determine the extent of contamination. Best professional judgement is used to identify the extent of the contamination through this spatial evaluation.

The FEMP also develops time verses concentration plots to identify concentration trends over time. The spatial evaluation and time verses concentration plots are two separate analyses used to confirm the results of the statistical analysis. Best professional judgment is used to identify differences between the evaluation techniques for further study.

10. Ohio EPA Specific Comment (j)

"The rate and extent of migration of hazardous waste or hazardous waste constituents in the ground water should not be calculated based solely upon non-statistical methods. Ground water data should be reviewed and compared to accepted background concentrations to determine ground water contamination. The use of statistics to define the rate and extent of migration of hazardous waste or hazardous waste constituents in the ground water can overlook lower concentrations of contaminants which this monitoring program is designed to include. Hydrogeological and geochemical factors must also be addressed in the determination of the rate and extent of migration."

FEMP Response to Ohio EPA Specific Comment (j)

The FEMP uses statistical procedures to identify monitoring well locations that have concentrations of concern. These statistics compare background to downgradient groundwater quality. The FEMP also evaluates groundwater concentrations using spatial analysis. The spatial method is a non-statistical representation of field data using interpretation between monitoring locations. Best professional judgement is used to determine the extent of contamination identified in both of these methods.

Variations exist between the results of the statistical procedures that compare downgradient to background and the results of the spatial evaluation. Best professional judgement involving Waste Pit 4 specific data, water elevation data, observed and modeled flow directions, and concentration variations is used to identify the extent of contamination specific to Waste Pit 4.

11. Ohio EPA Specific Comment (k)

"1989 Report 2, Page 17, para 1- This paragraph indicates that the lower aquifer is contaminated, however no ground water flow velocity, hydraulic gradient, or hydraulic conductivity is provided for this unit."

FEMP Response to Specific Comment (k)

The 1989 RCRA Report is not clear in stating that the flow velocity was determined at the time to be the same for both the upper and the lower

aquifer. The ground water flow velocity, hydraulic gradient, and hydraulic conductivity are reported on pages 13 and 14 of the 1989 RCRA report.

As explained in the FEMP response to OEPA specific comment (a), the coefficient of permeability of 2,000 gallons/day/foot or 267 ft/day was determined for the lower aquifer in a site specific pump test conducted in 1962 (Spieker and Norris, 1962). Spieker, 1968a, discusses the results of the 1962 pump test. The report states that "the test indicated that the transmissibility of the lower half of the aquifer is 150,000 gpd per ft.; therefore the transmissibility of the entire aquifer is estimated to be about 300,000 gpd per ft" (Spieker, 1968a, pg. A15). See FEMP response to OEPA specific comment (a) for further explanation.

In the 1990 RCRA report, results of the RI/FS modeling program were used to determine average velocity for the upper and lower aquifer. A hydraulic conductivity of 450 ft/day and 600 ft/day for the upper and lower aquifer respectively were used. These hydraulic conductivities are considerably higher than the pump test value of 267 ft/day. Best professional judgement indicated though that it was more conservative to use the modeling results. This resulted in a greater reported flow velocity than was made in the 1989 RCRA report.

In the 1991 RCRA report, hydraulic conductivities of 450 ft/day and 600 feet/day for the upper and lower aquifers were again used to calculate velocity. More detail was given to the determination of hydraulic gradient resulting in a range of velocity for the 2000 series being from 1.44 ft/day to 2.52. feet/day. A velocity of 1.8 ft/day for the 3000 series, and a velocity of 2.38 ft/day for the 4000 series. The differences though are due to the linear calculation of gradient between specific monitoring wells (i.e. between monitoring wells 2649 and 2037, and 2084 and 2010 for the 2000 series, between monitoring wells 3011 and 3010 for the 3000 series, and between monitoring wells 4011 and 4010 for the 4000 series.

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GROUND-WATER MOVEMENT AND CONTAMINATION AT THE AEC FEED MATERIALS PRODUCTION CENTER LOCATED NEAR FERNALD, OHIO

By

Andrew M. Spieker and Stanley N. Rorris
U.S. Geological Survey

Prepared by the U.S. Geological Survey for the U.S. Atomic Energy Commission.

Columbus, Ohio
September, 1962

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3 Map of the Miami River valley in the vicinity of the U.S. Government Reservation showing configuration of the piezometric surface, based on measurements made in wells on August 7-8, 1962 . . . . . .cover pocket

4 Map showing approximate location of existing and recommended additional wells at U.S. Government Reservation 24a

GROUND-WATER MOVEMENT AND CONTAMINATION AT THE AEC FEED MATERIALS PRODUCTION CENTER LOCATED NEAR FERNALD, OHIO

By Andrew M. Spieker and Stanley E. Morris
U.S. Geological Survey

INTRODUCTION

The purpose of this report is to present data on the movement of ground water and ground-water contamination in the vicinity of the Fernald Plant, a facility operated by the National Lead Co. of Ohio for the U.S. Atomic Energy Commission. The investigation was made at the request of the Atomic Energy Commission specifically to ascertain whether seepage from four large waste disposal pits located near the west edge of the plant production area has entered the principal aquifer from which water is supplied to the AEC plant and to many other ground-water users in the area.

This investigation would not have been possible without the wholehearted cooperation of officials of the U.S. Atomic Energy Commission and of the National Lead Co. of Ohio. The authors wish particularly to thank Messrs. Edward L. Giebel of the Atomic Energy Commission and H. Starkey and Leroy Williams of the National Lead Co. of Ohio for their assistance with the investigation.

Several earlier reports have covered various phases of the occurrence of ground water in the lower Miami River valley. Kleer and Thompson (1948), Bernhagen and Schaefer (1947), and Spieker (1961) have covered in general terms the geology and occurrence of ground water in the area. Dove (1961) discusses in detail the hydrology of the Venice area.

Dove and Morris (1951), Hartsock (1960), and Rye (1961a, 1961b, 1961c) have covered various aspects of geology, ground-water movement and contamination in administrative reports which provide a background and foundation for the present investigation.

GEOLOGY

The generalized geologic cross-section across the buried valley of the ancestral Miami River (fig. 1) portrays the geologic relations in the Fernald area. The AEC plant is situated on a terrace, ranging in altitude from 575 to 600 feet, about 50 feet above the Miami River floodplain (fig. 2). This terrace, which may be part of the Hartwell Moraine as shown by Goldthwait and others (1961), consists of clay-rich till 35 to 70 feet thick. The surficial till is not continuous to the west side of the valley; it probably pinches out into sand in the vicinity of Paddy's Run. Sand is exposed in the bed of Paddy's Run and is indicated in the drillers log of well Her-21. The absence of the till sheet west of Paddy's Run and the thinness of the till in the vicinity of the waste storage pits facilitates seepage of water into the underlying deposits.

Below the till sheet are sand and gravel deposits, about 150 feet thick, which fill the entire buried valley. Underneath the AEC plant these deposits are separated horizontally by a layer of clay about 10 ~~to 20~~ feet thick. The clay layer, the top of which is 130 to 140 feet below the surface, is believed to extend westward to the bedrock valley wall in the vicinity of Shandon Station and southwestward at least as far as New Haven. The clay layer does not extend entirely across the buried valley, as it is reported in none of the test wells drilled for the Southwestern Ohio Water Co. It appears to pinch out

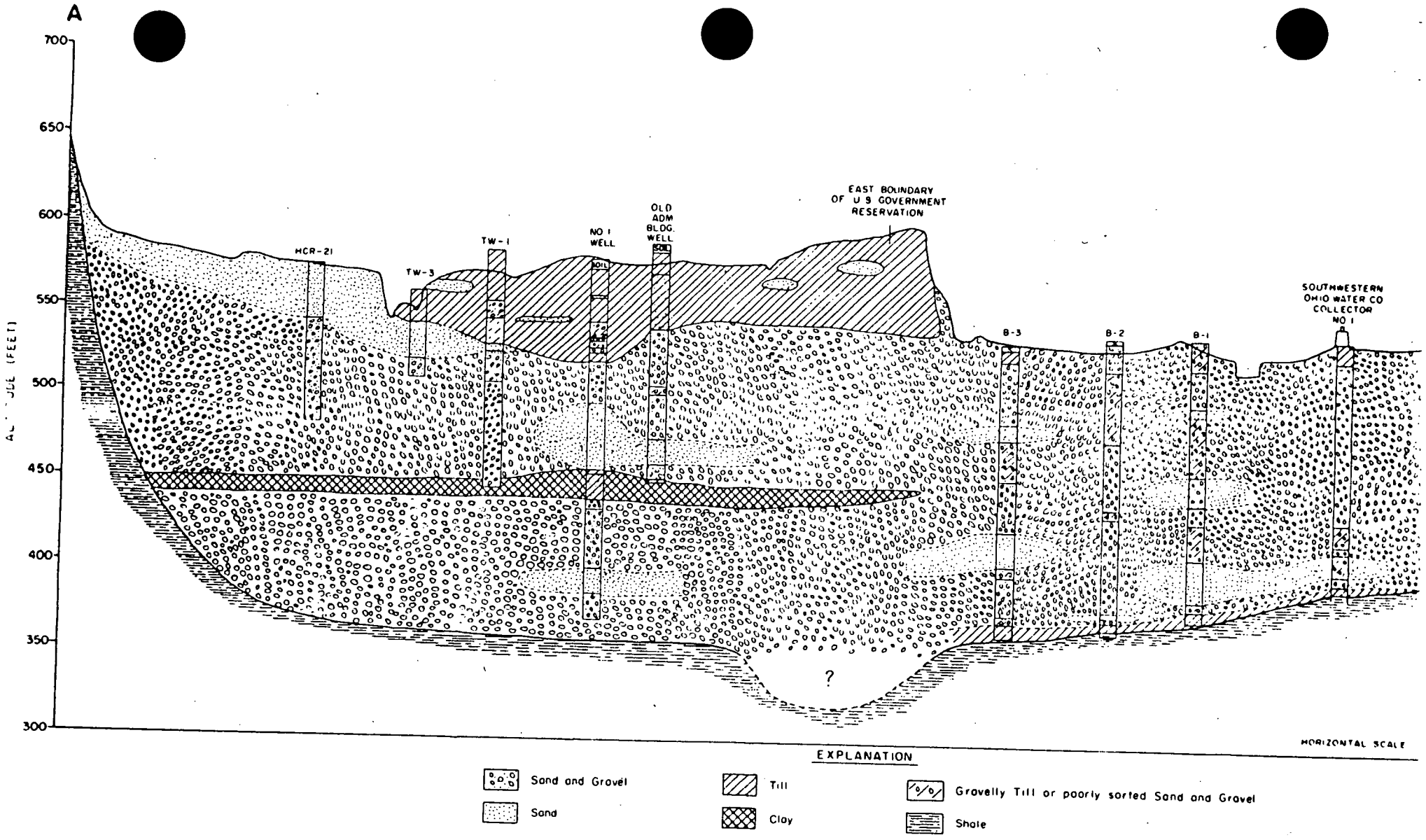
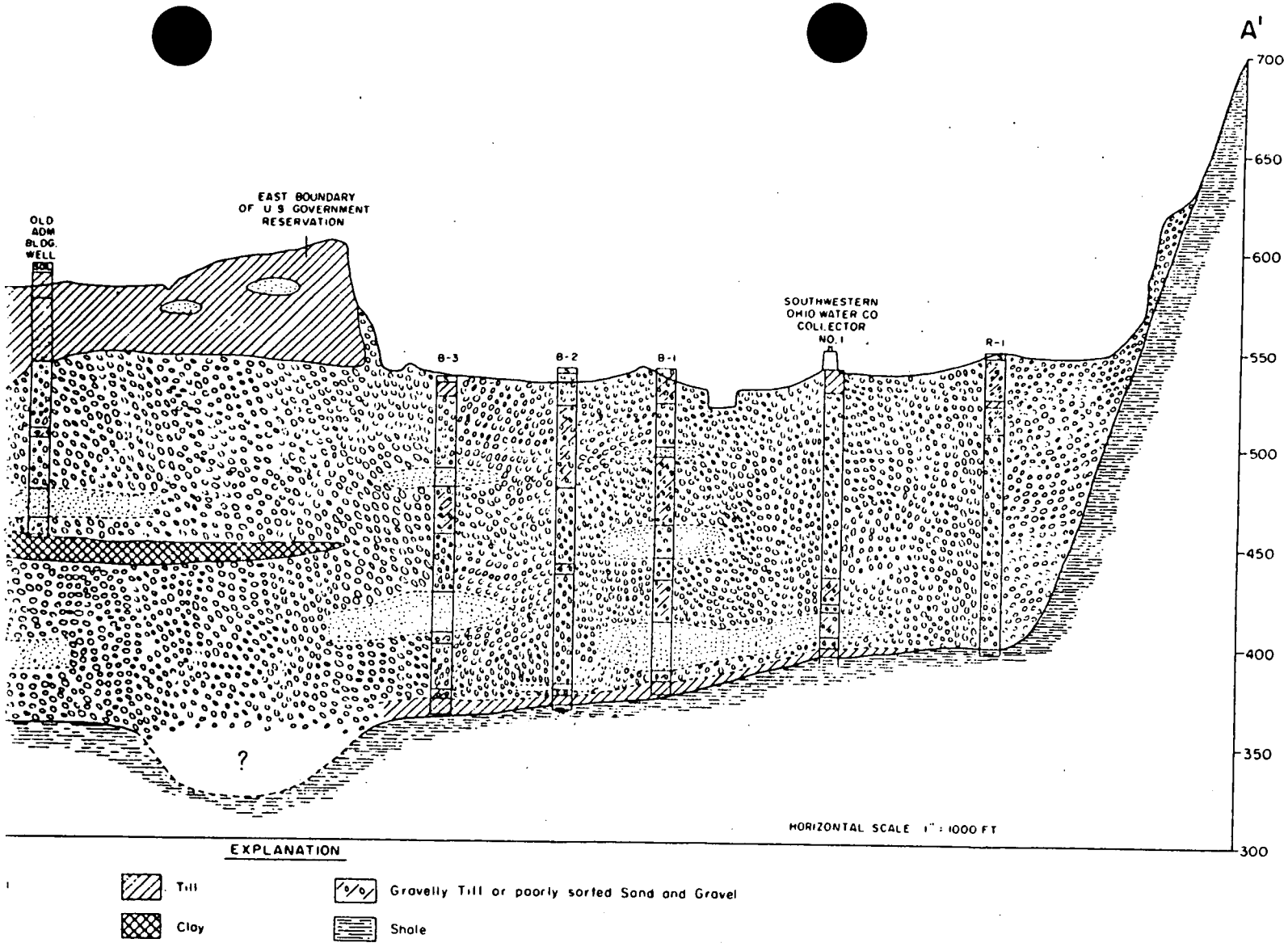


Figure 1. Geologic cross section through U. S. Government Reservation near Fernald, Ohio



cross section through U.S. Government Reservation near Fernald, Ohio.

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near the eastern boundary of the Government Reservation. The clay was probably deposited in an ice-marginal lake or as a backwater deposit of a pre-glacial stream.

The "shallow aquifer" of Dove and Morris (1951) is a perched body of water restricted to the high terrace. Dug wells at farms surrounding the Reservation tap this aquifer, which probably consists of discontinuous pockets of sand and gravel interstratified with the surficial till. This perched body of water is probably of little consequence with regard to the movement of ground water under the Government Reservation. In the present report the term upper aquifer refers to that portion of the principal sand and gravel aquifer situated above the clay bed about 140 feet below the surface and not to the perched aquifer. The usage of the present report thus corresponds to that of Rye (1961b, p. 4).

AQUIFER TESTS

The clay bed constitutes a poorly permeable confining bed, separating the sand and gravel deposits into an upper and a lower aquifer. On August 2, 1962 measurements made with a highly-sensitive, thermistor-type thermometer showed that ground-water temperature above the clay bed was about 0.5° F lower than that below the clay bed in the vicinity of the plant supply wells. Aquifer tests made on August 7 and 8 and on August 14 and 15, using the plant supply wells, show that vertical leakage through the clay bed, by which water moves from the upper to the lower sand and gravel aquifer, is the principal source of recharge to those wells. The tests yielded values of the transmissibility and storage coefficients of the lower aquifer, and of the permeability of the semi-confining clay bed. These factors are essential in assessing the rate of ground-water movement into the lower aquifer.

There are three water-supply wells at the AEC plant, located on the west side of the production area. The wells are spaced 400 feet apart and arrayed in a north-south line, with well 1 being the northernmost well. The wells are 210 feet deep and are screened in the lower 20 feet. Presently plant water-use amounts to about 1.2 mgd (million gallons per day).

In the aquifer test made on August 7 and 8, well 1 was pumped steadily at the rate of 300 gpm (gallons per minute) for approximately 20 hours while the drawdown and subsequently the recovery of the water level were recorded in a 6-inch diameter observation well 185 feet deep, located near supply well 2. For two days prior to and during the test, well 3 was pumped steadily at the rate of 800 gpm to supply the water requirements of the plant. On August 14 and 15 the pattern was reversed, well 3 being test pumped, at 275 gpm, while well 1 was used to supply water to the plant.

During both tests fluctuations in the water level were recorded in a well 118 feet deep, screened above the semi-confining clay bed, and located about 2,000 feet northeast of the supply wells at the site of the old Administration Building. The water level in the shallower well was unaffected by the tests; however, the well revealed fluctuations in water level caused by changes in atmospheric pressure in about the same degree as those recorded in the deeper observation well. The hydrograph of the shallow well was used, therefore, as a convenient barograph from which to correct apparent variation in trends of the drawdown and recovery curves caused by atmospheric pressure changes. Plant engineers maintained excellent control of pumping, keeping it at a very steady rate, and results of the two tests are similar.

The lower sand and gravel aquifer has a coefficient of transmissibility of about 140,000 gal per day per ft and a coefficient of storage of 0.001, the latter value being in the artesian range. With a saturated thickness of approximately 70 feet, the aquifer has a coefficient of permeability of approximately 2,000 gal per day per sq ft, a value typical of the sand and gravel deposits in the Miami Valley. At the pumping rates used in the tests recharge became noticeably effective after about 30 minutes, after which time there was essentially no more drawdown.

The coefficient of leakage of the confining bed, that is the ratio of its permeability to thickness, determined by methods described by Walton (1960), was computed as about 0.21 and 0.32 gal per day per ft^3 for wells 1 and 3, respectively. These values multiplied by its thickness at the respective wells, yields values for the coefficient of permeability of the semi-confining bed of 3.2 gal per day per sq ft, at the site of supply well 1, and of 2.5 gal per day per sq ft at the site of supply well 3. Although the semi-confining bed is only about one seven-hundredth as permeable as the sand and gravel aquifer which it overlies, it is nevertheless permeable enough to transmit large quantities of water from the upper to the lower aquifer where the area in which leakage occurs is fairly large, even though the difference in hydraulic head between the two aquifers may be small. For example, if we take as the coefficient of permeability of the semi-confining bed the value of 3.0 gal per day per sq ft, and use 12 feet as its average thickness, the leakage coefficient $\left(\frac{P'}{m'}\right)$ is $\frac{\text{3.0 gal per day per ft}^2}{\text{12 ft}}$ or 0.25 gal per day per ft^3.

If the average difference in head (Δh) between the upper and lower aquifers is, say 1 foot, over an area (A) of 1 square mile, the quantity of water (Q) moving through the semi-confining bed is:

$$Q = \left(\frac{p'}{m'}\right) A \Delta h$$
$$= 0.25 \times (5{,}280)^2 \times 1$$
$$= 7 \text{ mgd}$$

To illustrate further, the production area of the plant, including the land on which the disposal pits are dug, comprises about 400 acres. For 1.2 mgd of water, the amount presently being pumped at the plant, to move through the semi-confining bed in this area the average head difference between the upper and the lower aquifer needs only be about 0.2 foot. This is on the assumption that the leakage coefficient averages 0.25 gal per day per ft^3.

GROUND-WATER MOVEMENT

Figure 3 is a map of the Fernald area showing the configuration of the piezometric surface on August 7-8, 1962, based on measurements of nine wells on the Government Reservation, 37 test wells and two collectors of the Southwestern Ohio Water Co., and one domestic well. Movement of ground water is perpendicular to the contours and in the direction of decreasing head. The map is considered to be quite accurate in the area east of the Government Reservation, but owing to sparse data it is somewhat less accurate on and west of the Reservation. Any revisions made possible by additional data would be in the nature of refinement of detail rather than of changing the basic relationships.

The Government Reservation is situated just west of a major ground-water divide. Ground-water movement is in general from the vicinity of Shandon Station southeastward through the Reservation toward the Miami River. The divide is roughly parallel to and generally east of the east boundary of the Reservation. Water west of this divide moves toward the Miami River between Fernald and New Baltimore. The cone of influence caused by pumping at the AEC plant does not change the regional ground-water movement.

The effect on ground-water movement of the semi-confining clay layer reported in the AEC wells at the depth of about 140 feet is considered to be only of local extent. The regional ground-water movement in the sand and gravel is practically horizontal,

and the head difference between the upper and lower aquifers is slight -- generally less than 1 foot. Pumping of the plant's wells has caused vertical leakage through the clay by lowering the hydraulic head in the lower aquifer in the immediate vicinity of the pumping wells, but the bulk of the regional movement remains horizontal and parallel in both aquifers. In the preparation of figure 3, therefore, wells in both aquifers were used.

The average regional hydraulic gradient based on the piezometric contours is extremely flat -- about 0.0014 foot per foot, or 7.5 feet per mile. Locally, in the vicinity of pumping wells, this gradient is much steeper. The average velocity of ground-water motion can be determined using the equation

$$v = \frac{pI}{7.48\theta}$$

where:

v = velocity, in feet per day

I = hydraulic gradient, in feet per foot

p = coefficient of permeability of the aquifer, in gallons per square foot per day

θ = porosity of the material, in percent

Using the value of p = 2,000 gal per ft^2 per day, as determined from the aquifer tests, and the hydraulic gradient I = 0.0014, and assuming the porosity θ to be 25 percent;

$$v = \frac{2,000 \times 0.0014}{7.46 \times 0.25}$$

$$v = 1.5 \text{ ft per day}$$

Thus, the average ground-water velocity in the vicinity of the Government Reservation is about 1.5 feet per day.

The quantity of ground water moving in an aquifer can be calculated by the formula

$$Q = TIW$$

where:

Q = gallons per day

T = coefficient of transmissibility of the aquifer, in gallons per day per foot

I = hydraulic gradient, in feet per foot

W = width in feet of the section through which flow is occurring

Based on a coefficient of transmissibility of 300,000 gal per day per foot, for the entire saturated thickness of the aquifer (2,000 gal per day per sq ft x 150 ft), a hydraulic gradient of 0.0014, and width W;

$$Q = 300,000 \times 0.0014 \times W$$

$$= 420 \text{ gal per day} \times W$$

Taking 800 feet as the width (W) of the disposal pits, approximately 350,000 gallons of water move daily beneath the pits, in a generally southeastward direction.

The plant supply wells are located generally down-gradient from the disposal pits and much of the water being pumped enters these wells after passing beneath or in close proximity to the disposal pits. Part of the water moving beneath the pits bypasses the area of influence of the supply wells and discharges naturally to the Miami River near New Baltimore. If pumping is increased in the supply wells the extent of their area of influence will also be increased and they will then capture a correspondingly greater part of the water moving beneath the pits. It is not unlikely that a doubling of the present pumpage would result in capture by the supply wells of virtually all the flow that presently passes beneath the disposal pits.

Five test wells, located roughly in a circle about the disposal pits (fig. 4), were drilled in the summer of 1959 and have been pumped more or less continuously since the spring of 1962. Test well 1 is pumped at the comparatively high rate of about 200 gpm; each of the other test wells is pumped at less than about 20 gpm. Water from test well 1 is pumped back into the disposal pits; water pumped from the other wells is discharged to Paddy's Run.

Pumping of the test wells has created small cones of depression around these wells which locally reverse the regional gradient and capture part of the water that otherwise would move towards the supply wells. Data upon which to base the extent of the cones of depression around the test wells consist only of water-level measurements made in

wells themselves, and consequently the piezometric contours are approximate. It is possible, using these data, to draw the contours in such a way as to indicate a cone of depression extending entirely around the disposal pits, thus producing a ground-water divide between the pits and the plant supply wells. Under such conditions all seepage from the pits would be captured by the test wells and none would move towards the supply wells. However, unless the aquifer in the vicinity of the test wells is very much below average in permeability[1/], the cones of depression produced around the test wells at present pumping rates will be essentially of local extent, as indicated by the piezometric contours on figure 3.

Owing to the low regional velocity of the ground water, distant effects of contamination will not be noted until long after the contaminated water enters the aquifer. It requires an estimated 2 to 5 years for ground water to move the 2,000 feet from the pit area to the plant supply wells and as much as 25 or 30 years to move 14,000 feet to the Miami River near New Baltimore. These are believed to be the average travel times. Actual travel times could vary from the average by as much as 100 percent, either faster, owing to preferential flow paths of higher than average permeability, or slower, owing to more circuitous flow paths.

1/ The specific capacity of test well 1, that is the ratio of its yield to drawdown, is only about half as high as the specific capacities of the supply wells. This might indicate that the aquifer is less permeable in the vicinity of test well 1 than in the area of the supply wells but, as no data have been collected on relative well efficiencies no definite conclusion is warranted.

CONTAMINATION

Early in 1959 the large liquid waste disposal pit (Pit 3) was placed in use as a settling basin. Waste water, after being decanted to a clear-well portion of the pit, is pumped into the Miami River through a pipe line. The pit is dug into the surficial till at a point where this till is relatively thin. There is evidence that in excavating the pit the till was removed in places to the top of the underlying sand and gravel aquifer. Eye (1961, p. 4) states: "The waste disposal pits ... excavated to a depth of approximately 25 feet, extend below the somewhat impervious surface layers, and in some of these pit excavations lenses or deposits of pure sand and gravel were encountered. The bottom and sides of these pits were sealed initially with a layer of clay but there is no assurance that the seal is still completely continuous and water tight. The inside walls of Pit #3 show evidence of considerable 'slipping' or 'spalling' and it is likely that some of the clay liner on the sidewalls has been destroyed. If this is the case, pronounced seepage may occur when the water level in the pit rises above these 'slip' zones."

Formerly, about 1.3 mgd of waste effluent went into the pit and thence was pumped to the Miami River. Presently, about 0.8 mgd are going into the pit, which is kept nearly brim-full. About 50 million gallons are currently in storage in the pit, which comprises an area of about 7½ acres. Although the flow into and out of the pit is known with some accuracy, it is probable that several tens of thousands of gallons per day of effluent could seep from the pit without being detected.

Seepage into the underlying aquifer has been occurring ever since the pit was placed in use, as indicated by contamination in varying degree, reported in the shallow test wells drilled around the pit. Test wells 3 and 5 became contaminated in 1959, and test wells 1, 2, and 4, first showed contamination late in 1960. To date the plant's supply wells show no sign of contamination.

Of several potential contaminants, of principal concern are uranium and thorium compounds, chlorides, nitrates and fluorides. Rye (1961, p. 5) states: Of these, the chlorides, nitrates, and fluorides are the most likely contaminants. Chlorides and nitrates are present in the wastes in high concentrations (in the 1,000's of parts per million by weight). The chlorides and nitrates are extremely soluble and the fluorides relatively soluble. The uranium products are only slightly soluble and as such are probably of secondary significance in a consideration of ground water pollution in the area."

Listed as follows are nitrate and chloride concentrations in water samples collected from the test wells and plant supply wells on August 3, 1962:

Well	Parts per million NO_3	Cl
Supply 1	0.8	22
Do-- 2	.4	18
Do-- 3	.4	10
Test-- 1	900	600
Do-- 2	-	-
Do-- 3	350	150
Do-- 4	11	18
Do-- 5	300	100
Maximum permitted by U.S. Public Health Service for drinking water	45	250

More complete analyses of water samples from test well 1, plant supply well 1 and disposal pit 3, made by the National Lead Co. of Ohio, are listed as follows:

No 1 test well (sample collected September 16, 1962)

Constituents	Parts per million
Total hardness, as $CaCO_3$	1,460
Ca as $CaCO_3$	922
Mg as $CaCO_3$	538
Chlorides, as chlorides	820
Nitrates, as nitrates	1,350
Fluorides, as fluoride	1.12
Uranium, as uranium	.024
Alpha activity (disintegrations per minute per milliliter)	.04
Beta activity (disintegrations per minute per milliliter)	.03
pH	7.22
Total dissolved solids, based on conductivity	3,100

No 1 supply well (composite samples collected chiefly in past 6 months)

Constituents	Parts per million
Total hardness as $CaCO_3$	368
Ca as $CaCO_3$	248
Mg as $CaCO_3$	120
Methyl orange alkalinity as $CaCO_3$	294
Sulfates, as sulfate	72
Chlorides, as chloride	16
Silica as SiO_2	10.5
Nitrates, as nitrate	0.7
Fluorides, as fluoride	0.12
Uranium, as uranium	0.003
Iron, as Fe	3.0
Total dissolved solids based on conductivity	424
pH	7.25
Alpha activity (disintegrations per minute per milliliter)	.03
Beta activity (disintegrations per minute per milliliter)	.01

Pit 3 (samples collected during past several months)

Constituents	Parts per million
Total Hardness, as $CaCO_3$	5,260
Ca as $CaCO_3$	1,220
Mg as $CaCO_3$	4,040
Phenol alkalinity as $CaCO_3$	80
Methyl orange alkalinity as $CaCO_3$	360
Chlorides, as chloride	4,500
Nitrates, as nitrate	2,950
Sulfates, as sulfate	400
Fluorides, as fluoride	29
Uranium, as uranium	1.95
Iron, as Fe	0.54
Oil	4.0
Organic (ether extractable)	33
Silica as SiO_2	10
Phosphate as PO_4	1.4
Chromium as Cr	2.2
Total suspended solids	17
Total dissolved solids, based on conductivity	30,000
pH	8.62
Alpha activity (disintegrations per minute per milliliter)	4.04
Beta activity (disintegrations per minute per milliliter)	.95
Radium (micro micro gram per milliliter)	.06

The concentrations of the contaminants in the test wells fluctuate depending on the relative rates at which the wells are being pumped. In the fall of 1969 test well 1 yielded as much as 3,000 ppm (parts per million) Cl before continuous pumping at the rate of 220 gpm lowered these concentrations to near their present levels.

On the basis of presently available information it is not possible to determine either how far contamination has spread beyond the pits or whether the contaminants have leaked through the clay layer into the lower aquifer. Several additional test wells located between the pits and the production area and tapping both aquifers would be required to provide this information. On the basis of the piezometric contours (figure 3) the pit area is situated west of the major ground-water divide, and the contaminated water, once it leaves the immediate vicinity of the pits, will move toward the Miami River between Fernald and New Baltimore. It would thus appear that there is no danger of contaminating the Southwestern Ohio Water Co. supply. But the ground-water divide is not static. Its position is constantly shifting in response to changes in pumping and recharge. Although movement of ground-water from the pit area to the Southwestern Ohio Water Co. well field does not appear likely it cannot be ruled out. It can be stated with reasonable certainty, however, that there would be no potential danger of contaminating the proposed Cincinnati well field near Fairfield. The water table in this vicinity stands at an altitude of about 550 feet, nearly 30 feet higher than its altitude at the Fernald plant. The possibility that pumping at the proposed Cincinnati installation would spread a cone of depression downstream far enough to intercept ground-water runoff from the Fernald plant is indeed remote.

If contaminated water continues to enter the aquifer at the present rate some of the contaminant almost certainly will move into the cones of depression around the plant supply wells and, after leaking downward through the clay layer, will enter those wells. The chemical properties of the clay bed may be of great importance, therefore, with respect to potential contamination, as in passing through this bed concentrations of some of the more harmful constituents may be reduced. If the pits could be sealed to prevent further contamination of the aquifer, the contaminants already in the aquifer probably would eventually be sufficiently diluted to render them harmless. The need for sealing the pits to prevent further contamination cannot be too highly stressed.

Of major concern is the possibility that a catastrophic break might occur in the lining of the disposal pits, allowing the quick release of all the contaminant to the underlying aquifer. This would result initially in a ground-water mound being formed beneath the pits, thus steepening the hydraulic gradient locally, and causing water to move outward rapidly from the pits, possibly at a rate as high as 20 or 25 feet per day. Most of this water would bypass the test wells, even though these wells were being pumped to their present maximum capacity, and eventually would arrive in the area of influence of the plant supply wells. The rate of movement of the contaminated water would decrease progressively with its distance from the pits, as the hydraulic gradient became less steep.

An accident to the pit bottom might require drastic measures to prevent contamination of the plant supply wells. The supply wells might have to be relocated -- perhaps to a site upgradient from the pits -- or wells might have to be drilled and pumped between the pits and the supply wells. Such pumping would probably contain the contaminant and prevent it from reaching the supply wells, but disposal of the contaminated water pumped would create a problem in itself. The slow rate of ground-water movement would fortunately allow time for remedial action before the contaminants spread too far beyondthe pit area.

SUMMARY AND RECOMMENDATIONS

The Fernald plant of the AEC is located on a high terrace, composed of poorly permeable glacial till about 50 feet thick, overlying the highly permeable sand and gravel aquifer which fills the ancestral Miami River valley. In the vicinity of the plant the sand and gravel is divided into two aquifers, each about 25 feet thick, by a layer of clay about 10 to 20 feet thick. The clay layer, though poorly permeable, is capable of transmitting large quantities of water from one aquifer to the other where a head difference between these aquifers exists. The regional hydraulic gradient of the sand and gravel aquifer is about 7.5 feet per mile toward the southeast. Near the east border of the Government Reservation is a ground-water divide, east of which water moves eastward toward the Southwestern Ohio Water Co. collectors.

Contaminated water from the waste disposal pits northwest of the production area has already entered several test wells surrounding the pits. How far beyond the pit area contamination extends is as yet unknown, but it is assumed that contaminated water has moved beyond the test wells in response to the regional hydraulic gradient. Owing to the slow movement of ground water in the area, it will take from 2 to 5 years for contaminated water to reach the plant supply wells and from 25 to 30 years for it to reach the Miami River.

The following specific recommendations are made both to determine more precisely the extent and degree of contamination, and to minimize chances of greater contamination in the future:

(1) Approximately 18 test wells should be drilled as indicated on figure 4. Three of these should penetrate the clay confining bed into the lower aquifer, while the remainder should terminate in the upper aquifer at a depth of 70 to 100 feet. The shallow test wells should be drilled to the top of the semi-confining clay layer. Accurate logs should be kept of all wells. Samples should be collected, and changes in the water level as the wells are deepened should be carefully noted. An experienced geologist should observe and supervise all drilling.

(2) Monthly samples should be taken from all test wells, both existing and proposed, to determine the extent of contamination. A portable submersible pump would be suitable for such sampling.

(3) Periodic measurements of the static (non-pumping) water level should be made in all wells to determine any shifting of ground-water divides caused by changed patterns of pumping. These data should be pooled with similar measurements already being made by the Southwestern Ohio Water Co.

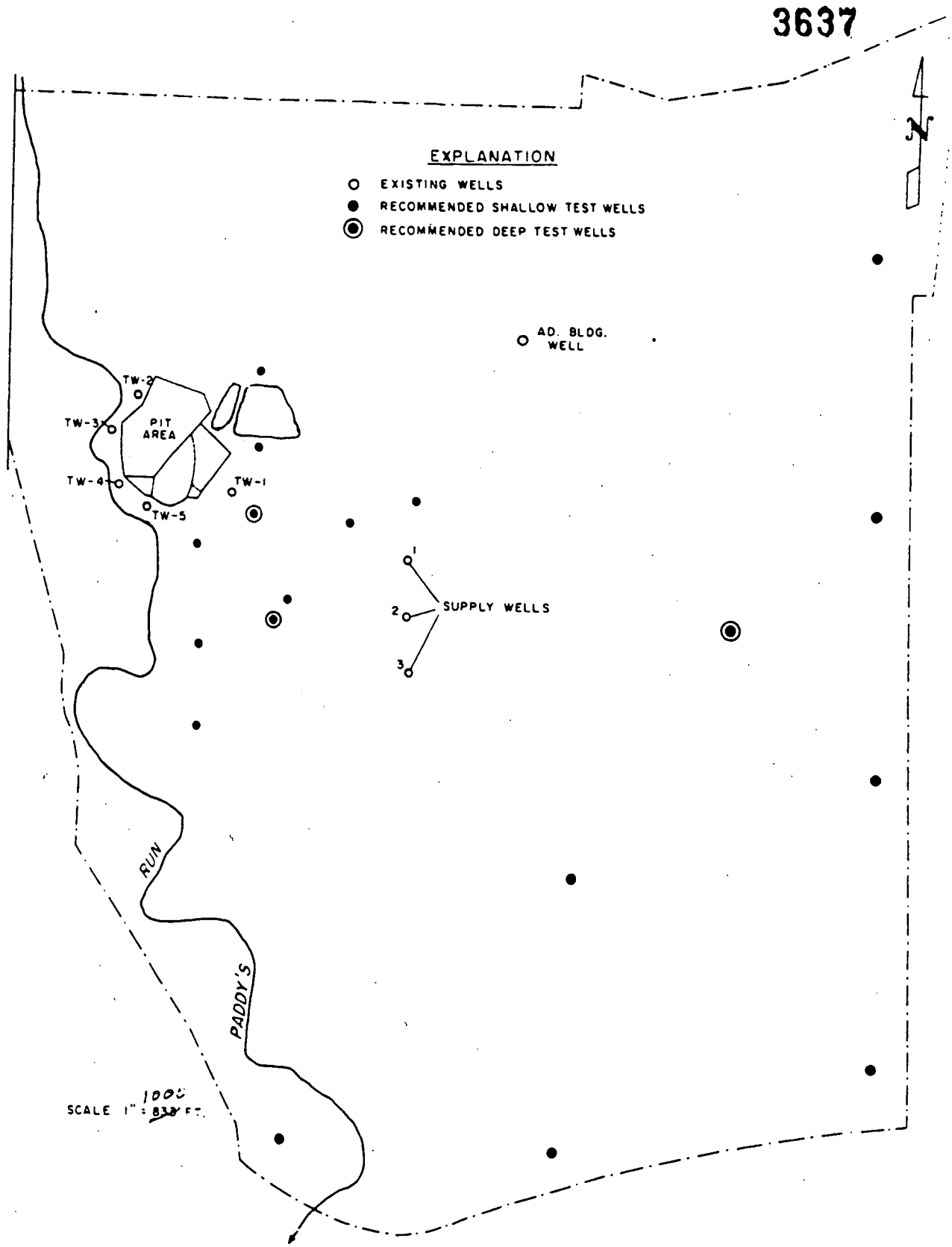

Figure 4. Map showing approximate location of existing and recommended additional wells at U. S. Government Reservation.

(4) All possible steps should be taken to prevent contaminants from continuing to enter the aquifer. This will no doubt involve more effective sealing of the bottoms of existing disposal pits. An alternate pit should be constructed so that it can be used while the existing pits are being repaired. Having an alternate pit would furthermore provide for protection in case of accidental damage to one of the existing pits.

(5) If it is determined that contaminated water in significant amount is leaving the pit area, a program of protective pumping should be instituted, and plans should be made for relocating the supply wells in the event the situation cannot be corrected by pumping. Adequate steps for safe disposal of the contaminated water must be taken.

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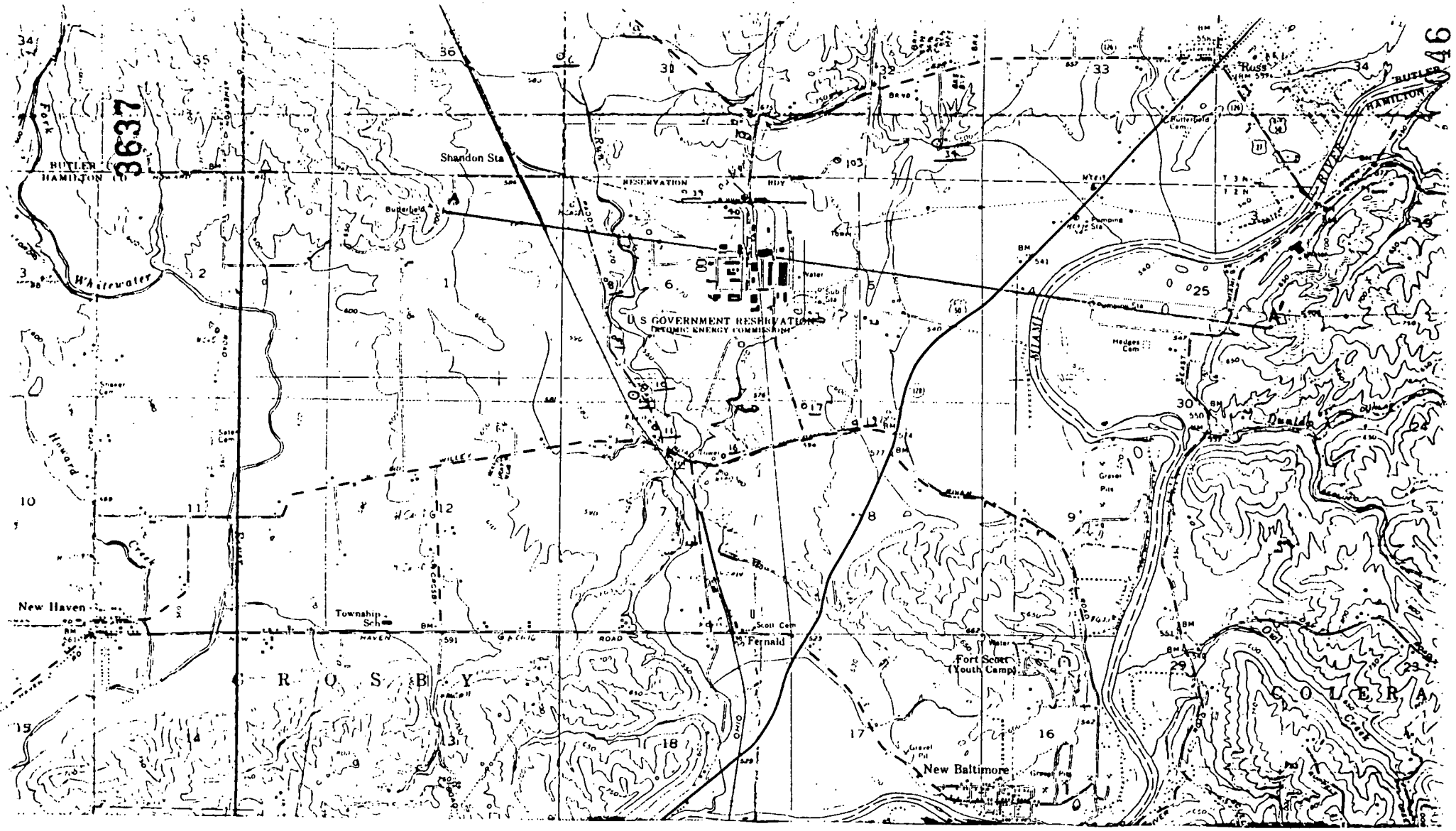
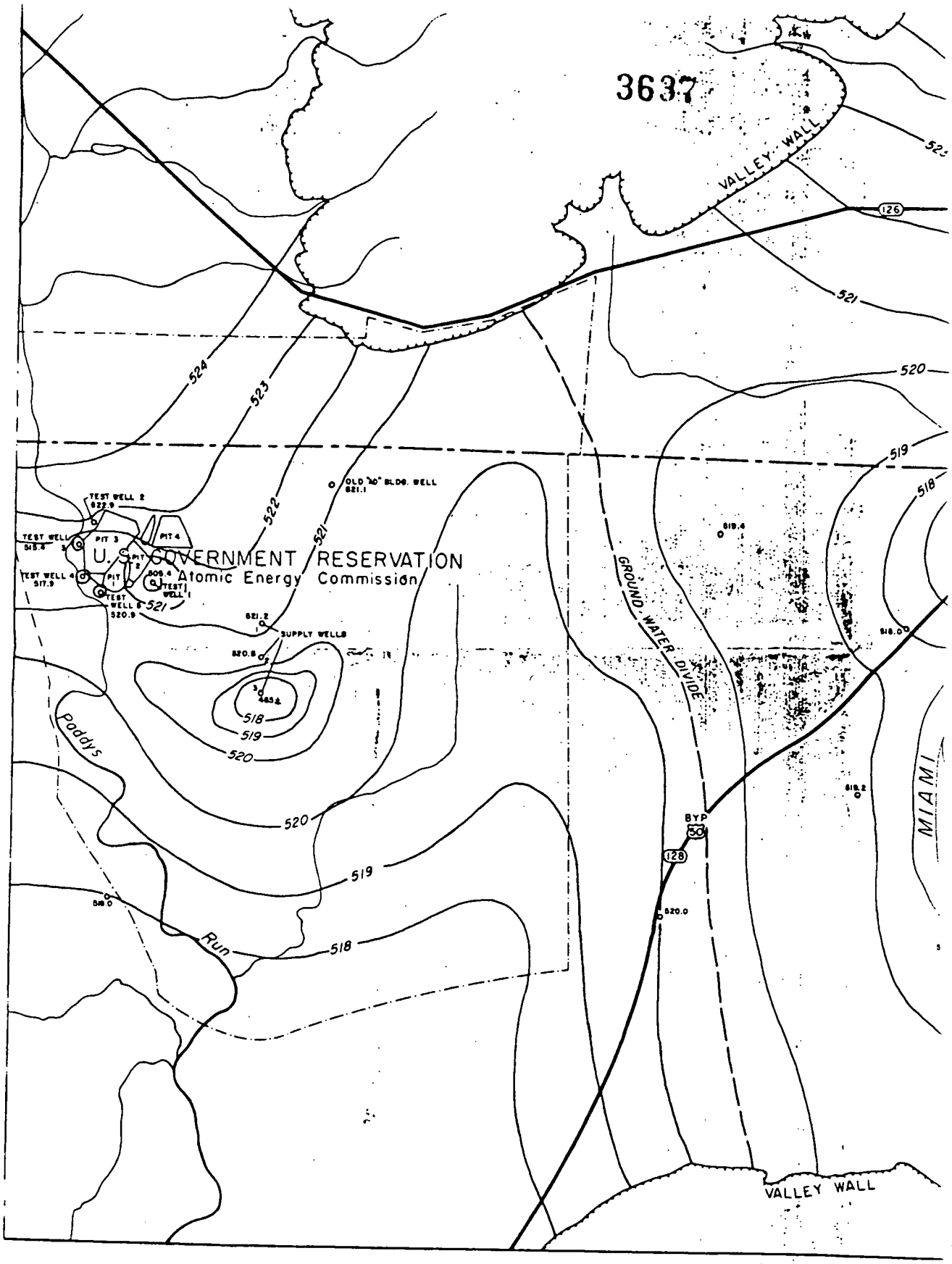


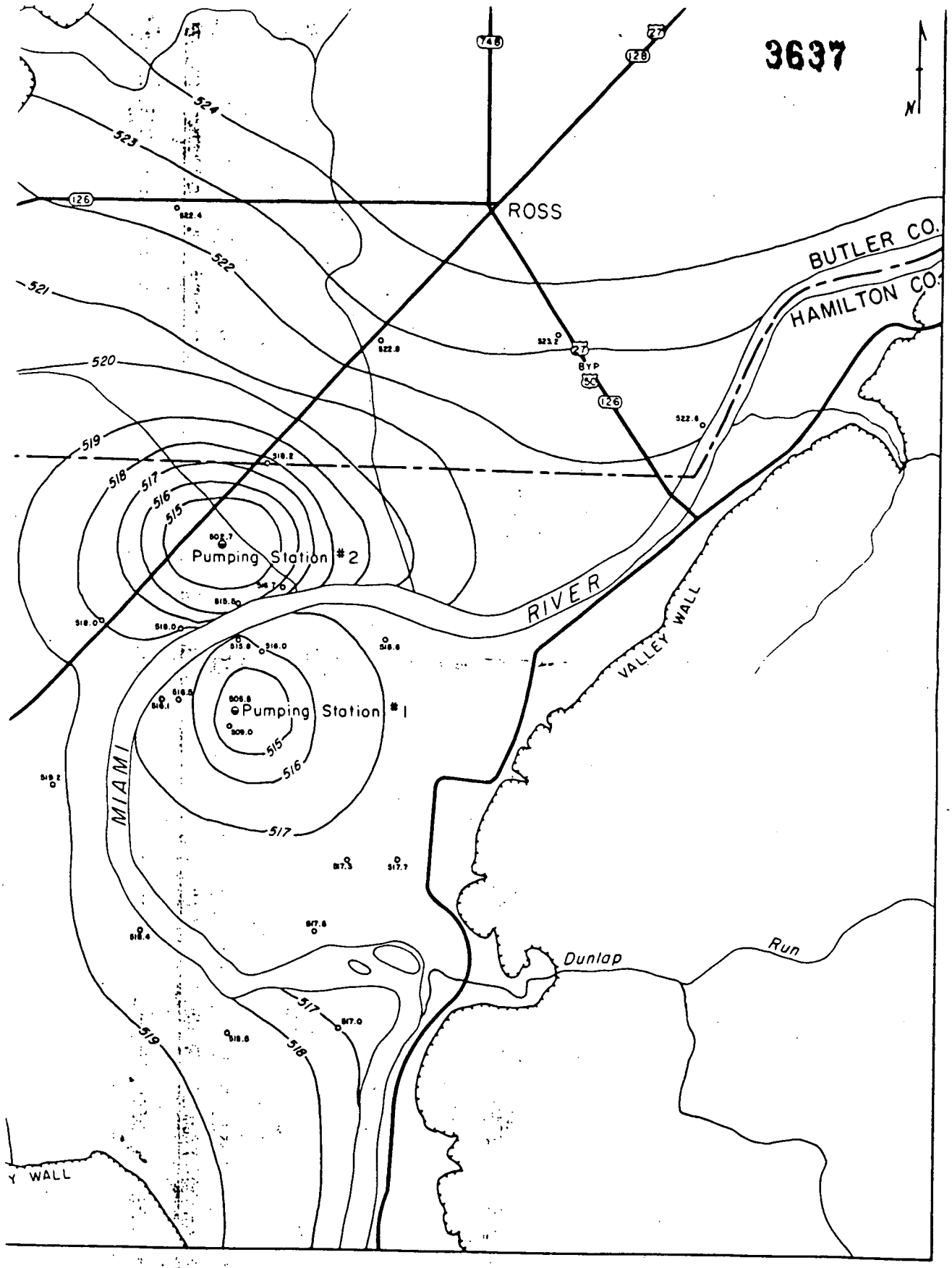
Figure 2. Map of Shandon, Ohio, 7½ minute quadrangle showing location of geologic cross section A – A' (figure 1)



SCALE

0 1000 2000 3000 FEET

Figure 3. Map of the Miami River Valley in the vicinity of the U. S. Government R
Measurements made in wells on August 7-8, 1962. (Not c



overnment Reservation showing configuration of the piezometric surface, based on
962. (Not all contours are shown around pumping wells.)

Field Data
Spicker and Norris, 1962

3637

Formation [illegible]

t (min)	s (ft)	Barometric change	Adjusted s	r^2/t	t (min)	s (ft)	Barometric change	Adjusted s	r^2/t
2	.004	0	.004	1.15×10^8	251	.306	.039	.345	9.2×10^5
3	.012		.012	7.7×10^7	271	.308	.045	.353	6.2
4	.020		.020	5.76	451	.317	.045	.362	5.1
5	.032		.032	4.6	579	.323	.045	.368	4.0
6	.040		.040	3.83	704	.327	.052	.379	3.3
7	.062		.062	3.29	815	.320	.065	.385	2.82
8	.081		.081	2.88	938	.328	.074	.402	2.45
9	.089		.089	2.55	1063	.323	.075	.398	2.15
10	.104		.104	2.3					
11	.113		.113	2.09	Q = 275 gpm				
12	.125		.125	1.92	r = 400 ft				
13	.137		.137	1.77	Measurements in [illegible] 2				
14	.150		.150	1.64	Start 8-14-62 1:59 PM				
15	.160		.160	1.53	end 8-15-62 9:22 AM				
16	.170		.170	1.44	duration – 19 hrs 23 min				
17	.179		.179	1.35					
18	.185		.185	1.28	Well 1 [illegible] 800 gpm				
19	.193		.193	1.21	Well 2 pumped 275 "				
20	.201		.201	1.15					
21	.209		.209	1.10					
22	.215		.215	1.05					
23	.222		.222	1.0					
24	.226		.226	9.6×10^6					
25	.232		.232	9.2					
27	.243		.243	8.5					
28	.247		.247	8.2					
30	.253		.253	7.9					
33	.264		.264	6.96					
35	.272		.272	6.77					
40	.283	.001	.284	5.76					
45	.292	.002	.294	5.1					
51	.297	.003	.300	4.5					
58	.302	.005	.307	3.95					
73	.302	.006	.308	3.15					
115	.303	.010	.313	2.0					
176	.304	.020	.324	1.31					
196	.305	.029	.334	1.17					

Field Data.
Spicker and Norris, 1962

9-230

AUGUST 7th and 8th

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

File No. { Washington District

3637

DATE	TIME	t min	Depth To Water	s								
8-7-62	1405	0	60.15	0								
	1407	2	60.15	0								
	1408	3	60.16	.01								
	1409	4	60.18	.03								
	1410	5	60.20	.05								
	1411	6	60.22	.07								
	1412	8	60.25	.10								
	1414	9	60.27	.12								
	1415	10	60.29	.14								
	1416	11	60.30	.15								
	1417	12	60.32	.17								
	1418	13	60.34	.19								
	1420	15	60.36	.21								
	1421	16	60.38	.23								
	1422	17	60.40	.25								
	1424	19	60.41	.26								
	1425	20	60.42	.27								
	1427	22	60.44	.29								
	1430	25	60.47	.32								
	1432	27	60.48	.33								
	1434	29	60.49	.34								
	1436	31	60.51	.36								
	1440	35	60.52	.37								
	1442	37	60.53	.38								
	1445	40	60.53	.38								
	1500	55	60.54	.39		.40						
	1530	85	60.54	.39								
	1542	97	60.56	.41								
	1630	145	60.56	.41		.43						
	1700	175	60.56	.41								
	1730	205	60.56	.41								

050

U. S. GOVERNMENT PRINTING OFFICE 10—48721-1

9-230

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

File No. { Washington District

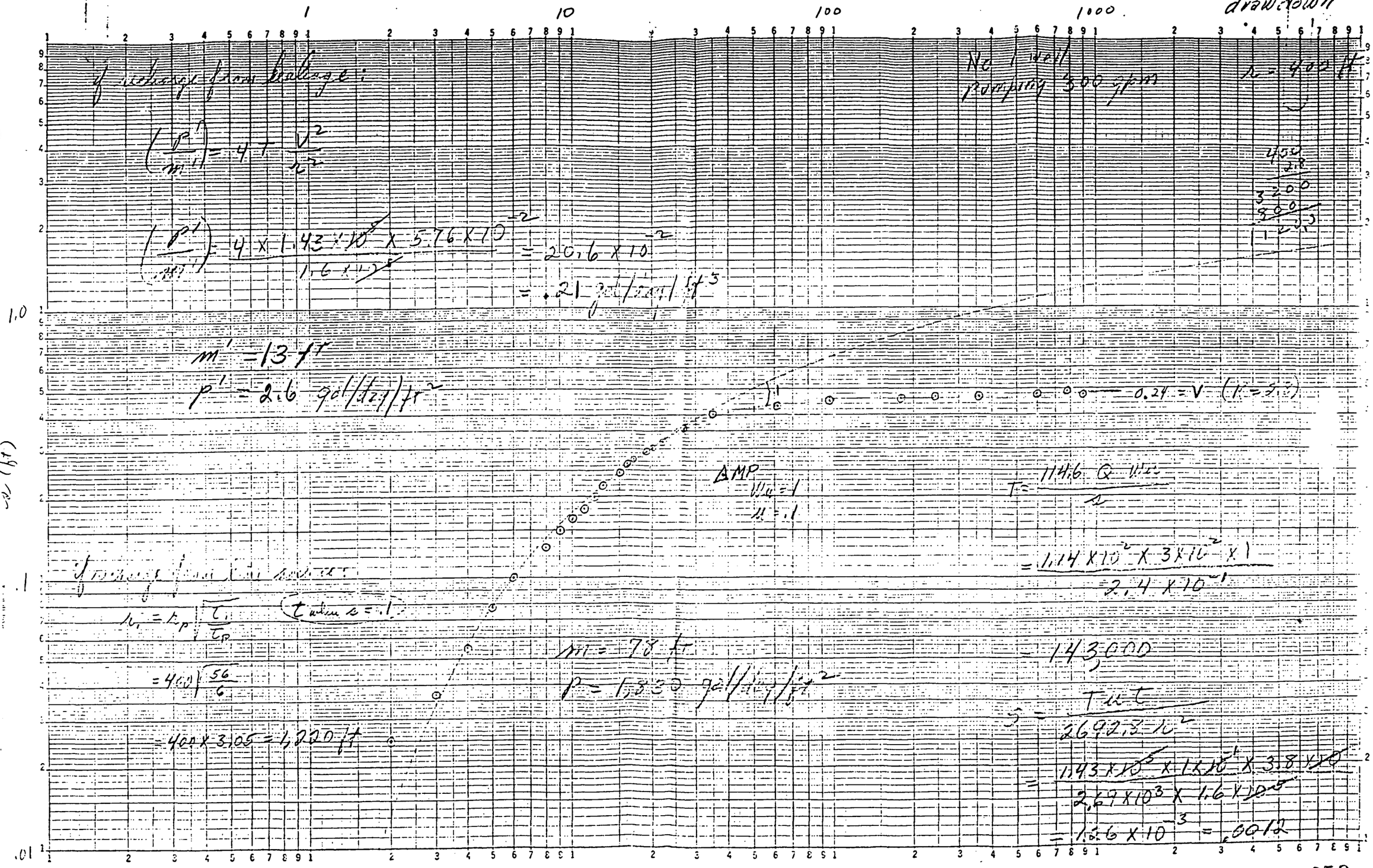
3637

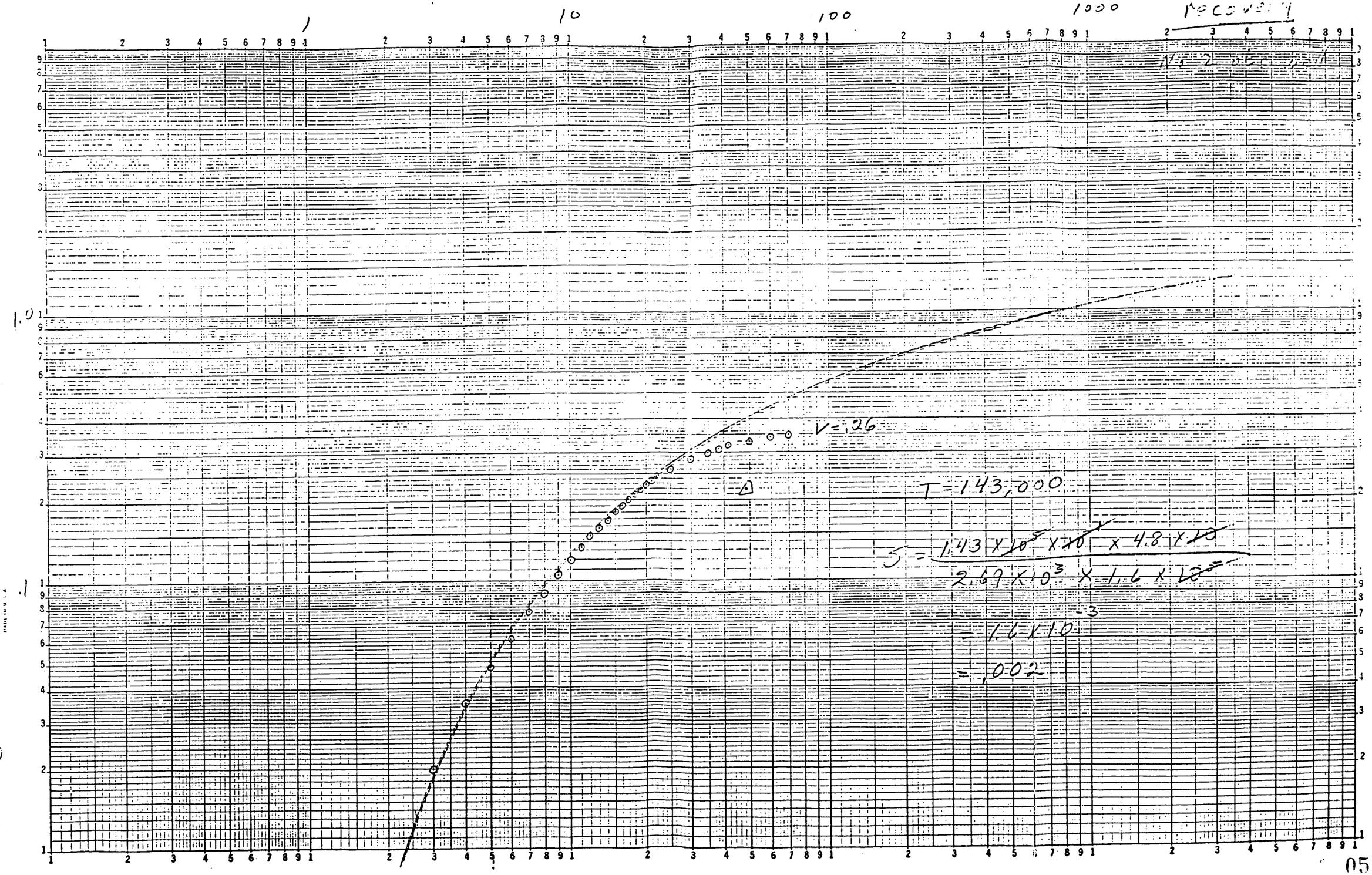
Date	Time	T. min	Depth to water	s								
	1500	235	60.[illegible]	.41		.44						
	1600	265	60.55	.40								
	1900	295	60.55	.40								
	1900	325	60.55	.40		.44						
	2000	355	60.55	.40								
	2030	385	60.55	.40								
	2100	415	60.56	.41		.43						
	2119	434	60.57	.42								
	2140	455	60.58	.42								
	2215	490	60.59	.44								
	2300	535	60.59	.44								
	2400	595	60.59	.44		.45						
8-5-72	0000	625	60.59	.44								
	0100	655	60.60	.45								
	0145	700	60.60	.45								
	0230	745	60.60	.45								
	0315	790	60.60	.45								
	0400	835	60.60	.45		—						
	0500	895	60.60	.45		.45						
	0600	955	60.60	.45		.44						
	0645	1000	60.61	.46		.44						
	0730	1045	60.62	.47								
	0755	1070	60.63	.48		.45						
	0815	1090	60.65	.50								
	0900	1135	60.65	.50		.46						

051

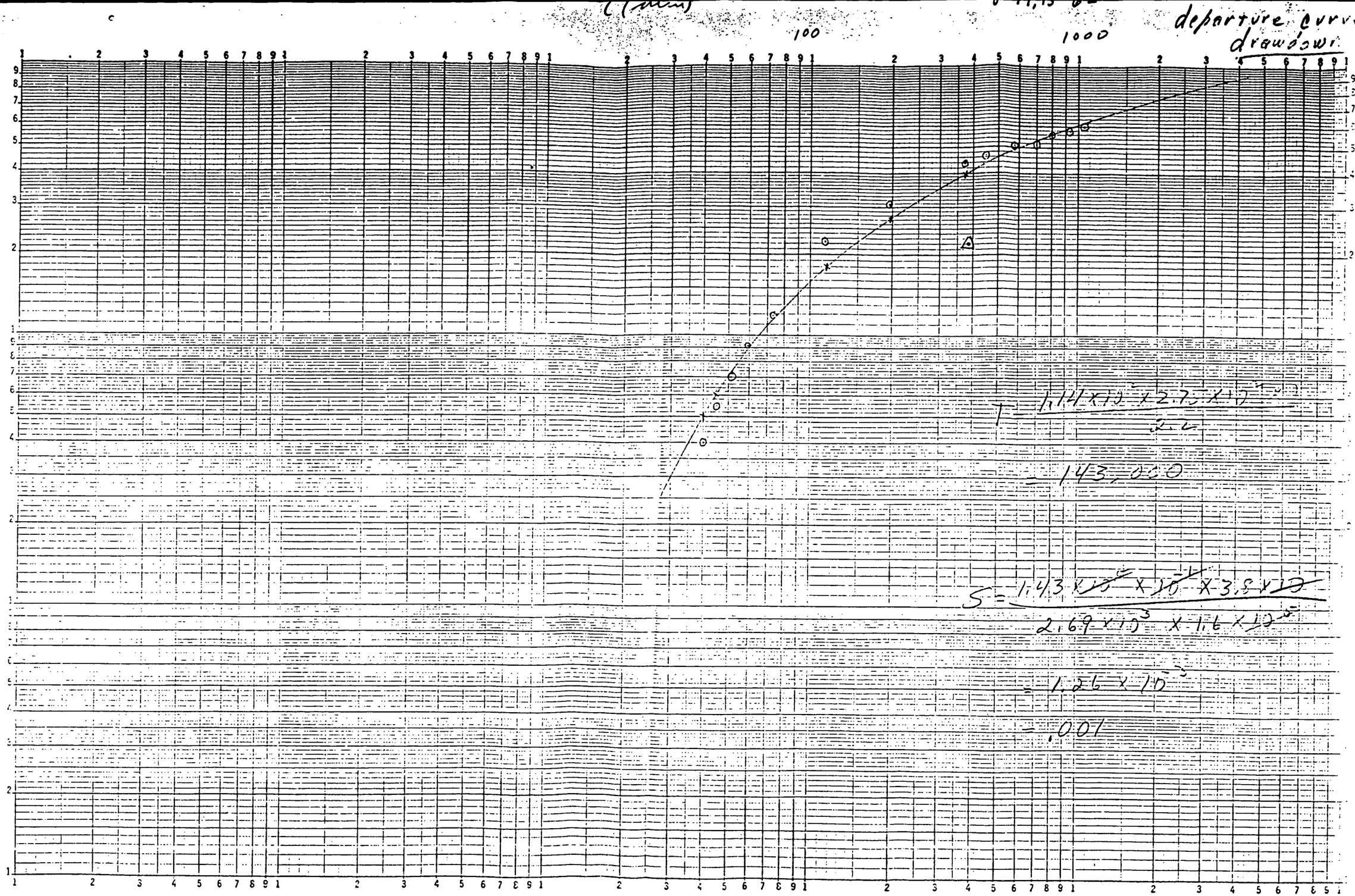
U. S. GOVERNMENT PRINTING OFFICE 10—45771-1

8-7,8-62 No 2 obs well drawdown





8-16-62
Recovery
No. 2 obs. well
1
10
100
1000
1.0
.1
V = .26
T = 143,000
$S = \frac{1.43 \times 10^5 \times 10^1 \times 4.8 \times 10}{2.69 \times 10^3 \times 1.6 \times 10^5}$
$= 1.6 \times 10^{-3}$
$= .002$



$$T = \frac{1.14 \times 10^{2} \times 2.75 \times 10^{3}}{2.2}$$

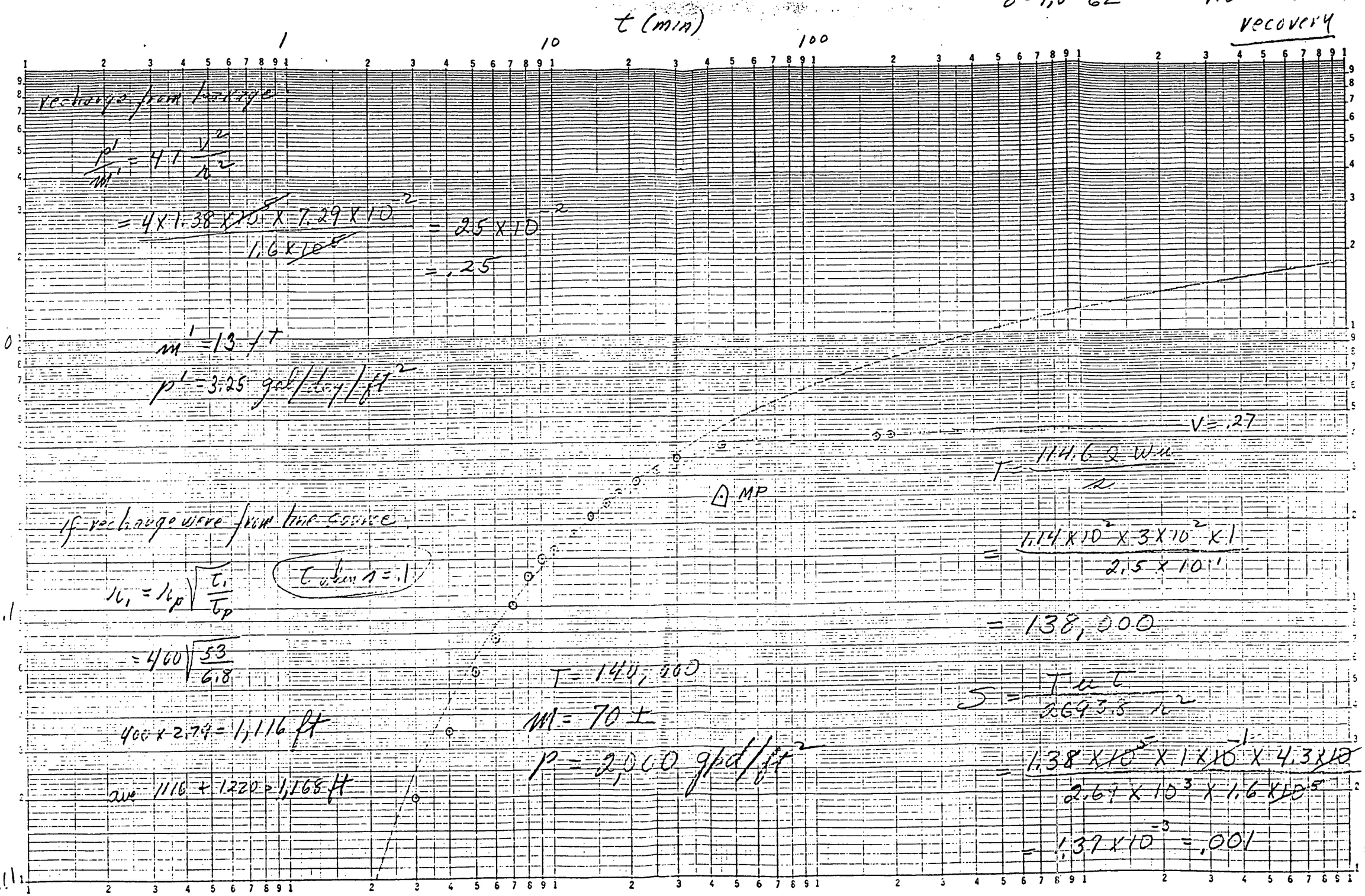
$$= 143{,}000$$

$$S = \frac{1.43 \times 10^{5} \times 10^{-1} \times 3.8 \times 10}{2.69 \times 10^{3} \times 1.6 \times 10^{5}}$$

$$= 1.26 \times 10^{-3}$$

$$= .001$$

8-1,8-62 No 2 ... vecovery



recharge from leakage

$$\frac{p'}{m'} = 4\pi \frac{V^2}{r^2}$$

$$= \frac{4 \times 1.38 \times 10^{5} \times 7.29 \times 10^{-2}}{1.6 \times 10^{5}} = 25 \times 10^{-2}$$

$$= .25$$

$m' = 13$ ft

$p' = 3.25$ gal/day/ft^2

$$T = \frac{114.6\, Q\, W_u}{s}$$

$$= \frac{1.14 \times 10^{2} \times 3 \times 10^{2} \times 1}{2.5 \times 10^{1}}$$

$$= 138{,}000$$

$$S = \frac{T u t}{2693.8\, r^2}$$

$$= \frac{1.38 \times 10^{5} \times 1 \times 10^{-1} \times 4.3 \times 10}{2.69 \times 10^{3} \times 1.6 \times 10^{5}}$$

$$= 1.37 \times 10^{-3} = .001$$

if recharge were from line source

$$r_1 = r_p \sqrt{\frac{\tau_1}{\tau_p}}$$

τ when $s = .1$

$$= 400 \sqrt{\frac{53}{6.8}}$$

$400 \times 2.79 = 1{,}116$ ft

ave $1116 + 1220 = 1{,}168$ ft

$T = 140{,}000$

$m = 70 \pm$

$p = 2{,}000$ gpd/ft^2

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1008
WELL NUMBER: 1008

FIELD ENG./GEO.: M. GOLDBERG DATE: 03/30/88
CHECKED BY : Not Noted DATE: N/A
N,E COORDINATES: 480660.43, 1378925.8
DATE OF INSTAL.: 03/30/88

BOREHOLE DRILLING

DRILLING METHOD: Cable Tool
DRILLING FLUID(S) USED: (in Feet)
FLUID: WATER FROM: 3 TO: 31
FLUID: N/A FROM: N/ATO: N/A
NOTES/COMMENTS:

TYPE OF BIT: Flat Head Hammer
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING
CASING DIAM.:
CASING SIZE(S) USED: (in Feet)
SIZE: 10 FROM: 0 TO: 31
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Screen
AVG. SIZE OF PERFORATIONS: .010 (In.)
TOTAL PERFORATED AREA: 10 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: Stainless Steel
RISER PIPE DIAMETERS:
O.D.: 4 3/8 In. I.D.: 4 In.
LENGTH OF 1ST PIPE SECTION: 10 Ft.
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: THREAD AND COUPLE

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5 Ft.
PROTECTIVE PIPE O.D.: 10 In.
• LOCKABLE CAP

OTHER PROTECTION (* NOTED BELOW)

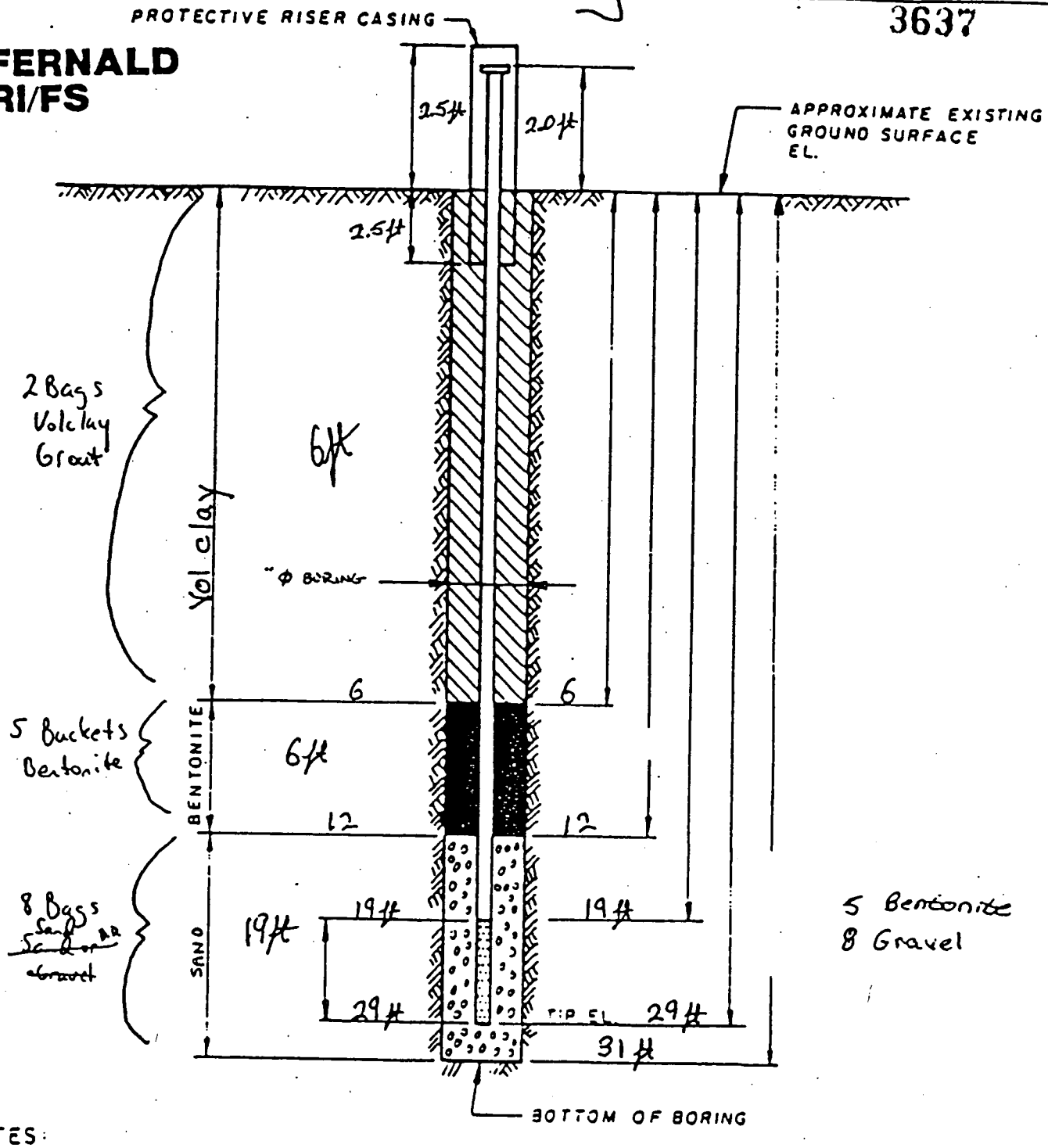
ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	2.0 Ft.		579.05	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	2.5 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
Grout/Slurry	0	6	N/A	N/A
Bentonite Pellets	6	12	N/A	N/A
Gravel	12	31	N/A	N/A
PERFORATED SECTION	19	29	N/A	N/A
WELL TIP	31		N/A	
BOTTOM OF BOREHOLE	31		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

Monitoring Well #108

3637

FERNALD RI/FS



DRAWING NUMBER

CHECKED BY

APPROVED BY

DRAWN BY

NOTES:

1. RISER PIPE IS IN 10 SCHEDULE PIPE, THREADED, FLUSH-JOINTED.
2. SCREEN IS IN 1.0 PIPE CONTINUOUS SLOT SCREEN (0.0 0 IN SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL
5. WATER LEVEL READING ON

INSTALLATION DETAILS
MONITORING WELL

PREPARED FOR
FMPC RI/FS

057

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 008	COORDINATES: NORTH 481,600 EAST 1,381,850	DATE: 03/11/88
GROUND ELEVATION:	GWL: Depth N/A Date/Time N/A	DATE STARTED: 03/11/88
ENGINEER/GEOLOGIST: B. DAVIES, B. MON	Depth N/A Date/Time N/A	DATE COMPLETED:
DRILLING METHODS:		PAGE 1 OF 1

DEPTH	SAMPLE	DATE	TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
1.0	20021	03/11/88	1105		12	VERY STIFF, BROWN (10YR 3/2) CLAY WITH TRACE SAND AND FINE GRAVEL, MOIST.	CL	3.5	Hnu= 0 ppm α = 5 cpm βΓ = 240 cpm
2.0	20022	03/11/88	1110			VERY STIFF, BROWN (10 YR 3/2) CLAY WITH TRACE SAND AND FINE GRAVEL, MOIST. HARD, BROWNISH GRAY (10 YR 5/3) CLAY WITH SOME FINE GRAVEL AND TRACE SAND, MOIST.	CL CL	3.5 >4.5	Hnu= 0 ppm α = 5 cpm βΓ = 280 cpm
3.0	20023	03/11/88	1110		15	HARD, BROWNISH GRAY (10YR 5/3) CLAY WITH SOME FINE GRAVEL AND TRACE SAND, MOIST.	CL	>4.5	Hnu= 0 ppm α = 5 cpm βΓ = 280 cpm

BOTTOM OF BORING

NOTES:
PENNSYLVANIA DRILLING COMPANY, DRILL RIG: RANGER W/PICK-UP, DRILLER: PETE MARTIN, HELPER: MARK REBOLD, DROVE 2 - 2 IN. X 18 IN. SPLIT SPOON SAMPLERS CONSECUTIVELY. SOIL COLORS FOLLOW MUNSELL COLOR CHARTS.

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 2008	COORDINATES: NORTH 480,661.42 EAST 1,378,918.03	DATE: 03/20/88
GROUND ELEVATION: 577.4	GWL: Depth N/A Date/Time N/A	DATE STARTED: 03/20/88
ENGINEER/GEOLOGIST: M. GOLDBERG	Depth N/A Date/Time N/A	DATE COMPLETED: 03/28/88
DRILLING METHODS: CABLE-TOOL		PAGE 1 OF 4

DEPTH	SAMPLE / DATE / TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
1.5	08241 03/20/88 1516	2 2 4	12	STIFF YELLOWISH BROWN SILTY CLAY (10YR, 5/6), DRY.	CL	1.5	Hnu= 3 ppm α = 0 cpm Bγ = 260 cpm
3.0	08242 03/20/88 1520	6 7 11	9	VERY STIFF DARK YELLOWISH BROWN SILTY CLAY (10YR, 4/6), DRY.	CL		Hnu= 2 ppm α = 0 cpm Bγ = 270 cpm
4.5	08243 03/20/88 1524	5 8 9	6	MEDIUM STIFF YELLOWISH BROWN CLAYEY SILT (10YR, 5/4), DRY.	ML	0.5	Hnu= 2 ppm α = 0 cpm Bγ = 250 cpm
6.0	08244 03/20/88 1540	3 4 4	11	STIFF DARK YELLOWISH BROWN SANDY CLAY (10YR, 5/4), MOIST.	CL	1.25	Hnu= 1 ppm α = 0 cpm Bγ = 240 cpm
7.5	08805 03/20/88 1645		18	SHELBY TUBE.			
9.0	08806 03/21/88 1430	4 8 8	10	LOOSE YELLOWISH BROWN SAND (10YR, 5/8), WET, TRACE SILT.	SP	<1	Hnu= 0 ppm α = 0 cpm Bγ = 200 cpm
10.5	08807 03/21/88 1435	6 9 10	14	LOOSE YELLOWISH BROWN SAND (10YR, 5/8), WET, TRACE SILT.	SP	<1	Hnu= 0 ppm α = 0 cpm Bγ = 200 cpm
12.0	08808 03/21/88 1440	7 9 10	14	STIFF DARK GRAY CLAY (5Y, 4/1) WITH SAND AND SILT.	CL	1.5	Hnu= 0 ppm α = 0 cpm Bγ = 200 cpm
13.5	08809 03/21/88 1445	10 10 9	14	STIFF DARK GRAY SILT (5Y, 4/1) WITH SAND, TRACE CLAY, WET.	ML	1.5	Hnu= 0 ppm α = 0 cpm Bγ = 200 cpm
15.0	08810 03/21/88 1500	2 3 4	16	MEDIUM STIFF DARK GRAY CLAY (5Y, 4/1), TRACE SILT, MOIST.	CL	<1	Hnu= 0 ppm α = 0 cpm Bγ = 200 cpm

NOTES:
PENNSYLVANIA DRILLING CO., DRILLER: TIM HARRIS, HELPER: CRAIG COULTER. BACKGROUND MEASUREMENTS. WATER USED = 600 GALLONS. COLORS VIA MUNCELL COLOR CHART.

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 2008	COORDINATES: NORTH 480,661.42 EAST 1,378,918.03	DATE: 03/20/88
GROUND ELEVATION:	GWL: Depth N/A Date/Time N/A	DATE STARTED: 03/20/88
ENGINEER/GEOLOGIST: M. GOLDBERG	Depth N/A Date/Time N/A	DATE COMPLETED: 03/28/88
DRILLING METHODS: CABLE-TOOL		PAGE 2 OF 4

DEPTH	SAMPLE	DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.5	08811	03/21/88 1510	5 7 6	18	MEDIUM STIFF DARK GRAY SILTY CLAY (5Y, 4/1), TRACE SAND AND SILT, WET.	ML	1.5	Hnu= 0 ppm α = 0 cpm βΓ = 200 cpm
18.0	08812	03/21/88 1535	6 7 10	18	MEDIUM STIFF DARK GRAY SILTY CLAY (5Y, 4/1), TRACE SAND AND GRAVEL, WET.	ML	1.5	Hnu= 0 ppm α = 0 cpm βΓ = 210 cpm
19.0	08813	03/21/88 1650		12	SHELBY TUBE.			
20.5	08814	03/22/88 0855	13 13 15	12	STIFF DARK GRAY SILTY CLAY (5Y, 4/1), TRACE GRAVEL, MOIST.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 210 cpm
22.0	08815	03/22/88 0900	7 7 9	10	STIFF DARK GRAY CLAY (5Y, 4/1), TRACE GRAVEL, DRY.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 210 cpm
23.5	08816	03/22/88 0925	5 6 9	12	VERY STIFF DARK GRAY CLAY (5Y, 4/1), TRACE GRAVEL, MOIST.	CL	2.5	Hnu= 0 ppm α = 0 cpm βΓ = 210 cpm
25.0	08817	03/22/88 0940	4 6 10	12	VERY STIFF DARK GRAY CLAY (5Y, 4/1), TRACE GRAVEL, MOIST.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 180 cpm
26.5	08818	03/22/88 0950	4 5 7	8	VERY STIFF DARK GRAY CLAY (5Y, 4/1), TRACE GRAVEL, DRY.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 180 cpm
28.0	08819	03/22/88 1030	2 4 3	12	STIFF DARK GRAY CLAY (5Y, 4/1), TRACE GRAVEL, DRY.	CL	1.0	Hnu= 0 ppm α = 0 cpm βΓ = 180 cpm
29.5	08820	03/22/88 1335	5 7 50	14	STIFF DARK GRAY CLAY (5Y, 4/1), TRACE GRAVEL, DRY.	CL	1.0	Hnu= 0 ppm α = 0 cpm βΓ = 190 cpm
31.0	08821	03/22/88 1400	50 50	18	VERY HARD OLIVE GRAY CLAY (5Y, 4/2), TRACE GRAVEL, DRY.	CL	>4.0	Hnu= 0 ppm α = 0 cpm βΓ = 190 cpm
32.5	08822	03/22/88 1415	14 34 50	18	VERY HARD DARK GRAY CLAY (5Y, 4/1), TRACE GRAVEL, DRY.	CL	>4.0	Hnu= 0 ppm α = 0 cpm βΓ = 190 cpm
34.0	08823	03/22/88 1445	14 24 35	18	VERY HARD DARK GRAY CLAY (5Y, 4/1), TRACE GRAVEL. DENSE YELLOWISH BROWN SAND (10YR, 5/6), DRY.	CL SW	>4.0 <1	Hnu= 0 ppm α = 0 cpm βΓ = 180 cpm

39.0							
40.5	08824 03/22/88 1545	14 47 50	18	VERY DENSE YELLOWISH BROWN SAND (10YR, 5/6), DRY.	SW	<1	Hnu= 0 ppm α = 0 cpm βΓ = 190 cpm
45.0							

NOTES:
PENNSYLVANIA DRILLLING CO., DRILLER: TIM HARRIS, HELPER: CRAIG COULTER. BACKGROUND MEASUREMENTS. WATER USED = 600 GALLONS. COLORS VIA MUNCELL COLOR CHART.

DRAFT

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 2008	COORDINATES: NORTH 480,661.42 EAST 1,378,918.03	DATE: 03/20/88
GROUND ELEVATION:	GWL: Depth N/A Date/Time N/A	DATE STARTED: 03/20/88
ENGINEER/GEOLOGIST: M. GOLDBERG	Depth N/A Date/Time N/A	DATE COMPLETED: 03/28/88
DRILLING METHODS: CABLE-TOOL		PAGE 3 OF 4

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
46.5	08825 03/23/88 0835	40 50 50	16	VERY DENSE YELLOWISH BROWN SAND (10YR, 5/6), TRACE GRAVEL, DRY	SW	<1	Hnu= 0 ppm α = 0 cpm βΓ = 190 cpm
50.0							
51.5	08826 03/23/88 0900	15 20 25	18	DENSE YELLOWISH BROWN SAND (10YR, 5/6), DRY.	SP	<1	Hnu= 0 ppm α = 0 cpm βΓ = 120 cpm
55.0							
56.5	08827 03/23/88 0925	7 14 22	18	DENSE DARK GRAY SAND (2.5Y, 4/1), MOIST.	SP	<1	Hnu= 0 ppm α = 0 cpm βΓ = 120 cpm
60.0							

NOTES:
PENNSYLVANIA DRILLING CO., DRILLER: TIM HARRIS, HELPER: CRAIG COULTER. BACKGROUND MEASUREMENTS. WATER USED = 600 GALLONS. COLORS VIA MUNCELL COLOR CHART.

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 2008	COORDINATES: NORTH 480,661.42 EAST 1,378,918.03	DATE: 03/20/88
GROUND ELEVATION:	GWL: Depth N/A Date/Time N/A	DATE STARTED: 03/20/88
ENGINEER/GEOLOGIST: M. GOLDBERG	Depth N/A Date/Time N/A	DATE COMPLETED: 03/28/88
DRILLING METHODS: CABLE-TOOL		PAGE 4 OF 4

DEPTH	SAMPLE	DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
61.5	08828	03/23/88 1030	5 7 11	14	MEDIUM DENSE YELLOWISH BROWN SAND (10YR, 5/6), WET.	SW	<1	Hnu= 0 ppm α = 0 cpm Bγ = 120 cpm
65.0								
66.5	08829	03/23/88 1310	12 10 16	18	MEDIUM DENSE YELLOWISH BROWN SAND (10YR, 5/6), WET, TRACE GRAVEL.	SW	<1	Hnu= 0 ppm α = 0 cpm Bγ = 120 cpm
70.0								
71.5	08830	03/23/88 1455	11 12 21	18	MEDIUM DENSE YELLOWISH BROWN SAND (10YR, 5/6), WITH GRAVEL, WET.	SW	<1	Hnu= 0 ppm α = 0 cpm Bγ = 110 cpm

BOTTOM OF BORING 72.8

NOTES:
PENNSYLVANIA DRILLING CO., DRILLER: TIM HARRIS, HELPER: CRAIG COULTER. BACKGROUND MEASUREMENTS. WATER USED = 600 GALLONS. COLORS VIA MUNCELL COLOR CHART.

FERNALD RI/FS

FIELD PERMEABILITY TESTS

FALLING HEAD *

PROJECT FMPC RI/FS
PROJECT NO. 602.03.02.01
BORING NO. 108

TESTED BY TS / BM DATE 5/3/88
CALCULATED BY FXM DATE 11/2/88
CHECKED BY AJS DATE 12/28/88
Copied By: FXM 10/31/88
Chk By: AJS 12/28/88

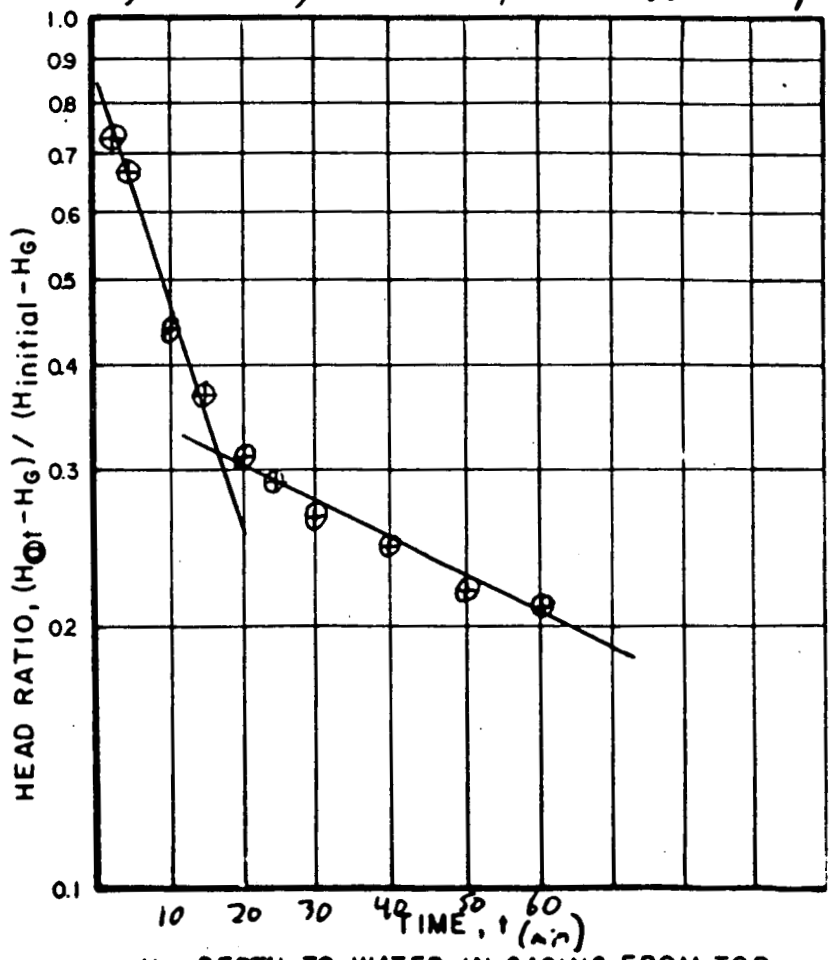
RADIUS OF TEST BORING, R 0.5 ft
PERMEABILITY, K 1.3×10^{-4} cm/s
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C ≈2.0 ft
DEPTH TO BOTTOM OF TEST POCKET, L_1 29.0 ft
DEPTH TO TOP OF TEST POCKET, L_2 19.0 ft
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 8.14 ft

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

Began Test 1503
5 gallon slug used

Readings:
HNU = 0 ppm
B/G = 280-320 cp.

ELAPSED TIME t min ~~SEC.~~	DEPTH TO WATER IN CASING H ft ~~Meters~~
0	0.50
1	2.11
2	2.45
3	2.64
4	2.91
5	3.11
6	3.34
7	3.64
8	4.09
9	4.45
10	4.74
12	5.10
14	5.35
16	5.55
18	5.65
20	5.75
25	5.92
30	6.05
40	6.25
50	6.43
60	6.57



$$K = \frac{R^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

INTERNATIONAL TECHNOLOGY CORPORATION

By EXM Date 11/1/88 Subject Slug Test Calculations Sheet No. 2 of 3
Chkd. By ___ Date ___ Well 108 Proj. No. 607.03.07.01

Well 108

$$\text{Head Ratio} = \frac{H_T - H_G}{H_i - H_G}$$

@ 10 min $\frac{4.74 - 8.14}{0.50 - 8.14} = 0.44$

@ 20 min $\frac{5.75 - 8.14}{0.50 - 8.14} = 0.31$

@ 30 min $\frac{6.05 - 8.14}{0.50 - 8.14} = 0.27$

@ 40 min $\frac{6.25 - 8.14}{0.50 - 8.14} = 0.25$

@ 50 min $\frac{6.43 - 8.14}{0.50 - 8.14} = 0.22$

@ 60 min $\frac{6.57 - 8.14}{0.50 - 8.14} = 0.21$

@ 14 min $\frac{5.35 - 8.14}{0.50 - 8.14} = 0.37$

@ 5 min $\frac{3.11 - 8.14}{0.50 - 8.14} = 0.66$

@ 3 min $\frac{2.64 - 8.14}{0.50 - 8.14} = 0.72$

@ 25 min $\frac{5.92 - 8.14}{0.50 - 8.14} = 0.29$

INTERNATIONAL TECHNOLOGY CORPORATION

By FYM Date 12/1/88 Subject Slug Test Calculations Sheet No. 3 of 3
Chkd. By ___ Date ___ Well 108 Proj. No. 602.03.02.01

Permeability:

$$K = \frac{r^2}{2(L_1-L_2)(t_2-t_1)} \ln\left[\frac{L_1-L_2}{R}\right] \ln\left[\frac{H_1-H_6}{H_2-H_6}\right]$$

Upper Curve: (1st 15 min)

$$= \frac{(0.167)^2}{2(29.0-19.0)(14-3)} \ln\left[\frac{29.0-19.0}{0.5}\right] \ln\left[\frac{2.64-8.14}{5.35-8.14}\right]$$

$K = 2.6 \times 10^{-4}$ ft/min

$K = 1.3 \times 10^{-4}$ cm/s

Lower Curve (Last 45 min)

$$= \frac{(0.167)^2}{2(29.0-19.0)(60-25)} \ln\left[\frac{29.0-19.0}{0.5}\right] \ln\left[\frac{5.92-8.14}{6.57-8.14}\right]$$

$K = 4.1 \times 10^{-5}$ ft/min

$K = 2.1 \times 10^{-5}$ cm/s

early data should be more representative
YK

Used Upper Curve as representative of K in the formation as lower curve is thought to be late-time data and not representative of the clay. The extremely early data (not shown on graph) from 0-2 minutes is a different slope and is a sandpack response.

YK

108-10-85

INTERNATIONAL TECHNOLOGY CORPORATION

602.3.2.3

By L. Willis Date 6-11-88 Subject Head Ratio Calculations Sheet No. ___ of ___
Chkd. By LKP Date 06-19-88 for MW10R Proj. No. 602.3.2.3

$$HR = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G = Depth to ground water below TOC before slug is added
H_i = Initial depth to ground water below TOC after slug is added
$H_{@t}$ = Depth to ground water below TOC at time t

at t = 1 minute
H = 2.11 ft

$$HR = \frac{2.11 - 8.14}{0.50 - 8.14} = 0.789$$

H_G = 8.14 ft
H_i = 0.50 ft

time (minutes)	H (feet)	HR dimensionless
1	2.11	0.789
2	2.45	0.745
3	2.64	0.720
4	2.91	0.685
5	3.11	0.653
6	3.34	0.628
7	3.69	0.582
8	4.09	0.530
9	4.45	0.483
10	4.74	0.445
12	5.10	0.398
14	5.35	0.365
16	5.55	0.339
18	5.65	0.326
20	5.75	0.313
25	5.92	0.291
30	6.05	0.274
40	6.25	0.247
50	6.43	0.224
60	6.67	0.1942

6.67 or 6.57 ?

checked by LKP 06-19-88

108-10-85

INTERNATIONAL TECHNOLOGY CORPORATION

By [illegible] Date 6-11-88 Subject Head Ratio Calculations Sheet No. ___ of ___
Chkd. By [illegible] Date 07-10-88 For MW108 Proj. No. 607.3.2.3

$$HR = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G = Depth to ground water below TOC before slug is added
H_i = Initial depth to ground water below TOC after slug is added
$H_{@t}$ = Depth to ground water below TOC at time t

at t = 1 minute
H = 2.11 ft

$$HR = \frac{2.11 - 8.14}{0.50 - 8.14} = 0.789$$

H_G = 8.14 ft
H_i = 0.50 ft

time (minutes)	H (feet)	HR dimensionless
1	2.11	0.789
2	2.45	0.745
3	2.64	0.720
4	2.91	0.685
5	3.11	0.658
6	3.34	0.628
7	3.69	0.582
8	4.09	0.530
9	4.45	0.483
10	4.74	0.445
12	5.10	0.398
14	5.35	0.365
16	5.55	0.339
18	5.65	0.326
20	5.75	0.313
25	5.92	0.291
30	6.05	0.274
40	6.25	0.247
50	6.43	0.224
60	~~6.57~~	~~0.174~~
	6.57	0.205

108-10-85

INTERNATIONAL TECHNOLOGY CORPORATION

3637

L Wille Date 6-11 88 Subject Head Ratio Calculations Sheet No. ___ of ___

Chkd. By [illegible] Date 07-10-88 for MW 108 Proj. No. 602.3.23

$$HR = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G = Depth to ground water below TOC before slug is added

H_i = Initial depth to ground water below TOC after slug is added

$H_{@t}$ = Depth to ground water below TOC at time t

at t = 1 minute
H = 2.11 ft

$$HR = \frac{2.11 - 8.14}{0.50 - 8.14} = 0.789$$

H_G = 8.14 ft
H_i = 0.50 ft

time (minutes)	H (feet)	HR dimensionless
1	2.11	0.789
2	2.45	0.745
3	2.64	0.720
4	2.91	0.685
5	3.11	0.658
6	3.34	0.628
7	3.69	0.582
8	4.09	0.530
9	4.45	0.483
10	4.74	0.445
12	5.10	0.398
14	5.35	0.365
16	5.55	0.339
18	5.65	0.326
20	5.75	0.313
25	5.92	0.291
30	6.05	0.274
40	6.25	0.247
50	6.43	0.224
60	~~6.67~~ 6.57	~~0.194~~ 0.205

069

108-10-85

LKP 07-10 83

3637

[illegible]: 1.00

Press / for commands

	A	B	C	D	E
1	1.00	2.11	0.7[illegible]		
2	2.00	2.45	0.745		
3	3.00	2.64	0.720		
4	4.00	2.91	0.685		
5	5.00	3.11	0.658		
6	6.00	3.34	0.628		
7	7.00	3.59	0.582		
8	8.00	4.09	0.530		
9	9.00	4.45	0.463		
10	10.00	4.74	0.445		
11	12.00	5.10	0.398		
12	14.00	5.35	0.365		
13	16.00	5.55	0.339		
14	18.00	5.65	0.326		
15	20.00	5.75	0.313		
16	25.00	5.92	0.291		
17	30.00	6.05	0.274		
18	40.00	6.25	0.247		
19	50.00	6.43	0.224		
20	60.00	6.57	0.205		
21					
22					

IN-SITU INC. HERMIT DATA MANAGEMENT PACKAGE

MONITORING WELL 108

SLUG/SWAB TEST

Ref. Value : 8.14 (Ft)
H(0) : 7.54 (Ft)
T(0) : .01 (Min)

ELAPSED TIME (Min)	VALUE (Ft)	HD/DRWDN (Ft)	DELTA TIME (Min)	H/H(0)
1.0000	2.11	6.03	.9900	.800
2.0000	2.45	5.69	1.9900	.755
3.0000	2.64	5.50	2.9900	.729
4.0000	2.91	5.23	3.9900	.694
5.0000	3.11	5.03	4.9900	.667
6.0000	3.34	4.80	5.9900	.637
7.0000	3.69	4.45	6.9900	.590
8.0000	4.09	4.05	7.9900	.537
9.0000	4.45	3.69	8.9900	.489
10.0000	4.74	3.40	9.9900	.451
12.0000	5.10	3.04	11.9900	.403
14.0000	5.35	2.79	13.9900	.370
16.0000	5.55	2.59	15.9900	.344
18.0000	5.65	2.49	17.9900	.330
20.0000	5.75	2.39	19.9900	.317
25.0000	5.92	2.22	24.9900	.294
30.0000	6.05	2.09	29.9900	.277
40.0000	6.25	1.89	39.9900	.251
50.0000	6.43	1.71	49.9900	.227
60.0000	6.57	1.57	59.9900	.208

LKP 07-10-88

3637

VALUE: 1.00

Press / for commands

	A	B	C	D	E
1	1.00	2.11	0.789		
2	2.00	2.45	0.745		
3	3.00	2.64	0.720		
4	4.00	2.91	0.685		
5	5.00	3.11	0.658		
6	6.00	3.34	0.628		
7	7.00	3.69	0.582		
8	8.00	4.09	0.530		
9	9.00	4.45	0.483		
10	10.00	4.74	0.445		
11	12.00	5.10	0.398		
12	14.00	5.35	0.365		
13	16.00	5.55	0.339		
14	18.00	5.65	0.326		
15	20.00	5.75	0.313		
16	25.00	5.92	0.291		
[illegible]	30.00	6.05	0.274		
[illegible]	40.00	6.25	0.247		
19	50.00	6.43	0.224		
20	60.00	6.65	0.192		
21					
22		6.57	0.205		

LKF 07 10 88

3637

VALUE: 0.789

Press / for commands

	A	B	C	D	E
1	1.00	2.11	0.789		
2	2.00	2.45	0.745		
3	3.00	2.64	0.720		
4	4.00	2.91	0.685		
5	5.00	3.11	0.658		
6	6.00	3.34	0.628		
7	7.00	3.69	0.582		
8	8.00	4.09	0.530		
9	9.00	4.45	0.483		
10	10.00	4.74	0.445		
11	12.00	5.10	0.398		
12	14.00	5.35	0.365		
13	16.00	5.55	0.339		
14	18.00	5.65	0.326		
15	20.00	5.75	0.313		
16	25.00	5.92	0.291		
17	30.00	6.05	0.274		
18	40.00	6.25	0.247		
19	50.00	6.43	0.224		
20	60.00	6.57	0.~~167~~ 0.205		
21					
22					

6.57 or 6.67 ?

3637

074

M.W. 108

$H_G = 8.14$

① H_1 3.34 ft, t_1 6 min; H_2 4.74 ft, t_2 10 min

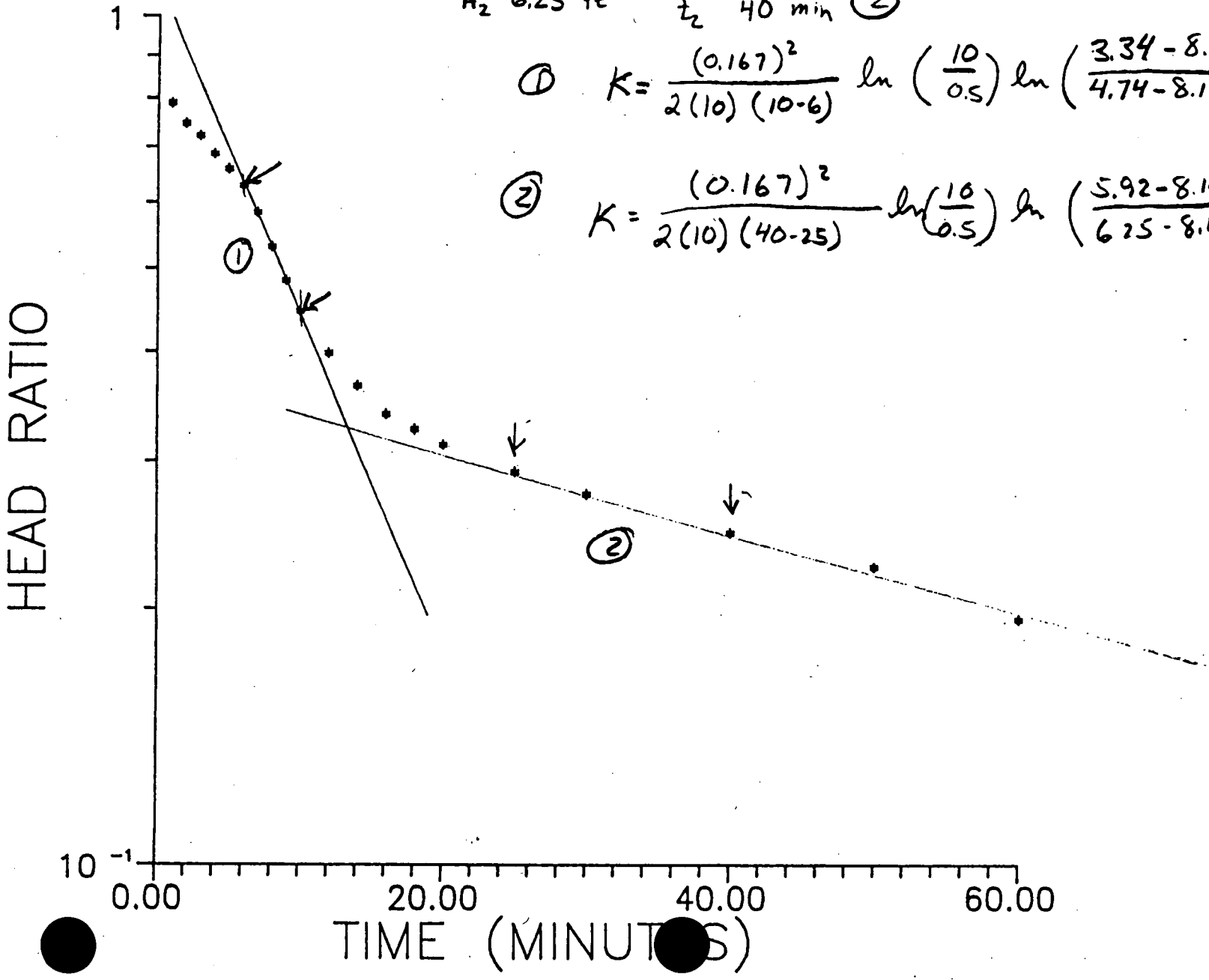
② H_1 5.92 ft, t_1 25 min; H_2 6.25 ft, t_2 40 min

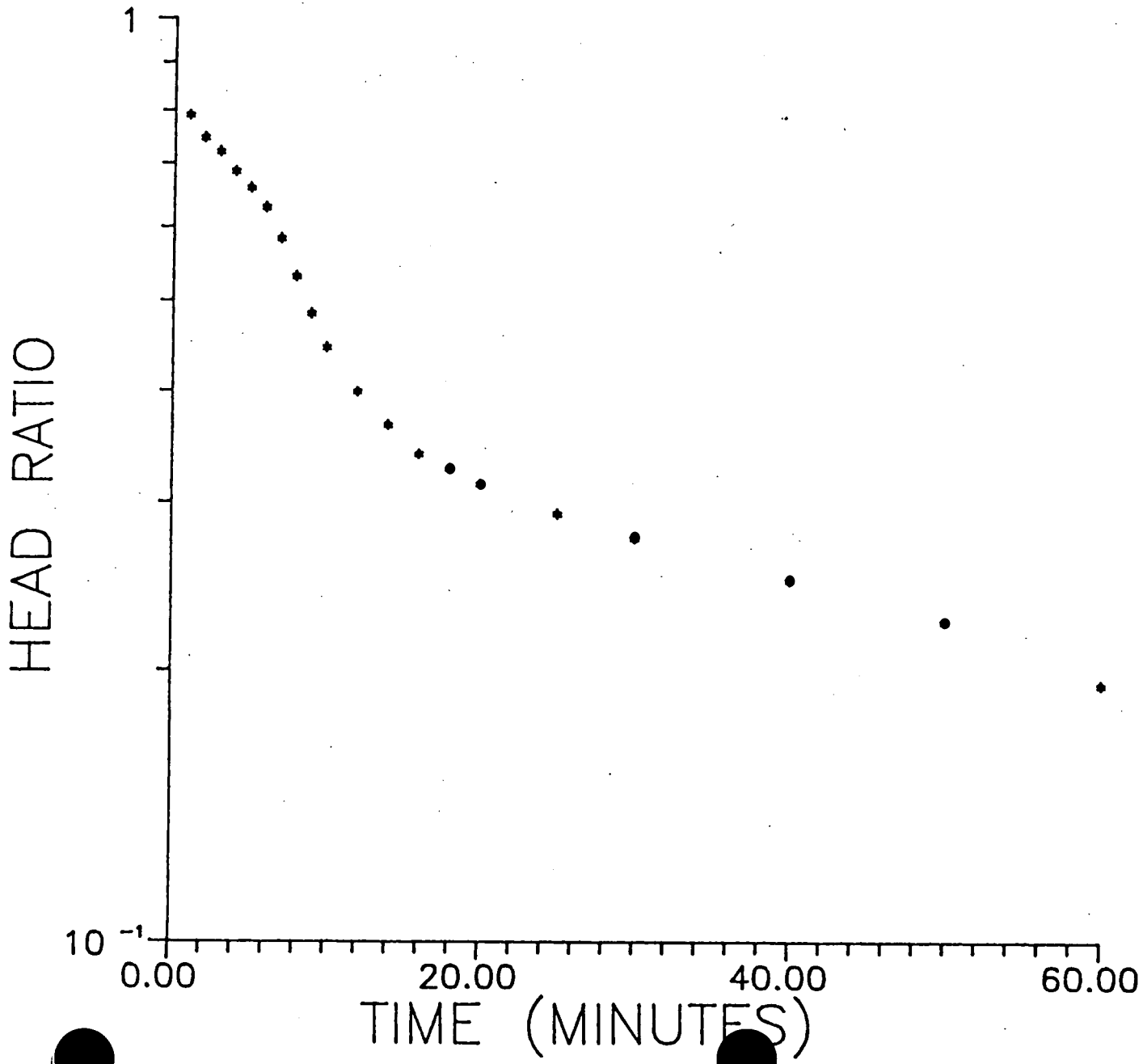
① $K = \frac{(0.167)^2}{2(10)(10-6)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{3.34-8.14}{4.74-8.14}\right) = 3.60 \times 10^{-4}$ ft/min

1.83×10^{-4} cm/sec

② $K = \frac{(0.167)^2}{2(10)(40-25)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{5.92-8.14}{6.25-8.14}\right) = 4.48 \times 10^{-5}$ ft/min

2.28×10^{-5} cm/sec




1
10 -1
HEAD RATIO
0.00
20.00
40.00
60.00
TIME (MINUTES)

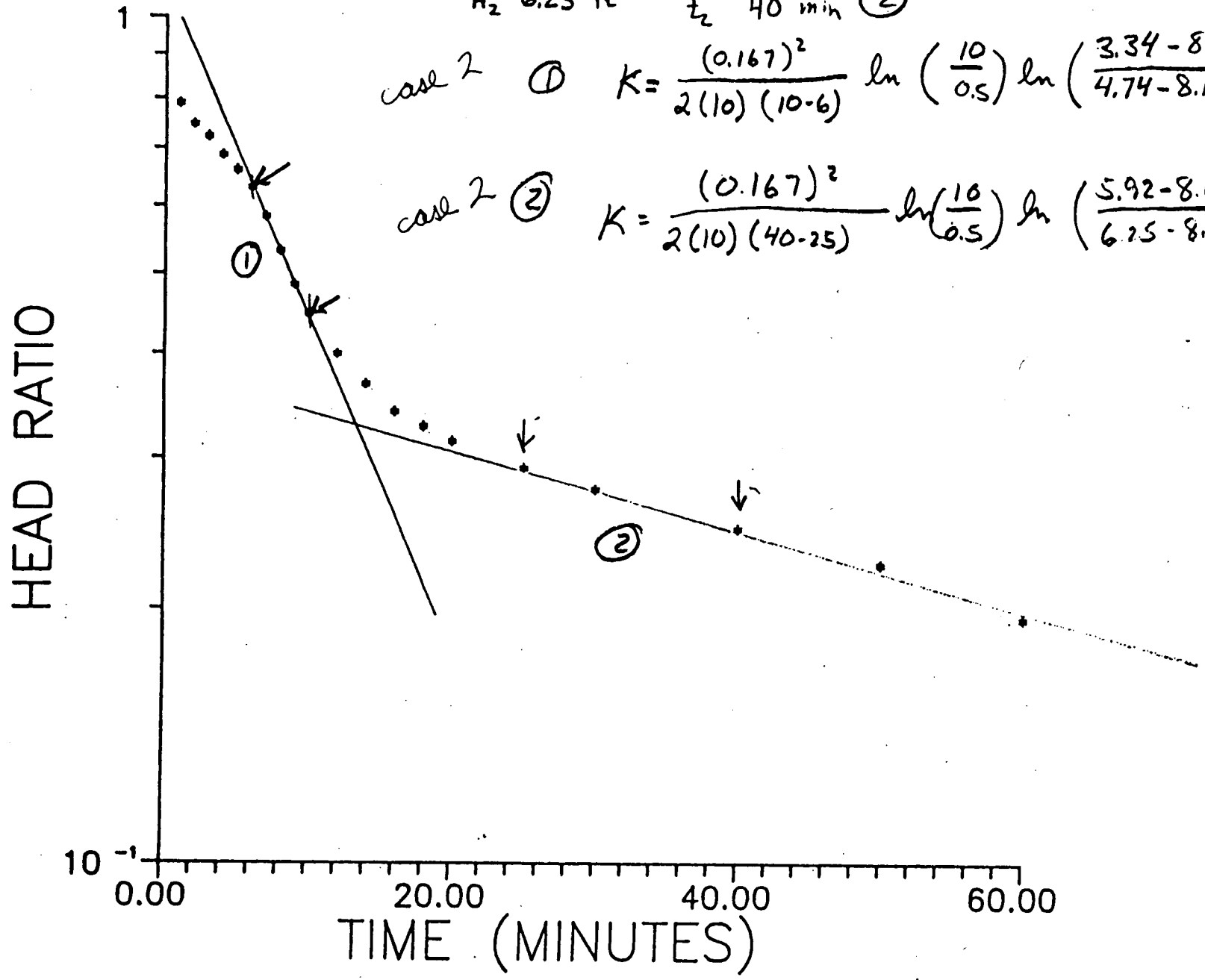
Checked by [illegible]
7-[illegible]-88

M.W. 108 H_2 4.74 ft 10 min ①

$H_G = 8.14$

H_1 5.92 ft t_1 25 min

H_2 6.25 ft t_2 40 min ②



case 2 ① $K = \frac{(0.167)^2}{2(10)(10-6)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{3.34-8.14}{4.74-8.14}\right) = 3.60\times10^{-4}$ ft/min

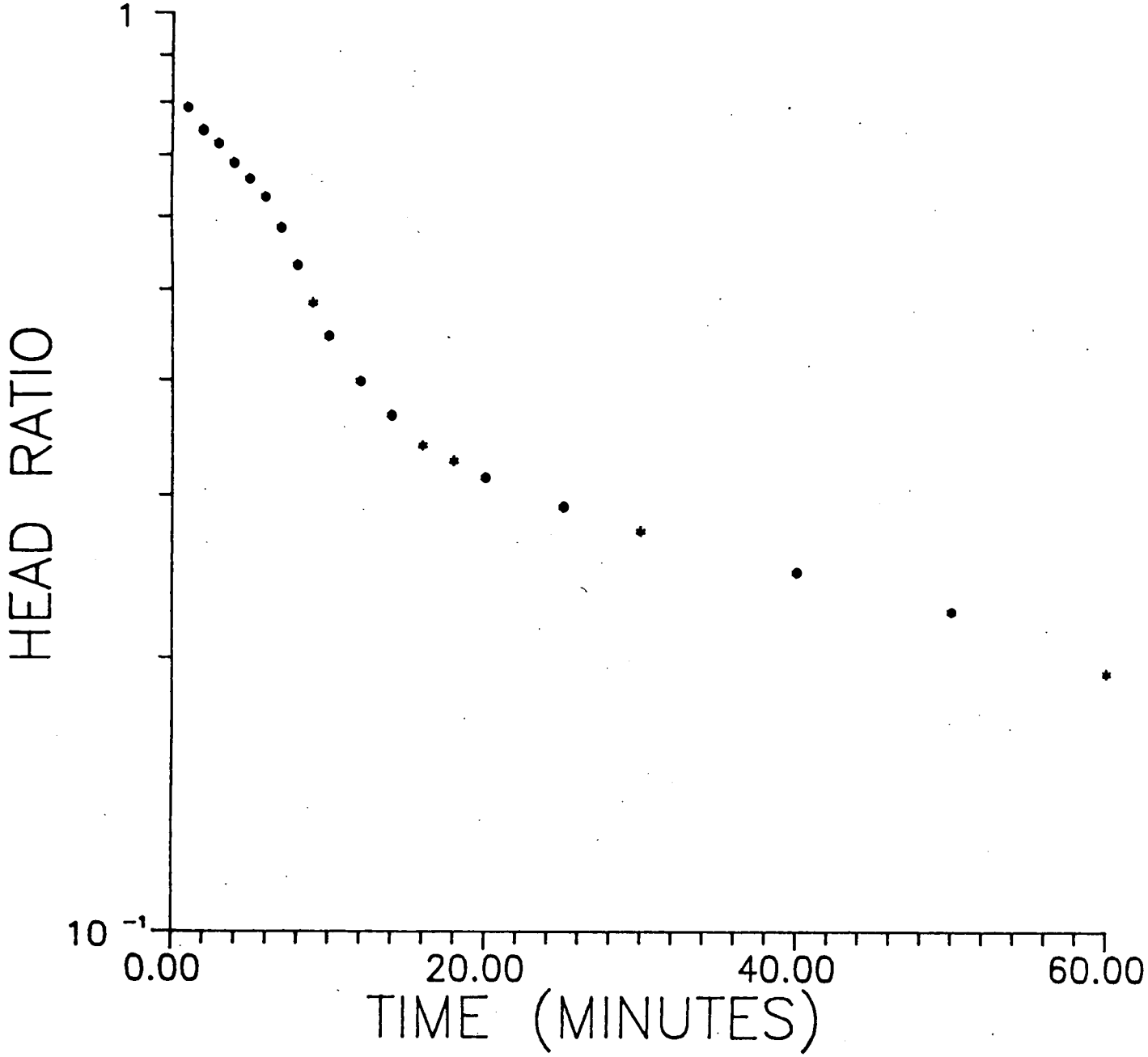
1.83×10^{-4} cm/sec

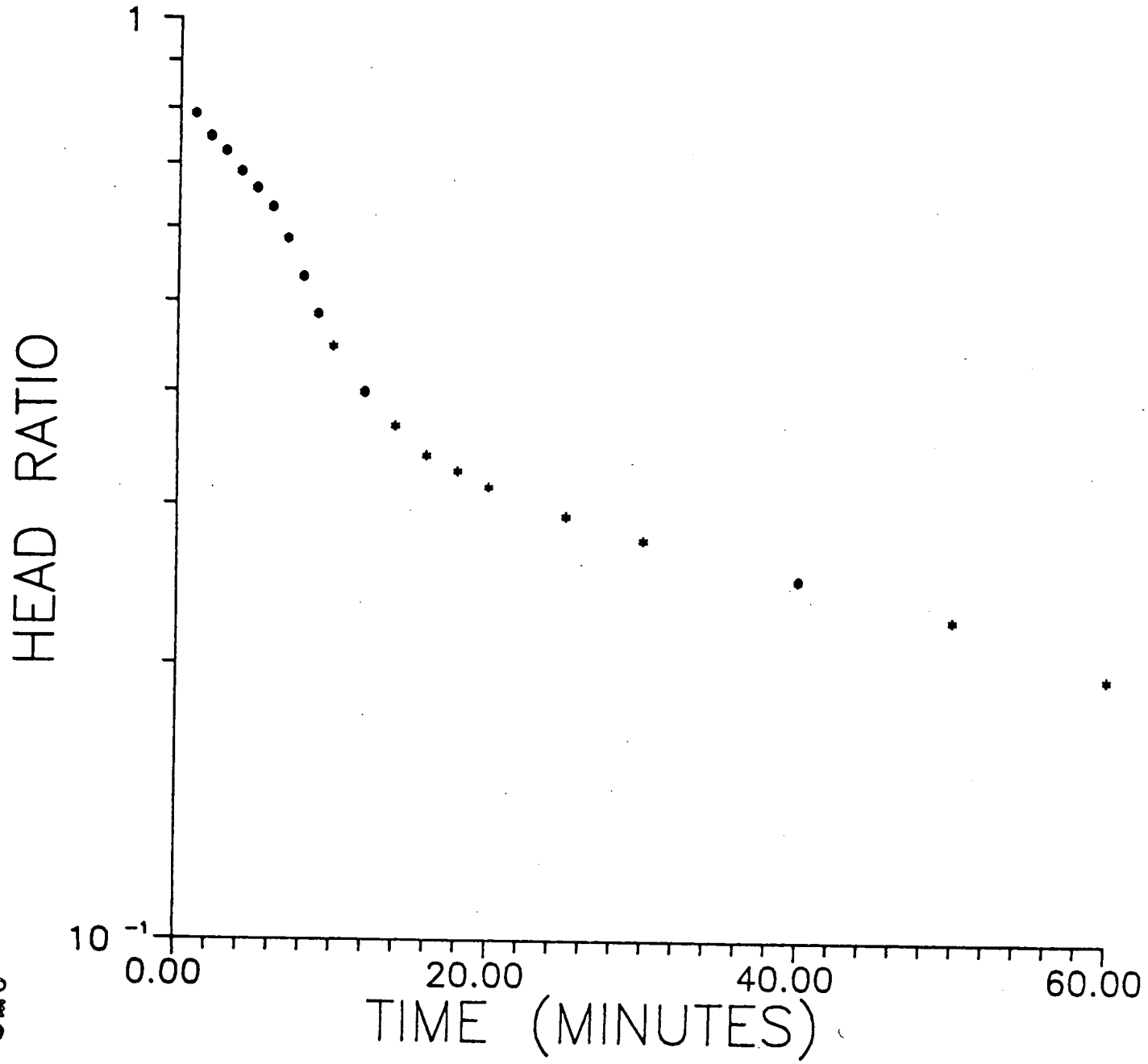
case 2 ② $K = \frac{(0.167)^2}{2(10)(40-25)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{5.92-8.14}{6.25-8.14}\right) = 4.48\times10^{-5}$ ft/min

2.28×10^{-5} cm/sec

076

3637


HEAD RATIO
1
10 -1
0.00
20.00
40.00
60.00
TIME (MINUTES)


1
10 -1
HEAD RATIO
0.00
20.00
40.00
60.00
TIME (MINUTES)

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1012
WELL NUMBER: 1012

FIELD ENG./GEO.:
CHECKED BY : Not Noted
N,E COORDINATES: 483703.23, 1380912.7
DATE OF INSTAL.:

DATE:
DATE: N/A

BOREHOLE DRILLING

DRILLING METHOD: Not Noted
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: N/A
IS CASING TEMPORARY?: N/A
CASING TYPE : Not Noted
CASING DIAM.:
CASING SIZE(S) USED: (Units N/A)
SIZE: FROM: N/A TO: N/A
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: N/A
AVG. SIZE OF PERFORATIONS: (N/A)
TOTAL PERFORATED AREA:
NOTES/COMMENTS:

RISER PIPE MATERIAL: N/A
RISER PIPE DIAMETERS:
O.D.: I.D.:
LENGTH OF 1ST PIPE SECTION:
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: Not Noted

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH:
PROTECTIVE PIPE O.D.:

OTHER PROTECTION (* NONE NOTED)

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	N/A		635.25	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	N/A			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
	N/A	N/A	N/A	N/A
PERFORATED SECTION	N/A	N/A	N/A	N/A
WELL TIP	N/A		N/A	
BOTTOM OF BOREHOLE	N/A		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : N/A
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : N/A

1012

3637

WELL INFORMATION SHEET

Well Number:
WMCO: 12d

Installer/I.D. Number:
D&M: 12d IT: _____ NLO: _____ Weston: (112)

Location:
Well Location: Off North access road
State Plane Coordinates: 1381000 E 493600 N
Approx. Site Coordinates: 1040 S or N 4280 E
Ground Elevation: 637.000

Monitoring:
Aquifer: Interface between glacial till and shale bedrock
Monitoring Program: _____
Parameters Monitored/Frequency: _____

Approx. Water Table Elevation: 610 Depth to Water: 31.37

Drilling:
Drilling Method: Rotary Driller: Layne-Ohio
Date of Installation: _____ Completion Date: 8-84
Borehole Diameter: _____ Casing Diameter: 4"
Borehole Depth: 62' Casing Length: _____
Type Of Logs: geologic

Well Construction:
Backfill Type: [illegible] Type Annular Space Seals: [illegible]
Screen Interval: 593-577 (26') Screenpack Material: gravel
Screen Type: [illegible] PVC Casing Type: PVC
Type of Pump: Submersible Pump Model: _____
Pump Capacity: 15 gpm Date Pump Installed: _____
Casing Elevation: 639.670 Height of Stick-up: 2.670

Hydrologic Tests: _____

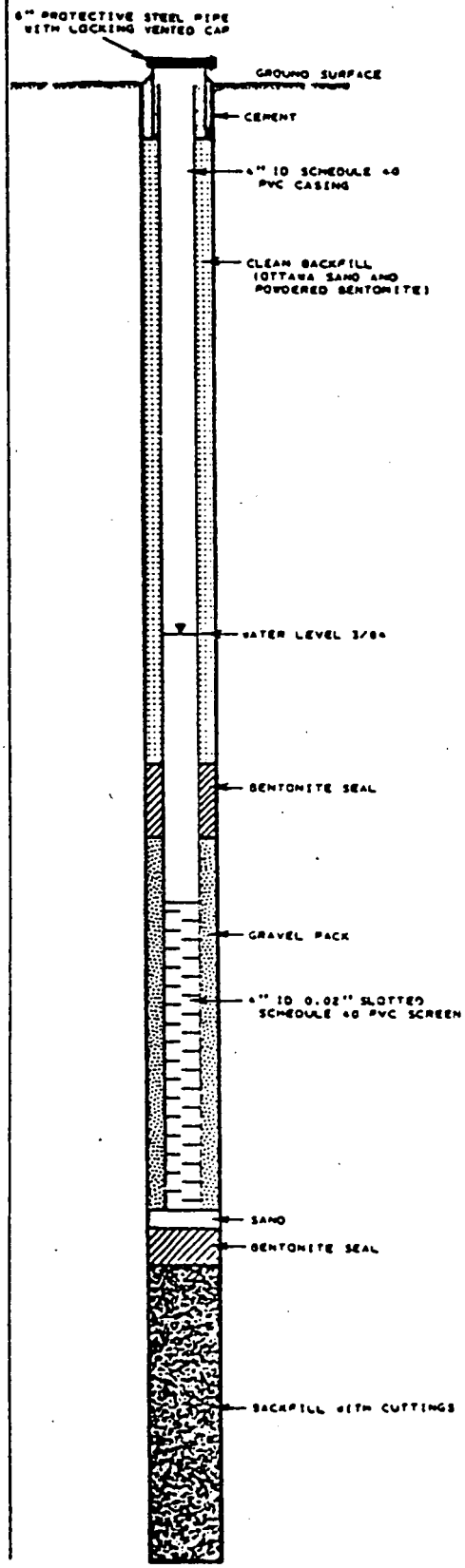
Remarks: Boring terminated @ 30', backfilled [illegible] to ~61' deep

Completed By: _____ **Ext.:** _____ **Date:** _____

080

WELL SCHEMATICS

12D



BORING 12

SURFACE ELEVATION 637.0'

3637

DEPTH IN FEET	ELEVATION IN FEET	GRAPHIC LOG	DESCRIPTIVE GEOLOGIC NOTES
0			GRASS, SILTY SAND WITH UNDERLYING RIP-RAP LIMESTONE COBBLES
	635		PALE OLIVE (10Y6/2) MASSIVE CLAY WITH SOME IRON STAINED FRACTURES
5			
	630		
10			MEDIUM BLUISH-GRAY CLAY (5B5/1) MASSIVE, DENSE, DRY, NO FRACTURES
	625		MEDIUM BLUISH-GRAY CLAY (5B5/1) WITH SOME GRAVEL, IRON OXIDE STAINING
15			
	620		MEDIUM BLUISH-GRAY CLAY (5B5/1) WITH SOME SAND
20			MEDIUM BLUISH-GRAY CLAY (5B5/1) MORE FRIABLE THAN ABOVE
	615		
25			MEDIUM BLUISH-GRAY CLAY (5B5/1), MASSIVE, VARVED, FRIABLE
	610		
30			
	605		
35			
	600		
40			OLIVE GRAY (5Y3/2) CLAY WITH SILT
	595		DARK GREENISH-GRAY (5GY4/1) CLAY WITH THIN GRAVEL LENS (~1/4" THICK) OF IRON STAINED QUARTZ, A FEW SHALE FRAGMENTS 1/2" DIAMETER PRESENT
45			
	590		DRILL BIT CHATTERING, CUTTINGS SHOW LIMESTONE FRAGMENTS, POSSIBLE BOULDERS OR BEDROCK
50			DARK GREENISH-GRAY (5GY4/1) CLAY, VERY DENSE, THINLY BEDDED, DRY, ALMOST A SHALE
	585		
55			
	580		NO SAMPLE, SOFT GREENISH-GRAY SHALE
60			
	575		
65			
	570		
70			
	565		
75			
	560		
80			BORING TERMINATED AT A DEPTH OF 80 FEET

3/6/7 a

DAMES & MOORE

FIGURE A4-2

081

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 012	COORDINATES: NORTH 481,850 EAST 1,381,900	DATE: 03/11/88
GROUND ELEVATION:	GWL: Depth N/A Date/Time N/A	DATE STARTED: 03/11/88
ENGINEER/GEOLOGIST: B. MONTGOMERY	Depth N/A Date/Time N/A	DATE COMPLETED:
DRILLING METHODS:		PAGE 1 OF 1

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
1.0	20033 03/11/88 1600		3	STIFF, BROWN (10YR 4/1) CLAY WITH SOME GRAVEL AND TRACE SAND, MOIST.	CL	1.5	Hnu= 0 ppm α = 5 cpm βΓ = 300 cpm
2.0	20034 03/11/88 1605			STIFF, BROWN (10 YR 4/1) CLAY WITH SOME GRAVEL AND TRACE SAND, MOIST. MEDIUM STIFF, GRAY 910 YR 4/1) CLAY WITH SOME GRAVEL, MOIST.	CL CL	1.5 1.0	Hnu= 0 ppm α = 8 cpm βΓ = 160 cpm
3.0	20035 03/11/88 1605		18	MEDIUM STIFF, GRAY (10YR 4/1) CLAY WITH SOME GRAVEL, MOIST.	CL	1.0	Hnu= 0 ppm α = 8 cpm βΓ = 160 cpm

BOTTOM OF BORING

NOTES:
PENNSYLVANIA DRILLING COMPANY, DRILL RIG: RANGER W/PICK-UP, DRILLER: PETE MARTIN, HELPER: MARK REBOLD, DROVE 2 - 2 IN. X 18 IN. SPLIT SPOON SAMPLERS CONSECUTIVELY. SOIL COLORS FOLLOW MUNSELL COLOR CHARTS.

3637

FERNALD RI/FS

Screened in clay & shale
Bedrock

FIELD PERMEABILITY TESTS
FALLING HEAD *

PROJECT FMPC RI/FS
PROJECT NO. 602.03.02.01
BORING NO. 112

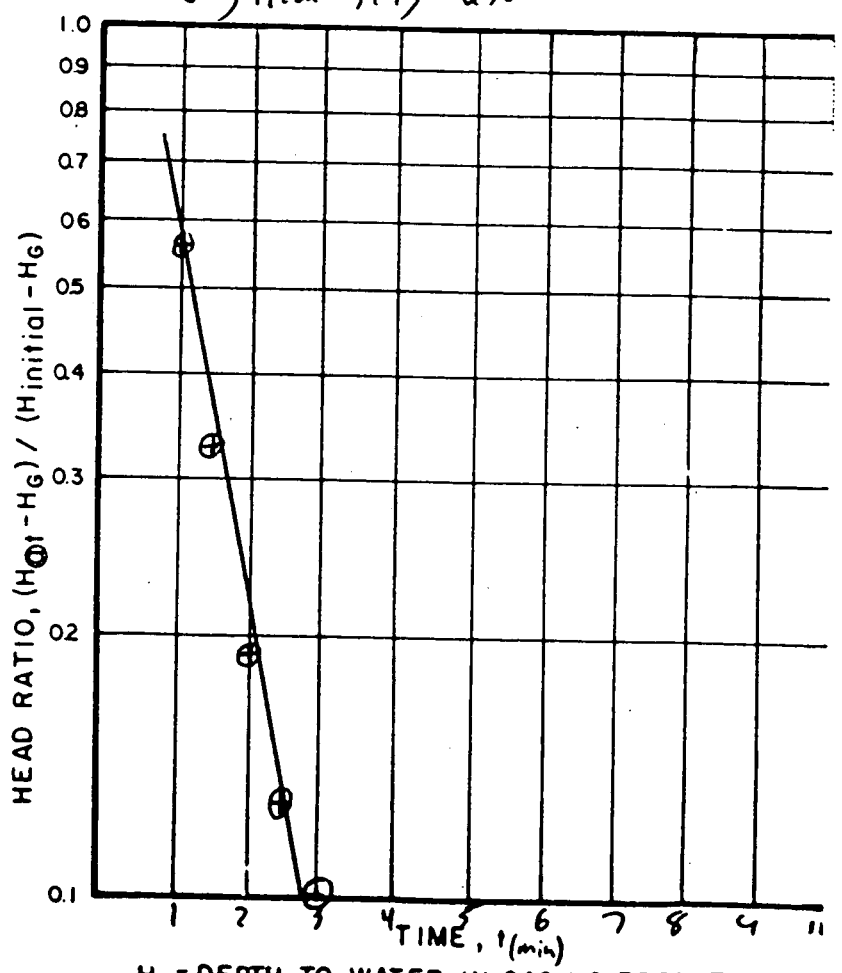
TESTED BY TS/BM DATE 4/27/88
CALCULATED BY FXM DATE 11/2/88
CHECKED BY HA DATE 12/28/88
Copied By: FXM 10/31/88
Chk'd By: HA 12/28/88

RADIUS OF TEST BORING, R 4in (0.33ft)
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C ≈2 ft
DEPTH TO BOTTOM OF TEST POCKET, L_1 63.4 ft
DEPTH TO TOP OF TEST POCKET, L_2 46.7 ft
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 30.75 ft
(Depths are from Top of Protective casing) Start test 1400
8 gallon slug used

PERMEABILITY, K 1.6×10^{-3} cm/s

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t min ~~sec.~~	DEPTH TO WATER IN CASING H ft ~~Meters~~
0.5	25.10
1	27.60
1.5	28.95
2	29.65
2.5	30.00
3	30.20
3.5	30.30
4	30.35
4.5	30.37
5	30.40
5.5	30.42
6	30.44
7	30.45
8	30.48
9	30.50
10	30.50
12	30.53
14	30.54
16	30.55
18	30.57
20	30.57
25	30.58
30	30.60
40	30.61
50	30.62



$$K = \frac{R^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1
H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

INTERNATIONAL TECHNOLOGY CORPORATION

By FXM Date 11/2/88 Subject Slug Test Calculations Well 112 Sheet No. 2 of 3

Chkd. By ___ Date ___ Proj. No. 602.03.02.01

Well 112

$$\text{Head Ratio} = \frac{H_T - H_G}{H_i - H_G}$$

@ 1 min $\frac{27.60 - 30.75}{25.10 - 30.75} = 0.56$

@ 1.5 min $\frac{28.95 - 30.75}{25.10 - 30.75} = 0.32$

@ 2 min $\frac{29.65 - 30.75}{25.10 - 30.75} = 0.19$

@ 2.5 min $\frac{30.00 - 30.75}{25.10 - 30.75} = 0.13$

@ 3 min $\frac{30.20 - 30.75}{25.10 - 30.75} = 0.10$

@ 3.5 min $\frac{30.30 - 30.75}{25.10 - 30.75} = 0.08$

@ 4 min $\frac{30.35 - 30.75}{25.10 - 30.75} = 0.07$

@ 5 min $\frac{30.40 - 30.75}{25.10 - 30.75} = 0.06$

@ 6 min $\frac{30.44 - 30.75}{25.10 - 30.75} = 0.055$

@ 7 min $\frac{30.45 - 30.75}{25.10 - 30.75} = 0.05$

INTERNATIONAL TECHNOLOGY CORPORATION

3637

By FXM Date 11/2/88 Subject Slug Test Calculations Sheet No. 3 of 3

Chkd. By ___ Date ___ Well 112 Proj. No. 602.03.02.01

Permeability:

$$K = \frac{r^2}{2(L_1 - L_2)(T_2 - T_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_6}{H_2 - H_6}\right]$$

$$= \frac{(0.166)^2}{2(63.4 - 46.7)(2.5 - 1)} \ln\left[\frac{63.4 - 46.7}{0.33}\right] \ln\left[\frac{27.60 - 30.75}{30.00 - 30.75}\right]$$

$K = 3.1 \times 10^{-3}$ ft/min

$K = 1.6 \times 10^{-3}$ cm/sec

085

108-10-85

INTERNATIONAL TECHNOLOGY CORPORATION

Wille Date 6-11-88 Subject Head Ratio Calculations Sheet No. ___ of ___
Chkd. By 22 Date 07 10 88 for MW 112 Proj. No. 602.3.2.3

$$HR = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G: Depth to ground water from TOC before slug added
H_i - Initial depth to ground water from TOC after slug added
$H_{@t}$: Depth to ground water from TOC at time t

at t = 0.5 minutes
H = 25.10 ft

$$HR = \frac{25.10 - 30.75}{22.50 - 30.75} = 0.685$$

H_G = 30.75 ft
H_i = 22.50 ft

time (minutes)	H (feet)	HR (dimensionless)
0.5	25.10	0.685
1	27.60	0.382
1.5	28.95	0.218
2	29.65	0.133
2.5	30.00	0.091
3	30.20	0.067
3.5	30.30	0.055
4	30.35	0.048
4.5	30.37	0.046
5	30.40	0.042
5.5	30.42	0.040
6	30.44	0.038
7	30.45	0.036
8	30.48	0.033
9	30.50	0.030
10	30.50	0.030
12	30.53	0.027
14	30.54	0.025
16	30.56	0.023
18	30.57	0.022
20	30.57	0.022
25	30.58	0.021
30	30.60	~~0.019~~ 0.018
40	30.61	0.017

INTERNATIONAL TECHNOLOGY CORPORATION

3637

[illegible] Date 6-11-88 Subject Head Ratio Calculations Sheet No. ____ of ____

[illegible]kd. By [illegible] Date 07-10-88 for MW 112 Proj. No. 602 3 2 3

$$HR = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G = Depth to ground water from TOC befor slug added

H_i - Initial depth to ground water from TOC after slug added

$H_{@t}$ = Depth to ground water from TOC at time t

at t = 0.5 minutes
H = 25.10 ft

$$HR = \frac{25.10 - 30.75}{22.50 - 30.75} = 0.685$$

H_G = 30.75 ft
H_i = 22.50 ft

time (minutes)	H (feet)	HR (dimensionless)
0.5	25.10	0.685
1	27.60	0.382
1.5	28.95	0.218
2	29.65	0.133
2.5	30.00	0.091
3	30.20	0.067
3.5	30.30	0.055
4	30.35	0.048
4.5	30.37	0.046
5	30.40	0.042
5.5	30.42	0.040
6	30.44	0.038
7	30.45	0.036
8	30.48	0.033
9	30.50	0.030
10	30.50	0.030
12	30.53	0.027
14	30.54	0.025
16	30.56	0.023
18	30.57	0.022
20	30.57	0.022
25	30.58	0.021
30	30.60	~~0.019~~ 0.018
40	30.61	0.017

087

108-10-85

INTERNATIONAL TECHNOLOGY CORPORATION

L Wille Date 6-14-88 Subject Head Ratio Calculations Sheet No. ___ of ___
Ckd. By LKP Date 06-19-88 for MW 112 Proj. No. 602.3.2.3

$$HR = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G = Depth to ground water from TOC before slug added
H_i = Initial depth to ground water from TOC after slug added
$H_{@t}$ = Depth to ground water from TOC at time t.

at t = 0.5 minutes
H = 25.10 ft

$$HR = \frac{25.10 - 30.75}{22.50 - 30.75} = 0.685$$

H_G = 30.75 ft
H_i = 22.50 ft

time (minutes)	H (feet)	HR (dimensionless)
0.5	25.10	0.685
1	27.60	0.382
1.5	28.95	0.218
2	29.65	0.133
2.5	30.00	0.091
3	30.20	0.067
3.5	30.30	0.055
4	30.35	0.048
4.5	30.37	0.046
5	30.40	0.042
5.5	30.42	0.040
6	30.44	0.038
7	30.45	0.036
8	30.48	0.033
9	30.50	0.030
10	30.50	0.030
12	30.53	0.027
14	30.54	0.025
16	30.56	0.023
18	30.57	0.022
20	30.57	0.022
25	30.58	0.021
30	30.60	0.017 8
40	30.61	0.017
50	30.62	0.016

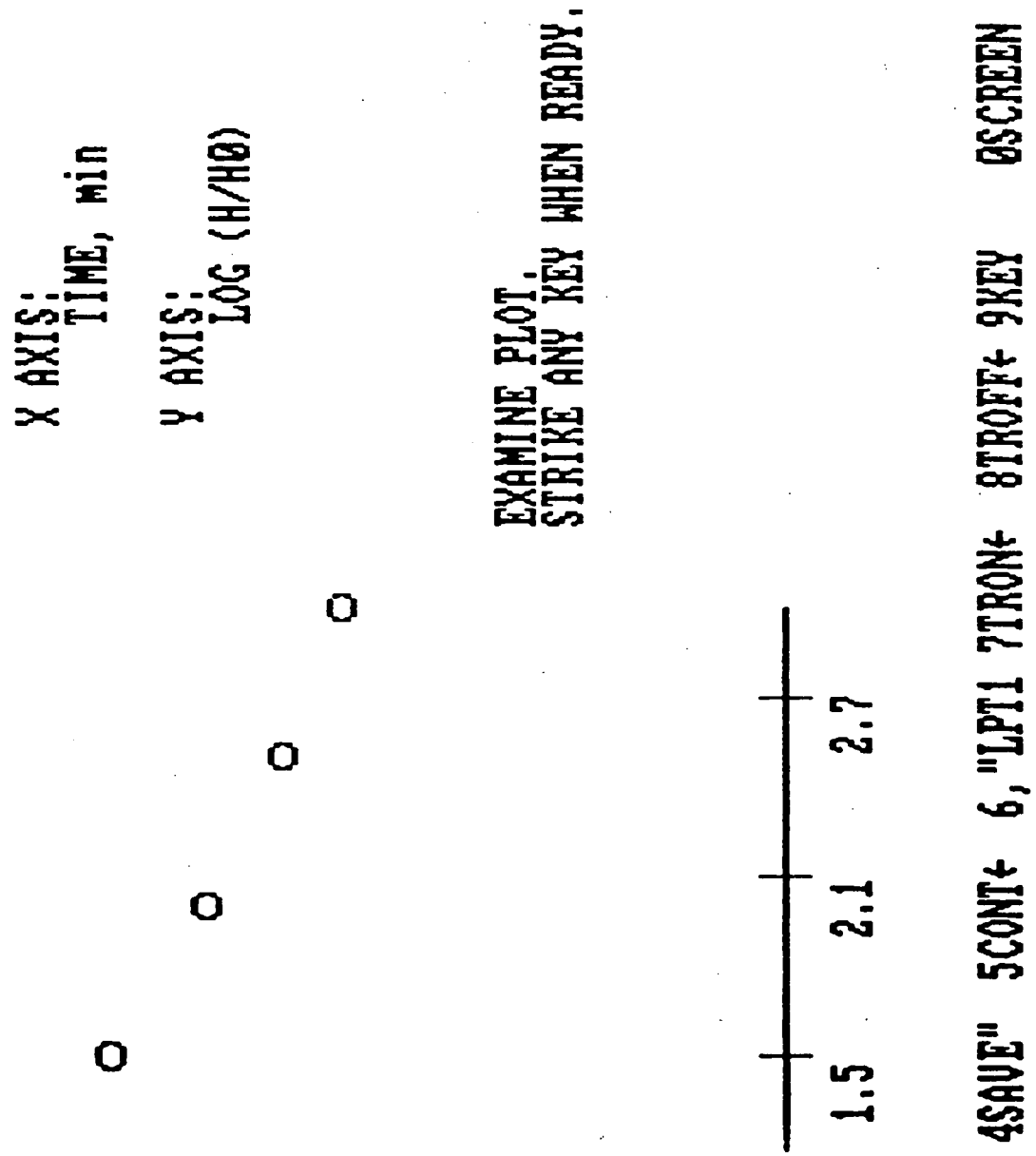
108-10-85

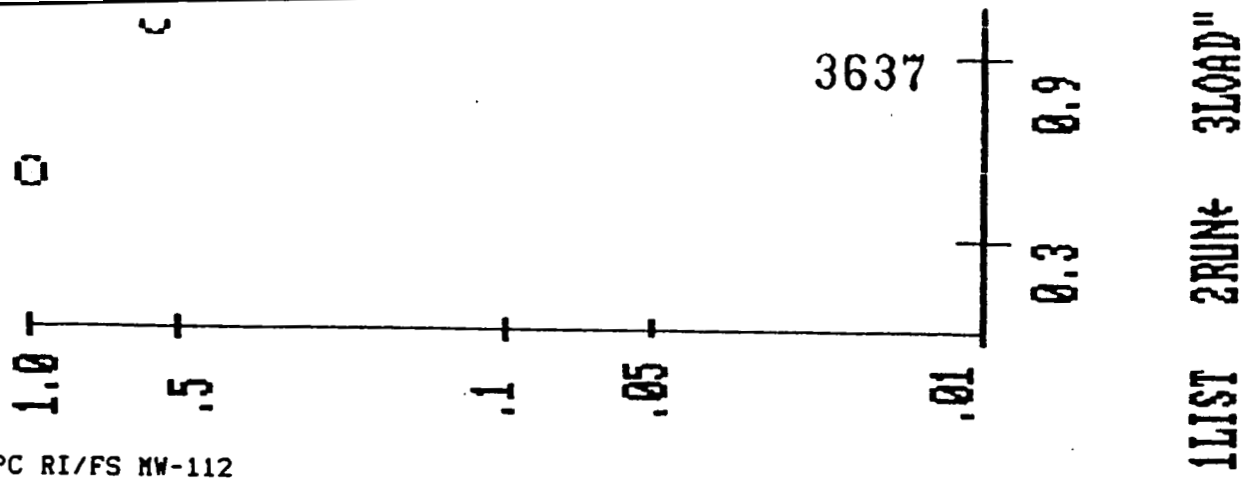
PERMEABILITY FROM TIME-LAG TESTS

```
TITLE:  ? FMPC RI/FS MW-112
(E)nglish or (M)etric units? E
(C)onfined or (U)nconfined conditions? U
Do you prefer to enter well radii as (I)nches or (F)eet? F
STANDPIPE RADIUS (feet) = ? .167
INTAKE RADIUS (feet) = ? .33
LENGTH OF INTAKE (feet or meters) = ? 16.7
DEPTH TO TOP OF INTAKE (feet or meters) = ? 46.7
STATIC WATER LEVEL, DEPTH (feet or meters) = ? 30.75
PURGE WATER LEVEL (feet or meters) = ? 25.1

ARE THESE DATA CORRECT? (Y/N)? Y
ARE WATER-LEVEL DATA TO BE READ FROM DISK? (Y/N)?

1LIST   2RUN  3LOAD"  4SAVE"  5CONT 6,"LPT1 7TRON 8TROFF9KEY   0SCREEN
```





FMPC RI/FS MW-112

TIME (seconds)	WATER LEVEL (feet)	DRAWDOWN (feet)	H/H0
30	25.1	-5.65	1
60	27.6	-3.15	.5575222
90	28.95	-1.80	.3185842
120	29.65	-1.10	.1946905
150	30	-0.75	.1327436
180	30.2	-0.55	9.734552E-02

UNCONFINED AQUIFER

K = 1.6E-03 cm/sec
= 33.1 gpd/ft2
= 5.1E-05 ft/sec
= 4.4 ft/day

REGRESSION COEFFICIENT = -.9932927

LKF 07-10-88

3637

VALUE: 0.50

Press ? for commands

	A	B	C	D	E
1	0.50	25.10	0.087		
2	1.00	27.00	0.092		
3	1.50	28.93	0.118		
4	2.00	29.07	0.122		
5	2.50	30.00	0.091		
6	3.00	30.20	0.067		
7	3.50	31.30	[illegible]		
8	4.00	33.33	[illegible]		
9	4.50	30.27	0.046		
10	5.00	30.40	0.041		
11	5.50	30.12	[illegible]		
12	6.00	30.44	0.038		
13	7.00	30.17	0.036		
14	8.00	30.48	0.032		
15	9.00	30.30	0.030		
16	10.00	30.30	0.030		
17	12.00	30.33	0.027		
18	14.00	30.34	0.025		
19	16.00	30.35	0.023		
20	18.00	30.37	0.022		
21	20.00	30.37	0.022		
22	25.00	30.38	0.021		

VALUE: 30.00

Press ? for commands

	A	B	C	D	E
23	30.00	30.00	0.018		
24	40.00	30.41	0.017		
25	50.00	30.62	0.016		
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					

IN-SITU INC. HERMIT DATA MANAGEMENT PACKAGE

MONITORING WELL 112

SLUG/SWAB TEST

Ref. Value : 30.75 (Ft)
H(0) : 5.65 (Ft)
T(0) : .00 (Min)

ELAPSED TIME (Min)	VALUE (Ft)	HD/DRWDN (Ft)	DELTA TIME (Min)	H/H(0)
.5000	25.10	5.65	.4990	1.000
1.0000	27.60	3.15	.9990	.558
1.5000	28.95	1.80	1.4990	.319
2.0000	29.65	1.10	1.9990	.195
2.5000	30.00	.75	2.4990	.133
3.0000	30.20	.55	2.9990	.097
3.5000	30.30	.45	3.4990	.080
4.0000	30.35	.40	3.9990	.071
4.5000	30.37	.38	4.4990	.067
5.0000	30.40	.35	4.9990	.062
5.5000	30.42	.33	5.4990	.058
6.0000	30.44	.31	5.9990	.055
7.0000	30.45	.30	6.9990	.053
8.0000	30.48	.27	7.9990	.048
9.0000	30.50	.25	8.9990	.044
10.0000	30.50	.25	9.9990	.044
12.0000	30.53	.22	11.9990	.039
14.0000	30.54	.21	13.9990	.037
16.0000	30.55	.20	15.9990	.035
18.0000	30.57	.18	17.9990	.032
20.0000	30.57	.18	19.9990	.032
25.0000	30.58	.17	24.9990	.030
30.0000	30.60	.15	29.9990	.027
40.0000	30.61	.14	39.9990	.025
50.0000	30.62	.13	49.9990	.023

LKP 07-10-89

3637

VALUE: 0.50

Press / for commands

	A	B	C	D	E
1	0.50	25.10	0.685		
2	1.00	27.60	0.382		
3	1.50	28.95	0.218		
4	2.00	29.65	0.133		
5	2.50	30.00	0.091		
6	3.00	30.20	0.067		
7	3.50	30.30	0.055		
8	4.00	30.35	0.048		
9	4.50	30.37	0.046		
10	5.00	30.40	0.042		
11	5.50	30.42	0.040		
12	6.00	30.44	0.038		
13	7.00	30.45	0.036		
14	8.00	30.48	0.033		
15	9.00	30.50	0.030		
16	10.00	30.50	0.030		
17	12.00	30.53	0.027		
18	14.00	30.54	0.025		
19	16.00	30.55	0.023		
20	18.00	30.57	0.022		
21	20.00	30.57	0.022		
22	25.00	30.58	0.021		

VALUE: 30.00

Press / for commands

	A	B	C	D	E
23	30.00	30.60	0.018		
24	40.00	30.61	0.017		
25	50.00	30.62	0.016		
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					

VALUE: 1.00

Press / for commands

	A	B	C	D	E

LKP 07-10-88

3637

VALUE: 0.50

Press / for commands

	A	B	C	D	E
1	0.50	25.10	0.685		
2	1.00	27.60	0.382		
3	1.50	28.95	0.218		
4	2.00	29.65	0.133		
5	2.50	30.00	0.091		
6	3.00	30.20	0.067		
7	3.50	30.30	0.055		
8	4.00	30.35	0.048		
9	4.50	30.37	0.046		
10	5.00	30.40	0.042		
11	5.50	30.42	0.040		
12	6.00	30.44	0.038		
13	7.00	30.45	0.036		
14	8.00	30.48	0.033		
15	9.00	30.50	0.030		
16	10.00	30.50	0.030		
17	12.00	30.53	0.027		
18	14.00	30.54	0.025		
19	16.00	30.55	0.023		
20	18.00	30.57	0.022		
	20.00	30.57	0.022		
	25.00	30.58	0.021		

VALUE: 30.00

Press / for commands

	A	B	C	D	E
23	30.00	30.60	0.018		
24	40.00	30.61	0.017		
25	50.00	30.62	0.016		
26					
27					
28					
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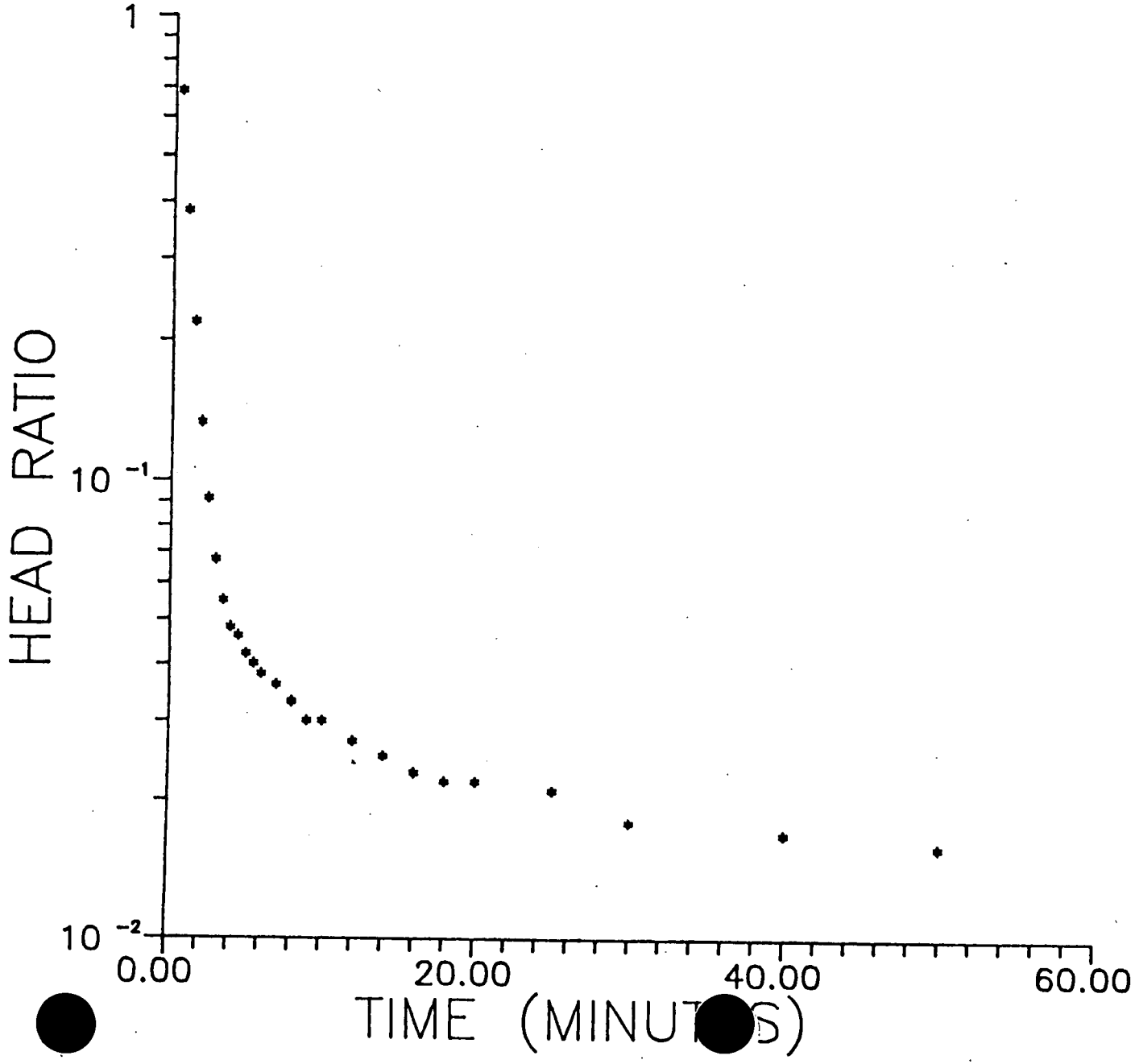
41					

3637



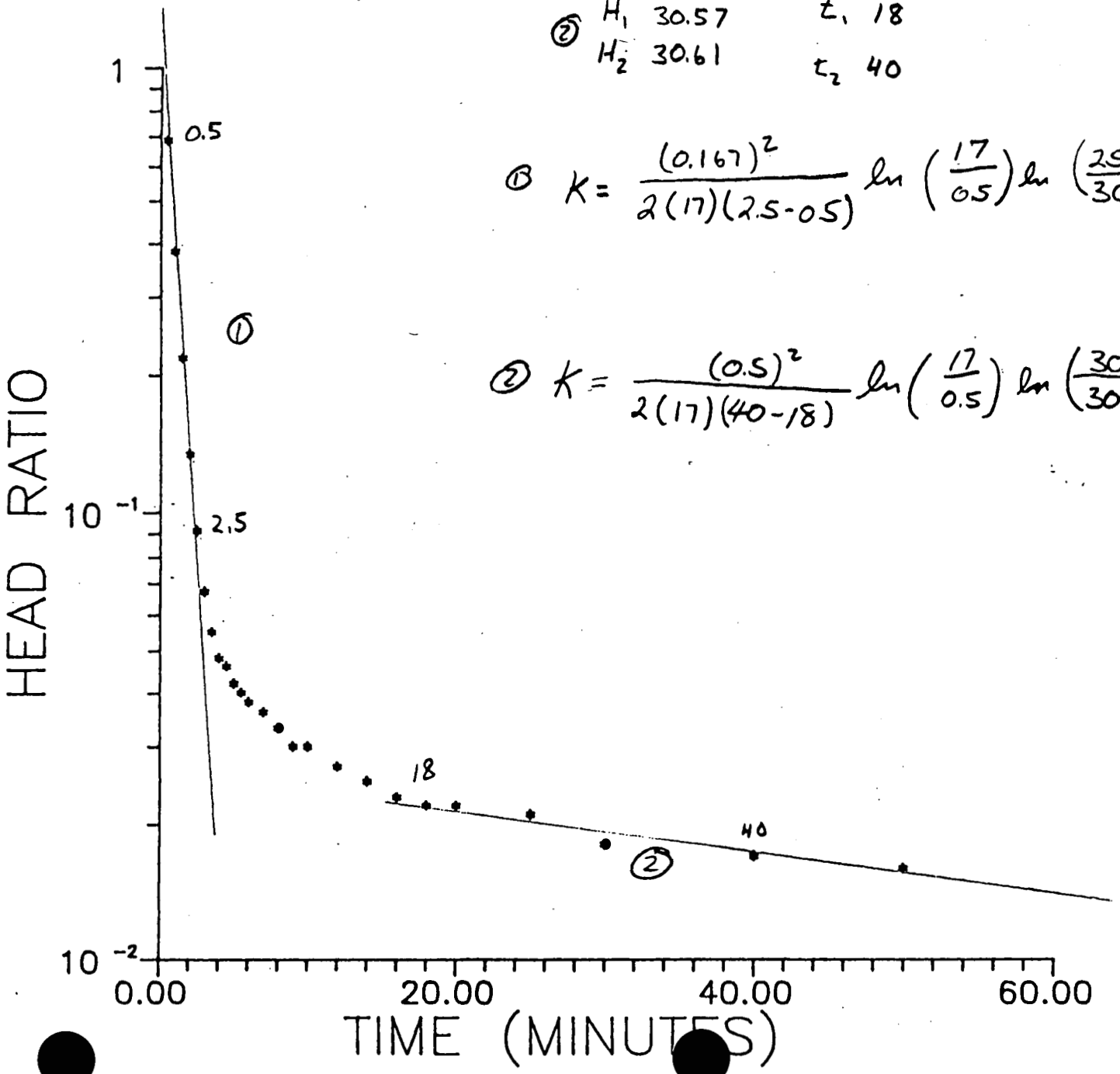
3637

MW 112

$H_G = 30.75$

① H_1 25.1 t_1 0.5
H_2 30.0 t_2 2.5

② H_1 30.57 t_1 18
H_2 30.61 t_2 40



① $K = \frac{(0.167)^2}{2(17)(2.5-0.5)} \ln\left(\frac{17}{0.5}\right) \ln\left(\frac{25.1-30.75}{30.0-30.75}\right) = 2.92\times10^{-3}$ ft/min

$= 1.48\times10^{-3}$ cm/sec

② $K = \frac{(0.5)^2}{2(17)(40-18)} \ln\left(\frac{17}{0.5}\right) \ln\left(\frac{30.57-30.75}{30.61-30.75}\right) = 2.96\times10^{-4}$ ft/min

1.50×10^{-4} cm/sec

Checked by
HEW
7-9-88

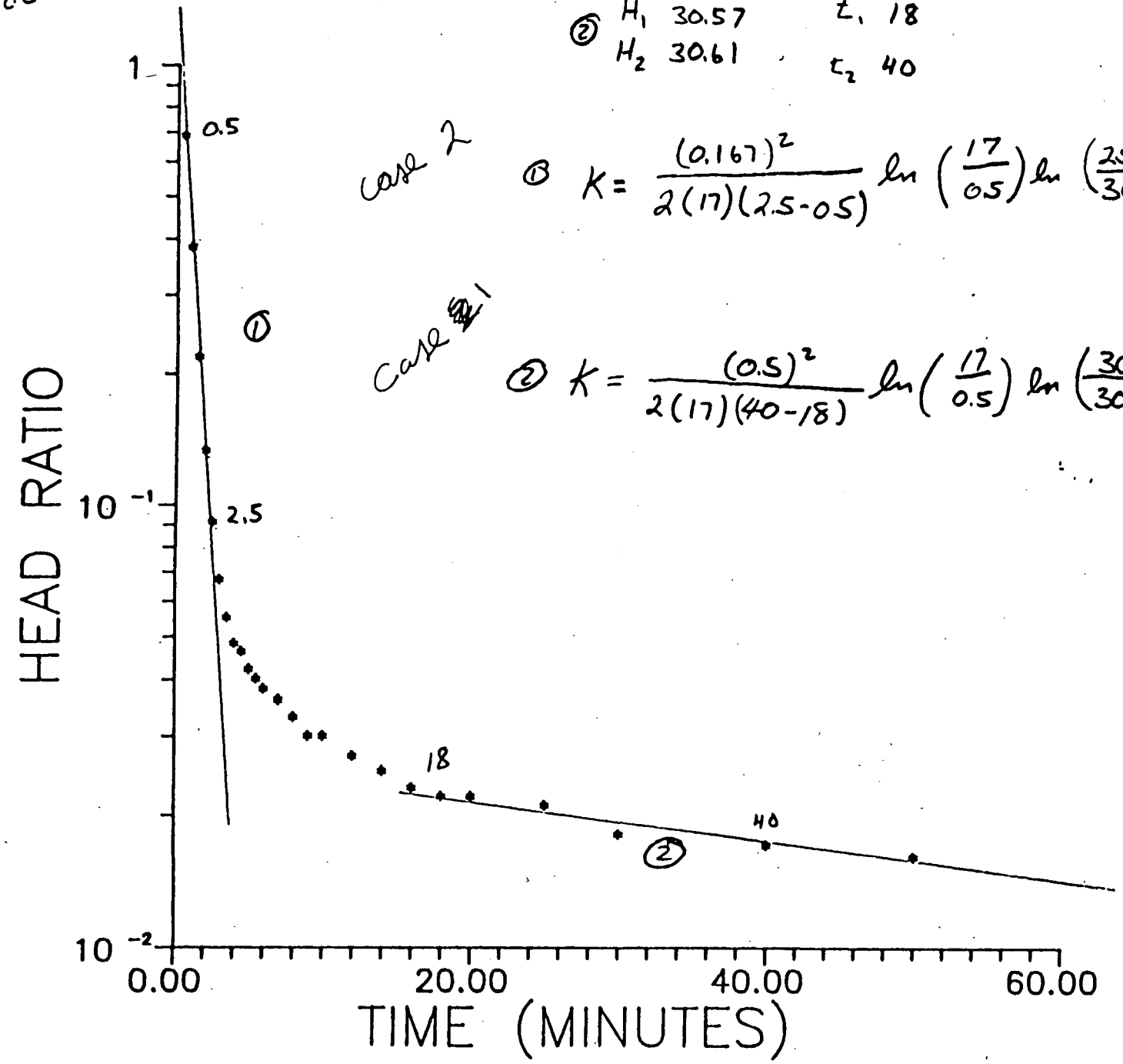
MW 112

$H_G = 30.75$

① H_1 25.1 t_1 0.5
H_2 [illegible] t_2 2.5

② H_1 30.57 t_1 18
H_2 30.61 t_2 40

Guess at 12in Φ [illegible]ring
Screen length 17ft (best guess)



case 2

① $K = \frac{(0.167)^2}{2(17)(2.5-0.5)} \ln\left(\frac{17}{0.5}\right) \ln\left(\frac{25.1-30.75}{30.0-30.75}\right) = 2.92\times10^{-3}$ ft/min

$= 1.48\times10^{-3}$ cm/sec

case 1

② $K = \frac{(0.5)^2}{2(17)(40-18)} \ln\left(\frac{17}{0.5}\right) \ln\left(\frac{30.57-30.75}{30.61-30.75}\right) = 2.96\times10^{-4}$ ft/min

1.50×10^{-4} cm/sec

097

3637

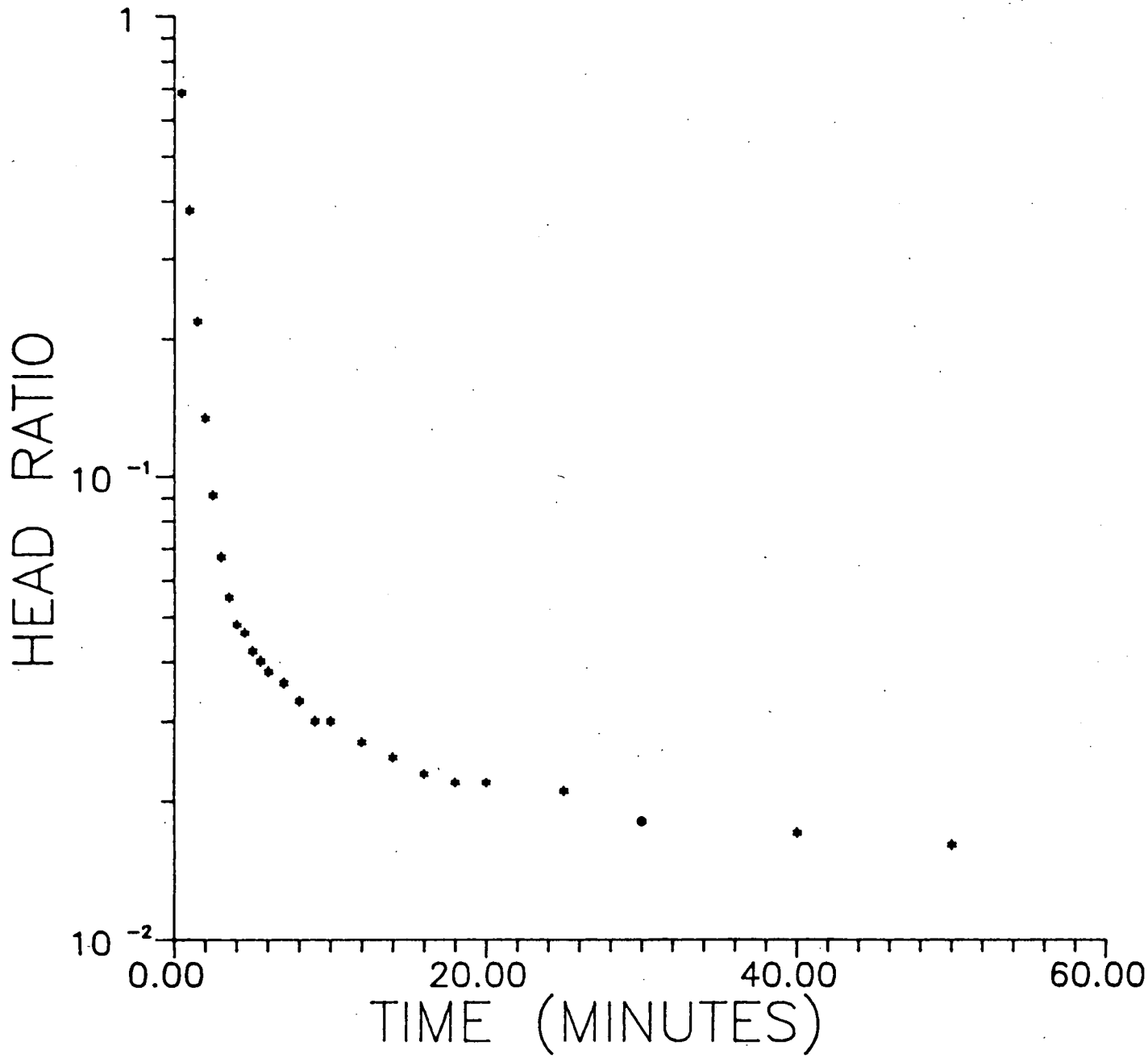
IN-SITU INC. HERMIT DATA MANAGEMENT PACKAGE

MONITORING WELL 112

SLUG/SWAB TEST

Ref. Value : 30.75 (Ft)
H(0) : 5.65 (Ft)
T(0) : .00 (Min)

ELAPSED TIME (Min)	VALUE (Ft)	HD/DRWDN (Ft)	DELTA TIME (Min)	H/H(0)
.5000	25.10	5.65	.4990	1.000
1.0000	27.60	3.15	.9990	.558
1.5000	28.95	1.80	1.4990	.319
2.0000	29.65	1.10	1.9990	.195
2.5000	30.00	.75	2.4990	.133
3.0000	30.20	.55	2.9990	.097
3.5000	30.30	.45	3.4990	.080
4.0000	30.35	.40	3.9990	.071
4.5000	30.37	.38	4.4990	.067
5.0000	30.40	.35	4.9990	.062
5.5000	30.42	.33	5.4990	.058
6.0000	30.44	.31	5.9990	.055
7.0000	30.45	.30	6.9990	.053
8.0000	30.48	.27	7.9990	.048
9.0000	30.50	.25	8.9990	.044
10.0000	30.50	.25	9.9990	.044
12.0000	30.53	.22	11.9990	.039
14.0000	30.54	.21	13.9990	.037
16.0000	30.55	.20	15.9990	.035
18.0000	30.57	.18	17.9990	.032
20.0000	30.57	.18	19.9990	.032
25.0000	30.58	.17	24.9990	.030
30.0000	30.60	.15	29.9990	.027
40.0000	30.61	.14	39.9990	.025
50.0000	30.62	.13	49.9990	.023


HEAD RATIO
1
10 -1
10 -2
0.00
20.00
40.00
60.00
TIME (MINUTES)

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1018
WELL NUMBER: 1018

FIELD ENG./GEO.: LOWELL WILLE DATE: 10/19/87
CHECKED BY : Not Noted DATE: N/A
N,E COORDINATES: 479450.19, 1378661.6
DATE OF INSTAL.: 10/19/87

BOREHOLE DRILLING

DRILLING METHOD: Cable Tool
DRILLING FLUID(S) USED: (in Feet)
FLUID: WATER FROM: 0 TO: 33
FLUID: N/A FROM: N/ATO: N/A
NOTES/COMMENTS:

TYPE OF BIT: Flat Head Hammer
IS CASING TEMPORARY?: Yes
CASING TYPE : MONITORING WELL
CASING DIAM.: 4 In.
CASING SIZE(S) USED: (in Feet)
SIZE: 10 FROM: 0 TO: 33 1/2
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Screen
AVG. SIZE OF PERFORATIONS: 0.010 (In.)
TOTAL PERFORATED AREA: 10 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: Stainless Steel
RISER PIPE DIAMETERS:
O.D.: 4 3/8 In. I.D.: 4 In.
LENGTH OF 1ST PIPE SECTION: 10 Ft.
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: FLUSH JOINT THREAD

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5 Ft.
PROTECTIVE PIPE O.D.: 10 In.
* LOCKABLE TOP AND LOCK

OTHER PROTECTION (* NOTED BELOW)

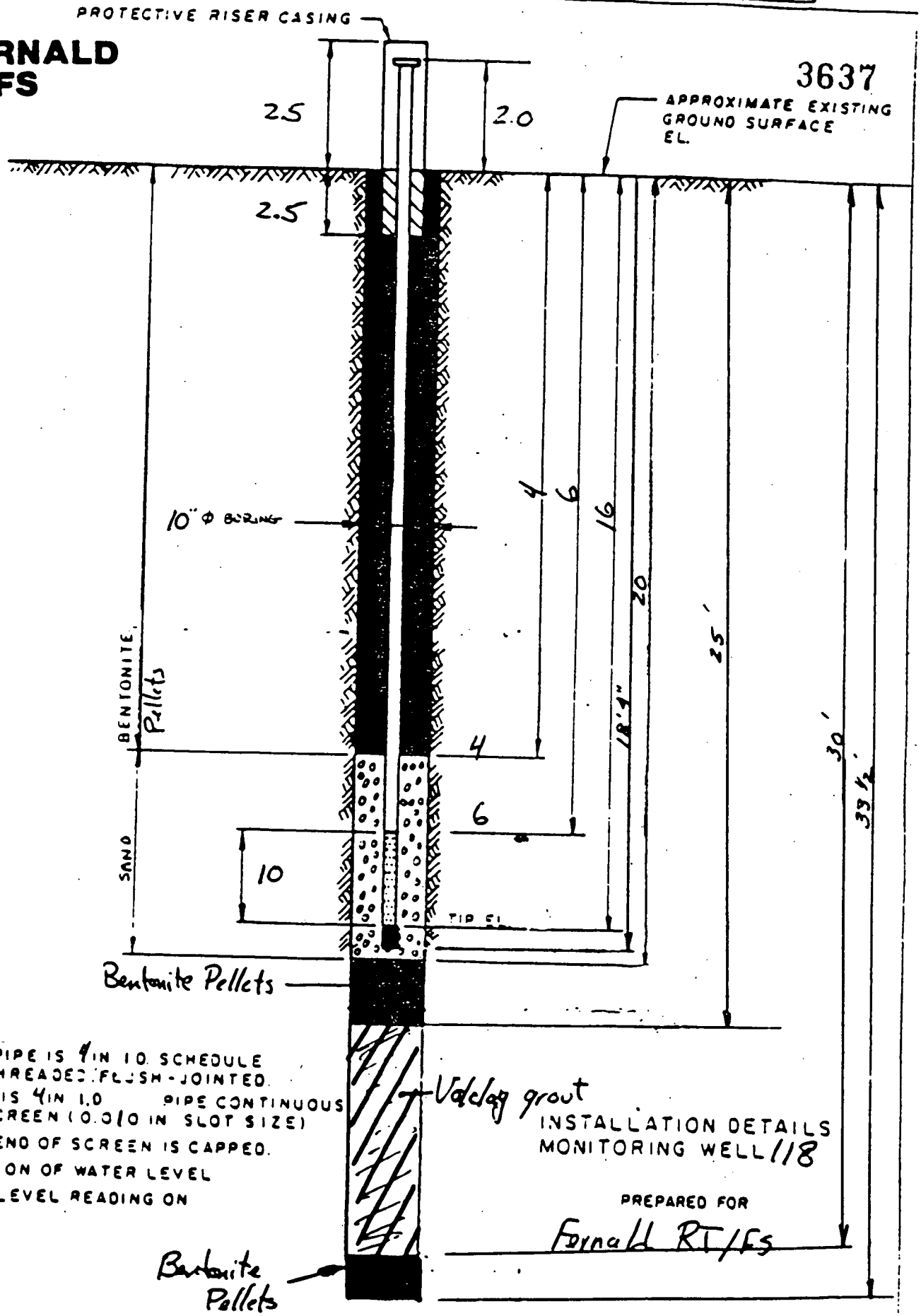
ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	2.0 Ft.		572.79	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	2 1/2 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
Bentonite Pellets	0	4	N/A	N/A
Sand	4	20	N/A	N/A
Bentonite Pellets	20	25	N/A	N/A
Grout/Slurry	25	30	N/A	N/A
Bentonite Pellets	30	33.5	N/A	N/A
PERFORATED SECTION	6	16	N/A	N/A
WELL TIP	18.4		N/A	
BOTTOM OF BOREHOLE	33.5		N/A	
GWL AFTER INSTALLATION	DRY		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

WELL 118

FERNALD RI/FS

3637



NOTES

1. RISER PIPE IS 4 IN 10 SCHEDULE PIPE, THREADED FLUSH-JOINTED.
2. SCREEN IS 4 IN 1.0 PIPE CONTINUOUS SLOT SCREEN (0.010 IN SLOT SIZE)
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL
5. WATER LEVEL READING ON

INSTALLATION DETAILS
MONITORING WELL 118

PREPARED FOR
Fernald RI/FS

DRAWING NUMBER
CHECKED BY
APPROVED BY

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1018	COORDINATES: NORTH 479,450.19 EAST 1,378,661.69	DATE: 10/18/87
GROUND ELEVATION:	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/18/87
ENGINEER/GEOLOGIST: LOWELL WILLE	Depth N/A Date/Time N/A	DATE COMPLETED: 10/19/87
DRILLING METHODS: CABLE-TOOL		PAGE 1 OF 3

DEPTH	SAMPLE / DATE / TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
1.5	07309 10/18/87 1110	2 8 10	14	SOFT BROWN (10YR, 6/4) SILTY CLAY - TRACE SAND, SOME ORGANIC PLANT MATERIAL - MOIST. STIFF BROWN (10YR, 6/0) SILTY CLAY, TRACE SAND - DRY.	OL CL	3.5 1.8	α = 2 cpm βΓ = 80 cpm
3.0	07310 10/18/87 1115	3 6 15	10	HARD BROWN (10YR, 6/8) CLAY, TRACE SILT AND FINE SAND - DRY.	CL	>5	α = 2 cpm βΓ = 80 cpm
4.5	07311 10/18/87 1120	7 15 21	12	HARD BROWN (10YR, 5/8) MOTTLED GRAY CLAY, TRACE SILT AND FINE SAND - DRY. LOOSE BROWN (10YR, 4/6) FINE SAND, SOME MEDIUM SAND AND SILT, TRACE CLAY - DRY.	CL SW	4.5 N/A	α = 2 cpm βΓ = 80 cpm
6.0	07312 10/18/87 1130	8 10 10	14	HARD BROWN (10YR, 6/8) CLAY, TRACE SILT AND FINE SAND - MOIST. HARD BORWN (10YR, 6/8) CLAYEY SILT, SOME FINE SAND - MOIST.	CL CL	3.5 2.8	α = 2 cpm βΓ = 80 cpm
7.5	07313 10/18/87 1230		13	HARD BROWN (10YR, 6/6) SILTY SAND, SOME CLAY, TRACE GRAVEL AND PEBBLES - DRY.	SM	>5	α = 2 cpm βΓ = 80 cpm
9.0	07314 10/18/87 1500	6 8 10	11	DENSE BROWN (10YR, 5/8) AND GRAY 10YR 6/2 INTERLAYERED SAND, SOME SILT, TRACE CLAY AND FINE GRAVEL - DRY.	SM	N/A	α = 2 cpm βΓ = 80 cpm
10.5	07315 10/18/87 1530	16 42 36	13	DENSE BROWN (10YR, 5/8) FINE TO MEDIUM SAND, SOME SILT, CLAY, TRACE GRAVEL - MOIST, SLIGHTLY BONDED.	SM	N/A	α = 2 cpm βΓ = 80 cpm
12.0	07316 10/18/87 1545	18 28 37	17	DENSE GRAY (10YR, 5/1) FINE SAND, SOME SILT AND CLAY - MOIST.	SM	0.5	α = 2 cpm βΓ = 80 cpm
13.5	07317 10/18/87 1700	45 17 15	17	DENSE GRAY (10YR, 6/0) SAND AND GRAVEL, SOME SILT AND CLAY - DRY. HARD GRAY (10YR, 6/1) CLAY - SOME SILT, MOIST. DENSE GRAY (10YR, 6/0) FINE SAND, SOME SILT, TRACE CLAY - DRY.	GC CL SM	N/A 1.0 0.5	α = 2 cpm βΓ = 80 cpm
15.0	07318 10/18/87 1730	16 44 50	17	HARD GRAY (10YR, 5/1) CLAY - SOME SILT - MOIST. DENSE GRAY (10YR, 5/1) SAND - SOME SILT AND CLAY - DRY. HARD GRAY (10YR, 5/1) CLAY, SOME SILT - MOIST.	CL SM CL	4.0 N/A 3.5	α = 2 cpm βΓ = 80 cpm

NOTES:
SCANNED SAMPLE - BACKGROUND.

VISUAL CLASSIFICATION OF SOILS

3637

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1018	COORDINATES: NORTH 479,450.19 EAST 1,378,661.69	DATE: 10/18/87
GROUND ELEVATION:	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/18/87
ENGINEER/GEOLOGIST: LOWELL WILLE	Depth N/A Date/Time N/A	DATE COMPLETED: 10/19/87
DRILLING METHODS: CABLE-TOOL		PAGE 2 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.5	07319 10/18/87 1805	4 7 12	10	STIFF GRAY (7.5YR, 6/2) CLAY, SOME SILT, TRACE FINE SAND - MOIST.	CL	3.5	α = 2 cpm Bγ = 75 cpm
18.0	07320 10/19/87 810	3 5 23	10	STIFF GRAY 10YR, 6/1 CLAY, SOME SILT, SAND AND GRAVEL - DRY.	CL	3.5	α = 2 cpm Bγ = 75 cpm
19.5	07321 10/19/87 820	8 10 23	11	STIFF GRAY 10YR 6/1 CLAY, SOME SILT AND SAND, TRACE GRAVEL - DRY.	CL	3.2	α = 2 cpm Bγ = 75 cpm
21.0	07322 10/19/87 930	43 27 32	12	HARD GRAY 10YR 5/1 GRAVELLY CLAY, SOME SILT AND CLAY, TRACE PEBBLES - DRY.	CL	>5	α = 2 cpm Bγ = 75 cpm
22.5	07323 10/19/87 940	50	6	HARD GRAY 10YR 5/1 CLAY, SOME GRAVEL, TRACE SAND AND SILT, DRY	CL	>5	α = 2 cpm Bγ = 75 cpm
24.0	07324 10/19/87 1130	8 14 50	18	HARD GRAY 10YR 6/1 CLAY, TRACE GRAVEL AND SAND, SOME SILT, DRY	CL	>5	α = 2 cpm Bγ = 75 cpm
25.5	07325 10/19/87 1300	6 16 36	14	HARD GRAY 10YR 6/1 CLAY, TRACE GRAVEL AND SILT, DRY.	CL	3.5	α = 2 cpm Bγ = 75 cpm
27.0	07326 10/19/87 1345	5 13 30	9	HARD GRAY 10YR 6/1 GRAVELLY CLAY, SOME SAND AND SLIT, MOIST.	CL	3.5	α = 2 cpm Bγ = 75 cpm
28.5	07327 10/19/87 1350	11 21 36	18	STIFF GRAY 10YR 6/1 CLAY, TRACE SAND, GRAVEL, AND SILT, DRY.	CL	2.5	α = 2 cpm Bγ = 75 cpm
30.0	07328 10/19/87 1430	12 9 12	13	LOOSE BROWN 10YR 6/6 SAND, SOME SILT AND CLAY - TRACE GRAVEL - DRY.	SM	N/A	α = 2 cpm Bγ = 75 cpm

NOTES:
SCANNED SAMPLE - BACKGROUND.

VISUAL CLASSIFICATION OF SOILS

3637

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1018	COORDINATES: NORTH 479,450.19 EAST 1,378,661.69	DATE: 10/18/87
GROUND ELEVATION:	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/18/87
ENGINEER/GEOLOGIST: LOWELL WILLE	Depth N/A Date/Time N/A	DATE COMPLETED: 10/19/87
DRILLING METHODS: CABLE-TOOL		PAGE 3 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
31.5	07329 10/19/87 1500	5 16 26	14	DENSE BROWN 10YR 6/6 SAND, SOME SILT AND CLAY, TRACE GRAVEL - DRY.	SM	N/A	α = 2 cpm βγ = 75 cpm
32.5	07330 10/19/87 1550	33 71	12	DENSE BROWN 10YR 5/6 SAND AND GRAVEL, SOME SILT AND CLAY - TRACE PEBBLES - DRY.	GC	N/A	α = 2 cpm βγ = 75 cpm
33.5	07331 10/19/87 1600	50	6	DENSE BROWN 10YR 5/6 SAND AND GRAVEL, SOME SILT AND CLAY - TRACE PEBBLES - DRY.	GM	N/A	α = 2 cpm βγ = 75 cpm

BOTTOM OF BORING 33.5

NOTES:
SCANNED SAMPLE - BACKGROUND.

Fine Sand w/ silt

FERNALD RI/FS

3637

FIELD PERMEABILITY TESTS

FALLING HEAD *

PROJECT FMPC RI/FS
PROJECT NO. 602.03.02.01
BORING NO. 118

TESTED BY TS/BM DATE 5/3/88
CALCULATED BY FXM DATE 11/4/88
CHECKED BY [illegible] DATE [illegible]
Copied By: FXM 10/31/88
Chk'd By [illegible]

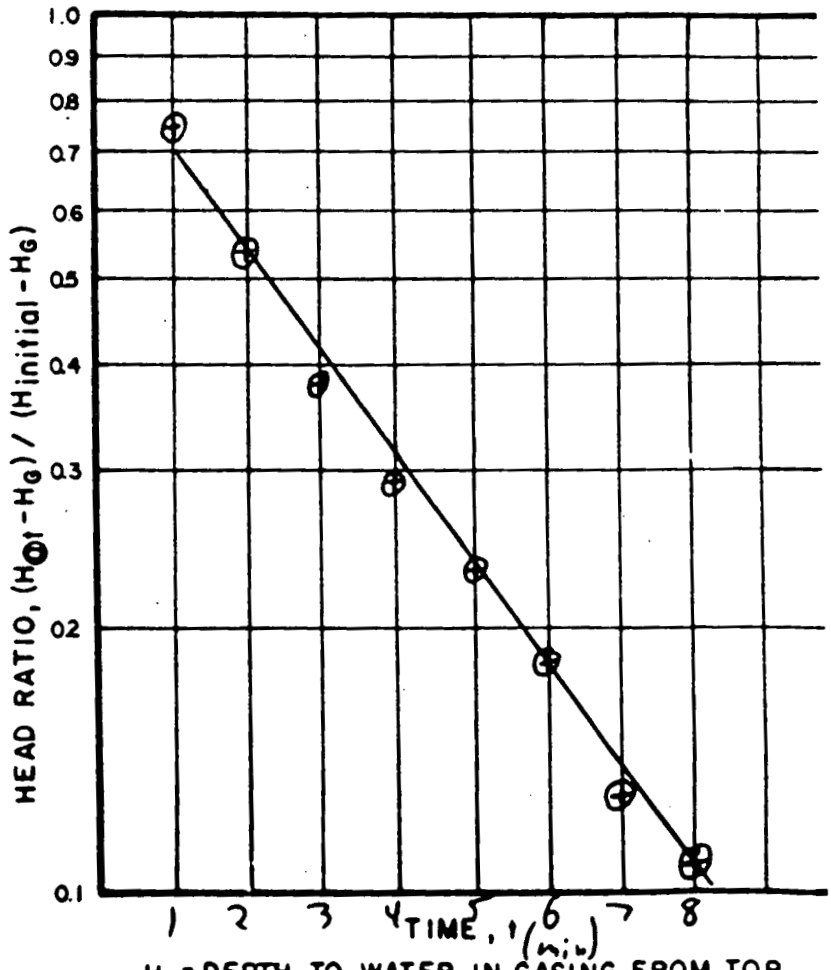
RADIUS OF TEST BORING, R 0.5 ft
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C ≈ 2.0 ft
DEPTH TO BOTTOM OF TEST POCKET, L_1 18 ft
DEPTH TO TOP OF TEST POCKET, L_2 ~~18 ft~~ 8 ft
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 7.07 ft

PERMEABILITY, K 5.7×10^{-4} cm/s

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

Began Test - 1025
5 gallon slug used

ELAPSED TIME t min ~~sec~~	DEPTH TO WATER IN CASING H ft ~~Meters~~
0	2.70
1	3.85
2	4.70
3	5.40
4	5.80
5	6.08
6	6.30
7	6.48
8	6.60
9	6.68
10	6.75
12	6.85
14	6.90
16	6.93
18	6.95
20	6.97
25	6.99
30	7.00
40	7.01
50	—
60	—



$$K = \frac{R^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

Well 118

$$\text{Head Ratio} = \frac{H_T - H_G}{H_i - H_G}$$

@ 1 min $\frac{3.85 - 7.07}{2.70 - 7.07} = 0.74$

@ 2 min $\frac{4.70 - 7.07}{2.70 - 7.07} = 0.54$

@ 3 min $\frac{5.40 - 7.07}{2.70 - 7.07} = 0.38$

@ 4 min $\frac{5.80 - 7.07}{2.70 - 7.07} = 0.29$

@ 5 min $\frac{6.08 - 7.07}{2.70 - 7.07} = 0.23$

@ 6 min $\frac{6.30 - 7.07}{2.70 - 7.07} = 0.18$

@ 7 min $\frac{6.48 - 7.07}{2.70 - 7.07} = 0.135$

@ 8 min $\frac{6.60 - 7.07}{2.70 - 7.07} = 0.11$

By FXM Date 11/4/88 Subject Slug Test Calculations Sheet No. 3 of 3
Ch. By ___ Date ___ Well 118 Proj. No. 602.3.2.1

Permeability:

$$K = \frac{r^2}{2(L_1-L_2)(t_2-t_1)} \ln\left[\frac{L_1-L_2}{R}\right] \ln\left[\frac{H_1-H_G}{H_2-H_G}\right]$$

$$= \frac{(0.167)^2}{2(18-8)(8-2)} \ln\left[\frac{18-8}{0.5}\right] \ln\left[\frac{4.70-7.07}{6.60-7.07}\right]$$

$K = 1.1 \times 10^{-3}$ ft/min

$K = 5.7 \times 10^{-4}$ cm/s

INTERNATIONAL TECHNOLOGY CORPORATION

3637

By L Wille Date 6-11-88 Subject Head Ratio Calculations Sheet No. ___ of ___

Rd. By LKP Date 07-10-88 for MW 118 Proj. No. 602323

$$\text{Head Ratio} = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G = Depth to ground water table from TOC, before slug added

H_i = Initial depth to ground water table from TOC after slug added

$H_{@t}$ = Depth to ground water table from TOC at time t

H_G = 7.07 ft

H_i = 2.70 ft

t = 1 minute H_t = 3.85 ft

$$HR = \frac{3.85 - 7.07}{2.70 - 7.07} = 0.737$$

time (minutes)	H_t (feet)	H.R. (dimensionless)
1	3.85	0.737
2	4.70	0.542
3	5.40	0.382
4	5.80	0.291
5	6.08	0.227
6	6.30	0.176
7	6.48	0.135
8	6.60	0.108
9	6.68	0.089
10	6.75	0.073
12	6.85	0.050
14	6.90	0.039
16	6.93	0.032
18	6.95	0.027
20	6.97	0.023
25	6.99	0.018
30	7.00	0.016
40	7.01	0.014
50	–	–
60	–	–

108-10-85

INTERNATIONAL TECHNOLOGY CORPORATION

3637

By L Wille Date 6-11-88 Subject Head Ratio Calculations Sheet No. ___ of ___
Chkd. By L.P Date 06-19-88 for MW 118 Proj. No. 602.323

$$\text{Head Ratio} = \frac{H_{@t} - H_6}{H_i - H_6}$$

H_6 = Depth to ground water table from TOC, before slug added

H_i = Initial depth to ground water table from TOC after slug added

$H_{@t}$ = Depth to ground water table from TOC at time t

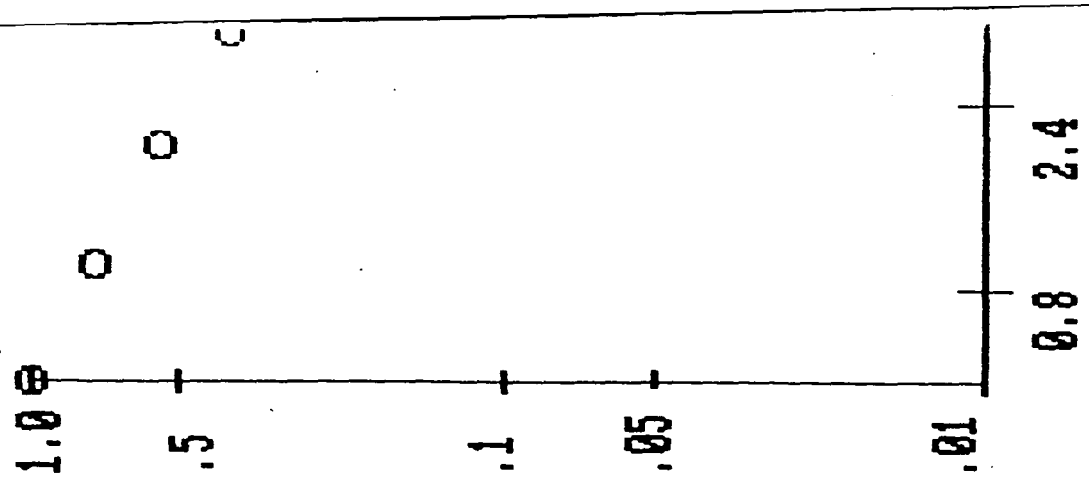
H_6 = 7.07 ft
H_i = 2.70 ft

t = 1 minute H_t = 3.85 ft

$$HR = \frac{3.85 - 7.07}{2.70 - 7.07} = 0.737$$

Time (minutes)	H_t (feet)	H.R. (dimensionless)
1	3.85	0.737
2	4.70	0.542
3	5.40	0.382
4	5.80	0.291
5	6.08	0.227
6	6.30	0.176
7	6.48	0.135
8	6.60	0.108
9	6.68	0.089
10	6.75	0.073
12	6.85	0.050
14	6.90	0.039
16	6.93	0.032
18	6.95	0.027
20	6.97	0.023
25	6.99	0.018
30	7.00	0.016
40	7.01	0.014
50	(illegible)	–
60	(illegible)	–

108-10-85



1LIST 2RUN+ 3LOAD"

3637

FMPC RI/FS MW-118

TIME (seconds)	WATER LEVEL (feet)	DRAWDOWN (feet)	H/H0
0	2.7	-4.37	1
60	3.85	-3.22	.7368421
120	4.7	-2.37	.5423341
180	5.4	-1.67	.382151
240	5.8	-1.27	.2906179
300	6.08	-0.99	.2265447
360	6.3	-0.77	.1762014
420	6.48	-0.59	.1350115
480	6.6	-0.47	.1075516

UNCONFINED AQUIFER

K = 5.9E-04 cm/sec
= 12.6 gpd/ft2
= 1.9E-05 ft/sec
= 1.7 ft/day

REGRESSION COEFFICIENT = -.9981543

FMPC RI/FS MW-118

TIME (seconds)	WATER LEVEL (feet)	DRAWDOWN (feet)	H/H0
120	4.7	-2.37	.5423341
180	5.4	-1.67	.382151
240	5.8	-1.27	.2906179
300	6.08	-0.99	.2265447
360	6.3	-0.77	.1762014
420	6.48	-0.59	.1350115
480	6.6	-0.47	.1075516

UNCONFINED AQUIFER

K = 5.6E-04 cm/sec
= 11.9 gpd/ft2
= 1.8E-05 ft/sec
= 1.6 ft/day

REGRESSION COEFFICIENT = -.9982914

PERMEABILITY FROM TIME-LAG TESTS

PERMEABILITY FROM TIME-LAG TESTS

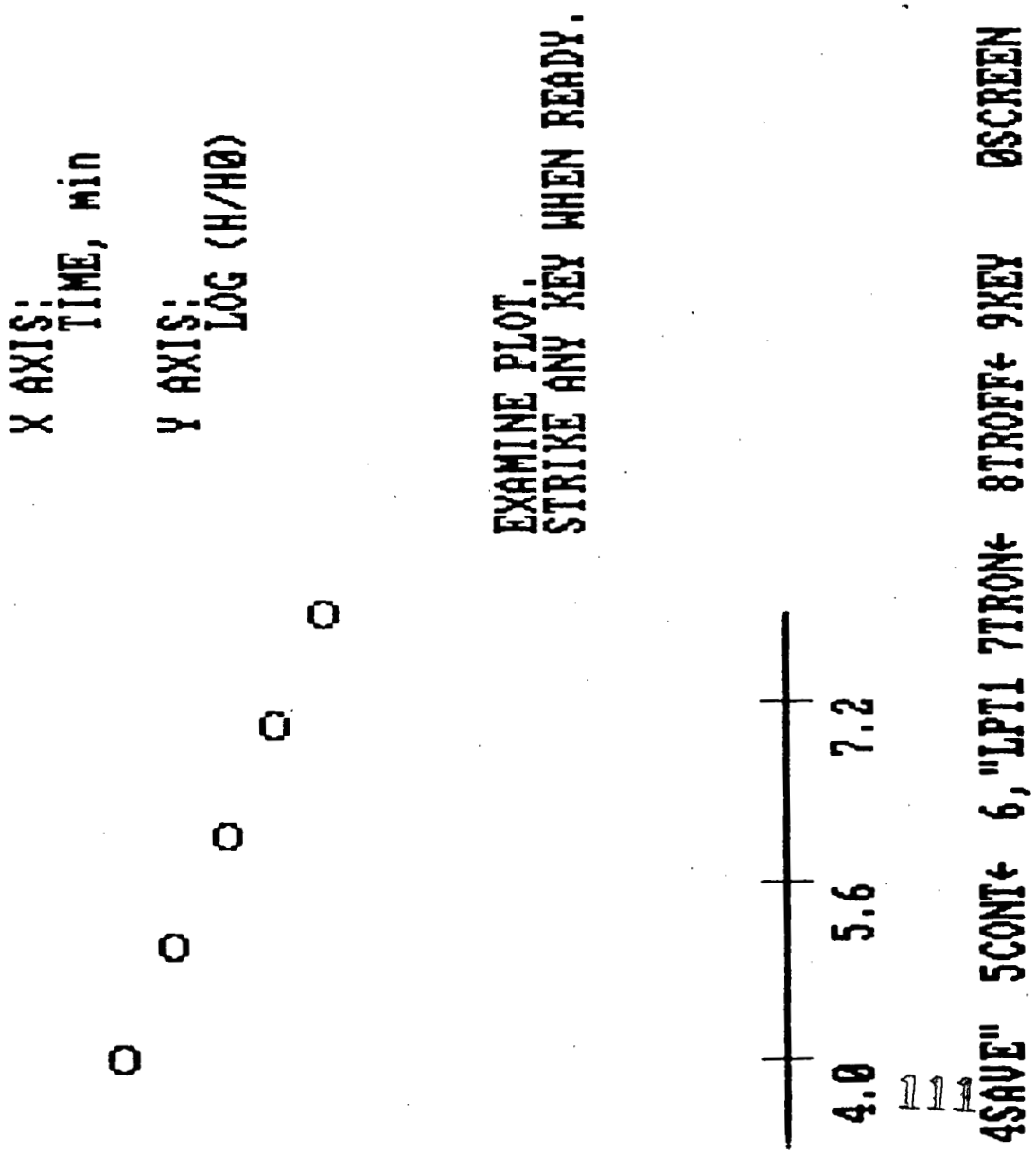
3637

```
TITLE:  ? FMPC RI/FS MW-118
(E)nglish or (M)etric units? E
(C)onfined or (U)nconfined conditions? U
Do you prefer to enter well radii as (I)nches or (F)eet? F
STANDPIPE RADIUS (feet) = ? .167
INTAKE RADIUS (feet) = ? .5
LENGTH OF INTAKE (feet or meters) = ? 10
DEPTH TO TOP OF INTAKE (feet or meters) = ? 8
STATIC WATER LEVEL, DEPTH (feet or meters) = ? 7.07
PURGE WATER LEVEL (feet or meters) = ? 2.7


ARE THESE DATA CORRECT? (Y/N)?


ARE THESE DATA CORRECT? (Y/N)?


1LIST   2RUN   3LOAD"   4SAVE"   5CONT 6,"LPT1 7TRON 8TROFF9KEY    0SCREEN
```



LKP 07-10-88

3637

VALUE: 1.00

Press / for commands

	A	B	C	D	E
1	1.00	3.85	0.737		
2	2.00	4.70	0.542		
3	3.00	5.40	0.382		
4	4.00	5.80	0.291		
5	5.00	6.08	0.227		
6	6.00	6.30	0.176		
7	7.00	6.48	0.135		
8	8.00	6.60	0.108		
9	9.00	6.68	0.089		
10	10.00	6.75	0.073		
11	12.00	6.85	0.050		
12	14.00	6.90	0.039		
13	16.00	6.93	0.032		
14	18.00	6.95	0.027		
15	20.00	6.97	0.023		
16	25.00	6.99	0.018		
17	30.00	7.00	0.016		
	40.00	7.01	0.014		
1					
20					
21					
22					

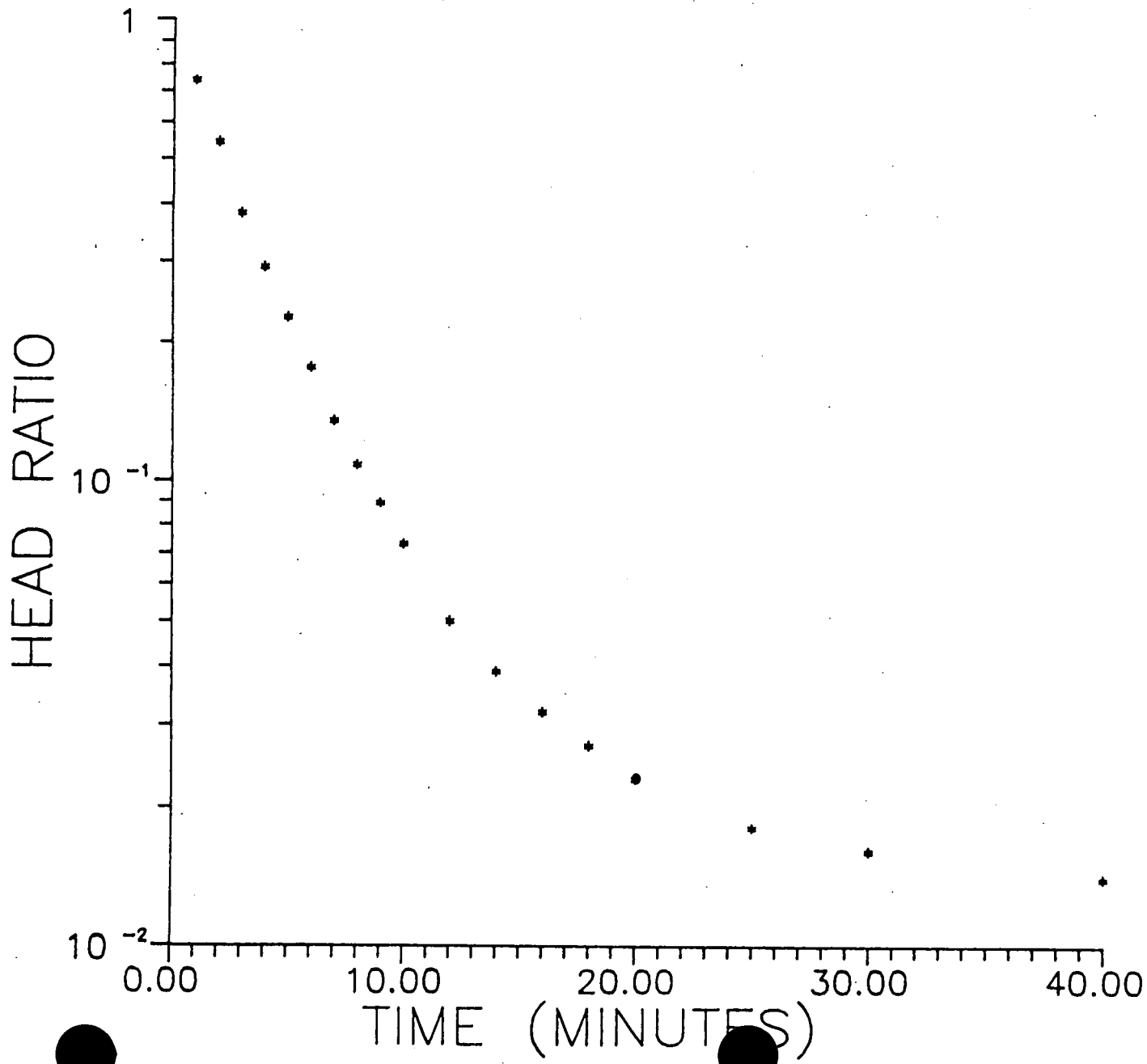
LKP 07-10-90

3637

ALUE: 1.00

Press / for commands

	A	B	C	D	E
1	1.00	3.85	0.737		
2	2.00	4.70	0.542		
3	3.00	5.40	0.382		
4	4.00	5.90	0.291		
5	5.00	6.05	0.227		
6	6.00	6.30	0.176		
7	7.00	6.45	0.131		
8	8.00	6.60	0.108		
9	9.00	6.68	0.089		
10	10.00	6.75	0.073		
11	12.00	6.85	0.050		
12	14.00	6.90	0.039		
13	16.00	6.93	0.032		
14	18.00	6.95	0.027		
15	20.00	6.97	0.023		
16	25.00	6.99	0.018		
17	30.00	7.00	0.016		
18	40.00	7.01	0.014		
19					
20					
21					
22					


HEAD RATIO
1
10 -1
10 -2
0.00
10.00
20.00
30.00
40.00
TIME (MINUTES)

B:\>type mw118.tbl

IN-SITU INC. HERMIT DATA MANAGEMENT PACKAGE

MONITORING WELL 118

SLUG/SWAB TEST

Ref. Value : 7.07 (Ft)
H(0) : 4.37 (Ft)
T(0) : .00 (Min)

ELAPSED TIME (Min)	VALUE (Ft)	HD/DRWDN (Ft)	DELTA TIME (Min)	H/H(0)
1.0000	3.85	3.22	.9990	.737
2.0000	4.70	2.37	1.9990	.542
3.0000	5.40	1.67	2.9990	.382
4.0000	5.80	1.27	3.9990	.291
5.0000	6.08	.99	4.9990	.227
6.0000	6.30	.77	5.9990	.176
7.0000	6.48	.59	6.9990	.135
8.0000	6.60	.47	7.9990	.108
9.0000	6.68	.39	8.9990	.089
10.0000	6.75	.32	9.9990	.073
12.0000	6.85	.22	11.9990	.050
14.0000	6.90	.17	13.9990	.039
16.0000	6.93	.14	15.9990	.032
18.0000	6.95	.12	17.9990	.027
20.0000	6.97	.10	19.9990	.023
25.0000	6.99	.08	24.9990	.018
30.0000	7.00	.07	29.9990	.016
40.0000	7.01	.06	39.9990	.014

MW 118

r_1 = 4 in 0.167 ft

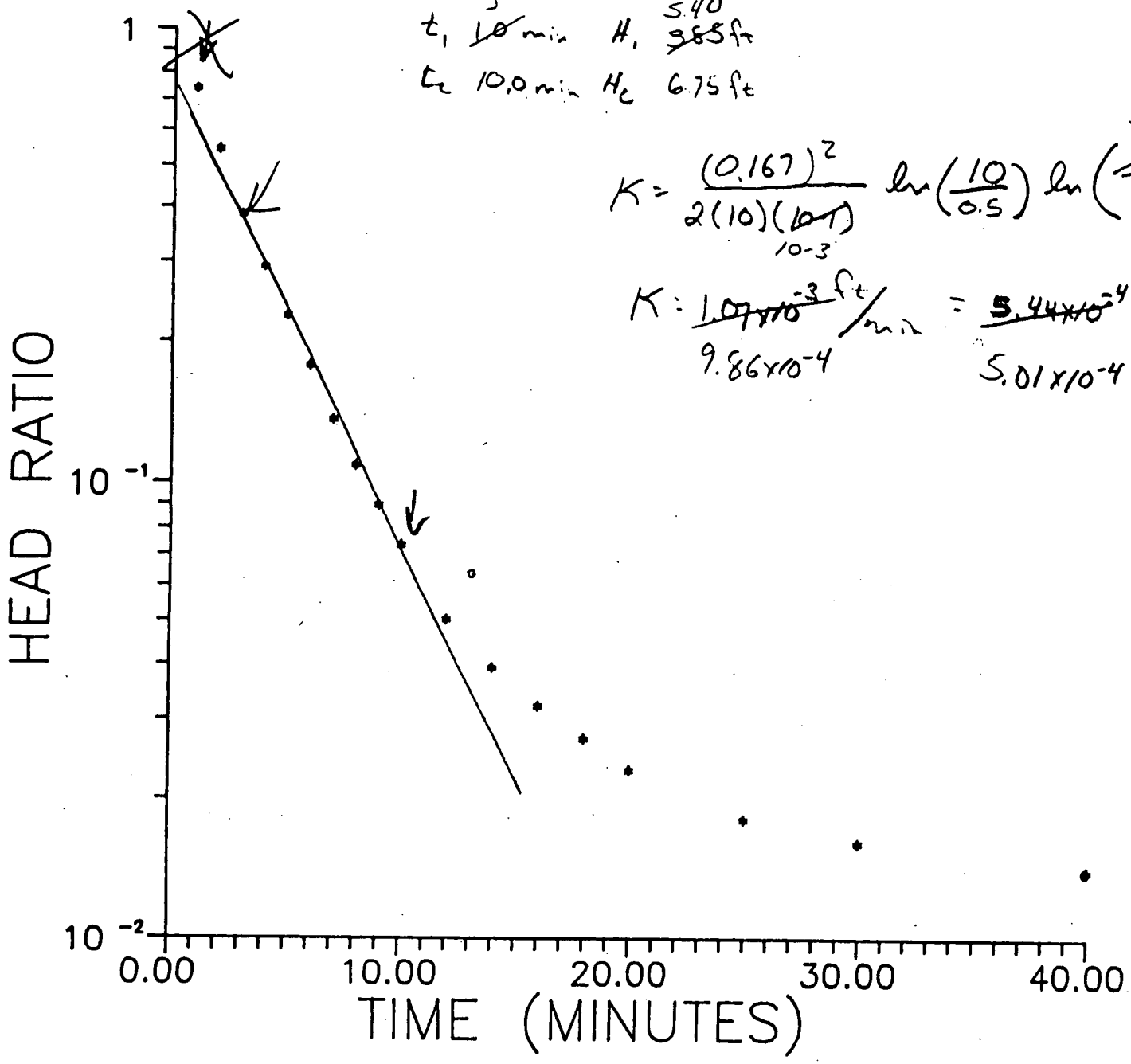
r_2 = 6 in 0.5 ft

t_1 ~~10~~ 3 min H_1 ~~3.85~~ 5.40 ft

t_2 10.0 min H_2 6.75 ft

$$K = \frac{(0.167)^2}{2(10)(\cancel{10^{-1}})\ 10^{-3}} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{\cancel{3.85}\ 5.40 - 7.07}{6.75 - 7.07}\right)$$

$$K = \frac{\cancel{1.07\times10^{-3}}}{9.86\times10^{-4}} \text{ ft/min} = \frac{\cancel{5.44\times10^{-4}}}{5.01\times10^{-4}} \text{ cm/sec}$$



MW 118

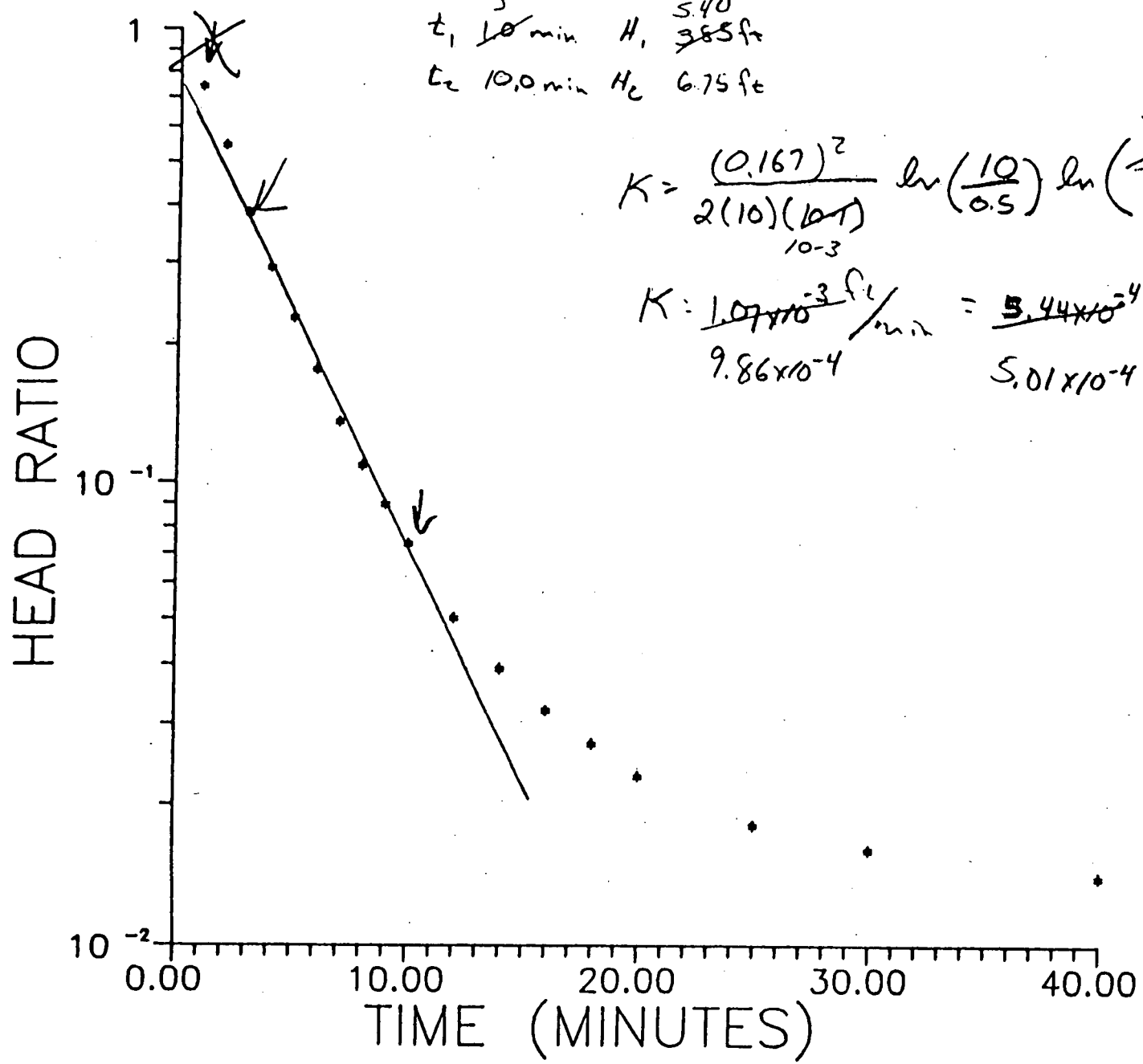
r_2 : 6 [illegible] 0.5 ft

t_1 ~~10~~ 3 min H_1 ~~3.85~~ 5.40 ft

t_2 10.0 min H_2 6.75 ft

$$K = \frac{(0.167)^2}{2(10)(\cancel{10-1})\ 10-3} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{\cancel{3.85}\ 5.40 - 7.07}{6.75 - 7.07}\right)$$

$$K = \cancel{1.07\times10^{-3}}\ 9.86\times10^{-4}\ \text{ft/min} = \cancel{5.44\times10^{-4}}\ 5.01\times10^{-4}\ \text{cm/sec}$$



MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1025
WELL NUMBER: 1025

FIELD ENG./GEO.: M. GOLDBERG DATE: 01/08/88
CHECKED BY : Not Noted DATE: N/A
N,E COORDINATES: 482021.82, 1378309.4
DATE OF INSTAL.: 01/08/88

BOREHOLE DRILLING

DRILLING METHOD: Cable Tool
DRILLING FLUID(S) USED: (in Feet)
FLUID: WATER FROM: 3 TO: 23
FLUID: N/A FROM: N/ATO: N/A
NOTES/COMMENTS:

TYPE OF BIT: Flat Head Hammer
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING
CASING DIAM.: 4 In.
CASING SIZE(S) USED: (in Feet)
SIZE: 10 FROM: 0 TO: 23
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Screen
AVG. SIZE OF PERFORATIONS: .010 (In.)
TOTAL PERFORATED AREA: 10 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: Stainless Steel
RISER PIPE DIAMETERS:
O.D.: 4 3/8 In. I.D.: 4 In.
LENGTH OF 1ST PIPE SECTION: 10 Ft.
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: THREAD AND COUPLE (FLUSH JOINT THREADED)

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5 Ft.
PROTECTIVE PIPE O.D.: 10 In.
* LOCKABLE CAP AND LOCK

OTHER PROTECTION (* NOTED BELOW)

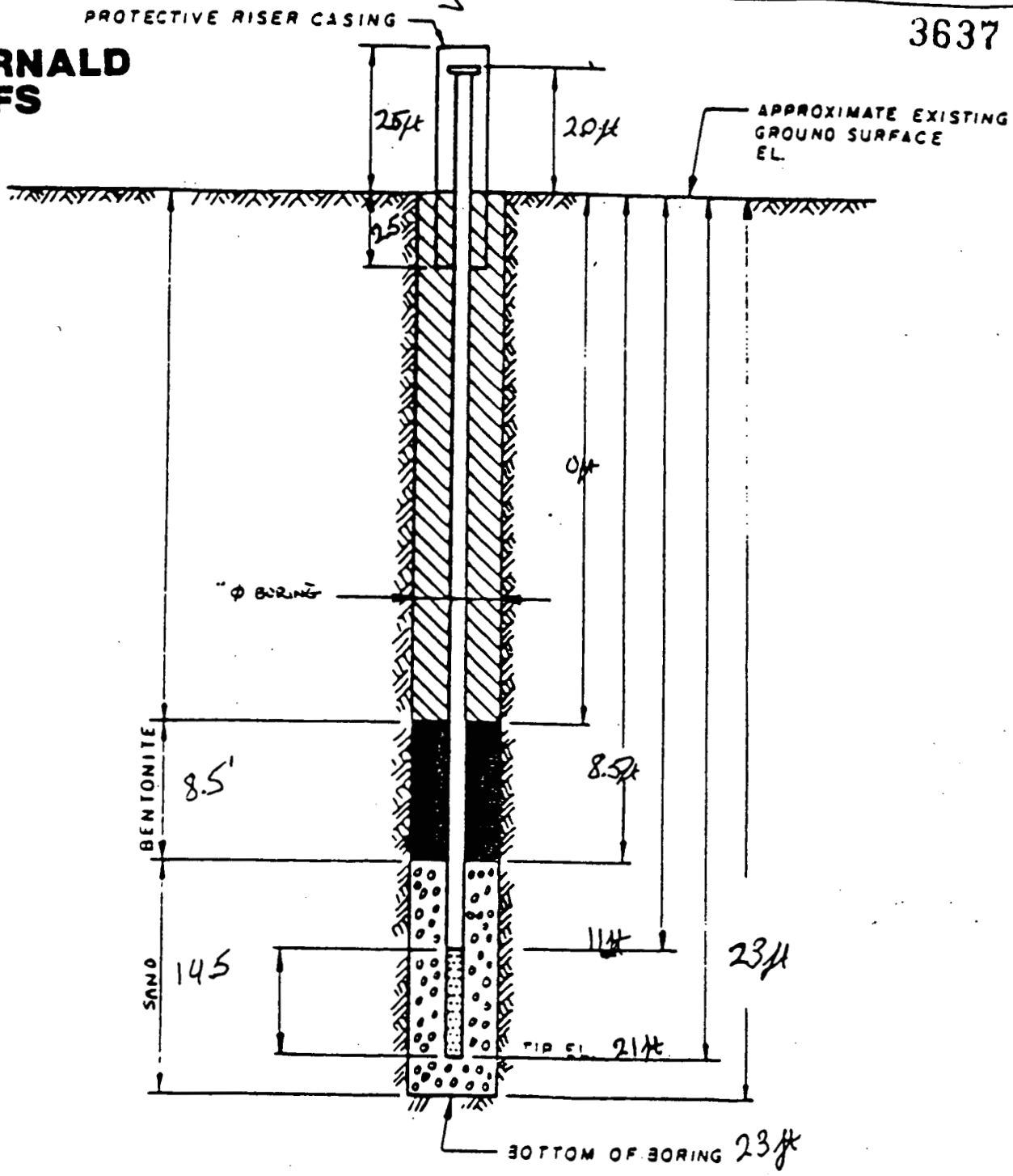
ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	2.0 Ft.		582.99	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	2.5 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
Bentonite Pellets	0	8.5	N/A	N/A
Sand	8.5	23	N/A	N/A
PERFORATED SECTION	11.0	21.0	N/A	N/A
WELL TIP	23		N/A	
BOTTOM OF BOREHOLE	23		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

Monitoring Well #125

3637

FERNALD RI/FS



DRAWING NUMBER

CHECKED BY

APPROVED BY

NOTES:

1. RISER PIPE IS 4 IN I.D. SCHEDULE PIPE, THREADED. FLUSH-JOINTED.
2. SCREEN IS 4 IN I.D. SS PIPE CONTINUOUS SLOT SCREEN (0.010 IN SLOT SIZE)
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL
5. WATER LEVEL READING ON

INSTALLATION DETAILS
MONITORING WELL 125

PREPARED FOR

Gravel From 23 - 8.5 ft
Bentonite from 8.5 - surface

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1025	COORDINATES: NORTH 482,021.82 EAST 1,378,309.45	DATE: 12/21/87
GROUND ELEVATION:	GWL: Depth N/A Date/Time N/A	DATE STARTED: 12/21/87
ENGINEER/GEOLOGIST: B. DUNNING	Depth N/A Date/Time N/A	DATE COMPLETED: 01/08/88
DRILLING METHODS: CABLE-TOOL		PAGE 1 OF 2

DEPTH	SAMPLE / DATE / TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
1.5	07800 12/21/87 1500	4 16 15	15	DENSE YELLOWISH-BROWN SAND (10YR, 5/4), WET. DENSE LIGHT GRAY GRAVEL ROCK (10YR, 6/1), WET. HARD, DARK BROWN CLAY (10YR, 4/3) WITH SOME COARSE GRAVEL, DRY	SM GW CL	N/A N/A 4.5	Hnu= 0 ppm α = 0 cpm Bγ = 80 cpm
3.0	07801 12/21/87 1504	50 43 36	9	HARD DARK BROWN CLAY (10YR, 4/3) WITH SOME COARSE GRAVEL, DRY. HARD DARK OLIVE-GRAY CLAY (5Y, 3/2) WITH SOME GRAVEL, DRY. LIGHT GRAY VERY DENSE GRAVEL (10YR, 6/1).	CL CL GP	4.5 4.5+ N/A	Hnu= 0 ppm α = 0 cpm Bγ = 60 cpm
4.5	07802 12/21/87 1645	10 13 13	18	HARD OLIVE CLAY (5Y, 4/3), DRY.	CL		Hnu= 0 ppm α = 0 cpm Bγ = 80 cpm
6.0	07803 12/22/87 1016	31 22 28	18	HARD OLIVE CLAY (5Y, 4/3), DRY. HARD, DARK OLIVE GRAY CLAY (5Y, 3/2) WITH A TRACE OF FINE GRAVEL, DRY.	CL CL	4.5+	Hnu= 0 ppm α = 0 cpm Bγ = 80 cpm
7.5	07804 12/22/87 1021	19 23 30	6	HARD DARK OLIVE GRAY CLAY (5Y, 3/2) WITH A TRACE OF FINE GRAVEL, DRY.	CL	4.5+	Hnu= 0 ppm α = 0 cpm Bγ = 60 cpm
9.0	07806 12/22/87 1351	13 17 20	15	HARD, OLIVE-GRAY CLAY (5Y, 4/2) WITH A TRACE OF FINE GRAVEL, DRY.	CL	4.5	Hnu= 0 ppm α = 0 cpm Bγ = 120 cpm
10.5	07807 12/22/87 1357	25 27 33	18	HARD, OLIVE-GRAY CLAY (5Y, 4/2) WITH A TRACE OF FINE GRAVEL, DRY. STIFF, YELLOWISH-BROWN CLAY (10YR, 5/6) SILTY AND DRY.	CL CL	4.5 1.5	Hnu= 0 ppm α = 0 cpm Bγ = 120 cpm
12.0	07808 12/22/87 1625	12 19 22	18	STIFF, YELLOWISH-BROWN CLAY (10YR, 5/6) SILTY AND DRY. HARD, BROWNISH-YELLOW CLAY (10YR, 6/8) WITH A TRACE OF FINE GRAVEL, DRY.	CL CL	1.5 4.5	Hnu= 0 ppm α = 0 cpm Bγ = 120 cpm
13.5	07809 12/23/87 0826	5 7 11	12	VERY STIFF, YELLOWISH-BROWN CLAY (10YR, 5/4) TO (10YR, 5/8) WITH A TRACE OF GRAVEL, DRY.	CL	3.5	Hnu= 0 ppm α = 0 cpm Bγ = 60 cpm
15.0	07810 12/23/87 0840	17 26 27	18	VERY STIFF, YELLOWISH-BROWN CLAY (10YR, 5/4) TO (10YR, 5/8) WITH A TRACE OF GRAVEL, DRY.	CL	3.5	Hnu= 0 ppm α = 0 cpm Bγ = 40-60 cpm

NOTES:
SAMPLES COLOR BY MUNSELL COLOR CHART AND BLOW COUNTS VIA ASTM.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1025	COORDINATES: NORTH 482,021.82 EAST 1,378,309.45	DATE: 12/21/87
GROUND ELEVATION:	GWL: Depth N/A Date/Time N/A	DATE STARTED: 12/21/87
ENGINEER/GEOLOGIST: B. DUNNING	Depth N/A Date/Time N/A	DATE COMPLETED: 01/08/88
DRILLING METHODS: CABLE-TOOL		PAGE 2 OF 2

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.5	07811 12/23/87 0935		14	SHELBY TUBE PUSHED.			Hnu= 0 ppm α = 0 cpm βΓ = 60-80 cpm
18.0	07812 01/07/88 0945	18 18 22	14	HARD, BROWNISH YELLOW CLAY, W/TRACE OF GRAVEL (5Y, 6/6) SLIGHTLY MOIST AT 18 FT.	CL	4.5	Hnu= 0 ppm α = 0 cpm βΓ = 60 cpm
19.5	07813 01/07/88 1010	29 22 27	12	HARD, BROWNISH YELLOW CLAY, W/TRACE OF GRAVEL (5Y, 6/6) SLIGHTLY MOIST AT 18 FT.	CL	4.5	Hnu= 0 ppm α = 0 cpm βΓ = 50 cpm
21.0	07814 01/07/88 1350	12 17 18	12	STIFF, DARK GRAY CLAY (10YR, 4/1), TRACE OF GRAVEL, MOIST.	CL	1.5	Hnu= 0 ppm α = 0 cpm βΓ = 60-80 cpm
22.5	07815 01/07/88 1500	3 4 3	14	STIFF, DARK GRAY CLAY (10YR, 3/1) TRACE OF GRAVEL.	CL		Hnu= 0 ppm α = 0 cpm βΓ = 80 cpm

BOTTOM OF BORING 23

NOTES:
SAMPLES COLOR BY MUNSELL COLOR CHART AND BLOW COUNTS VIA ASTM.

FERNALD RI/FS

Mostly Clay

3637

FIELD PERMEABILITY TESTS

FALLING HEAD *

PROJECT FMPC RI/FS
PROJECT NO. 602.03.02.01
BORING NO. 125

TESTED BY TS/BM DATE 5/4/88
CALCULATED BY FXM DATE 11/4/88
CHECKED BY [illegible] DATE 12/23/88
Copied By: FXM 10/31/88
Chkd By: [illegible] 12/23/88

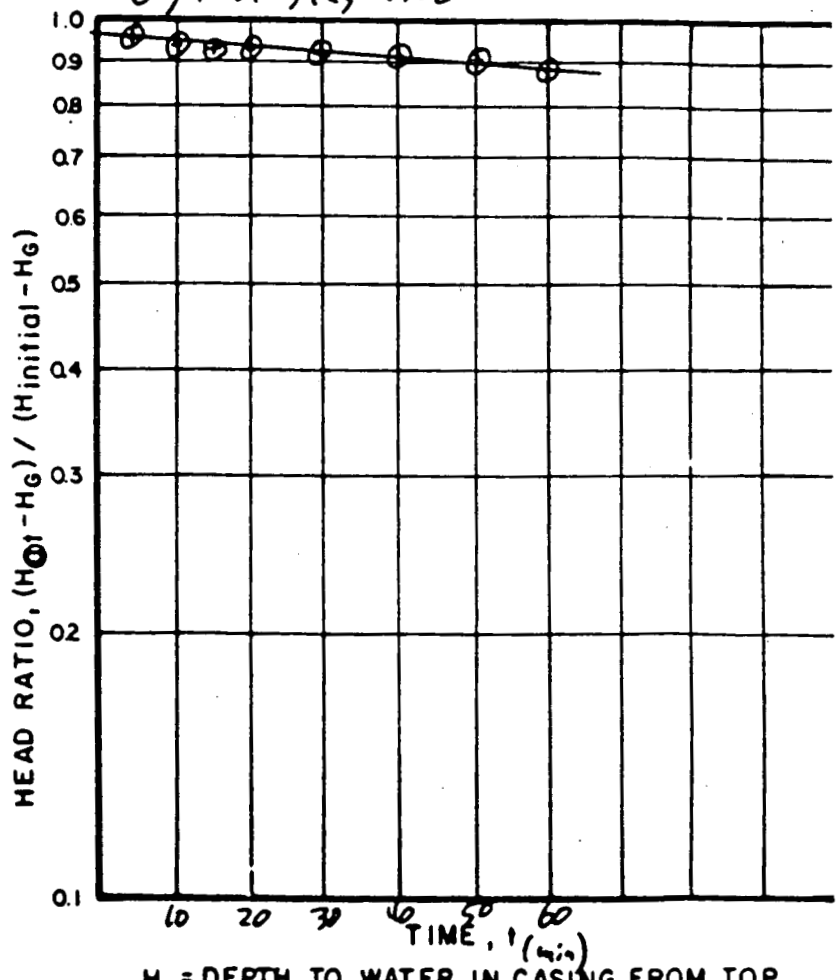
RADIUS OF TEST BORING, R 6 in (0.5 ft)
PERMEABILITY, K 2.5×10^{-6} cm/s
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C ≈ 2 ft
DEPTH TO BOTTOM OF TEST POCKET, L_1 23 ft
DEPTH TO TOP OF TEST POCKET, L_2 13 ft
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 12.7

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

HNU = 0 ppm

Start: 1032
6 gallon slug used

ELAPSED TIME t ~~min SEC.~~	DEPTH TO WATER IN CASING H ft ~~Meters~~
0	6.15
1	6.40
2	6.43
3	6.45
4	6.46
5	6.47
6	6.48
7	6.49
8	6.50
9	6.52
10	6.53
12	6.54
14	6.56
16	6.58
18	6.60
20	6.61
25	6.65
30	6.69
40	6.75
50	6.80
60	6.86



$$K = \frac{R^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

Well 125

$$\text{Head Ratio} = \frac{H_T - H_G}{H_i - H_G}$$

@ 5 min $\frac{6.47 - 12.7}{6.15 - 12.7} = 0.951$

@ 10 min $\frac{6.53 - 12.7}{6.15 - 12.7} = 0.942$

@ 16 min $\frac{6.58 - 12.7}{6.15 - 12.7} = 0.934$

@ 20 min $\frac{6.61 - 12.7}{6.15 - 12.7} = 0.930$

@ 30 min $\frac{6.69 - 12.7}{6.15 - 12.7} = 0.918$

@ 40 min $\frac{6.75 - 12.7}{6.15 - 12.7} = 0.908$

@ 50 min $\frac{6.80 - 12.7}{6.15 - 12.7} = 0.901$

@ 60 min $\frac{6.86 - 12.7}{6.15 - 12.7} = 0.892$

Permeability:

$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_6}{H_2 - H_6}\right]$$

$$= \frac{(0.167)^2}{2(20-10)(60-5)} \ln\left[\frac{20-10}{0.5}\right] \ln\left[\frac{6.47 - 12.7}{6.86 - 12.7}\right]$$

$K = 4.9 \times 10^{-6}$ ft/min

$K = 2.5 \times 10^{-6}$ cm/sec

INTERNATIONAL TECHNOLOGY CORPORATION

Wittle Date 6-11-88 Subject Head Ratio Calculations Sheet No. ___ of ___
Chkd. By LKP Date 07-10-88 for MW 125 Proj. No. 602323

$$\text{Head Ratio} = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G = Depth to ground water from TOC before slug added
H_i = Initial depth to ground water from TOC after slug added
$H_{@t}$ = Depth to ground water from TOC at time t

H_G = 12.70 ft
H_i = 6.15 ft

t = 1 minute H_t = 6.40 ft

$$HR = \frac{6.40 - 12.70}{6.15 - 12.70} = 0.962$$

time (minutes)	H (feet)	H.R (dimensionless)
1	6.40	0.962
2	6.43	0.957
3	6.45	0.954
4	6.46	0.953
5	6.47	0.951
6	6.48	0.950
7	6.49	0.948
8	6.50	0.947
9	6.52	0.944
10	6.53	0.942
12	6.54	0.940
14	6.56	0.937
16	6.58	0.934
18	6.60	0.931
20	6.61	0.930
25	6.65	0.924
30	6.69	0.918
40	6.75	0.908
50	6.80	0.901
60	6.86	0.892

INTERNATIONAL TECHNOLOGY CORPORATION

By L. Wille Date 6-11-88 Subject Head Ratio Calculations Sheet No. ___ of ___
Chkd. By LKP Date 06-19-88 For MW 12S Proj. No. 602323

$$\text{Head Ratio} = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G = Depth to ground water from TOC before slug added
H_i = Initial depth to ground water from TOC after slug added
$H_{@t}$ = Depth to ground water from TOC at time t

H_G = 12.70 ft
H_i = 6.15 ft

t = 1 minute H_t = 6.40 ft

$$HR = \frac{6.40 - 12.70}{6.15 - 12.70} = 0.962$$

time (minutes)	H (feet)	H.R (dimensionless)
1	6.40	0.962
2	6.43	0.957
3	6.45	0.954
4	6.46	0.953
5	6.47	0.951
6	6.48	0.950
7	6.49	0.948
8	6.50	0.947
9	6.52	0.944
10	6.53	0.942
12	6.54	0.940
14	6.56	0.937
16	6.58	0.934
18	6.60	0.931
20	6.61	0.930
25	6.65	0.924
30	6.69	0.918
40	6.75	0.908
50	6.80	0.901
60	6.86	0.892

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IN-SITU INC. HERMIT DATA MANAGEMENT PACKAGE

MONITORING WELL 12S

SLUG/SWAB TEST

Ref. Value : 12.70 (Ft)
H(0) : 6.55 (Ft)
T(0) : .00 (Min)

ELAPSED TIME (Min)	VALUE (Ft)	HD/DRWDN (Ft)	DELTA TIME (Min)	H/H(0)
1.0000	6.40	6.30	.9990	.962
2.0000	6.43	6.27	1.9990	.957
3.0000	6.45	6.25	2.9990	.954
4.0000	6.46	6.24	3.9990	.953
5.0000	6.47	6.23	4.9990	.951
6.0000	6.48	6.22	5.9990	.950
7.0000	6.49	6.21	6.9990	.948
8.0000	6.50	6.20	7.9990	.947
9.0000	6.52	6.18	8.9990	.944
10.0000	6.53	6.17	9.9990	.942
12.0000	6.54	6.16	11.9990	.940
14.0000	6.56	6.14	13.9990	.937
16.0000	6.58	6.12	15.9990	.934
18.0000	6.60	6.10	17.9990	.931
20.0000	6.61	6.09	19.9990	.930
25.0000	6.65	6.05	24.9990	.924
30.0000	6.69	6.01	29.9990	.918
40.0000	6.75	5.95	39.9990	.908
50.0000	6.80	5.90	49.9990	.901
60.0000	6.86	5.84	59.9990	.892

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IN-SITU INC. HERMIT DATA MANAGEMENT PACKAGE

MONITORING WELL 125

SLUG/SWAB TEST

Ref. Value : 12.70 (Ft)
H(0) : 6.55 (Ft)
T(0) : .00 (Min)

ELAPSED TIME (Min)	VALUE (Ft)	HD/DRWDN (Ft)	DELTA TIME (Min)	H/H(0)
1.0000	6.40	6.30	.9990	.962
2.0000	6.43	6.27	1.9990	.957
3.0000	6.45	6.25	2.9990	.954
4.0000	6.46	6.24	3.9990	.953
5.0000	6.47	6.23	4.9990	.951
6.0000	6.48	6.22	5.9990	.950
7.0000	6.49	6.21	6.9990	.948
8.0000	6.50	6.20	7.9990	.947
9.0000	6.52	6.18	8.9990	.944
10.0000	6.53	6.17	9.9990	.942
12.0000	6.54	6.16	11.9990	.940
14.0000	6.56	6.14	13.9990	.937
16.0000	6.58	6.12	15.9990	.934
18.0000	6.60	6.10	17.9990	.931
20.0000	6.61	6.09	19.9990	.930
25.0000	6.65	6.05	24.9990	.924
30.0000	6.69	6.01	29.9990	.918
40.0000	6.75	5.95	39.9990	.908
50.0000	6.80	5.90	49.9990	.901
60.0000	6.86	5.84	59.9990	.892

B:\

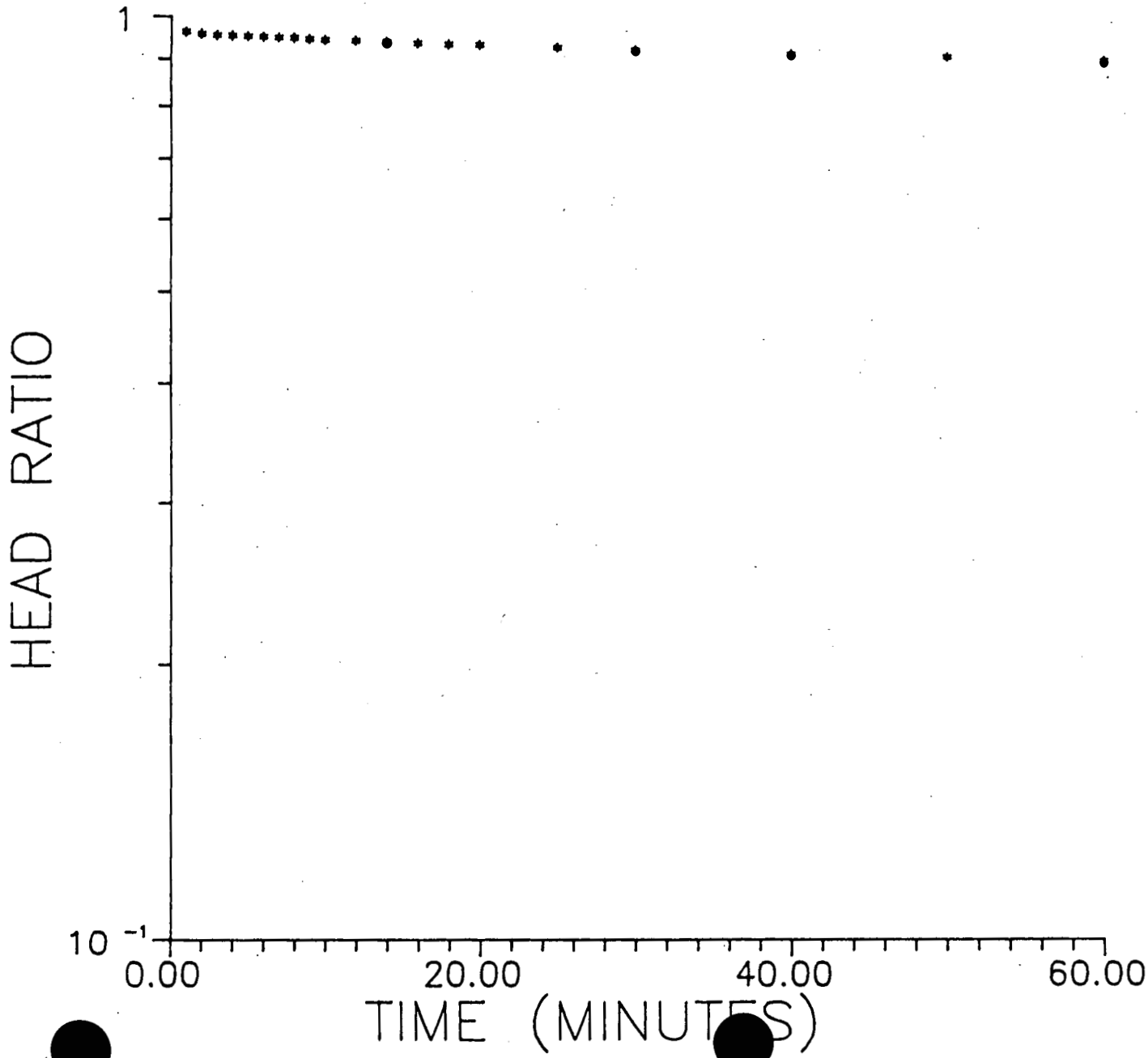
LKP 07-10-88

3637

TITLE: 1.00

Press / for commands

A	B	C	D	E
1.00	6.1[illegible]	0.962		
2.00	6.[illegible]3	0.957		
3.00	[illegible]	[illegible]		
4.00	[illegible]	[illegible]		
5.00	6.[illegible]7	0.[illegible]		
6.00	6.15	0.950		
7.00	[illegible]	[illegible]		
8.00	6.5[illegible]	0.947		
9.00	6.52	0.944		
10.00	6.53	0.942		
12.00	6.54	0.940		
14.00	6.56	0.937		
16.00	6.58	0.934		
18.00	6.60	0.931		
20.00	6.61	0.930		
25.00	6.65	0.924		
30.00	6.69	0.918		
40.00	6.77	0.908		
50.00	6.80	0.901		
60.00	6.86	0.892		


1
10 -1
HEAD RATIO
0.00
20.00
40.00
60.00
TIME (MINUTES)

LKP 5-10-88

3637

VALUE: 1.00

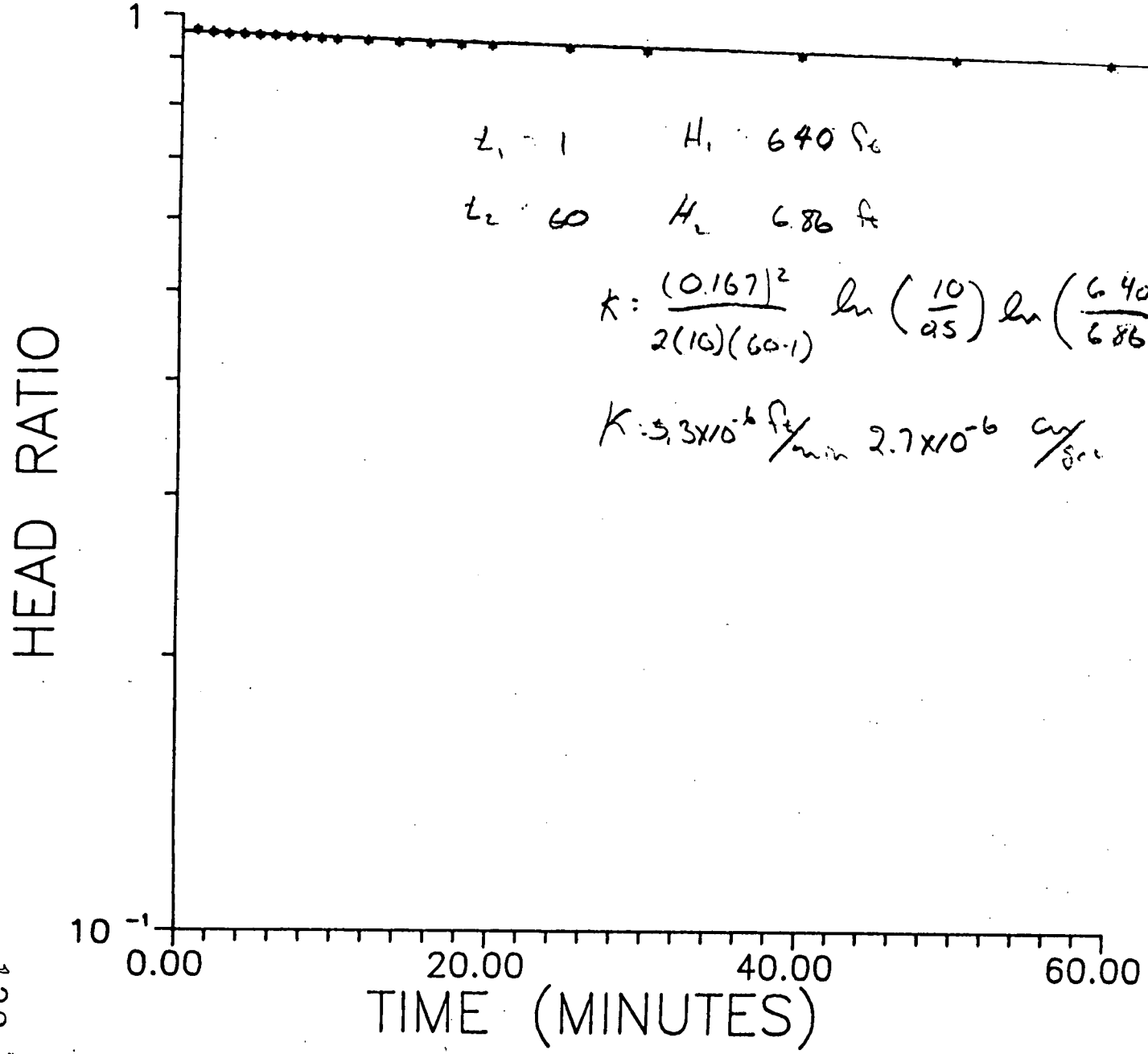
Press / for commands

	A	B	C	D	E
1	1.00	6.40	0.962		
2	2.00	6.43	0.957		
3	3.00	6.45	0.954		
4	4.00	6.46	0.953		
5	5.00	6.47	0.951		
6	6.00	6.48	0.950		
7	7.00	6.49	0.948		
8	8.00	6.50	0.947		
9	9.00	6.52	0.944		
10	10.00	6.53	0.942		
11	12.00	6.54	0.940		
12	14.00	6.56	0.937		
13	16.00	6.58	0.934		
14	18.00	6.60	0.931		
15	20.00	6.61	0.930		
16	25.00	6.65	0.924		
17	30.00	6.69	0.918		
18	40.00	6.75	0.908		
19	50.00	6.80	0.901		
20	60.00	6.86	0.892		
21					
22					

MW 125

$r_1 = 4\,in = 0.167\,ft$

$r_2 = 6\,in = 0.5\,ft$



$t_1 = 1 \qquad H_1 = 6.40\,ft$

$t_2 = 60 \qquad H_2 = 6.86\,ft$

$$K = \frac{(0.167)^2}{2(10)(60-1)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{6.40-12.7}{6.86-12.7}\right)$$

$K = 5.3\times10^{-6}\,ft/min \quad 2.7\times10^{-6}\,cm/sec$

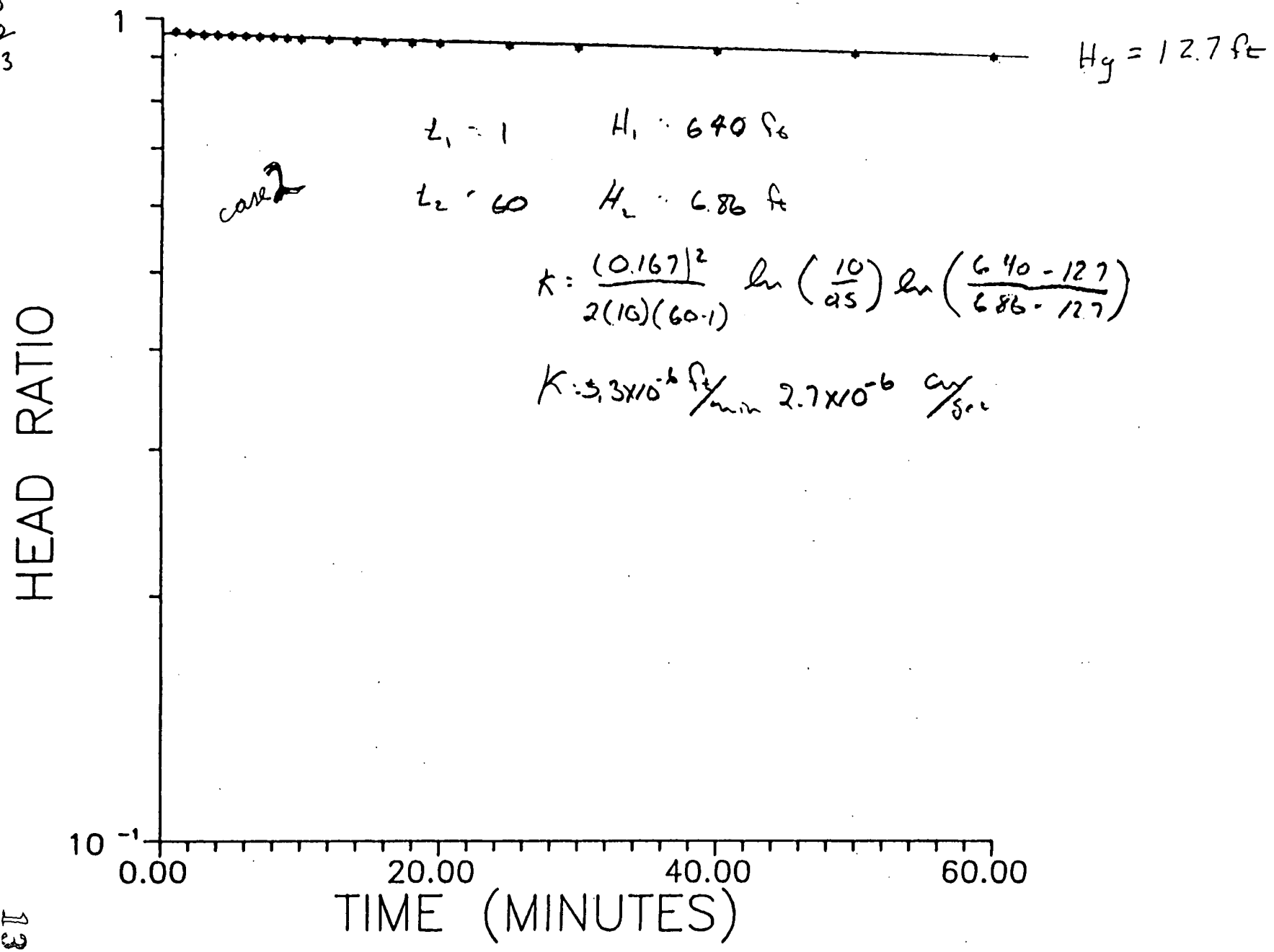
checked by [illegible]
7-9-82

MW 125

r_1 = [illegible]

r_2 = 6 in = 0.5 ft

25.7
-2.4
23.3
.10
13.3



case 2

$t_1 = 1$ $H_1 = 6.40$ ft

$t_2 = 60$ $H_2 = 6.86$ ft

$$K = \frac{(0.167)^2}{2(10)(60-1)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{6.40-12.7}{6.86-12.7}\right)$$

$K = 5.3 \times 10^{-6}$ ft/min 2.7×10^{-6} cm/sec

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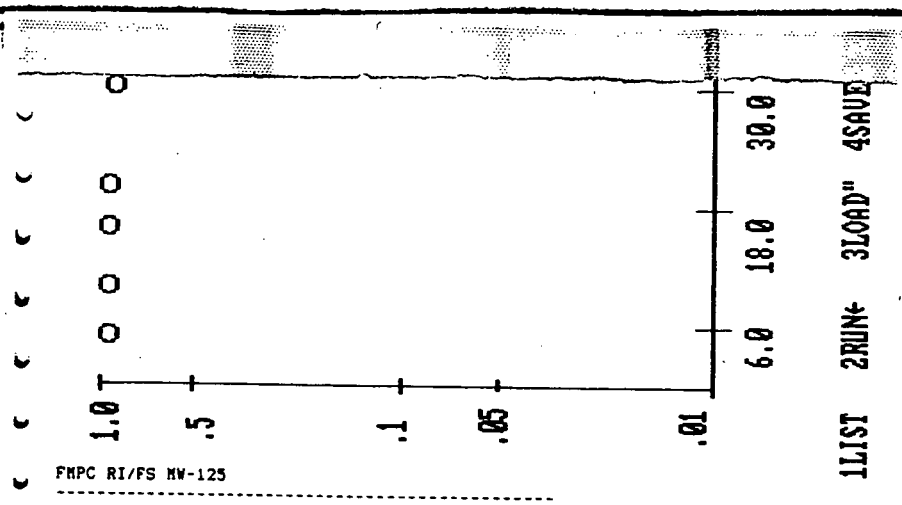


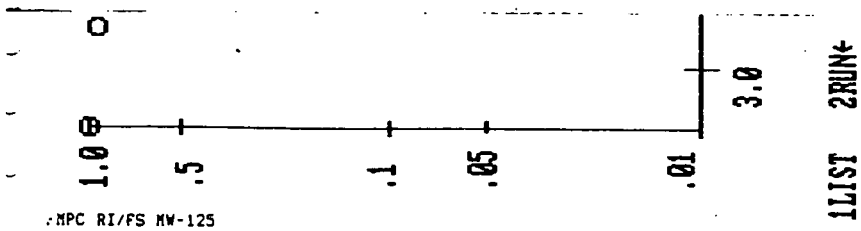
FMPC RI/FS MW-125

TIME (seconds)	WATER LEVEL (feet)	DRAWDOWN (feet)	H/H0
300	6.47	-6.23	.9511451
600	6.53	-6.17	.9419847
960	6.58	-6.12	.9343511
1200	6.61	-6.09	.929771
1800	6.69	-6.01	.9175572
2400	6.75	-5.95	.9083969
3000	6.8	-5.90	.9007634
3600	6.86	-5.84	.8916031

UNCONFINED AQUIFER

K = 2.4E-06 cm/sec
= 0.1 gpd/ft2
= 8.0E-08 ft/sec
= 0.0 ft/day

REGRESSION COEFFICIENT = .9942362



FMPC RI/FS MW-125

TIME (seconds)	WATER LEVEL (feet)	DRAWDOWN (feet)	H/H0
0	6.15	-6.55	1
300	6.47	-6.23	.9511451
600	6.53	-6.17	.9419847
840	6.56	-6.14	.9374046
1200	6.61	-6.09	.929771
1500	6.65	-6.05	.9236641
1800	6.69	-6.01	.9175572

early data

UNCONFINED AQUIFER

K = 5.0E-06 cm/sec
= 0.1 gpd/ft2
= 1.6E-07 ft/sec
= 0.0 ft/day

REGRESSION COEFFICIENT = .8839694

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1031
WELL NUMBER: 1031

FIELD ENG./GEO.: M. GOLDBERG DATE: 04/07/88
CHECKED BY : Not Noted DATE: N/A
N,E COORDINATES: 481167.08, 1378136.5
DATE OF INSTAL.: 04/07/88

BOREHOLE DRILLING

DRILLING METHOD: Cable Tool
DRILLING FLUID(S) USED: (in Feet)
FLUID: WATER FROM: 3 TO: 30
FLUID: N/A FROM: N/ATO: N/A
NOTES/COMMENTS:

TYPE OF BIT: Flat Head Hammer
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING
CASING DIAM.:
CASING SIZE(S) USED: (in Feet)
SIZE: 10 FROM: 0 TO: 30
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Screen
AVG. SIZE OF PERFORATIONS: .010 (In.)
TOTAL PERFORATED AREA: 10 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: Stainless Steel
RISER PIPE DIAMETERS:
O.D.: 4 3/8 In. I.D.: 4 In.
LENGTH OF 1ST PIPE SECTION: 10 Ft.
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: THREAD AND COUPLE

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5 Ft.
PROTECTIVE PIPE O.D.: 10 In.
* LOCKABLE CAP

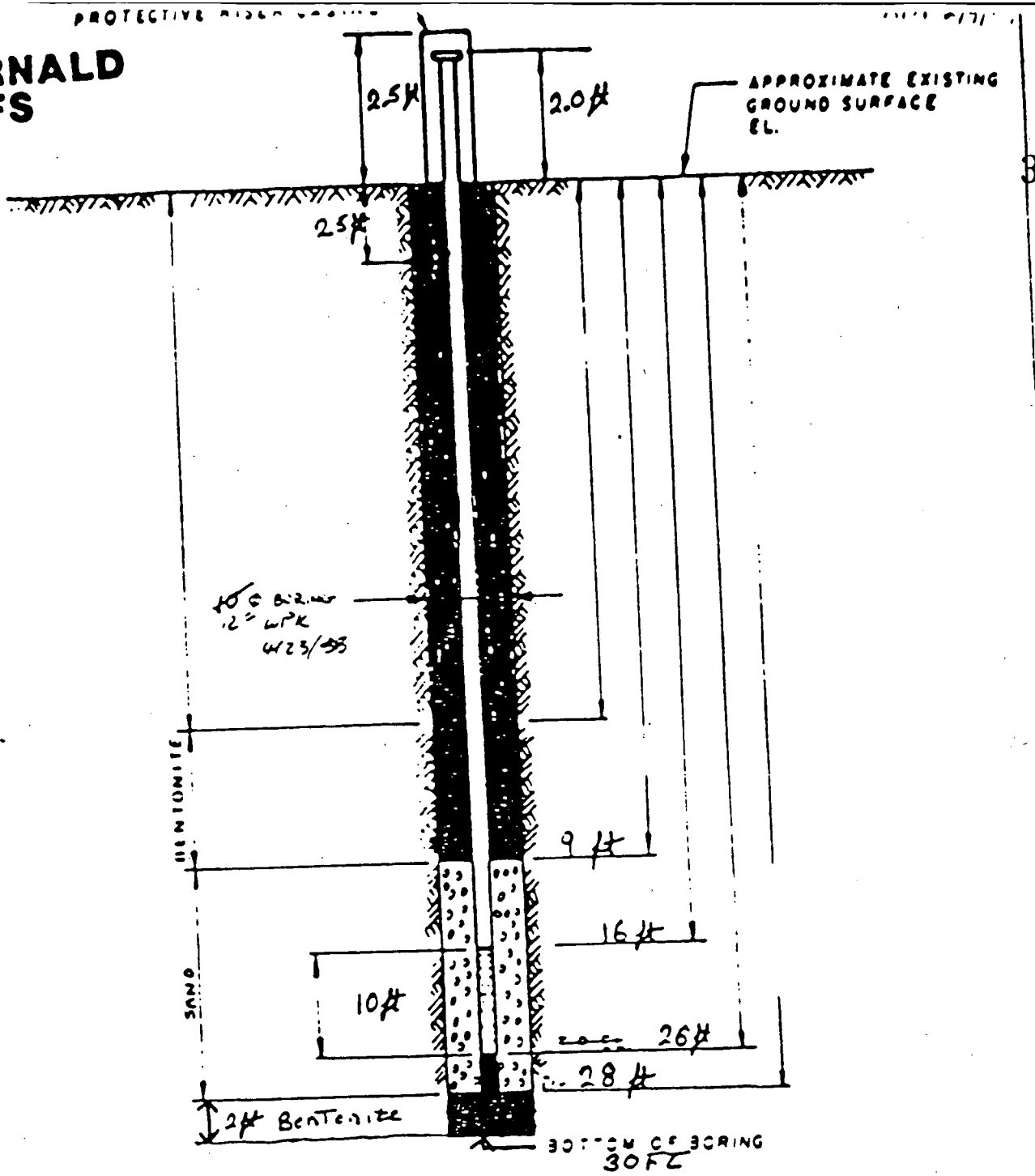
OTHER PROTECTION (* NOTED BELOW)

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE	ELEVATION MSL
TOP OF RISER PIPE	2.0 Ft.	577.75
GROUND SURFACE	0.0	N/A
BOTTOM OF PROTECTIVE PIPE	2.5 Ft.	

BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
Bentonite Pellets	0	9	N/A	N/A
Gravel	9	28	N/A	N/A
PERFORATED SECTION	16	26	N/A	N/A
WELL TIP	28		N/A	
BOTTOM OF BOREHOLE	30		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

FERNALD RI/FS



3637

DRAWN BY
CHECKED BY
APPROVED BY
DRAW NUM

NOTES

1. RISER PIPE IS 4 IN I.D SCHEDULE PIPE, THREADED FLUSH-JOINTED
2. SCREEN IS 4 IN I.D SS PIPE CONTINUOUS SLOT SCREEN (0.010 IN SLOT SIZE)
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL
5. WATER LEVEL READING ON

INSTALLATION DETAILS
MONITORING WELL

PREPARED FOR
FMPC RI/FS

VISUAL CLASSIFICATION OF SOILS

3637

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1031	COORDINATES: NORTH 481,167.08 EAST 1,378,136.55	DATE: 04/05/88
GROUND ELEVATION:	GWL: Depth N/A Date/Time N/A	DATE STARTED: 04/05/88
ENGINEER/GEOLOGIST: M. GOLDBERG	Depth N/A Date/Time N/A	DATE COMPLETED: 04/07/88
DRILLING METHODS: CABLE-TOOL		PAGE 1 OF 2

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
1.5	08832 04/05/88 0915	2 9 13	10	HARD VERY DARK GRAYISH BROWN CLAY (10YR, 3/2), DRY.	CL	>4	Hnu= 0 ppm α = 0 cpm βΓ = 260 cpm
3.0	08833 04/05/88 0920	6 6 8	12	HARD DARK BROWN CLAY (10YR, 4/3), DRY.	CL	>4	Hnu= 0 ppm α = 0 cpm βΓ = 260 cpm
4.5	08834 04/05/88 0925	21 10 11	12	VERY STIFF DARK BROWN CLAY (10YR, 4/3) DRY.	CL	>4	Hnu= 0 ppm α = 0 cpm βΓ = 200 cpm
6.0	08835 04/05/88 0930	9 11 7	10	VERY STIFF DARK BROWN CLAY (10YR, 4/3), DRY. MEDIUM STIFF GRAY CLAY (5Y, 5/1), MOIST, TRACE GRAVEL.	CL CL	>4 <1	Hnu= 0 ppm α = 0 cpm βΓ = 200 cpm
7.5	08836 04/05/88 0935	8 11 7	10	MEDIUM STIFF DARK BROWN CLAY (10YR, 4/3), MOIST.	CL	<1	Hnu= 0 ppm α = 0 cpm βΓ = 220 cpm
9.0	08837 04/05/88 0937	9 11 12	12	MEDIUM STIFF GRAY CLAY (5Y, 5/1) DRY, TRACE GRAVEL.	CL	<1	Hnu= 0 ppm α = 0 cpm βΓ = 210 cpm
10.5	08839 08838 04/05/88 0940	16 11 13	18	MEDIUM STIFF, GRAY CLAY (5Y, 5/1) DRY, TRACE GRAVEL. MEDIUM STIFF, YELLOWISH BROWN CLAY (10YR, 5/8) MOIST, TRACE GRAVEL.	CL CL	<1 <1	Hnu= 0 ppm α = 0 cpm βΓ = 210 cpm
12.0	08840 04/05/88 1400	4 5 9	18	MEDIUM STIFF OLIVE GRAY CLAY (5Y, 4/2) DRY, TRACE GRAVEL.	CL	<1	Hnu= 0 ppm α = 0 cpm βΓ = 210 cpm
13.5	08841 04/05/88 1410	5 7 11	18	MEDIUM STIFF OLIVE GRAY CLAY (5Y, 4/2) DRY, TRACE GRAVEL. MEDIUM STIFF VERY DARK GRAY (2.5Y, 3/0) TRACE GRAVEL.	CL CL	<1 <1	Hnu= 0 ppm α = 0 cpm βΓ = 210 cpm
15.0	08842 04/05/88 1415	7 5 12	10	MEDIUM STIFF OLIVE GRAY CLAY (5Y, 4/2) DRY, TRACE GRAVEL.	CL	<1	Hnu= 0 ppm α = 0 cpm βΓ = 210 cpm

NOTES:
COLOR VIA MUNSELL COLOR CHART

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1031	COORDINATES: NORTH 481,167.08 EAST 1,378,136.55	DATE: 04/05/88
GROUND ELEVATION:	GWL: Depth N/A Date/Time N/A	DATE STARTED: 04/05/88
ENGINEER/GEOLOGIST: M. GOLDBERG	Depth N/A Date/Time N/A	DATE COMPLETED: 04/07/88
DRILLING METHODS: CABLE-TOOL		PAGE 2 OF 2

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.5	08843 04/05/88 1500	4 5 11	18	MEDIUM STIFF DARK GRAY CLAY (5Y, 4/1) DRY, TRACE GRAVEL.	CL	<1	Hnu= 0 ppm α = 0 cpm βΓ = 200 cpm
18.0	08844 04/05/88 1510	4 10 10	16	MEDIUM STIFF DARK GRAY CLAY (5Y, 4/1) DRY, TRACE GRAVEL.	CL	<1	Hnu= 0 ppm α = 0 cpm βΓ = 200 cpm
19.5	08845 04/05/88 1645		18	SHELBY TUBE.			
21.0	08846 04/07/88 0930	2 2 2	8	MEDIUM STIFF YELLOWISH BROWN CLAY (10YR, 5/6) TRACE GRAVEL.	CL	<1	Hnu= 0 ppm α = 0 cpm βΓ = 200 cpm
22.5	08847 04/07/88 0940	5 4 7	10	STIFF DARK YELLOWISH BROWN CLAY (10YR, 4/6), TRACE GRAVEL, DRY	CL	1.5	Hnu= 0 ppm α = 0 cpm βΓ = 240 cpm
24.0	08848 04/07/88 0955	16 13 14	6	STIFF DARK YELLOWISH BROWN CLAY (10YR, 5/6), TRACE GRAVEL. TRACE GRAY CLAY (5Y, 5/1).	CL	1.5	Hnu= 0 ppm α = 0 cpm βΓ = 240 cpm
25.5	08849 04/07/88 1040	15 22 50	18	VERY DENSE DARK BROWN SANDY SILT (10YR, 4/3) DRY, NO CLAY.	SM	4.0	Hnu= 0 ppm α = 0 cpm βΓ = 240 cpm
27.0	08850 04/07/88 1055	14 32 36	18	VERY DENSE DARK BROWN SANDY SILT (10YR, 4/3) DRY, NO CLAY. VERY HARD YELLOWISH BROWN CLAY WITH SILT (10YR, 4/8) DRY, TRACE GRAVEL.	SM CL	4.0 4.0	Hnu= 0 ppm α = 0 cpm βΓ = 240 cpm
28.5	08851 04/07/88 1300	16 22 37	18	VERY HARD GRAYISH BROWN CLAY (2.5Y, 5/2) DRY, TRACE GRAVEL.	CL	>4.0	Hnu= 0 ppm α = 0 cpm βΓ = 240 cpm
30.0	08852 04/07/88 1315	20 22 17	18	VERY HARD GRAYISH BROWN CLAY (2.5Y, 5/2) DRY, TRACE GRAVEL. DENSE YELLOWISH BROWN SAND (10YR, 5/8), DRY.	CL SW	>4.0 <1	Hnu= 0 ppm α = 0 cpm βΓ = 200 cpm

BOTTOM OF BORING 30

NOTES:
COLOR VIA MUNSELL COLOR CHART

FIELD PERMEABILITY TESTS
FALLING HEAD*

3637

PROJECT: FMPC RI/FS
PROJECT NO.: 602.3.7.4
BORING NO.: MW-1031

TESTED BY: MS — DATE: 10-11-90
CALCULATED BY: MS — DATE: 10-23-90
CHECKED BY: CY — DATE: 11/2/90

RADIUS OF WELL, ~~R~~ r = 2 in = 0.167 FT
RADIUS OF TEST BORING, R = 0.4479
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C = 2.0 FT off - logs
DEPTH TO BOTTOM OF TEST POCKET, L_1 = ~~28.0 FT~~ 30 FT
DEPTH TO TOP OF TEST POCKET, L_2 = 24.95 FT ; 24.861
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G = 24.95 FT

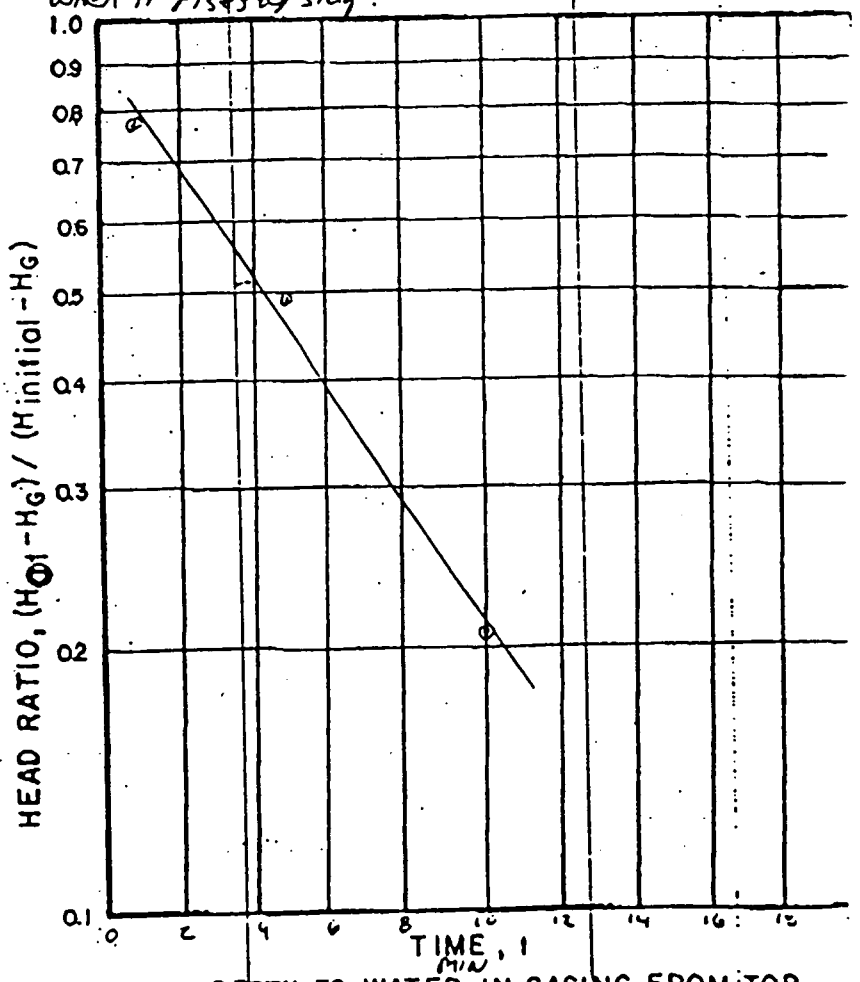
HYDRAULIC CONDUCTIVITY, K = ~~1.82×10⁻⁵ FT/SEC~~ 1.39×10⁻⁵ FT/SEC AND 1.40×10⁻⁵ FT/SEC

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

make 2 calcs. 1) w/ top being intial WL - m spe ← first Reference pt
2) Top of Test Pocket the reading when it rises w/ slug.

Bottom of screen → Top of screen → out if WL is below screen then

ELAPSED TIME t ~~SEC~~ MIN	DEPTH TO WATER IN CASING H FEET	
0	24.861	~~25.034~~
.1	24.868	~~25.032~~
1	24.880	
2	24.887	
5	24.906	
10	24.931	
15	24.937	
20	24.943	
30	24.95	



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1
H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

HYDRAULIC CONDUCTIVITY CALCULATIONS FOR MW-1031

$$\text{HEAD RATIO} = \frac{H_{@t} - H_G}{H_i - H_G}$$

WHERE: H_G = DEPTH TO GROUND WATER BELOW TOC BEFORE SLUG IS ADDED

H_i = INITIAL DEPTH TO GROUND WATER BELOW TOC AFTER SLUG IS ADDED

$H_{@t}$ = DEPTH TO GROUND WATER BELOW TOC AT TIME = t

HR

.1 MIN: $\frac{24.868 - 24.95}{24.861 - 24.95} = \frac{.082}{.089} = .921$

1 MIN: $\frac{24.88 - 24.95}{24.861 - 24.95} = \frac{.07}{.089} = .787$

5 MIN: $\frac{24.906 - 24.95}{24.861 - 24.95} = \frac{.044}{.089} = .494$

10 MIN: $\frac{24.931 - 24.95}{24.861 - 24.95} = \frac{.019}{.089} = .213$

20 MIN: $\frac{24.943 - 24.95}{24.861 - 24.95} = \frac{.007}{.089} = .079$

$$\text{HYDRAULIC CONDUCTIVITY} = K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_i - H_G}{H_2 - H_G}\right]$$

$$\Rightarrow K = \frac{(0.167)^2}{2(\cancel{28-24.95}\ 30-24.95)(20-.1)} \ln\left[\frac{\cancel{28-24.95}\ 30-24.95}{0.4479}\right] \ln\left[\frac{24.868-24.95}{24.943-24.95}\right]$$

$$\cancel{= (0.00023)(1.918)(2.461)}$$

$$\cancel{= [.04 \times 10^{-3}\ FT/MIN]}$$

$$\cancel{= 1.824 \times 10^{-5}\ FT/SEC}$$

$$= (0.00014)(2.423)(2.461)$$

$$= 8.35 \times 10^{-4}\ FT/MI$$

$$= 1.39 \times 10^{-5}\ FT/S$$

ALSO

$$K = \frac{(0.167)^2}{2(30-24.861)(20-.1)} \ln\left[\frac{30-24.861}{0.4474}\right] \ln\left[\frac{24.868-24.95}{24.943-24.95}\right]$$

$$= (0.00014)(2.44)(2.461) = 8.41 \times 10^{-4}\ FT/M$$

$$= 1.4 \times 10^{-5}\ FT/S$$

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1034
WELL NUMBER: 1034

FIELD ENG./GEO.: W. MONTGOMERY DATE: 04/06/88
CHECKED BY : Not Noted DATE: N/A
N,E COORDINATES: 480240.85, 1378410.2
DATE OF INSTAL.: 04/07/88

BOREHOLE DRILLING

DRILLING METHOD: Cable Tool
DRILLING FLUID(S) USED: (in Feet)
FLUID: WATER FROM: 0 TO: 20
FLUID: N/A FROM: N/ATO: N/A
NOTES/COMMENTS:

TYPE OF BIT: Flat Head Hammer
IS CASING TEMPORARY?: N/A
CASING TYPE : MONITORING WELL
CASING DIAM.: 4 In.
CASING SIZE(S) USED: (Units N/A)
SIZE: FROM: N/A TO: N/A
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Screen
AVG. SIZE OF PERFORATIONS: 0.010 (In.)
TOTAL PERFORATED AREA: 10. Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: Stainless Steel
RISER PIPE DIAMETERS:
O.D.: 4 3/8 In. I.D.: 4 In.
LENGTH OF 1ST PIPE SECTION: 2 Ft.
2ND PIPE SECTION: 10 Ft.
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: THREADED COUPLE

PROTECTION SYSTEM

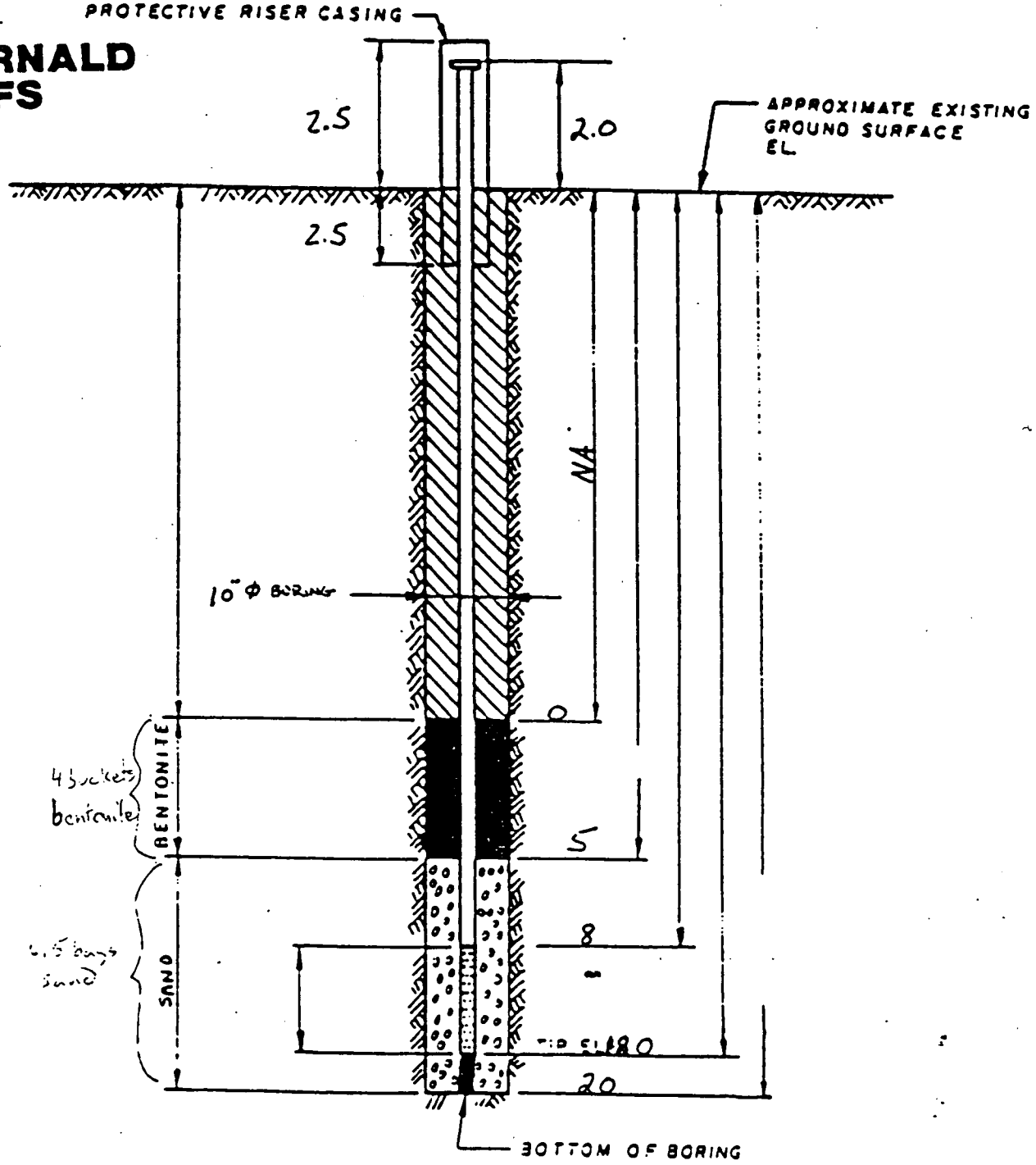
RISER PROTECTIVE PIPE LENGTH: 5 Ft.
PROTECTIVE PIPE O.D.: 10 3 In.
* LOCKING CAP W/MASTER LOCK

OTHER PROTECTION (* NOTED BELOW)

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	N/A		571.29	
GROUND SURFACE	0.0		569.2	
BOTTOM OF PROTECTIVE PIPE	2.5 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
Bentonite Pellets	0.0	5.0	N/A	N/A
Sand	5.0	20.0	N/A	N/A
PERFORATED SECTION	8.0	18.0	N/A	N/A
WELL TIP	20.0		N/A	
BOTTOM OF BOREHOLE	20.0		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

FERNALD RI/FS



NOTES:

1. RISER PIPE IS 4 IN 10 SCHEDULE PIPE, THREADED, FLUSH-JOINTED.
2. SCREEN IS 4 IN 1.0 SS PIPE CONTINUOUS SLOT SCREEN (0.010 IN SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL
5. WATER LEVEL READING ON DRY

INSTALLATION DETAILS
MONITORING WELL

PREPARED FOR
Fernald RI/FS

134

DRAWING NUMBER

CHECKED BY

APPROVED BY

DRAWN BY

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1034	COORDINATES: NORTH 480,240.85 EAST 1,378,410.28	DATE: 04/07/88
GROUND ELEVATION: 569.2	GWL: Depth N/A Date/Time N/A	DATE STARTED: 04/07/88
ENGINEER/GEOLOGIST: W. MONTGOMERY	Depth N/A Date/Time N/A	DATE COMPLETED: 04/07/88
DRILLING METHODS: CABLE-TOOL		PAGE 1 OF 1

DEPTH	SAMPLE	DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
18.0								
19.0	08307 04/07/88 1550				MEDIUM DENSE DARK GRAY (5Y, 4/1) SANDY CLAY WITH SOME GRAVEL AND TRACE SILT, MOIST.. PUSHED SHELBY TUBE 11 INCHES AND RECOVERED 8.5 INCHES..		3.0	
					BOTTOM OF BORING 20.0			

NOTES:

Mostly Clay w/ Gravel
Some Sand Silt

FERNALD RI/FS

3637

FIELD PERMEABILITY TESTS

FALLING HEAD *

PROJECT FMPC RI/FS
PROJECT NO. 602.03.02.01
BORING NO. 134

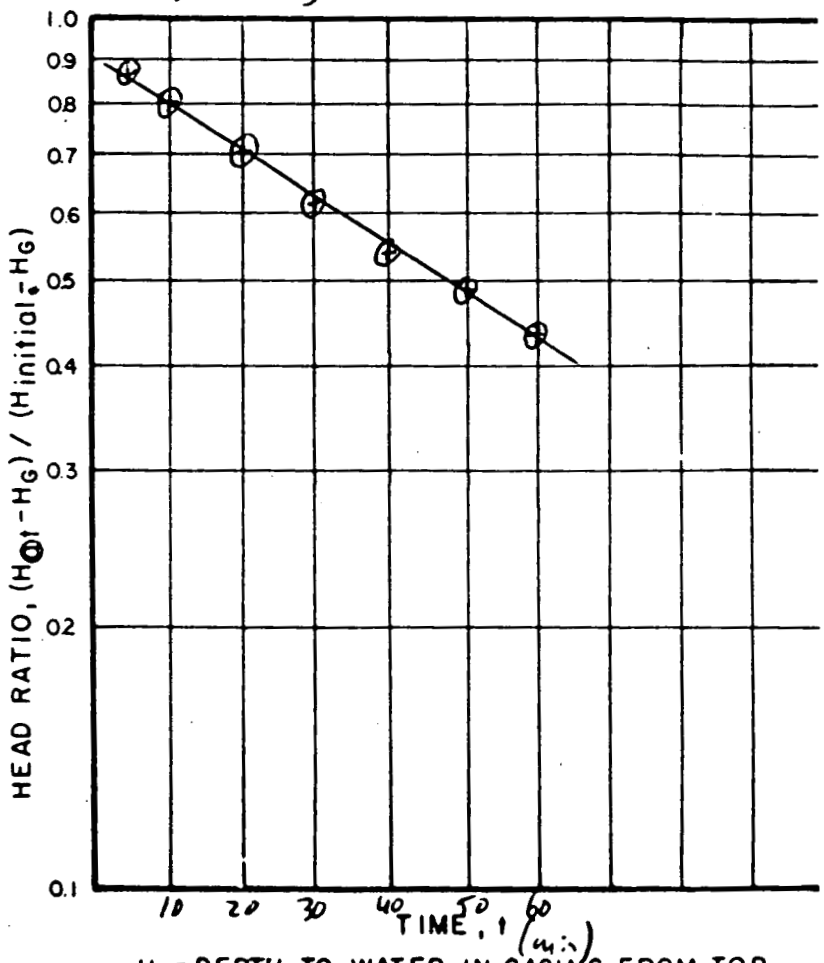
TESTED BY TS/BM DATE 4/27/88
CALCULATED BY FXM DATE 11/4/88
CHECKED BY [illegible] DATE 12/28/88
Copied By: FXM 10/31/88
Ckd By: [illegible] 12/28/88

RADIUS OF TEST BORING, R 0.5 ft
PERMEABILITY, K 2.5×10^{-5} cm/s
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C ≈ 2 ft
DEPTH TO BOTTOM OF TEST POCKET, L_1 20 ft
DEPTH TO TOP OF TEST POCKET, L_2 10 ft
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 4.25 ft

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

Start Test 1610
4 gal slug used

ELAPSED TIME t min ~~SEC.~~	DEPTH TO WATER IN CASING H ft. ~~Meters~~
1	0.3
2	0.5
3	0.62
4	0.75
5	0.82
6	0.88
7	0.95
8	1.00
9	1.05
10	1.10
12	1.18
14	1.27
16	1.35
18	1.43
20	1.50
25	1.67
30	1.82
40	2.10
50	2.32
60	2.50



$$K = \frac{R^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

INTERNATIONAL TECHNOLOGY CORPORATION

FXM Date 11/4/88 Subject Slug Test Calculations Sheet No. 2 of 3
Chkd. By ___ Date ___ Well 134 Proj. No. 602.03.02.01

Well 134

$$\text{Head Ratio} = \frac{H_T - H_6}{H_i - H_6}$$

@ 5 min $\frac{0.82 - 4.25}{0.3 - 4.25} = 0.87$

@ 10 min $\frac{1.10 - 4.25}{0.3 - 4.25} = 0.80$

@ 20 min $\frac{1.50 - 4.25}{0.3 - 4.25} = 0.70$

@ 30 min $\frac{1.82 - 4.25}{0.3 - 4.25} = 0.61$

@ 40 min $\frac{2.10 - 4.25}{0.3 - 4.25} = 0.54$

@ 50 min $\frac{2.32 - 4.25}{0.3 - 4.25} = 0.49$

@ 60 min $\frac{2.50 - 4.25}{0.3 - 4.25} = 0.44$

EXM Date 11/4/88 Subject Slug Test Calculations Sheet No. 3 of 3
Chkd. By ___ Date ___ Well 134 Proj. No. 602.03.02.01

Permeability:

$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

$$\frac{(0.167)^2}{2(20-10)(60-10)} \ln\left[\frac{20-10}{0.5}\right] \ln\left[\frac{1.10-4.25}{2.50-4.25}\right]$$

$K = 4.9 \times 10^{-5}$ ft/min

$K = 2.5 \times 10^{-5}$ cm/s

INTERNATIONAL TECHNOLOGY CORPORATION

3637

L Wille Date 6-11-88 Subject Head Ratio Calculations Sheet No. ___ of ___
Chkd. By LKP Date 06-19-88 for MW 134 Proj. No. 602323

$$HR = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G = Depth to ground water below TOC before slug added
H_i = Initial depth to ground water below TOC after slug added
$H_{@t}$ = Depth to ground water below TOC at time t

at t = 1 minute
H = 0.3 ft

$$HR = \frac{0.3 - 4.25}{0 - 4.25} = 0.929$$

$H_G = 4.25$ ft
$H_i = 0$ ft

time (minutes)	H (feet)	HR (dimensionless)
1	0.30	0.929
2	0.50	0.882
3	0.62	0.854
4	0.75	0.824
5	0.82	0.807
6	0.88	0.793
7	0.95	0.776
8	1.00	0.765
9	1.05	0.753
10	1.10	0.741
12	1.18	0.722
14	1.27	0.701
16	1.35	0.682
18	1.43	0.664
20	1.50	0.647
25	1.67	0.607
30	1.82	0.572
40	2.10	0.506
50	2.32	0.454
60	2.50	0.412

LKP 07-10-88

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INTERNATIONAL TECHNOLOGY CORPORATION

Willis Date 6-11-88 Subject Head Ratio Calculations Sheet No. ___ of ___

Chkd. By ___ Date ___ Car MW 134 Proj. No. 602.323

$$HR = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G = Depth to ground water below TOC before slug added

H_i = Initial depth to ground water below TOC after slug added

$H_{@t}$ = Depth to ground water below TOC at time t

at t = 1 minute
H = 0.3 ft

$$HR = \frac{0.3 - 4.25}{0 - 4.25} = 0.929$$

$H_G = 4.25$ ft
$H_i = 0$ ft

time (minutes)	H (feet)	HR (dimensionless)
1	0.30	0.929
2	0.50	0.882
3	0.62	0.854
4	0.75	0.824
5	0.82	0.807
6	0.88	0.793
7	0.95	0.776
8	1.00	0.765
9	1.05	0.753
10	1.10	0.741
12	1.18	0.722
14	1.27	0.701
16	1.35	0.682
18	1.43	0.664
20	1.50	0.647
25	1.67	0.607
30	1.82	0.572
40	2.10	0.506
50	2.32	0.454
60	2.50	0.412

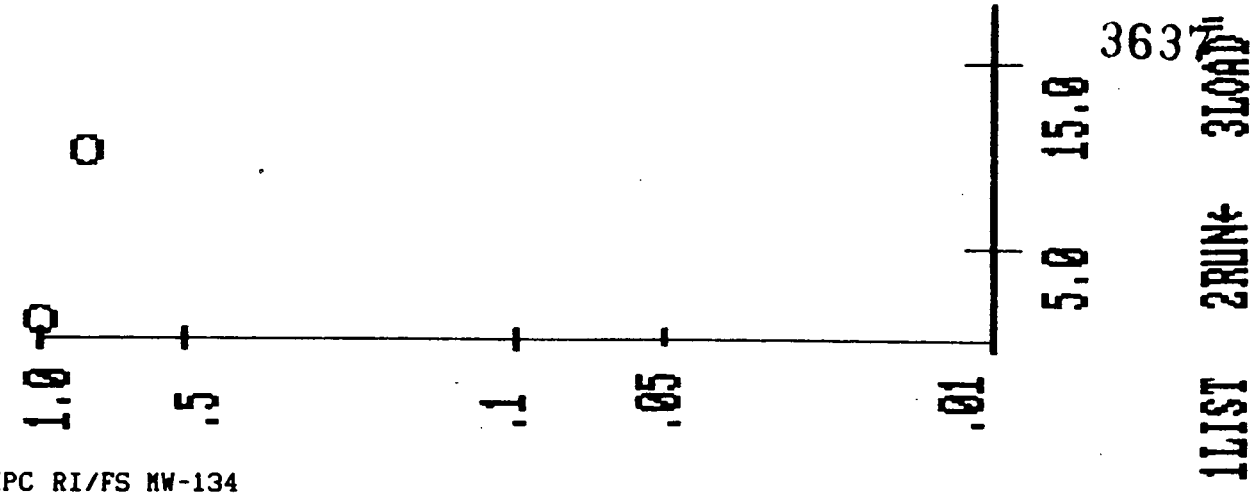
IN-SITU INC. HERMIT DATA MANAGEMENT PACKAGE

MONITORING WELL 134

SLUG/SHAR TEST

Ref. Value : 4.25 (Ft)
H(0) : 3.95 (Ft)
T(0) : .01 (min)

ELAPSED TIME (min)	VALUE (Ft)	HD/DRWDN (Ft)	DELTA TIME (Min)	H/H(0)
1.0000	.30	3.95	.9900	1.000
2.0000	.50	3.75	1.9900	.949
3.0000	.62	3.63	2.9900	.919
4.0000	.75	3.50	3.9900	.886
5.0000	.82	3.43	4.9900	.868
6.0000	.88	3.37	5.9900	.853
7.0000	.95	3.30	6.9900	.835
8.0000	1.00	3.25	7.9900	.823
9.0000	1.05	3.20	8.9900	.810
10.0000	1.10	3.15	9.9900	.797
[illegible]	1.15	3.07	11.9900	.777
[illegible]	1.27	2.99	13.9900	.754
15.0000	1.35	2.90	15.9900	.734
18.0000	1.43	2.82	17.9900	.714
20.0000	1.50	2.75	19.9900	.696
25.0000	1.67	2.58	24.9900	.653
30.0000	1.82	2.43	29.9900	.615
40.0000	2.10	2.15	39.9900	.544
50.0000	2.32	1.93	49.9900	.489
60.0000	2.50	1.75	59.9900	.443



FMPC RI/FS MW-134

TIME (seconds)	WATER LEVEL (feet)	DRAWDOWN (feet)	H/H0
600	1.1	-3.15	.7974683
1200	1.5	-2.75	.6962025
1800	1.82	-2.43	.6151899
2400	2.1	-2.15	.5443038
3000 50 min	2.32	-1.93	.4886076

UNCONFINED AQUIFER

K = 2.6E-05 cm/sec
= 0.6 gpd/ft2
= 8.5E-07 ft/sec
= 0.1 ft/day

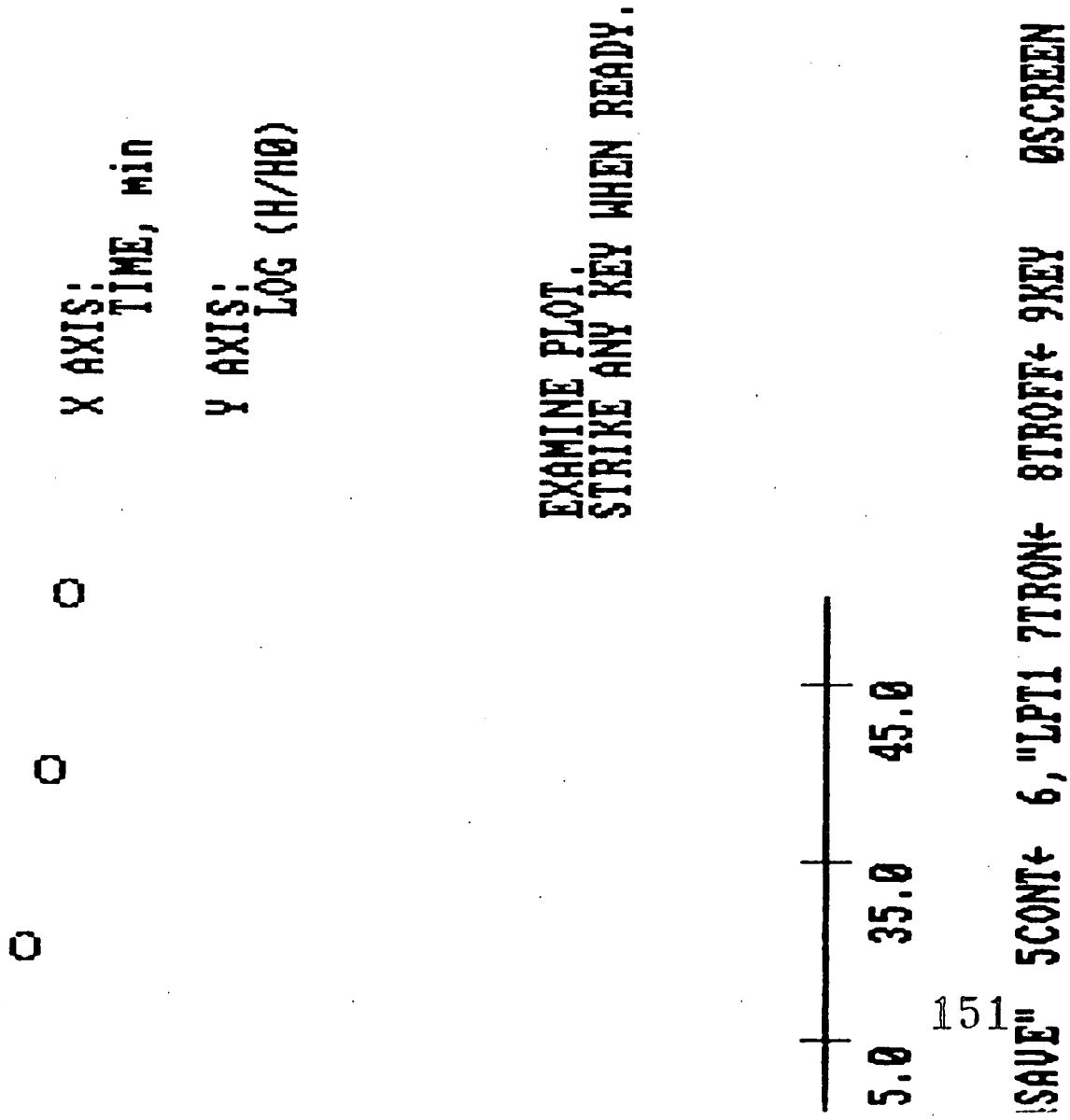
REGRESSION COEFFICIENT = -.9992005

PERMEABILITY FROM TIME-LAG TESTS

```
TITLE:  ? FMPC RI/FS MW-134
(E)nglish or (M)etric units? E
(C)onfined or (U)nconfined conditions? U
Do you prefer to enter well radii as (I)nches or (F)eet? F
STANDPIPE RADIUS (feet) = ? .167
INTAKE RADIUS (feet) = ? .5
LENGTH OF INTAKE (feet or meters) = ? 10
DEPTH TO TOP OF INTAKE (feet or meters) = ? 10
STATIC WATER LEVEL, DEPTH (feet or meters) = ? 4.25
PURGE WATER LEVEL (feet or meters) = ? .3


ARE THESE DATA CORRECT? (Y/N)? Y
ARE WATER-LEVEL DATA TO BE READ FROM DISK? (Y/N)?


1LIST   2RUN   3LOAD"   4SAVE"   5CONT 6,"LPT1 7TRON 8TROFF9KEY    0SCREEN
```



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VALUE: 1.00

Press / for commands

	A	B	C	D	E
1	1.00	0.30	0.929		
2	2.00	0.50	0.882		
3	3.00	0.62	0.854		
4	4.00	0.75	0.824		
5	5.00	0.82	0.807		
6	6.00	0.88	0.793		
7	7.00	0.95	0.776		
8	8.00	1.00	0.765		
9	9.00	1.05	0.753		
10	10.00	1.10	0.741		
11	12.00	1.18	0.722		
12	14.00	1.27	0.701		
13	16.00	1.35	0.682		
14	18.00	1.43	0.664		
15	20.00	1.50	0.647		
16	25.00	1.67	0.607		
17	30.00	1.82	0.572		
18	40.00	2.10	0.506		
19	50.00	2.32	0.454		
20	60.00	2.50	0.412		
21					
22					

VALUE: 1.00

Press for comments

A	B	C	D	E
1.00	0.30	0.929		
2.00	0.50	0.882		
3.00	0.62	0.854		
4.00	0.73	0.824		
5.00	0.82	0.807		
6.00	0.88	0.793		
7.00	0.95	0.776		
8.00	1.00	0.765		
9.00	1.05	0.755		
10.00	1.10	0.741		
12.00	1.18	0.722		
14.00	1.27	0.701		
16.00	1.33	0.682		
18.00	1.43	0.664		
20.00	1.50	0.647		
25.00	1.67	0.607		
30.00	1.82	0.572		
40.00	2.10	0.506		
50.00	2.32	0.454		
60.00	2.50	0.412		

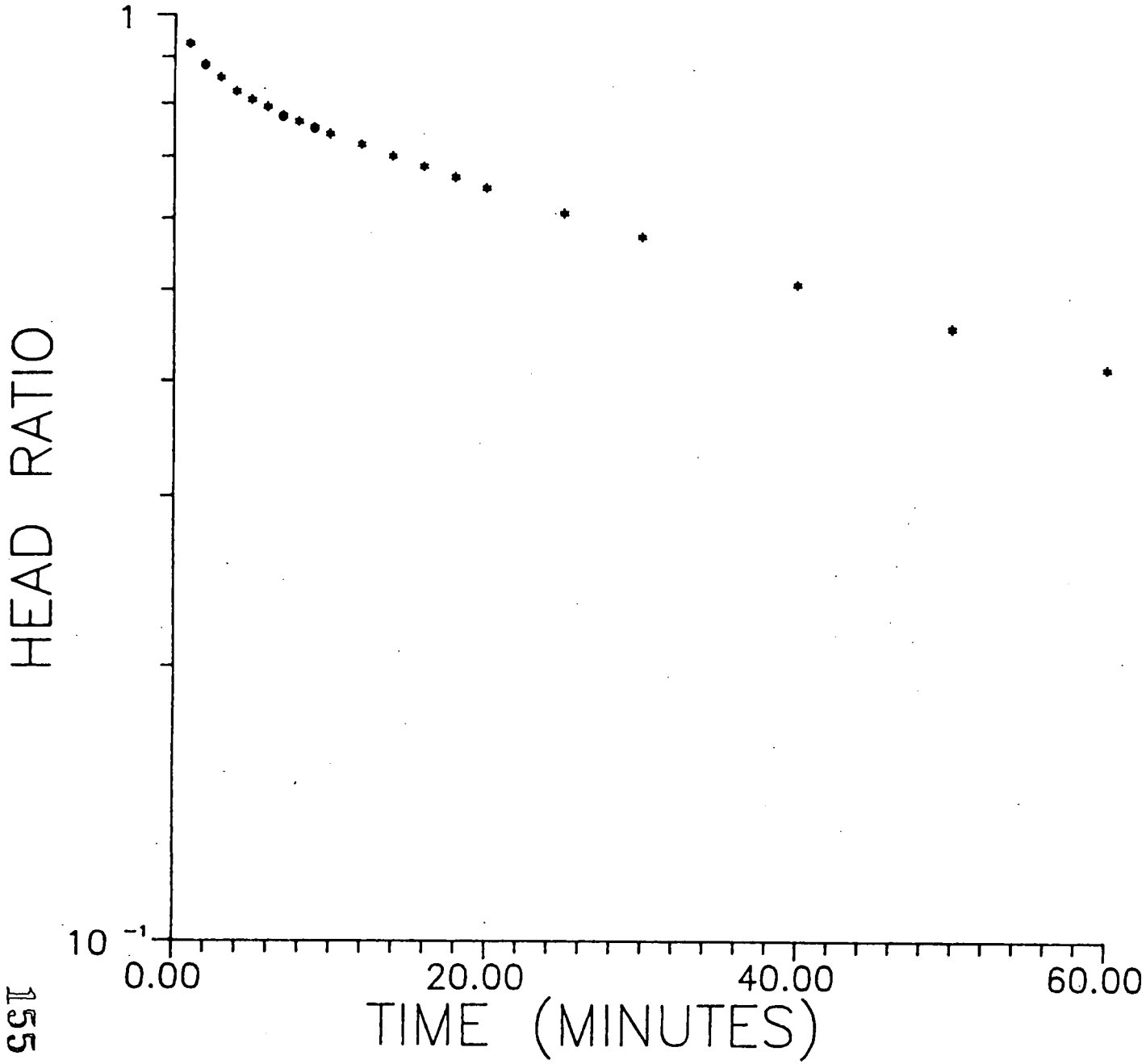
IN-SITU INC. HERMIT DATA MANAGEMENT PACKAGE

MONITORING WELL 134

SLUG/SWAB TEST

Ref. Value : 4.25 (Ft)
H(0) : 3.95 (Ft)
T(0) : .01 (Min)

ELAPSED TIME (Min)	VALUE (Ft)	HD/DRWDN (Ft)	DELTA TIME (Min)	H/H(0)
1.0000	.30	3.95	.9900	1.000
2.0000	.50	3.75	1.9900	.949
3.0000	.62	3.63	2.9900	.919
4.0000	.75	3.50	3.9900	.886
5.0000	.82	3.43	4.9900	.868
6.0000	.88	3.37	5.9900	.853
7.0000	.95	3.30	6.9900	.835
8.0000	1.00	3.25	7.9900	.823
9.0000	1.05	3.20	8.9900	.810
10.0000	1.10	3.15	9.9900	.797
12.0000	1.18	3.07	11.9900	.777
14.0000	1.27	2.98	13.9900	.754
16.0000	1.35	2.90	15.9900	.734
18.0000	1.43	2.82	17.9900	.714
20.0000	1.50	2.75	19.9900	.696
25.0000	1.67	2.58	24.9900	.653
30.0000	1.82	2.43	29.9900	.615
40.0000	2.10	2.15	39.9900	.544
50.0000	2.32	1.93	49.9900	.489
60.0000	2.50	1.75	59.9900	.443


1
10 -1
HEAD RATIO
0.00
20.00
40.00
60.00
TIME (MINUTES)

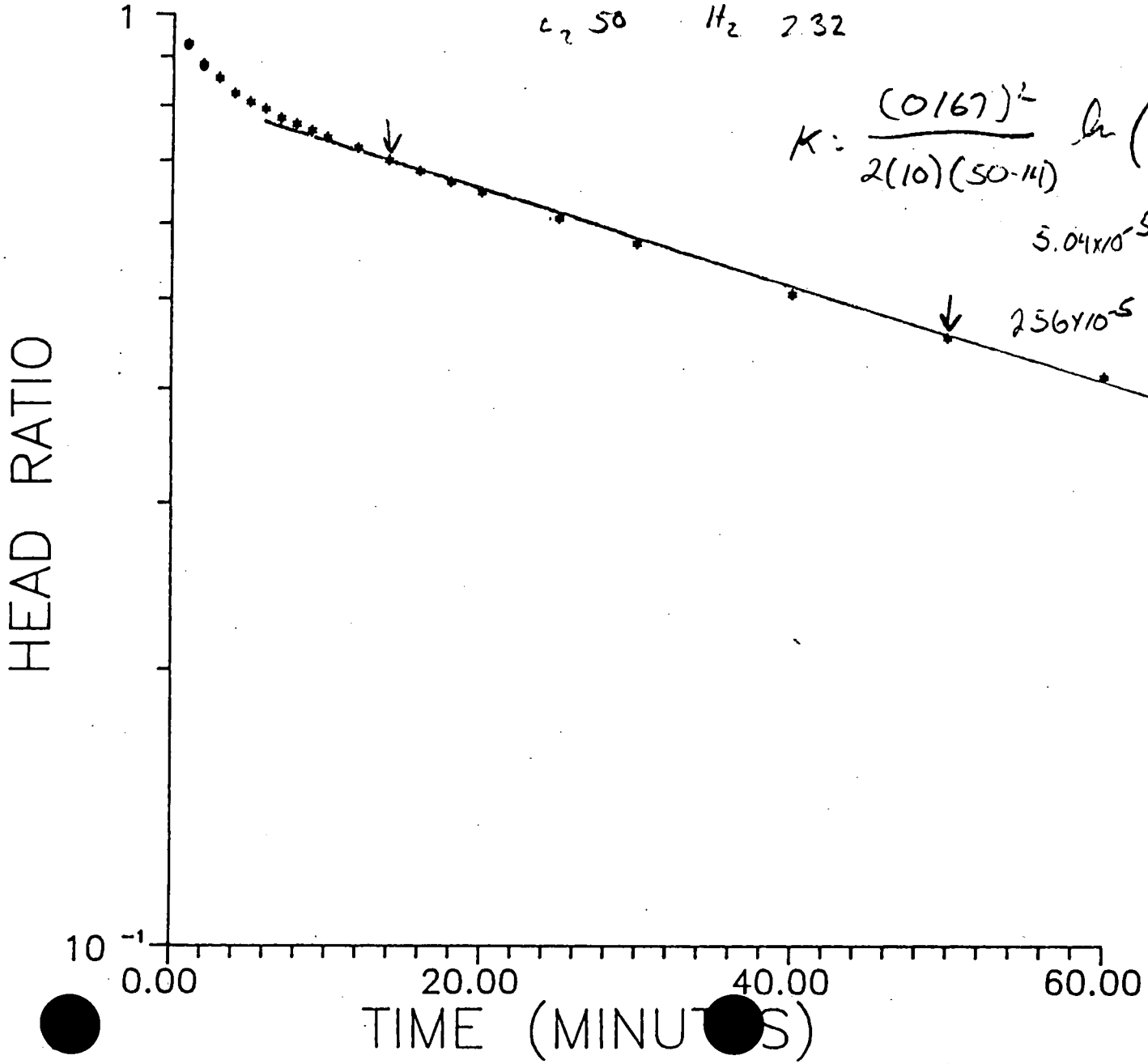
MW 134

r_1 : 4 in : 0.167 ft

r_2 : 6 in : 0.50 ft

L_1 14 H_1 1.27

L_2 50 H_2 2.32



$$K = \frac{(0.167)^2}{2(10)(50-14)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{1.27-4.25}{2.32-4.25}\right)$$

5.04×10^{-5} ~~5.11×10^{-5}~~ ft/min

2.56×10^{-5} ~~2.6×10^{-5}~~ cm/sec

MW 134

r_1 : 4 in : 0.167 ft

r_2 : 6 in : 0.50 ft

Hg = ~~22.7 ft~~ 4.25 ft

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22.7
-2.4
20.3
-10.0
10.3

t_1 14 H_1 1.27

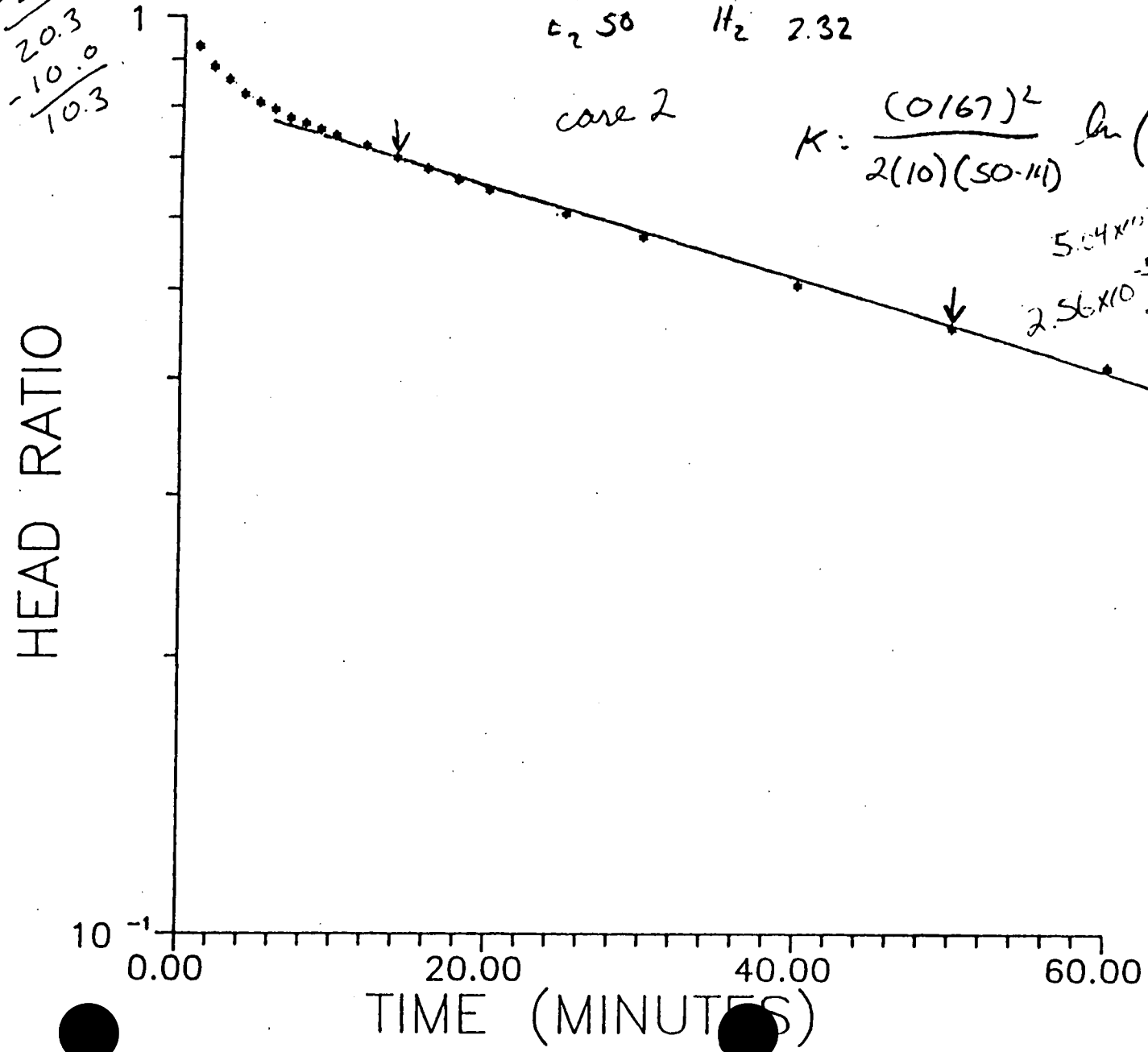
t_2 50 H_2 2.32

case 2

$$K = \frac{(0.167)^2}{2(10)(50-14)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{1.27-4.25}{2.32-4.25}\right)$$

5.04×10^{-5} ~~5.11×10^{-5} ft/min~~

2.56×10^{-5} ~~2.6×10^{-5} cm/sec~~



MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1035
WELL NUMBER: 1035

FIELD ENG./GEO.: M. SLUSARSKI DATE: 03/21/88
CHECKED BY : Not Noted DATE: N/A
N,E COORDINATES: 482290.60, 1379710.4
DATE OF INSTAL.: 03/21/88

BOREHOLE DRILLING

DRILLING METHOD: Cable Tool
DRILLING FLUID(S) USED: (in Feet)
FLUID: WATER FROM: 0.0TO: 27.0
FLUID: N/A FROM: N/ATO: N/A
NOTES/COMMENTS:

TYPE OF BIT: Flat Head Hammer
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING WELL
CASING DIAM.: 4 In. ID
CASING SIZE(S) USED: (in Feet)
SIZE: 10 FROM: 0.0 TO: 27.0
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Screen
AVG. SIZE OF PERFORATIONS: 0.010 (In.)
TOTAL PERFORATED AREA: 11. Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: Stainless Steel
RISER PIPE DIAMETERS:
O.D.: 4 3/8 In. I.D.: 4 In.
LENGTH OF 1ST PIPE SECTION:
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: SCREW TYPE FLUSH JOINT THREADS

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5 Ft.
PROTECTIVE PIPE O.D.: 10 3 In.
* LOCKING CAP

OTHER PROTECTION (* NOTED BELOW)

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	2.5 Ft.		586.19	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	2.5 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
Bentonite Pellets	0.0	9.0	N/A	N/A
Sand	19.0	27.0	N/A	N/A
Gravel	9.0	19.0	N/A	N/A
PERFORATED SECTION	13.0	24.0	N/A	N/A
WELL TIP	26.5		N/A	
BOTTOM OF BOREHOLE	27.0		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

Boring # [illegible]

5

FERNALD RI/FS

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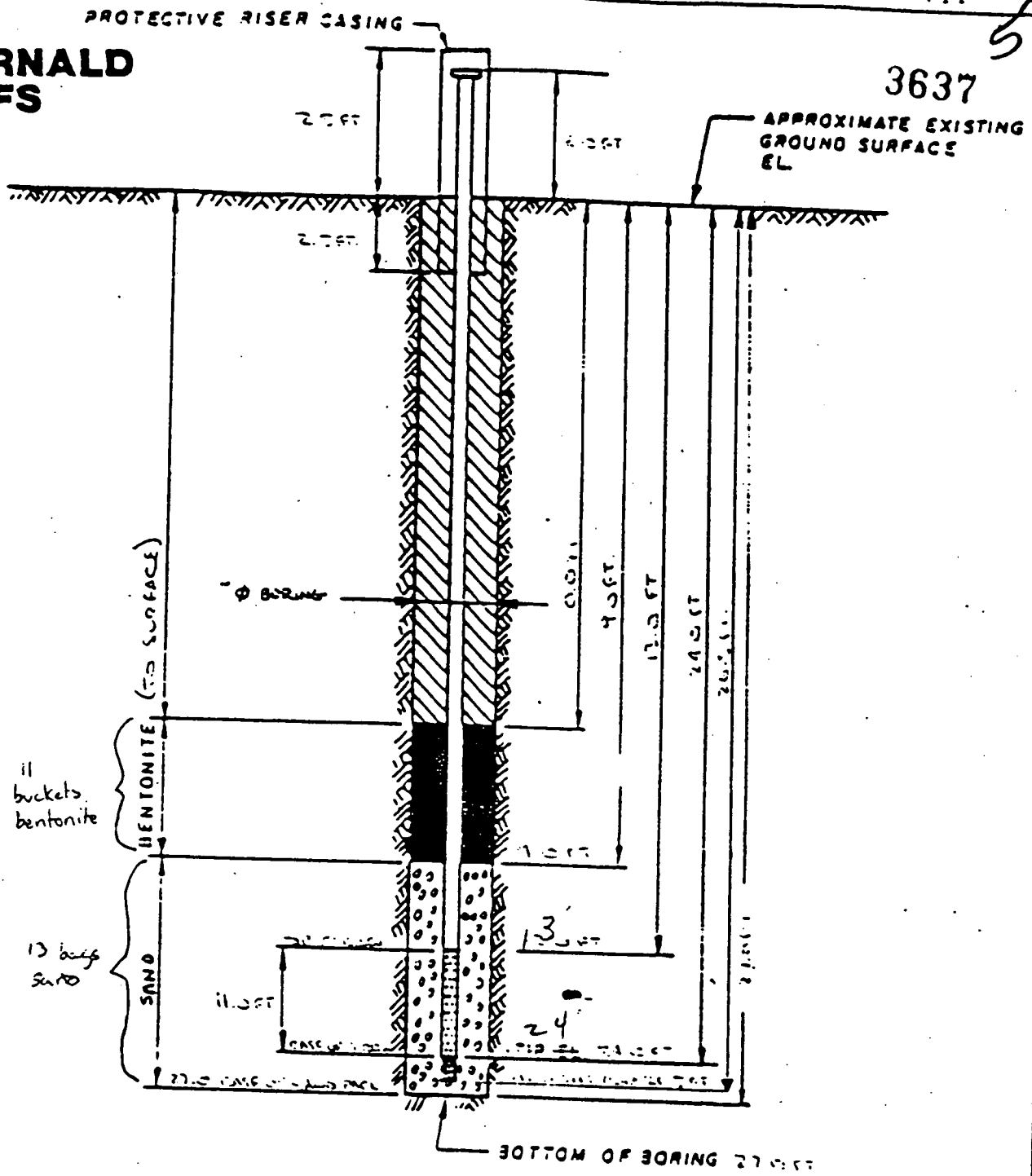

NOTES:

1. RISER PIPE IS 4 IN I.D. SCHEDULE PIPE, THREADED, FLUSH-JOINTED.
2. SCREEN IS 4 IN I.D. SCH 40 PIPE CONTINUOUS SLOT SCREEN (0.010 IN SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL
5. WATER LEVEL READING ON

INSTALLATION DETAILS
MONITORING WELL
03-21-88
PREPARED FOR
Boring # [illegible]

DRAWING NUMBER
CHECKED BY
APPROVED BY
DRAWN BY

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1035	COORDINATES: NORTH 482,290.60 EAST 1,379,710.46	DATE: 03/20/88
GROUND ELEVATION: 584.8	GWL: Depth N/A Date/Time N/A	DATE STARTED: 03/20/88
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth N/A Date/Time N/A	DATE COMPLETED: 03/21/88
DRILLING METHODS: CABLE-TOOL		PAGE 2 OF 2

DEPTH	SAMPLE DATE TIME	BLOWS DN SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.5	08384 03/20/88 1600	2 5 5	14	SOFT, GREY (5Y, 5/1) CLAY, SOME SILT AND FINE GRAVEL, DAMP.	CL	.5	Hnu= 0 ppm BΓ = 80 cpm
18.0	08385 03/20/88 1608	2 3 4	14	SOFT, GREY (5Y, 5/1) CLAY, SOME SILT AND FINE GRAVEL, DAMP.	CL	.5	Hnu= 0 ppm BΓ = 80 cpm
19.5	08386 03/20/88 1617	3 4 6	14	MEDIUM STIFF, GREY (5Y, 5/1) CLAY, SOME SILT AND FINE GRAVEL, DAMP.	CL	1.0	Hnu= 0 ppm BΓ = 80 cpm
21.0	08387 03/21/88 0907	5 5 7	8	SOFT GREY (5Y, 5/1) CLAY, SOME MEDIUM-FINE GRAVEL, DAMP.. PUSHED SHELBY FROM 19.5 FT. TO 21.5 FT., NO RECOVERY. OPTED TO TAKE SPLIT SPOON SAMPLE FROM 19.5 FT. TO 21.0 FT.	CL	.5	Hnu= 0 ppm BΓ = 80 cpm
22.5	08388 03/21/88 0920	5 13 >5	12	MEDIUM STIFF, GREY (5Y, 5/1) CLAY, SOME FINE GRAVEL, DAMP.	CL	1.0	Hnu= 0 ppm BΓ = 80 cpm
24.0	08389 03/21/88 0955	14 50 34	10	STIFF, GREY-GREEN (5Y, 5/2) SILTY CLAY, DRY.	CL	1.5	Hnu= 0 ppm BΓ = 80 cpm
25.5	08390 03/21/88 1051	9 14 23	16	MEDIUM DENSE, GREY (5Y, 5/1) WELL GRADED GRAVEL-SAND MIXTURE, WET. HARD, GREY (5Y, 5/1) CLAY, SOME SILT, DRY.	GW CL	N/A >4.0	Hnu= 0 ppm BΓ = 80 cpm
27.0	08391 03/21/88 1117	11 18 20	14	MEDIUM DENSE, GREY (5Y, 5/1) WELL GRADED GRAVEL-SAND MIXTURE, WET. STIFF, GREY (5Y, 4/1) CLAY, SOME SILT, DRY.	GW CL	N/A 3.5	Hnu= 0 ppm BΓ = 80 cpm

BOTTOM OF BORING 27.0

NOTES:
SAMPLES COLLECTED AS PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1035	COORDINATES: NORTH 482,290.60 EAST 1,379,710.46	DATE: 03/20/88
GROUND ELEVATION:	GWL: Depth N/A Date/Time N/A	DATE STARTED: 03/20/88
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth N/A Date/Time N/A	DATE COMPLETED: 03/21/88
DRILLING METHODS: CABLE-TOOL		PAGE 1 OF 2

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
1.5	08374 03/20/88 0933	1 3 4	8	MEDIUM STIFF, YELLOW-BROWN (10YR, 4/2) CLAY, SOME SILT, ROOTLETS, DRY.	CL	1.0	Hnu= 0 ppm BΓ = 80 cpm
3.0	08375 03/20/88 0935	2 3 4	10	MEDIUM STIFF, YELLOW-BROWN (10YR, 4/4) CLAY, SOME SILT, DRY.	CL	1.0	Hnu= 0 ppm BΓ = 80 cpm
4.5	08376 03/20/88 0938	4 6 8	14	STIFF, GREY (10YR, 6/1) CLAY, SOME SILT, DRY.	CL	1.5	Hnu= 0 ppm BΓ = 80 cpm
6.0	08377 03/20/88 0941	7 8 9	12	STIFF, GREY (10YR, 6/1) CLAY, TRACE MEDIUM GRAVEL, DRY. SOFT, GREY (10YR, 6/1) CLAY, SOME SILT, DAMP.	CL CL	2.0 .5	Hnu= 0 ppm BΓ = 80 cpm
7.5	08378 03/20/88 0945	7 8 9	2	SOFT, GREY (10YR, 6/1) CLAY, SOME SILT, DAMP. SOFT, GREY-BROWN (10YR, 5/4) CLAY, SOME SILT, DAMP. STIFF, YELLOW-BROWN (10YR, 5/3) CLAY, SOME SILT, SOME FINE GRAVEL, DRY.	CL CL CL	2.0 .5 2.0	Hnu= 0 ppm BΓ = 80 cpm
9.0	08379 03/20/88 1031	6 8 12	18	STIFF, YELLOW-BROWN (10YR, 5/3) CLAY, SOME SILT, SOME FINE GRAVEL, DRY.	CL	2.0	Hnu= 0 ppm BΓ = 80 cpm
11.0	08380 03/20/88 1405			SHELBY TUBE.. PUSHED SHELBY TUBE FROM 9.0 FT. TO 11.0 FT., RECOVERED 1.3 FT..			Hnu= 0 ppm BΓ = 80 cpm
12.0	08381 03/20/88 1518	12 20	10	STIFF, YELLOW-BROWN (10YR, 5/4) CLAY, SOME SILT AND MEDIUM GRAVEL, DRY.	CL	2.0	Hnu= 0 ppm BΓ = 80 cpm
13.5	08382 03/20/88 1540	12 10 13	12	STIFF, YELLOW-BROWN (10YR, 5/4) CLAY, SOME SILT AND FINE GRAVEL, DRY.	CL	1.5	Hnu= 0 ppm BΓ = 80 cpm
15.0	08383 03/20/88 1550	3 5 6	14	SOFT GREY (5Y, 5/1) CLAY, SOME SILT AND FINE GRAVEL, DAMP.	CL	.5	Hnu= 0 ppm BΓ = 80 cpm

NOTES:
SAMPLES COLLECTED AS PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

clay, some silt

FERNALD RI/FS

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FIELD PERMEABILITY TESTS

FALLING HEAD *

PROJECT FMPC RI/FS
PROJECT NO. 602.03.02.01
BORING NO. 135

TESTED BY TS/BM DATE 5/3/88
CALCULATED BY FXM DATE 11/10/88
CHECKED BY [illegible] DATE 12/28/88
Copied By: FXM 10/31/88
Chk. By: [illegible] 12/28/88

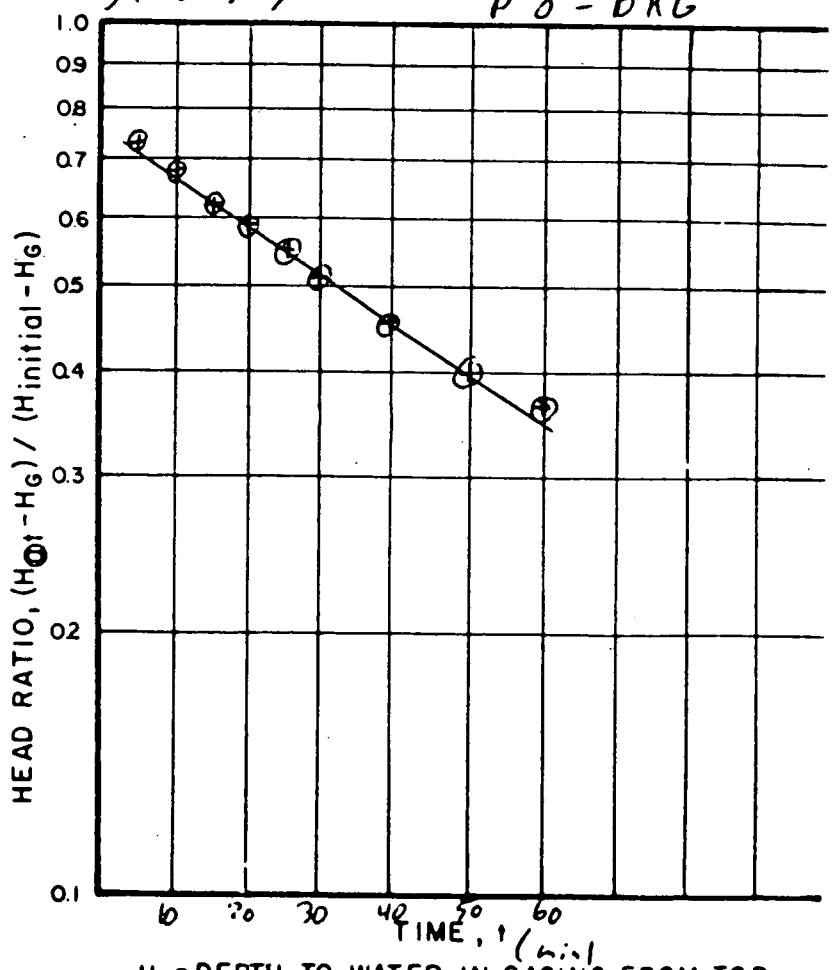
RADIUS OF TEST BORING, R 0.5 ft
PERMEABILITY, K 2.5×10^{-5} cm/s
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C ≈ 2.0 ft
DEPTH TO BOTTOM OF TEST POCKET, L_1 26 ft
DEPTH TO TOP OF TEST POCKET, L_2 15 ft
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 7.75 ft

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

Began Test 1330
5 gallon slug used

Readings
HNU = 0 ppm
β-γ = BKG

ELAPSED TIME t ~~min sec.~~	DEPTH TO WATER IN CASING H ft ~~Meters~~
0	0.00
0.5	0.65
1	1.73
2	1.95
3	2.17
4	2.40
5	2.55
6	2.62
7	2.72
8	2.80
9	2.87
10	2.95
12	3.10
14	3.20
16	3.35
18	3.48
20	3.59
25	3.86
30	4.11
40	4.53
50	4.92
60	5.21
(1635) 185	6.70



$$K = \frac{R^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

FXM Date 11/10/88 Subject Slug Test Calculations Sheet No. 2 of 3
Rd. By ___ Date ___ Well 135 Proj. No. 602.07.07.01

Well 135

$$\text{Head Ratio} = \frac{H_T - H_G}{H_i - H_G}$$

@ 5 min $\frac{2.55 - 7.75}{0.65 - 7.75} = 0.73$

@ 10 min $\frac{2.95 - 7.75}{0.65 - 7.75} = 0.68$

@ 16 min $\frac{3.35 - 7.75}{0.65 - 7.75} = 0.62$

@ 20 min $\frac{3.59 - 7.75}{0.65 - 7.75} = 0.59$

@ 25 min $\frac{3.86 - 7.75}{0.65 - 7.75} = 0.55$

@ 30 min $\frac{4.11 - 7.75}{0.65 - 7.75} = 0.51$

@ 40 min $\frac{4.53 - 7.75}{0.65 - 7.75} = 0.45$

@ 50 min $\frac{4.92 - 7.75}{0.65 - 7.75} = 0.40$

@ 60 min $\frac{5.21 - 7.75}{0.65 - 7.75} = 0.36$

FXM Date 11/18/88 Subject Slug Test Calculations Sheet No. 3 of 3

Chkd. By ____ Date ____ Well 135 Proj. No. 602.03.02.01

Permeability:

$$K = \frac{r^2}{2(L_1 - L_2)(T_2 - T_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

$$= \frac{(0.167)^2}{2(26-15)(50-20)} \ln\left[\frac{26-15}{0.5}\right] \ln\left[\frac{3.59-7.75}{4.92-7.75}\right]$$

$K = 5.0 \times 10^{-5}$ ft/min

$K = 2.5 \times 10^{-5}$ cm/sec

INTERNATIONAL TECHNOLOGY CORPORATION

3637

L.Wille Date 6-11 88 Subject Head Ratio Calculations Sheet No. ___ of ___

Chkd. By LKP Date 07-10-88 for MW 135 Proj. No. 602.3.23

$$HR = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G = Depth to ground water below TOC before slug is added

H_i = Initial depth to ground water below TOC after slug is added

$H_{@t}$ = Depth to ground water below TOC at time t

at t = 0.5 minutes
H = 0.65 ft

$$HR = \frac{0.65 - 7.75}{0 - 7.75} = \cancel{0.764}\ 0.916 \text{ JEW}$$

H_G = 7.75 ft
H_i = 0 ft

time (minutes)	H (feet)	HR (dimensionless)
0.5	0.65	0.916
1	1.73	0.777
2	1.95	0.748
3	2.17	0.720
4	2.40	0.690
5	2.55	0.671
6	2.62	0.662
7	2.72	0.649
8	~~2.80~~ 2.80 JEW	~~0.639~~ 0.639 JEW
9	2.87	0.630
10	2.95	0.619
12	3.10	0.600
14	3.20	0.587
16	3.35	0.568
18	3.48	0.551
20	3.59	0.537
25	3.86	0.502
30	4.11	0.470
40	4.53	0.415
50	4.92	0.365
60	5.21	0.328
185	6.70	0.135

INTERNATIONAL TECHNOLOGY CORPORATION

3637

By [illegible] Date 5-11-88 Subject Head Ratio Calculations Sheet No. ____ of ____

Chkd. By LKP Date 07-10-88 For MW 135 Proj. No. 607.2.3.3

$$HR = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G = Depth to ground water below TOC before slug is added

H_i = Initial depth to ground water below TOC after slug is added

$H_{@t}$ = Depth to ground water below TOC at time t

at t = 0.5 minutes
H = 0.65 ft

$$HR = \frac{0.65 - 7.75}{0 - 7.75} = \cancel{0.764}\ 0.916 \text{ fcw}$$

H_G = 7.75 ft
H_i = 0 ft

time (minutes)	H (feet)	HR (dimensionless)
0.5	0.65	0.916
1	1.73	0.777
2	1.95	0.748
3	2.17	0.720
4	2.40	0.690
5	2.55	0.671
6	2.62	0.662
7	2.72	0.649
8	~~2.80~~ 2.80 fcw	~~0.639~~ 0.639 fcw
9	2.87	0.630
10	2.95	0.619
12	3.10	0.600
14	3.20	0.587
16	3.35	0.568
18	3.48	0.551
20	3.59	0.537
25	3.86	0.502
30	4.11	0.470
40	4.53	0.415
50	4.[illegible]	0.365
60	5.21	0.328
185	6.70	0.135

108-10-85

INTERNATIONAL TECHNOLOGY CORPORATION

3637

By L. Wille Date 6-11-88 Subject Head Ratio Calculations Sheet No. ___ of ___

Chkd. By LKP Date 06-17-88 for MW 135 Proj. No. 602.3.2.3

$$HR = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G = Depth to ground water below TOC before slug is added

H_i = Initial depth to ground water below TOC after slug is added

$H_{@t}$ = Depth to ground water below TOC at time t

at t = 0.5 minutes

H = 0.65 ft

$$HR = \frac{0.65 - 2.75}{0 - 2.75} = 0.764 \; 0.916$$

H_G = 2.75 ft

H_i = 0 ft

time (minutes)	H (feet)	HR (dimensionless)
0.5	0.65	0.916
1	1.23	0.777
2	1.95	0.748
3	2.17	0.720
4	2.40	0.690
5	2.55	0.671
6	2.62	0.662
7	2.72	0.649 OK MW 06-17-88
8	3.80 2.80	0.639
9	2.87	0.630
10	2.95	0.619
12	3.10	0.600
14	3.20	0.587
16	3.35	0.568
18	3.48	0.551
20	3.59	0.537
25	3.86	0.502
30	4.11	0.470
40	4.53	0.415
50	4.92	0.365
60	5.21	0.328
1185	6.70	0.135

108-10-85

IN-SITU INC. HERMIT DATA MANAGEMENT PACKAGE

MONITORING WELL 135

SLUG/SWAB TEST

Ref. Value : 7.75 (Ft)
H(0) : 7.75 (Ft)
T(0) : .00 (Min)

ELAPSED TIME (Min)	VALUE (Ft)	HD/DRWDN (Ft)	DELTA TIME (Min)	H/H(0)
.5000	.65	7.10	.4990	.916
1.0000	1.73	6.02	.9990	.777
2.0000	1.95	5.80	1.9990	.748
3.0000	2.17	5.58	2.9990	.720
4.0000	2.40	5.35	3.9990	.690
5.0000	2.55	5.20	4.9990	.671
6.0000	2.62	5.13	5.9990	.662
7.0000	2.72	5.03	6.9990	.649
8.0000	2.80	4.95	7.9990	.639
9.0000	2.87	4.88	8.9990	.630
10.0000	2.95	4.80	9.9990	.619
12.0000	3.10	4.65	11.9990	.600
14.0000	3.20	4.55	13.9990	.587
16.0000	3.35	4.40	15.9990	.568
18.0000	3.48	4.27	17.9990	.551
20.0000	3.59	4.16	19.9990	.537
25.0000	3.86	3.89	24.9990	.502
30.0000	4.11	3.64	29.9990	.470
40.0000	4.53	3.22	39.9990	.415
50.0000	4.92	2.83	49.9990	.365
60.0000	5.21	2.54	59.9990	.328
185.0000	6.70	1.05	184.9990	.135

LKF 07-10-88

3637

VALUE: 0.50

Press / for commands

	A	B	C	D	E
1	0.50	0.65	0.916		
2	1.00	1.73	0.777		
3	2.00	1.95	0.748		
4	3.00	2.17	0.720		
5	4.00	2.40	0.690		
6	5.00	2.55	0.671		
7	6.00	2.62	0.662		
8	7.00	2.72	0.649		
9	8.00	2.80	0.639		
10	9.00	2.87	0.630		
11	10.00	2.95	0.619		
12	12.00	3.10	0.600		
13	14.00	3.20	0.587		
14	16.00	3.35	0.568		
15	18.00	3.48	0.551		
16	20.00	3.59	0.537		
17	25.00	3.86	0.502		
18	30.00	4.11	0.470		
19	40.00	4.53	0.415		
20	50.00	4.92	0.365		
21	60.00	5.21	0.328		
22	185.00	6.70	0.135		

LKP 07-10-88

3637

ALE: 0.50

Press / for commands

	A	B	C	D	E
1	0.50	0.63	0.916		
2	1.00	1.75	0.777		
3	2.00	1.93	0.748		
4	3.00	2.17	0.720		
5	4.00	2.40	0.690		
6	5.00	2.55	0.671		
7	6.00	2.62	0.662		
8	7.00	2.72	0.649		
9	8.00	2.80	0.639		
10	9.00	2.87	0.630		
11	10.00	2.95	0.619		
12	12.00	3.10	0.600		
13	14.00	3.20	0.587		
14	16.00	3.35	0.568		
15	18.00	3.48	0.551		
16	20.00	3.59	0.537		
17	25.00	3.86	0.502		
18	30.00	4.11	0.470		
19	40.00	4.53	0.415		
20	50.00	4.92	0.365		
21	60.00	5.21	0.328		
22	180.00	6.70	0.135		

B:\>

IN-SITU INC. HERMIT DATA MANAGEMENT PACKAGE

3637

MONITORING WELL 135

SLUG/SWAB TEST

Ref. Value : 7.75 (Ft)
H(0) : 7.75 (Ft)
T(0) : .00 (Min)

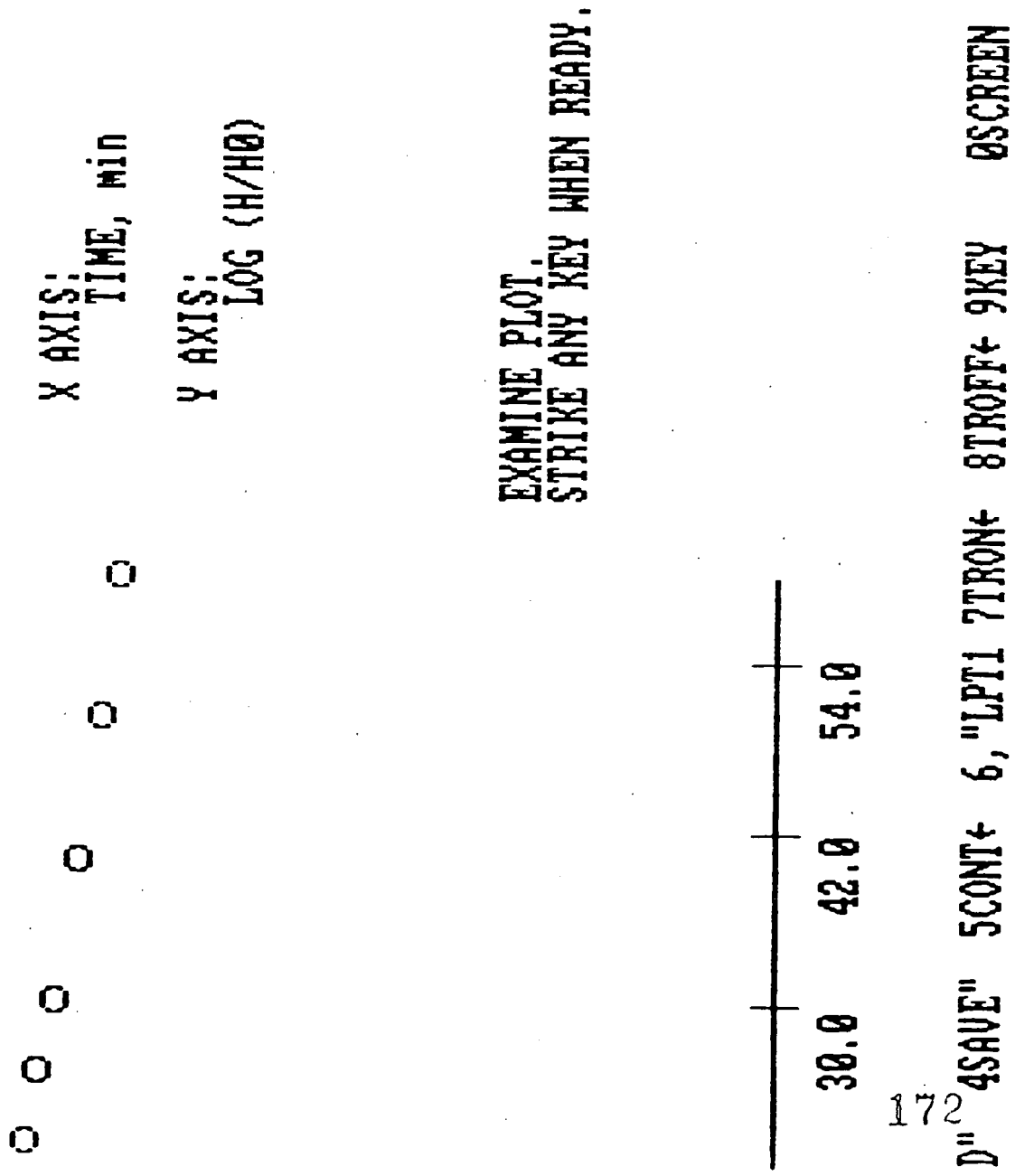
ELAPSED TIME (Min)	VALUE (Ft)	HO/DRWDN (Ft)	DELTA TIME (Min)	H/H(0)
.5000	.65	7.10	.4990	.916
1.0000	1.73	6.02	.9990	.777
2.0000	1.95	5.80	1.9990	.748
3.0000	2.17	5.58	2.9990	.720
4.0000	2.40	5.35	3.9990	.690
5.0000	2.55	5.20	4.9990	.671
6.0000	2.62	5.13	5.9990	.662
7.0000	2.72	5.03	6.9990	.649
8.0000	2.80	4.95	7.9990	.639
9.0000	2.87	4.88	8.9990	.630
10.0000	2.95	4.80	9.9990	.619
12.0000	3.10	4.65	11.9990	.600
14.0000	3.20	4.55	13.9990	.587
16.0000	3.35	4.40	15.9990	.568
18.0000	3.48	4.27	17.9990	.551
20.0000	3.59	4.16	19.9990	.537
25.0000	3.86	3.89	24.9990	.502
30.0000	4.11	3.64	29.9990	.470
40.0000	4.53	3.22	39.9990	.415
50.0000	4.92	2.83	49.9990	.365
60.0000	5.21	2.54	59.9990	.328
185.0000	6.70	1.05	184.9990	.135

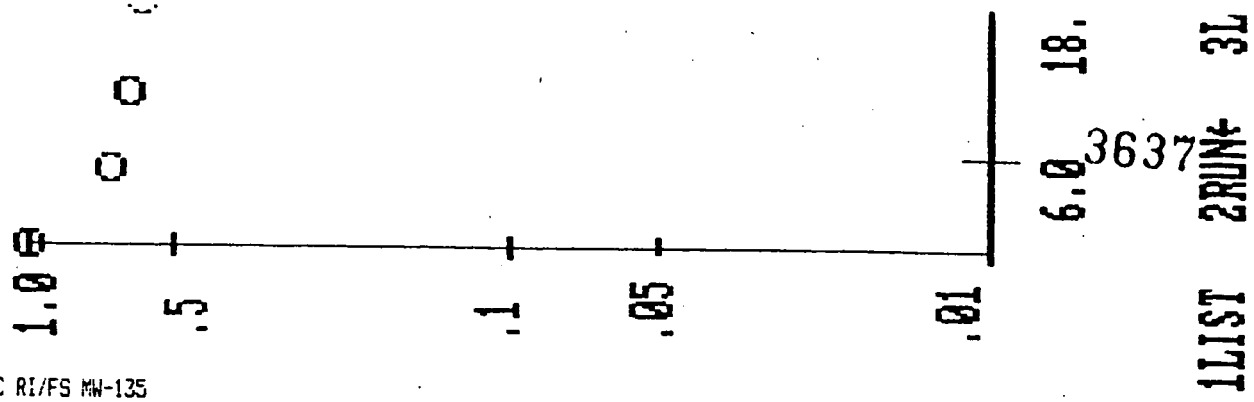
PERMEABILITY FROM TIME-LAG TESTS

```
TITLE:  ? FMPC RI/FS MW-135
(E)nglish or (M)etric units? E
(C)onfined or (U)nconfined conditions? U
Do you prefer to enter well radii as (I)nches or (F)eet? F
STANDPIPE RADIUS (feet) = ? .167
INTAKE RADIUS (feet) = ? .5
LENGTH OF INTAKE (feet or meters) = ? 11
DEPTH TO TOP OF INTAKE (feet or meters) = ? 15
STATIC WATER LEVEL, DEPTH (feet or meters) = ? 7.75
PURGE WATER LEVEL (feet or meters) = ? .001

ARE THESE DATA CORRECT? (Y/N)? Y
ARE WATER-LEVEL DATA TO BE READ FROM DISK? (Y/N)?

1LIST  2RUN  3LOAD"  4SAVE"  5CONT 6,"LPT1 7TRON 8TROFF9KEY   0SCREEN
```





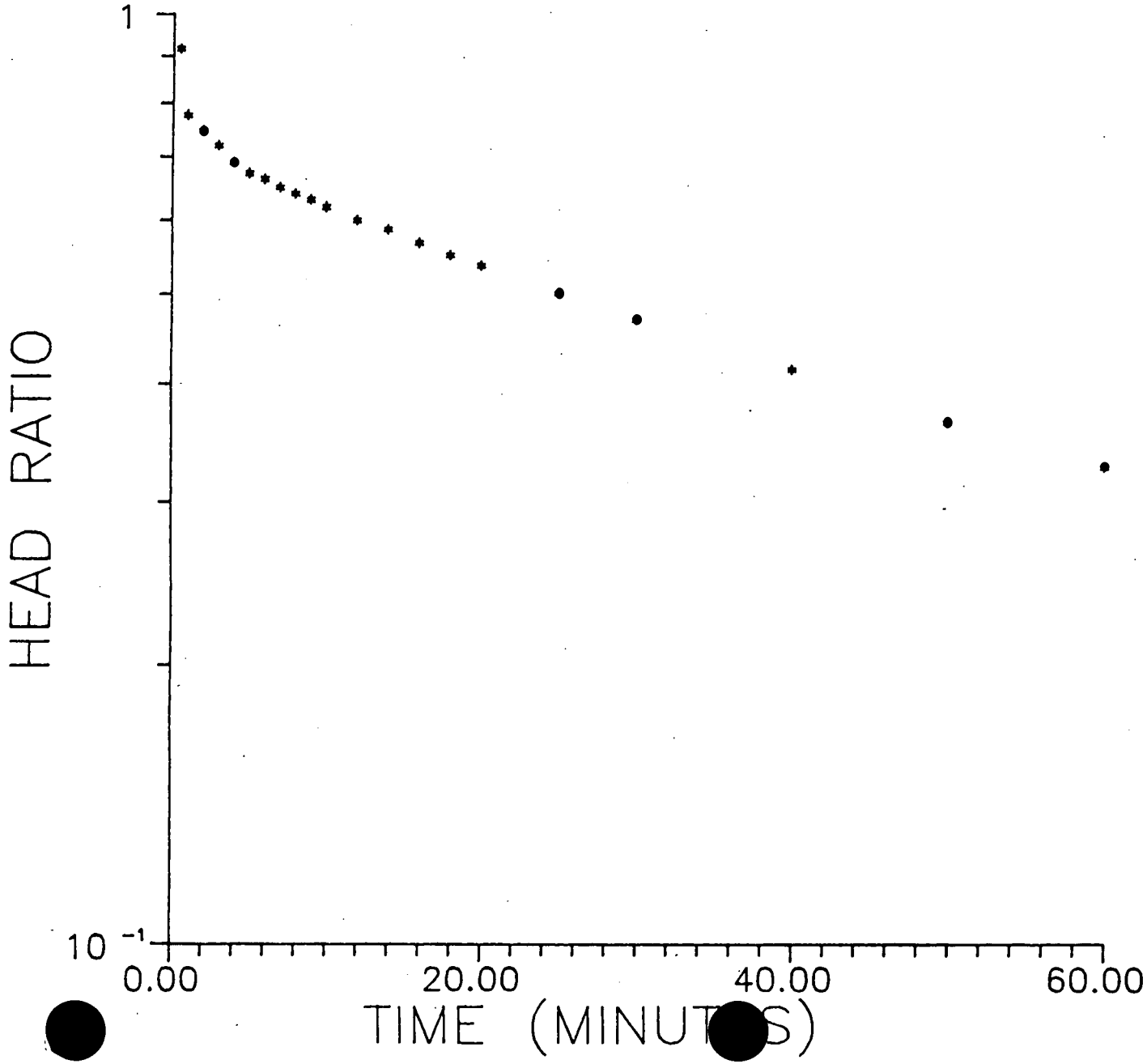
FMPC RI/FS MW-135

TIME (seconds)	WATER LEVEL (feet)	DRAWDOWN (feet)	H/H0
1200	3.59	-4.16	.5368436
1500	3.86	-3.89	.5020003
1800	4.11	-3.64	.4697391
2400	4.53	-3.22	.4155375
3000	4.98	-2.83	.3652084

UNCONFINED AQUIFER

K = 2.5E-05 cm/sec
= 0.5 gpd/ft2
= 8.3E-07 ft/sec
= 0.1 ft/day

REGRESSION COEFFICIENT = -.9998887


1
10 -1
HEAD RATIO
0.00
20.00
40.00
60.00
TIME (MINUTES)

3637

175

MW 135

r_1 : 4 in : 0.167 ft

r_2 : 6 in : 0.5 ft

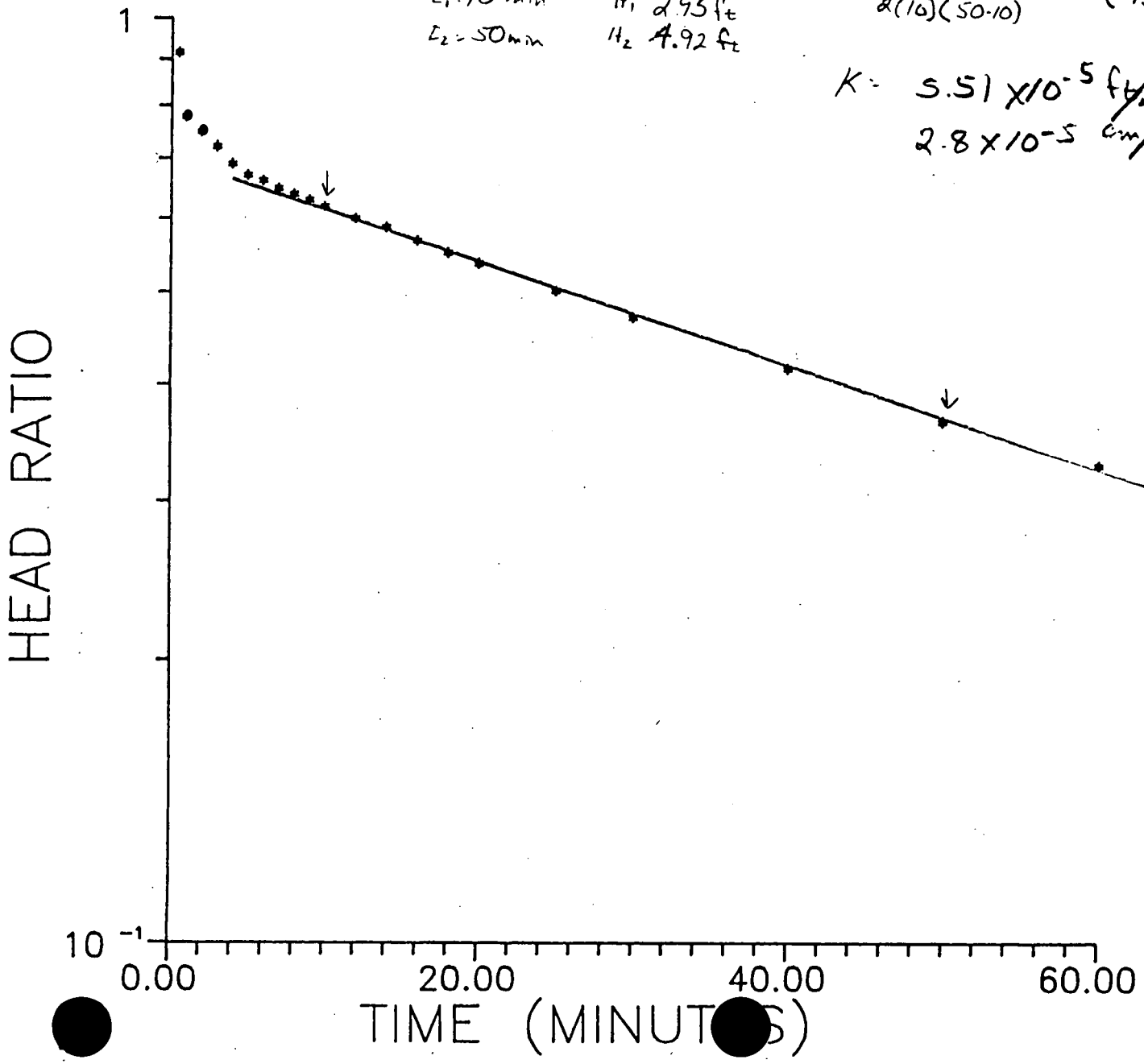
t_1 : 10 min H_1 2.95 ft

t_2 = 50 min H_2 4.92 ft

$$K = \frac{(0.167)^2}{2(10)(50-10)} \ln\left(\frac{10}{.5}\right) \ln\left(\frac{2.95-7.75}{4.92-7.75}\right)$$

$K = 5.51 \times 10^{-5}$ ft/min

2.8×10^{-5} cm/sec



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Checked by
FEW 7-9-88

MW 135

r_1 = 4 in = 0.167 ft

r_2 = 6 in = 0.5 ft

H_g = 7.75 ft

t_1 = 10 min H_1 2.95 ft

t_2 = 50 min H_2 4.92 ft

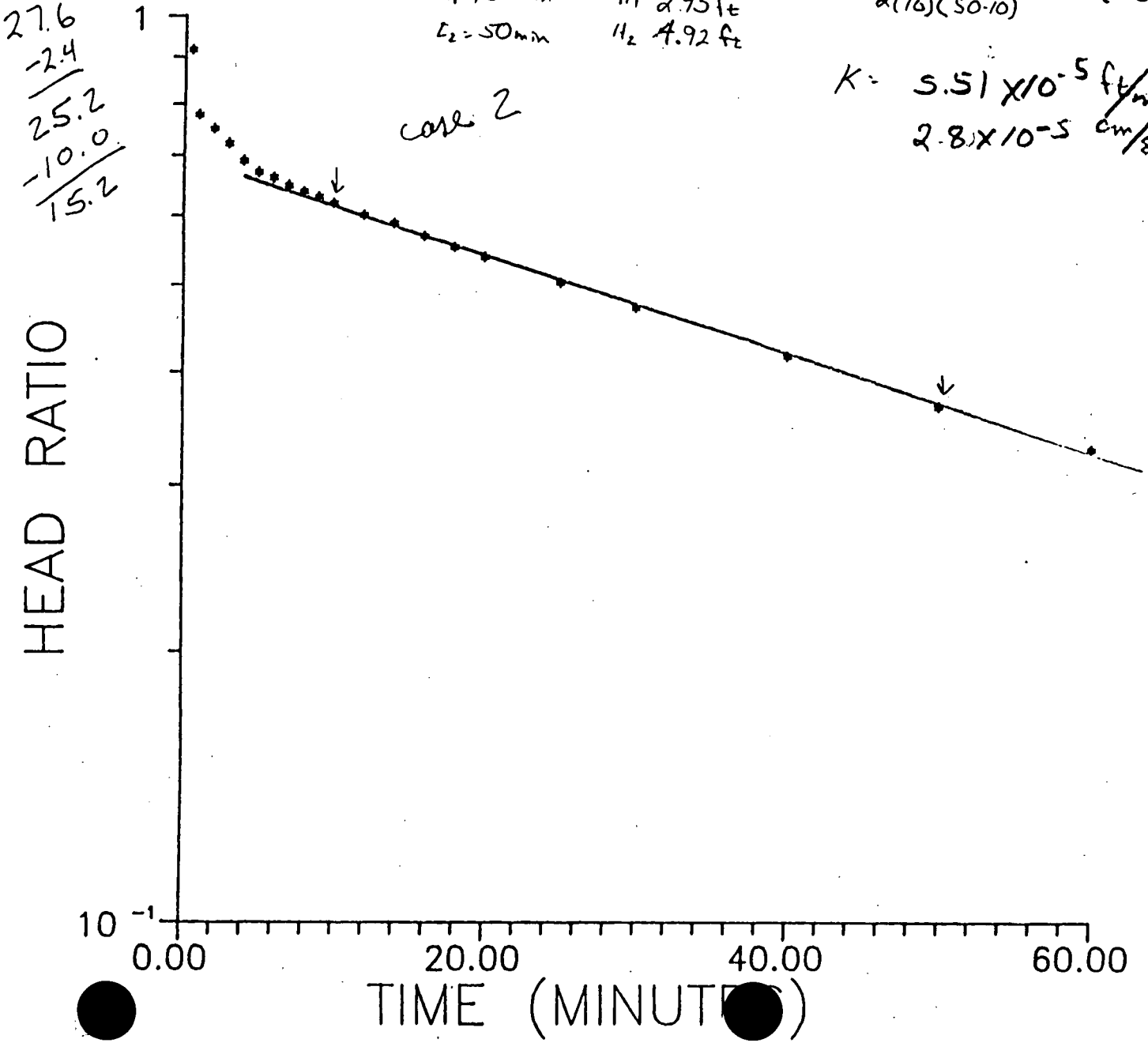
$$K = \frac{(0.167)^2}{2(10)(50-10)} \ln\left(\frac{10}{15}\right) \ln\left(\frac{2.95-7.75}{4.92-7.75}\right)$$

$K = 5.51 \times 10^{-5}$ ft/min

2.8×10^{-5} cm/sec

case 2

27.6
-2.4
25.2
-10.0
15.2



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MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1041
WELL NUMBER: 1041

FIELD ENG./GEO.: M. SLUSARSKI
CHECKED BY : Not Noted
N,E COORDINATES: 480550.15, 1379798.6
DATE OF INSTAL.: 04/11/88

DATE: 04/11/88
DATE: N/A

BOREHOLE DRILLING

DRILLING METHOD: Cable Tool
DRILLING FLUID(S) USED: (in Feet)
FLUID: WATER FROM: 0.0TO: 22.5
FLUID: N/A FROM: N/ATO: N/A
NOTES/COMMENTS:

TYPE OF BIT: Flat Head Hammer
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING WELL
CASING DIAM.: 4 In. ID
CASING SIZE(S) USED: (in Feet)
SIZE: 10 FROM: 0.0 TO: 22.5
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Screen
AVG. SIZE OF PERFORATIONS: 0.010 (In.)
TOTAL PERFORATED AREA: 10 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: Stainless Steel
RISER PIPE DIAMETERS:
O.D.: 4 3/8 In. I.D.: 4 In.
LENGTH OF 1ST PIPE SECTION:
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: SCREW TYPE FLUSH JOINT THREADED

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5.0 Ft.
PROTECTIVE PIPE O.D.: 10 3 In.
* LOCKING CAP

OTHER PROTECTION (* NOTED BELOW)

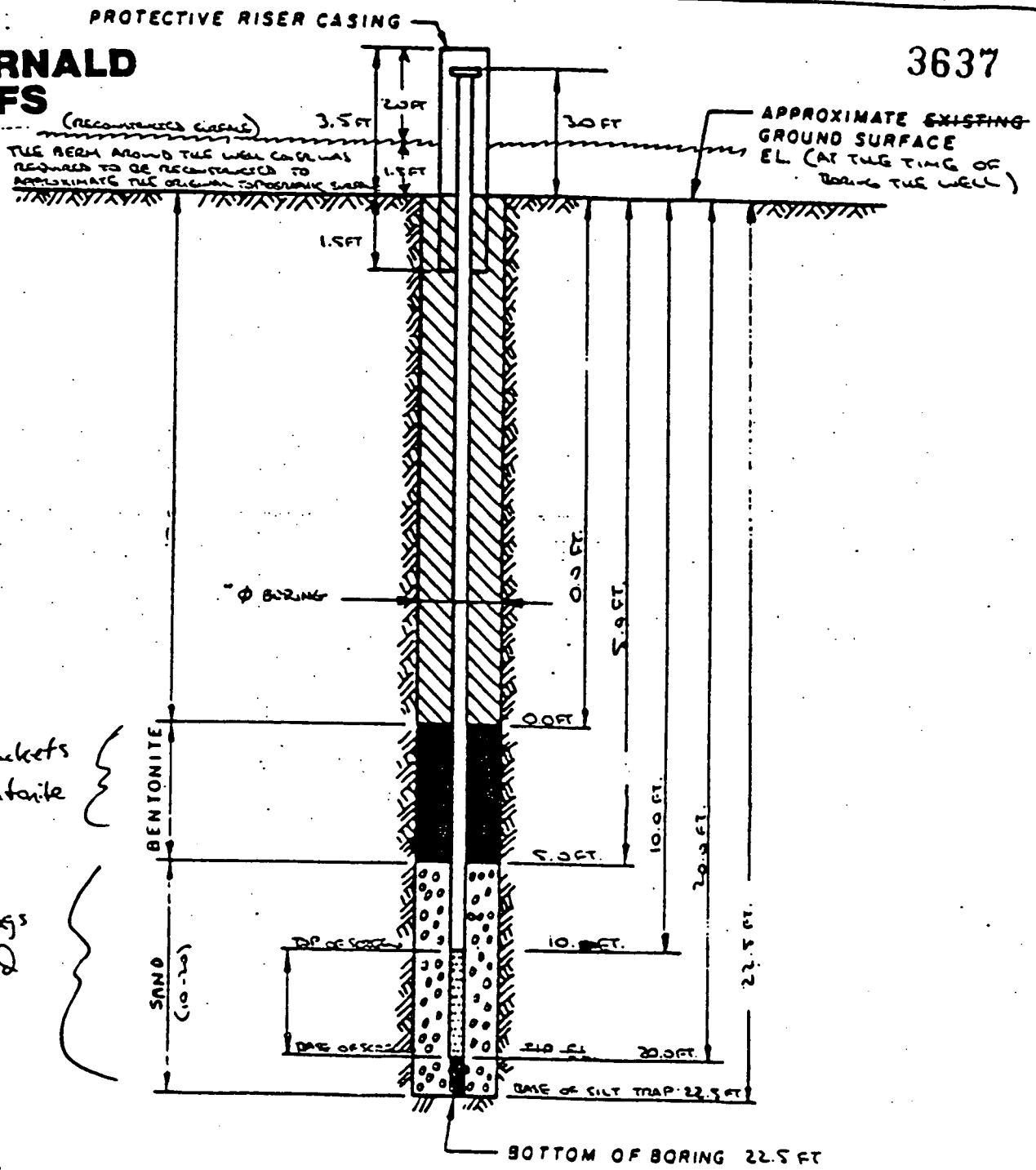
ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	3.5 Ft.		583.13	
GROUND SURFACE	0.0		581.3	
BOTTOM OF PROTECTIVE PIPE	1.5 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
Bentonite Pellets	0.0	5.0	N/A	N/A
Sand	5.0	22.5	N/A	N/A
PERFORATED SECTION	10.0	20.0	N/A	N/A
WELL TIP	22.5		N/A	
BOTTOM OF BOREHOLE	22.5		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

Boring # 141

FERNALD RI/FS

3637



NOTES:

1. RISER PIPE IS 4 IN I.D. SCHEDULE PIPE, THREADED, FLUSH-JOINTED.
2. SCREEN IS 4 IN I.D. SS PIPE CONTINUOUS SLOT SCREEN (0.010 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL
5. WATER LEVEL READING ON

INSTALLATION DETAILS
MONITORING WELL
04-11-88
PREPARED FOR
Boring # 141

MATERIALS USED: 10-20 SAND (80 LB SACKS): 8 BAGS
BENTONITE: 7 BUCKETS

DRAWING NUMBER | CHECKED BY | APPROVED BY | MLS | DRAWN BY

VISUAL CLASSIFICATION OF SOILS

3637

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1041	COORDINATES: NORTH 480,550.15 EAST 1,379,798.62	DATE: 04/10/88
GROUND ELEVATION: 581.3	GWL: Depth N/A Date/Time N/A	DATE STARTED: 04/10/88
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth N/A Date/Time N/A	DATE COMPLETED: 04/11/88
DRILLING METHODS: CABLE-TOOL		PAGE 1 OF 2

DEPTH	SAMPLE / DATE / TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
1.5	08448 04/10/88 1409	2 4 7	12	STIFF YELLOW-BROWN CLAY (10YR, 4/3) SOME FINE GRAVEL, ROOTLETS, DRY.	CL	2.0	Hnu= 0 ppm BΓ = 140 cpm
3.0	08449 04/10/88 1412	3 5 17	12	STIFF YELLOW-BROWN CLAY (10YR, 4/3) SOME FINE GRAVEL, ROOTLETS, DRY.	CL	2.0	Hnu= 0 ppm BΓ = 140 cpm
4.5	08450 04/10/88 1417	18 20 18	18	VERY STIFF, YELLOW-BROWN (5Y, 4/4) CLAY, SOME FINE GRAVEL, DRY STIFF GREY-BROWN, MOTTLED (10YR, 3/1) CLAY, SOME FINE GRAVEL, DRY.	CL CL	2.5 2.0	Hnu= 0 ppm BΓ = 120 cpm
6.0	08451 04/10/88 1421	24 25 30	18	VERY STIFF YELLOW-BROWN-GREY, MOTTLED (10YR, 4/4) CLAY, DRY.	CL	3.0	Hnu= 0 ppm BΓ = 120 cpm
7.5	08452 04/10/88 1426	24 26 24	14	STIFF GREY-YELLOW BROWN, MOTTLED, (10YR, 5/1) CLAY, DRY.	CL	2.0	Hnu= 0 ppm BΓ = 120 cpm
9.0	08453 04/10/88 1428	25 28 27	8	STIFF GREY-YELLOW BROWN, MOTTLED, (10YR, 5/1) CLAY, DRY.	CL	2.0	Hnu= 0 ppm BΓ = 120 cpm
11.0	08454 04/11/88 0908			SHELBY TUBE.. PUSHED SHELBY TUBE FROM 9.0 FT. TO 11.0 FT. RECOVERED: .75 FT..			Hnu= 0 ppm BΓ = 120 cpm
12.0	08455 04/11/88 0937	3 9	12	STIFF, GREY (5Y, 5/1) CLAY, SOME SILT, DAMP.	CL	2.0	Hnu= 0 ppm BΓ = 120 cpm
13.5	08456 04/11/88 0940	5 6 8	12	STIFF, GREY (5Y, 5/1) CLAY, SOME SILT, DAMP.	CL	2.0	Hnu= 0 ppm BΓ = 100 cpm
15.0	08457 04/11/88 0944	5 5 7	12	STIFF, GREY (5Y, 5/1) CLAY, SOME SILT, DAMP.	CL	2.0	Hnu= 0 ppm BΓ = 100 cpm

NOTES:
SAMPLES COLLECTED AS PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

VISUAL CLASSIFICATION OF SOILS

3637

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1041	COORDINATES: NORTH 480,550.15 EAST 1,379,798.62	DATE: 04/10/88
GROUND ELEVATION: 581.3	GWL: Depth N/A Date/Time N/A	DATE STARTED: 04/10/88
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth N/A Date/Time N/A	DATE COMPLETED: 04/11/88
DRILLING METHODS: CABLE-TOOL		PAGE 2 OF 2

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.5	08458 04/11/88 0948	3 4 4	12	STIFF, GREY (5Y, 5/1) CLAY, SOME SILT, DAMP.	CL	2.0	Hnu= 0 ppm BΓ = 100 cpm
18.0	08459 04/11/88 0951	4 4 6	12	STIFF, GREY (5Y, 5/1) CLAY, SOME SILT, DAMP.	CL	2.0	Hnu= 0 ppm BΓ = 100 cpm
19.5	08460 04/11/88 1100	1 5 6	14	STIFF, GREY (5Y, 5/1) CLAY, SOME SILT, DAMP.	CL	2.0	Hnu= 0 ppm BΓ = 100 cpm
21.0	08461 04/11/88 1102	3 4 4	18	STIFF, GREY (5Y, 5/1) CLAY, SOME SILT, DAMP.	CL	2.0	Hnu= 0 ppm BΓ = 100 cpm
22.5	08462 04/11/88 1115	2 2 4	18	STIFF, GREY (5Y, 5/1) CLAY, SOME SILT, DAMP.	CL	2.0	Hnu= 0 ppm BΓ = 100 cpm

BOTTOM OF BORING 22.5

NOTES:
SAMPLES COLLECTED AS PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

clay some silt

FERNALD RI/FS

3637

FIELD PERMEABILITY TESTS

FALLING HEAD *

PROJECT Fernald RI/FS
PROJECT NO. 602.03.02.01
BORING NO. 141

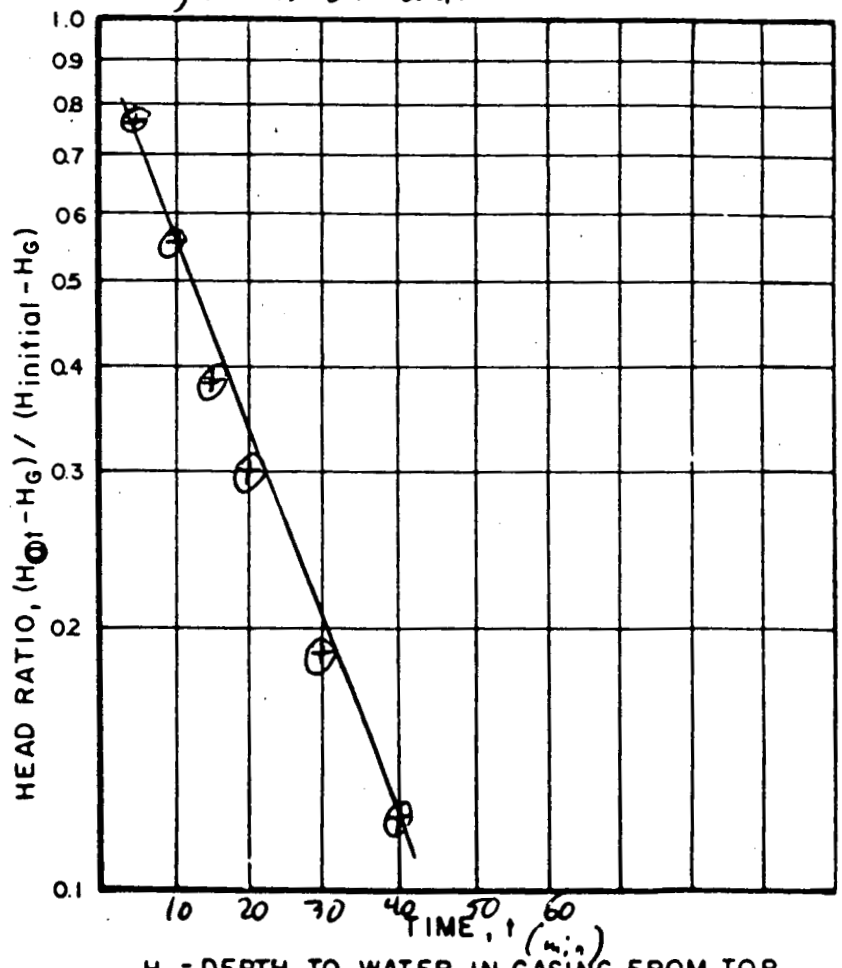
TESTED BY LW, MSG DATE 6/6/88
CALCULATED BY FXM DATE 11/11/88
CHECKED BY KH DATE 12/28/88
Copied By: FXM 10/31/88
Chkd By: KH 12/28/88

RADIUS OF TEST BORING, R 0.5 ft
PERMEABILITY, K 1.1×10^{-4} cm/s
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C ≈ 2 ft
DEPTH TO BOTTOM OF TEST POCKET, L_1 23.0 ft
DEPTH TO TOP OF TEST POCKET, L_2 13.0 ft
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 9.95 ft

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

Began Test 1415
9 gallons of water used

ELAPSED TIME t min ~~sec.~~	DEPTH TO WATER IN CASING H ft ~~Meters~~
1	3.10
2	3.65
3	4.05
4	4.40
5	4.80
6	5.10
7	5.40
8	5.70
9	5.95
10	6.20
12	6.65
14	7.05
16	7.35
18	7.65
20	7.90
25	8.35
30	8.70
35	8.95
40	9.10
45	9.25
50	9.35
55	9.43
60	9.48
0	1.75



$$K = \frac{R^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

INTERNATIONAL TECHNOLOGY CORPORATION

By FXM Date 11/11/88 Subject Slug Test Calculations Sheet No. 2 of 3
Chkd. By ___ Date ___ Well 141 Proj. No. 602.03.07.01

Well 141

$$\text{Head Ratio} = \frac{H_T - H_G}{H_i - H_G}$$

@ 5 min $\frac{4.80 - 9.95}{3.10 - 9.95} = 0.75$

@ 10 min $\frac{6.20 - 9.95}{3.10 - 9.95} = 0.55$

@ 16 min $\frac{7.35 - 9.95}{3.10 - 9.95} = 0.38$

@ 20 min $\frac{7.90 - 9.95}{3.10 - 9.95} = 0.30$

@ 30 min $\frac{8.70 - 9.95}{3.10 - 9.95} = 0.18$

@ 40 min $\frac{9.10 - 9.95}{3.10 - 9.95} = 0.12$

@ 50 min $\frac{9.35 - 9.95}{3.10 - 9.95} = 0.09$

Calc. By FYM Date 11/11/88 Subject Slug Test Calculations Well 141 Sheet No. 3 of 3

Rev. By ____ Date ____ Proj. No. 602.03.02.01

Permeability:

$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

$$= \frac{(0.167)^2}{2(23-13)(40-10)} \ln\left[\frac{23-13}{0.5}\right] \ln\left[\frac{6.20-9.95}{9.10-9.95}\right]$$

$K = 2.1 \times 10^{-4}$ ft/min

$K = 1.1 \times 10^{-4}$ cm/s

INTERNATIONAL TECHNOLOGY CORPORATION

J. Wille Date 6-11-88 Subject Head Ratio Calculations Sheet No. ___ of ___
Chkd. By LKP Date 07-10-88 For MW 141 Proj. No. 602 3.2.3

$$\text{Head Ratio} = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G = Depth to ground water from TOC before slug added
H_i = Initial depth to ground water from TOC after slug added
$H_{@t}$ = Depth to ground water from TOC at time t

time = 1 minute $H_t = 3.10$ ft

$$HR = \frac{3.10 - 9.95}{1.75 - 9.95} = 0.835$$

H_G = 9.95 ft
H_i = 1.75 ft

time (minutes)	H (feet)	H.R (dimensionless)
1	3.10	0.835
2	3.65	0.768
3	4.05	0.720
4	4.40	0.677
5	4.80	0.628
6	5.10	0.591
7	5.40	0.555
8	5.70	0.518
9	5.95	0.488
10	6.20	0.457
12	6.65	0.402
14	7.05	0.354
16	7.35	0.317
18	7.65	0.280
20	7.90	0.250
25	8.35	0.195
30	8.90	0.~~152~~ ~~0.0128~~ 0.128
35	8.95	0.122
40	9.10	0.104
45	9.25	0.085
50	9.35	0.073
55	9.43	0.063
60	9.48	0.057

INTERNATIONAL TECHNOLOGY CORPORATION

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L Wille Date 6-11-88 Subject Head Ratio Calculations Sheet No. ____ of ____

Chkd. By LKP Date 06-19-88 for MW 141 Proj. No. 602.3.2.3

$$\text{Head Ratio} = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G = Depth to ground water from TOC before slug added

H_i = Initial depth to ground water from TOC after slug added

$H_{@t}$ = Depth to ground water from TOC at time t

time = 1 minute $H_t = 3.10$ ft

$$HR = \frac{3.10 - 9.95}{1.75 - 9.95} = 0.835$$

H_G = 9.95 ft

H_i = 1.75 ft

time (minutes)	H (feet)	H.R (dimensionless)
1	3.10	0.835
2	3.65	0.768
3	4.05	0.720
4	4.40	0.677
5	4.80	0.628
6	5.10	0.591
7	5.40	0.555
8	5.70	0.518
9	5.95	0.488
10	6.20	0.457
12	6.65	0.402
14	7.05	0.354
16	7.35	0.317
18	7.65	0.280
20	7.90	0.250
25	8.35 ok	0.195
30	~~8.90~~ 8.90	~~0.152~~ 0.128
35	8.95	0.122
40	9.10	0.104
45	9.25	0.085
50	9.35	0.073
55	9.43	0.063
60	9.48	0.057

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106-10-85

LKP 07-10-88

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ALIE: 1.00

Press / for commands

	A	B	C	D	E
1	1.00	3.10	0.835		
[illegible]	2.00	3.47	0.766		
[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	4.00	[illegible]	0.677		
[illegible]	5.00	4.80	0.628		
[illegible]	6.00	[illegible]	0.591		
[illegible]	7.00	5.40	0.555		
[illegible]	8.00	5.70	0.518		
[illegible]	9.00	5.95	0.488		
10	10.00	6.20	0.457		
11	11.00	6.65	0.402		
12	12.00	7.05	0.354		
13	13.00	7.35	0.317		
14	14.00	7.65	0.280		
15	15.00	7.90	0.250		
16	16.00	8.25	0.195		
17	17.00	8.90	0.128		
18	18.00	8.95	0.122		
19	19.00	9.10	0.104		
20	20.00	9.25	0.085		
21	21.00	9.35	0.073		
22	22.00	9.45	0.063		

ALIE: 60.00

Press / for commands

	A	B	C	D	E
23	60.00	9.48	0.057		
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					

.type mw141.tbl

IN-SITU INC. HERMIT DATA MANAGEMENT PACKAGE

3637

MONITORING WELL 141

SLUG/SWAB TEST

Ref. Value : 9.95 (Ft)
H(0) : 8.20 (Ft)
T(0) : .01 (Min)

ELAPSED TIME (Min)	VALUE (Ft)	HO/DRWDN (Ft)	DELTA TIME (Min)	H/H(0)
1.0000	3.10	6.85	.9900	.835
2.0000	3.65	6.30	1.9900	.768
3.0000	4.05	5.90	2.9900	.720
4.0000	4.40	5.55	3.9900	.677
5.0000	4.80	5.15	4.9900	.628
6.0000	5.10	4.85	5.9900	.591
7.0000	5.40	4.55	6.9900	.555
8.0000	5.70	4.25	7.9900	.518
9.0000	5.95	4.00	8.9900	.488
10.0000	6.20	3.75	9.9900	.457
12.0000	6.65	3.30	11.9900	.402
14.0000	7.05	2.90	13.9900	.354
16.0000	7.35	2.60	15.9900	.317
18.0000	7.65	2.30	17.9900	.280
20.0000	7.90	2.05	19.9900	.250
25.0000	8.35	1.60	24.9900	.195
30.0000	8.90	1.05	29.9900	.128
35.0000	8.95	1.00	34.9900	.122
40.0000	9.10	.85	39.9900	.104
45.0000	9.25	.70	44.9900	.085
50.0000	9.35	.60	49.9900	.073
55.0000	9.43	.52	54.9900	.063
60.0000	9.48	.47	59.9900	.057

type mw141.tbl

IN-SITU INC. HERMIT DATA MANAGEMENT PACKAGE

3637

MONITORING WELL 141

SLUG/SWAB TEST

Ref. Value : 9.95 (Ft)
H(0) : 8.20 (Ft)
T(0) : .01 (Min)

ELAPSED TIME (Min)	VALUE (Ft)	HD/DRHDN (Ft)	DELTA TIME (Min)	H/H(0)
1.0000	3.10	6.35	.9900	.835
2.0000	3.65	6.30	1.9900	.769
3.0000	4.05	5.90	2.9900	.720
4.0000	4.40	5.55	3.9900	.677
5.0000	4.80	5.15	4.9900	.628
6.0000	5.10	4.85	5.9900	.591
7.0000	5.40	4.55	6.9900	.555
8.0000	5.70	4.25	7.9900	.519
9.0000	5.95	4.00	8.9900	.488
10.0000	6.20	3.75	9.9900	.457
[illegible].0000	6.65	3.30	11.9900	.402
[illegible]0000	7.05	2.90	13.9900	.354
[illegible].0000	7.35	2.60	15.9900	.317
18.0000	7.65	2.30	17.9900	.280
20.0000	7.90	2.05	19.9900	.250
25.0000	8.35	1.60	24.9900	.195
30.0000	8.90	1.05	29.9900	.128
35.0000	8.95	1.00	34.9900	.122
40.0000	9.10	.85	39.9900	.104
45.0000	9.25	.70	44.9900	.085
50.0000	9.35	.60	49.9900	.073
55.0000	9.47	.52	54.9900	.063
60.0000	9.48	.47	59.9900	.057

LKP 07-10-88

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VALUE: 1.00

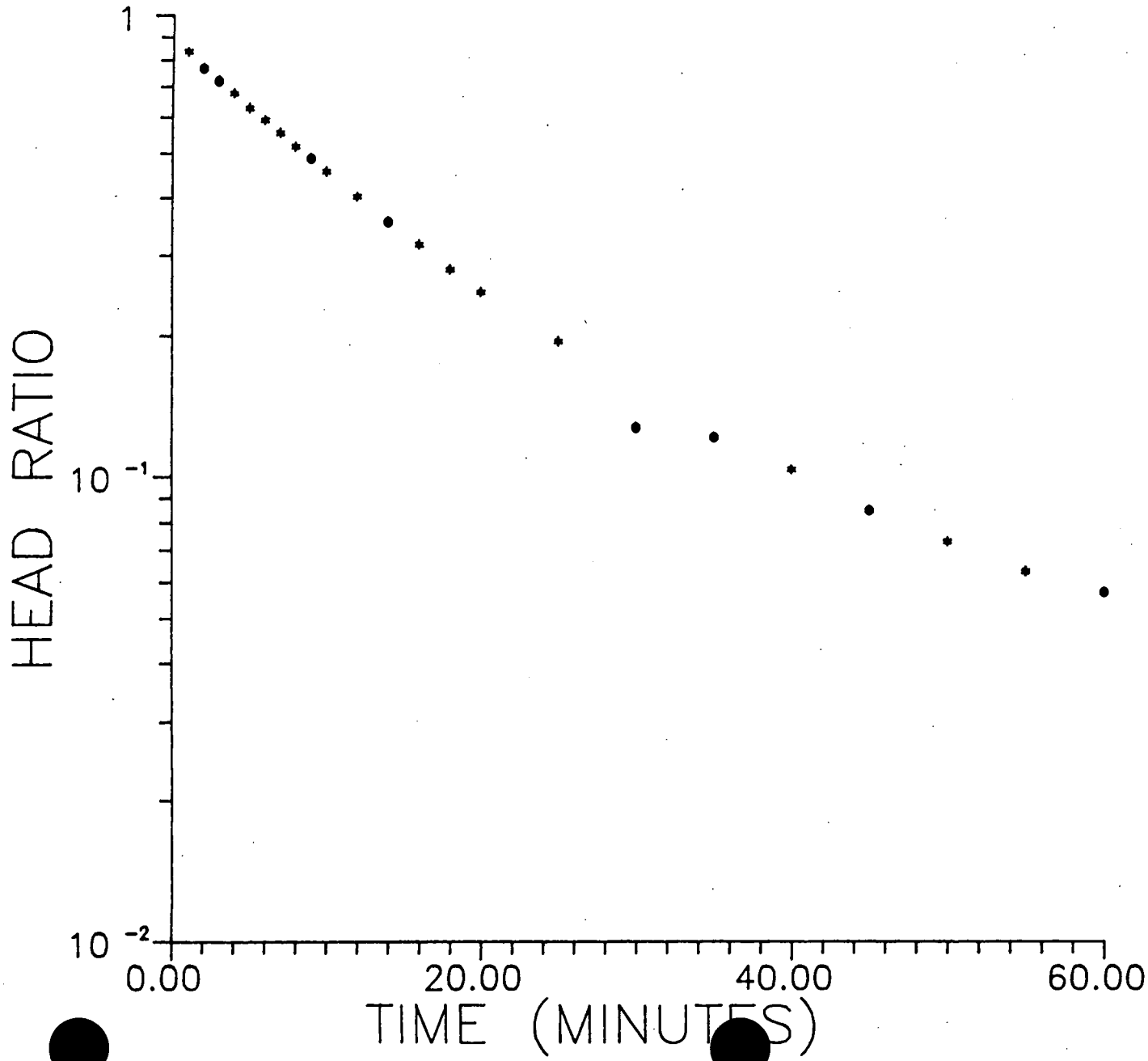
Press / for commands

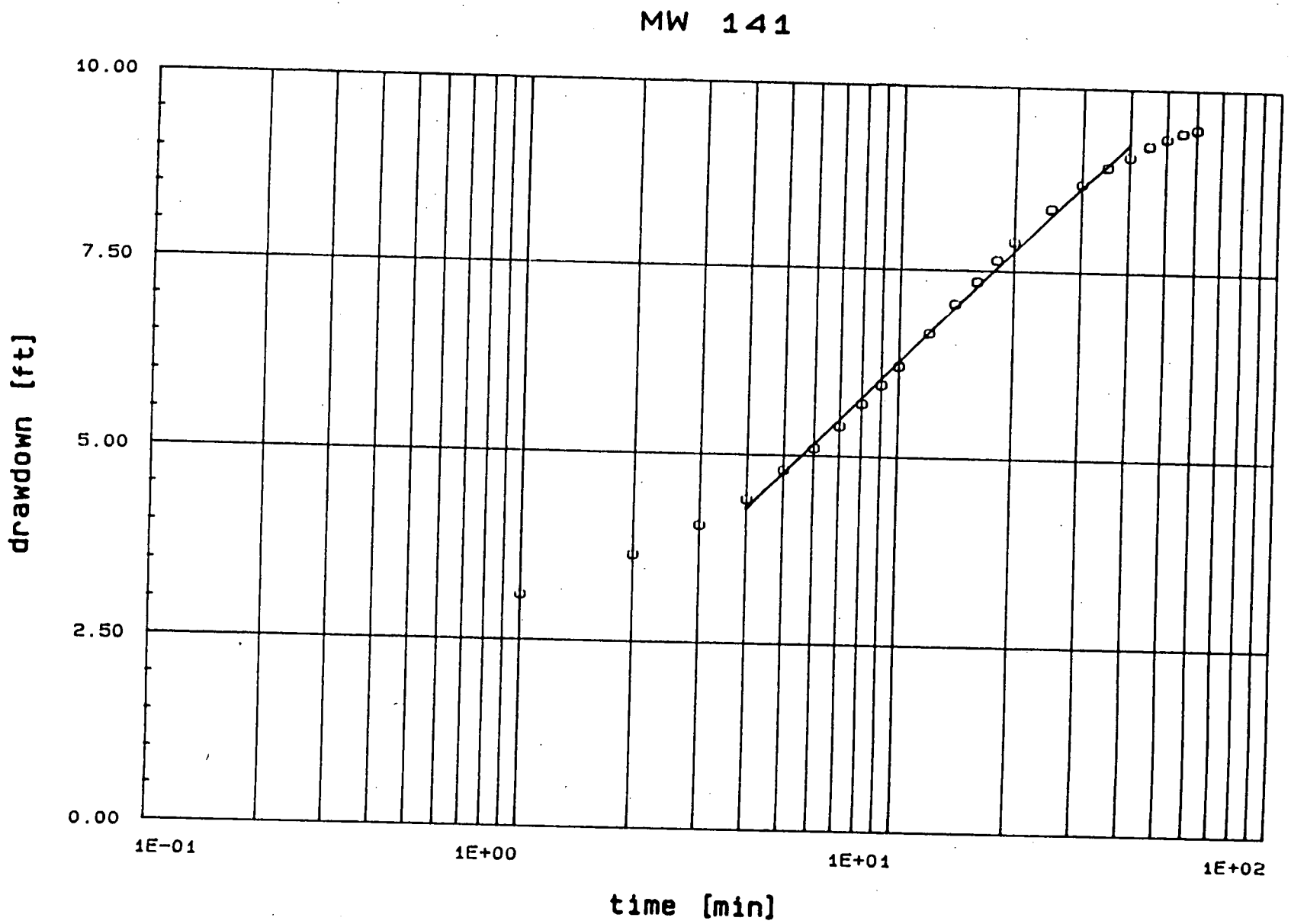
	A	B	C	D	E
1	1.00	3.10	0.835		
2	2.00	3.65	0.768		
3	3.00	4.05	0.720		
4	4.00	4.40	0.677		
5	5.00	4.80	0.628		
6	6.00	5.10	0.591		
7	7.00	5.40	0.555		
8	8.00	5.70	0.518		
9	9.00	5.95	0.488		
10	10.00	6.20	0.457		
11	12.00	6.65	0.402		
12	14.00	7.05	0.354		
13	16.00	7.35	0.317		
14	18.00	7.65	0.280		
15	20.00	7.90	0.250		
16	25.00	8.35	0.195		
17	30.00	8.90	0.128		
18	35.00	8.95	0.122		
19	40.00	9.10	0.104		
20	45.00	9.25	0.085		
21	50.00	9.35	0.073		
22	55.00	9.43	0.063		

VALUE: 60.00

Press / for commands

	A	B	C	D	E
23	60.00	9.48	0.057		
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					


1
10 -1
10 -2
HEAD RATIO
0.00
20.00
40.00
60.00
TIME (MINUTES)



FILE: MW141.DAT

T = 53 [gpd/ft]
S = .246E-01

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MW 141

① $t_1 = 1$ H_1 3.10
$t_2 = 18$ H_2 7.65

$$K_1 = \frac{(0.167)^2}{2(10)(18-1)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{3.10 - 9.95}{7.65 - 9.95}\right)$$

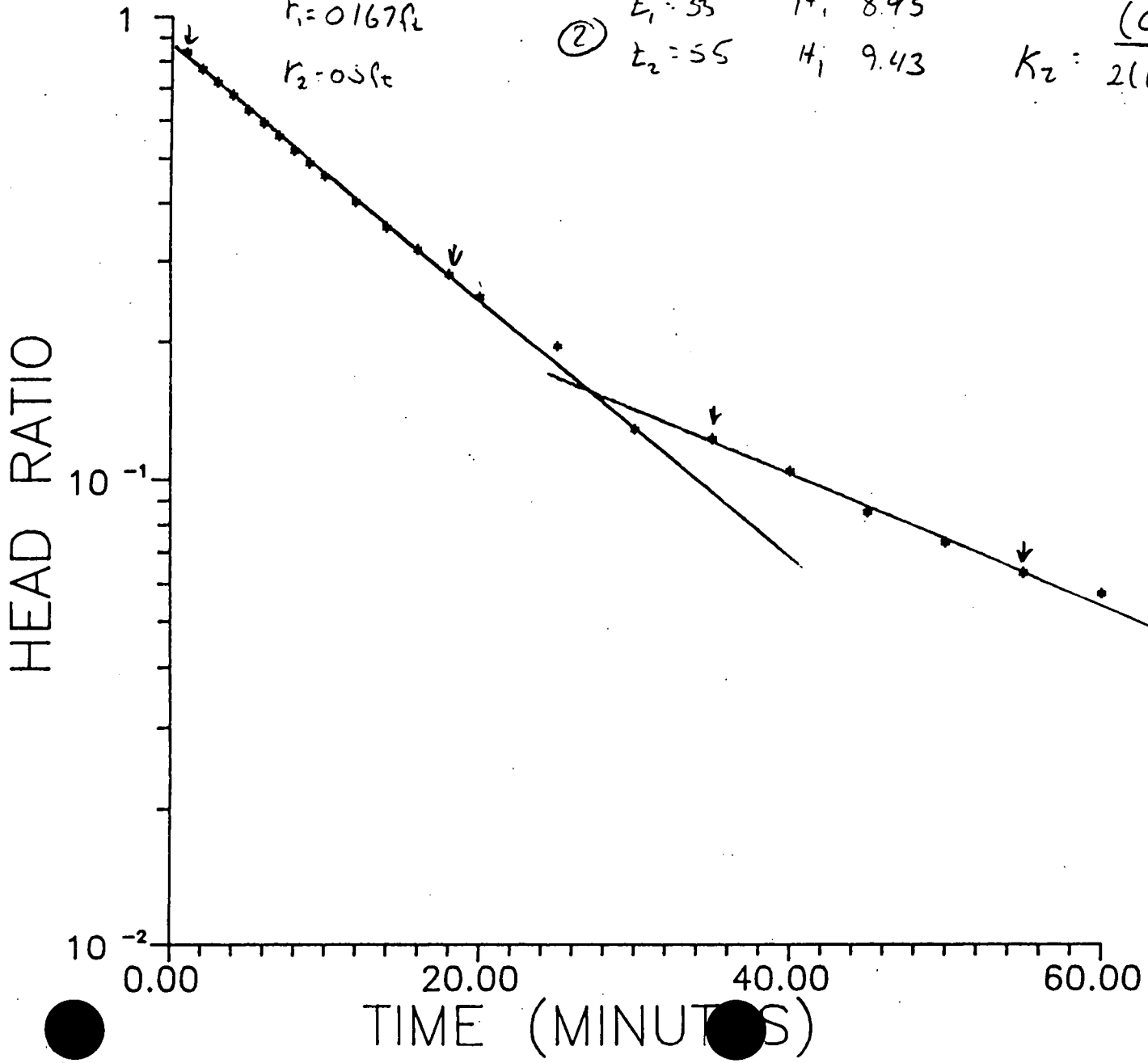
2.68×10^{-4} ft/min
1.36×10^{-4} cm/sec

② $t_1 = 35$ H_1 8.95
$t_2 = 55$ H_1 9.43

$$K_2 = \frac{(0.167)^2}{2(10)(35-55)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{8.95 - 9.95}{9.43 - 9.95}\right)$$

1.36×10^{-4} ft/min
6.93×10^{-5} cm/sec

$r_1 = 0.167$ ft
$r_2 = 0.5$ ft



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Checked by [illegible]
7-9-88

MW 141

① $t_1 = 1$ H_1 3.10
$t_2 = 18$ H_2 7.65

$K_1 = \frac{(0.167)^2}{2(10)(18-1)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{3.10 - 9.95}{7.65 - 9.95}\right)$

2.68×10^{-4} ft/min
1.36×10^{-4} cm/sec

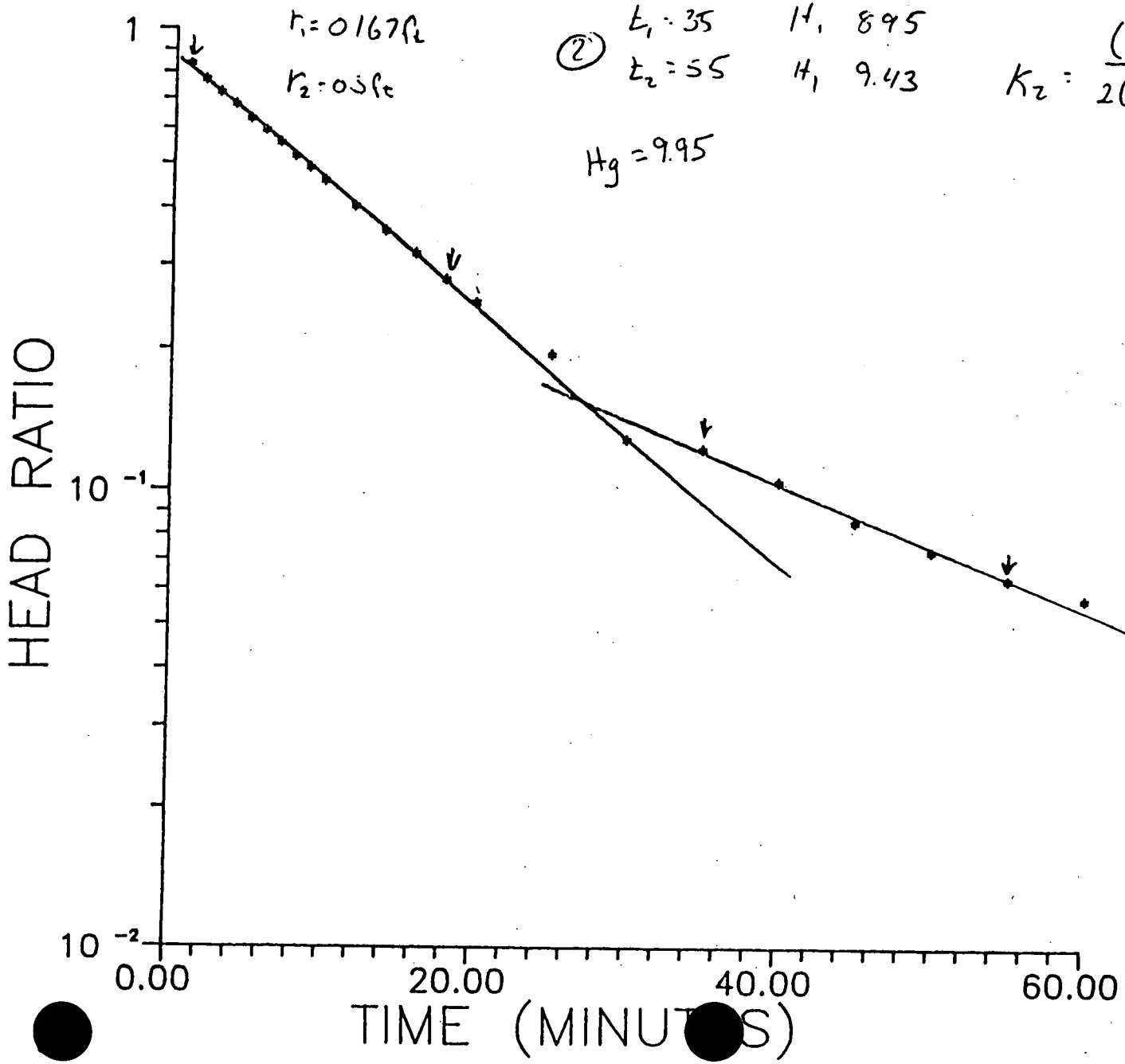
② $t_1 = 35$ H_1 8.95
$t_2 = 55$ H_1 9.43

$K_2 = \frac{(0.167)^2}{2(10)(35-55)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{8.55 - 9.95}{9.43 - 9.95}\right)$

1.36×10^{-4} ft/min
6.9×10^{-5} cm/sec
ok [illegible]

$r_1 = 0.167$ ft
$r_2 = 0.5$ ft

$H_g = 9.95$



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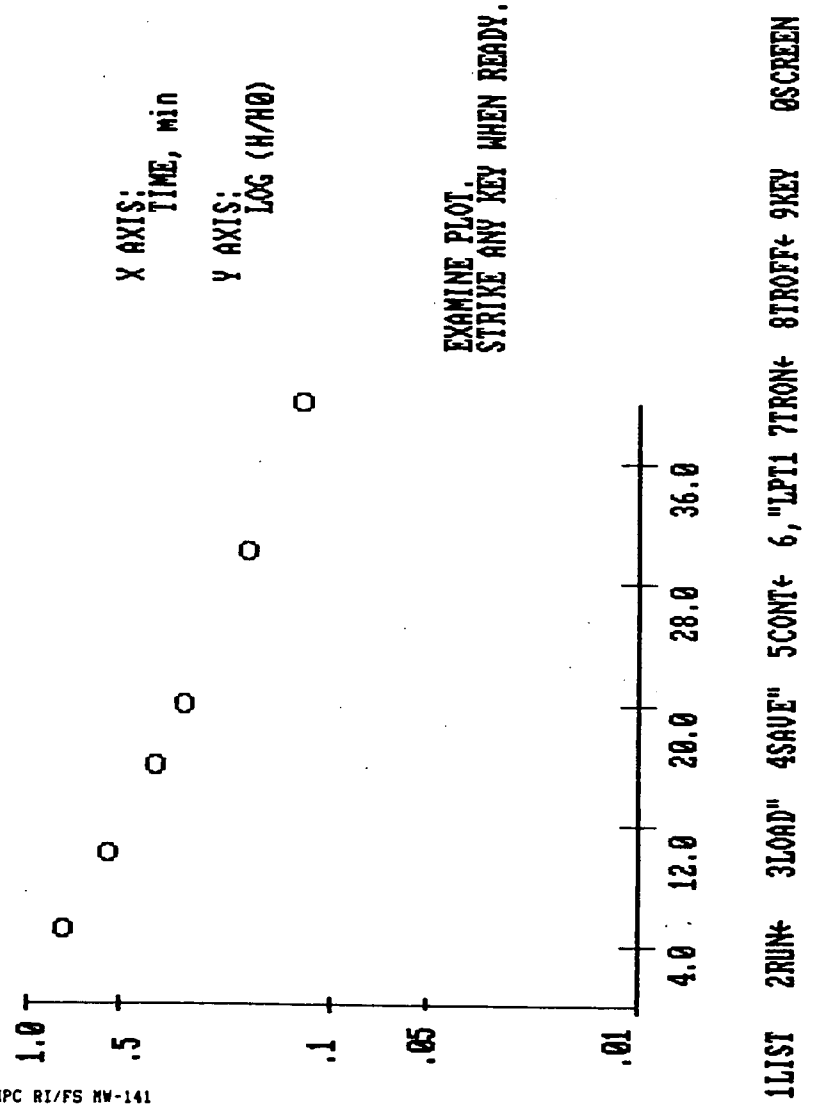
PERMEABILITY FROM TIME-LAG TESTS

```
TITLE: ? FMPC RI/FS MW-141
(E)nglish or (M)etric units? E
(C)onfined or (U)nconfined conditions? U
Do you prefer to enter well radii as (I)nches or (F)eet? F
STANDPIPE RADIUS (feet) = ? .167
INTAKE RADIUS (feet) = ? .5
LENGTH OF INTAKE (feet or meters) = ? 10
DEPTH TO TOP OF INTAKE (feet or meters) = ? 13
STATIC WATER LEVEL, DEPTH (feet or meters) = ? 9.95
PURGE WATER LEVEL (feet or meters) = ? 3.1

ARE THESE DATA CORRECT? (Y/N)?

1LIST   2RUN   3LOAD"   4SAVE"   5CONT 6,"LPT1 7TRON 8TROFF9KEY    0SCREEN
```



FMPC RI/FS MW-141

TIME (seconds)	WATER LEVEL (feet)	DRAWDOWN (feet)	H/H0
600	6.2	-3.75	.5474453
960	7.35	-2.60	.3795621
1200	7.9	-2.05	.29927
1800	8.7	-1.25	.1824818
2400	9.100001	-0.85	.1240875

UNCONFINED AQUIFER

K = 1.0E-04 cm/sec
= 2.2 gpd/ft2
= 3.4E-06 ft/sec
= 0.3 ft/day

REGRESSION COEFFICIENT = -.9956321

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1046
WELL NUMBER: 1046

FIELD ENG./GEO.: T. SULLIVAN DATE: 02/09/88
CHECKED BY : Not Noted DATE: N/A
N,E COORDINATES: 478054.76, 1379428.4
DATE OF INSTAL.: 02/09/88

BOREHOLE DRILLING

DRILLING METHOD: Cable Tool
DRILLING FLUID(S) USED: (in Feet)
FLUID: WATER FROM: 0 TO: 27
FLUID: N/A FROM: N/ATO: N/A
NOTES/COMMENTS:

TYPE OF BIT: Flat Head Hammer
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING WELL
CASING DIAM.: 4 In. ID
CASING SIZE(S) USED: (in Feet)
SIZE: 10 FROM: 0 TO: 25
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Screen
AVG. SIZE OF PERFORATIONS: 0.010 (In.)
TOTAL PERFORATED AREA: 10 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: Stainless Steel
RISER PIPE DIAMETERS:
O.D.: 4 3/8 In. I.D.: 4 In.
LENGTH OF 1ST PIPE SECTION:
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: SCREW FLUSH JOINT THREADS.

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5 Ft.
PROTECTIVE PIPE O.D.: 10 3 In.
* LOCKING CAP AND LOCK.

OTHER PROTECTION (* NOTED BELOW)

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	2.5 Ft.		579.13	
GROUND SURFACE	0.0		576.5	
BOTTOM OF PROTECTIVE PIPE	2.25 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
Bentonite Pellets	0	7	N/A	N/A
Sand	7	22	N/A	N/A
PERFORATED SECTION	9.5	19.5	N/A	N/A
WELL TIP	21.9		N/A	
BOTTOM OF BOREHOLE	28.5		N/A	
GWL AFTER INSTALLATION	4.05		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

B146

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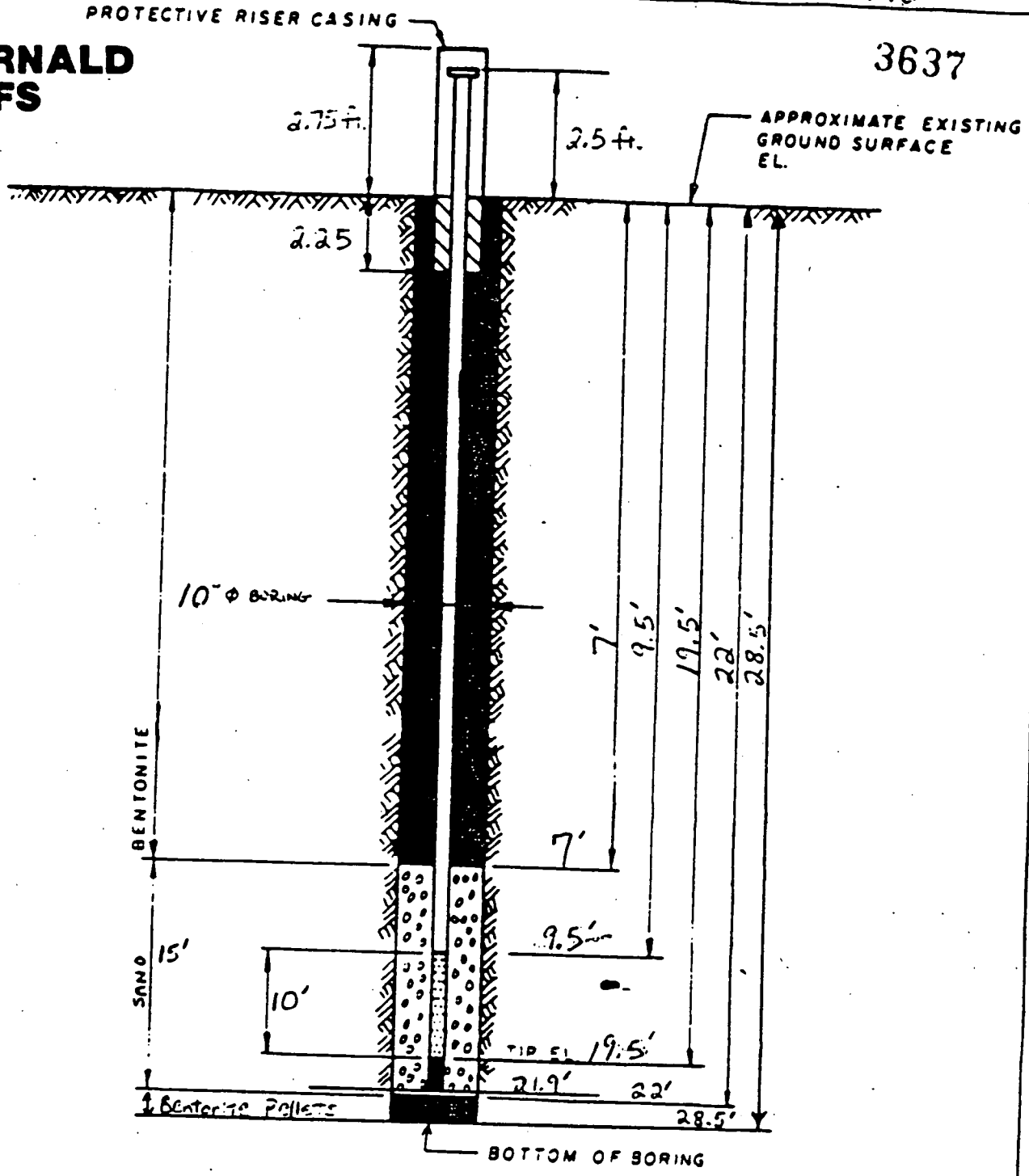
FERNALD RI/FS



NOTES

1. RISER PIPE IS 4 IN I.D. SCHEDULE PIPE, THREADED, FLUSH-JOINTED.
2. SCREEN IS 4 IN I.D. S.S. PIPE CONTINUOUS SLOT SCREEN (0.010 IN SLOT SIZE)
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL 6.55 ft below TOC,
5. WATER LEVEL READING ON 4.05 ft below ground surface.
   2/1/88 09:50

INSTALLATION DETAILS
MONITORING WELL 146

PREPARED FOR
FMPC RI/FS

(Bentonite plug from [illegible] depth 14 to 22 ft.)

DRAWING NUMBER

CHECKED BY

APPROVED BY

7 Sullivan

DRAWN BY

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VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1046	COORDINATES: NORTH 478,054.76 EAST 1,379,428.45	DATE: 02/06/88
GROUND ELEVATION: 576.5	GWL: Depth N/A Date/Time N/A	DATE STARTED: 02/06/88
ENGINEER/GEOLOGIST: T. SULLIVAN	Depth N/A Date/Time N/A	DATE COMPLETED: 02/09/88
DRILLING METHODS: CABLE-TOOL		PAGE 1 OF 2

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
1.5	08014 02/06/88 1120	5 5 7	14	HARD DARK BROWNISH GRAY 10YR 3/1 SILT (TOPSOIL), ORGANIC RICH, DRY. HARD YELLOW-BROWN 10YR 3/6 SILTY CLAY, DRY.	OL CL	>5 >5	Hnu= 0 ppm α = 2 cpm BΓ = 60 cpm
3.0	08015 02/06/88 1128	6 9 14	17	HARD, YELLOW-BROWN 10YR 3/6 SILTY CLAY, DRY.	CL	3.0	Hnu= 0 ppm α = 2 cpm BΓ = 60 cpm
4.5	08016 02/06/88 1135	10 8 7	16	SOFT, YELLOW-BROWN 10YR 3/6 SILTY CLAY, DRY.	CL	0.5	Hnu= 0 ppm α = 0 cpm BΓ = 80 cpm
6.0	08017 02/06/88 1140	7 11 15	18	SOFT YELLOW-BROWN 10YR 3/4 SILT, TRACE SAND, WET.	ML	1.0	Hnu= 0 ppm α = 2 cpm BΓ = 60 cpm
7.5	08018 02/06/88 1145	5 10 15	17	MEDIUM DENSE, YELLOW-BROWN 10YR 3/4 FINE GRAINED SAND, SOME SILT, WET.	SM	N/A	Hnu= 0 ppm α = 0 cpm BΓ = 100 cpm
9.0	08019 02/07/88 1455	4 7 7	11	MEDIUM DENSE, YELLOW-BROWN 10YR, 4/6 FINE GRAINED SAND AND SILT, WET. VERY STIFF, YELLOW-BROWN 10YR 4/4 CLAY, TRACE SILT, DRY. VERY STIFF, GRAY 10YR, 4/1 CLAY, DRY.	SM CL	N/A 3.0	Hnu= 0 ppm α = 0 cpm BΓ = 100 cpm
10.5	08020 02/07/88 1645	3 5 4	11	STIFF, GRAY 10YR 5/1 CLAY, SOME SILT, DRY.	CL	1.25	Hnu= 0 ppm α = 2 cpm BΓ = 100 cpm
12.0	08021 02/07/88 1730			GRAY, 10YR 5/1 CLAY, TRACE GRAVEL, DRY. SHELBY TUBE 10.5 - 12.2 FT. PUSHED SHELBY TUBE 2FT, 1.7 FT RECOVERED.	CL	N/A	Hnu= 0 ppm α = 2 cpm BΓ = 100 cpm
13.5	08022 02/08/88 0815	0 4 6	8	LOOSE, GRAY-BROWN 10YR 4/2 FINE GRAINED SAND, SOME SILT, MOIST VERY STIFF, GRAY 10YR 4/1 CLAY, TRACE SILT, MOIST.	SM CL	N/A 2.25	Hnu= 0 ppm α = 0 cpm BΓ = 100 cpm
15.0	08023 02/08/88 0825	6 6 5	7	STIFF, GRAY 10YR 4/1 CLAY, TRACE SILT, MOIST. MEDIUM DENSE, GRAY-BROWN 10YR 3/2 SAND, SOME SILT AND CLAY, MOIST.	CL SM	1.5 N/A	Hnu= 0 ppm α = 2 cpm BΓ = 80 cpm

NOTES:
PENNSYLVANIA DRILLING CO. BUCYRUS ERIE 24-W DRILLING RIG. DRILLER: DAVE NEWMAN, HELPER: JOE BARILE. BLOWS ON SAMPLER FOLLOW ASTM STANDARD FOR 2IN X 18IN SPLIT SPOON SAMPLER. SOILD COLORS FOLLOW MUNSELL COLOR CHARTS. APPROX. 95 GALLONS USED IN DRI

VISUAL CLASSIFICATION OF SOILS

3637

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1046	COORDINATES: NORTH 478,054.76 EAST 1,379,428.45	DATE: 02/06/88
GROUND ELEVATION: 576.5	GWL: Depth N/A Date/Time N/A	DATE STARTED: 02/06/88
ENGINEER/GEOLOGIST: T. SULLIVAN	Depth N/A Date/Time N/A	DATE COMPLETED: 02/09/88
DRILLING METHODS: CABLE-TOOL		PAGE 2 OF 2

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.5	08024 02/08/88 0840	6 7 7	13	MEDIUM DENSE, GRAY-BROWN 10YR 3/2 SAND, SOME SILT AND CLAY, TRACE GRAVEL, MOIST. STIFF GRAY 10YR 4/1 SILT AND CLAY, SOME SAND, MOIST.	SM CL	N/A 1.25	Hnu= 0 ppm α = 2 cpm Bγ = 100 cpm
18.0	08027 02/08/88 0910	5 4 5	13	STIFF, GRAY 10YR 4/1 SAND, SOME SILT AND CLAY, TRACE GRAVEL, MOIST. VERY STIUL, GRAY-BROWN 10YR 3/1 CLAY, SOME GRAVEL, DRY.	SM CL	N/A 4	Hnu= 0 ppm α = 2 cpm Bγ = 100 cpm
19.5	08028 02/08/88 0940	5 6 8	8	STIFF, GRAY 10YR 5/1 CLAY, SOME DRAVEL, DRY.	CL	1.25	Hnu= 0 ppm α = 0 cpm Bγ = 100 cpm
21.0	08029 02/08/88 1025	3 3 6	9	STIFF, GRAY 10YR 4/1 CLAY, SOME SILT, TRACE GRAVEL, DRY.	CL	1.0	Hnu= 0 ppm α = 0 cpm Bγ = 80 cpm
22.5	08030 02/08/88 1040	3 13 18	18	HARD, GREEN-GRAY 5Y 4/1 CLAY, SOME GRAVEL AND PEBBLES, WOOD FRAGMENTS, DRY.	CL	>5	Hnu= 0 ppm α = 0 cpm Bγ = 110 cpm
24.0	08031 02/08/88 1145	8 18 20	13	HARD, GREEN-GRAY 5Y 4/1 CLAY, SOME GRAVEL AND PEBBLES, DRY. VERY STIFF, GREEN-GRAY 5Y 4/1 CLAY, SOME GRAVEL, DRY.	CL CL	>5 3.0	Hnu= 0 ppm α = 2 cpm Bγ = 100 cpm
25.5	08032 02/08/88 1400	9 19 23	16	VERY STIFF, GREEN-GRAY 5Y 4/1 CLAY, SOME GRAVEL, DRY. HARD, YELLOW-BROWN 10YR 4/4 CLAY, SOME GRAVEL, DRY. DENSE, BROWN 10YR 4/3 SAND, SOME SILT AND GRAVEL, TRACE CLAY, DRY.	CL SP	>5 N/A	Hnu= 0 ppm α = 0 cpm Bγ = 100 cpm
27.0							
28.5	08033 02/08/88 1455	14 23 24	14	DENSE YELLOW-BROWN 10YR 4/4 SAND, SOME GRAVEL AND SILT, DRY.	SP	N/A	Hnu= 0 ppm α = 2 cpm Bγ = 80 cpm

BOTTOM OF BORING 28.5

NOTES:
BASE OF TILL: 24.8 FT.

Clay w/ silt Sand
Gravel

3637

FERNALD RI/FS

FIELD PERMEABILITY TESTS
FALLING HEAD *

PROJECT Fernald RI/FS
PROJECT NO. 602.03.02.01
BORING NO. 146

TESTED BY L. Wille DATE 6/7/88
CALCULATED BY FXM DATE 11/11/88
CHECKED BY [illegible] DATE 12/28/88
Copied By: FXM 10/31/88
Ckd By: [illegible] 12/28/88

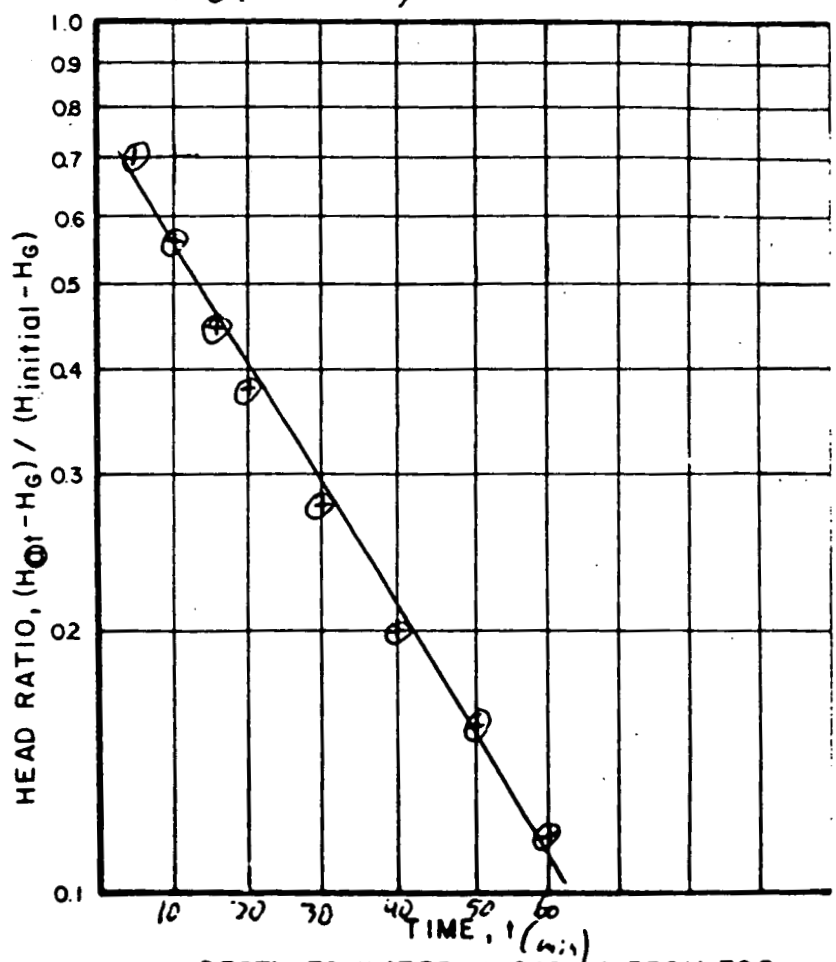
RADIUS OF TEST BORING, R 0.50 ft
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C ≈ 2.0 ft
DEPTH TO BOTTOM OF TEST POCKET, L_1 22.0 ft
DEPTH TO TOP OF TEST POCKET, L_2 12.0 ft
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 11.58 ft

PERMEABILITY, K 6.8×10^{-5} cm/s

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

Began Test 1030
9 Gallon Slug Used

ELAPSED TIME t min ~~sec~~	DEPTH TO WATER IN CASING H ft ~~Meters~~
0	3.10
1	3.45
2	4.52
3	4.95
4	5.30
5	5.60
6	5.88
7	6.15
8	6.40
9	6.64
10	6.85
12	7.23
14	7.58
16	7.88
18	8.15
20	8.40
25	8.90
30	9.30
35	9.62
40	9.88
45	10.10
50	10.28
55	10.41
60	10.55



$$K = \frac{R^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

FXM Date 11/11/88 Subject Slug Test Calculations Sheet No. 2 of 3

Chkd. By ____ Date ____ Well 146 Proj. No. 602.07.02.01

Well 146

$$\text{Head Ratio} = \frac{H_T - H_G}{H_i - H_G}$$

@ 5 min $\frac{5.60 - 11.58}{3.10 - 11.58} = 0.70$

@ 10 min $\frac{6.85 - 11.58}{3.10 - 11.58} = 0.56$

@ 16 min $\frac{7.88 - 11.58}{3.10 - 11.58} = 0.44$

@ 20 min $\frac{8.40 - 11.58}{3.10 - 11.58} = 0.37$

@ 30 min $\frac{9.30 - 11.58}{3.10 - 11.58} = 0.27$

@ 40 min $\frac{9.88 - 11.58}{3.10 - 11.58} = 0.20$

@ 50 min $\frac{10.28 - 11.58}{3.10 - 11.58} = 0.15$

@ 60 min $\frac{10.55 - 11.58}{3.10 - 11.58} = 0.12$

INTERNATIONAL TECHNOLOGY CORPORATION

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By FXM Date 11/11/88 Subject Slug Test Calculations Sheet No. 3 of 3

Chkd. By ___ Date ___ Well 146 Proj. No. 602.03.02.01

Permeability:

$$K = \frac{r^2}{2(L_1-L_2)(t_2-t_1)} \ln\left[\frac{L_1-L_2}{R}\right] \ln\left[\frac{H_1-H_6}{H_2-H_6}\right]$$

$$= \frac{(0.167)^2}{2(22-12)(50-10)} \ln\left[\frac{22-12}{0.5}\right] \ln\left[\frac{6.85-11.58}{10.28-11.58}\right]$$

$$K = 1.3 \times 10^{-4} \text{ ft/min}$$

$$= 6.8 \times 10^{-5} \text{ cm/s}$$

108-10-85

INTERNATIONAL TECHNOLOGY CORPORATION

By _____ Date _____ Subject Head Ratio Calculations Sheet No. ____ of ____

Chkd. By LKP Date [illegible] for MW 146 Proj. No. 602323

$$\text{Head Ratio} = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G = Depth to ground water from TOC before slug is added

H_i = Initial depth to ground water from TOC after slug added

$H_{@t}$ = Depth to ground water from TOC at time t

H_G = 11.58 ft

H_i = 3.10 ft

t = 1 minute H_t = 3.95

$$H.R. = \frac{3.95 - 11.58}{3.10 - 11.58} = 0.900$$

Time (minutes)	H (feet)	H.R. (dimensionless)
1	3.95	0.900
2	4.52	0.833
3	4.95	0.782
4	5.30	0.741
5	5.60	0.705
6	5.88	0.672
7	6.15	0.640
8	6.40	0.611
9	6.64	0.583
10	6.85	0.558
12	7.23	0.513
14	7.58	0.472
16	~~7.53~~ 7.88 few	0.436
18	8.15	0.404
20	8.40	0.375
25	8.90	0.316
30	9.30	0.269
35	9.62	0.231
40	9.88	0.200
45	10.10	0.175
50	10.28	0.153
55	10.41	0.138
60	10.55	0.121

108-10-85

IN-SITU INC. HERMIT DATA MANAGEMENT PACKAGE

MONITORING WELL 146

SLUG/SWAB TEST

Ref. Value : 11.58 (Ft)
H(0) : 8.48 (Ft)
T(0) : .00 (Min)

ELAPSED TIME (Min)	VALUE (Ft)	HD/DRWDN (Ft)	DELTA TIME (Min)	H/H(0)
1.0000	3.95	7.63	.9990	.900
2.0000	4.52	7.06	1.9990	.833
3.0000	4.95	6.63	2.9990	.782
4.0000	5.30	6.28	3.9990	.741
5.0000	5.60	5.98	4.9990	.705
6.0000	5.88	5.70	5.9990	.672
7.0000	6.15	5.43	6.9990	.640
8.0000	6.40	5.18	7.9990	.611
9.0000	6.64	4.94	8.9990	.583
10.0000	6.85	4.73	9.9990	.558
12.0000	7.23	4.35	11.9990	.513
14.0000	7.58	4.00	13.9990	.472
16.0000	7.88	3.70	15.9990	.436
18.0000	8.15	3.43	17.9990	.404
20.0000	8.40	3.18	19.9990	.375
25.0000	8.90	2.68	24.9990	.316
30.0000	9.30	2.28	29.9990	.269
35.0000	9.62	1.96	34.9990	.231
40.0000	9.88	1.70	39.9990	.200
45.0000	10.10	1.48	44.9990	.175
50.0000	10.28	1.30	49.9990	.153
55.0000	10.41	1.17	54.9990	.138
60.0000	10.55	1.03	59.9990	.121

LKF 07-10-88

3637

ALUE: 1.00

Press / for commands

	A	B	C	D	E
	1.00	[illegible]	[illegible]		
	1.00	1.72	0.81[illegible]		
	[illegible]	[illegible]	0.762		
	[illegible]	[illegible]	0.741		
	1.00	3.66	0.705		
	4.00	5.88	0.671		
	5.00	6.11	[illegible]		
	6.00	6.32	0.511		
	9.00	6.64	0.58[illegible]		
0	10.00	6.85	0.558		
1	12.00	7.1[illegible]	0.51[illegible]		
2	14.00	7.5[illegible]	0.472		
3	16.00	7.86	0.456		
4	18.00	8.1[illegible]	0.404		
5	20.00	8.40	0.375		
6	25.00	8.9[illegible]	0.316		
7	30.00	9.30	0.269		
8	35.00	9.61	0.231		
9	40.00	9.88	0.200		
0	45.00	10.10	0.175		
1	50.00	10.28	0.15[illegible]		
2	55.00	10.41	0.14[illegible]		

ALUE: 60.00

Press / for commands

	A	B	C	D	E
3	60.00	10.5[illegible]	0.121		
4					
5					
6					
7					
8					

B:\

IN-SITU INC. HERMIT DATA MANAGEMENT PACKAGE

MONITORING WELL 146

SLUG/SWAB TEST

Ref. Value : 11.58 (Ft)
H(0) : 8.48 (Ft)
T(0) : .00 (Min)

ELAPSED TIME (Min)	VALUE (Ft)	HD/DRWDN (Ft)	DELTA TIME (Min)	H/H(0)
1.0000	3.95	7.63	.9990	.900
2.0000	4.52	7.06	1.9990	.833
3.0000	4.95	6.63	2.9990	.782
4.0000	5.30	6.28	3.9990	.741
5.0000	5.60	5.98	4.9990	.705
6.0000	5.88	5.70	5.9990	.672
7.0000	6.15	5.43	6.9990	.640
8.0000	6.40	5.18	7.9990	.611
9.0000	6.64	4.94	8.9990	.583
10.0000	6.85	4.73	9.9990	.558
12.0000	7.23	4.35	11.9990	.513
14.0000	7.58	4.00	13.9990	.472
16.0000	7.88	3.70	15.9990	.436
18.0000	8.15	3.43	17.9990	.404
20.0000	8.40	3.18	19.9990	.375
25.0000	8.90	2.68	24.9990	.316
30.0000	9.30	2.28	29.9990	.269
35.0000	9.62	1.96	34.9990	.231
40.0000	9.88	1.70	39.9990	.200
45.0000	10.10	1.48	44.9990	.175
50.0000	10.28	1.30	49.9990	.153
55.0000	10.41	1.17	54.9990	.138
60.0000	10.55	1.03	59.9990	.121

LKP 07-10-88

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ALUE: 1.00

Press / for commands

	A	B	C	D	E
1	1.00	3.93	0.900		
2	2.00	4.32	0.835		
3	3.00	4.95	0.782		
4	4.00	5.30	0.741		
5	5.00	5.60	0.705		
6	6.00	5.88	0.672		
7	7.00	6.15	0.640		
8	8.00	6.40	0.611		
9	9.00	6.64	0.583		
10	10.00	6.85	0.558		
11	12.00	7.23	0.513		
12	14.00	7.58	0.472		
13	16.00	7.88	0.436		
14	18.00	8.15	0.404		
15	20.00	8.40	0.375		
16	25.00	8.90	0.316		
17	30.00	9.30	0.269		
18	35.00	9.62	0.231		
19	40.00	9.88	0.200		
20	45.00	10.10	0.175		
21	50.00	10.28	0.153		
22	55.00	10.41	0.138		

ALUE: 60.00

Press / for commands

	A	B	C	D	E
23	60.00	10.55	0.121		
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					

$r_1 = 0.167$ ft $r_2 = 0.5$ ft

MW 146

t_1	4	H_1	5.30
t_2	9	H_2	6.64
t_1	35	H_1	9.62
t_2	60	H_2	10.55

$$K_1 = \frac{(0.167)^2}{2(10)(9-4)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{5.30 - 11.58}{6.64 - 11.58}\right)$$

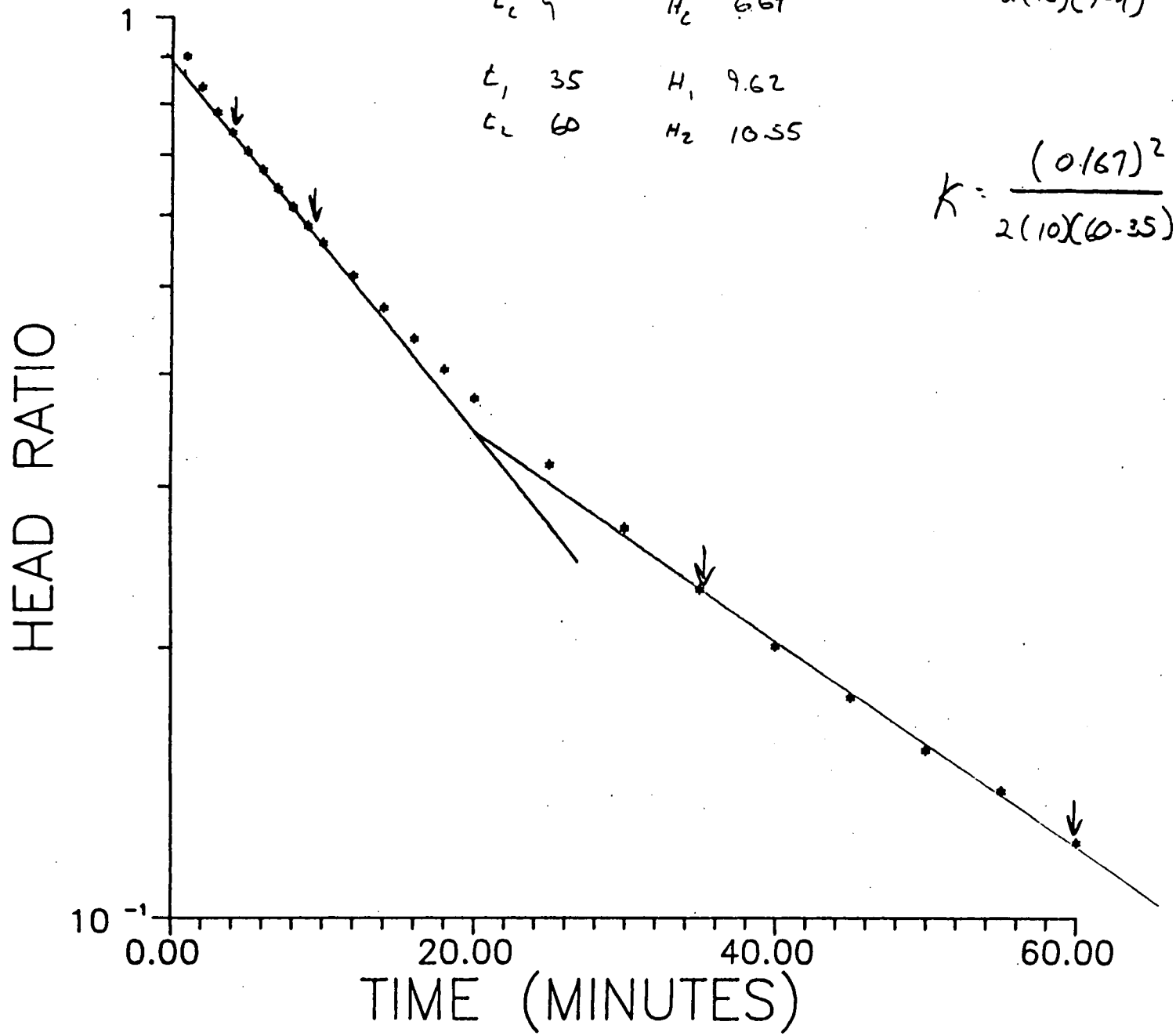
2.01×10^{-4} ft/min

1.02×10^{-4} cm/sec

$$K = \frac{(0.167)^2}{2(10)(60-35)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{9.62 - 11.58}{10.55 - 11.58}\right)$$

1.08×10^{-4} ft/min

5.46×10^{-5} cm/sec



Checked by
HW
7-4-86

Slug test

MW 146

case 1

t_1 4 H_1 5.30
t_2 9 H_2 6.64

t_1 35 H_1 9.62
t_2 60 H_2 10.55

$H_g = 11.58$

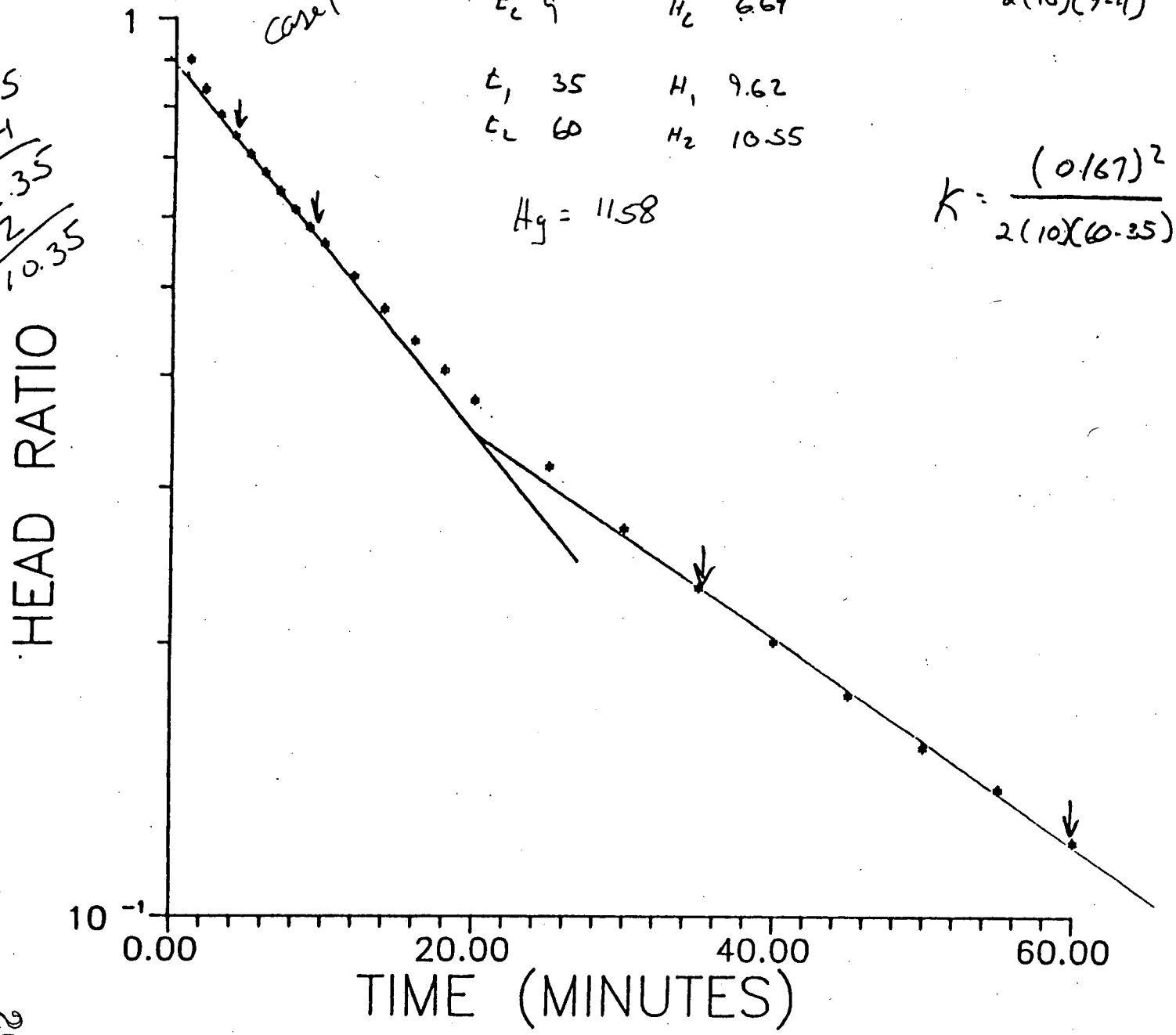
$$K_1 = \frac{(0.167)^2}{2(10)(9-4)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{5.30 - 11.58}{6.64 - 11.58}\right)$$

2.01×10^{-4} ft/min
1.02×10^{-4} cm/sec

$$K = \frac{(0.167)^2}{2(10)(60-35)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{9.62 - 11.58}{10.55 - 11.58}\right)$$

1.08×10^{-4} ft/min
5.46×10^{-5} cm/sec

24.75
-12.4
12.35
-2
10.35



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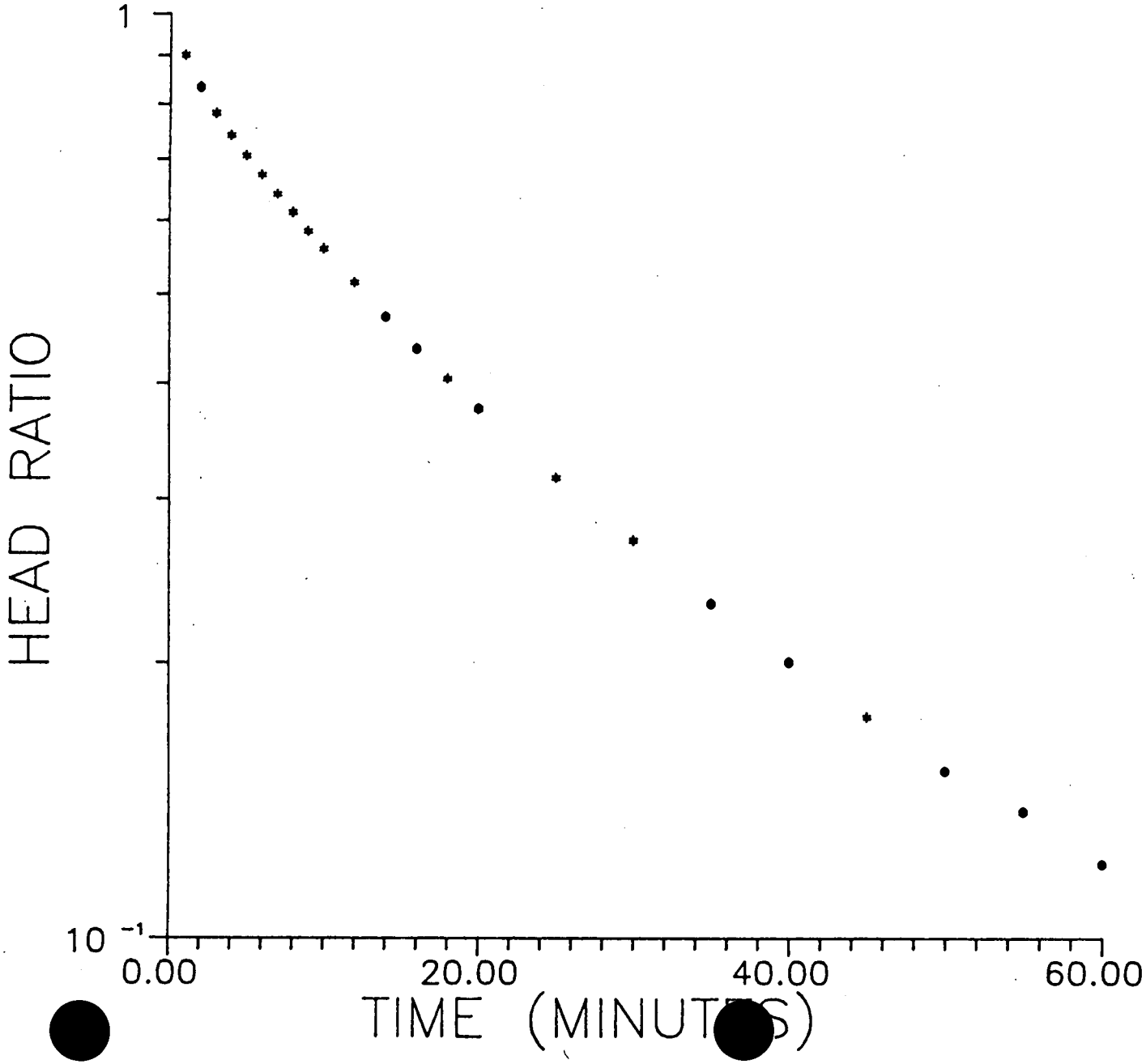

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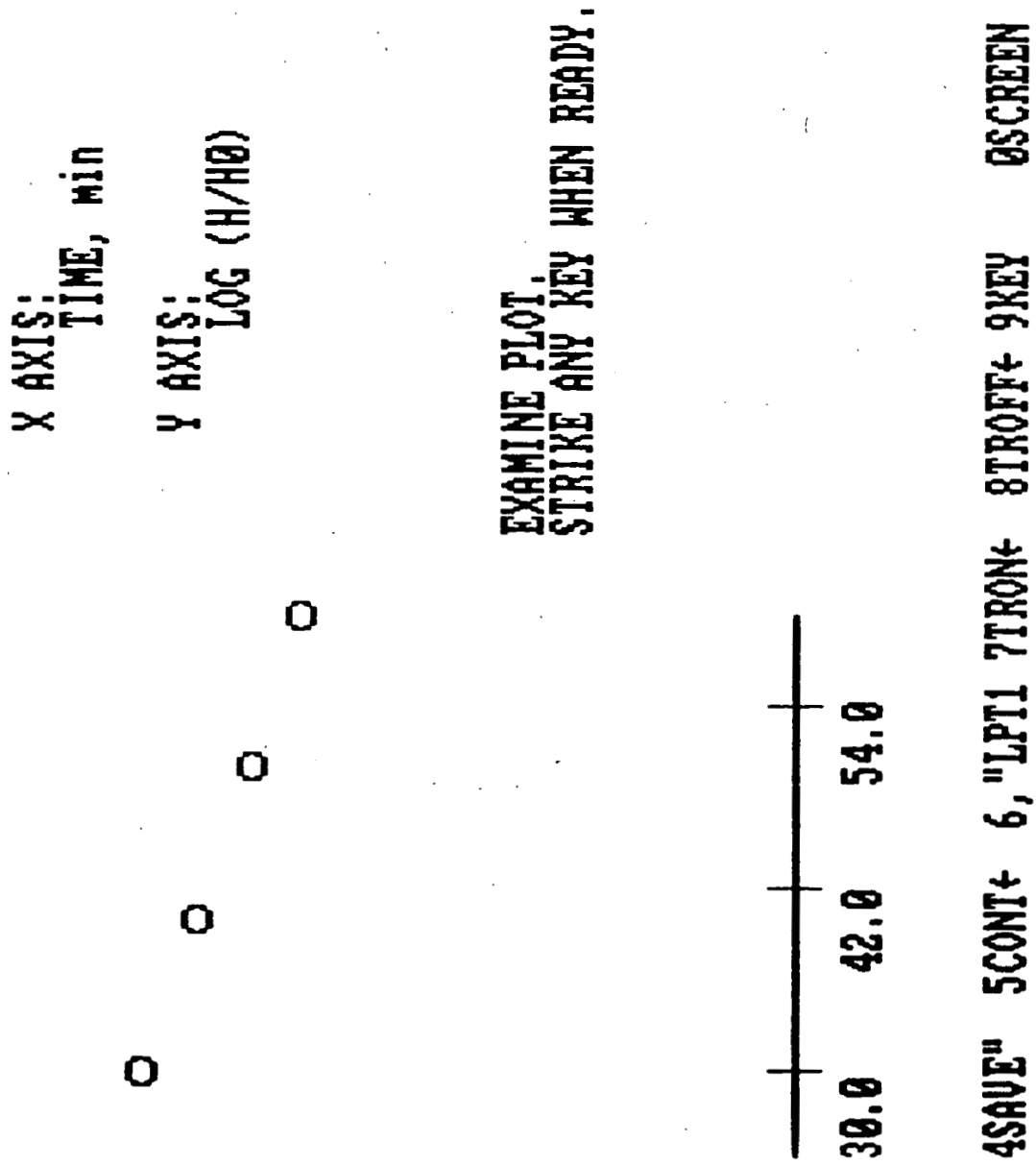
PERMEABILITY FROM TIME-LAG TESTS

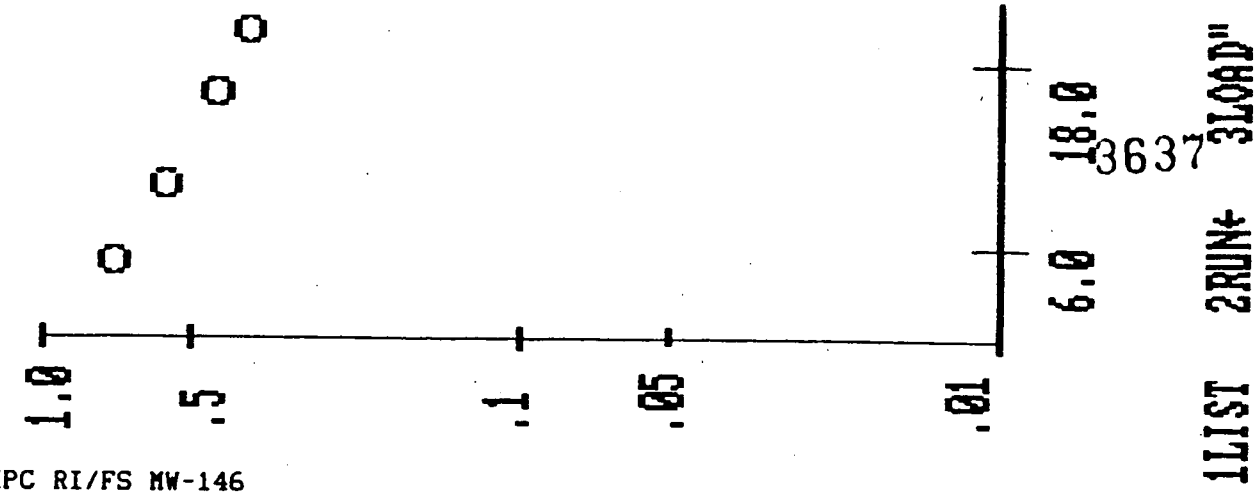
3637

```
LE: ? FMPC RI/FS MW-146
nglish or (M)etric units? E
(C)onfined or (U)nconfined conditions? U
Do you prefer to enter well radii as (I)nches or (F)eet? F
STANDPIPE RADIUS (feet) = ? .167
INTAKE RADIUS (feet) = ? .5
LENGTH OF INTAKE (feet or meters) = ? 10
DEPTH TO TOP OF INTAKE (feet or meters) = ? 12
STATIC WATER LEVEL, DEPTH (feet or meters) = ? 11.58
PURGE WATER LEVEL (feet or meters) = ? 3.1


ARE THESE DATA CORRECT? (Y/N)? Y
ARE WATER-LEVEL DATA TO BE READ FROM DISK? (Y/N)?


1LIST   2RUN  3LOAD"  4SAVE"  5CONT 6,"LPT1 7TRON 8TROFF9KEY    0SCREEN
```





FMPC RI/FS MW-146

TIME (seconds)	WATER LEVEL (feet)	DRAWDOWN (feet)	H/H0
600	6.85	-4.73	.5577831
960	7.88	-3.70	.4363208
1200	8.399999	-3.18	.375
1800	9.3	-2.28	.2688679
2400	9.88	-1.70	.2004717
3000	10.28	-1.30	.1533019

UNCONFINED AQUIFER

K = 6.8E-05 cm/sec
= 1.4 gpd/ft2
= 2.2E-06 ft/sec
= 0.2 ft/day

REGRESSION COEFFICIENT = -.997298

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1048
WELL NUMBER: 1048

FIELD ENG./GEO.: WILL KEGLEY DATE: 10/14/87
CHECKED BY : Not Noted DATE: N/A
N,E COORDINATES: 477477.45, 1379877.1
DATE OF INSTAL.: 10/14/87

BOREHOLE DRILLING

DRILLING METHOD: Cable Tool
DRILLING FLUID(S) USED: (in Feet)
FLUID: WATER FROM: 0 TO: 19.5
FLUID: N/A FROM: N/ATO: N/A
NOTES/COMMENTS:

TYPE OF BIT: Flat Head Hammer
IS CASING TEMPORARY?: Yes
CASING TYPE : MONITORING WELL
CASING DIAM.: 4 In. ID
CASING SIZE(S) USED: (in Feet)
SIZE: 10 FROM: 0 TO: 18
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Screen
AVG. SIZE OF PERFORATIONS: .010 (In.)
TOTAL PERFORATED AREA: 10 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: Stainless Steel
RISER PIPE DIAMETERS:
O.D.: 4 3/8 In. I.D.: 4 In.
LENGTH OF 1ST PIPE SECTION: 5 Ft.
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: THREAD COUPLE (FLUSH JOINT THREAD)

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5.0 Ft.
PROTECTIVE PIPE O.D.: 10 In.
* LOCKING TOP AND LOCK

OTHER PROTECTION (* NOTED BELOW)

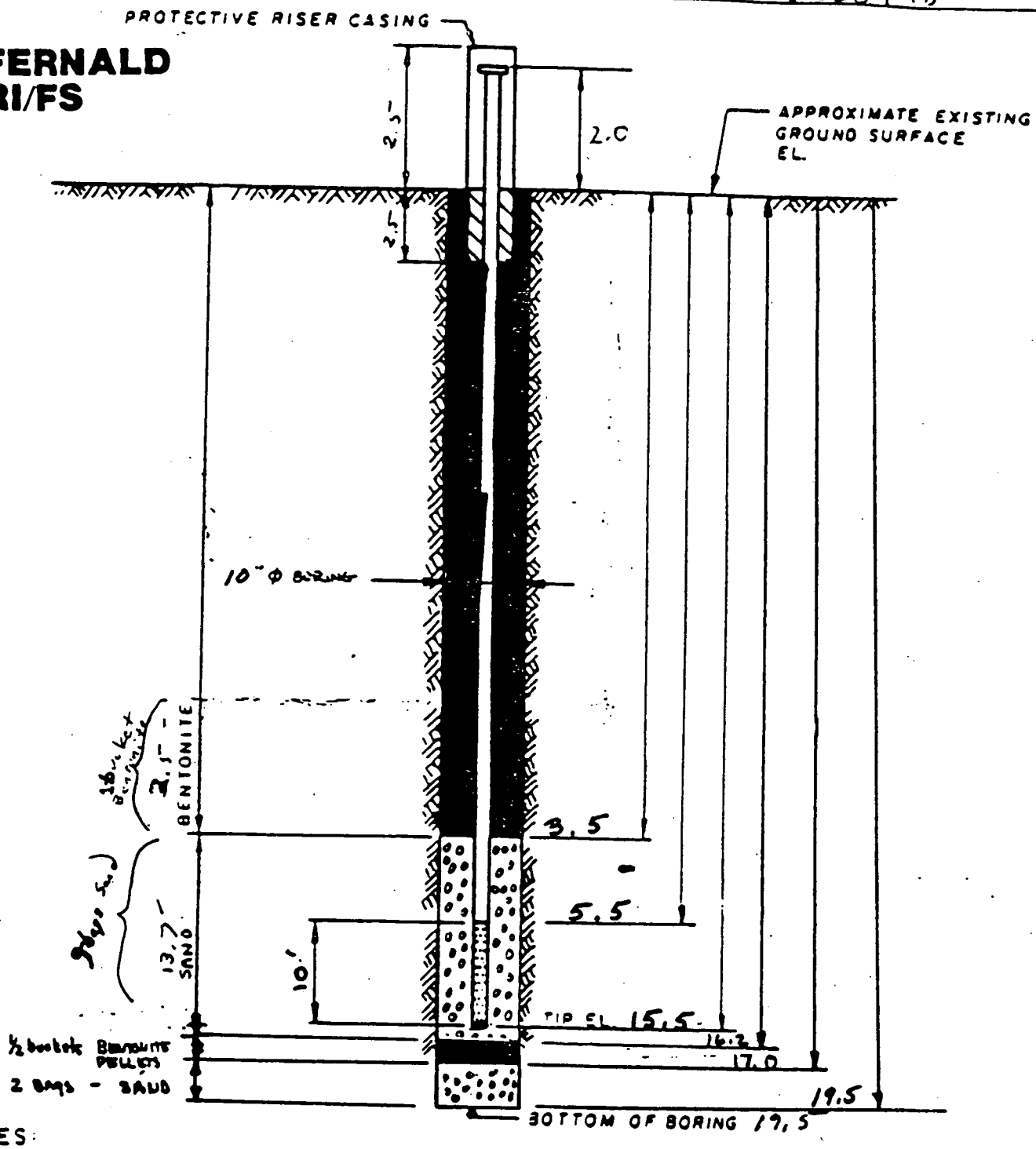
ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE	ELEVATION MSL
TOP OF RISER PIPE	2.0 Ft.	573.17
GROUND SURFACE	0.0	N/A
BOTTOM OF PROTECTIVE PIPE	-2.5 Ft.	

BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
Bentonite Pellets	0	3.5	N/A	N/A
Sand	3.5	16.2	N/A	N/A
Bentonite Pellets	16.2	17.0	N/A	N/A
Sand	17.0	19.5	N/A	N/A
PERFORATED SECTION	5.5	15.5	N/A	N/A
WELL TIP	15.5		N/A	
BOTTOM OF BOREHOLE	19.5		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

WELL 148 3637

FERNALD RI/FS



NOTES:

1. RISER PIPE IS 4 IN I.D. SCHEDULE PIPE, THREADED, FLUSH-JOINTED.
2. SCREEN IS 4 IN I.D SS. PIPE CONTINUOUS SLOT SCREEN (0.010 IN SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL
5. WATER LEVEL READING ON

INSTALLATION DETAILS
MONITORING WELL 148

PREPARED FOR

FMPC RI/FS

DRAWING NUMBER

CHECKED BY

APPROVED BY

DRAWN BY

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1048	COORDINATES: NORTH 477,477.45 EAST 1,379,877.15	DATE: 10/13/87
GROUND ELEVATION:	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/13/87
ENGINEER/GEOLOGIST: WILL KEGLEY	Depth N/A Date/Time N/A	DATE COMPLETED: 10/14/87
DRILLING METHODS: CABLE-TOOL		PAGE 1 OF 2

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
1.5	07216 10/13/87 0958	4 17 22	14	HARD YELLOWISH BROWN SILT - DRY.	ML	4.5	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
3.0	07217 07220 10/13/87 1545	12 29 50	11	HARD, VERY PALE, BROWN SILT, TRACE SAND - DRY.	ML	4.5+	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
4.5	07218 10/13/87 1115	27 33 50	15	HARD, LIGHT YELLOWISH BROWN SILT, SOME CLAY, TRACE SAND - DRY.	ML	4.5+	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
6.0	07219 10/13/87 1135	50	6	HARD, LIGHT YELLOWISH BROWN CLAY, SOME SIFT, TRACE SAND - DRY.	CL	4.5+	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
7.5	07221 10/13/87 1750	5 22 27	13	VERY STIFF, BROWNISH YELLOW CLAY, TRACE SILT - DRY. DENSE, BROWN FINE SAND, CLAY, AND SILT, SOME GRAVEL - DRY.	CL GM	2.5 2.5	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
9.0	07222 10/13/87 1805	15 20 21	17	DENSE, YELLOWISH BROWN, FINE SAND AND SILT - DRY.	SM	1.00	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
9.7	07224 10/14/87			SHELBY TUBE.			
10.5							
12.0	07225 10/14/87 1035	12 9 8	11	MEDIUM DENSE, YELLOWISH BROWN SAND AND GRAVEL, SOME SILT - MOIST.	GM	.5	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
13.5	07226 10/14/87 1055	6 10 14	10	VERY STIFF, GRAY SILT, SOME GRAVEL SOME CLAY - DRY.	ML	3.0	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
15.0	07227 10/14/87 1115	7 16 20	13	VERY STIFF GREY SILT, SOME GRAVEL, SOME SAND - DRY.	ML	3.00	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm

NOTES:
MUNSELL 10YR 5/1 SAMPLE SCANNED-AT BACKGROUND

VISUAL CLASSIFICATION OF SOILS

3637

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1048	COORDINATES: NORTH 477,477.45 EAST 1,379,877.15	DATE: 10/13/87
GROUND ELEVATION:	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/13/87
ENGINEER/GEOLOGIST: WILL KEGLEY	Depth N/A Date/Time N/A	DATE COMPLETED: 10/14/87
DRILLING METHODS: CABLE-TOOL		PAGE 2 OF 2

DEPTH	SAMPLE	DATE	TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.5	07228	10/14/87	1138	16 22 30	15	VERY STIFF SILT, SOME GRAVEL SOME SAND - DRY.	ML	3.5	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
18.0	07229	10/14/87	1350	7 16 25	11	MEDIUM STIFF, GRAY SILT, SOME GRAVEL -DRY. DENSE, BROWNISH, YELLOW FINE SAND AND SILT, SOME CLAY.	ML SM	1.0 3.5	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
19.5	07230	10/14/87	1415	23 36 41	15	VERY DENSE, BROWNISH, YELLOW SAND, SOME GRAVEL - DRY. BOTTOM OF BORING.	GW	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm

BOTTOM OF BORING 19.5

NOTES:
SAMPLE SCANNED AT BACKGROUND - MUNSELL 10YR, 6/6. RIG: CYCLONE 42. DRILLER: HARRY DYKES, ASSISTANT: JOHN VANDINE.

FERNALD RI/FS

FIELD PERMEABILITY TESTS

FALLING HEAD *

PROJECT FMPC RI/FS
PROJECT NO. 602.03.02.01
BORING NO. 148

TESTED BY TS/BM DATE 5/3/88
CALCULATED BY FXM DATE 11/11/88
CHECKED BY AA DATE 12/28/88
Copied By: FXM 10/31/88
Chk'd By: AA 12/28/88

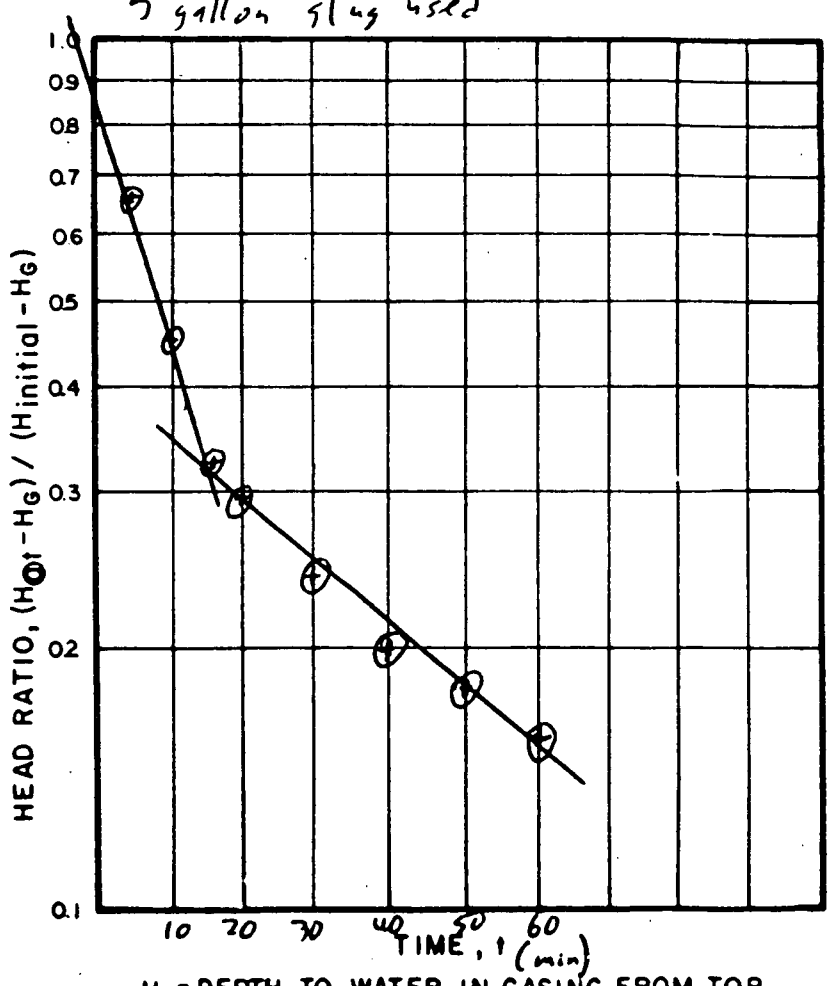
RADIUS OF TEST BORING, R 0.50 ft
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C ≈2 ft
DEPTH TO BOTTOM OF TEST POCKET, L_1 17.5 ft
DEPTH TO TOP OF TEST POCKET, L_2 7.5 ft
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 6.65 ft

PERMEABILITY, K 1.6×10^{-4} cm/sec

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

Began Test 0910
5 gallon slug used

ELAPSED TIME t min ~~sec.~~	DEPTH TO WATER IN CASING H ft ~~Meters~~
0	0.00
1	3.40
2	3.80
3	4.10
4	4.35
5	4.55
6	4.70
7	4.88
8	5.00
9	5.12
10	5.22
12	5.37
14	5.50
16	5.60
18	5.65
20	5.70
25	5.80
30	5.88
40	6.00
50	6.10
60	6.15
(115) 125	6.35



$$K = \frac{R^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

EXM Date 11/11/88 Subject Slug Test Calculations Sheet No. 2 of 3
Well 148
Chkd. By ____ Date ____ Proj. No. 602.03.02.01

Well 148

$$\text{Head Ratio} = \frac{H_T - H_G}{H_i - H_G}$$

@ 5 min $\frac{4.55-6.65}{3.40-6.65} = 0.65$

@ 10 min $\frac{5.22-6.65}{3.40-6.65} = 0.44$

@ 16 min $\frac{5.60-6.65}{3.40-6.65} = 0.32$

@ 20 min $\frac{5.70-6.65}{3.40-6.65} = 0.29$

@ 30 min $\frac{5.88-6.65}{3.40-6.65} = 0.24$

@ 40 min $\frac{6.00-6.65}{3.40-6.65} = 0.20$

@ 50 min $\frac{6.10-6.65}{3.40-6.65} = 0.17$

@ 60 min $\frac{6.15-6.65}{3.40-6.65} = 0.15$

Permeability:

Upper Curve: $K = \frac{r^2}{2(L_1 - L_2)(T_2 - T_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_6}{H_2 - H_6}\right]$

$$= \frac{(0.167)^2}{2(17.5-7.5)(10-5)} \ln\left[\frac{17.5-7.5}{0.5}\right] \ln\left[\frac{4.55-6.65}{5.22-6.65}\right]$$

$K = 3.2 \times 10^{-4}$ ft/min

$K = 1.6 \times 10^{-4}$ cm/s

~~Lower Curve:~~

$$= \frac{(0.167)^2}{2(17.5-7.5)(60-20)} \ln\left[\frac{17.5-7.5}{0.5}\right] \ln\left[\frac{5.70-6.65}{6.15-6.65}\right]$$

$K = 6.7 \times 10^{-5}$ ft/min

$K = 3.4 \times 10^{-5}$ cm/s

Upper Curve reported as permeability value as had a better fit than lower curve. Lower curve probably represents late time data and is not representative of the formation. The higher value of 1.6×10^{-4} cm/s is more representative of silty clays w/ sand interbeds.

108-10-85

INTERNATIONAL TECHNOLOGY CORPORATION

Willo Date 6-11-88 Subject Head Ratio Calculations Sheet No. ___ of ___
Chkd. By LKP Date 07-10-88 for MW 148 Proj. No. 602 3 2 3

$$HR = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G = Depth to groundwater below TOC before slug added
H_i = Depth to groundwater below TOC after slug added
$H_{@t}$ = Depth to groundwater below TOC at time t

at t = 1 minute
H = 3.40 ft

H_G = 6.65
H_i = 0 ft

$$HR = \frac{3.40 - 6.65}{0 - 6.65} = 0.489$$

time (minutes)	H (feet)	HR (dimensionless)
1	3.40	0.489
2	3.80	0.429
3	4.10	0.383
4	4.35	0.346
5	4.55	0.316
6	4.70	0.293
7	4.88	0.266
8	5.00	0.248
9	5.12	0.230
10	5.22	0.215
12	5.30	0.192
14	5.50	0.173
16	5.60	0.158
18	5.65	0.150
20	5.70	0.142
25	5.80	0.128
30	5.88	0.116
40	6.00	0.098
50	6.10	0.083
60	6.15	0.075
125	6.35	0.045

INTERNATIONAL TECHNOLOGY CORPORATION

By L Willo Date 6-21-88 Subject Head Ratio Calculations Sheet No. ___ of ___

Chkd. By LKP Date 06-19-88 MW 148 Proj. No. 602 3 2 2

$$HR = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G = Depth to groundwater below TOC before slug added

H_i = Depth to groundwater below TOC after slug added

$H_{@t}$ = Depth to ground water below TOC at time t

at t = 1 minute
H = 3.40 ft

H_G = 6.65
H_i = 0 ft

$$HR = \frac{3.40 - 6.65}{0 - 6.65} = 0.489$$

time (minutes)	H (feet)	HR (dimensionless)
1	3.40	0.489
2	3.80	0.429
3	4.10	0.383
4	4.35	0.346
5	4.55	0.316
6	4.10	0.293
7	4.88	0.266
8	5.00	0.248
9	5.12	0.230
10	5.22	0.215
12	5.37	0.192
14	5.50	0.173
16	5.60	0.158
18	5.65	0.150
20	5.70	0.142
25	5.80	0.128
30	5.88	0.116
40	6.00	0.098
50	6.10	0.083
60	6.15	0.075
125	6.35	0.045

108-10-85

n:\>type mw148.tbl

IN-SITU INC. MERMIT DATA MANAGEMENT PACKAGE

MONITORING WELL 148

SLUG/SWAB TEST

Ref. Value : 6.65 (Ft)
H(0) : 6.65 (Ft)
T(0) : .01 (Min)

ELAPSED TIME (Min)	VALUE (Ft)	HD/DRWDN (Ft)	DELTA TIME (Min)	H/H(0)
1.0000	3.40	3.25	.9900	.489
2.0000	3.80	2.85	1.9900	.429
3.0000	4.10	2.55	2.9900	.383
4.0000	4.35	2.30	3.9900	.346
5.0000	4.55	2.10	4.9900	.316
6.0000	4.70	1.95	5.9900	.293
7.0000	4.88	1.77	6.9900	.266
8.0000	5.00	1.65	7.9900	.248
9.0000	5.12	1.53	8.9900	.230
10.0000	5.22	1.43	9.9900	.215
12.0000	5.37	1.28	11.9900	.192
14.0000	5.50	1.15	13.9900	.173
16.0000	5.60	1.05	15.9900	.158
18.0000	5.65	1.00	17.9900	.150
20.0000	5.70	.95	19.9900	.143
25.0000	5.80	.85	24.9900	.128
30.0000	5.88	.77	29.9900	.116
40.0000	6.00	.65	39.9900	.098
50.0000	6.10	.55	49.9900	.083
60.0000	6.15	.50	59.9900	.075
125.0000	6.35	.30	124.9900	.045

n:\>

ALUE: 1.00

Press / for commands

	A	B	C	D	E
1	1.00	3.40	0.489		
2	2.00	3.80	0.429		
3	3.00	4.10	0.383		
4	4.00	4.35	0.346		
5	5.00	4.55	0.316		
6	6.00	4.70	0.293		
7	7.00	4.88	0.266		
8	8.00	5.00	0.248		
9	9.00	5.12	0.230		
10	10.00	5.22	0.215		
11	12.00	5.37	0.192		
12	14.00	5.50	0.173		
13	16.00	5.60	0.158		
14	18.00	5.65	0.150		
15	20.00	5.70	0.143		
16	25.00	5.80	0.128		
17	30.00	5.88	0.116		
18	40.00	6.00	0.098		
19	50.00	6.10	0.083		
20	60.00	6.15	0.075		
21	125.00	6.35	0.043		
22					

IN-SITU INC. HERMIT DATA MANAGEMENT PACKAGE

MONITORING WELL 148

SLUG/SWAB TEST

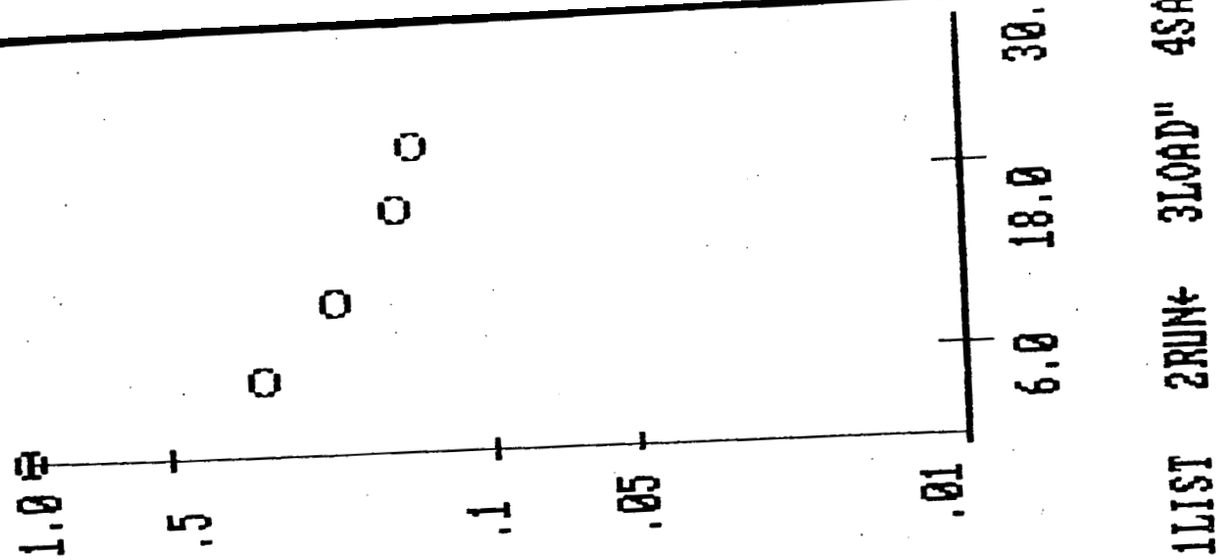
Ref. Value : 6.65 (Ft)
H(0) : 6.65 (Ft)
T(0) : .01 (Min)

ELAPSED TIME (Min)	VALUE (Ft)	HD.DRWDN (Ft)	DELTA TIME (Min)	H/H(0)
1.0000	3.40	3.25	.9900	.489
2.0000	3.80	2.85	1.9900	.429
3.0000	4.10	2.55	2.9900	.383
4.0000	4.35	2.30	3.9900	.346
5.0000	4.55	2.10	4.9900	.316
6.0000	4.70	1.95	5.9900	.293
7.0000	4.88	1.77	6.9900	.266
8.0000	5.00	1.65	7.9900	.248
9.0000	5.12	1.53	8.9900	.230
10.0000	5.22	1.43	9.9900	.215
[illegible]0000	5.37	1.28	11.9900	.192
[illegible]000	5.50	1.15	13.9900	.173
[illegible].0000	5.60	1.05	15.9900	.158
18.0000	5.65	1.00	17.9900	.150
20.0000	5.70	.95	19.9900	.143
25.0000	5.80	.85	24.9900	.128
30.0000	5.88	.77	29.9900	.116
40.0000	6.00	.65	39.9900	.098
50.0000	6.10	.55	49.9900	.083
60.0000	6.15	.50	59.9900	.075
125.0000	6.35	.30	124.9900	.045

LLE: 1.00

Press / for commands

A	B	C	D	E
1.00	3.40	0.485		
2.00	3.80	0.429		
3.00	4.10	0.383		
4.00	4.33	0.346		
5.00	4.52	0.316		
6.00	4.70	0.293		
7.00	4.88	0.266		
8.00	5.06	0.248		
9.00	5.12	0.230		
10.00	5.22	0.215		
12.00	5.37	0.191		
14.00	5.50	0.173		
16.00	5.60	0.158		
18.00	5.65	0.150		
20.00	5.70	0.143		
25.00	5.80	0.128		
30.00	5.88	0.116		
40.00	6.00	0.098		
50.00	6.10	0.083		
60.00	6.15	0.075		
125.00	6.45	0.043		



3637

FMPC RI/FS MW-148

TIME (seconds)	WATER LEVEL (feet)	DRAWDOWN (feet)	H/H0
0	.001	-6.65	1
300	4.55	-2.10	.315837

UNCONFINED AQUIFER

K = 5.1E-04 cm/sec
= 10.7 gpd/ft2
= 1.7E-05 ft/sec
= 1.4 ft/day

REGRESSION COEFFICIENT = -1

FMPC RI/FS MW-148

TIME (seconds)	WATER LEVEL (feet)	DRAWDOWN (feet)	H/H0
300	4.55	-2.10	.315837
600	5.22	-1.43	.21507

UNCONFINED AQUIFER

K = 1.7E-04 cm/sec
= 3.6 gpd/ft2
= 5.5E-06 ft/sec
= 0.5 ft/day

REGRESSION COEFFICIENT = -.9999991

FMPC RI/FS MW-148

TIME (seconds)	WATER LEVEL (feet)	DRAWDOWN (feet)	H/H0
[illegible]	5.7	-0.95	.1428787
[illegible]	5.88	-0.77	.1158069
2420	6	-0.65	9.775912E-02
3000	6.1	-0.55	8.271925E-02
3600	6.15	-0.50	.0751993

UNCONFINED AQUIFER

K = [illegible] cm/sec
= 0.[illegible] gpd/ft2
= 1.2E-06 ft/sec
= 0.1 ft/day

REGRESSION COEFFICIENT = -.9922709
[illegible] RI/FS MW-14B

TIME (seconds)	WATER LEVEL (feet)	DRAWDOWN (feet)	H/H0
300	4.55	-2.10	.315837
600	5.22	-1.43	.21507
960	5.6	-1.05	.1579185

UNCONFINED AQUIFER

K = 1.4E-04 cm/sec
= 0.9 gpd/ft2
= 4.5E-06 ft/sec
= 0.4 ft/day

REGRESSION COEFFICIENT = -.9933788

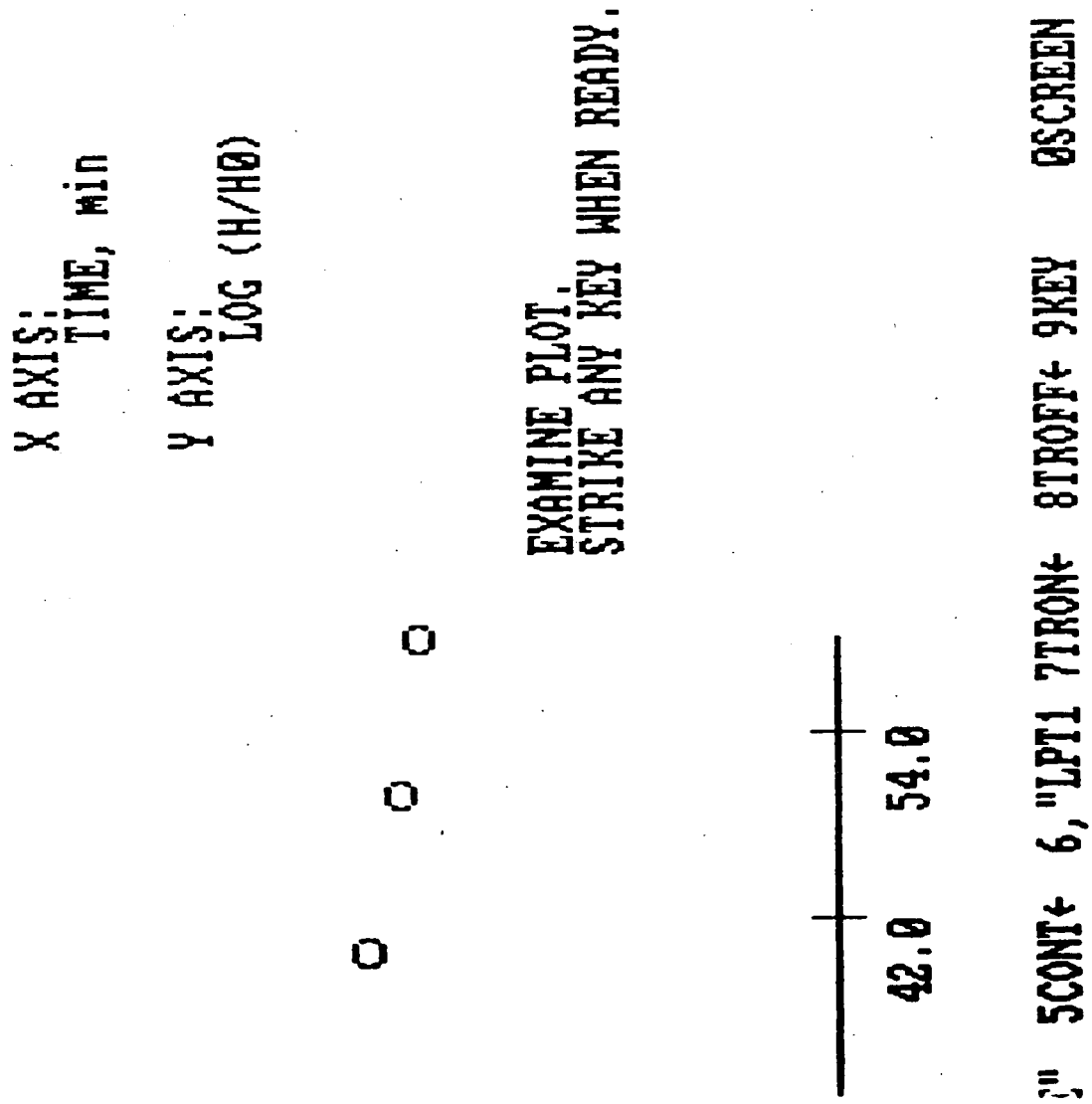
PERMEABILITY FROM TIME-LAG TESTS

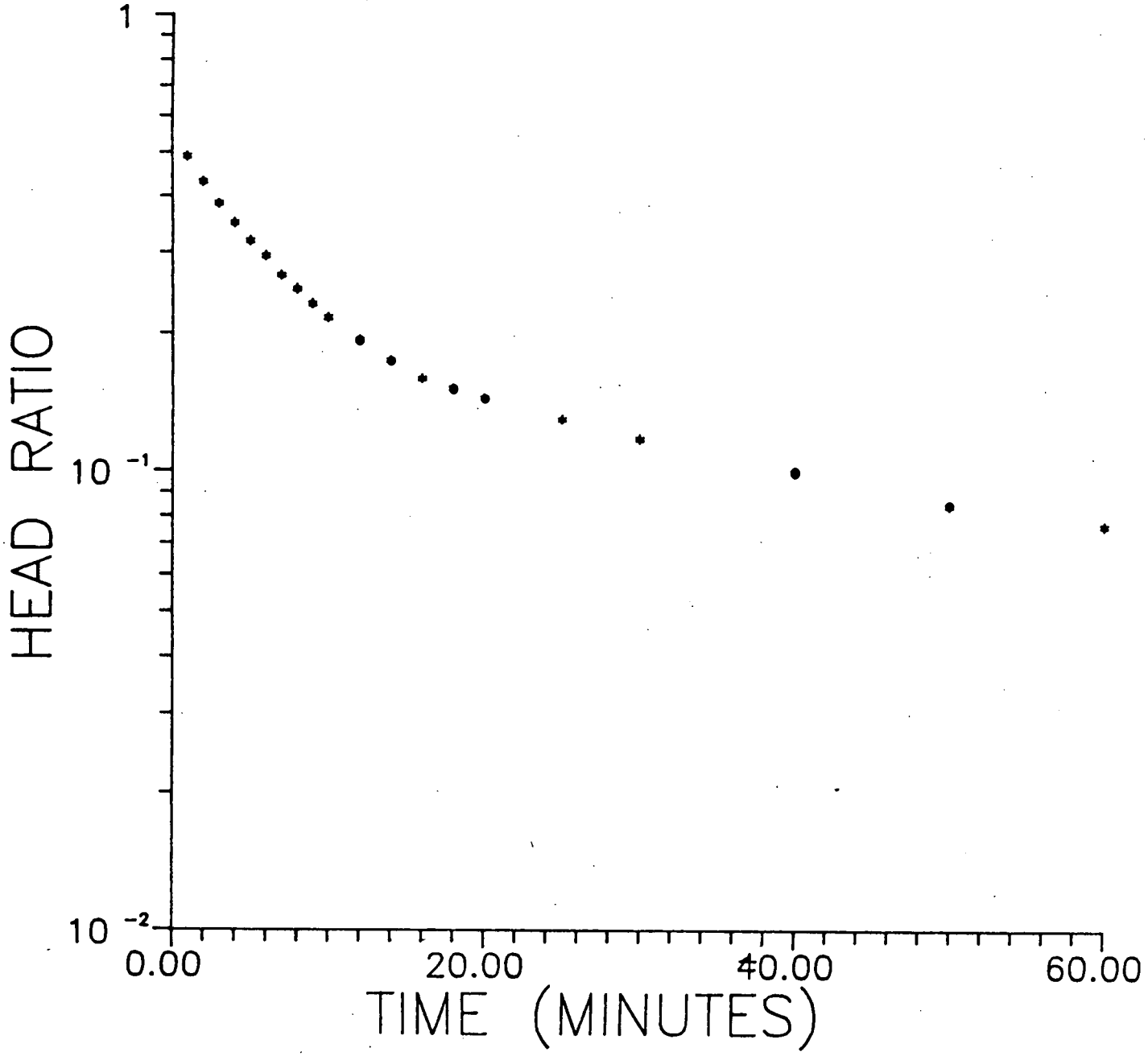
```
TITLE:  ? FMPC RI/FS MW-148
(E)nglish or (M)etric units? E]
(C)onfined or (U)nconfined conditions? U
(E)nglish or (M)etric units? E
(C)onfined or (U)nconfined conditions? U
Do you prefer to enter well radii as (I)nches or (F)eet? F
STANDPIPE RADIUS (feet) = ? .167
INTAKE RADIUS (feet) = ? .5
LENGTH OF INTAKE (feet or meters) = ? 9.5
DEPTH TO TOP OF INTAKE (feet or meters) = ? 7.5
STATIC WATER LEVEL, DEPTH (feet or meters) = ? 6.65
PURGE WATER LEVEL (feet or meters) = ? .001

ARE THESE DATA CORRECT? (Y/N)? Y
ARE WATER-LEVEL DATA TO BE READ FROM DISK? (Y/N)? N

Number of time and water level measurements?

1LIST  2RUN  3LOAD"  4SAVE"  5CONT 6,"LPT1 7TRON 8TROFF9KEY   0SCREEN
```




HEAD RATIO
1
10 -1
10 -2
0.00
20.00
40.00
60.00
TIME (MINUTES)

MW 148

$r = 0.167$

$= 0.5$

H_2 5.22 L_2 10

H_1 5.88 L_1 30

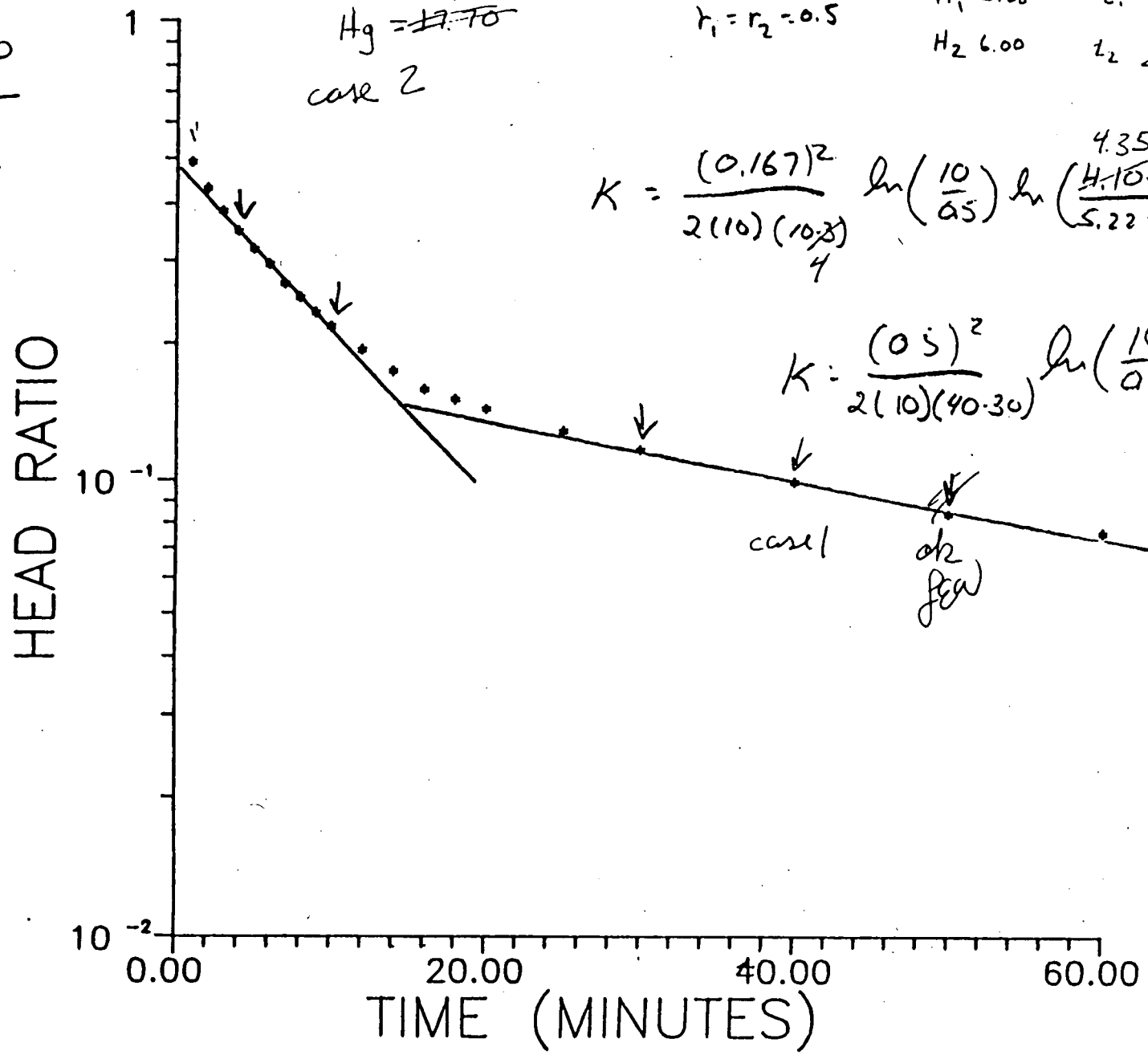
H_2 6.00 L_2 ~~40~~ 50 ok few

$r_1 = r_2 = 0.5$

$Hg = \cancel{17.70}$ 6.65 few

case 2

17.70
-12.4
05.3
-2.0
3.3



$$K = \frac{(0.167)^2}{2(10)(10\cancel{3})_{4}} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{\cancel{4.10}\,4.35 - 6.65}{5.22 - 6.65}\right) = \cancel{3.45\times10^{-4}}\ 3.31\times10^{-4}\ \text{ft/min}$$

$$= \cancel{1.75\times10^{-4}}\ 1.68\times10^{-4}\ \text{cm/sec}$$

$$K = \frac{(0.5)^2}{2(10)(40-30)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{5.88 - 6.65}{6.00 - 6.65}\right)$$

$$= 6.34\times10^{-4}\ \text{ft/min}$$

$$= 3.22\times10^{-4}\ \text{cm/sec}$$

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MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1065
WELL NUMBER: 1065

FIELD ENG./GEO.: D. OAKLEY DATE: 10/06/87
CHECKED BY : D. HOLZMAN DATE: 10/07/87
N,E COORDINATES: 477860.01, 1380415.9
DATE OF INSTAL.: 10/06/87

BOREHOLE DRILLING

DRILLING METHOD: Cable Tool
DRILLING FLUID(S) USED: (in Feet)
FLUID: WATER FROM: 2 TO: 14
FLUID: N/A FROM: N/ATO: N/A
NOTES/COMMENTS:

TYPE OF BIT: Flat Head Hammer
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING
CASING DIAM.: 4 In. ID
CASING SIZE(S) USED: (in Feet)
SIZE: 10 FROM: 0 TO: 14
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Screen
AVG. SIZE OF PERFORATIONS: .010 (In.)
TOTAL PERFORATED AREA: 10 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: Stainless Steel
RISER PIPE DIAMETERS:
O.D.: 4 3/8 In. I.D.: 4 In.
LENGTH OF 1ST PIPE SECTION: 5 Ft.
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: THREAD AND COUPLE (FLUSH JOINT THREADS)

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5 Ft.
PROTECTIVE PIPE O.D.: 10 In.
* LOCKING CAP AND LOCK

OTHER PROTECTION (* NOTED BELOW)

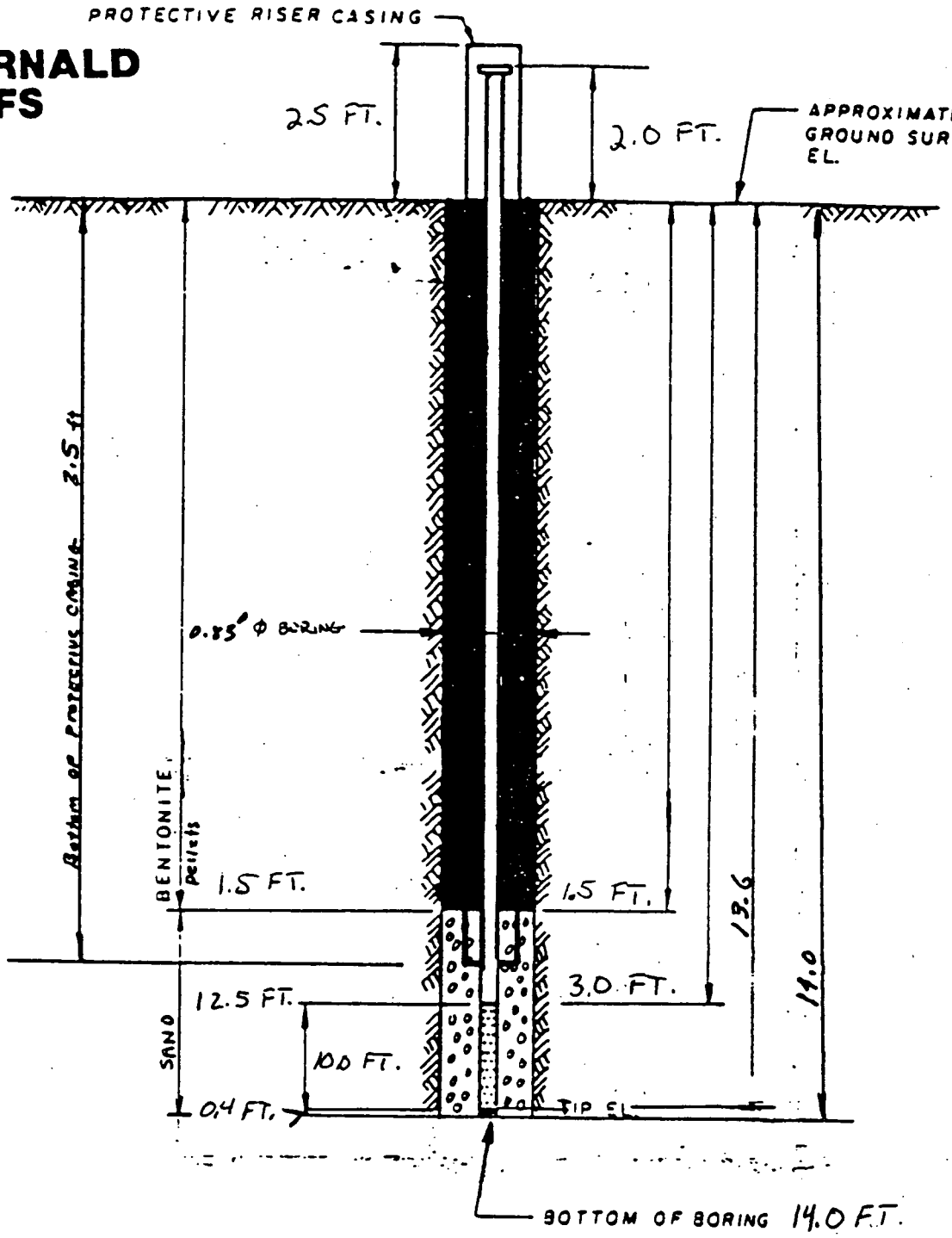
ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	2.0 Ft.		572.96	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	2.5 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
Bentonite Pellets	0	1.5	N/A	N/A
Sand	1.5	14	N/A	N/A
PERFORATED SECTION	3.0	13.6	N/A	N/A
WELL TIP	14.0		N/A	
BOTTOM OF BOREHOLE	14.0		N/A	
GWL AFTER INSTALLATION	NONE		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

WELL # 165

FERNALD RI/FS

3637



NOTES:

1. RISER PIPE IS 4 IN I.D. SCHEDULE [redacted] 5 PIPE, THREADED, FLUSH-JOINTED.
2. SCREEN IS 4 IN I.D. SS. PIPE CONTINUOUS SLOT SCREEN (0.010 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL
5. WATER LEVEL READING ON

INSTALLATION DETAILS
MONITORING WELL 165

PREPARED FOR

PMPC - RI/FS

DRAWING NUMBER
CHECKED BY
APPROVED BY
DRAWN BY

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1065	COORDINATES: NORTH 477,860.01 EAST 1,380,415.92	DATE: 10/05/87 3637
GROUND ELEVATION:	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/05/87
ENGINEER/GEOLOGIST: D. OAKLEY	Depth N/A Date/Time N/A	DATE COMPLETED: 10/06/87
DRILLING METHODS: CABLE-TOOL		PAGE 1 OF 1

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
10.0							
12.0	07200 10/05/87 1900			SHELBY TUBE.			
				BOTTOM OF BORING 14.0			

NOTES:

silty clay

3637

FERNALD RI/FS

FIELD PERMEABILITY TESTS
FALLING HEAD *

PROJECT FMPC RI/FS
PROJECT NO. 602.03.02.01
BORING NO. 165

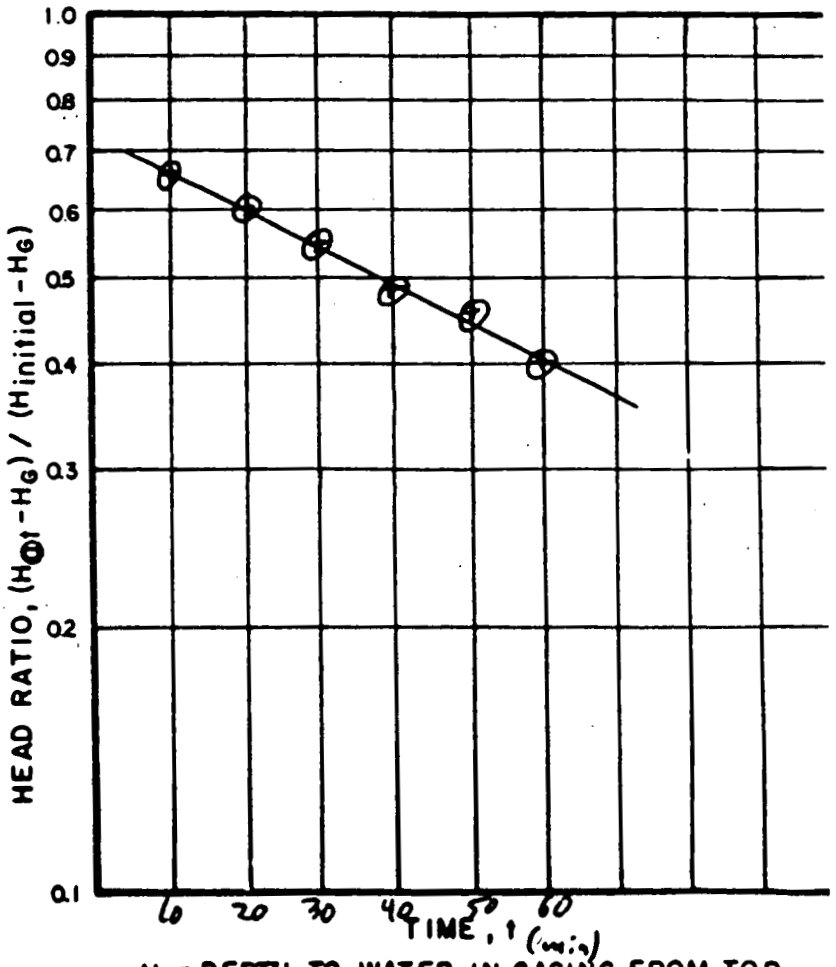
TESTED BY TS/BM DATE 4/27/88
CALCULATED BY FYM DATE 11/11/88
CHECKED BY [illegible] DATE [illegible]
Copied By: FYM 10/31/88
Chk By: [illegible] 12/08/88

RADIUS OF TEST BORING, R 0.5 ft
PERMEABILITY, K 2.2×10^{-5} cm/
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C ≈2 ft
DEPTH TO BOTTOM OF TEST POCKET, L_1 15.0 ft
DEPTH TO TOP OF TEST POCKET, L_2 5.0 ft
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 8.5 ft

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

Start Test 0846
8 gallon Slug Used

ELAPSED TIME t min ~~sec.~~	DEPTH TO WATER IN CASING H ft ~~Meters~~
0	4.35
1	4.60
2	4.75
3	4.95
4	5.10
5	5.25
6	5.40
7	5.50
8	5.60
9	5.65
10	5.70
12	5.80
14	5.85
16	5.90
18	5.95
20	6.00
25	6.15
30	6.25
40	6.50
50	6.65
60	6.85
(1135) 169min	7.85



$$K = \frac{R^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

By FXM Date 11/11/88 Subject Slug Test Calculations Sheet No. 2 of 3
Ckd. By ___ Date ___ Well 165 Proj. No. 602.07.07.01

Well 165

$$\text{Head Ratio} = \frac{H_T - H_G}{H_i - H_G}$$

@ 10 min $\frac{5.70 - 8.5}{4.35 - 8.5} = 0.67$

@ 20 min $\frac{6.00 - 8.5}{4.35 - 8.5} = 0.60$

@ 30 min $\frac{6.25 - 8.5}{4.35 - 8.5} = 0.54$

@ 40 min $\frac{6.50 - 8.5}{4.35 - 8.5} = 0.48$

@ 50 min $\frac{6.65 - 8.5}{4.35 - 8.5} = 0.45$

@ 60 min $\frac{6.85 - 8.5}{4.35 - 8.5} = 0.40$

By FXM Date 11/11/88 Subject Slug Test Calculations Sheet No. 3 of 3

By ____ Date ____ Well 165 Proj. No. 607.07.07.01

Permeability

$$K = \frac{r^2}{2(L_1-L_2)(t_2-t_1)} \ln\left[\frac{L_1-L_2}{R}\right] \ln\left[\frac{H_1-H_G}{H_2-H_G}\right]$$

$$= \frac{(0.167)^2}{2(15-5)(60-20)} \ln\left[\frac{15-5}{0.5}\right] \ln\left[\frac{6.00-8.5}{6.85-8.5}\right]$$

$K = 4.3 \times 10^{-5}$ ft/min

$K = 2.2 \times 10^{-5}$ cm/s

Calculated Date 6-11-88 Subject Head Ratio Calculations Sheet No. ___ of ___

Chkd. By LKP Date 06-14-88 For M.W 165 Proj. No. 602 3 3 3

$$HR = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G = Depth to ground water below TOC before slug is added

H_i = Initial depth to ground water below TOC after slug added

H_t = Depth to ground water below TOC at time t

at t = 1 minute
H = 4.60 ft

H_G = 8.5 ft
H_i = 4.35 ft

$$HR = \frac{4.60 - 8.5}{4.35 - 8.5} = 0.940$$

time (minutes)	H (feet)	HR (dimensionless)
1	4.60	0.940
2	4.75	0.904
3	4.95	0.855
4	5.10	0.819
5	5.25	0.783
6	5.40	0.747
7	5.50	0.723
8	5.60	0.699
9	5.65	0.687
10	5.70	0.675
12	5.80	0.651
14	5.85	0.639
16	5.90	0.627
18	5.95	0.614
20	6.00	0.602
25	6.15	0.566
30	6.25	0.542
40	6.50	0.482
50	6.65	0.446
60	6.85	0.398
169	7.85	0.157

108-10-85

IN-SITU INC. HERMIT DATA MANAGEMENT PACKAGE

MONITORING WELL 165

SLUG/SWAB TEST

Ref. Value : 8.50 (Ft)
H(0) : 4.15 (Ft)
T(0) : .00 (Min)

ELAPSED TIME (Min)	VALUE (Ft)	HD/DRWDN (Ft)	DELTA TIME (Min)	H/H(0)
1.0000	4.60	3.90	.9990	.940
2.0000	4.75	3.75	1.9990	.904
3.0000	4.95	3.55	2.9990	.855
4.0000	5.10	3.40	3.9990	.819
5.0000	5.25	3.25	4.9990	.783
6.0000	5.40	3.10	5.9990	.747
7.0000	5.50	3.00	6.9990	.723
8.0000	5.60	2.90	7.9990	.699
9.0000	5.65	2.85	8.9990	.687
10.0000	5.70	2.80	9.9990	.675
12.0000	5.80	2.70	11.9990	.651
14.0000	5.85	2.65	13.9990	.639
16.0000	5.90	2.60	15.9990	.627
18.0000	5.95	2.55	17.9990	.614
20.0000	6.00	2.50	19.9990	.602
25.0000	6.15	2.35	24.9990	.566
30.0000	6.25	2.25	29.9990	.542
40.0000	6.50	2.00	39.9990	.482
50.0000	6.65	1.85	49.9990	.446
60.0000	6.85	1.65	59.9990	.398
169.0000	7.85	.65	168.9990	.157

LKP 07-10-80

8 of 9

3637

LLE: 1.00

Press / for commands

A	B	C	D	E
1.00	4.60	0.940		
2.00	4.75	0.904		
3.00	4.95	0.855		
4.00	5.10	0.819		
5.00	5.25	0.783		
6.00	5.40	0.747		
7.00	5.50	0.723		
8.00	5.60	0.699		
9.00	5.65	0.687		
10.00	5.70	0.675		
12.00	5.80	0.651		
14.00	5.85	0.639		
16.00	5.90	0.627		
18.00	5.95	0.614		
20.00	6.00	0.602		
25.00	6.15	0.566		
30.00	6.25	0.542		
40.00	6.30	0.482		
50.00	6.65	0.446		
60.00	6.85	0.398		
160.00	7.85	0.137		

IN-SITU INC. HERMIT DATA MANAGEMENT PACKAGE

MONITORING WELL 165

SLUG/SWAB TEST

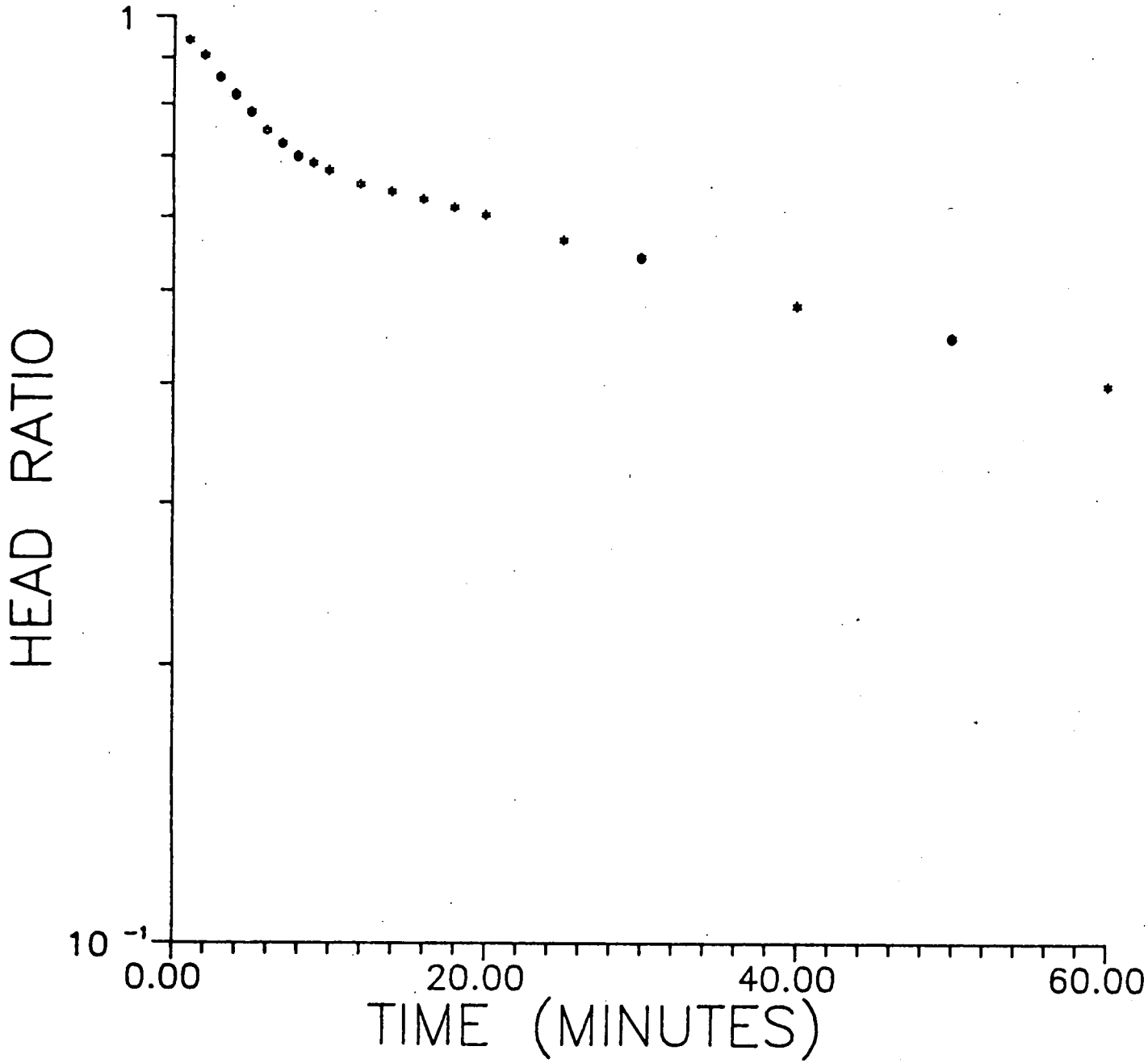
Ref. Value : 8.50 (Ft)
H(0) : 4.15 (Ft)
T(0) : .00 (Min)

ELAPSED TIME (Min)	VALUE (Ft)	HD/DRWDN (Ft)	DELTA TIME (Min)	H/H(0)
1.0000	4.60	3.90	.9990	.940
2.0000	4.75	3.75	1.9990	.904
3.0000	4.95	3.55	2.9990	.855
4.0000	5.10	3.40	3.9990	.819
5.0000	5.25	3.25	4.9990	.783
6.0000	5.40	3.10	5.9990	.747
7.0000	5.50	3.00	6.9990	.723
8.0000	5.60	2.90	7.9990	.699
9.0000	5.65	2.85	8.9990	.687
10.0000	5.70	2.80	9.9990	.675
12.0000	5.80	2.70	11.9990	.651
14.0000	5.85	2.65	13.9990	.639
16.0000	5.90	2.60	15.9990	.627
18.0000	5.95	2.55	17.9990	.614
20.0000	6.00	2.50	19.9990	.602
25.0000	6.15	2.35	24.9990	.566
30.0000	6.25	2.25	29.9990	.542
40.0000	6.50	2.00	39.9990	.482
50.0000	6.65	1.85	49.9990	.446
60.0000	6.85	1.65	59.9990	.398
169.0000	7.85	.65	168.9990	.157

VALUE: 1.00

Press / for commands

	A	B	C	D	E
1	1.00	4.60	0.940		
2	2.00	4.75	0.904		
3	3.00	4.95	0.855		
4	4.00	5.10	0.819		
5	5.00	5.25	0.783		
6	6.00	5.40	0.747		
7	7.00	5.50	0.723		
8	8.00	5.60	0.699		
9	9.00	5.65	0.687		
10	10.00	5.70	0.675		
11	12.00	5.80	0.651		
12	14.00	5.85	0.639		
13	16.00	5.90	0.627		
14	18.00	5.95	0.614		
15	20.00	6.00	0.602		
16	25.00	6.15	0.566		
17	30.00	6.25	0.542		
18	40.00	6.50	0.482		
19	50.00	6.65	0.446		
20	60.00	6.85	0.398		
21	169.00	7.85	0.157		
22					


1
10 -1
HEAD RATIO
0.00
20.00
40.00
60.00
TIME (MINUTES)

MW 165 $r_1 = r_2 = 0.5$ in

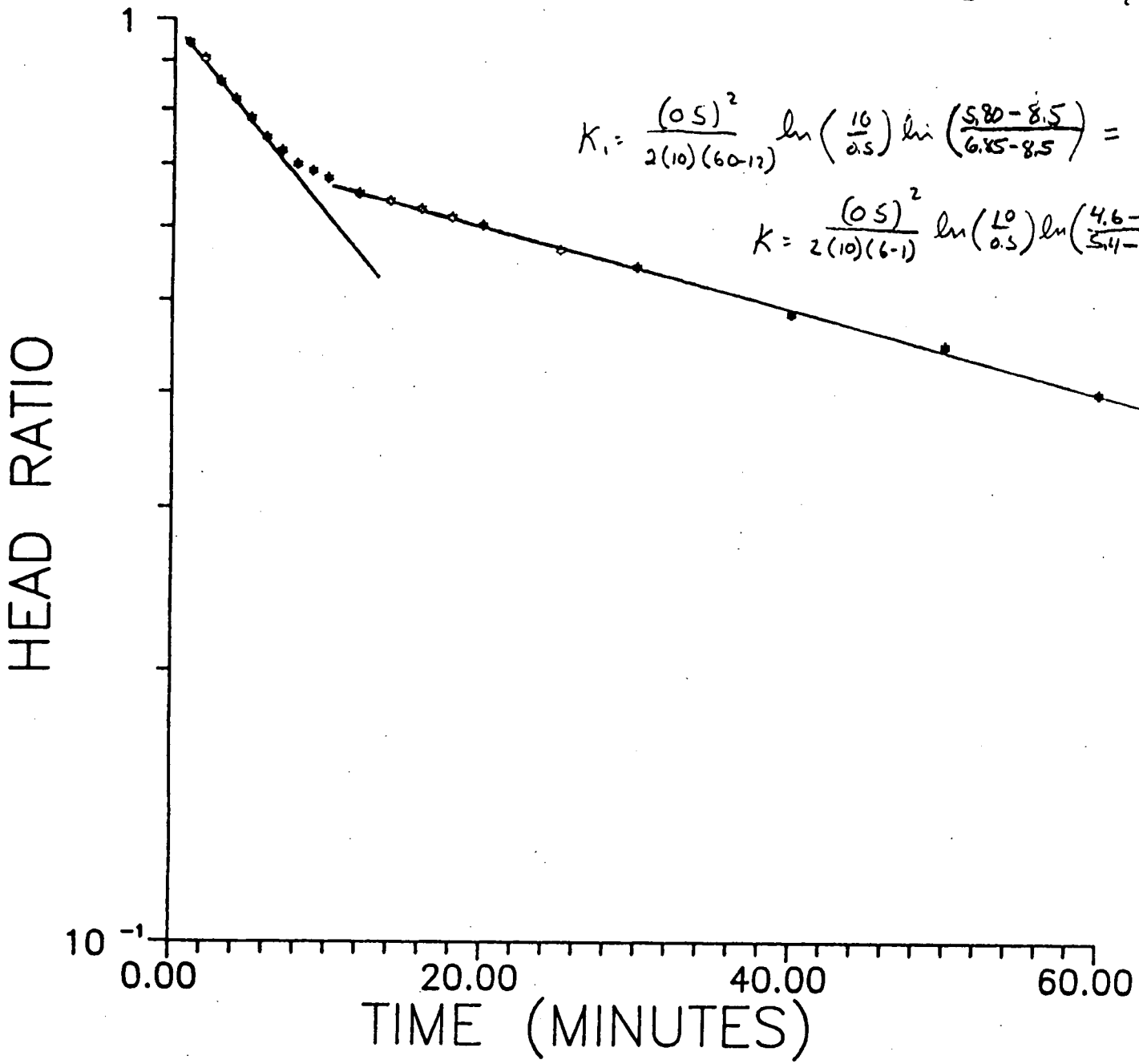
$H_g = 8.50$ in

H_1 [illegible] $L_1 = 12$

H_2 6.85 $L_1 = 60$

H_1 4.60 $L_1 = 1$

H_2 5.40 $L_1 = 6$



$$K_1 = \frac{(0.5)^2}{2(10)(60-12)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{5.80-8.5}{6.85-8.5}\right) = 3.84 \times 10^{-4}\ \text{ft/min} = 1.95 \times 10^{-4}\ \text{cm/sec}$$

$$K = \frac{(0.5)^2}{2(10)(6-1)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{4.6-8.5}{5.4-8.5}\right) = 1.72 \times 10^{-3}\ \text{ft/min} = 8.73 \times 10^{-4}\ \text{cm/sec}$$

MW 765

$H_g = 8.50$ ft

$H_g = 8.5$

H_2 6.85 $L_2 = 60$

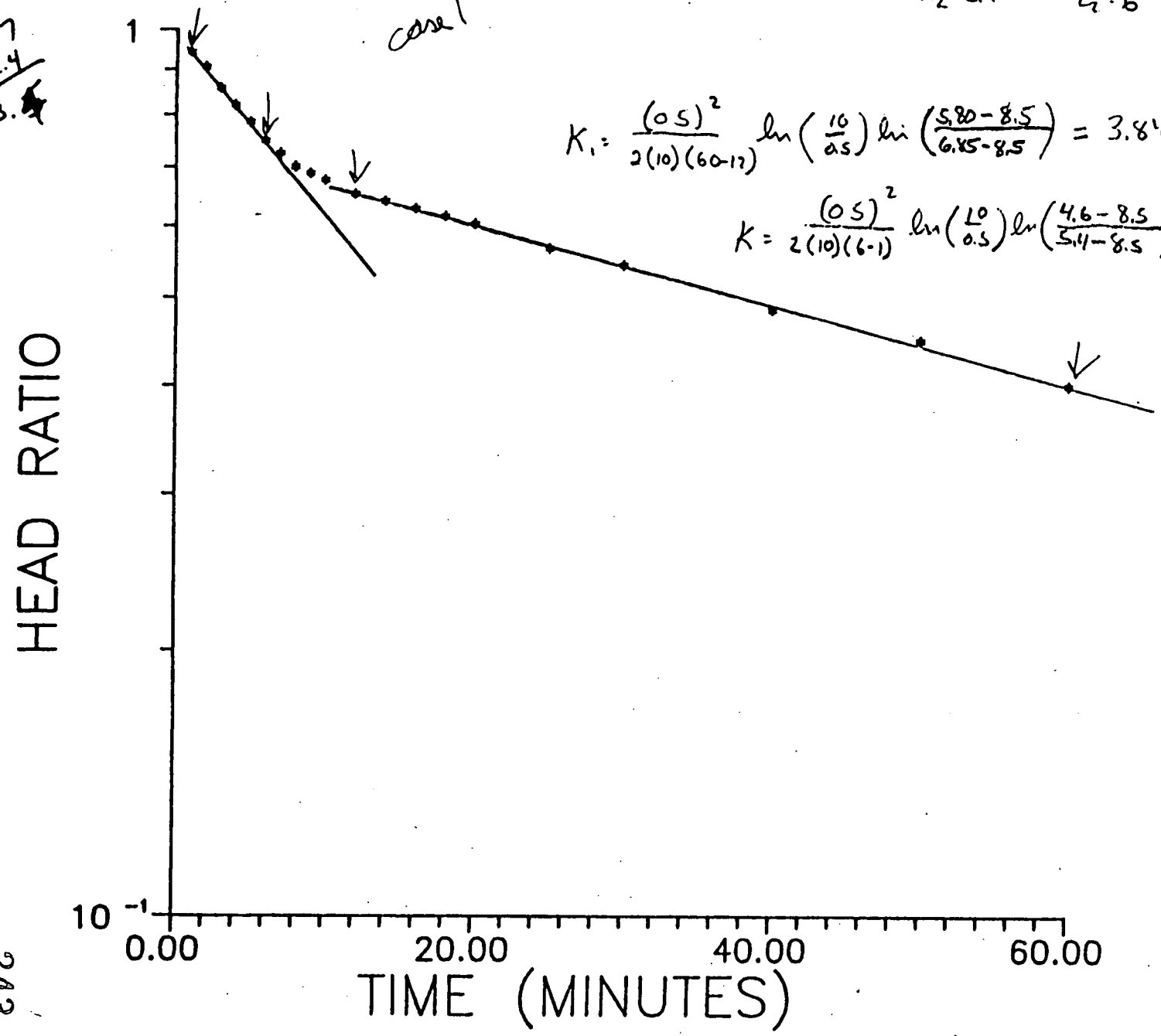
H_1 4.60 $L_1 = 1$

H_2 5.40 $L_2 = 6$

checked by JEW 7-4

15.7
12.4
3.4

case 1



$$K_1 = \frac{(0.5)^2}{2(10)(60-12)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{5.80-8.5}{6.85-8.5}\right) = 3.84 \times 10^{-4}\ \text{ft/min} = 1.95 \times 10^{-4}\ \text{cm/sec}$$

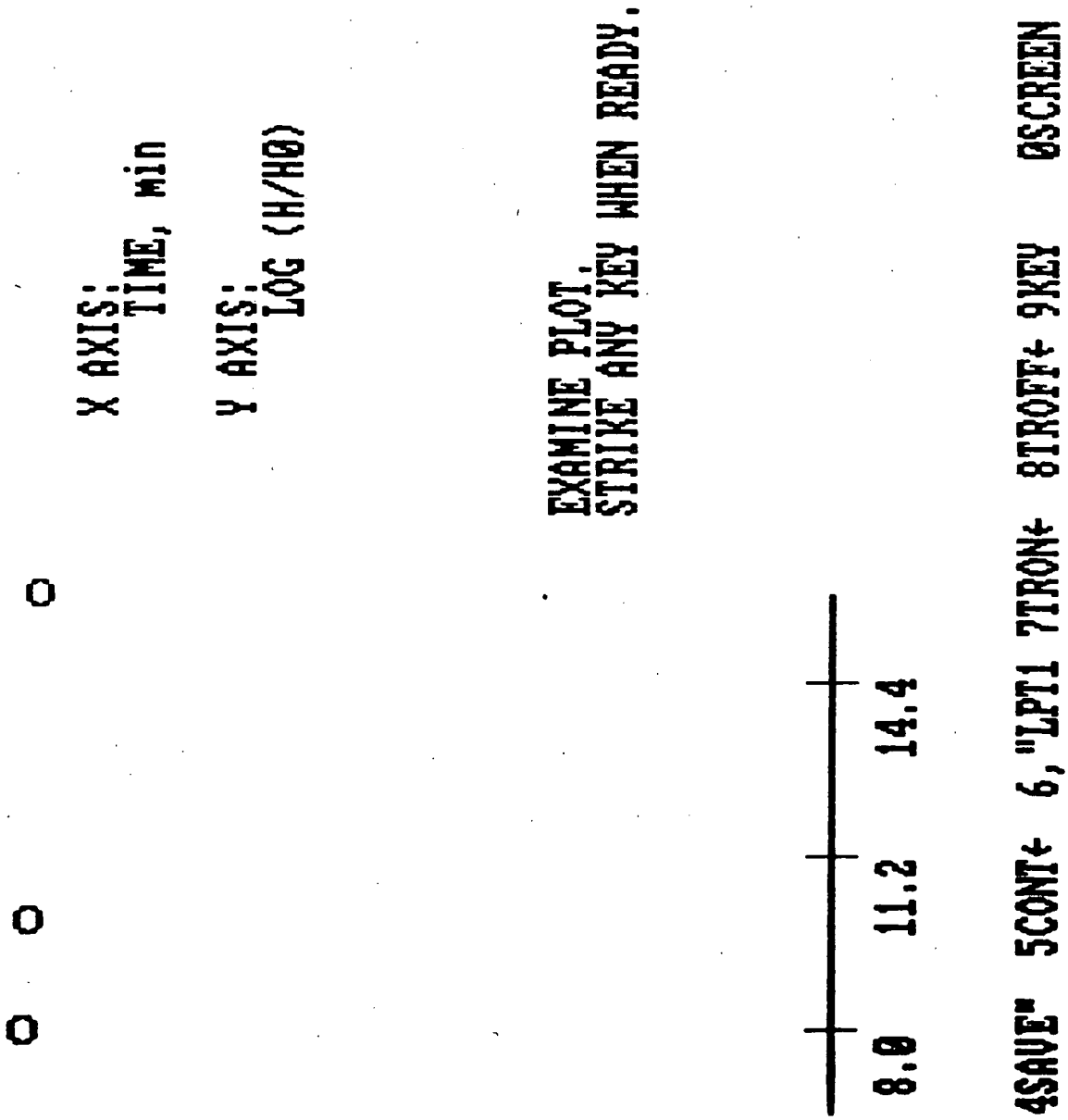
$$K = \frac{(0.5)^2}{2(10)(6-1)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{4.6-8.5}{5.4-8.5}\right) = 1.72 \times 10^{-3}\ \text{ft/min} = 8.73 \times 10^{-4}\ \text{cm/sec}$$

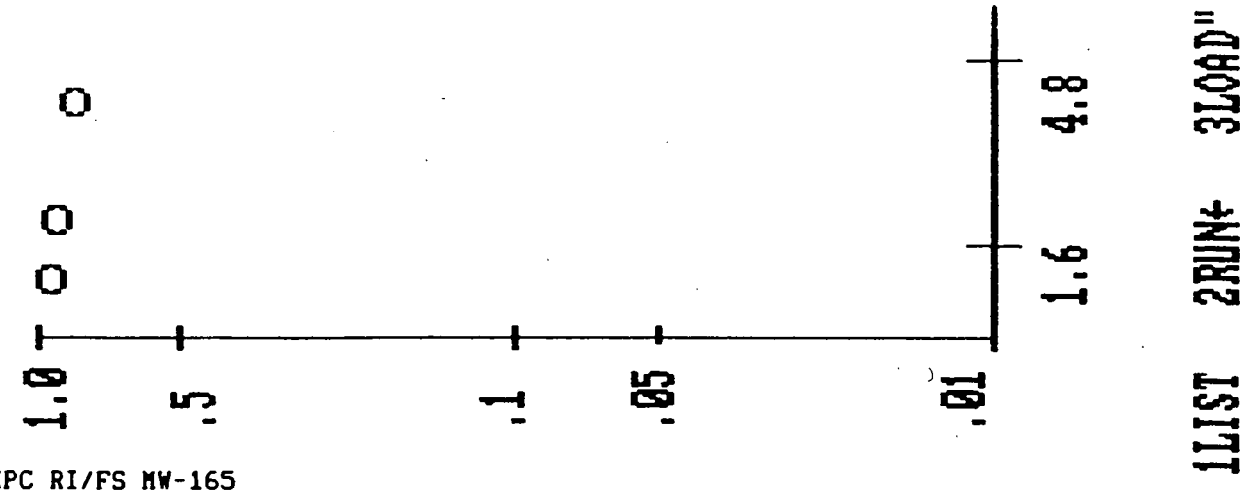
PERMEABILITY FROM TIME-LAG TESTS


```
TITLE:  ? FMPC RI/FS MW-165 $
(E)nglish or (M)etric units? E
(C)onfined or (U)nconfined conditions? U
Do you prefer to enter well radii as (I)nches or (F)eet? F
STANDPIPE RADIUS (feet) = ? .167
INTAKE RADIUS (feet) = ? .5
LENGTH OF INTAKE (feet or meters) = ? 10
DEPTH TO TOP OF INTAKE (feet or meters) = ? 5
STATIC WATER LEVEL, DEPTH (feet or meters) = ? 8.5
PURGE WATER LEVEL (feet or meters) = ? 4.35


ARE THESE DATA CORRECT? (Y/N)? Y
ARE WATER-LEVEL DATA TO BE READ FROM DISK? (Y/N)?


1LIST   2RUN  3LOAD"  4SAVE"  5CONT 6,"LPT1 7TRON 8TROFF9KEY    0SCREEN
```





1LIST 2RUN+ 3LOAD"

FMPC RI/FS MW-165

TIME (seconds)	WATER LEVEL (feet)	DRAWDOWN (feet)	H/H0
60	4.6	-3.90	.939759
120	4.75	-3.75	.9036144
240	5.1	-3.40	.8192771
360	5.4	-3.10	.7469879
480	5.6	-2.90	.6987952
600	5.7	-2.80	.6746988

UNCONFINED AQUIFER

K = 8.2E-05 cm/sec
= 1.7 gpd/ft2
= 2.7E-06 ft/sec
= 0.2 ft/day

REGRESSION COEFFICIENT = -.9894225

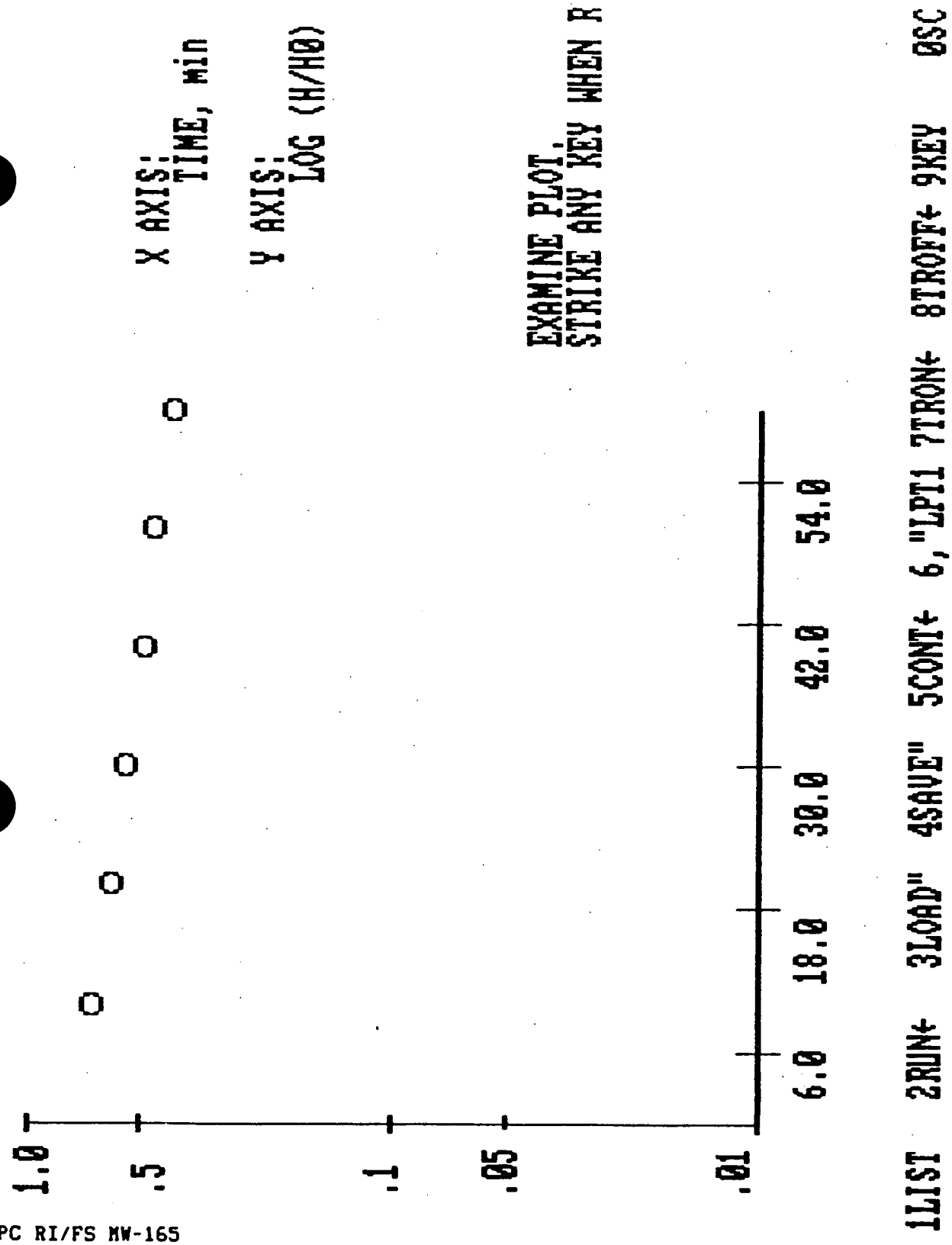
PERMEABILITY FROM TIME-LAG TESTS

```
TITLE:  ? FMPC RI/FS MW-165
(E)nglish or (M)etric units? E
(C)onfined or (U)nconfined conditions? U
Do you prefer to enter well radii as (I)nches or (F)eet? F
STANDPIPE RADIUS (feet) = ? .167
INTAKE RADIUS (feet) = ? .5
LENGTH OF INTAKE (feet or meters) = ? 10
DEPTH TO TOP OF INTAKE (feet or meters) = ? 5
STATIC WATER LEVEL, DEPTH (feet or meters) = ? 8.5
PURGE WATER LEVEL (feet or meters) = ? 4.35


ARE THESE DATA CORRECT? (Y/N)? Y
ARE WATER-LEVEL DATA TO BE READ FROM DISK? (Y/N)?
```

1LIST 2RUN 3LOAD" 4SAVE" 5CONT 6,"LPT1 7TRON 8TROFF9KEY 0SCREEN

DY. EN



FMPC RI/FS MW-165

TIME (seconds)	WATER LEVEL (feet)	DRAWDOWN (feet)	H/H0
1200	6	-2.50	.6024097
1800	6.25	-2.25	.5421687
2400	6.5	-2.00	.4819277
3000	6.65	-1.85	.4457831
3600	6.85	-1.65	.3975905

UNCONFINED AQUIFER

K = 2.2E-05 cm/sec

= 7.1E-07 ft/sec
= 0.1 ft/day

REGRESSION COEFFICIENT = -.9984502

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1079
WELL NUMBER: 1079

FIELD ENG./GEO.: D. OAKLEY DATE: 10/21/87
CHECKED BY : Not Noted DATE: N/A
N,E COORDINATES: 482273.70, 1378165.4
DATE OF INSTAL.: 10/21/87

BOREHOLE DRILLING

DRILLING METHOD: Cable Tool
DRILLING FLUID(S) USED: (in Feet)
FLUID: WATER FROM: 1 TO: 26
FLUID: N/A FROM: N/ATO: N/A
NOTES/COMMENTS:

TYPE OF BIT: Flat Head Hammer
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING
CASING DIAM.: 4 In. ID
CASING SIZE(S) USED: (in Feet)
SIZE: 10 FROM: 0 TO: 35
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Screen
AVG. SIZE OF PERFORATIONS: .010 (In.)
TOTAL PERFORATED AREA: 5 ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: Stainless Steel
RISER PIPE DIAMETERS:
O.D.: 4 3/8 In. I.D.: 4 In.
LENGTH OF 1ST PIPE SECTION: 10 Ft.
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: THREAD AND COUPLE

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5 Ft.
PROTECTIVE PIPE O.D.: 10 In.
* LOCKABLE CAP AND LOCK

OTHER PROTECTION (* NOTED BELOW)

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE	ELEVATION MSL
TOP OF RISER PIPE	2.0 Ft.	583.98
GROUND SURFACE	0.0	N/A
BOTTOM OF PROTECTIVE PIPE	2.5 Ft.	

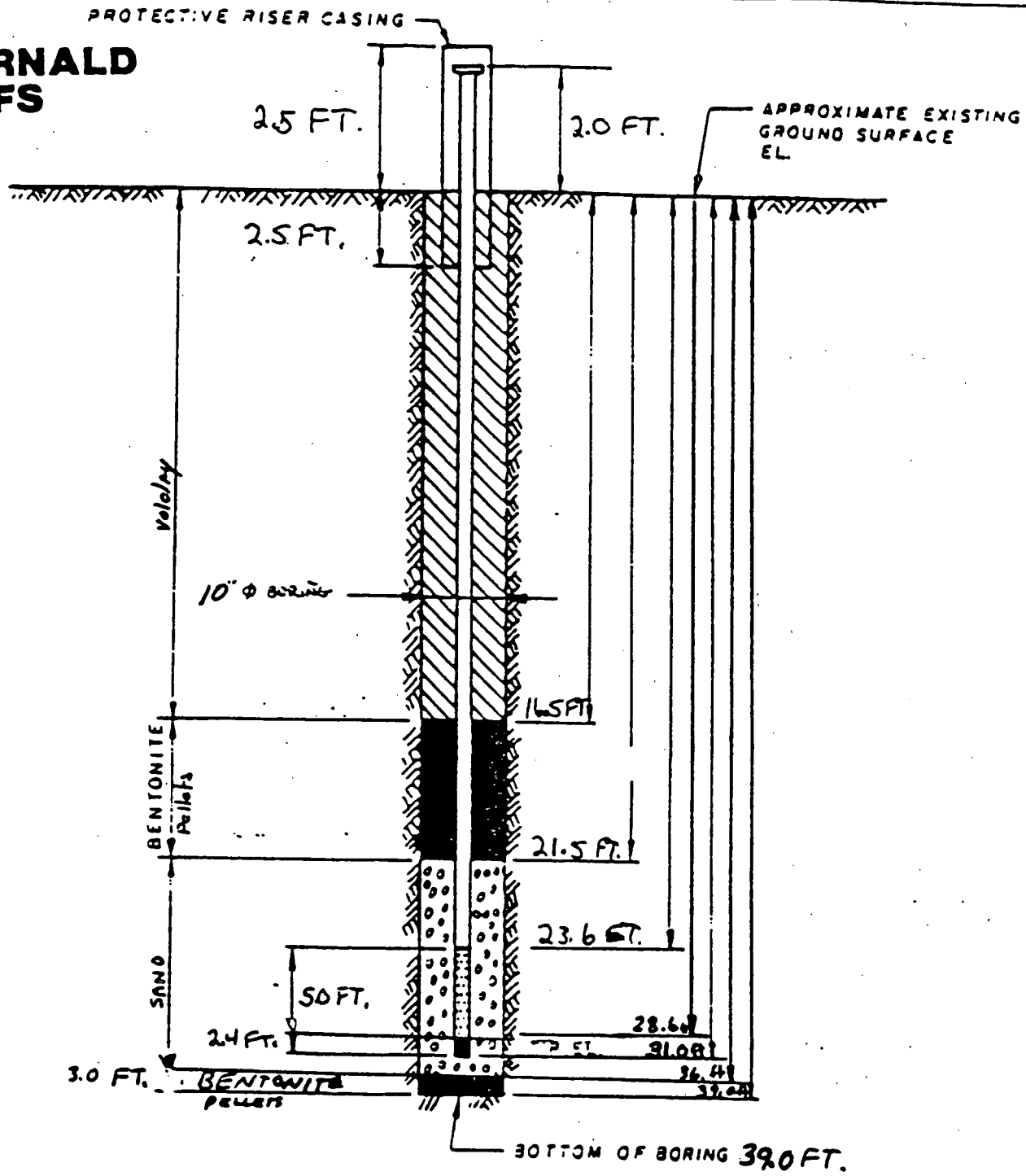
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
Grout/Slurry	1.0	16.5	N/A	N/A
Bentonite Pellets	16.5	21.5	N/A	N/A
Sand	21.5	36.0	N/A	N/A
Bentonite Pellets	36.0	39.0	N/A	N/A
PERFORATED SECTION	23.6	28.6	N/A	N/A

WELL TIP	31.0	N/A
BOTTOM OF BOREHOLE	39.0	N/A
GWL AFTER INSTALLATION	N/A	N/A

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

WELL # 179

FERNALD RI/FS



DRAWING NUMBER

CHECKED BY

APPROVED BY

DRAWN BY

NOTES:

1. RISER PIPE IS 4 IN I.D. SCHEDULE PIPE, THREADED, FLUSH-JOINTED.
2. SCREEN IS 4 IN I.D SS PIPE CONTINUOUS SLOT SCREEN (0.010 IN SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL
5. WATER LEVEL READING ON

INSTALLATION DETAILS
MONITORING WELL 179

PREPARED FOR

VISUAL CLASSIFICATION OF SOILS

3637

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1079	COORDINATES: NORTH 482,273.70 EAST 1,378,165.47	DATE: 10/19/87
GROUND ELEVATION:	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/19/87
ENGINEER/GEOLOGIST: D. OAKLEY	Depth N/A Date/Time N/A	DATE COMPLETED: 10/21/87
DRILLING METHODS: CABLE-TOOL		PAGE 1 OF 3

DEPTH	SAMPLE	DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
1.5	07369	10/19/87 1035	5 13 17	13	YELLOWISH BROWN SILT, TRACE SAND AND CLAY AND GRAVEL - DRY. HARD, VERY PALE BROWN CLAY, SILT, TRACE SAND - DRY.	ML CL	4.5+ 4.5+	Hnu= 0 ppm α = 0 cpm βγ = 40-80 cpm
3.0	07370	10/19/87 1045	26 24 33	18	HARD, LIGHT YELLOWISH BROWN CLAY AND SILT, TRACE SAND - DRY.	CL	4.5+	Hnu= 0 ppm α = 0 cpm βγ = 40-80 cpm
4.5	07371	10/19/87 1050	50	4	HARD, LIGHT YELLOWISH BROWN CLAY, SOME SILT AND GRAVEL, TRACE SAND, DRY.	CL	4.5+	Hnu= 0 ppm α = 0 cpm βγ = 40-80 cpm
6.0	07372	10/19/87 1520	8 11 13	14	MEDIUM STIFF GRAY SILT, TRACE CLAY AND SAND - DRY. MEDIUM STIFF LIGHT YELLOWISH BROWN CLAY, TRACE SILT, GRAVEL, AND SAND - DRY.	ML CL	4.5+ 3.5	Hnu= 0 ppm α = 0 cpm βγ = 40-80 cpm
7.5	07373	10/19/87 1600	6 8 15	12	GRAY GRAVEL AND SILT, TRACE SAND AND CLAY. MEDIUM STIFF GRAY SILT, TRACE CLAY AND SAND - DRY.	GM ML	3.5 N/A	Hnu= 0 ppm α = 0 cpm βγ = 40-80 cpm
9.0	07374	10/19/87 1615	6 8 13	14	MEDIUM STIFF GRAY SILT, SOME CLAY, TRACE GRAVEL AND SAND - DRY MEDIUM STIFF OLIVE CLAY, SOME SILT - DRY.	ML CL	2.0	Hnu= 0 ppm α = 0 cpm βγ = 40-80 cpm
10.5	07375	10/19/87 1645	5 6 8	16	STIFF YELLOWISH RED CLAY, TRACE SILT, DRY WOOD FRAGMENTS. STIFF GRAY SILT, SOME CLAY - MOIST. LIGHT YELLOWISH BROWN SILT, TRACE SAND AND CLAY.	CL ML ML	1.25 .1 .1	Hnu= 0 ppm α = 0 cpm βγ = 40-80 cpm
12.0	07376	10/19/87 1700	5 6 8	18	LIGHT YELLOWISH BROWN SILT, TRACE SAND AND CLAY. STIFF REDDISH YELLOW CLAY - TRACE SILT AND SAND - DRY. GRAY CLAY, SOME SILT, TRACE SAND - DRY.	ML CL CL	.1 1.75	Hnu= 0 ppm α = 0 cpm βγ = 40-80 cpm
13.5	07377	10/19/87 1730	2 10 18	10	OLIVE GRAY SILT, TRACE GRAVEL AND SAND - MOIST. MEDIUM DENSE, OLIVE YELLOW SAND, SOME GRAVEL, SOME CLAY, TRACE SILT.	ML SC	N/A .2	Hnu= 0 ppm α = 0 cpm βγ = 40-80 cpm
15.0	07378	10/19/87 1800	8 10 15	12	PALE OLIVE CLAY, TRACE SILT, GRAVEL, SAND - MOIST. VERY STIFF, LIGHT YELLOWISH BROWN GRAVEL, SOME CLAY, TRACE SILT AND SAND - MOIST. LIGHT OLIVE BROWN CLAY, SOME SILT, TRACE SILT - MOIST.	CL GC CH	 N/A N/A	Hnu= 0 ppm α = 0 cpm βγ = 40-80 cpm

NOTES:
MUNSELL 5Y 6/3, SAMPLE SCANNED AT BACKGROUND.

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1079	COORDINATES: NORTH 482,273.70 EAST 1,378,165.47	DATE: 10/19/87
GROUND ELEVATION:	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/19/87
ENGINEER/GEOLOGIST: D. OAKLEY	Depth N/A Date/Time N/A	DATE COMPLETED: 10/21/87
DRILLING METHODS: CABLE-TOOL		PAGE 2 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.5	07379 10/19/87 1830	10 16 27	12	GRAY CLAY, SOME GRAVEL, TRACE SAND AND SILT, DRY. HARD, GRAY CLAY, SOME GRAVEL, TRACE SILT AND SAND, MOIST.	CL CL	1.25 1.25	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
18.0	07381 10/20/87 0940	2 7 13	18	VERY STIFF, LIGHT GRAYISH BROWN CLAY, SOME GRAVEL, TRACE SILT AND SAND - MOIST.	CH	.25	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
18.5	07380 10/20/87 0915			SHELBY TUBE.	CH	.25	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
19.5	07382 10/20/87 1010	2 6 10	5	VERY STIFF, LIGHT GRAYISH BROWN CLAY, SOME GRAVEL, TRACE SILT AND SAND - MOIST.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
21.0	07383 10/20/87 1030	10 12 20	13	HARD, LIGHT GRAYISH BROWN CLAY, SOME GRAVEL, TRACE SILT AND SAND - WET.	CL	1.25	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
22.5	07384 10/20/87 1045	8 5 10	3	STIFF LIGHT YELLOWISH BROWN CLAY, SOME GRAVEL, TRACE SILT AND SAND - WET.	CH	N/A	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
24.0	07385 10/20/87 1115	4 6 9	15	STIFF, LIGHT YELLOWISH BROWN CLAY, SOME GRAVEL, TRACE SAND AND SILT - WET.	CH	1.25	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
25.5	07386 10/20/87 1320	4 6 15	10	STIFF, LIGHT YELLOWISH BROWN CLAY, SOME GRAVEL, TRACE SAND AND SILT - MOIST.	CH	1.25	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
27.0	07387 10/20/87 1335	5 20 48	13	STIFF, LIGHT YELLOWISH BROWN CLAY, SOME GRAVEL, TRACE SAND AND SILT - WET. VERY DENSE, GRAY GRAVEL, SOME SAND, TRACE CLAY AND SILT - MOIST.	CH GC	1.0 N/A	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
28.5	07388 10/20/87 1400	39 20 29	15	DENSE, LIGHT YELLOWISH BROWN GRAVE, SOME SAND, TRACE CLAY - WET. HARD, LIGHT YELLOWISH BROWN CLAY, TRACE GRAVEL, SAND, AND SILT - MOIST.	GC CL	N/A 4.5	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
30.0	07389 10/20/87 1520	10 17 35	15	HARD, LIGHT YELLOWISH BROWN CLAY, SOME GRAVEL AND SILT, TRACE SAND - MOIST.	CL	4.5	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm

NOTES:
MUNSELL 2.5Y 6/2

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.2	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1079	COORDINATES: NORTH 482,273.70 EAST 1,378,165.47	DATE: 10/19/87
GROUND ELEVATION:	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/19/87
ENGINEER/GEOLOGIST: D. OAKLEY	Depth N/A Date/Time N/A	DATE COMPLETED: 10/21/87
DRILLING METHODS: CABLE-TOOL		PAGE 3 OF 3

DEPTH	SAMPLE	DATE	TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
31.5	07390	10/20/87	1530	12 22 32	17	LIGHT YELLOWISH BROWN CLAY, SOME GRAVEL, TRACE SAND AND SILT - DRY. HARD OLIVE CLAY, SOME GRAVEL, AND SILT, TRACE SAND - DRY.	CL CL	4.5	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
33.0	07391	10/20/87	1600	11 50	12	OLIVE CLAY, SOME GRAVEL, TRACE SILT AND SAND - DRY. HARD, LIGHT BROWNISH GRAY SILT, SOME SAND - MOIST.	CL ML	4.5 2.0	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
34.5	07392	10/20/87	1615	20 28 30	18	HARD LIGHT BROWNISH GRAY SILT, SOME SAND, TRACE GRAVEL - MOIST HARD OLIVE CLAY, SOME FINE GRAVEL, TRACE SILT AND SAND.	ML CL	2.5 4.5	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
36.0	07393	10/20/87	1645	9 17 27	18	HARD OLIVE CLAY, SOME GRAVEL, TRACE SILT AND SAND - MOIST.	CL	4.25	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
37.5	07394	10/20/87	1700	9 10 13	13	VERY STIFF, OLIVE SILT, TRACE CLAY - WET. OLIVE SILT, SOME CLAY - WET.	ML ML	1.25 1.25	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm
39.0	07395	10/20/87	1810	8 18 30	15	OLIVE SILT, SOME CLAY, TRACE SAND - WET. HARD BROWNISH YELLOW SILT, SOME CLAY - MOIST. DENSE YELLOWISH BROWN SAND, TRACE SILT.	ML ML SW	1.25 3.5 1.5	Hnu= 0 ppm α = 0 cpm βΓ = 40-80 cpm

BOTTOM OF BORING 39.0

NOTES:
MUNSELL 5Y 5/3, MUNSELL 10YR 6/8, MUNSELL 10YR 5/6

Clay Some Gravel 3637
Gravel, Some Sand

FERNALD RI/FS

FIELD PERMEABILITY TESTS

FALLING HEAD *

PROJECT FMPC RI/FS
PROJECT NO. 602030201
BORING NO. 179

TESTED BY TS/BM DATE 4/27/88
CALCULATED BY FXM DATE 11/11/88
CHECKED BY [illegible] DATE 12/28/88
Copied By: FXM 10/31/88
Chk By: [illegible] 12/28/88

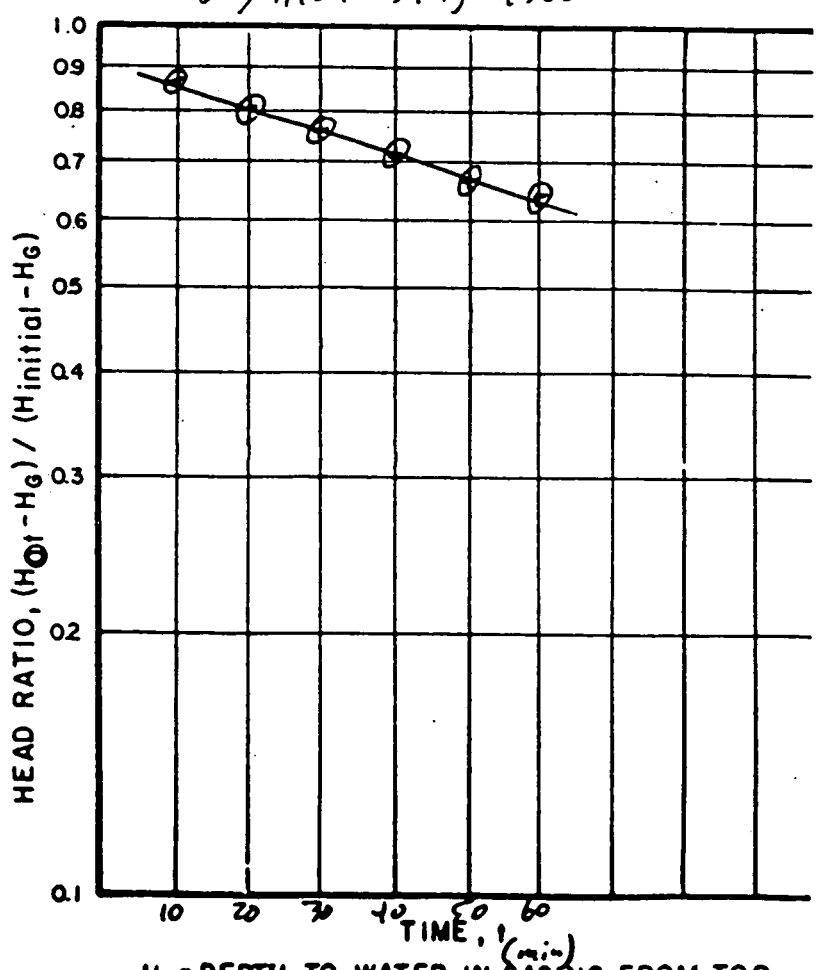
RADIUS OF TEST BORING, R 0.5 ft (6 in)
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C ≈ 2 ft
DEPTH TO BOTTOM OF TEST POCKET, L_1 29.6 ft
DEPTH TO TOP OF TEST POCKET, L_2 23.6 ft
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 27.15 ft

PERMEABILITY, K 1.8×10^{-5} cm/s

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

Start Test 0725
8 gallon Slug used

ELAPSED TIME t min ~~sec.~~	DEPTH TO WATER IN CASING H ft ~~Meters~~
0	20.25
1	20.40
2	20.55
3	20.70
4	20.80
5	20.90
6	20.95
7	21.05
8	21.10
9	21.15
10	21.20
12	21.35
14	21.40
16	21.50
18	21.60
20	21.65
25	21.80
30	21.95
40	22.25
50	22.50
60	22.70
(1105) 220 min	24.45



$$K = \frac{R^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1
H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

INTERNATIONAL TECHNOLOGY CORPORATION

FXM Date 11/11/88 Subject Slug Test Calculations Sheet No. 2 of 3
Chkd. By ____ Date ____ Well 179 Proj. No. 602.03.02.01

Well 179

$$\text{Head Ratio} = \frac{H_T - H_G}{H_i - H_G}$$

@ 10 min $\frac{21.20 - 27.15}{20.25 - 27.15} = 0.86$

@ 20 min $\frac{21.65 - 27.15}{20.25 - 27.15} = 0.80$

@ 30 min $\frac{21.95 - 27.15}{20.25 - 27.15} = 0.75$

@ 40 min $\frac{22.25 - 27.15}{20.25 - 27.15} = 0.71$

@ 50 min $\frac{22.50 - 27.15}{20.25 - 27.15} = 0.67$

@ 60 min $\frac{22.70 - 27.15}{20.25 - 27.15} = 0.64$

INTERNATIONAL TECHNOLOGY CORPORATION

FXM Date 11/11/88 Subject Slug Test Calculations Sheet No. 3 of 3
Chkd. By ___ Date ___ Well 179 Proj. No. 607.03.01.01

Permeability

$$K = \frac{r^2}{2(L_1-L_2)(t_2-t_1)} \ln\left[\frac{L_1-L_2}{R}\right] \ln\left[\frac{H_1-H_G}{H_2-H_G}\right]$$

$$= \frac{(0.167)^2}{2(30.6-25.6)(50-20)} \ln\left[\frac{30.6-25.6}{0.5}\right] \ln\left[\frac{21.65-27.}{2250-27.}\right.$$

$$K = 3.6 \times 10^{-5} \text{ ft/min}$$

$$= 1.8 \times 10^{-5} \text{ cm/s}$$

INTERNATIONAL TECHNOLOGY CORPORATION

[illegible] Date [illegible] Subject Head Ratio Calculations Sheet No. ____ of ____
Chkd. By LKP Date 07-10-98 [illegible] MW 179 Proj. No. [illegible]

$$HR = \frac{H_{@t} - H_G}{H_i - H_G}$$

H_G: Depth to ground water from toc before slug added
H_i: Initial depth to ground water from toc after slug added
$H_{@t}$: Depth to ground water from toc at time t

at t = 1 minute
H = 20.40 ft

H_G = 27.15 ft
H_i = 20.25 ft

$$HR = \frac{20.40 - 27.15}{20.25 - 27.15} =$$

t (minutes)	H (feet)	HR (dimensionless)	
1	20.40	0.978	
2	20.55	0.957	
3	20.70	0.935	
4	20.80	0.920	
5	20.90	0.906	
6	20.95	0.899	
7	21.05	0.884	
8	21.10	~~0.881~~	0.877
9	21.15	0.870	JEW
10	21.20	0.862	
12	21.35	0.841	
14	21.40	0.833	
16	21.50	0.819	
18	21.60	0.804	
20	21.65	~~0.792~~	0.797
25	21.80	0.775	JEW
30	21.95	0.754	
40	22.25	0.710	
50	22.50	0.764	0.674
60	22.70	0.645	JEW
220	24.45	0.391	

B:\>

IN-SITU INC. HERMIT DATA MANAGEMENT PACKAGE

MONITORING WELL 179

SLUG/SWAB TEST

Ref. Value : 27.15 (Ft)
H(0) : 6.90 (Ft)
T(0) : .00 (Min)

ELAPSED TIME (Min)	VALUE (Ft)	HD/ORWDN (Ft)	DELTA TIME (Min)	H/H(0)
1.0000	20.40	6.75	.9990	.978
2.0000	20.55	6.60	1.9990	.957
3.0000	20.70	6.45	2.9990	.935
4.0000	20.80	6.35	3.9990	.920
5.0000	20.90	6.25	4.9990	.906
6.0000	20.95	6.20	5.9990	.899
7.0000	21.05	6.10	6.9990	.884
8.0000	21.10	6.05	7.9990	.877
9.0000	21.15	6.00	8.9990	.870
10.0000	21.20	5.95	9.9990	.862
12.0000	21.35	5.80	11.9990	.841
14.0000	21.40	5.75	13.9990	.833
16.0000	21.50	5.65	15.9990	.819
18.0000	21.60	5.55	17.9990	.804
20.0000	21.65	5.50	19.9990	.797
25.0000	21.80	5.35	24.9990	.775
30.0000	21.95	5.20	29.9990	.754
40.0000	22.25	4.90	39.9990	.710
50.0000	22.50	4.65	49.9990	.674
60.0000	22.70	4.45	59.9990	.645
220.0000	24.45	2.70	219.9990	.391

B:\>

IN-SITU INC. HERMIT DATA MANAGEMENT PACKAGE

MONITORING WELL 179

SLUG/SWAB TEST

Ref. Value : 27.15 (Ft)
H(0) : 6.90 (Ft)
T(0) : .00 (Min)

ELAPSED TIME (Min)	VALUE (Ft)	HD/DRWDN (Ft)	DELTA TIME (Min)	H/H(0)
1.0000	20.40	6.75	.9990	.978
2.0000	20.55	6.60	1.9990	.957
3.0000	20.70	6.45	2.9990	.935
4.0000	20.80	6.35	3.9990	.920
5.0000	20.90	6.25	4.9990	.906
6.0000	20.95	6.20	5.9990	.899
7.0000	21.05	6.10	6.9990	.884
8.0000	21.10	6.05	7.9990	.877
9.0000	21.15	6.00	8.9990	.870
10.0000	21.20	5.95	9.9990	.862
12.0000	21.35	5.80	11.9990	.841
14.0000	21.40	5.75	13.9990	.833
16.0000	21.50	5.65	15.9990	.819
18.0000	21.60	5.55	17.9990	.804
20.0000	21.65	5.50	19.9990	.797
25.0000	21.80	5.35	24.9990	.775
30.0000	21.95	5.20	29.9990	.754
40.0000	22.25	4.90	39.9990	.710
50.0000	22.50	4.65	49.9990	.674
60.0000	22.70	4.45	59.9990	.645
220.0000	24.45	2.70	219.9990	.391

VALUE: 1.00

Press / for commands

	A	B	C	D	E
1	1.00	20.40	0.978		
2	2.00	20.55	0.957		
3	3.00	20.70	0.935		
4	4.00	20.80	0.920		
5	5.00	20.90	0.906		
6	6.00	20.95	0.899		
7	7.00	21.05	0.884		
8	8.00	21.10	0.877		
9	9.00	21.15	0.870		
10	10.00	21.20	0.862		
11	12.00	21.35	0.841		
12	14.00	21.40	0.833		
13	16.00	21.50	0.819		
14	18.00	21.60	0.804		
15	20.00	21.65	0.797		
16	25.00	21.80	0.775		
17	30.00	21.95	0.754		
18	40.00	22.25	0.710		
19	50.00	22.50	~~0.740~~ 0.674		
20	60.00	22.70	0.645		
21	220.00	24.45	0.391		
22					

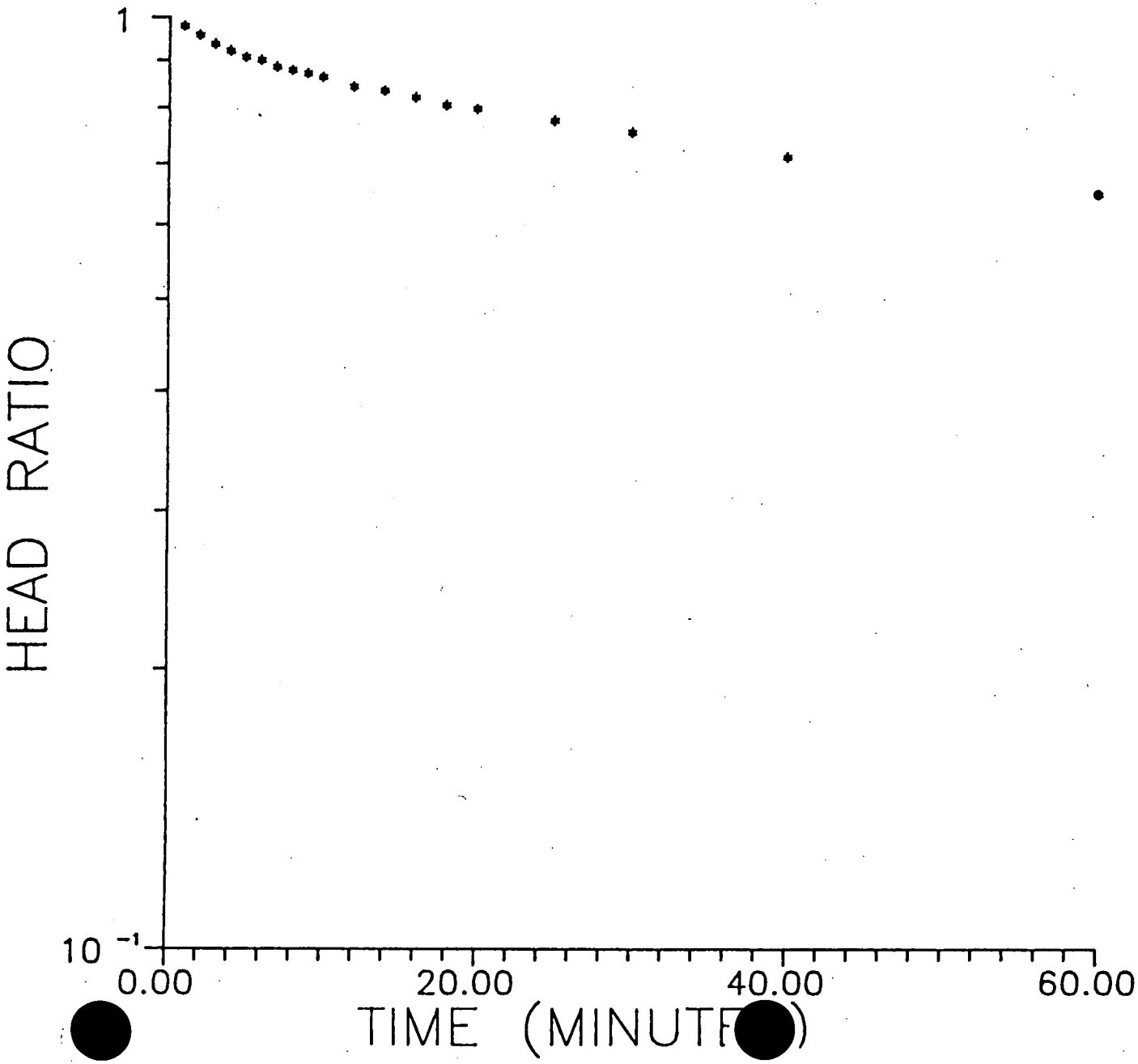
LKP 07-10-38

3637

[illegible]

Press - for commands

	A	B	C	D	E
1	[illegible]	[illegible]	[illegible]		
2	[illegible]	[illegible]	[illegible]		
3	[illegible]	[illegible]	[illegible]		
4	4.00	[illegible]	[illegible]		
5	5.00	[illegible]	[illegible]		
6	6.00	[illegible]	[illegible]		
7	7.00	21.05	0.884		
8	8.00	21.10	0.877		
9	9.00	21.15	0.870		
10	10.00	21.20	0.862		
11	12.00	21.35	0.841		
12	14.00	21.40	0.833		
13	16.00	21.50	0.819		
14	18.00	21.60	0.804		
15	20.00	21.65	0.797		
16	25.00	21.80	0.775		
17	30.00	21.95	0.754		
18	40.00	22.25	0.710		
19	50.00	22.50	0.674		
20	60.00	22.70	0.645		
21	220.00	24.45	0.331		
22					


HEAD RATIO
1
10 -1
0.00
20.00
40.00
60.00
TIME (MINUTES)

MW 179

$r_1 = r_2 = 0.5$ ft

$H_2 = 22.25$ $t_1 = 40$ min

$H_g = 27.15$

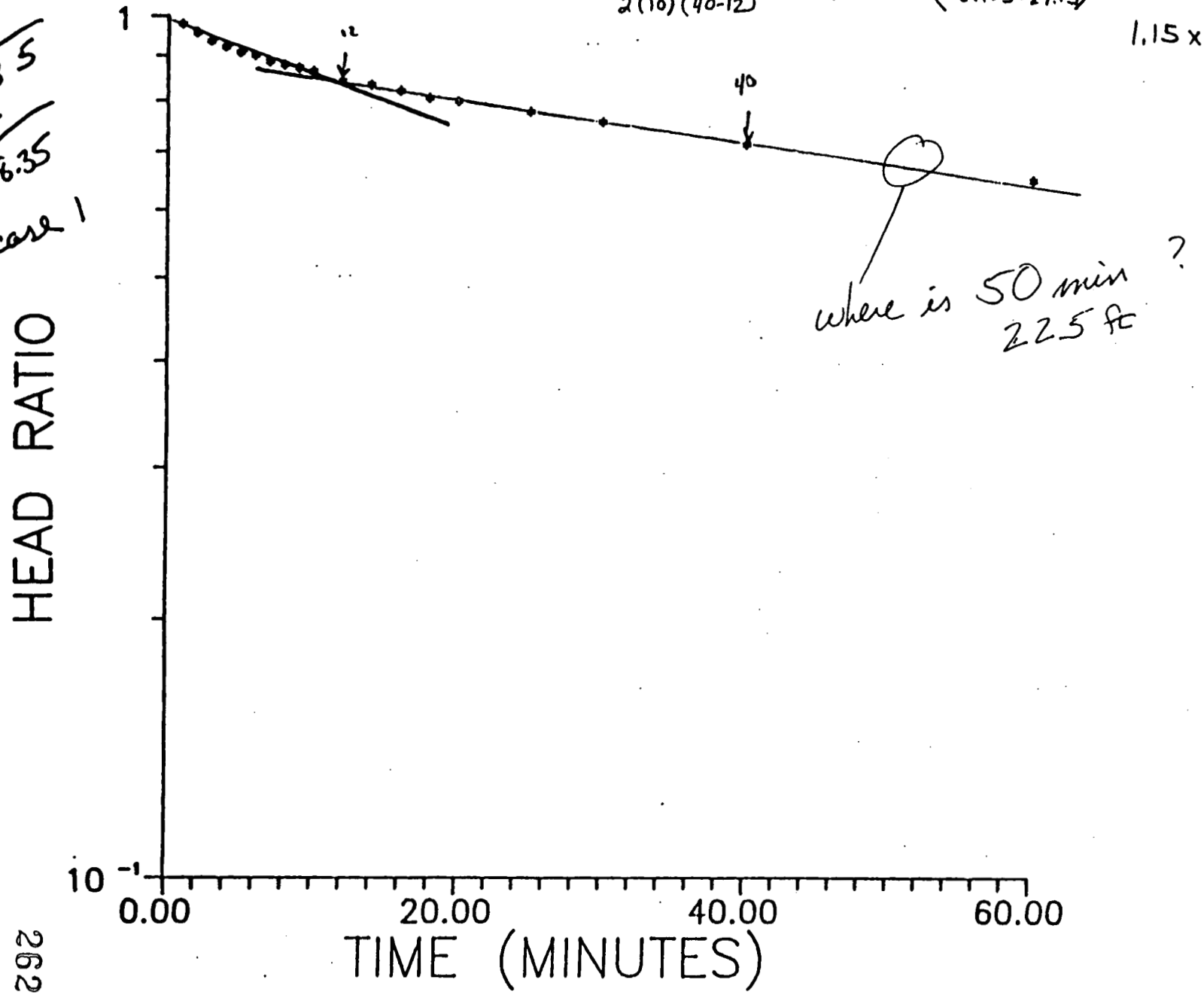
$$K = \frac{(0.5)^2}{2(10)(40-12)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{21.35-27.15}{22.25-27.15}\right) = 2.26 \times 10^{-4} \text{ ft/min}$$

1.15×10^{-4} cm/sec

checked by [illegible] 1-9-[illegible]

,275
12.4
20.35
-2
18.35

case 1



where is 50 min ?
22.5 ft

MW 179

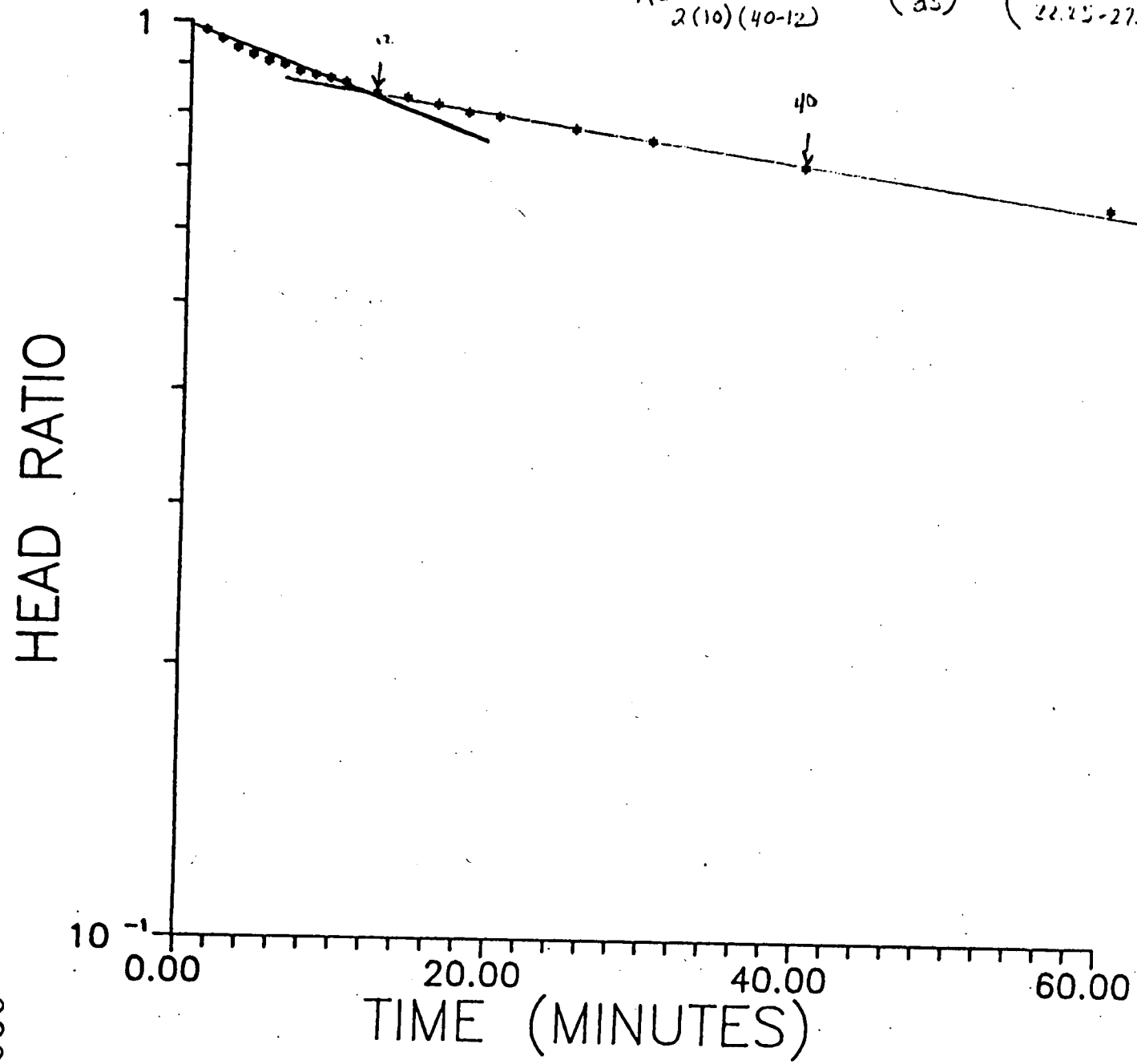
$r_1 = r_2$

H_1 : 21.35 t_1 = 12 min

H_2 : 22.25 t_2 = 40 min

$$K = \frac{(0.5)^2}{2(10)(40-12)} \ln\left(\frac{10}{0.5}\right) \ln\left(\frac{21.35-27.15}{22.25-27.15}\right) = 2.26 \times 10^{-4}\ ft/min$$

1.15×10^{-4} cm/sec



MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1167
WELL NUMBER: 1167

FIELD ENG./GEO.: L. SINFIELD DATE: 05/03/89
CHECKED BY : BD DATE: 06/05/89
N,E COORDINATES: 480022.72, 1380741.1
DATE OF INSTAL.: 05/03/89

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: AUGER BIT
IS CASING TEMPORARY?: No
CASING TYPE : SCHEDULE 40 PVC
CASING DIAM.: 2 In.
CASING SIZE(S) USED: (Units N/A)
SIZE: N/A FROM: N/A TO: N/A
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: 0.020 (In.)
TOTAL PERFORATED AREA: 4.8 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: SCHEDULE 40 PVC
RISER PIPE DIAMETERS:
O.D.: 2 5/16 In. I.D.: 2 In.
LENGTH OF 1ST PIPE SECTION: 7.0 Ft.
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: FLUSH-THREADED

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5.0 Ft.
PROTECTIVE PIPE O.D.: 4 1/ In.
* LOCKING CAP

OTHER PROTECTION (* NOTED BELOW)

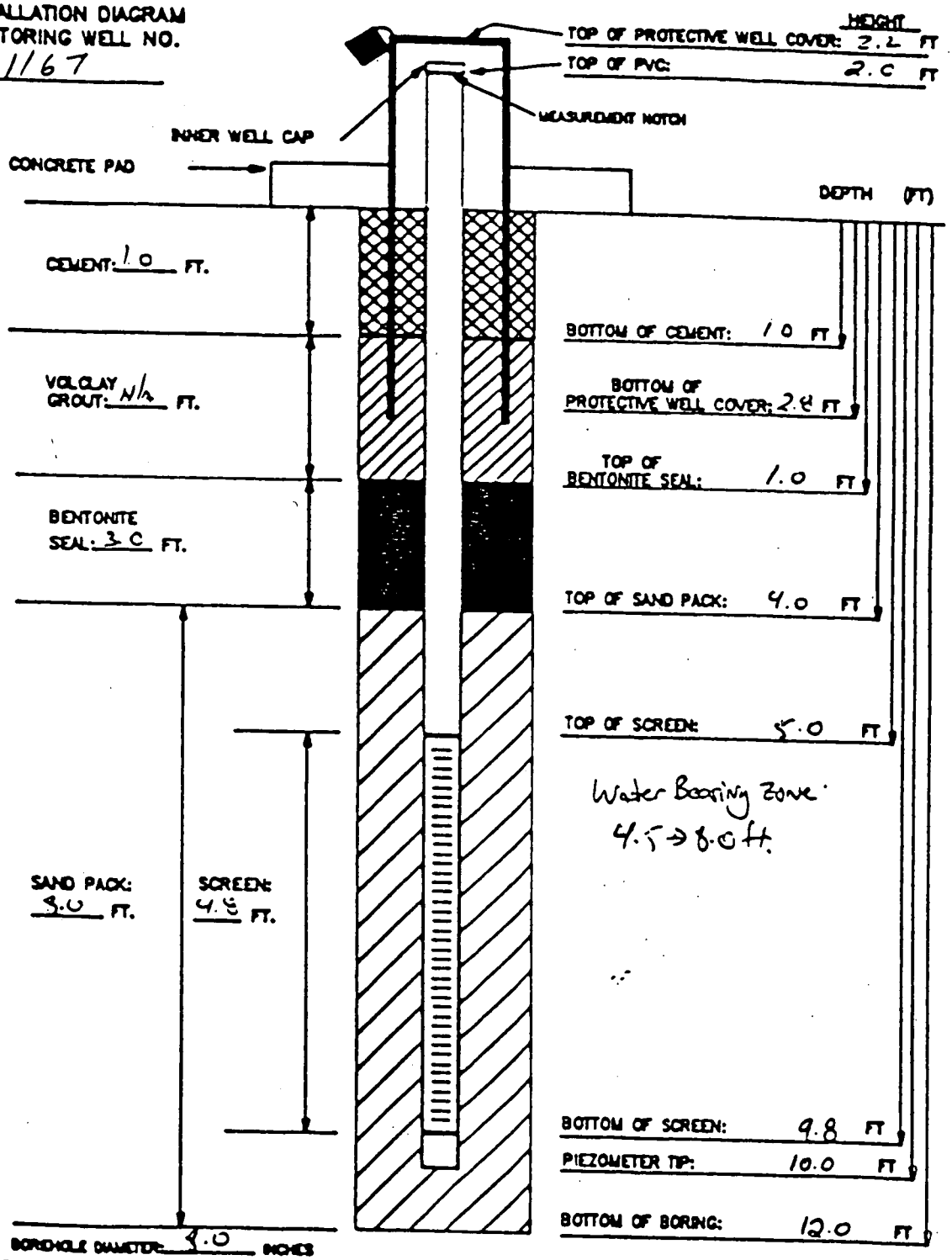
ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	2.0 Ft.		581.06	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	2.8 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
Bentonite Pellets	1.0	4.0	N/A	N/A
Sand	4.0	10.0	N/A	N/A
PERFORATED SECTION	5.0	9.8	N/A	N/A
WELL TIP	10.0		N/A	
BOTTOM OF BOREHOLE	12.0		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1167

INSTALLATION DATE: 5-3-89



MATERIALS USED:
SAND TYPE AND QUANTITY: 2½ Bags 10/20 80lb Bags
BENTONITE PELLETS (5-GALLON BUCKETS): 2
BAGS OF VOLCLAY GROUT: ~1/2
AMOUNT OF CEMENT: 1 Bag (94 lb)
AMOUNT OF WATER USED: 10 gallons
OTHER: Protective Cover.

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602 3.7.1

GEOLOGIST/ENGINEER: L. Sinfield

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS 3637	
BORING NUMBER: 1167	COORDINATES: NORTH 480,022.72 EAST 1,380,741.19	DATE: 05/03/89
GROUND ELEVATION: 579.29	GWL: Depth N/A Date/Time N/A	DATE STARTED: 05/03/89
ENGINEER/GEOLOGIST: L. SINFIELD	Depth N/A Date/Time N/A	DATE COMPLETED: 05/03/89
DRILLING METHODS: B-53, HOLLOW STEM AUGER WITH SPLIT SPOON		PAGE 1 OF 2

DEPTH	SAMPLE	DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
0.5	16353 05/03/89 0907		7	8	LOOSE TO MEDIUM DENSE GRAVEL GM WITH SILT AND SAND.	GM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 800 cpm
1.0	16354 05/03/89 0907		12	8	LOOSE TO MEDIUM DENSE GRAVEL GM WITH SILT AND SAND.	GM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 800 cpm
1.5	16355 05/03/89 0907		13		NO RECOVERY.			
2.0	16356 05/03/89 0910		4	9	VERY STIFF, BROWNISH YELLOW (10 YR 6/6) LEAN CLAY, CL-DRY, MOTTLED, MEDIUM PLASTIC, MASSIVE WITH SAND AND SILT.	CL	2.1	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
2.5	16357 05/03/89 0910		4	9	VERY STIFF, BROWNISH YELLOW (10 YR 6/6) LEAN CLAY, CL-DRY, MOTTLED, MEDIUM PLASTIC, MASSIVE WITH SAND AND SILT.	CL	2.1	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
3.0	16358 05/03/89 0910		6		NO RECOVERY.			
3.5	16359 05/03/89 0910		4		NO RECOVERY.			
4.0	16360 05/03/89 0910		5		NO RECOVERY.			
4.5	16361 05/03/89 0912		3	6	VERY STIFF, BROWNISH YELLOW (10 YR 6/6) LEAN CLAY, CL-DRY, MOTTLED, MEDIUM PLASTIC, MASSIVE WITH SAND AND SILT, MOIST AT	CL	2.1	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
5.0	16362 05/03/89 0915		1	12	VERY SOFT, LEAN CLAY WITH GRAY SAND AND GRAVEL, SATURATED WITH H2O, VERY PLASTIC, MASSIVE.	CL	0.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm
5.5	16363 05/03/89 0915			12	VERY SOFT, LEAN CLAY WITH GRAY SAND AND GRAVEL, SATURATED WITH H2O, VERY PLASTIC, MASSIVE.	CL	0.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm
6.0	16364 05/03/89 0915				NO RECOVERY.			
6.5	16365 05/03/89 0915		1	8	NO RECOVERY.			
7.0	16366 05/03/89 1015		1	8	VERY SOFT, LEAN CLAY WITH GRAY SAND AND GRAVEL, SATURATED WITH H2O, VERY PLASTIC, MASSIVE.	CL	0.0	Hnu= 1 ppm α = 0 cpm βΓ = 100-120cpm
7.5	16367 05/03/89 1015		2	8	VERY SOFT, LEAN CLAY WITH GRAY SAND AND GRAVEL, SATURATED WITH H2O, VERY PLASTIC, MASSIVE.	CL	0.0	Hnu= 1 ppm α = 0 cpm βΓ = 100-120cpm
8.0	16368 05/03/89 1020		4	12	SLOUGH - GRAVEL, MOIST, LOOSE WITH SILT.	CL	1.5	Hnu= 0 ppm α = 0 cpm βΓ = 60-100 cpm

NOTES:

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VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1167	COORDINATES: NORTH 480,022.72 EAST 1,380,741.19	DATE: 05/03/89
GROUND ELEVATION: 579.29	GWL: Depth N/A Date/Time N/A	DATE STARTED: 05/03/89
ENGINEER/GEOLOGIST: L. SINFIELD	Depth N/A Date/Time N/A	DATE COMPLETED: 05/03/89
DRILLING METHODS: B-53, HOLLOW STEM AUGER WITH SPLIT SPOON		PAGE 2 OF 2

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	16369 05/03/89 1020	4	12	STIFF, BROWNISH YELLOW (10 YR 6/6) MOTTLED LEAN CLY, CL-DRY MEDIUM PLASTIC, MASSIVE.	CL	1.5	Hnu= 0 ppm α = 0 cpm βΓ = 60-100 cpm
9.0	16370 05/03/89 0915	7		NO RECOVERY.			
9.5	16371 05/03/89 1030	7	18	SOFT LIGHT OLIVE BROWN (2.5 Y 5/4) CLAY, CL-MOIST, MASSIVE, VERY PLASTIC.	CL	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm
10.0	16372 05/03/89 1030	5	18	SOFT, LIGHT OLIVE BROWN (2.5 Y 5/4) CLAY, CL-MOIST, MASSIVE, VERY PLASTIC. VERY STIFF, BROWNISH YELLOW (10 YR 6/6) LEAN CLAY, CL-SOME SILT, DRY, MASSIVE, MEDIUM PLASTIC.	CL CL	NA NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm
10.5	16373 05/03/89 1030	4	18	VERY STIFF, BROWNISH YELLOW (10 YR 6/6) LEAN CLAY, CL-SOME SILT, DRY, MASSIVE, MEDIUM PLASTIC.	CL	3.2	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm
11.0	16374 05/03/89 1040	6	18	HARD, BROWNISH YELLOW (10 YR 6/6) LEAN CLAY, CL-DRY, MASSIVE, MEDIUM PLASTIC, RARE GRAVEL, SOME SILT.	CL	>4.5	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
11.5	50647 05/03/89 1040	9	18	HARD, BROWNISH YELLOW (10 YR 6/6) LEAN CLAY, CL-DRY, MASSIVE, MEDIUM PLASTIC, RARE GRAVEL, SOME SILT.	CL	>4.5	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
12.0	50648 05/03/89 1040	12	18	HARD, BROWNISH YELLOW (10 YR 6/6) LEAN CLAY, CL-DRY, MASSIVE, MEDIUM PLASTIC, RARE GRAVEL, SOME SILT.	CL	>4.5	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm

BOTTOM OF BORING 12.0

NOTES:

FIELD PERMEABILITY TESTS
FALLING HEAD*

1167

3637

PROJECT Fernald RI/FS
PROJECT NO. 60.2 3.7
BORING NO. 1167

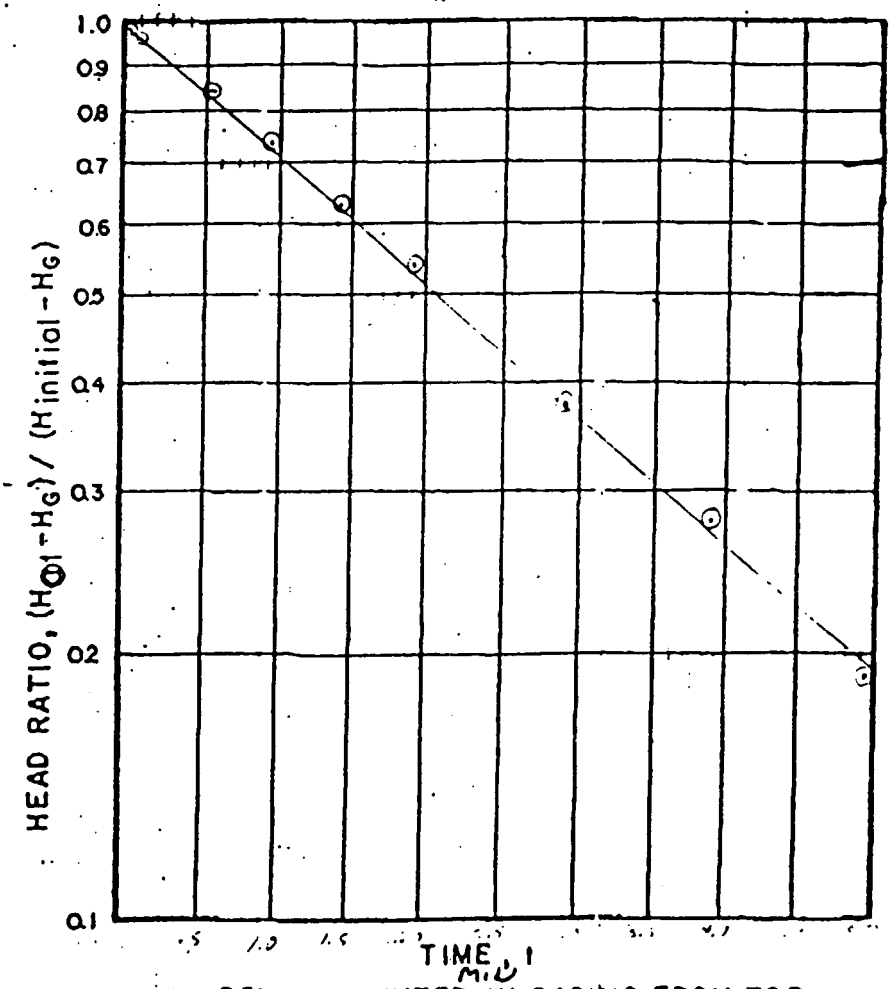
TESTED BY CG/CM DATE 03/02/91
CALCULATED BY CG DATE 03/12/91
CHECKED BY _____ DATE _____

RADIUS OF WELL, r = 1.0 in = 0.0833 FT
RADIUS OF TEST BORING, R = 4.0 in = .3333 FT
HEIGHT OF CASING (REF. LEVEL)
ABOVE GROUND SURFACE, H_C 2.2 FT
DEPTH TO BOTTOM OF TEST POCKET, L_1 9.8 FT
DEPTH TO TOP OF TEST POCKET, L_2 5.0 FT
DEPTH TO GROUNDWATER TABLE
FROM TOP OF CASING, H_G 6.07 FT

HYDRAULIC CONDUCTIVITY, K 1.074×10^{-5} FT/sec

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t SEC/MIN	DEPTH TO WATER IN CASING H FEET
0.000	5.[illegible]
0.008	[illegible]
0.050	[illegible]
0.100	5.[illegible]
0.133	[illegible]
0.183	[illegible]
0.350	[illegible]
0.517	[illegible]
0.683	[illegible]
0.933	[illegible]
1.183	[illegible]
1.433	[illegible]
1.767	[illegible]
1.933	[illegible]
2.933	[illegible]
3.933	[illegible]
4.933	[illegible]
6.933	5.9[illegible]
9.433	[illegible]
10.933	[illegible]
12.933	[illegible]
14.933	[illegible]



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1
H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

≈ 1615

FIELD PERMEABILITY TESTS
FALLING HEAD*

Field Copy 3637

PROJECT Fernald RI/FS — TESTED BY CG/CM — DATE 03/02/91
PROJECT NO. 6023.7 — CALCULATED BY ____ — DATE ____
BORING NO. 1167 — CHECKED BY ____ — DATE ____

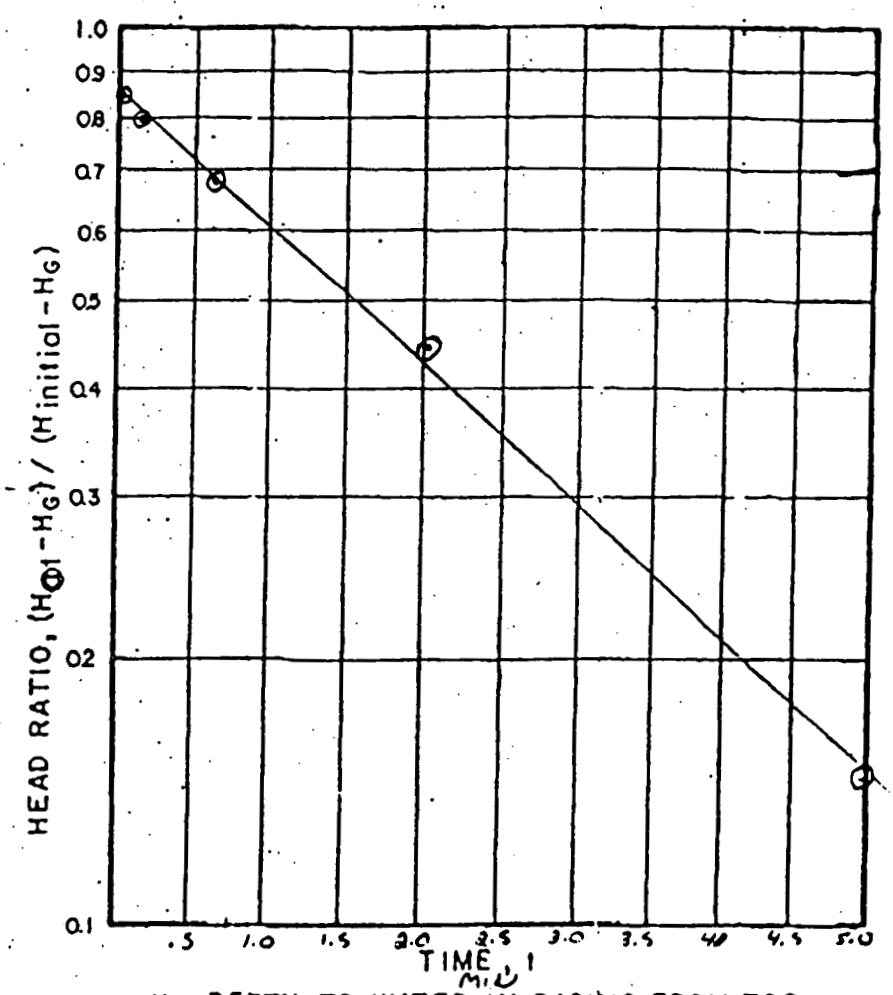
RADIUS OF WELL, r 0.0833
RADIUS OF TEST BORING, R 0.333
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C 2.2
DEPTH TO BOTTOM OF TEST POCKET, L_1 9.8
DEPTH TO TOP OF TEST POCKET, L_2 5.0
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 6.088

HYDRAULIC CONDUCTIVITY, K ____

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

Initial WL - 6.07 FT (5.498)

ELAPSED TIME t SEC/MIN	DEPTH TO WATER IN CASING H FEET
0.0 (0.025)	4.959
0.0583	5.231
0.0666	5.111
0.0750	5.142
0.0833	5.155
0.0916	5.149
0.1000	5.155
0.1083	5.161
0.1250	5.168
0.1416	5.174
0.1583	5.174
0.1750	5.180
0.1916	5.186
0.2083	5.193
0.2250	5.199
0.2416	5.205
0.2583	5.212
0.2750	5.218
0.3083	5.224
0.3250	5.231
0.3416	5.237
0.4416	5.262
0.5250	5.287
0.6083	5.306
0.6916	5.330
0.7750	5.350
0.8583	5.369



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

1.0250	5.407
1.1083	5.426
1.2750	5.458
1.4416	5.489
1.5250	5.502
1.6916	5.538
1.8583	5.559
2.0250	[illegible]

3.0250	5.729
4.0250	5.824
5.0250	5.906
6.0250	5.956
7.0250	5.994
8.0250	6.006
9.0250	6.025
10.0250	6.051
11.0250	6.070
12.0250	6.076
13.0250	6.079

IT CORPORATION

By [illegible] Date [illegible] Subject Slug Test # 5 Sheet No. ___ of ___

Chkd. By ___ Date ___ Hydraulic Conductivity Calculations for [illegible] Proj. No. [illegible]

$$(HR)\ \text{Head RATIO} = \frac{H_{@t} - H_G}{H_i - H_G}$$

Where: H_G = Depth to Groundwater below TOC before slug was added

H_i = Initial Depth to Groundwater below TOC after slug is added

$H_{@t}$ = Depth to Groundwater below TOC at time = t

HR

0.050 min: $\frac{5.174 - 6.07}{5.149 - 6.07} = \frac{.896}{.921} = .973$

$H_1 \rightarrow$ 0.100 min: $\frac{[illegible] - 6.07}{5.149 - 6.07} = \frac{.884}{.921} = .960$

0.517 min: $\frac{5.306 - 6.07}{5.149 - 6.07} = \frac{.764}{.921} = .830$

0.933 min: $\frac{5.407 - 6.07}{5.149 - 6.07} = \frac{.663}{.921} = .720$

1.433 min: $\frac{5.502 - 6.07}{5.149 - 6.07} = \frac{.568}{.921} = .617$

1.933 min: $\frac{5.5[illegible] - 6.07}{5.149 - 6.07} = \frac{.480}{.921} = .521$

$H_2 \rightarrow$ 2.933 min: $\frac{5.729 - 6.07}{5.149 - 6.07} = \frac{.341}{.921} = .370$

3.933 min: $\frac{5.824 - 6.07}{5.149 - 6.07} = \frac{.246}{.921} = .267$

4.933 min: $\frac{5.906 - 6.07}{5.149 - 6.07} = \frac{.164}{.921} = .178$

$$\text{Hydraulic Conductivity} = K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

$$K = \frac{(0.0833)^2}{2(9.8 - 5.0)(2.933 - 0.100)} \ln\left[\frac{9.8 - 5.0}{333}\right] \ln\left[\frac{5.186 - 6.07}{5.729 - 6.07}\right]$$

$$K = \frac{(0.0069)}{2(9.8)(2.833)} \ln\left[14.401\right] \ln\left[\frac{.884}{.921}\ 2.592\right]$$

$K = (2.537 \times 10^{-4})(2.667)(.952)$

$K = 6.441 \times 10^{-4}$ FT/min

$K = 1.074 \times 10^{-5}$ FT/sec

$K = 0.928$ FT/day

Bailing/Piezometer 1167

SE2000
Environmental Logger
03/04 12:08

3637

[illegible]t# 0000000 Test# 5

INPUT 1: Level (F) TOC

Reference	6.070
Scale factor	19.982
Offset	0.018
SG	1.000

Step 0 03/02 16:12:07

Elapsed Time		Value
0.0000		2.197
0.0083		5.760
0.0166		5.250
0.0250		4.959
0.0333		5.231
0.0416		5.111
0.0500		5.142
0.0583		5.155
0.0666	0.0000	5.149
0.0750	0.0084	5.155
0.0833		5.161
0.1000		5.168
0.1166	[illegible]	5.174
0.1333		5.174
0.1500		5.180
0.1666	[illegible]	5.186
0.1833		5.193
0.2000	[illegible]	5.199
0.2166		5.205
0.2333		5.212
0.2500	[illegible]	5.218
0.2666		5.218
0.2833		5.224
0.3000		5.231
0.3166		5.237
0.3333		5.237
0.4166	[illegible]	5.262
0.5000		5.287
0.5833	[illegible]	5.306
0.6666		5.332
0.7500	[illegible]	5.350
0.8333		5.369
0.9166		5.388
1.0000	.9331	5.407
1.0833		5.426
1.1666		5.439
1.2500	1.1833	5.458
1.3333		5.470
[illegible].4166		5.489
[illegible].5000	1.4331	5.502
1.5833		5.521
1.6666		5.533
1.7500		5.546
1.8333	.7467	5.559
1.9166		5.571
2.0000	1.9336	5.590

2.5000		5.590
3.0000	2.9334	5.729
3.5000		5.779
4.0000	3.9334	5.824
4.5000		5.868
5.0000	4.9334	5.906
5000		5.931
0000		5.956
.5000		5.975
7.0000	[illegible]	5.994
7.5000		6.006
8.0000		6.025
8.5000		6.032
9.0000		6.044
9.5000	9.4334	6.051
10.0000		6.057
11.0000	10.9334	6.070
12.0000		6.076
13.0000	12.933[illegible]	6.076
14.0000		6.082
15.0000	14.9334	6.088
16.0000		6.088
17.0000		6.088

END

3637

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1185
WELL NUMBER: 1185

FIELD ENG./GEO.: C. GRUBE DATE: 10/25/89
CHECKED BY : BD DATE: 10/31/89
N,E COORDINATES: 480688.28, 1380471.8
DATE OF INSTAL.: 10/25/89

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: HOLLOW AUGER
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING PIEZOMETE
CASING DIAM.: 2.0 In. ID
CASING SIZE(S) USED: (Units N/A)
SIZE: N/A FROM: N/A TO: N/A
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: 0.020 (In.)
TOTAL PERFORATED AREA: 5.0 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: SCHEDULE 40 PVC
RISER PIPE DIAMETERS:
O.D.: 2 5/16 In. I.D.: 2.0 In.
LENGTH OF 1ST PIPE SECTION: 10.0 Ft.
2ND PIPE SECTION: 6.0 Ft.
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: SCREW TYPE - FLUSH JOINT THREADED

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5.0 Ft.
PROTECTIVE PIPE O.D.: 4 3/ In.
• HINGED PROTECTIVE COVER WITH I

OTHER PROTECTION (* NOTED BELOW)

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE	ELEVATION MSL
TOP OF RISER PIPE	2.0 Ft.	581.40
GROUND SURFACE	0.0	579.5
BOTTOM OF PROTECTIVE PIPE	2.7 Ft.	

BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
	0.0	1.0	N/A	N/A
Bentonite Pellets	1.0	9.0	N/A	N/A
Sand	9.0	20.0	N/A	N/A
PERFORATED SECTION	14.0	19.0	N/A	N/A

WELL TIP	19.0	N/A
BOTTOM OF BOREHOLE	20.0	N/A
GWL AFTER INSTALLATION	N/A	N/A

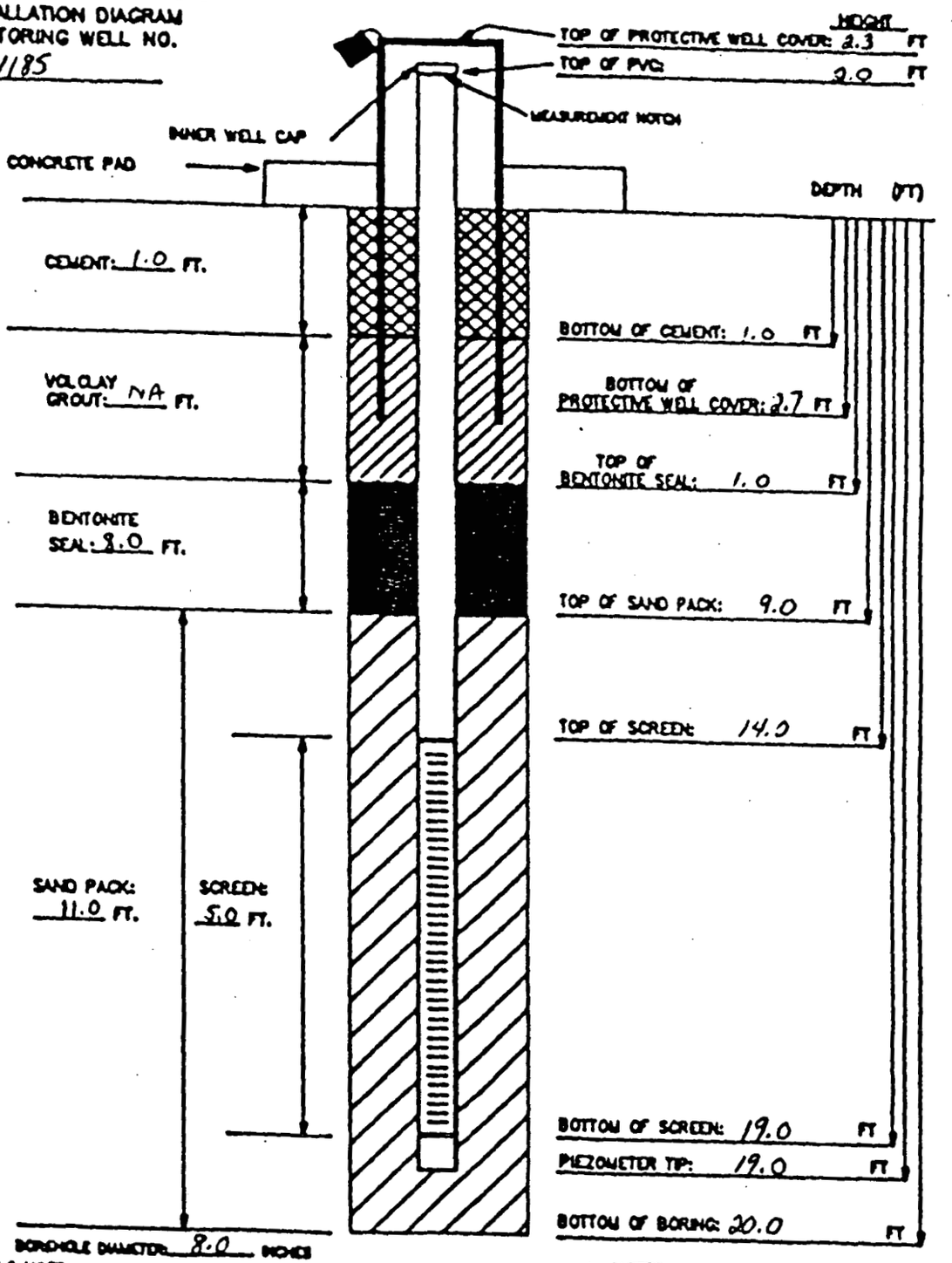
WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

3637

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1185

INSTALLATION DATE: 10-25-89



MATERIALS USED:
SAND TYPE AND QUANTITY: 10/20 sand - 2 sac (80#)
BENTONITE PELLETS (5-GALLON BUCKETS): 3 buckets
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: ½ (94#) sk
AMOUNT OF WATER USED: 10 gal
OTHER: 5.0 FT Protective casing w/cover

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602 3.7

GEOLOGIST/ENGINEER: C. Grube

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1185	COORDINATES: NORTH 480,688.28 EAST 1,380,471.80	DATE: 10/24/89
GROUND ELEVATION: 579.5	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/24/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 10/25/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
0.5	16639 10/24/89 1428	2	6	MEDIUM DENSE LIGHT OLIVE BROWN (2.5 Y 5/4) GRAVEL, DRY.	GC	NA	Hnu= 0 ppm α = 0 cpm βΓ = 650-700cpm
1.0	16640 10/24/89 1428	5	6	MEDIUM DENSE (2.5 Y 4/4) OLIVE BROWN CLAYEY SILT DRY.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 650-700cpm
1.5	16641 10/24/89 1428	7		NO RECOVERY.			
2.0	16642 10/24/89 1434	6	6	MEDIUM DENSE (2.5 Y 6/4) LIGHT YELLOWISH BROWN SILT, VERY MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 150-160cpm
2.5	16643 10/24/89 1434	6		NO RECOVERY.			
3.0	16644 10/24/89 1434	5		NO RECOVERY.			
3.5	16645 10/24/89 1436	5	6	STIFF (5 Y 4/1) DARK GRAY CLAY TRACE OF SILT MEDIUM PLASTICITY, MOIST.	CL	1.25	Hnu= 0 ppm α = 0 cpm βΓ = 150-160cpm
4.0	16646 10/24/89 1436	3	6	VERY SOFT (5 Y 4/3) OLIVE CLAY, MEDIUM PLASTICITY MOIST.	CL	<.25	Hnu= 0 ppm α = 0 cpm βΓ = 150-160cpm
4.5	16647 10/24/89 1436	7	2	VERY SOFT (5 Y 4/3) OLIVE CLAY, MEDIUM PLASTICITY MOIST.	CL	<.25	Hnu= 0 ppm α = 0 cpm βΓ = 150-160cpm
5.0	16648 10/24/89 1440	4	6	VERY SOFT (5 Y 4/3) OLIVE CLAY, MEDIUM PLASTICITY MOIST.	CL	<.25	Hnu= 0 ppm α = 0 cpm βΓ = 140-150cpm
5.5	16649 10/24/89 1440	3	6	STIFF (5 Y 4/3) OLIVE CLAY, MEDIUM PLASTICITY MOIST.	CL	1.0	Hnu= 0 ppm α = 0 cpm βΓ = 140-150cpm
6.0	16650 10/24/89 1440	4	3	STIFF (5 Y 4/3) OLIVE CLAY, MEDIUM PLASTICITY MOIST.	CL	1.25	Hnu= 0 ppm α = 0 cpm βΓ = 140-150cpm
6.5	16651 10/24/89 1503	3	6	STIFF (5 Y 4/3) OLIVE CLAY, MEDIUM PLASTICITY MOIST.	CL	1.75	Hnu= 0 ppm α = 0 cpm βΓ = 100-110cpm
7.0	16652 10/24/89 1503	3	6	STIFF (5 Y 4/3) OLIVE CLAY, MEDIUM PLASTICITY MOIST.	CL	1.75	Hnu= 0 ppm α = 0 cpm βΓ = 100-110cpm
7.5	16653 10/24/89 1503	3	3	STIFF (5 Y 4/3) OLIVE CLAY, MEDIUM PLASTICITY MOIST.	CL	1.5	Hnu= 0 ppm α = 0 cpm βΓ = 100-110cpm
8.0	16654 10/24/89 1506	7	6	STIFF (5 Y 4/2) OLIVE GRAY SILTY CLAY, LOW PLASTICITY MOIST.	CL	1.0	Hnu= 0 ppm α = 0 cpm βΓ = 160-180cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

VISUAL CLASSIFICATION OF SOILS

3637

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1185	COORDINATES: NORTH 480,688.28 EAST 1,380,471.80	DATE: 10/24/89
GROUND ELEVATION: 579.5	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/24/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 10/25/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	16655 10/24/89 1506	6	6	LOOSE (5 Y 5/1) GRAY TO (2.5 Y 4/4) OLIVE BROWN CLAYEY SILT MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm BΓ = 160-180cpm
9.0	16656 10/24/89 1506	4		NO RECOVERY.			
9.5	16657 10/24/89 1510	5	6	LOOSE (5 Y 5/1) GRAY TO (2.5 Y 4/4) OLIVE BROWN CLAYEY SILT MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm BΓ = 140-150cpm
10.0	16658 10/24/89 1510	5	6	LOOSE (5 Y 5/1) GRAY TO (2.5 Y 4/4) OLIVE BROWN CLAYEY SILT MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm BΓ = 140-150cpm
10.5	16659 10/24/89 1510	4		NO RECOVERY.			
11.0	16660 10/24/89 1523	4	6	LOOSE (2.5 Y 5/6) LIGHT OLIVE GRAY TO (5 Y 5/2) OLIVE GRAY CLAY SILT TO SILT, MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm BΓ = 130-140cpm
11.5	51775 10/24/89 1523	5	6	LOOSE (2.5 Y 5/6) LIGHT OLIVE GRAY TO (5 Y 5/2) OLIVE GRAY CLAY SILT TO SILT, MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm BΓ = 130-140cpm
12.0	51776 10/24/89 1523	5	6	LOOSE (2.5 Y 5/6) LIGHT OLIVE GRAY TO (5 Y 5/2) OLIVE GRAY CLAY SILT TO SILT, MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm BΓ = 130-140cpm
12.5	51777 10/24/89 1526	5	6	LOOSE (2.5 Y 5/6) LIGHT OLIVE GRAY TO (5 Y 5/2) OLIVE GRAY CLAY SILT TO SILT, MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm BΓ = 140-150cpm
13.0	51778 10/24/89 1526	6	6	LOOSE (2.5 Y 5/4) LIGHT OLIVE BROWN SANDY SILT TRACE OF CLAY MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm BΓ = 140-150cpm
13.5	51779 10/24/89 1526	4	5	LOOSE (5 Y 5/1) GRAY, SILT, MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm BΓ = 140-150cpm
14.0	51780 10/24/89 1538	3	6	MEDIUM DENSE (5 Y 5/1) GRAY TO (2.5 Y 4/4) LIGHT OLIVE BROWN CLAYEY SILT MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm BΓ = 150-160cpm
14.5	51781 10/24/89 1538	4	6	MEDIUM DENSE (5 Y 5/1) GRAY TO (2.5 Y 4/4) LIGHT OLIVE BROWN CLAYEY SILT MOIST. MEDIUM DENSE (5 Y 4/2) OLIVE GRAY POORLY GRADED SAND, SOME SILT, WET.	ML SP	NA NA	Hnu= 0 ppm α = 0 cpm BΓ = 150-160cpm
15.0	51782 10/24/89 1538	7	6	MEDIUM DENSE (5 Y 4/2) OLIVE GRAY POORLY GRADED SAND, SOME SILT, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm BΓ = 150-160cpm
15.5	51783 10/24/89 1544	3	6	MEDIUM DENSE (2.5 Y 4/2) OLIVE GRAY POORLY GRADED SAND, SOME SILT WET.	SP	NA	Hnu= 0 ppm α = 0 cpm BΓ = 150-160cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

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VISUAL CLASSIFICATION OF SOILS

3637

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1185	COORDINATES: NORTH 480,688.28 EAST 1,380,471.80	DATE: 10/24/89
GROUND ELEVATION: 579.5	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/24/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 10/25/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 3

DEPTH	SAMPLE	DATE	TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.0	51784	10/24/89	1544	10	6	MEDIUM DENSE (5 Y 4/2) OLIVE GRAY WELL GRADED SAND, TRACE OF FINE GRAVEL, WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 150-160cpm
16.5	51785	10/24/89	1544	11	5	MEDIUM DENSE (5 Y 4/2) OLIVE GRAY WELL GRADED SAND, TRACE OF FINE GRAVEL, WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 150-160cpm
17.0	51786	10/24/89	1549	4	6	MEDIUM DENSE (5 Y 4/2) OLIVE GRAY WELL GRADED SAND, TRACE OF FINE GRAVEL, WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 130-140cpm
17.5	51787	10/24/89	1549	9	6	MEDIUM DENSE (5 Y 4/2) OLIVE GRAY WELL GRADED SAND, TRACE OF FINE GRAVEL, WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 130-140cpm
18.0	51788	10/24/89	1549	11	6	MEDIUM DENSE (5 Y 5/2) OLIVE GRAY CLAYEY SILT, VERY MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 130-140cpm
18.5	51789	10/24/89	1600	5	6	MEDIUM DENSE (5 Y 4/3) OLIVE WELL GRADED SAND TRACE OF FINE GRAVEL, WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 110-120cpm
19.0	51790	10/24/89	1600	6	6	MEDIUM DENSE (5 Y 4/3) OLIVE WELL GRADED SAND TRACE OF FINE GRAVEL, WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 110-120cpm
19.5	51791	10/24/89	1600	10	6	STIFF, (5 Y 4/1) DARK GRAY SILTY CLAY, TRACE OF FINE GRAVEL, MEDIUM PLASTICITY, MOIST.	CL	1.25	Hnu= 0 ppm α = 0 cpm βΓ = 110-120cpm
20.0	51792	10/24/89	1600	12	5	STIFF, (5 Y 4/1) DARK GRAY SILTY CLAY, TRACE OF FINE GRAVEL, MEDIUM PLASTICITY, MOIST.	CL	1.25	Hnu= 0 ppm α = 0 cpm βΓ = 110-120cpm

BOTTOM OF BORING 20.0

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

1185

FIELD PERMEABILITY TESTS
FALLING HEAD*

3637

PROJECT FMPC RI/FS
PROJECT NO. 602 3.7.4
BORING NO. 1185

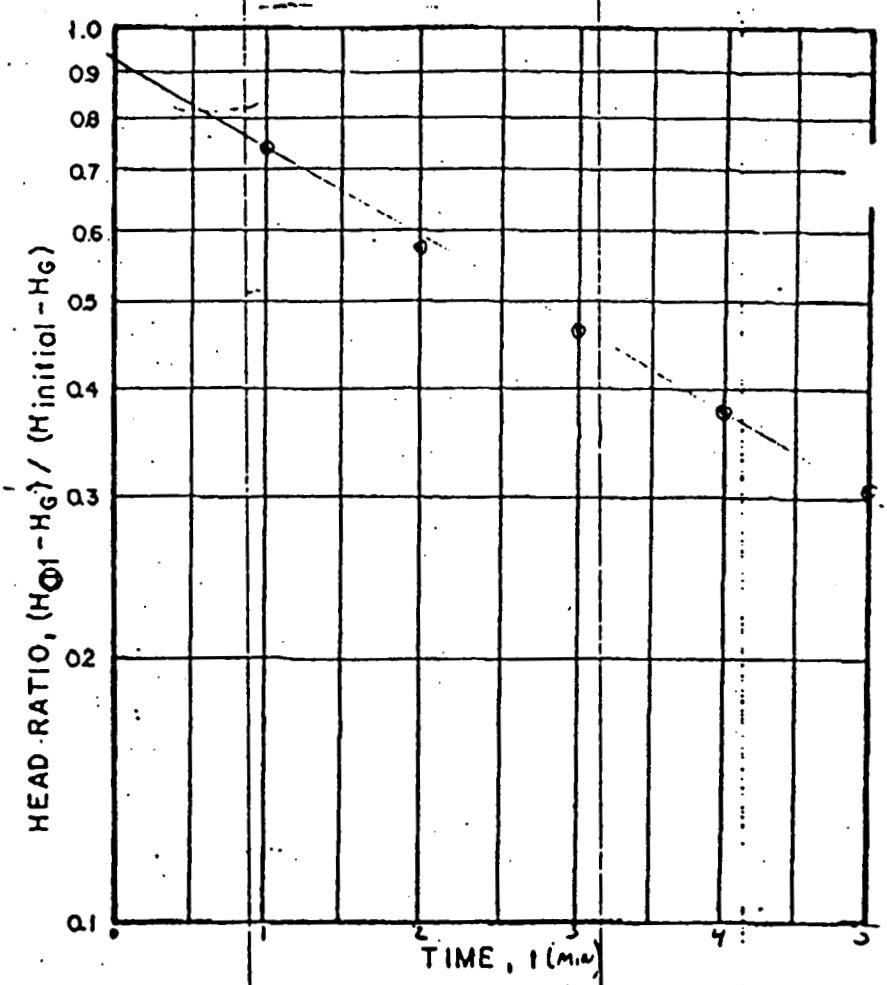
TESTED BY MS/BA DATE 8-02-90
CALCULATED BY MS DATE 10-20-90
CHECKED BY CG DATE 11/2/90 11/19/90

RADIUS OF WELL, ~~R~~ r = 1 IN = 0.0833 FT
RADIUS OF TEST BORING, R = 4 IN = .333 FT
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C 2.0 FT
DEPTH TO BOTTOM OF TEST POCKET, L_1 ~~19.0 FT~~ 21.0 FT
DEPTH TO TOP OF TEST POCKET, L_2 ~~10.26 FT~~ 16.0 FT
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 10.26 FT

HYDRAULIC CONDUCTIVITY, K ~~4.6×10⁻⁶ FT/SEC~~ ~~4.0×10⁻⁵ FT/SEC~~ MS 11-19-90 6.56×10^{-6} FT/SEC

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t ~~SEC~~ MIN	DEPTH TO WATER IN CASING H FEET
0	9.561
1	9.743
2	9.857
3	9.933
4	9.996
5	10.04
6	10.078
7	10.103
8	10.122
9	10.147
10	10.16
12	10.191
14	10.21
16	10.229
18	10.242
20	10.254
21	10.26



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1
H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

HYDRAULIC CONDUCTIVITY CALCULATIONS FOR 11BS

$$\text{HEAD RATIO} = \frac{H_{@t} - H_G}{H_i - H_G}$$

WHERE: H_G = DEPTH TO GROUND WATER BELOW TOC BEFORE SLUG IS ADDED

H_i = INITIAL DEPTH TO GROUND WATER BELOW TOC AFTER SLUG IS ADDED

$H_{@t}$ = DEPTH TO GROUND WATER BELOW TOC AT TIME = t

HR

1 min: $\frac{9.743 - 10.26}{9.561 - 10.26} = \frac{.517}{.699} = .740$

2 min: $\frac{9.857 - 10.26}{9.561 - 10.26} = \frac{.403}{.699} = .577$

3 min: $\frac{9.933 - 10.26}{9.561 - 10.26} = \frac{.327}{.699} = .468$

4 min: $\frac{9.996 - 10.26}{9.561 - 10.26} = \frac{.264}{.699} = .378$

5 min: $\frac{10.04 - 10.26}{9.561 - 10.26} = \frac{.220}{.699} = .315$

$$\text{HYDRAULIC CONDUCTIVITY} = K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

$$\Rightarrow K = \frac{(0.0833\,FT)^2}{2(\cancel{14.0 - 10.26})(5-1)} \ln\left[\frac{\cancel{14.0 - 10.26}\ 21-16}{.333}\right] \ln\left[\frac{9.743 - 10.26}{10.04 - 10.26}\right]$$

$$= \cancel{(0.00049)(3.268)(.854)}$$

$$= \cancel{2.73 \times 10^{-4}\ FT/MIN}$$

$$= \cancel{4.6 \times 10^{-6}\ FT/SEC}$$

$$= \cancel{2.76 \times 10^{-3}\ FT/MIN}$$

$$= \cancel{4.61 \times 10^{-5}\ FT/SEC}$$

MS 11-14-96

$$= (0.00017)(2.71)(.854)$$

$$= 3.94 \times 10^{-4}\ FT/MIN$$

$$= 6.56 \times 10^{-6}\ FT/SEC$$

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1186
WELL NUMBER: 1186

FIELD ENG./GEO.: T. SANTANGELO DATE: 07/01/89
CHECKED BY : BD DATE: 07/02/89
N,E COORDINATES: 480701.93, 1380533.3
DATE OF INSTAL.: 07/01/89

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: AUGER
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING PIEZOMETE
CASING DIAM.: 2.0 In. ID
CASING SIZE(S) USED: (Units N/A)
SIZE: NA FROM: N/A TO: N/A
SIZE: NA FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: 0.02 (In.)
TOTAL PERFORATED AREA: 5.0 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: SCHEDULE 40 PVC
RISER PIPE DIAMETERS:
O.D.: 2 5/16 In. I.D.: 2.0 In.
LENGTH OF 1ST PIPE SECTION: 5.5 Ft.
2ND PIPE SECTION: 10 Ft.
3RD PIPE SECTION: 1.7 Ft.
COMMENTS

RISER JOINING METHOD: SCREW TYPE - FLUSH JOINT THREADED

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5 Ft.
PROTECTIVE PIPE O.D.: 4 3/ In.
* HINGED PROTECTIVE COVER WITH I

OTHER PROTECTION (* NOTED BELOW)

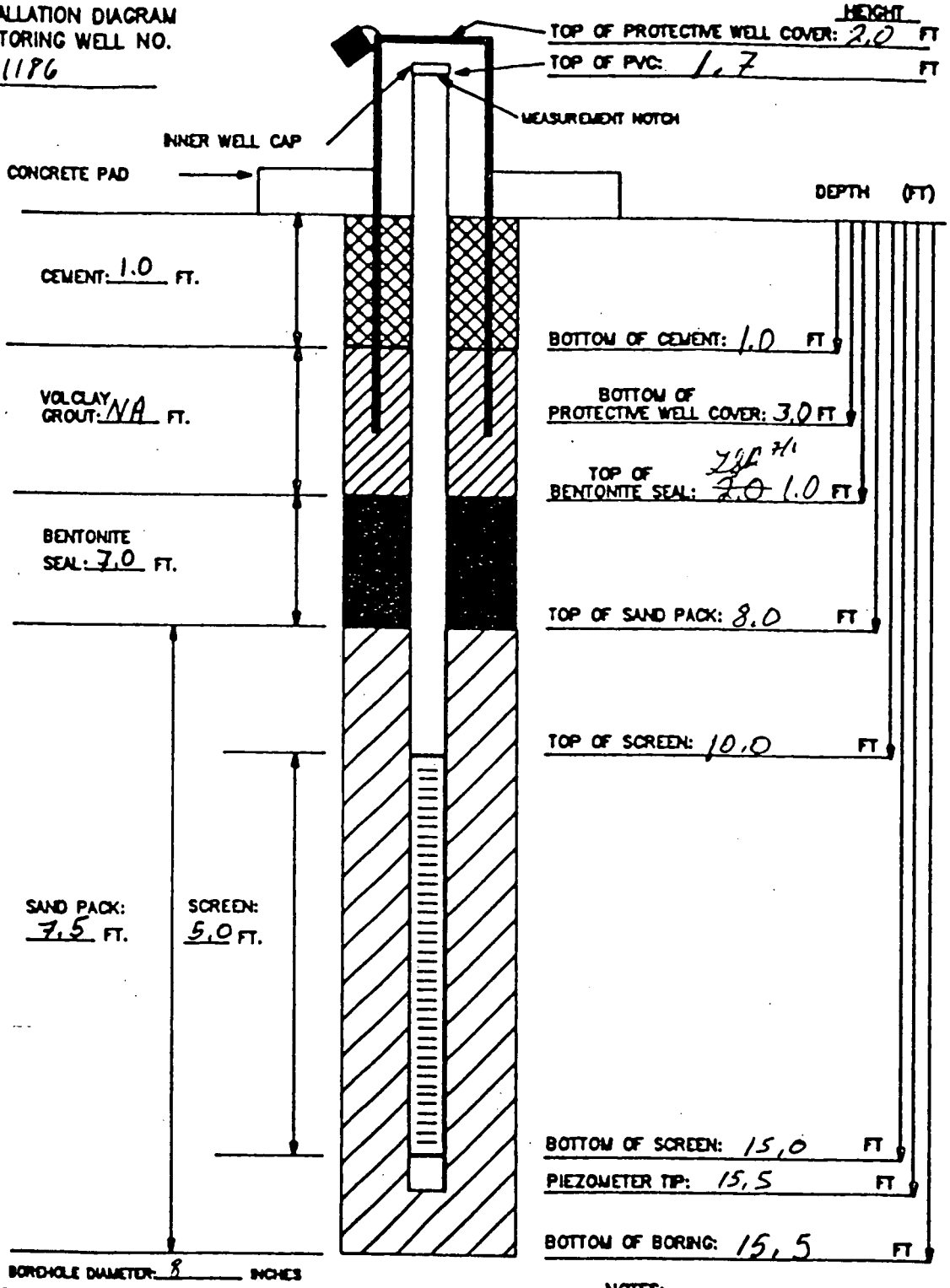
ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	1.7 Ft.		581.34	
GROUND SURFACE	0.0		579.5	
BOTTOM OF PROTECTIVE PIPE	3.0 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
	0.0	1.0	N/A	N/A
Bentonite Pellets	1.0	8.0	N/A	N/A
Sand	8.0	15.5	N/A	N/A
PERFORATED SECTION	10.0	15.0	N/A	N/A
WELL TIP	15.5		N/A	
BOTTOM OF BOREHOLE	18.0		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1186

INSTALLATION DATE: 7/1/89



BOREHOLE DIAMETER: 8 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY:
BENTONITE PELLETS (5-GALLON BUCKETS):
BAGS OF VOLCLAY GROUT:
AMOUNT OF CEMENT:
AMOUNT OF WATER USED:
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 3.7.1

GEOLOGIST/ENGINEER: T. Santangelo

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1186	COORDINATES: NORTH 480,701.93 EAST 1,380,533.38	DATE: 07/01/89
GROUND ELEVATION: 579.5	GWL: Depth N/A Date/Time N/A	DATE STARTED: 07/01/89
ENGINEER/GEOLOGIST: TSD	Depth N/A Date/Time N/A	DATE COMPLETED: 07/01/89
DRILLING METHODS: HOLLOW AUGER		PAGE 1 OF 3

DEPTH	SAMPLE	DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
0.5	16661	07/01/89 1008	14	6	DENSE (10 YR 4/3) DARK BROWN SAND SOME GRAVEL AND CLAY, DRY.	SC	NA	Hnu= 3 ppm α = 0 cpm βΓ = 120-140cpm
1.0	16662	07/01/89 1008	14	6	HARD (2.5 Y 5/4) LIGHT OLIVE BROWN SILTY CLAY SOME SAND, TRACE OF GRAVEL DRY, LOW PLASTICITY.	CL	>4.0	Hnu= 3 ppm α = 0 cpm βΓ = 120-140cpm
1.5	16663	07/01/89 1008	11	0	NO RECOVERY.			
2.0	16664	07/01/89 1010	11	6	HARD (2.5 Y 5/4) LIGHT OLIVE BROWN SILTY CLAY, SOME SAND, TRACE OF GRAVEL LOW PLASTICITY, MOIST.	CL	>4.0	Hnu= 6 ppm α = 0 cpm βΓ = 80-100 cpm
2.5	16665	07/01/89 1010	8	5	HARD (2.5 Y 5/4) LIGHT OLIVE BROWN SILTY CLAY, SOME SAND, TRACE OF GRAVEL LOW PLASTICITY, MOIST.	CL	3.5	Hnu= 6 ppm α = 0 cpm βΓ = 80-100 cpm
3.0	16666	07/01/89 1010	8	0	NO RECOVERY.			
3.5	16667	07/01/89 1013	7	6	STIFF (2.5 Y 5/4) LIGHT OLIVE BROWN SILTY CLAY SOME SAND, TRACE OF GRAVEL MED. PLASTICITY, MOIST.	CL	1.75	Hnu= 2 ppm α = 0 cpm βΓ = 100 cpm
4.0	16668	07/01/89 1013	6	2	SOFT (5 Y 4/1) DARK GRAY SILTY CLAY TRACE OF SAND AND GRAVEL, MED. PLASTICITY MOIST.	CL	0.5	Hnu= 2 ppm α = 0 cpm βΓ = 100 cpm
4.5	16669	07/01/89 1013	5	0	NO RECOVERY.			
5.0	16670	07/01/89 1016	3	6	STIFF (5 Y 4/1) DARK GRAY SILTY CLAY TRACE OF SAND, MED. PLASTICITY, MOIST.	CL	2.0	Hnu= 4 ppm α = 0 cpm βΓ = 100 cpm
5.5	16671	07/01/89 1016	2	4	STIFF (5 Y 4/1) DARK GRAY SILTY CLAY TRACE OF SAND, MED. PLASTICITY, MOIST.	CL	1.5	Hnu= 4 ppm α = 0 cpm βΓ = 100 cpm
6.0	16672	07/01/89 1016	3	0	NO RECOVERY.			
6.5	16673	07/01/89 1034	3	6	MED. STIFF (2.5 Y 5/4) LIGHT OLIVE BRWON SANDY CLAY, TRACE OF GRAVEL, MED. PLASTICITY MOIST.	CL	0.75	Hnu= 1 ppm α = 0 cpm βΓ = 120 cpm
7.0	16674	07/01/89 1034	5	6	STIFF (2.5 Y 4/4) OLIVE BROWN SILTY CLAY TRACE OF SAND, MED PLASTICITY, MOIST.	CL	1.75	Hnu= 1 ppm α = 0 cpm βΓ = 120 cpm
7.5	16675	07/01/89 1034	8	3	VERY STIFF (2.5 Y 4/4) OLIVE BROWN SILTY CLAY TRACE OF SAND, MED PLASTICITY, MOIST.	CL	4.0	Hnu= 1 ppm α = 0 cpm βΓ = 120 cpm
8.0	16676	07/01/89 1041	7	6	STIFF (2.5 Y 6/8) OLIVE YELLOW (5 Y 5/1) GRAY MOTTLED SILTY CLAY, TRACE OF SAND MED PLASTICITY MOIST.	CL	1.75	Hnu= 1 ppm α = 0 cpm βΓ = 140-160cpm

NOTES:
SAMPLES COLLECTED AS PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED BY MUNSELL COLOR CHART.

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1186	COORDINATES: NORTH 480,701.93 EAST 1,380,533.38	DATE: 07/01/89
GROUND ELEVATION: 579.5	GWL: Depth N/A Date/Time N/A	DATE STARTED: 07/01/89
ENGINEER/GEOLOGIST: TSD	Depth N/A Date/Time N/A	DATE COMPLETED: 07/01/89
DRILLING METHODS: HOLLOW AUGER		PAGE 2 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	16677 07/01/89 1041	7	6	VERY STIFF (2.5 Y 6/8) OLIVE YELLOW (5 Y 5/1) GRAY MOTTLED SILTY CLAY TRACE OF SAND MED PLASTICITY MOIST.	CL	3.5	Hnu= 1 ppm α = 0 cpm βΓ = 140-160cpm
9.0	16678 07/01/89 1041	8	1	VERY STIFF (2.5 Y 6/8) OLIVE YELLOW (5 Y 5/1) GRAY MOTTLED SILTY CLAY TRACE OF SAND MED PLASTICITY MOIST.	CL	2.75	Hnu= 1 ppm α = 0 cpm βΓ = 140-160cpm
9.5	16679 07/01/89 1050	7	6	VERY STIFF (2.5 Y 6/8) OLIVE YELLOW (5 Y 5/1) GRAY MOTTLED SILTY CLAY TRACE OF SAND MED PLASTICITY MOIST.	CL	2.75	Hnu= 0 ppm α = 1 cpm βΓ = 120-140cpm
10.0	16680 07/01/89 1050	7	6	VERY STIFF (2.5 Y 6/8) OLIVE YELLOW (5 Y 5/1) GRAY MOTTLED SILTY CLAY TRACE OF SAND MED PLASTICITY MOIST. VERY STIFF (10 YR 5/3) BROWN SANDY SILT WET.	CL ML	2.75 2.75	Hnu= 0 ppm α = 1 cpm βΓ = 120-140cpm
10.5	16681 07/01/89 1050	9	3	VERY STIFF (10 YR 5/3) BROWN CLEAN FINE SAND SEAM SILT WET.	ML	2.25	Hnu= 0 ppm α = 1 cpm βΓ = 120-140cpm
11.0	16682 07/01/89 1058	3	6	MED. STIFF (5 Y 5/2) OLIVE GRAY SILTY CLAY SOME SAND, MED. PLASTICITY MOIST.	CL	1.0	Hnu= 1 ppm α = 0 cpm βΓ = 100-120cpm
11.5	51795 07/01/89 1058	5	3	STIFF (5 Y 5/2) OLIVE GRAY SILTY CLAY SOME SAND, MED. PLASTICITY MOIST. MED. DENSE (2.5 Y 5/4) LIGHT OLIVE BROWN SILTY FINE SAND VERY MOIST.	CL SM	1.0 1.0	Hnu= 1 ppm α = 0 cpm βΓ = 100-120cpm
12.0	51796 07/01/89 1058	7	0	NO RECOVERY.			
12.5	51797 07/01/89 1127	8	6	MED. DENSE (5 Y 5/2) OLIVE GRAY SANDY SILT, WET.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 140-120cpm
13.0	51798 07/01/89 1127	6	6	MED. DENSE (2.5 Y 5/4) LIGHT OLIVE BROWN SILTY SAND, WET, W/ 1" CLEAN FINE SAND AT THE BOTTOM.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 140-120cpm
13.5	51799 07/01/89 1127	11	4	MED. DENSE (2.5 Y 5/4) LIGHT OLIVE BROWN FINE-MED. SAND, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 140-120cpm
14.0	51800 07/01/89 1140	10	6	DENSE (2.5 Y 4/2) DARK GRAYISH BROWN FINE TO MED. SAND, SOME CLAY, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
14.5	51801 07/01/89 1140	10	6	DENSE (2.5 Y 4/2) DARK GRAYISH BROWN FINE TO MED. SAND, SOME CLAY, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
15.0	51802 07/01/89 1140	12	6	DENSE (2.5 Y 5/4) LIGHT OLIVE BROWN SILTY SAND WET. DENSE (2.5 Y 5/4) LIGHT OLIVE BROWN FINE TO MED. SAND SOME SILT, TRACE OF CLAY WET.	SM SP	NA NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
15.5	51803 07/01/89 1212	6	6	MED. STIFF (2.5 Y 5/4) LIGHT OLIVE BROWN SILTY CLAY SOME SAND, MED. PLASTICITY, MOIST. MED. STIFF, (2.5 Y 5/2) GRAYISH BROWN SANDY CLAY TRACE OF GRAVEL, MOIST.	CL CL	0.75 0.75	Hnu= 0 ppm α = 0 cpm βΓ = 120-140cpm

NOTES:
SAMPLES COLLECTED AS PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED BY MUNSELL COLOR CHART.

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1186	COORDINATES: NORTH 480,701.93 EAST 1,380,533.38	DATE: 07/01/89
GROUND ELEVATION: 579.5	GWL: Depth N/A Date/Time N/A	DATE STARTED: 07/01/89
ENGINEER/GEOLOGIST: TSD	Depth N/A Date/Time N/A	DATE COMPLETED: 07/01/89
DRILLING METHODS: HOLLOW AUGER		PAGE 3 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.0	51804 07/01/89 1212	9	6	STIFF (2.5 Y 5/2) GRAYISH BROWN SANDY CLAY, CLAYEY SAND, TRACE OF GRAVEL, MOIST.	CL	1.75	Hnu= 0 ppm α = 0 cpm βΓ = 120-140cpm
16.5	51805 07/01/89 1212	9	5	STIFF (2.5 Y 5/2) GRAYISH BROWN SANDY CLAY, CLAYEY SAND, TRACE OF GRAVEL, MOIST.	CL	1.75	Hnu= 0 ppm α = 0 cpm βΓ = 120-140cpm
17.0	51806 07/01/89 1221	8	6	VERY STIFF (2.5 Y 5/2) GRAYISH BROWN SANDY CLAY, TRACE OF GRAVEL, MED. PLASTICITY, MOIST.	CL	2.75	Hnu= 0 ppm α = 0 cpm βΓ = 180-200cpm
17.5	51807 07/01/89 1221	10	3	VERY STIFF (2.5 Y 5/2) GRAYISH BROWN SANDY CLAY, TRACE OF GRAVEL, MED. PLASTICITY, MOIST.	CL	2.50	Hnu= 0 ppm α = 0 cpm βΓ = 180-200cpm
18.0	51808 07/01/89 1221	11	0	NO RECOVERY.			

BOTTOM OF BORING 18.0

NOTES:
SAMPLES COLLECTED AS PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED BY MUNSELL COLOR CHART.

1186

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FIELD PERMEABILITY TESTS
FALLING HEAD*

PROJECT FMPC RI/FS
PROJECT NO. 602 3.7.4
BORING NO. 1186

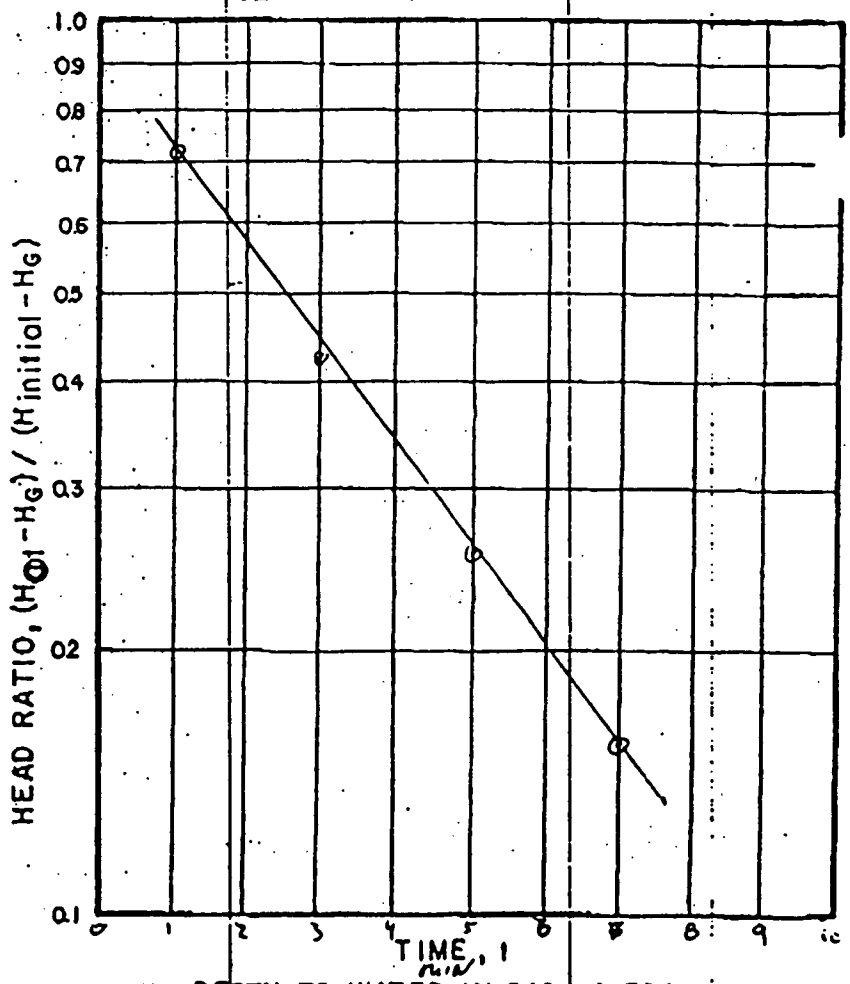
TESTED BY MS/BA DATE 8-02-90
CALCULATED BY MS DATE 10-20-90
CHECKED BY CY DATE 11/2/90
CY 11/19/90

RADIUS OF WELL, ~~R~~ r = 1 IN = ~~0.167~~ 0.0833
RADIUS OF TEST BORING, R = 4 IN = ~~0.417~~ .333
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C ~~2.0 FT~~ 1.7 FT
DEPTH TO BOTTOM OF TEST POCKET, L_1 ~~15.5 FT~~ 17.2 FT
DEPTH TO TOP OF TEST POCKET, L_2 ~~10.0 FT~~ 11.7 FT
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 10.63 FT

HYDRAULIC CONDUCTIVITY, K ~~8.5×10⁻⁶ FT/SEC~~ 7.71×10⁻⁶ FT/SEC
MS 11-19-90

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t SEC, MIN	DEPTH TO WATER IN CASING H FEET
0	10.006
1	10.183
2	10.290
3	10.366
4	10.422
5	10.467
6	10.504
7	10.530
8	10.544
9	10.567
10	10.580
12	10.605
14	10.618
16	10.630



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1
H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

HYDRAULIC CONDUCTIVITY CALCULATIONS FOR B-1186

HEAD RATIO = $\frac{H_{@t} - H_G}{H_i - H_G}$

WHERE: H_G = DEPTH TO GROUND WATER BELOW TOC BEFORE SLUG IS ADDED

H_i = INITIAL DEPTH TO GROUND WATER BELOW TOC AFTER SLUG IS ADDED

$H_{@t}$ = DEPTH TO GROUND WATER BELOW TOC AT TIME = t

HR

.1 min: $\frac{10.038 - 10.63}{10.006 - 10.63} = \frac{.592}{.624} = .949$

1 min: $\frac{10.183 - 10.63}{10.006 - 10.63} = \frac{.447}{.624} = .716$

3 min: $\frac{10.366 - 10.63}{10.006 - 10.63} = \frac{.264}{.624} = .423$

5 min: $\frac{10.467 - 10.63}{10.006 - 10.63} = \frac{.163}{.624} = .261$

7 min: $\frac{10.530 - 10.63}{10.006 - 10.63} = \frac{.100}{.624} = .160$

HYDRAULIC CONDUCTIVITY = $K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_i - H_G}{H_2 - H_G}\right]$

$\Rightarrow K = \frac{(0.0833)^2}{2(\cancel{18.5-10}\ 17.2-11.7)(7-.1)} \ln\left[\frac{\cancel{15.5-10}\ 17.2-11.7}{.333}\right] \ln\left[\frac{10.038-10.63}{10.530-10.63}\right]$

$= (0.00011)(2.604)(1.778)$

$= 5.04 \times 10^{-4}$ FT/MIN

$= 8.5 \times 10^{-6}$ FT/SEC

FOR t = 7 to 1: $K = \frac{(0.0833)^2}{2(15.5-10)(7-1)} \ln\left[\frac{15.5-10}{.333}\right] \ln\left[\frac{10.183-10.63}{10.530-10.63}\right]$

$= (0.00012)(2.604)(1.50)$

$= 4.63 \times 10^{-4}$ FT/MIN

$= 7.71 \times 10^{-6}$ FT/SEC

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1195
WELL NUMBER: 1195

FIELD ENG./GEO.: C. GRUBE
CHECKED BY : Not Noted
N,E COORDINATES: 480636.53, 1380456.8
DATE OF INSTAL.: 11/16/89

DATE: 11/16/89
DATE: N/A

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: HOLLOW AUGER
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING PIEZOMETE
CASING DIAM.: 4.0 In. ID
CASING SIZE(S) USED: (Units N/A)
SIZE: N/A FROM: N/A TO: N/A
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: 0.020 (In.)
TOTAL PERFORATED AREA: 3.9 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: SCHEDULE 40 PVC
RISER PIPE DIAMETERS:
O.D.: 4 1/2 In. I.D.: 4.0 In.
LENGTH OF 1ST PIPE SECTION: 10.0 Ft.
2ND PIPE SECTION: 1.0 Ft.
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: SCREW TYPE - FLUSH JOINT THREADED

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 1.0 Ft.
PROTECTIVE PIPE O.D.: 8 1/ In.
* PROTECTIVE FLUSH MOUNT COVER

OTHER PROTECTION (* NOTED BELOW)

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	0.1 Ft.		579.97	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	1.0 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
	0.0	1.0	N/A	N/A
Bentonite Pellets	1.0	8.8	N/A	N/A
Sand	8.8	16.1	N/A	N/A
PERFORATED SECTION	11.0	15.7	N/A	N/A
WELL TIP	16.1		N/A	
BOTTOM OF BOREHOLE	16.5		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1195

INSTALLATION DATE: 11/16/89

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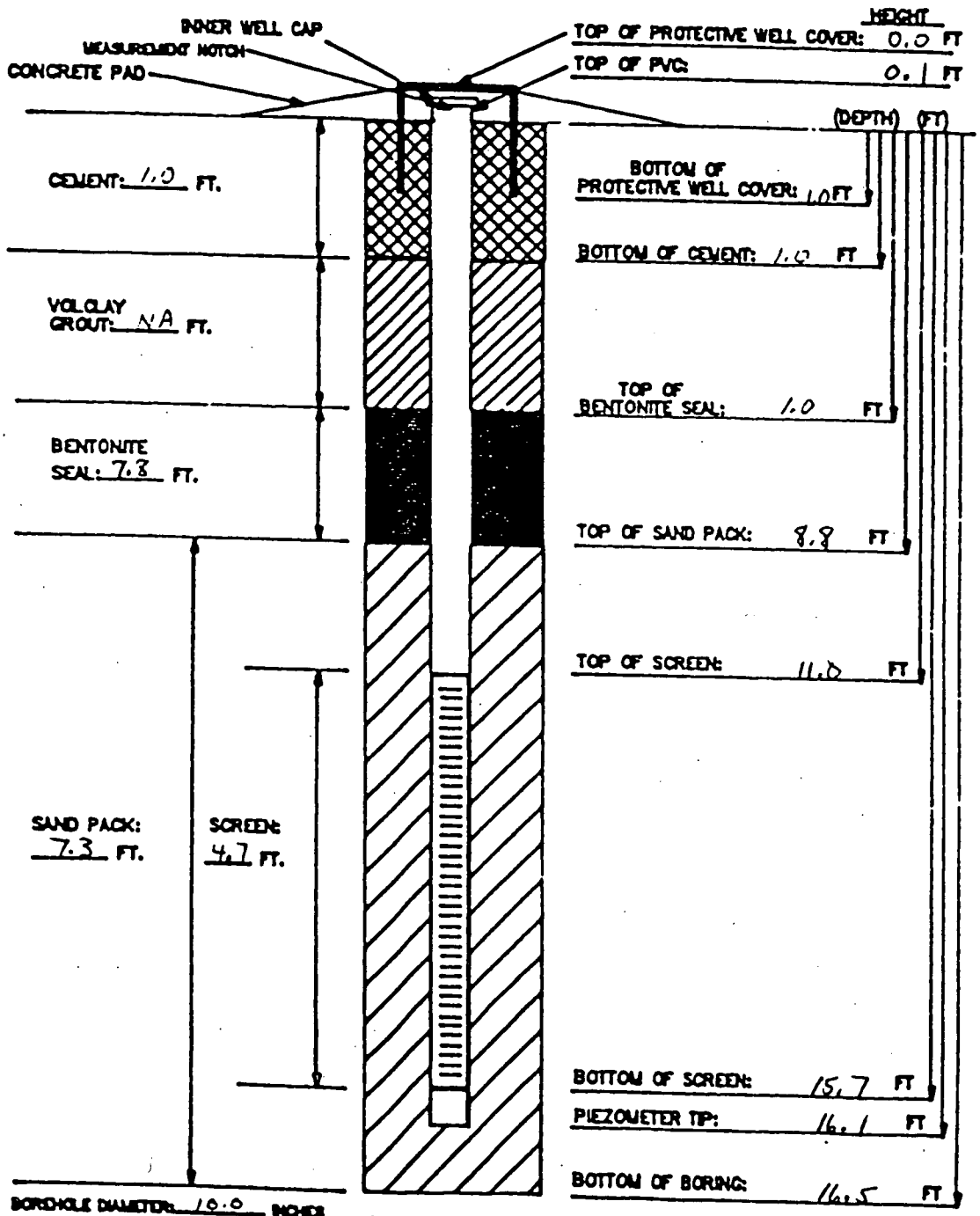


BOREHOLE DIAMETER: 10.0 INCHES

MATERIALS USED:

SAND TYPE AND QUANTITY: 10/20 4 1/2 (100) sks
BENTONITE PELLETS (5-GALLON BUCKETS): 4 1/2
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: 1/2 (94#) sk
AMOUNT OF WATER USED: 10 gal
OTHER: 1 FT Protective Flushmount cover

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602 3.7

GEOLOGIST/ENGINEER: C. Grube

VISUAL CLASSIFICATION OF SOILS

3637

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1195	COORDINATES: NORTH 480,636.53 EAST 1,380,456.82	DATE: 11/09/89
GROUND ELEVATION: 580.27	GWL: Depth N/A Date/Time N/A	DATE STARTED: 11/09/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 11/16/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 3

DEPTH	SAMPLE	DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
1.0								
1.5	16861 11/14/89 1010		5	6	STIFF (2.5 Y 4/4) OLIVE BROWN SILTY CLAY, TRACE OF SAND AND FINE GRAVEL, LOW PLASTICITY, VERY MOIST.	CL	1.75	Hnu= 0 ppm α = 0-15 cpm
2.0	16862 11/14/89 1010		9	6	HARD (2.5 Y 4/4) OLIVE BROWN SILTY CLAY, TRACE OF FINE TO MEDIUM GRAVEL, LOW PLASTICITY, MOIST.	CL	4.25	Hnu= 0 ppm α = 0 cpm Bγ = 450-500cpm
2.5	16863 11/14/89 1010		13	6	HARD (2.5 Y 4/4) OLIVE BROWN SILTY CLAY, TRACE OF FINE TO MEDIUM GRAVEL, LOW PLASTICITY, MOIST.	CL	4.50	Hnu= 0 ppm α = 0 cpm Bγ = 450-500cpm
3.0	16864 11/14/89 1010		16	0	NO RECOVERY.			
3.5	16865 11/14/89 1017		12	6	HARD (2.5 Y 4/4) OLIVE BROWN SILTY CLAY, TRACE OF FINE TO MEDIUM GRAVEL, LOW PLASTICITY, MOIST.	CL	4.25	Hnu= 0 ppm α = 0 cpm Bγ = 400-450cpm
4.0	16866 11/14/89 1017		16	6	VERY STIFF (2.5 Y 4/4) OLIVE BROWN SILTY CLAY, TRACE OF FINE TO MEDIUM GRAVEL, LOW PLASTICITY, MOIST.	CL	3.0	Hnu= 0 ppm α = 0 cpm Bγ = 400-450cpm
4.5	16867 11/14/89 1017		17	3	STIFF (2.5 Y 4/4) OLIVE BROWN SILTY CLAY, TRACE OF FINE TO MEDIUM GRAVEL, LOW PLASTICITY, MOIST.	CL	1.25	Hnu= 0 ppm α = 0 cpm Bγ = 400-450cpm
5.0	16868 11/14/89 1058		16	6	HARD (5 Y 4/1) DARK GRAY SILTY CLAY, TRACE OF SAND AND FINE GRAVEL MEDIUM PLASTICITY, MOIST.	CL	4.5	Hnu= 0 ppm α = 0 cpm Bγ = 160-180cpm
5.5	16869 11/14/89 1058		18	6	HARD (5 Y 4/1) DARK GRAY SILTY CLAY, TRACE OF SAND AND FINE GRAVEL MEDIUM PLASTICITY, MOIST.	CL	4.25	Hnu= 0 ppm α = 0 cpm Bγ = 160-180cpm
6.0	16870 11/14/89 1058		21	2	VERY STIFF (5 Y 4/1) DARK GRAY SILTY CLAY, TRACE OF SAND AND FINE GRAVEL MEDIUM PLASTICITY, MOIST.	CL	2.0	Hnu= 0 ppm α = 0 cpm Bγ = 160-180cpm
6.5	16871 11/14/89 1345		5	6	VERY STIFF (5 Y 4/3) OLIVE SILTY CLAY TRACE OF SAND & FINE TO MEDIUM GRAVEL, LOW PLASTICITY, MOIST.	CL	2.75	Hnu= 0 ppm α = 0 cpm Bγ = 190-200cpm
7.0	16872 11/14/89 1345		5	6	VERY STIFF (5 Y 4/1) DARK GRAY SILTY CLAY, TRACE OF SAND, LOW PLASTICITY MOIST.	CL	2.75	Hnu= 0 ppm α = 0 cpm Bγ = 190-200cpm
7.5	16873 11/14/89 1345		9	6	VERY STIFF (5 Y 4/3) OLIVE CLAY, TRACE OF SILT, MEDIUM PLASTICITY MOIST.	CL	2.5	Hnu= 0 ppm α = 0 cpm Bγ = 190-200cpm
8.0	16874 11/14/89 1352		10	6	VERY STIFF (2.5 Y 4/4) OLIVE BROWN CLAY, TRACE OF SILT, MEDIUM PLASTICITY, MOIST.	CL	2.25	Hnu= 0 ppm α = 0 cpm Bγ = 160-170cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1195	COORDINATES: NORTH 480,636.53 EAST 1,380,456.82	DATE: 11/09/89
GROUND ELEVATION: 580.27	GWL: Depth N/A Date/Time N/A	DATE STARTED: 11/09/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 11/16/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	16875 11/14/89 1352	10	6	STIFF (2.5 Y 4/4) OLIVE BROWN CLAY, TRACE OF SILT, MEDIUM PLASTICITY, MOIST.	CL	1.75	Hnu= 0 ppm α = 0 cpm βΓ = 160-170cpm
9.0	16876 11/14/89 1352	11	2	VERY STIFF (2.5 Y 4/4) OLIVE BROWN CLAY, TRACE OF SILT, MEDIUM PLASTICITY, MOIST.	CL	2.5	Hnu= 0 ppm α = 0 cpm βΓ = 160-170cpm
9.5	16877 11/14/89 1400	16	6	STIFF (2.5 Y 4/4) OLIVE BROWN CLAY, TRACE OF SILT AND SAND, MEDIUM PLASTICITY MOIST.	CL	1.0	Hnu= 0 ppm α = 0 cpm βΓ = 180-190cpm
10.0	16878 11/14/89 1400	13	5	MED. STIFF (2.5 Y 4/4) OLIVE BROWN CLAY, TRACE OF SILT AND SAND, MEDIUM PLASTICITY MOIST.	CL	.75	Hnu= 0 ppm α = 0 cpm βΓ = 180-190cpm
10.5	16879 11/14/89 1400	10	0	NO RECOVERY.			
11.0	16880 11/14/89 1413	3	6	MEDIUM SJTIFF (5 Y 5/3) OLIVE SILTY CLAY, SOME SAND LOW PLASTICITY MOIST TO VERY MOIST.	CL	.75	Hnu= 0 ppm α = 0 cpm βΓ = 150-160cpm
11.5	51975 11/14/89 1413	2	6	MEDIUM SJTIFF (5 Y 5/3) OLIVE SILTY CLAY, SOME SAND LOW PLASTICITY MOIST TO VERY MOIST.	CL	.75	Hnu= 0 ppm α = 0 cpm βΓ = 150-160cpm
12.0	51976 11/14/89 1413	2	4	SOFT (5 Y 5/3) OLIVE SILTY CLAY, SOME SAND LOW PLASTICITY MOIST TO VERY MOIST.	CL	.25	Hnu= 0 ppm α = 0 cpm βΓ = 150-160cpm
12.5	51977 11/14/89 1418	3	6	MEDIUM STIFF (5 Y 5/3) OLIVE SILTY CLAY, SOME SAND LOW PLASTICITY MOIST TO VERY MOIST.	CL	1.0	Hnu= 0 ppm α = 0-5 cpm βΓ = 140-150cpm
13.0	51978 11/14/89 1418	3	6	LOOSE (2.5 Y 4/4) OLIVE SAND SILT, SOME CLAY, WET.	ML	NA	Hnu= 0 ppm α = 0-5 cpm βΓ = 140-150cpm
13.5	51979 11/14/89 1418	6	2	LOOSE (2.5 Y 4/4) OLIVE SILTY SAND, TRACE OF CLAY, WET.	SM	NA	Hnu= 0 ppm α = 0-5 cpm βΓ = 140-150cpm
14.0	51980 11/14/89 1428	5	6	MEDIUM LOOSE (2.5 Y 4/4) OLIVE SILTY SAND, TRACE OF CLAY, WET.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 110-120cpm
14.5	51981 11/14/89 1428	8	6	MEDIUM DENSE (2.5 Y 4/4) OLIVE SANDY SILT, WET TO VERY MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 110-120cpm
15.0	51982 11/14/89 1428	15	6	MEDIUM DENSE (2.5 Y 4/4) OLIVE SILT, VERY MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 110-120cpm
15.5	51983 11/14/89 1520	7	6	LOOSE (2.5 Y 5/4) LIGHT OLIVE BROWN POORLY GRADED SAND TRACE OF SILT WET. MED. STIFF (5 Y 4/2) OLIVE GRAY SILTY CLAY MED. PLASTICITY MOIST.	SP CL	NA NA	Hnu= 0 ppm α = 0 cpm βΓ = 130-140cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1195	COORDINATES: NORTH 480,636.53 EAST 1,380,456.82	DATE: 11/09/89
GROUND ELEVATION: 580.27	GWL: Depth N/A Date/Time N/A	DATE STARTED: 11/09/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 11/16/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.0	51984 11/14/89 1520	5	6	LOOSE (5 Y 4/2) OLIVE GRAY SILTY SAND TO SANDY SILT WET.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 130-140cpm
16.5	51985 11/14/89 1520	5	6	LOOSE (5 Y 4/2) OLIVE GRAY SILTY SAND TO SANDY SILT WET. MEDIUM STIFF (5 Y 4/1) DARK GRAY SILTY CLAY, TRACE OF FINE GRAVEL LOW PLASTICITY MOIST.	ML CL	NA NA	Hnu= 0 ppm α = 0 cpm βΓ = 130-140cpm

BOTTOM OF BORING 16.5

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

FIELD PERMEABILITY TESTS
FALLING HEAD*

PROJECT FMPC RI/FS
PROJECT NO. 602 3.2.1
BORING NO. 1195

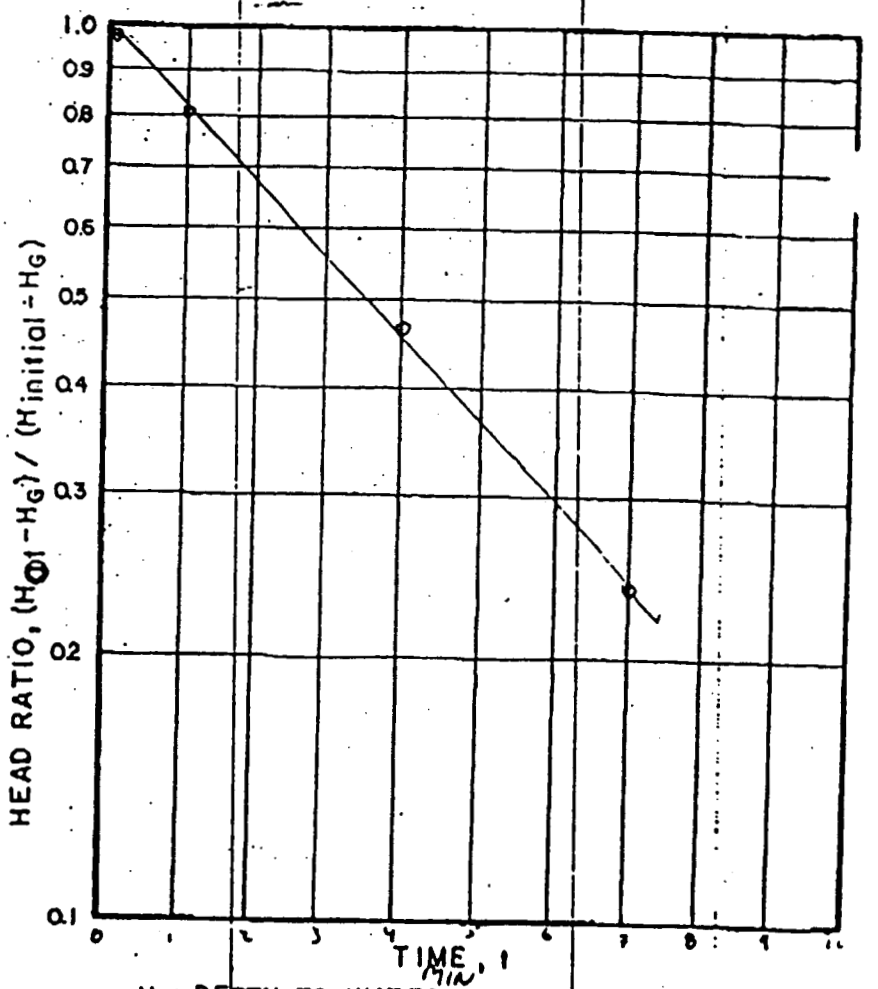
TESTED BY MS/SA DATE 8-20-90
CALCULATED BY MS DATE 10-23-90
CHECKED BY CG DATE 11/2/90 11/19/90

RADIUS OF WELL, ~~R~~ r = 2 in = 0.167 FT
RADIUS OF TEST BORING, R = 5 in = 0.417 FT
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C 0.0
DEPTH TO BOTTOM OF TEST POCKET, L_1 16.1 FT
DEPTH TO TOP OF TEST POCKET, L_2 11.0 FT
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 7.45 FT

HYDRAULIC CONDUCTIVITY, K ~~2.52 × 10⁻⁵ FT/SEC~~ 2.49 × 10⁻⁵ FT/SEC MS 11-14-90

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t SEC. MIN	DEPTH TO WATER IN CASING H FEET
0	7.167
1	7.223
2	7.261
3	7.293
4	7.318
5	7.343
6	7.362
7	7.381
8	7.394
9	7.406
10	7.419
12	7.432
14	7.438
16	7.440
18	7.450



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

HYDRAULIC CONDUCTIVITY CALCULATIONS FOR B-1145

HEAD RATIO = $\frac{H_{@t} - H_G}{H_i - H_G}$

WHERE: H_G = DEPTH TO GROUND WATER BELOW TOC BEFORE SLUG IS ADDED

H_i = INITIAL DEPTH TO GROUND WATER BELOW TOC AFTER SLUG IS ADDED

$H_{@t}$ = DEPTH TO GROUND WATER BELOW TOC AT TIME = t

HR

.1 MIN: $\frac{7.173 - 7.45}{7.167 - 7.45} = \frac{.277}{.283} = .979$

1 MIN: $\frac{7.223 - 7.45}{7.167 - 7.45} = \frac{.227}{.283} = .802$

4 MIN: $\frac{7.318 - 7.45}{7.167 - 7.45} = \frac{.132}{.283} = .466$

7 MIN: $\frac{7.381 - 7.45}{7.167 - 7.45} = \frac{.069}{.283} = .244$

10 MIN: $\frac{7.414 - 7.45}{7.167 - 7.45} = \frac{.031}{.283} = .110$

HYDRAULIC CONDUCTIVITY = $K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$

$\Rightarrow K = \frac{(0.167)^2}{(2)(16.1 - 11.0)(10 - .1)} \ln\left[\frac{16.1 - 11.0}{0.417}\right] \ln\left[\frac{7.173 - 7.45}{7.414 - 7.45}\right]$

$= (0.000276)(2.504)(2.19)$

$= 1.51 \times 10^{-5}$ FT/MIN

$= 2.52 \times 10^{-7}$ FT/SEC

FOR t = 10 & 1 :

$K = \frac{(0.167)^2}{2(16.1 - 11.0)(10 - 1)} \ln\left[\frac{16.1 - 11.0}{0.417}\right] \ln\left[\frac{7.223 - 7.45}{7.414 - 7.45}\right]$

$= (0.0003)(2.504)(1.491)$

$= 1.50 \times 10^{-5}$ FT/MIN

$= 2.49 \times 10^{-7}$ FT/SEC

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1196
WELL NUMBER: 1196

FIELD ENG./GEO.: C. GRUBE DATE: 11/08/89
CHECKED BY : BD DATE: 11/10/89
N,E COORDINATES: 480627.89, 1380507.3
DATE OF INSTAL.: 11/08/89

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: HOLLOW AUGER
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING PIEZOMETE
CASING DIAM.: 4.0 In. ID
CASING SIZE(S) USED: (Units N/A)
SIZE: N/A FROM: N/A TO: N/A
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: 0.020 (In.)
TOTAL PERFORATED AREA: 3.9 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: SCHEDULE 40 PVC
RISER PIPE DIAMETERS:
O.D.: 4 1/2 In. I.D.: 4.0 In.
LENGTH OF 1ST PIPE SECTION: 9.4 Ft.
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: FLUSH JOINT THREADED, SCREW TYPE

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 1.0 Ft.
PROTECTIVE PIPE O.D.: 8 1/ In.
* FLUSH MOUNT PROTECTIVE COVER.

OTHER PROTECTION (* NOTED BELOW)

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	0.2 Ft.		580.02	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	1.0 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
	0.0	1.0	N/A	N/A
Bentonite Pellets	1.0	8.6	N/A	N/A
Sand	8.6	15.0	N/A	N/A
PERFORATED SECTION	9.6	14.6	N/A	N/A
WELL TIP	15.0		N/A	
BOTTOM OF BOREHOLE	15.0		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

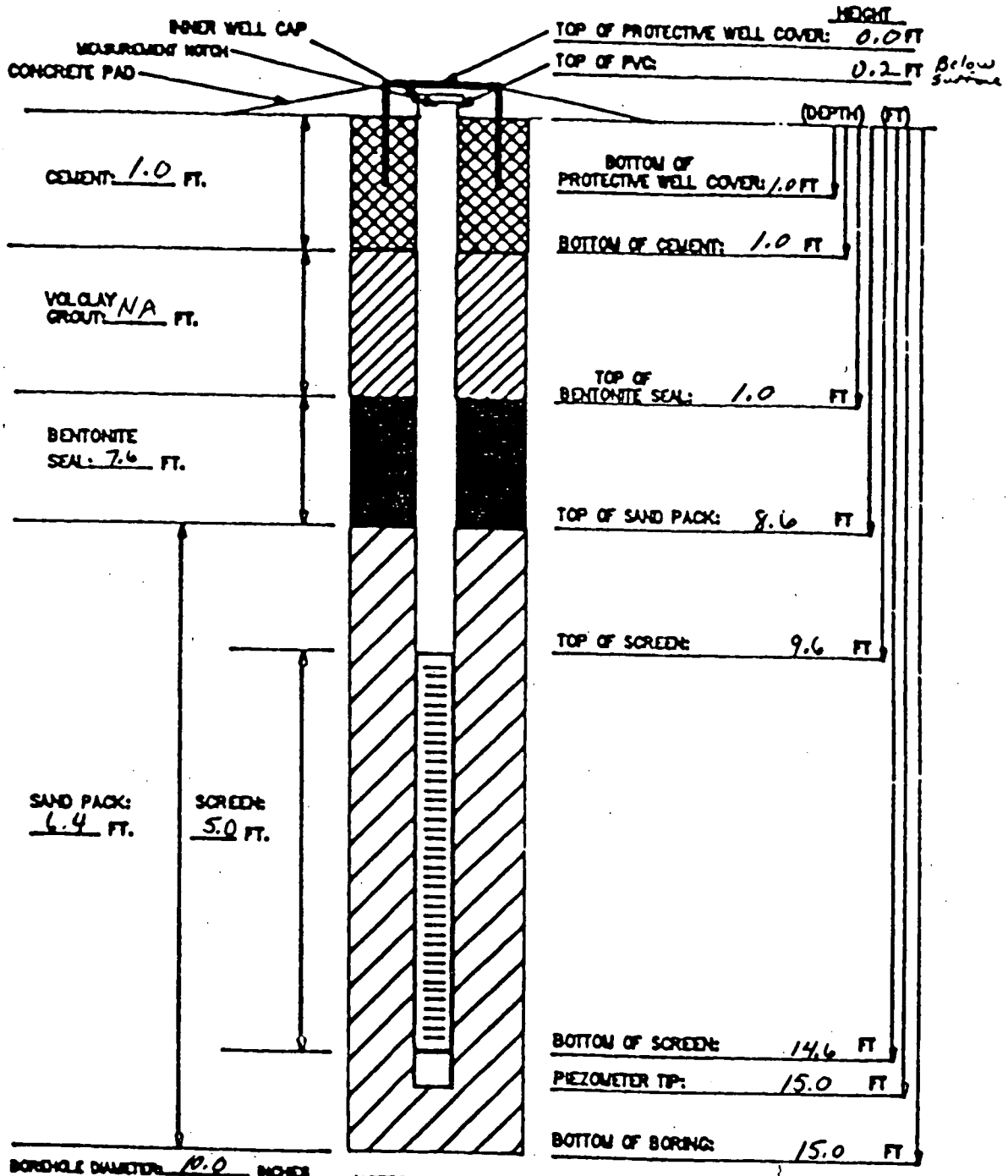
WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1196

INSTALLATION DATE: 11/08/89

3637



MATERIALS USED:

SAND TYPE AND QUANTITY: #1/20 sand - 2 60 lbs
BENTONITE PELLETS (5-GALLON BUCKETS): 2½
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: ½ sack (94#)
AMOUNT OF WATER USED: 10 gal
OTHER: 1 FT Flush mount cover

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602 9.7

GEOLOGIST/ENGINEER: C. Grube

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1196	COORDINATES: NORTH 480,627.89 EAST 1,380,507.31	DATE: 11/07/89
GROUND ELEVATION: 580.23	GWL: Depth N/A Date/Time N/A	DATE STARTED: 11/07/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 11/08/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 2

DEPTH	SAMPLE	DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
1.0								
1.5	16881	11/08/89 0850	2	6	STIFF (10 YR 5/3) BROWN SILTY CLAY, TRACE OF FINE TO COARSE GRAVEL, LOW PLASTICITY MOIST.	CL	2.0	
2.0	16882	11/08/89 0850	3	6	STIFF (10 YR 5/3) BROWN SILTY CLAY, TRACE OF FINE TO COARSE GRAVEL, LOW PLASTICITY MOIST.	CL	1.25	Hnu= 0 ppm α = 0 cpm BΓ = 230-240cpm
2.5	16883	11/08/89 0850	5	4	STIFF (10 YR 5/3) BROWN SILTY CLAY, TRACE OF FINE TO COARSE GRAVEL, LOW PLASTICITY MOIST.	CL	1.0	Hnu= 0 ppm α = 0 cpm BΓ = 230-240cpm
3.0	16884	11/08/89 0850	6		NO RECOVERY.			
3.5	16885	11/08/89 0857	5	6	STIFF (10 YR 5/4) YELLOWISH BROWN SILTY CLAY, TRACE OF FINE TO COARSE GRAVEL, LOW PLASTICITY MOIST.	CL	1.75	Hnu= 0 ppm α = 0 cpm BΓ = 240-250cpm
4.0	16886	11/08/89 0857	7	6	STIFF (10 YR 5/4) YELLOWISH BROWN SILTY CLAY, TRACE OF FINE TO COARSE GRAVEL, LOW PLASTICITY MOIST.	CL	1.75	Hnu= 0 ppm α = 0 cpm BΓ = 240-250cpm
4.5	16887	11/08/89 0857	17	6	MEDIUM DENSE (10 YR 5/4) YELLOWISH BROWN CLAYEY GRAVEL, SOME SAND, MOIST TO VERY MOIST.	GC	NA	Hnu= 0 ppm α = 0 cpm BΓ = 240-250cpm
5.0	16888	11/08/89 0904	5	6	MEDIUM DENSE (10 YR 5/4) YELLOWISH BROWN CLAYEY GRAVEL, SOME SAND, MOIST TO VERY MOIST. VERY STIFF (5 Y 3/1) VERY DARK GRAY CLAY, TRACE OF SILT LOW PLASTICITY MOIST.	GC CL	NA NA	Hnu= 0 ppm α = 0-10 cpm BΓ = 250-260cpm
5.5	16889	11/08/89 0904	7	6	VERY STIFF (5 Y 3/1) VERY DARK GRAY CLAY, TRACE OF SILT LOW PLASTICITY MOIST.	CL	3.25	Hnu= 0 ppm α = 0-10 cpm BΓ = 250-260cpm
6.0	16890	11/08/89 0904	13	3	VERY STIFF (5 Y 3/1) VERY DARK GRAY CLAY, TRACE OF SILT LOW PLASTICITY MOIST.	CL	3.25	Hnu= 0 ppm α = 0-10 cpm BΓ = 250-260cpm
6.5	16891	11/08/89 0920	2	6	VERY STIFF (5 Y 3/1) VERY DARK GRAY CLAY, TRACE OF SILT LOW PLASTICITY MOIST.	CL	3.0	Hnu= 0 ppm α = 0 cpm BΓ = 220-230cpm
7.0	16892	11/08/89 0920	5	6	STIFF (5 Y 4/2) OLIVE GRAY CLAY, TRACE OF SILT, LOW PLASTICITY, MOIST.	CL	1.5	Hnu= 0 ppm α = 0 cpm BΓ = 220-230cpm
7.5	16893	11/08/89 0920	7	4	STIFF (5 Y 4/2) OLIVE GRAY CLAY, TRACE OF SILT, LOW PLASTICITY, MOIST.	CL	2.0	Hnu= 0 ppm α = 0 cpm BΓ = 220-230cpm
8.0	16894	11/08/89 0934	7	6	VERY STIFF (2.5 Y 4/2) DARK GRAYISH BROWN CLAY TRACE OF SILT LOW PLASTICITY MOIST.	CL	2.5	Hnu= 0 ppm α = 0 cpm BΓ = 250-260cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1196	COORDINATES: NORTH 480,627.89 EAST 1,380,507.31	DATE: 11/07/89
GROUND ELEVATION: 580.23	GWL: Depth N/A Date/Time N/A	DATE STARTED: 11/07/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 11/08/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 2

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	16895 11/08/89 0934	9	6	STIFF (2.5 Y 4/2)DARK GRAYISH BROWN CLAY, TRACE OF SILT, LOW PLASTICITY MOIST.	CL	1.5	Hnu= 0 ppm α = 0 cpm βΓ = 250-260cpm
9.0	16896 11/08/89 0934	12		NO RECOVERY.			
9.5	16897 11/08/89 0937	7	6	STIFF (2.5 Y 4/2) DARK GRAYISH BROWN CLAY, TRACE OF SILT, LOW PLASTICITY, MOIST.	CL	1.5	Hnu= 0 ppm α = 0-10 cpm βΓ = 260-270cpm
10.0	16898 11/08/89 0937	13	6	MEDIUM DENSE (2.5 Y 5/4) LIGHT OLIVE BROWN CLAYEY SILT, MOIST.	ML	NA	Hnu= 0 ppm α = 0-10 cpm βΓ = 260-270cpm
10.5	16899 11/08/89 0937	15	2	MEDIUM DENSE (2.5 Y 5/4) LIGHT OLIVE BROWN CLAYEY SILT, MOIST.	ML	NA	Hnu= 0 ppm α = 0-10 cpm βΓ = 260-270cpm
11.0	16900 11/08/89 0953	3	6	LOOSE (2.5 Y 5/4) LIGHT OLIVE BROWN CLAYEY SILT VERY MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 180-190cpm
11.5	16901 11/08/89 0953	3	6	LOOSE (2.5 Y 5/4) LIGHT OLIVE BROWN CLAYEY SILT VERY MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 180-190cpm
12.0	16902 11/08/89 0953	5	6	LOOSE (2.5 Y 5/4) LIGHT OLIVE BROWN CLAYEY SILT VERY MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 180-190cpm
12.5	51995 11/08/89 0958	9	6	MEDIUM DENSE (2.5 Y 5/4) LIGHT OLIVE BROWN CLAYEY SILT VERY MOIST TO MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 240-260cpm
13.0	51996 11/08/89 0958	10	6	MEDIUM DENSE (2.5 Y 5/4) LIGHT OLIVE BROWN CLAYEY SILT VERY MOIST TO MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 240-260cpm
13.5	51997 11/08/89 0958	10	6	MEDIUM DENSE (2.5 Y 5/4) LIGHT OLIVE BROWN CLAYEY SILT VERY MOIST TO MOIST TRACE OF SAND.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 240-260cpm
14.0	51998 11/08/89 1001	10	6	MEDIUM DENSE (2.5 Y 5/4) LIGHT OLIVE BROWN CLAYEY SILT WET.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 230-240cpm
14.5	51999 11/08/89 1001	10	6	MEDIUM DENSE (2.5 Y 5/4) LIGHT OLIVE BROWN CLAYEY SILT VERY MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 230-240cpm
15.0	52000 11/08/89 1001	15	6	MEDIUM DENSE (2.5 Y 5/4) LIGHT OLIVE BROWN CLAYEY SILT VERY MOIST. STIFF (5 Y 5/2) OLIVE GRAY SILTY CLAY LOW PLASTICITY MOIST.	ML CL	NA NA	Hnu= 0 ppm α = 0 cpm βΓ = 230-240cpm

BOTTOM OF BORING 15.0

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

1196
3637

FIELD PERMEABILITY TESTS
FALLING HEAD*

PROJECT FMPC RI/FS
PROJECT NO. 602 3.2.1
BORING NO. 1196

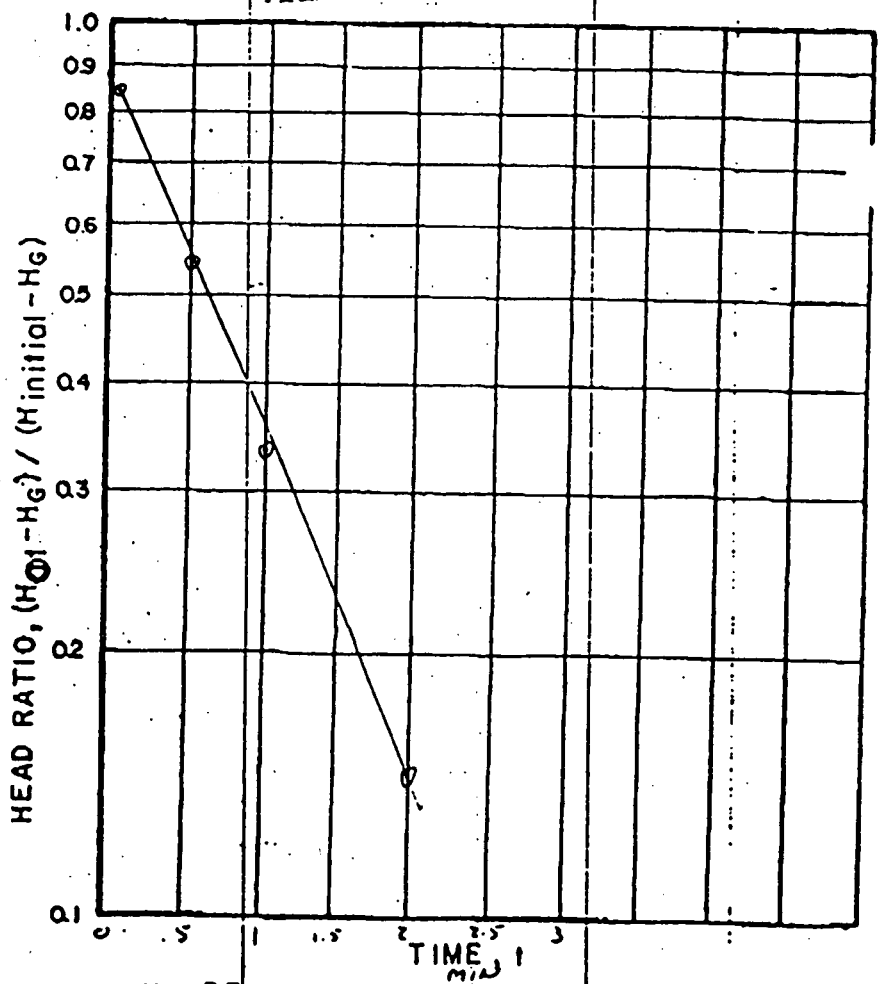
TESTED BY MS/ISA DATE 8-10-90
CALCULATED BY MS DATE 10-23-90
CHECKED BY CY DATE 11/2/90

RADIUS OF WELL, ~~R~~ r = 2 in = 0.167 ft
RADIUS OF TEST BORING, R = 5 in = 0.417 ft
HEIGHT OF CASING (REF. LEVEL)
ABOVE GROUND SURFACE, H_C 0.0 ft
DEPTH TO BOTTOM OF TEST POCKET, L_1 15.0 ft
DEPTH TO TOP OF TEST POCKET, L_2 9.6 ft
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 8.74 ft

HYDRAULIC CONDUCTIVITY, K 1.02×10^{-4} ft/sec

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t sec. min	DEPTH TO WATER IN CASING H FEET
0	8.532
.1	8.564
.5	8.667
1	8.671
2	8.704
3	8.728
4	8.734
5	8.734
6	8.740



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

400-8-87

HYDRAULIC CONDUCTIVITY CALCULATIONS FOR B-1196

$$\text{HEAD RATIO} = \frac{H_{@t} - H_G}{H_i - H_G}$$

WHERE: H_G = DEPTH TO GROUND WATER BELOW TOC BEFORE SLUG IS ADDED

H_i = INITIAL DEPTH TO GROUND WATER BELOW TOC AFTER SLUG IS ADDED

$H_{@t}$ = DEPTH TO GROUND WATER BELOW TOC AT TIME = t

HR

.1 MIN: $\frac{8.564 - 8.74}{8.532 - 8.74} = \frac{.176}{.208} = .846$

.5 MIN: $\frac{8.627 - 8.74}{8.532 - 8.74} = \frac{.113}{.208} = .543$

1 MIN: $\frac{8.671 - 8.74}{8.532 - 8.74} = \frac{.069}{.208} = .332$

2 MIN: $\frac{8.709 - 8.74}{8.532 - 8.74} = \frac{.031}{.208} = .149$

3 MIN: $\frac{8.728 - 8.74}{8.532 - 8.74} = \frac{.012}{.208} = .058$

$$\text{HYDRAULIC CONDUCTIVITY} = K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

$$\Rightarrow K = \frac{(0.167)^2}{2(15 - 9.6)(3 - .1)} \ln\left[\frac{15 - 9.6}{0.417}\right] \ln\left[\frac{8.564 - 8.74}{8.728 - 8.74}\right]$$

$$= (0.00089)(2.561)(2.686)$$

$$= 6.12 \times 10^{-3} \text{ FT/MIN}$$

$$= 1.02 \times 10^{-4} \text{ FT/SEC}$$

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1197
WELL NUMBER: 1197

FIELD ENG./GEO.: C. GRUBE
CHECKED BY : BD
N,E COORDINATES: 480626.41, 1380538.4
DATE OF INSTAL.: 11/06/89

DATE: 11/06/89
DATE: 11/09/89

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: HOLLOW AUGER
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING PIEZOMETE
CASING DIAM.: 4.0 In. ID
CASING SIZE(S) USED: (Units N/A)
SIZE: N/A FROM: N/A TO: N/A
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: 0.020 (In.)
TOTAL PERFORATED AREA: 3.9 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: SCHEDULE 40 PVC
RISER PIPE DIAMETERS:
O.D.: 4 1/2 In. I.D.: 4.0 In.
LENGTH OF 1ST PIPE SECTION: 10.3 Ft.
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: SCREW TYPE - FLUSH JOINT THREADED.

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 1.0 Ft.
PROTECTIVE PIPE O.D.: 8 1/ In.
* FLUSH MOUNT PROTECTIVE CASING

OTHER PROTECTION (* NOTED BELOW)

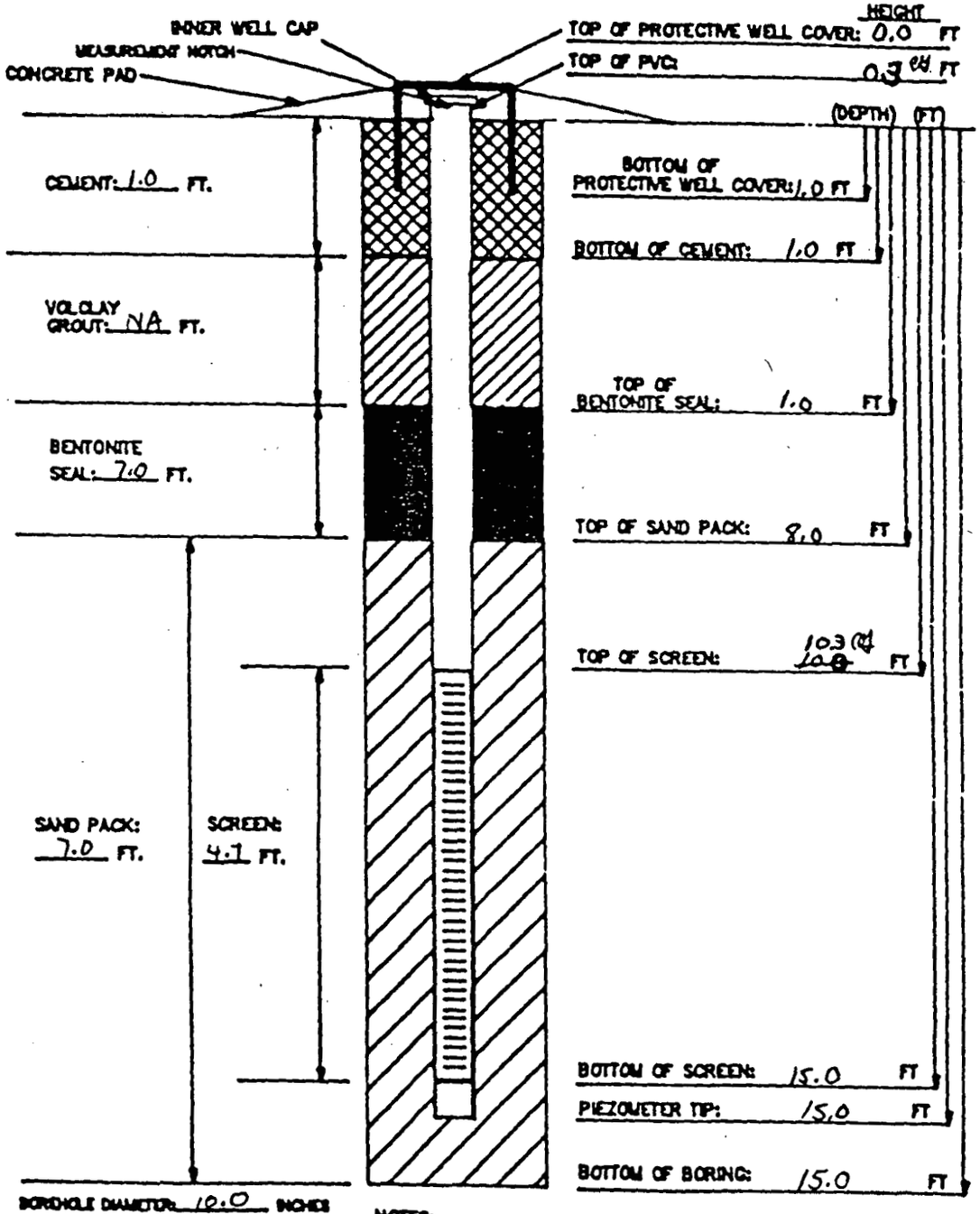
ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	0.3 Ft.		579.77	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	1.0 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
	0.0	1.0	N/A	N/A
Bentonite Pellets	1.0	8.0	N/A	N/A
Sand	8.0	15.0	N/A	N/A
PERFORATED SECTION	10.3	15.0	N/A	N/A
WELL TIP	15.0		N/A	
BOTTOM OF BOREHOLE	15.0		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1197

INSTALLATION DATE: 11/06/89



BOREHOLE DIAMETER: 10.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 10/20 sand 1½ - 80 sks
BENTONITE PELLETS (5-GALLON BUCKETS): 2
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: ½ (94#) sk.
AMOUNT OF WATER USED: 5 gal
OTHER: 1.0 FT 8½ ap. in. Protective flush mount cover

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESIS INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602 3.7

GEOLOGIST/ENGINEER: C. Gruba

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1197	COORDINATES: NORTH 480,626.41 EAST 1,380,538.45	DATE: 11/05/89
GROUND ELEVATION: 580.19	GWL: Depth N/A Date/Time N/A	DATE STARTED: 11/05/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 11/06/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 2

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
1.0							
1.5	16903 11/05/89 1039	6	6	VERY STIFF (2.5 Y 5/4) LIGHT OLIVE BROWN SANDY CLAY TRACE OF SILT, LOW PLATICITY MOIST TO VERY MOIST.	CL	3.0	Hnu= 0 ppm α = 0 cpm βΓ = 350-400cpm
2.0	16904 11/05/89 1039	6	6	VERY STIFF (2.5 Y 5/4) LIGHT OLIVE BROWN SILTY CLAY TRACE OF SAND AND FINE GRAVEL, LOW PLASTICITY MOIST.	CL	3.25	Hnu= 0 ppm α = 0 cpm βΓ = 200-220cpm
2.5	16905 11/05/89 1039	12	2	VERY STIFF (2.5 Y 5/4) LIGHT OLIVE BROWN SILTY CLAY TRACE OF SAND AND FINE GRAVEL, LOW PLASTICITY MOIST.	CL	2.25	Hnu= 0 ppm α = 0 cpm βΓ = 200-220cpm
3.0	16906 11/05/89 1039	8		NO RECOVERY.			
3.5	16907 11/05/89 1047	5	4	MEDIUM STIFF (2.5 Y 5/4) LIGHT OLIVE BROWN SILTY CLAY LOW PLASTICITY VERY MOIST. MEDIUM STIFF 5 Y 5/2 OLIVE GRAY SILTY CLAY, LOW PLASTICITY MOIST, COARSE GRAVEL.	CL	.50 .50	Hnu= 0 ppm α = 0 cpm βΓ = 200-220cpm
.0	16908 11/05/89 1047	6		NO RECOVERY.			
4.5	16909 11/05/89 1047	10		NO RECOVERY.			
5.0	16910 11/05/89 1055	8	6	VERY STIFF (2.5 Y 5/4) LT. OLIVE BROWN TO (5 Y 5/2) OLIVE GRAY SILTY CLAY, TRACE FINE GRAVEL, LOW PLASTICITY VERY MOIST.	CL	4.0	Hnu= 0 ppm α = 0 cpm βΓ = 140-150cpm
5.5	16911 11/05/89 1055	13	6	HARD (5 Y 3/1) VERY DARK GRAY SILTY CLAY, LOW PLASTICITY, MOIST.	CL	4.5	Hnu= 0 ppm α = 0 cpm βΓ = 140-150cpm
6.0	16912 11/05/89 1055	15	4	VERY STIFF (5 Y 3/1) VERY DARK GRAY SILTY CLAY, LOW PLASTICITY, MOIST.	CL	3.0	Hnu= 0 ppm α = 0 cpm βΓ = 140-150cpm
6.5	16913 11/05/89 1330	7	6	VERY STIFF (5 Y 4/1) DARK GRAY CLAY, TRACE OF SILT, MEDIUM PLASTICITY, MOIST.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 150-160cpm
7.0	16914 11/05/89 1330	8	6	VERY STIFF (5 Y 4/1) DARK GRAY CLAY, TRACE OF SILT, MEDIUM PLASTICITY, MOIST.	CL	2.25	Hnu= 0 ppm α = 0 cpm βΓ = 150-160cpm
7.5	16915 11/05/89 1330	9		NO RECOVERY.			
8.0	16916 11/05/89 1340	10	6	STIFF (5 Y 4/1) DARK GRAY CLAY, TRACE OF SILT, MEDIUM PLASTICITY MOIST. VERY STIFF (5 Y 5/2) OLIVE GRAY CLAY TRACE OF SILT LOW PLASTICITY MOIST.	CL CL	1.0 1.0	Hnu= 0 ppm α = 0 cpm βΓ = 130-150cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1197	COORDINATES: NORTH 480,626.41 EAST 1,380,538.45	DATE: 11/05/89
GROUND ELEVATION: 580.19	GWL: Depth N/A Date/Time N/A	DATE STARTED: 11/05/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 11/06/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 2

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	16917 11/05/89 1340	12	6	VERY STIFF (5 Y 5/2) OLIVE GRAY CLAY TRACE OF SILT LOW PLASTICITY MOIST.	CL	2.5	Hnu= 0 ppm α = 0 cpm BΓ = 130-150cpm
9.0	16918 11/05/89 1340	13	3	VERY STIFF (5 Y 5/2) OLIVE GRAY CLAY TRACE OF SILT LOW PLASTICITY MOIST.	CL	4.0	Hnu= 0 ppm α = 0 cpm BΓ = 130-150cpm
9.5	16919 11/05/89 1348	15	6	VERY STIFF (5 Y 5/2) OLIVE GRAY SILTY CLAY, TRACE OF SAND, LOW PLASTICITY MOIST.	CL	2.25	Hnu= 0 ppm α = 0 cpm BΓ = 140-180cpm
T0.0	16920 11/05/89 1348	13	6	STIFF (5 Y 5/2) OLIVE GRAY VERY SILTY CLAY, TRACE OF SAND, LOW PLASTICITY, MOIST.	CL	1.75	Hnu= 0 ppm α = 0 cpm BΓ = 140-180cpm
10.5	16921 11/05/89 1348	10		NO RECOVERY.			
11.0	16922 11/05/89 1422	4	6	STIFF (10 YR 5/4) YELLOWISH BROWN SILTY CLAY, TRACE SAND AND FINE TO MEDIUM GRAVEL, LOW PLASTICITY MOIST.	CL	1.25	Hnu= 0 ppm α = 0 cpm BΓ = 170-180cpm
11.5	16923 11/05/89 1422	4	6	LOOSE (10 YR 5/2) BROWN CLAYEY SILT, TRACE OF SAND, MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm BΓ = 170-180cpm
12.0	16924 11/05/89 1422	5		NO RECOVERY.			
12.5	52015 11/05/89 1431	6	6	STIFF (10 YR 5/4) YELLOWISH BROWN SANDY CLAY, SOME SILT TRACE OF FINE GRAVEL, LOW PLASTICITY MOIST TO VERY MOIST.	CL	1.25 2.0	Hnu= 0 ppm α = 0 cpm BΓ = 160-180cpm
13.0	52016 11/05/89 1431	6	6	VERY STIFF (10 YR 5/4) YELLOWISH BROWN SANDY CLAY, SOME SILT TRACE OF FINE GRAVEL, LOW PLASTICITY MOIST TO VERY MOIST.	CL	2.25	Hnu= 0 ppm α = 0 cpm BΓ = 160-180cpm
13.5	52017 11/05/89 1431	7	5	MEDIUM DENSE (2.5 Y 5/4) LIGHT OLIVE BROWN CLAYEY SILT, VERY MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm BΓ = 160-180cpm
14.0	52018 11/05/89 1438	6	6	MEDIUM DENSE (2.5 Y 5/2) GRAYISH BROWN CLAYEY SILT WET.	ML	NA	Hnu= 0 ppm α = 0 cpm BΓ = 190-200cpm
14.5	52019 11/05/89 1438	7	6	MEDIUM DENSE (2.5 Y 5/2) GRAYISH BROWN CLAYEY SILT WET.	ML	NA	Hnu= 0 ppm α = 0 cpm BΓ = 190-200cpm
15.0	52020 11/05/89 1438	8	6	MEDIUM DENSE (2.5 Y 4/4) OLIVE BROWN SILTY TO POORLY GRADED SAND TRACE OF FINE GRAVEL, WET. SOFT (2.5 Y 5/4) LIGHT OLIVE BROWN SILTY CLAY LOW PLASTICITY MOIST.	SM CL	NA NA	Hnu= 0 ppm α = 0 cpm BΓ = 190-200cpm

BOTTOM OF BORING 15.0

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

FIELD PERMEABILITY TESTS
FALLING HEAD*

PROJECT FMPC LIPS
PROJECT NO. 602.3.2.1
BORING NO. 1197

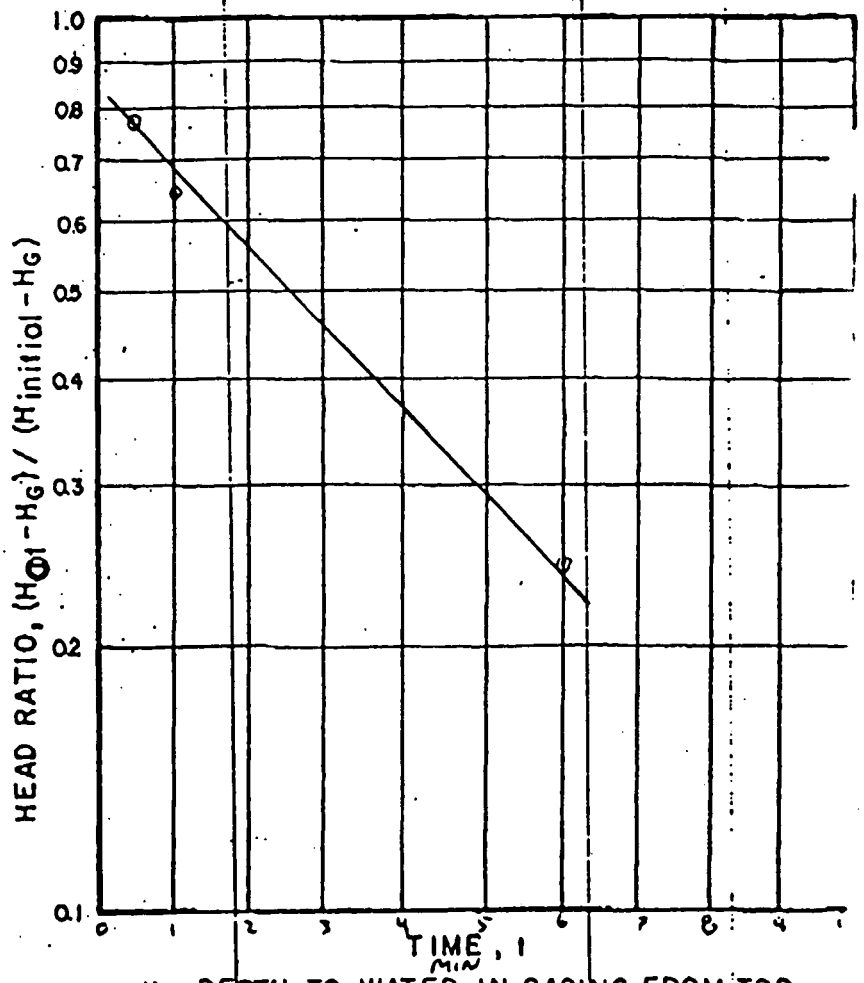
TESTED BY MS/DA DATE 8-18-90
CALCULATED BY MS DATE 10-23-90
CHECKED BY CY DATE 11/2/90

RADIUS OF WELL, ~~R~~ r = 2 IN = 0.167 FT
RADIUS OF TEST BORING, R = 5 IN = 0.417 FT
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C 0.0 FT
DEPTH TO BOTTOM OF TEST POCKET, L_1 15.0 FT
DEPTH TO TOP OF TEST POCKET, L_2 10.3 FT
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 8.62 FT

HYDRAULIC CONDUCTIVITY, K 2.92×10^{-5} FT/SEC

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t SEC, MIN	DEPTH TO WATER IN CASING H FEET
0	8.393
.1	8.406
.5	8.444
1	8.475
2	8.526
4	8.563
6	8.582
8	8.584
10	8.601
12	8.601
14	8.608
16	8.608
18	8.608
20	8.614
25	8.614
30	8.620



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

HYDRAULIC CONDUCTIVITY CALCULATIONS FOR B-1147

$$\text{HEAD RATIO} = \frac{H_{@t} - H_G}{H_i - H_G}$$

WHERE: H_G = DEPTH TO GROUND WATER BELOW TOC BEFORE SLUG IS ADDED

H_i = INITIAL DEPTH TO GROUND WATER BELOW TOC AFTER SLUG IS ADDED

$H_{@t}$ = DEPTH TO GROUND WATER BELOW TOC AT TIME = t

HR

.1 MIN: $\frac{8.406 - 8.620}{8.393 - 8.620} = \frac{.214}{.227} = .943$

.5 MIN: $\frac{8.444 - 8.620}{8.393 - 8.620} = \frac{.176}{.227} = .775$

1 MIN: $\frac{8.475 - 8.620}{8.393 - 8.620} = \frac{.145}{.227} = .639$

4 MIN: $\frac{8.503 - 8.620}{8.393 - 8.620} = \frac{.057}{.227} = .251$

6 MIN: $\frac{8.582 - 8.620}{8.393 - 8.620} = \frac{.038}{.227} = .167$

10 MIN: $\frac{8.601 - 8.620}{8.393 - 8.620} = \frac{.019}{.227} = .084$

$$\text{HYDRAULIC CONDUCTIVITY} = K = \frac{r^2}{2(t_1 - t_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

$$\Rightarrow K = \frac{(0.167)^2}{2(15 - 10.3)(10 - .1)} \ln\left[\frac{15 - 10.3}{0.417}\right] \ln\left[\frac{8.406 - 8.620}{8.601 - 8.620}\right]$$

$$= (0.000299)(2.422)(2.422)$$

$$= 1.75 \times 10^{-3}\ \text{FT/MIN}$$

$$= 2.92 \times 10^{-5}\ \text{FT/SEC}$$

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1199
WELL NUMBER: 1199

FIELD ENG./GEO.: C. GRUBE DATE: 05/25/89
CHECKED BY : BD DATE: 06/06/89
N,E COORDINATES: 480598.61, 1380213.2
DATE OF INSTAL.:

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: 8 IN. HOLLOW AUGER
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING PIEZOMETE
CASING DIAM.: 2.0 In. ID
CASING SIZE(S) USED: (Units N/A)
SIZE: N/A FROM: N/A TO: N/A
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: 0.020 (In.)
TOTAL PERFORATED AREA: 10. Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: SCHEDULE 40 PVC
RISER PIPE DIAMETERS:
O.D.: 2 5/16 In. I.D.: 2.0 In.
LENGTH OF 1ST PIPE SECTION: 10.0 Ft.
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: SCREW TYPE, FLUSH THREADED JOINT

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5.0 Ft.
PROTECTIVE PIPE O.D.: 4 3/ In.
* HINGED COVER WITH INSTALLED PA

OTHER PROTECTION (* NOTED BELOW)

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE	ELEVATION MSL
TOP OF RISER PIPE	2.0 Ft.	581.31
GROUND SURFACE	0.0	N/A
BOTTOM OF PROTECTIVE PIPE	2.7 Ft.	

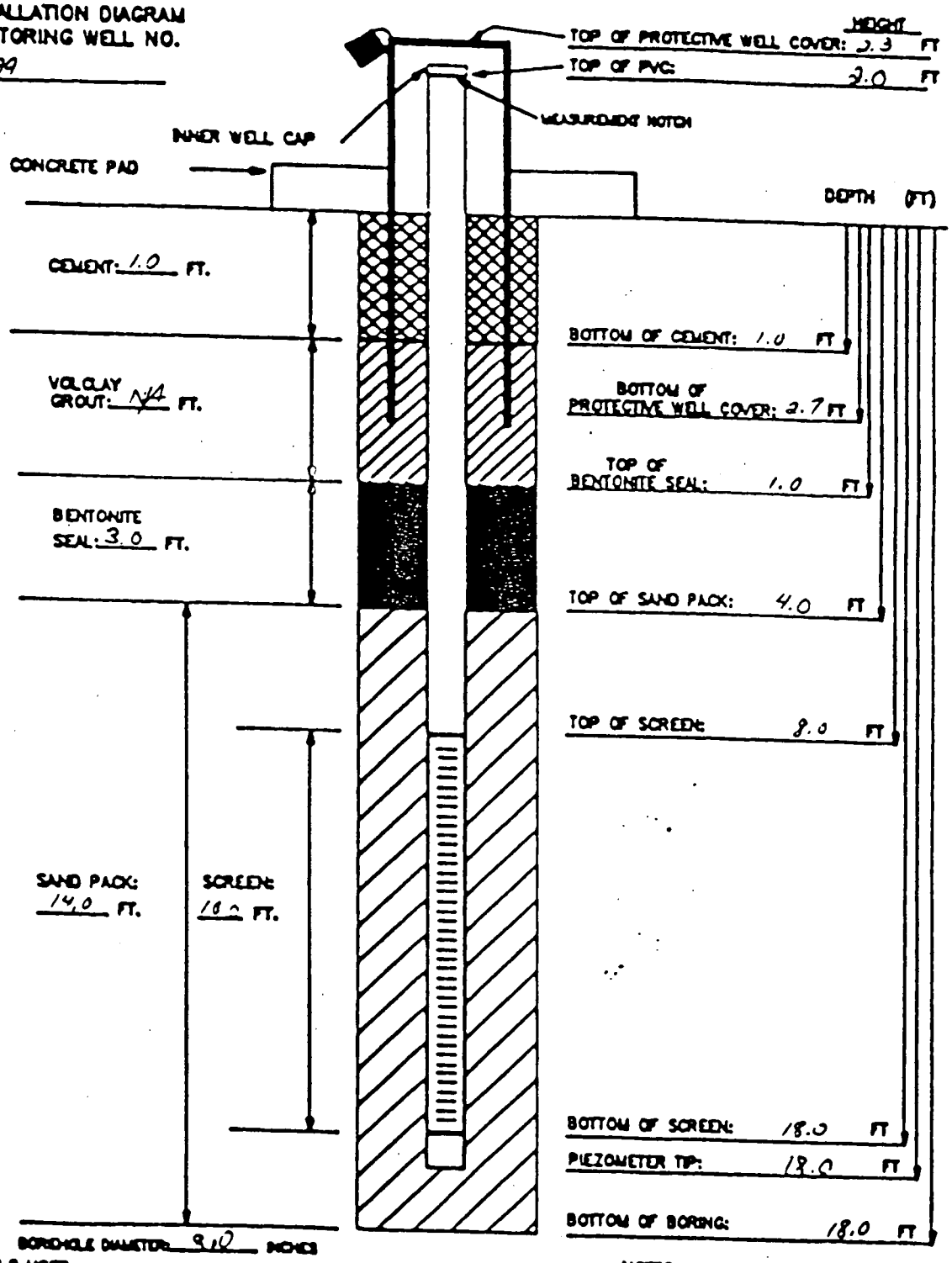
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
	0.0	1.0	N/A	N/A
Bentonite Pellets	1.0	4.0	N/A	N/A
Sand	4.0	18.0	N/A	N/A
PERFORATED SECTION	8.0	18.0	N/A	N/A
WELL TIP	18.00		N/A	
BOTTOM OF BOREHOLE	18.0		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
=1199

INSTALLATION DATE: 5-25-89



BOREHOLE DIAMETER: 8.10 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 3 50# sacks of 10/20 sand
BENTONITE PELLETS (5-GALLON BUCKETS): 1 1/2 buckets
BAGS OF VOLCLAY GROUT: 0/4
AMOUNT OF CEMENT: 1/2 Sack (94#)
AMOUNT OF WATER USED: 20 gal.
OTHER: 5.0 FT Protective casing

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED BAMP.
4) WATER DEPTH/DATE:

TASK: 1023

GEOLOGIST/ENGINEER: C. Grube

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1199	COORDINATES: NORTH 480,598.61 EAST 1,380,213.23	DATE: 05/25/89
GROUND ELEVATION: 580.01	GWL: Depth N/A Date/Time N/A	DATE STARTED: 05/25/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 05/25/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 3

DEPTH	SAMPLE / DATE / TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
0.5	16947 05/25/89 1024	3	2	SURFACE GRAVEL WITH UNCONSOLIDATED SANDY CLAY (10 YR 4/4) DARK YELLOWISH BROWN, DRY.	GC	NA	Hnu= 0 ppm α = 0 cpm BΓ = 8000 cpm
1.0	16948 05/25/89 1024	3	0	NO RECOVERY.			
1.5	16949 05/25/89 1024	4	0	NO RECOVERY.			
2.0	16950 05/25/89 1028	6	6	SANDY CLAY W/ TRACE SILT, (10 YR 5/4) YELLOWISH BROWN, LOW PLASTICITY, MOIST, TRACE SURFACE GRAVEL.	CL	.75	Hnu= 0 ppm α = 0 cpm BΓ = 700 cpm
2.5	16951 05/25/89 1028	7	6	SANDY CLAY W/ TRACE SILT, (10 YR 5/4) YELLOWISH BROWN, LOW PLASTICITY, MOIST, TRACE SURFACE GRAVEL.	CL	.75	Hnu= 0 ppm α = 0 cpm BΓ = 700 cpm
3.0	16952 05/25/89 1028	9	0	NO RECOVERY.			
3.5	16953 05/25/89 1033	9	6	SOFT SANDY CLAY W/ TRACE SILT, (10 YR 5/4) YELLOWISH BROWN, LOW PLASTICITY, MOIST, TRACE SURFACE GRAVEL.	CL	.25	Hnu= 0 ppm BΓ = 900 cpm
4.0	16954 05/25/89 1033	6	6	VERY STIFF (2.5 Y 4/2) DARK GREYISH BROWN, SILTY CLAY, TRACE SAND, LOW PLASTICITY, MOIST.	CL	2.25	Hnu= 0 ppm BΓ = 900 cpm
4.5	16955 05/25/89 1033	8	6	MEDIUM STIFF (2.5 Y 4/2) DARK GREYISH BROWN, SILTY CLAY, TRACE SAND. MEDIUM PLASTIC, MOIST.	CL	1.0	Hnu= 0 ppm BΓ = 900 cpm
5.0	16956 05/25/89 1040	10	6	(2.5 Y 4/4) OLIVE BROWN SILTY, CLAY W/ TRACE SAND. MED. PLASTIC, MOIST, MED. STIFF.	CL	.75 .75	Hnu= 0 ppm BΓ = 160-200cpm
5.5	16957 05/25/89 1040	6	5	MED. STIFF, (2.5 Y 4/4) OLIVE BROWN SILTY CLAY W/ TRACE SAND. MED. PLASTIC, MOIST.	CL	.75 .75	Hnu= 0 ppm BΓ = 160-200cpm
6.0	16958 05/25/89 1040	7	0	NO RECOVERY.			
6.5	16959 05/25/89 1040	4	0	NO RECOVERY.			
7.0	16960 05/25/89 1040	3	0	NO RECOVERY.			
7.5	16961 05/25/89 1040	4	0	NO RECOVERY.			
8.0	16962 05/25/89 1059	5	6	MEDIUM STIFF (5 Y 5/2) OLIVE GRAY TO (10 YR 5/6) YELLOWISH BROWN SILTY MOTTLED CLAY, TRACE SAND, MEDIUM PLASTIC, MOIST.	CL	.75	Hnu= 0 ppm BΓ = 300-320cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1199	COORDINATES: NORTH 480,598.61 EAST 1,380,213.23	DATE: 05/25/89
GROUND ELEVATION: 580.01	GWL: Depth N/A Date/Time N/A	DATE STARTED: 05/25/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 05/25/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	16963 05/25/89 1059	4	6	STIFF, (5 Y 5/2) OLIVE GRAY TO (10 YR 5/6) YELLOWISH BROWN SILTY MOTTLED CLAY, TRACE SAND, MEDIUM PLASTIC, MOIST.	CL	1.75	Hnu= 0 ppm BΓ = 300-320cpm
9.0	16964 05/25/89 1059	4	2	VERY STIFF, (5 Y 5/2) OLIVE GRAY TO (10 YR 5/6) YELLOWISH BROWN MOTTLED SILTY CLAY, SOME SAND, LOW PLASTICITY, MOIST.	CL	3.0	Hnu= 0 ppm BΓ = 300-320cpm
9.5	16965 05/25/89 1114	4	6	LOOSE, (10 YR 5/4) YELLOWISH BROWN CLAYEY SILT, MOIST.	ML	NA	Hnu= 0 ppm BΓ = 360-380cpm
10.0	16966 05/25/89 1114	4	2	LOOSE (5 Y 6/2) LIGHT OLIVE GREY, SILT SOME SAND, VERY MOIST.	ML	NA	Hnu= 0 ppm BΓ = 360-380cpm
10.5	16967 05/25/89 1114	4	0	NO RECOVERY.			
11.0	16968 05/25/89 1125	4	6	(10 YR 5/6) YELLOWISH BROWN SANDY, SILT, VERY MOIST, MEDIUM DENSE.	ML	NA	Hnu= 0 ppm BΓ = 170-200cpm
11.5	52055 05/25/89 1125	5	6	STIFF (10 YR 5/4) YELLOWISH BROWN TO (5 Y 6/1) LIGHT GRAY, VERY SILTY CLAY, TRACE SAND & FINE GRAVEL, MOIST.	CL	1.5	Hnu= 0 ppm BΓ = 170-200cpm
12.0	52056 05/25/89 1125	7	3	(2.5 Y 5/2) GREYISH BROWN SANDY SILT MOIST TO VERY MOIST, MEDIUM DENSE.	ML	NA	Hnu= 0 ppm BΓ = 170-200cpm
12.5	52057 05/25/89 1130	6	6	(2.5 Y 5/2) GREYISH BROWN, CLAYEY SILT SOME SAND, VERY MOIST, MEDIUM DENSE.	ML	NA	Hnu= 0 ppm BΓ = 100-140cpm
13.0	52058 05/25/89 1130	4	6	(10 YR 5/3) BROWN, CLAYEY SILT, MEDIUM DENSE, WET.	ML	NA	Hnu= 0 ppm BΓ = 100-140cpm
13.5	52059 05/25/89 1130	9	6	(10 YR 5/6) YELLOWISH BROWN, SILTY SAND, POORLY GRADED, VERY MOIST, MEDIUM DENSE. (10 YR 5/3) BROWN TO (5 Y 5/1) GRAY CLAYEY SILT SOME SAND, WET, MEDIUM DENSE.	SM ML	NA NA	Hnu= 0 ppm BΓ = 100-140cpm
14.0	52060 05/25/89 1356	4	6	(10 YR 5/3) BROWN, CLAYEY GRAVEL, WET, MEDIUM DENSE.	GC	NA	Hnu= 0 ppm BΓ = 100-140cpm
14.5	52061 05/25/89 1356	5	6	(10 YR 5/6) YELLOWISH BROWN, SILTY SAND, WET, MEDIUM DENSE.	SM	NA	Hnu= 0 ppm BΓ = 100-140cpm
15.0	52062 05/25/89 1356	8	6	(2.5 Y 5/2) GREYISH BROWN, WET, SILT MEDIUM DENSE.	ML	NA	Hnu= 0 ppm BΓ = 100-140cpm
15.5	52063 05/25/89 1410	10	6	(2.5 Y 3/2) VERY DARK GREYISH BROWN SANDY CLAY, TRACE FINE GRAVEL, STIFF, MOIST.	CL	1.25	Hnu= 0 ppm BΓ = 500 cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1199	COORDINATES: NORTH 480,598.61 EAST 1,380,213.23	DATE: 05/25/89
GROUND ELEVATION: 580.01	GWL: Depth N/A Date/Time N/A	DATE STARTED: 05/25/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 05/25/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.0	52064 05/25/89 1410	13	6	(2.5 Y 4/4) OLIVE BROWN CLAYEY GRAVEL SOME SAND, WET, MEDIUM DENSE.	GC	NA	Hnu= 0 ppm Br = 500 cpm
16.5	52065 05/25/89 1410	15	6	(5 Y 4/3) OLIVE SANDY SILT, WET, MEDIUM DENSE.	ML	NA	Hnu= 0 ppm Br = 500 cpm
17.0	52066 05/25/89 1428	12	6	(2.5 Y 4/4) OLIVE BROWN CLAYEY GRAVEL WET, MEDIUM DENSE.	GC	NA	Hnu= 0 ppm Br = 100-140cpm
17.5	52067 05/25/89 1428	15	6	(2.5 Y 5/4) LIGHT OLIVE BROWN SILTY CLAY TRACE SAND, LWO PLASTICITY, MOIST, STIFF.	CL	1.0	Hnu= 0 ppm Br = 100-140cpm
18.0	52068 05/25/89 1428	15	6	(2.5 Y 5/2) GRAYISH BROWN SANDY SILT, WET, MEDIUM DENSE.	ML	NA	Hnu= 0 ppm Br = 100-140cpm

BOTTOM OF BORING 18.0

NOTES:
BOTTOM OF BORING AND SAMPLING AT 18.0 FT.
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

FIELD PERMEABILITY TESTS
FALLING HEAD*

PROJECT: FMPC RI/FS
PROJECT NO.: 602.32.1
BORING NO.: 1199

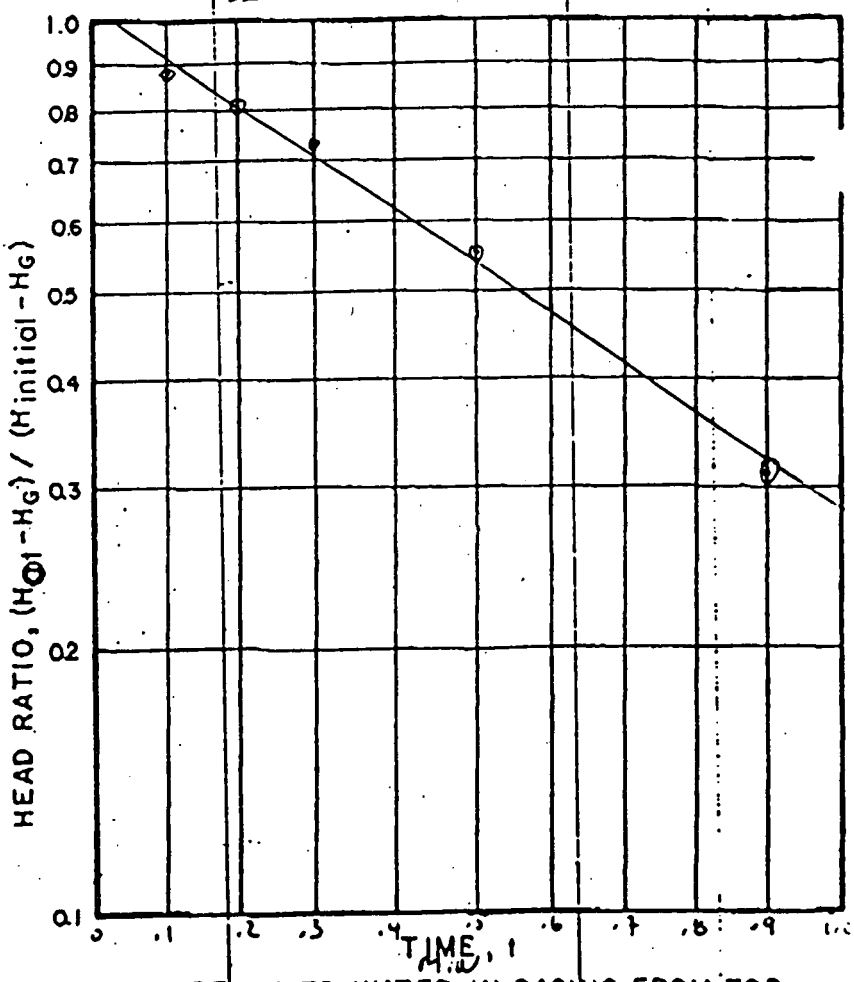
TESTED BY: MS/SA — DATE: 8-02-90
CALCULATED BY: MS — DATE: 10-20-90
CHECKED BY: RB, CB — DATE: 11/2/90, 11/19/90

RADIUS OF WELL, ~~R~~ r = 1 in = 0.0833 ft
RADIUS OF TEST BORING, R = 4 in = .333 ft
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C: 2.8 ft
DEPTH TO BOTTOM OF TEST POCKET, L_1: ~~18.0 ft~~ 20.0 ft
DEPTH TO TOP OF TEST POCKET, L_2: ~~7.46 ft~~ 10.0 ft
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G: 7.46 ft

HYDRAULIC CONDUCTIVITY, K: ~~2.37×10^{-5} ft/sec~~ ~~3.07×10^{-5} ft/sec~~ MS 11-19-90 2.04×10^{-5} ft/sec

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t SEC. MIN	DEPTH TO WATER IN CASING H FEET
0	6.779
.1	6.861
.2	6.912
.3	6.969
.5	7.082
.92	7.216
1	7.271
2	7.423
3	7.454
4	7.454
5	7.460



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

HYDRAULIC CONDUCTIVITY CALCULATIONS FOR B-1199

$$\text{HEAD RATIO} = \frac{H_{@t} - H_G}{H_i - H_G}$$

WHERE: H_G = DEPTH TO GROUND WATER BELOW TOC BEFORE SLUG IS ADDED

H_i = INITIAL DEPTH TO GROUND WATER BELOW TOC AFTER SLUG IS ADDED

$H_{@t}$ = DEPTH TO GROUND WATER BELOW TOC AT TIME = t

HR

.1min: $\frac{6.861 - 7.46}{6.779 - 7.46} = \frac{.599}{.681} = .880$

.2min: $\frac{6.912 - 7.46}{6.779 - 7.46} = \frac{.548}{.681} = .805$

.3min: $\frac{6.969 - 7.46}{6.779 - 7.46} = \frac{.491}{.681} = .721$

.5min: $\frac{7.082 - 7.46}{6.779 - 7.46} = .555$

.92min: $\frac{7.216 - 7.46}{6.779 - 7.46} = \frac{.244}{.681} = .368$

$$\text{HYDRAULIC CONDUCTIVITY} = K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

$$\Rightarrow K = \frac{(.0833)^2}{2(\cancel{18 - 7.46}\ 20 - 10)(.92 - .1)} \ln\left[\frac{\cancel{18 - 7.46}\ 20 - 10}{.333}\right] \ln\left[\frac{6.861 - 7.46}{7.216 - 7.46}\right]$$

$$= (0.0004)(\cancel{3.475}\ 3.402)(\cancel{1.029}\ 0.848)$$ MS 11-14-90

$$= \cancel{1.42 \times 10^{-5}\ FT/MIN}$$

$$= \cancel{2.37 \times 10^{-5}\ FT/SEC}$$

$$= (0.0004)(3.402)(0.848)$$

$$= \cancel{1.24 \times 10^{-5}\ FT/MIN}$$ MS 11-14-90

$$= 1.22 \times 10^{-5}\ FT/MIN$$

$$= \cancel{2.07 \times 10^{-5}\ FT/SEC}$$

$$= 2.04 \times 10^{-5}\ FT/SEC$$

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS FIELD ENG./GEO.: C. GRUBE DATE: 06/01/89
PROJECT NO. : 602.3.2 CHECKED BY : BD DATE: 06/05/89
BORING NO. : 1208 N,E COORDINATES: 480550.53, 1380198.7
WELL NUMBER: 1208 DATE OF INSTAL.: 05/31/89

BOREHOLE DRILLING

DRILLING METHOD: AUGER	TYPE OF BIT: 8 IN. HOLLOW AUGER
DRILLING FLUID(S) USED: NONE NOTED	IS CASING TEMPORARY?: No
NOTES COMMENTS:	CASING TYPE : MONITORING PIEZOMETE
	CASING DIAM.: 2.0 In. ID
	CASING SIZE(S) USED: (Units N/A)
	SIZE: N/A FROM: N/A TO: N/A
	SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL	RISER PIPE MATERIAL: SCHEDULE 40 PVC
DIAMETER OF PERFORATED SECTION:	RISER PIPE DIAMETERS:
PERFORATION TYPE: Slots	O.D.: 2 5/16 In. I.D.: 2.0 In.
AVG. SIZE OF PERFORATIONS: 0.020 (In.)	LENGTH OF 1ST PIPE SECTION: 10.0 Ft.
TOTAL PERFORATED AREA: 10. Ft.	2ND PIPE SECTION: Not Noted
NOTES/COMMENTS:	3RD PIPE SECTION: Not Noted
	COMMENTS

RISER JOINING METHOD: SCREW TYPE - FLUSH JOINT THREADED

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5.0 Ft.	OTHER PROTECTION (* NOTED BELOW)
PROTECTIVE PIPE O.D.: 4 3/ In.	
* HINGED PROTECTIVE COVER WITH I	

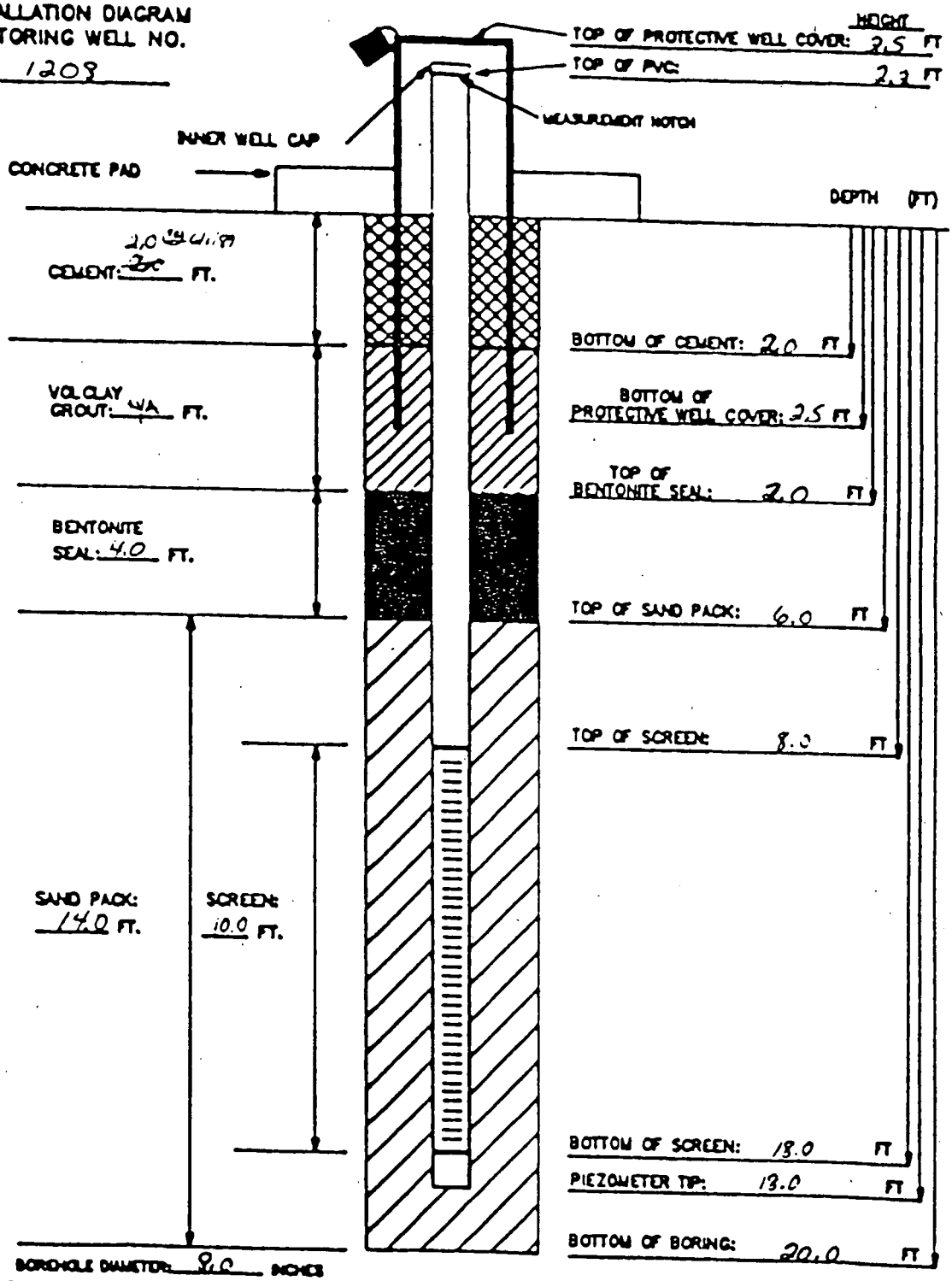
ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	2.2 Ft.		581.34	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	2.5 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
	0.0	2.0	N/A	N/A
Bentonite Pellets	2.0	6.0	N/A	N/A
Sand	6.0	20.0	N/A	N/A
PERFORATED SECTION	8.0	18.0	N/A	N/A
WELL TIP	18.0		N/A	
BOTTOM OF BOREHOLE	20.0		N/A	
GWL AFTER INSTALLATION	7.0		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1209

INSTALLATION DATE: 6/1/89 4/1/91



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 50 lbs sacks 10/20 sand
BENTONITE PELLETS (5-GALLON BUCKETS): 2 buckets
BAGS OF VOL CLAY GROUT: N/A
AMOUNT OF CEMENT: 1/3 sack (94 lb)
AMOUNT OF WATER USED: 10 gal
OTHER: 5.0 FT Protective casing

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 6023.7

GEOLOGIST/ENGINEER: C. Grabe

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1208	COORDINATES: NORTH 480,550.53 EAST 1,380,198.75	DATE: 05/31/89
GROUND ELEVATION: 579.97	GWL: Depth N/A Date/Time N/A	DATE STARTED: 05/31/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 06/01/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 3

DEPTH M	SAMPLE	DATE	TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
0.5	17145	05/31/89	1008	10	6	MEDIUM DENSE CLAYEY GRAVEL (SURFACE) TRACE SAND (10 YR 5/3) BROWN DRY.	GC	NA	Hnu= 0 ppm α = 0 cpm BΓ = 500 cpm
1.0	17146	05/31/89	1008	9	6	HARD (10 YR, 5/4) YELLOWISH BROWN SANDY CLAY, TRACE FINE GRAVEL, LOW PLASTICITY, DRY.	CL	4.5	Hnu= 0 ppm α = 0 cpm BΓ = 500 cpm
1.5	17147	05/31/89	1008	8	3	HARD (10 YR, 5/4) YELLOWISH BROWN SANDY CLAY, TRACE FINE GRAVEL, LOW PLASTICITY, DRY.	CL	4.5	Hnu= 0 ppm α = 0 cpm BΓ = 500 cpm
2.0	17148	05/31/89	1020	4	6	VERY STIFF (10 YR, 5/4) YELLOWISH BROWN SANDY CLAY, TRACE FINE GRAVEL, LOW PLASTICITY, SLIGHTLY MOIST.	CL	3.25	Hnu= 0 ppm α = 0 cpm BΓ = 120-140cpm
2.5	17149	05/31/89	1020	8	5	MEDIUM STIFF (5 Y 4/4) OLIVE SANDY CLAY, LOW PLASTICITY, SLIGHTLY MOIST.	CL	.5	Hnu= 0 ppm α = 0 cpm BΓ = 120-140cpm
3.0	17150	05/31/89	1020	11	0	NO RECOVERY.			
3.5	17151	05/31/89	1022	11	6	VERY STIFF (2.5 Y, 5/4) LIGHT OLIVE BROWN SANDY CLAY, TRACE FINE GRAVEL, LOW PLASTICITY, SLIGHTLY MOIST.	CL	2.75	Hnu= 0 ppm α = 0 cpm BΓ = 120-150cpm
4.0	17152	05/31/89	1022	14	6	STIFF (10 YR 3/3) DARK BROWN SILTY CLAY, LOW PLASTICITY, SLIGHTLY MOIST.	CL	1.75	Hnu= 0 ppm α = 0 cpm BΓ = 120-150cpm
4.5	17153	05/31/89	1022	13	4	STIFF (10 YR 3/2) VERY DARK GREYISH BROWN SANDY CLAY, LOW PLASTICITY, MOIST.	CL	1.0	Hnu= 0 ppm α = 0 cpm BΓ = 120-150cpm
5.0	17154	05/31/89	1041	4	6	MEDIUM STIFF (10 YR 4/2) DARK GREYISH BROWN, SANDY CLAY, MEDIUM PLASTICITY, MOIST.	CL	.5	Hnu= 0 ppm α = 0 cpm BΓ = 140-160cpm
5.5	17155	05/31/89	1041	4	5	STIFF, (2.5 Y 4/2) DARK GRAYISH BROWN, SILTY CLAY, TRACE OF SAND, MEDIUM PLASTICITY, MOIST.	CL	1.0	Hnu= 0 ppm α = 0 cpm BΓ = 140-160cpm
6.0	17156	05/31/89	1041	4	0	NO RECOVERY.			
6.5	17157	05/31/89	1044	6	6	SOFT (2.5 Y, 4/4) OLIVE BROWN SANDY CLAY, TRACE FINE GRAVEL, MEDIUM PLASTICITY, MOIST.	CL	.25	Hnu= 0 ppm α = 0 cpm BΓ = 100-120cpm
7.0	17158	05/31/89	1044	6	4	SOFT (2.5 Y 4/2) DARK GREYISH BROWN SANDY CLAY, TRACE FINE GRAVEL, MEDIUM PLASTICITY, MOIST.	CL	.25	Hnu= 0 ppm α = 0 cpm BΓ = 100-120cpm
7.5	17159	05/31/89	1041	7	0	NO RECOVERY.			
8.0	17160	05/31/89	1049	2	6	VERY LOOSE (10 YR, 5/4) YELLOWISH BROWN POORLY GRADED GRAVELLY SAND, VERY WET.	SP	NA	Hnu= 0 ppm α = 0 cpm BΓ = 200-240cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1208	COORDINATES: NORTH 480,550.53 EAST 1,380,198.75	DATE: 05/31/89
GROUND ELEVATION: 579.97	GWL: Depth N/A Date/Time N/A	DATE STARTED: 05/31/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 06/01/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 3

DEPTH	SAMPLE	DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	17161	05/31/89 1049	2	6	VERY LOOSE (10 YR, 5/4) YELLOWISH BROWN CLAYEY SAND, TRACE FINE GRAVEL, WET.	SC	NA	Hnu= 0 ppm α = 0 cpm βΓ = 200-240cpm
9.0	17162	05/31/89 1049	1	0	NO RECOVERY.			
9.5	17163	05/31/89 1125	1	6	VERY LOOSE (10 YR, 5/4) YELLOWISH BROWN CLAYEY SAND, TRACE FINE GRAVEL, WET.	SC	NA	Hnu= 0 ppm α = 0 cpm βΓ = 120-140cpm
10.0	17164	05/31/89 1125	1	4	VERY LOOSE (10 YR, 5/4) YELLOWISH BROWN POORLY GRADED GRAVELLY SAND, TRACE FINE GRAVEL, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 120-140cpm
10.5	17165	05/31/89 1125	1	0	NO RECOVERY.			
11.0	17166	05/31/89 1130	8	6	MEDIUM DENSE (2.5 Y 4/2) DARK GREYISH BROWN WELL GRADED, GRAVELLY SAND, WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
11.5	52195	05/31/89 1130	8	6	MEDIUM DENSE (2.5 Y 4/2) DARK GREYISH BROWN WELL GRADED, GRAVELLY SAND, WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
12.0	52196	05/31/89 1130	7	6	MEDIUM DENSE (10 YR, 5/4) YELLOWISH BROWN WELL GRADED SAND, TRACE FINE GRAVEL, TRACE CLAY, WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
12.5	52197	05/31/89 1320	6	6	MEDIUM DENSE (10 YR, 5/4) YELLOWISH BROWN WELL GRADED SAND, TRACE FINE GRAVEL, TRACE CLAY, WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 60-80 cpm
13.0	52198	05/31/89 1320	3	6	MEDIUM DENSE (10 YR, 5/4) YELLOWISH BROWN WELL GRADED SAND, TRACE FINE GRAVEL, TRACE CLAY, WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 60-80 cpm
13.5	52199	05/31/89 1320	10	6	MEDIUM DENSE (10 YR, 5/4) YELLOWISH BROWN WELL GRADED SAND, TRACE FINE GRAVEL, TRACE CLAY, WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 60-80 cpm
14.0	52200	05/31/89 1325	6	6	MEDIUM DENSE (10 YR, 5/4) YELLOWISH BROWN WELL GRADED SAND, TRACE FINE GRAVEL, TRACE CLAY, WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
14.5	52201	05/31/89 1325	8	6	MEDIUM DENSE (10 YR, 5/4) YELLOWISH BROWN WELL GRADED SAND, TRACE FINE GRAVEL, TRACE CLAY, WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
15.0	52202	05/31/89 1325	10	6	MED. DENSE (10 YR 4/6) DARK YELLOWISH BROWN POORLY GRADED SAND, WET. MED. DENSE (10 YR 4/6) DARK YELLOWISH BROWN SILTY SAND, WET.	SP SM	NA NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
15.5	52203	05/31/89 1340	12	6	MED. DENSE (10 YR, 5/4) YELLOWISH BROWN CLAYEY SAND, TRACE FINE GRAVEL, WET.	SC	NA	Hnu= 0 ppm α = 0 cpm βΓ = 120-140cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1208	COORDINATES: NORTH 480,550.53 EAST 1,380,198.75	DATE: 05/31/89
GROUND ELEVATION: 579.97	GWL: Depth N/A Date/Time N/A	DATE STARTED: 05/31/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 06/01/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 3

DEPTH	SAMPLE	DATE TIME	BLOWS ON	SAMPLE	RECOVERY	INCHES		USCS SYMBOL	TSF	REMARKS
16.0	52204	05/31/89 1340	14		6		MED. DENSE (2.5 Y, 4/2) DARK GRAYISH BROWN POORLY GRADED SAND, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 120-140cpm
16.5	52205	05/31/89 1340	15		6		MED. DENSE (2.5 Y, 4/2) DARK GRAYISH BROWN POORLY GRADED SAND, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 120-140cpm
17.0	52206	05/31/89 1345	7		6		MED. DENSE (2.5 Y, 4/2) DARK GRAYISH BROWN POORLY GRADED SAND, VERY MOIST.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
17.5	52207	05/31/89 1345	13		6		MED. DENSE (2.5 Y, 4/2) DARK GRAYISH BROWN POORLY GRADED SAND, VERY MOIST.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
18.0	52208	05/31/89 1345	12		6		MED. DENSE (2.5 Y, 4/2) DARK GRAYISH BROWN POORLY GRADED SAND, VERY MOIST.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
18.5	52209	05/31/89 1520	8		6		MED. DENSE (2.5 Y, 4/2) DARK GRAYISH BROWN POORLY GRADED SAND, VERY MOIST.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
19.0	52210	05/31/89 1520	10		6		MED. DENSE (2.5 Y, 4/2) DARK GRAYISH BROWN POORLY GRADED SAND, VERY MOIST.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
19.5	52211	05/31/89 1520	10		6		MED. DENSE (2.5 Y, 4/2) DARK GRAYISH BROWN POORLY GRADED SAND, VERY MOIST.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
20.0	52212	05/31/89 1520	10		6		MED. DENSE (2.5 Y, 4/2) DARK GRAYISH BROWN POORLY GRADED SAND, VERY MOIST.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm

BOTTOM OF BORING 20.0

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

1208

3637

FIELD PERMEABILITY TESTS
FALLING HEAD*

PROJECT FMPC LI/FS
PROJECT NO. 602 3.2.1
BORING NO. 1208

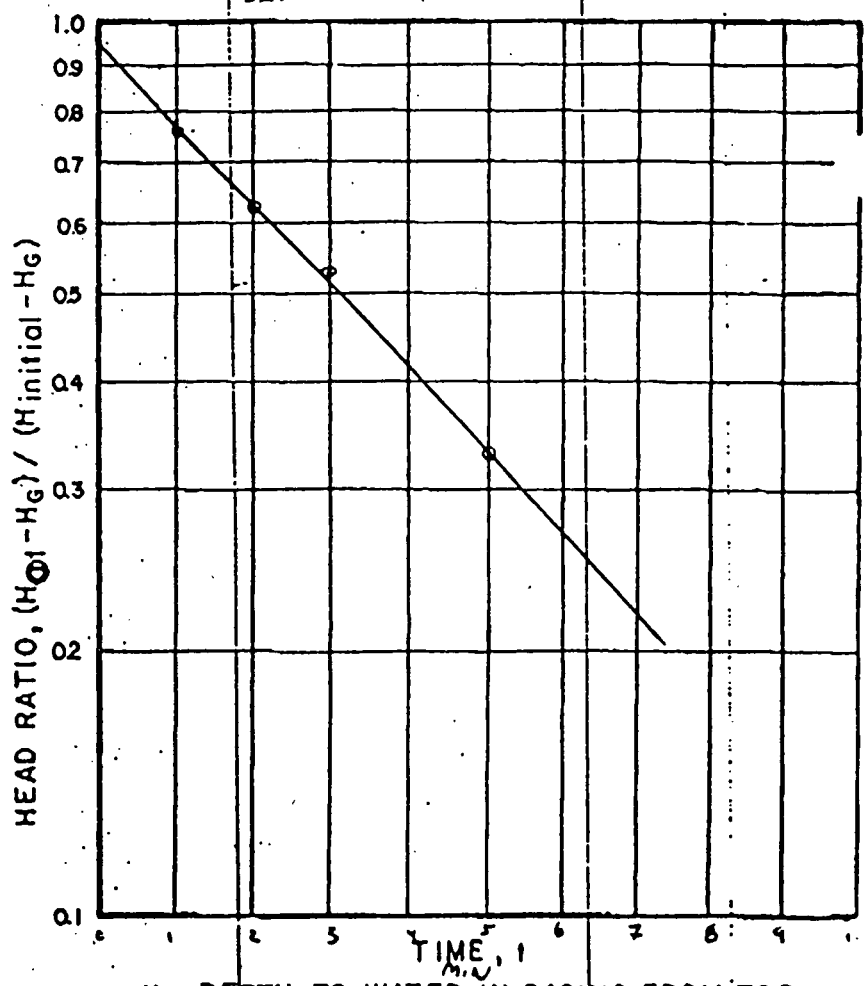
TESTED BY MS/BA DATE 8-01-90
CALCULATED BY MS DATE 10-21-90
CHECKED BY [illegible] DATE 11/2/90

RADIUS OF WELL, ~~R~~ r = 1 IN = 0.0833 FT
RADIUS OF TEST BORING, R = 4 IN = .333 FT
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C 2.8 FT
DEPTH TO BOTTOM OF TEST POCKET, L_1 ~~18.0 FT~~ 20.2 FT
DEPTH TO TOP OF TEST POCKET, L_2 ~~7.46 FT~~ 10.2 FT
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 7.46 FT

HYDRAULIC CONDUCTIVITY, K 5.90×10^{-6} FT/SEC

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t ~~SEC.~~ MIN	DEPTH TO WATER IN CASING H FEET
0	7.229
1	7.406
2	7.506
3	7.576
4	7.664
5	7.721
6	7.771
7	7.828
8	7.872
9	7.910
10	7.935
11	7.960



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1
H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

HYDRAULIC CONDUCTIVITY CALCULATIONS FOR B-1208

$$\text{HEAD RATIO} = \frac{H_{@t} - H_G}{H_i - H_G}$$

WHERE: H_G = DEPTH TO GROUND WATER BELOW TOC BEFORE SLUG IS ADDED

H_i = INITIAL DEPTH TO GROUND WATER BELOW TOC AFTER SLUG IS ADDED

$H_{@t}$ = DEPTH TO GROUND WATER BELOW TOC AT TIME = t

HR

1 MIN: $\frac{7.406 - 7.96}{7.229 - 7.96} = \frac{.554}{.731} = .758$

2 MIN: $\frac{7.506 - 7.96}{7.229 - 7.96} = \frac{.454}{.731} = .621$

3 MIN: $\frac{7.576 - 7.96}{7.229 - 7.96} = \frac{.384}{.731} = .525$

5 MIN: $\frac{7.721 - 7.96}{7.229 - 7.96} = \frac{.239}{.731} = .327$

9 MIN: $\frac{7.910 - 7.96}{7.229 - 7.96} = \frac{.05}{.731} = .068$

$$\text{HYDRAULIC CONDUCTIVITY} = K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

$$\Rightarrow K = \frac{(0.0833)^2}{2(\cancel{18-7.96}\ 20.2-10.2)(9-1)} \ln\left[\frac{\cancel{18-7.96}\ 20.2-10.2}{0.833}\right] \ln\left[\frac{7.406-7.96}{7.910-7.96}\right]$$

$$= (0.000043)(3.408)(2.405)$$

$$= 3.52 \times 10^{-4}\ \text{FT/MIN}$$

$$= 5.90 \times 10^{-6}\ \text{FT/SEC}$$

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1209
WELL NUMBER: 1209

FIELD ENG./GEO.: C. GRUBE — DATE: 06/01/89
CHECKED BY : BD — DATE: 07/02/89
N,E COORDINATES: 480549.50, 1380231.8
DATE OF INSTAL.:

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: 8 IN. - HOLLOW AUGER
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING PIEZOMETE
CASING DIAM.: 2.0 In. ID
CASING SIZE(S) USED: (Units N/A)
SIZE: N/A FROM: N/A TO: N/A
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: 0.020 (In.)
TOTAL PERFORATED AREA: 10. Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: SCHEDULE 40 PVC
RISER PIPE DIAMETERS:
O.D.: 2 5/16 In. I.D.: 2.0 In.
LENGTH OF 1ST PIPE SECTION: 8.5 Ft.
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: SCREW TYPE - FLUSH JOINTED - THREADED

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5.0 Ft.
PROTECTIVE PIPE O.D.: 4 3/ In.
* HINGED PROTECTIVE COVER WITH I

OTHER PROTECTION (* NOTED BELOW)

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	2.0 Ft.		581.43	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	2.6 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
	0.0	0.7	N/A	N/A
Bentonite Pellets	0.7	3.8	N/A	N/A
Sand	3.8	16.5	N/A	N/A
PERFORATED SECTION	6.5	16.5	N/A	N/A
WELL TIP	16.5		N/A	
BOTTOM OF BOREHOLE	16.5		N/A	
GWL AFTER INSTALLATION	16.5		N/A	

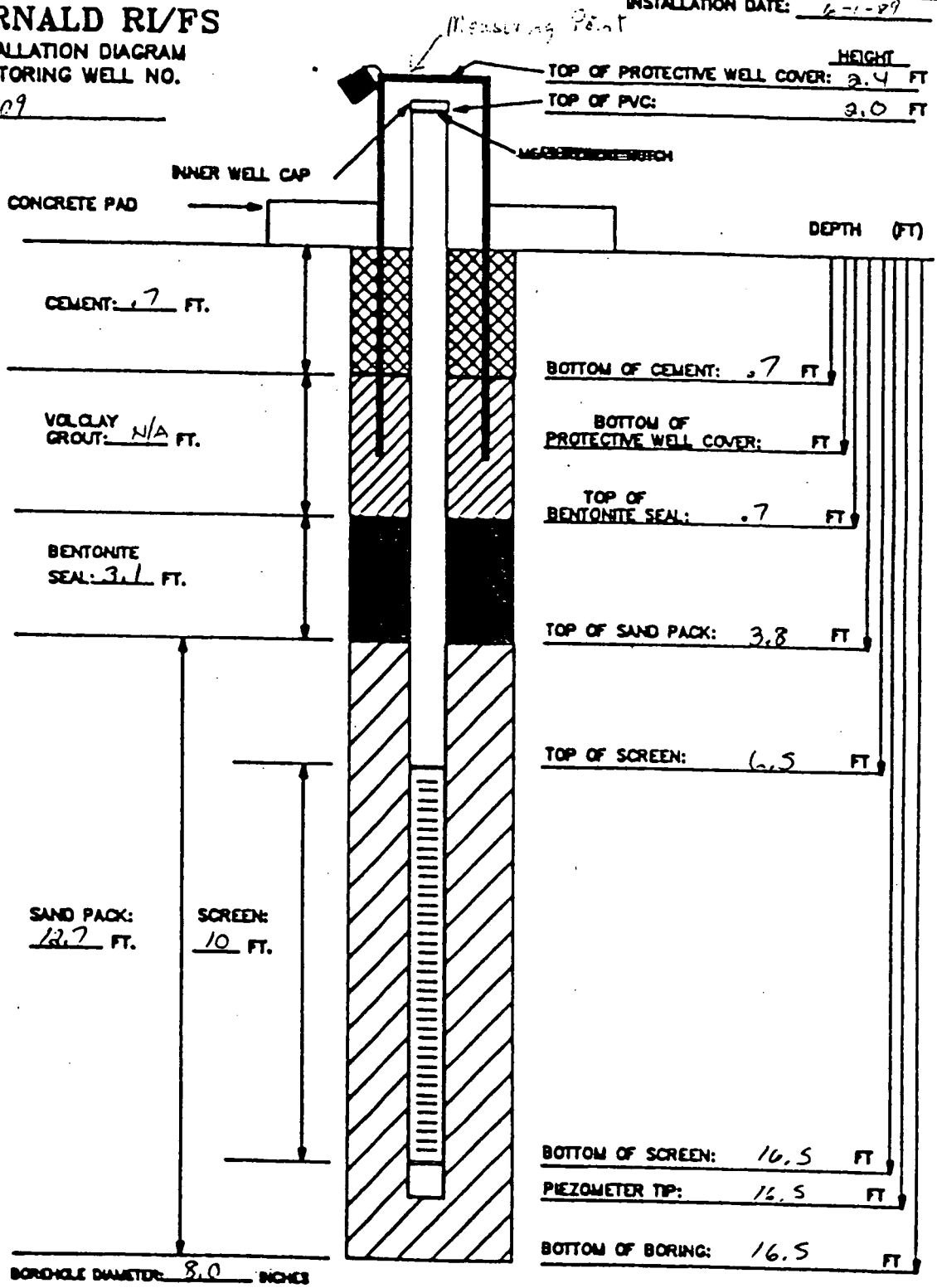
WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

3637

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1209

INSTALLATION DATE: 6-1-89



MATERIALS USED:

SAND TYPE AND QUANTITY: 3 (80 # sacks) #20 sand
BENTONITE PELLETS (5-GALLON BUCKETS): 1 bucket
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: ½ sack (94 #)
AMOUNT OF WATER USED: 10 gal
OTHER: 5.0 FT protective casing.

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 6.02 3.7

GEOLOGIST/ENGINEER: C. Grube

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1209	COORDINATES: NORTH 480,549.50 EAST 1,380,231.87	DATE: 06/01/89
GROUND ELEVATION: 579.82	GWL: Depth N/A Date/Time N/A	DATE STARTED: 06/01/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 06/01/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 3

DEPTH	SAMPLE / DATE / TIME	BLOWS ON SAMPLER	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
0.5	17167 06/01/89 1410	18	6	HARD (10 YR, 4/6) DARK YELLOWISH BROWN GRAVELLY CLAY, LOW PLASTICITY, DRY.	CL	4.0	Hnu= 0 ppm α = 0 cpm βΓ = 150-170cpm
1.0	17168 06/01/89 1410	13	6	HARD (10 YR, 4/6) DARK YELLOWISH BROWN GRAVELLY CLAY, LOW PLASTICITY, DRY.	CL	4.0	Hnu= 0 ppm α = 0 cpm βΓ = 150-170cpm
1.5	17169 06/01/89 1410	6	0	NO RECOVERY.			
2.0	17170 06/01/89 1416	7	6	HARD (10 YR, 4/6) DARK YELLOWISH BROWN GRAVELLY CLAY, LOW PLASTICITY, DRY. (2.5 Y, 4/4) OLIVE BROWN, MEDIUM STIFF, MOIST SANDY CLAY, TRACE FINE GRAVEL, MED. PLASTICITY.	CL CL	4.0 4.0	Hnu= 0 ppm α = 0 cpm βΓ = 130-150cpm
2.5	17171 06/01/89 1416	5	4	(2.5 Y, 4/4) OLIVE BROWN, MEDIUM STIFF, MOIST SANDY CLAY, TRACE FINE GRAVEL, MED. PLASTICITY.	CL	1.0	Hnu= 0 ppm α = 0 cpm βΓ = 130-150cpm
3.0	17172 06/01/89 1416	5	0	NO RECOVERY.			
3.5	17173 06/01/89 1422	7	6	SOFT (2.5 Y, 4/4) OLIVE BROWN, GRAVELLY CLAY, MEDIUM PLASTICITY, TRACE SAND, MOIST.	CL	0.5	Hnu= 0 ppm α = 0 cpm βΓ = 140-160cpm
4.0	17174 06/01/89 1422	5	4	SOFT (2.5 Y, 4/4) OLIVE BROWN, GRAVELLY CLAY, MEDIUM PLASTICITY, TRACE SAND, MOIST.	CL	0.5	Hnu= 0 ppm α = 0 cpm βΓ = 140-160cpm
4.5	17175 06/01/89 1422	3	0	NO RECOVERY.			
5.0	17176 06/01/89 1425	5	6	SOFT (2.5 Y, 4/4) OLIVE BROWN, GRAVELLY CLAY, TRACE SAND, MED PLASTICITY, MOIST.	CL	.25	Hnu= 0 ppm α = 0 cpm βΓ = 160-180cpm
5.5	17177 06/01/89 1425	4	2	SOFT (2.5 Y, 4/4) OLIVE BROWN, GRAVELLY CLAY, TRACE SAND, MED PLASTICITY, MOIST.	CL	.25	Hnu= 0 ppm α = 0 cpm βΓ = 160-180cpm
6.0	17178 06/01/89 1425	2	0	NO RECOVERY.			
6.5	17179 06/01/89 1427	6	6	SOFT (2.5 Y, 4/4) OLIVE BROWN GRAVELLY CLAY, TRACE SAND, MED PLASTIC, MOIST.	CL	.25	Hnu= 0 ppm α = 0 cpm βΓ = 180-200cpm
7.0	17180 06/01/89 1427	5	6	STIFF (2.5 Y 4/4) OLIVE BROWN GRAVELLY CLAY, TRACE SAND, MED PLASTIC, MOIST.	CL	1.25	Hnu= 0 ppm α = 0 cpm βΓ = 180-200cpm
7.5	17181 06/01/89 1427	9	6	MEDIUM DENSE (2.5 Y, 5/4) LIGHT OLIVE BROWN, TO (2.5 Y, 5/6) LIGHT OLIVE BROWN MOTTLED, SANDY SILT, TRACE FINE GRAVEL, V. M	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 180-200cpm
8.0	17182 06/01/89 1433	4	6	MED. DENSE (2.5 Y 4/4) OLIVE BROWN, CLAYEY GRAVEL SOME SAND, WET.	GC	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1209	COORDINATES: NORTH 480,549.50 EAST 1,380,231.87	DATE: 06/01/89
GROUND ELEVATION: 579.82	GWL: Depth N/A Date/Time N/A	DATE STARTED: 06/01/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 06/01/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 3

DEPTH	SAMPLE / DATE / TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	17183 06/01/89 1433	6	6	MED. DENSE (2.5 Y 5/4) LIGHT OLIVE BROWN CLAYEY SILT, SOME SAND, VERY MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
9.0	17184 06/01/89 1433	7	6	MED. DENSE (10 YR, 4/6) DARK YELLOWISH BROWN CLAYEY SAND, WET.	SC	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
9.5	17185 06/01/89 1503	2	6	LOOSE, (2.5 Y 5/4) LIGHT OLIVE BROWN CLAYEY SILT, TRACE GRAVEL, TRACE SAND, VERY MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 120-140cpm
10.0	17186 06/01/89 1503	1	6	LOOSE, (10YR 4/6) DARK YELLOWISH BROWN, POORLY GRADED SAND (SILTY) TRACE FINE GRAVEL, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 120-140cpm
10.5	17187 06/01/89 1503	1	0	NO RECOVERY.			
11.0	17188 06/01/89 1505	2	6	LOOSE (10 YR, 4/6) DARK YELLOWISH BROWN, POORLY GRADED SAND, TRACE SILT, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 120-140cpm
11.5	52215 06/01/89 1505	2	6	LOOSE (10 YR, 4/6) DARK YELLOWISH BROWN, POORLY GRADED SAND, TRACE SILT, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 120-140cpm
12.0	52216 06/01/89 1505	3	6	LOOSE (10 YR, 4/6) DARK YELLOWISH BROWN, POORLY GRADED SAND, TRACE SILT, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 120-140cpm
12.5	52217 06/01/89 1508	5	6	LOOSE (10 YR, 4/6) DARK YELLOWISH BROWN, POORLY GRADED SAND, TRACE SILT, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
13.0	52218 06/01/89 1508	11	6	LOOSE (10 YR, 4/6) DARK YELLOWISH BROWN, POORLY GRADED SAND, TRACE SILT, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
13.5	52219 06/01/89 1508	12	6	LOOSE (10 YR, 4/6) DARK YELLOWISH BROWN, POORLY GRADED SAND, TRACE SILT, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
14.0	52220 06/01/89 1520	10	6	MEDIUM DENSE, (2.5 Y, 5/6) LIGHT OLIVE BROWN, POORLY GRADED SAND W/ TRACE FINE GRAVEL, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
14.5	52221 06/01/89 1520	10	6	MEDIUM DENSE, (2.5 Y, 5/6) LIGHT OLIVE BROWN, POORLY GRADED SAND W/ TRACE FINE GRAVEL, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
15.0	52222 06/01/89 1520	9	6	MEDIUM DENSE, (2.5 Y, 5/6) LIGHT OLIVE BROWN, POORLY GRADED SAND W/ TRACE FINE GRAVEL, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
15.5	52223 06/01/89 1530	10	6	MEDIUM DENSE, (2.5 Y, 5/6) LIGHT OLIVE BROWN, POORLY GRADED SAND W/ TRACE FINE GRAVEL, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 140-150cpm

NOTES:
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FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

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ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 06/01/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.0	52224 06/01/89 1530	10	6	SOFT (VERY), (10 YR 5/4) YELLOWISH BROWN, SANDY CLAY, SOME SILT, VERY MOIST, TRACE GRAVEL.	CL	.25	Hnu= 0 ppm α = 0 cpm βΓ = 140-150cpm
16.5	52225 06/01/89 1530	6	6	MEDIUM DENSE (2.5 Y, 4/4) OLIVE BROWN GRAVELLY SAND, POORLY GRADED, TRACE SILT, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 140-150cpm
				BOTTOM OF BORING 16.5			

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1209

FIELD PERMEABILITY TESTS
FALLING HEAD*

3637

PROJECT FMPC RI/FS
PROJECT NO. 602 3.2.1
BORING NO. 1209

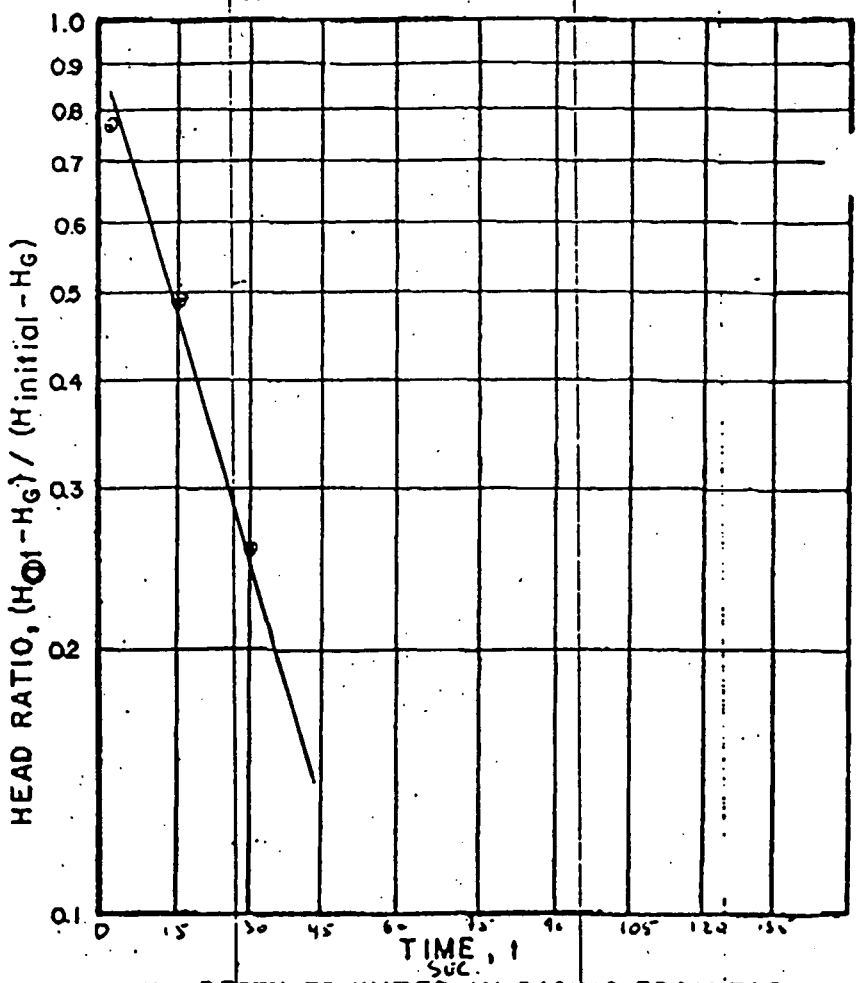
TESTED BY MS/BA DATE 8-02-90
CALCULATED BY MS DATE 10-21-90
CHECKED BY [illegible] DATE 11/2/90 11/19/90

RADIUS OF WELL, ~~R~~ r = 1 in = 0.0833 FT
RADIUS OF TEST BORING, R = 4 in = 0.333 FT
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C ~~2.4 FT~~ 2.0 FT
DEPTH TO BOTTOM OF TEST POCKET, L_1 ~~16.5 FT~~ 18.5 FT
DEPTH TO TOP OF TEST POCKET, L_2 ~~7.5 FT~~ 8.5 FT
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 7.5 FT

HYDRAULIC CONDUCTIVITY, K ~~8.88×10⁻⁵ FT/SEC~~ ~~5.58×10⁻⁵ FT/SEC~~ MS 11-19-90 5.22×10⁻⁵ FT/SEC

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t ~~SEC.~~ MIN	DEPTH TO WATER IN CASING H FEET
0	7.077
0.25	7.292
0.50	7.342
0.75	7.443
1.0	7.468
1.25	7.481
1.50	7.487
1.75	7.443
2.0	7.443
2.5	7.50



H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1
H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

HYDRAULIC CONDUCTIVITY CALCULATIONS FOR B-1209

HEAD RATIO $= \dfrac{H_{@t} - H_G}{H_i - H_G}$ WHERE: H_G = DEPTH TO GROUND WATER BELOW TOC BEFORE SLUG IS ADDED

H_i = INITIAL DEPTH TO GROUND WATER BELOW TOC AFTER SLUG IS ADDED

$H_{@t}$ = DEPTH TO GROUND WATER BELOW TOC AT TIME = t

HR

.25 min: $\dfrac{7.292-7.5}{7.077-7.5} = \dfrac{.208}{.423} = .492$

.5 min: $\dfrac{7.392-7.5}{7.077-7.5} = \dfrac{.108}{.423} = .255$

1.25 min ~~.75 min~~: $\dfrac{7.481-7.5}{7.077-7.5} = \dfrac{.019}{.423} = .045$

.75 min $\dfrac{7.443-7.5}{7.077-7.5} = \dfrac{0.057}{0.423} = .135$

.1 min: $\dfrac{7.184-7.5}{7.077-7.5} = \dfrac{.316}{.423} = .747$

.05 min: $\dfrac{7.140-7.5}{7.077-7.5} = \dfrac{.360}{.423} = .851$

HYDRAULIC CONDUCTIVITY $= K = \dfrac{r^2}{2(L_1-L_2)(t_2-t_1)} \ln\left[\dfrac{L_1-L_2}{R}\right] \ln\left[\dfrac{H_1-H_G}{H_2-H_G}\right]$

$\Rightarrow K = \dfrac{(0.0833)^2}{2(16.5-7.5)(.75-.05)} \ln\left[\dfrac{16.5-7.5}{.333}\right] \ln\left[\dfrac{7.140-7.5}{7.481-7.5}\right]$

$= (0.00055)(3.297)(2.942)$

$= 5.33 \times 10^{-3}$ FT/min

$= 8.88 \times 10^{-5}$ FT/sec

.05 to .75 min

$K = \dfrac{(0.0833)^2}{2(16.5-7.5)(.75-.05)} \ln\left[\dfrac{16.5-7.5}{.333}\right] \ln\left[\dfrac{7.140-7.5}{7.443-7.5}\right]$

$K = (0.00055071)(3.297)(1.843)$

$K = 3.35 \times 10^{-3}$ FT/min

$K = 5.58 \times 10^{-5}$ FT/sec

$(0.0005)(3.402)(1.843)$

$= 3.13 \times 10^{-3}$ FT/min

$= 5.22 \times 10^{-5}$ FT/min

.05 to 1.25 min

$K = \dfrac{(0.0833)^2}{2(16.5-7.5)(1.25-0.05)} \ln\left[\dfrac{16.5-7.5}{.333}\right] \ln\left[\dfrac{7.140}{7.481}\right]$

$K = \left(\dfrac{0.00693289}{21.6}\right)(3.297)(2.942)$

$K = (0.00032124)(3.297)(2.942)$

$= 3.12 \times 10^{-3}$ FT/min

$K = 5.2 \times 10^{-5}$ FT/min

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1212
WELL NUMBER: 1212

FIELD ENG./GEO.: E. TROLLINGER DATE: 11/02/89
CHECKED BY : BD DATE: 11/09/89
N,E COORDINATES: 480483.60, 1380175.4
DATE OF INSTAL.: 11/02/89

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: AUGER
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING PIEZOMETE
CASING DIAM.: 2.0 In. ID
CASING SIZE(S) USED: (Units N/A)
SIZE: N/A FROM: N/A TO: N/A
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: 0.020 (In.)
TOTAL PERFORATED AREA: 9.5 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: SCH. 40 PVC
RISER PIPE DIAMETERS:
O.D.: 2 5/16 In. I.D.: 2.0 In.
LENGTH OF 1ST PIPE SECTION: 6.5 Ft.
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: SCREW TYPE FLUSH JOINT.

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: .7 Ft.
PROTECTIVE PIPE O.D.: 4 5/ In.
* COVER PLATE

OTHER PROTECTION (* NOTED BELOW)

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	0.0 Ft.		579.42	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	0.6 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
	0.1	1.0	N/A	N/A
Bentonite Pellets	1.0	4.5	N/A	N/A
Sand	4.5	16.5	N/A	N/A
PERFORATED SECTION	6.5	16.0	N/A	N/A
WELL TIP	16.5		N/A	
BOTTOM OF BOREHOLE	16.5		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

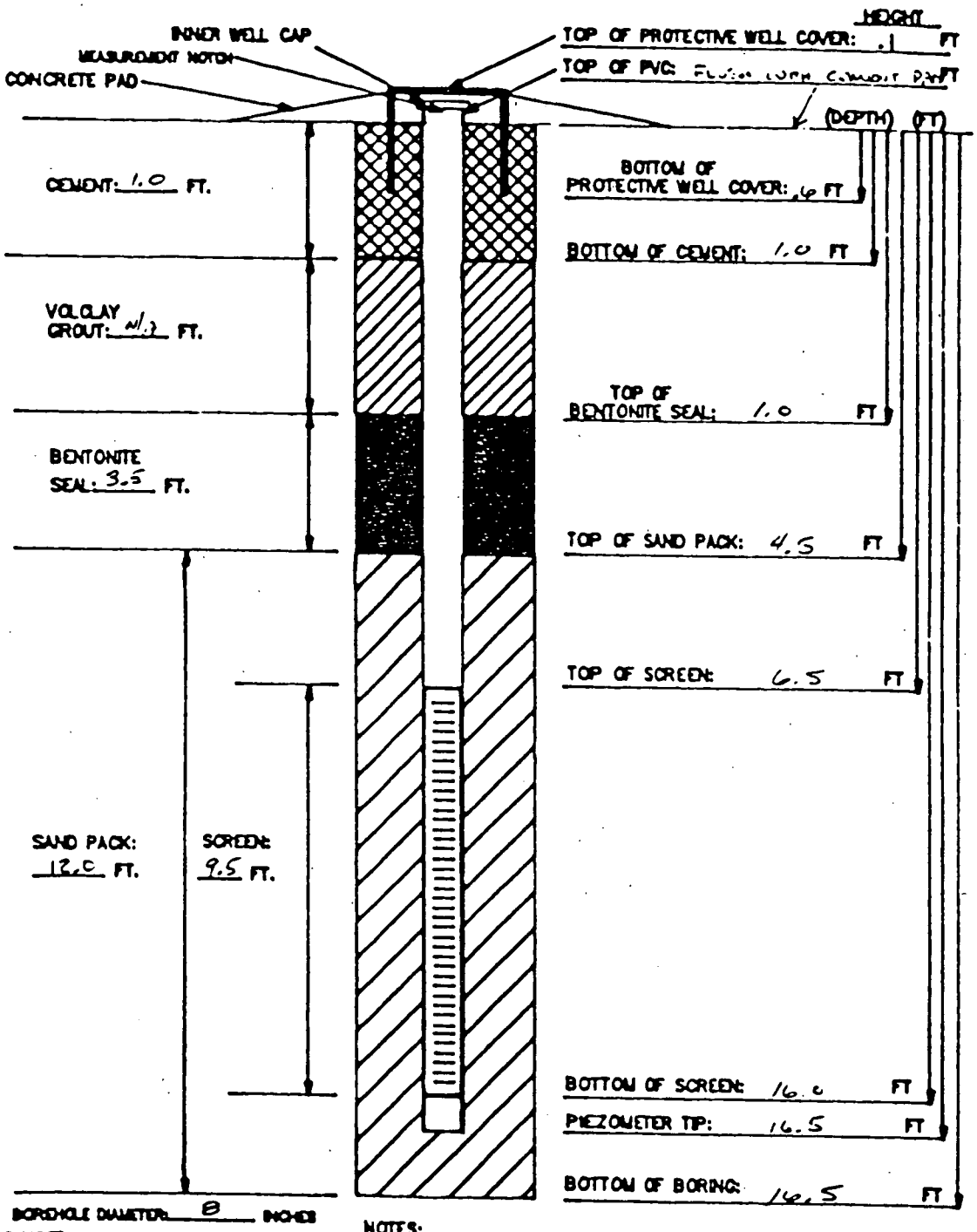
WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1212

INSTALLATION DATE: 11-02-89

3637



MATERIALS USED:

SAND TYPE AND QUANTITY: 10/20 2 bags
BENTONITE PELLETS (5-GALLON BUCKETS): 2
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: 1/2 bag.
AMOUNT OF WATER USED: 5 gals
OTHER:

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED BUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 3.7.1

GEOLOGIST/ENGINEER: E. Trellinger

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

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BORING NUMBER: 1212	COORDINATES: NORTH 480,483.60 EAST 1,380,175.49	DATE: 11/01/89
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ENGINEER/GEOLOGIST: E. TROLLINGER	Depth N/A Date/Time N/A	DATE COMPLETED: 11/02/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
1.0							
1.5	17233 11/01/89 1543	3	6	VERY STIFF, BROWNISH GRAY (10 YR 4/3) CLAY, TRACE OF FINE GRAVEL (MAINLY FROM BASE COARSE)(.25 - .5 IN) LOW PLASTICITY,	CL	3.0	Hnu= 0.0 ppm α = 0.0 cpm BΓ = 120 cpm
2.0	17234 11/01/89 1543	5	6	VERY STIFF, BROWNISH GRAY (10 YR 4/3) CLAY, TRACE OF FINE GRAVEL (MAINLY FROM BASE COARSE)(.25 - .5 IN) LOW PLASTICITY,	CL	3.0	Hnu= 0.0 ppm α = 0 cpm BΓ = 120-200cpm
2.5	17235 11/01/89 1543	5	5	VERY STIFF, BROWNISH GRAY (10 YR 4/3) CLAY, TRACE OF FINE GRAVEL (MAINLY FROM BASE COARSE)(.25 - .5 IN) LOW PLASTICITY,	CL	3.0	Hnu= 0.0 ppm α = 0 cpm BΓ = 120-200cpm
3.0	17236 11/01/89 1543	5		NO RECOVERY.			
3.5	17237 11/01/89 1547	5	6	VERY STIFF, BROWN (10 YR 4/2) CLAY, TRACE OF FINE GRAVEL, (.25 - .50 IN), MEDIUM PLASTICITY, MOIST.	CL	2.5	Hnu= 0.0 ppm α = 0 cpm BΓ = 180 cpm
4.0	17238 11/01/89 1547	7	6	VERY STIFF, VERY DARK GRAY TO BLACK (5 Y 3/1), SILTY CLAY, LOW PLASTICITY, MOIST.	CL	3.0	Hnu= 0.0 ppm α = 0 cpm BΓ = 180 cpm
4.5	17239 11/01/89 1547	10		NO RECOVERY.			
5.0	17240 11/01/89 1556	8	6	STIFF, GRAYISH BROWN (10 YR 4/2) CLAY, TRACE OF FINE GRAVEL, (.25 - .50 IN), MEDIUM PLASTICITY, MOIST.	CL	2.0	Hnu= 0.2 ppm α = 0 cpm BΓ = 180-200cpm
5.5	17241 11/01/89 1556	10	6	STIFF, GRAYISH BROWN (10 YR 4/2) CLAY, TRACE OF FINE GRAVEL, (.25 - .50 IN), MEDIUM PLASTICITY, MOIST.	CL	2.0	Hnu= 0.2 ppm α = 0 cpm BΓ = 180-200cpm
6.0	17242 11/01/89 1556	12	4	STIFF, GRAYISH BROWN (10 YR 4/2) CLAY, TRACE OF FINE GRAVEL, (.25 - .50 IN), MEDIUM PLASTICITY, MOIST.	CL	2.0	Hnu= 0.2 ppm α = 0 cpm BΓ = 180-200cpm
6.5	17243 11/02/89 0833	4	6	MEDIUM STIFF, GRAYISH BROWN (10 YR 4/2) CLAY, TRACE OF GRAVEL, (.25 - .50 IN), MEDIUM PLASTICITY, MOIST.	CL	1.0	Hnu= 0.3 ppm α = 0 cpm BΓ = 180-200cpm
7.0	17244 11/02/89 0833	8	5	MEDIUM STIFF, GRAYISH BROWN (10 YR 4/2) CLAY, TRACE OF GRAVEL, (.25 - .50 IN), MEDIUM PLASTICITY, MOIST.	CL	1.0	Hnu= 0.3 ppm α = 0 cpm BΓ = 180-200cpm
7.5	17245 11/02/89 0833	10		NO RECOVERY.			
8.0	17246 11/02/89 0845	3	6	SOFT, GRAYISH BROWN, (10 YR 4/3) CLAY, TRACE OF COARSE SAND (.25 IN), MEDIUM PLASTICITY, MOIST TO WET.	CL	<1.0	Hnu= 0.0 ppm α = 0 cpm BΓ = 110-130cpm

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FERNALD RI/FS

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ENGINEER/GEOLOGIST: E. TROLLINGER	Depth N/A Date/Time N/A	DATE COMPLETED: 11/02/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	17247 11/02/89 0845	2	6	SOFT, GRAYISH BROWN, (10 YR 4/3) CLAY, TRACE OF COARSE SAND (.25 IN), MEDIUM PLASTICITY, MOIST TO WET.	CL	.50	Hnu= 0.0 ppm α = 0 cpm βΓ = 110-130cpm
9.0	17248 11/02/89 0845	2	3	VERY LOOSE, BROWN (10 YR 4/4) POORLY GRADED SAND, TRACE OF SILT, WET.	SP	NA	Hnu= 0.0 ppm α = 0 cpm βΓ = 110-130cpm
9.5	17249 11/02/89 0850	3	6	LOOSE, BROWN (10 YR 4/3) SILTY SAND, POORLY GRADED, WET.	SM	NA	Hnu= 0.0 ppm α = 0 cpm βΓ = 200 cpm
10.0	17250 11/02/89 0850	3	6	LOOSE, BROWN (10 YR 4/3) SILTY SAND, POORLY GRADED, WET.	SM	NA	Hnu= 0.0 ppm α = 0 cpm βΓ = 200 cpm
10.5	17251 11/02/89 0850	3		NO RECOVERY.			
11.0	17252 11/02/89 0920	1	6	LOOSE, BROWN (10 YR 4/3) SILTY SAND, TRACE OF SAND (.25 COARSE) WET.	SM	NA	Hnu= 0.0 ppm α = 0 cpm βΓ = 180-200cpm
11.5	17253 11/02/89 0920	2	4	LOOSE, BROWN (10 YR 4/3) SILTY SAND, TRACE OF SAND (.25 COARSE) WET.	SM	NA	Hnu= 0.0 ppm α = 0 cpm βΓ = 180-200cpm
12.0	17254 11/02/89 0920	3		NO RECOVERY.			
12.5	52235 11/02/89 0922	4	6	LOOSE, BROWN (10 YR 4/3) SILTY SAND, TRACE OF FINE GRAVEL (.50 IN), WET.	SM	NA	Hnu= 0.0 ppm α = 0 cpm βΓ = 180 cpm
13.0	52236 11/02/89 0922	4	6	LOOSE, BROWN (10 YR 4/3) SILTY SAND, TRACE OF FINE GRAVEL (.50 IN), WET.	SM	NA	Hnu= 0.0 ppm α = 0 cpm βΓ = 180 cpm
13.5	52237 11/02/89 0922	7		NO RECOVERY.			
14.0	52238 11/02/89 0930	13	6	MEDIUM DENSE, BROWN (10 YR 4/3) SILTY SAND, TRACE OF COARSE SAND (.25 IN), WET.	SM	NA	Hnu= 0.0 ppm α = 0 cpm βΓ = 120 cpm
14.5	52239 11/02/89 0930	13	6	MEDIUM DENSE, BROWN (10 YR 4/3) SILTY SAND, TRACE OF COARSE SAND (.25 IN), WET.	SM	NA	Hnu= 0.0 ppm α = 0 cpm βΓ = 120 cpm
15.0	52240 11/02/89 0930	15	3	MEDIUM DENSE, BROWN (10 YR 4/3) SILTY SAND, TRACE OF COARSE SAND (.25 IN), WET.	SM	NA	Hnu= 0.0 ppm α = 0 cpm βΓ = 120 cpm
15.5	52241 11/02/89 0945	1	4	MEDIUM STIFF, GRAY (10 YR 4/1) CLAY, TRACE OF GRAVEL (.25 - .50 IN), MEDIUM PLASTICITY, MOIST.	CL	1.0	Hnu= 0.0 ppm α = 0 cpm βΓ = 110-120cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1212	COORDINATES: NORTH 480,483.60 EAST 1,380,175.49	DATE: 11/01/89
GROUND ELEVATION: 579.78	GWL: Depth N/A Date/Time N/A	DATE STARTED: 11/01/89
ENGINEER/GEOLOGIST: E. TROLLINGER	Depth N/A Date/Time N/A	DATE COMPLETED: 11/02/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.0	52242 11/02/89 0945	3		NO RECOVERY.			
16.5	52243 11/02/89 0945	3		NO RECOVERY.			
				BOTTOM OF BORING 16.5			

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

1212
3637

FIELD PERMEABILITY TESTS
FALLING HEAD*

PROJECT FMPC R1/FS
PROJECT NO. 60L 3.2.1
BORING NO. 1212

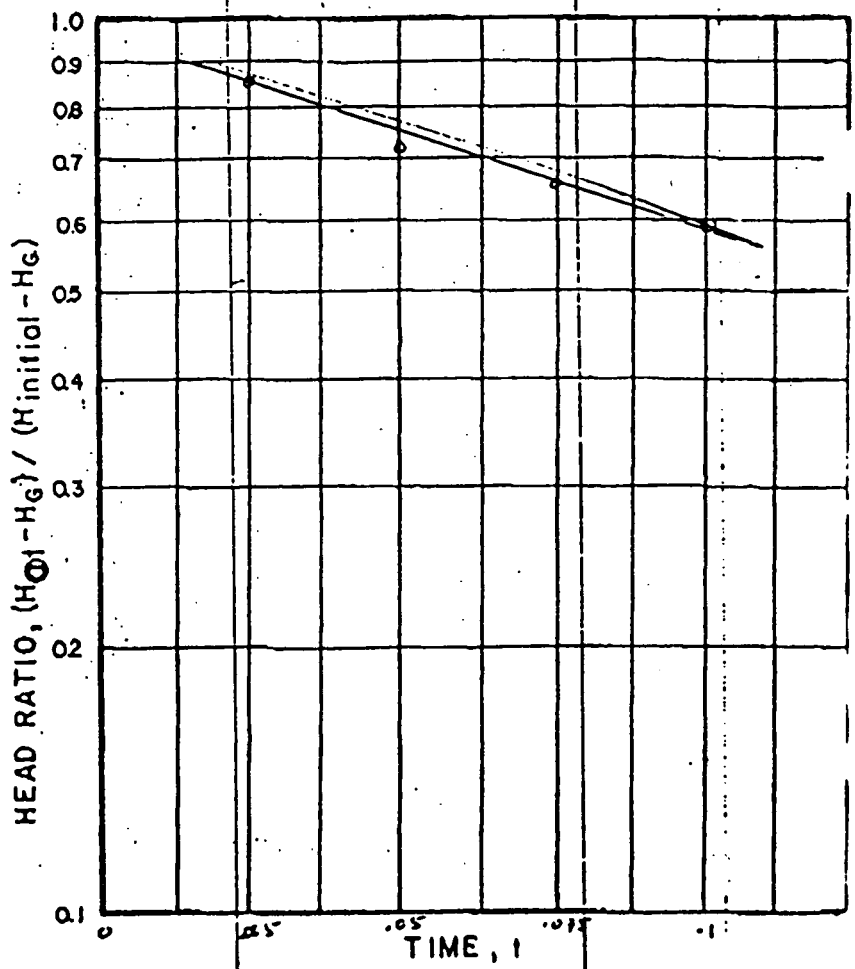
TESTED BY MS/SM DATE 8-08-90
CALCULATED BY MS DATE 10-23-90
CHECKED BY [illegible] DATE 11/2/90 11/14/90

RADIUS OF WELL, r = 1 in = 0.0833 FT.
RADIUS OF TEST BORING, R = 4 in = 0.333 FT
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C 0.1 FT
DEPTH TO BOTTOM OF TEST POCKET, L_1 ~~16.0 FT~~ 16.6 FT
DEPTH TO TOP OF TEST POCKET, L_2 ~~6.0 FT~~ 6.6 FT
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 6.00 FT

HYDRAULIC CONDUCTIVITY, K ~~4.6×10⁻⁵ FT/SEC~~ ~~4.06×10⁻⁵ FT/SEC~~ MS 11-14-90 4.07×10⁻⁵ FT/SEC

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t SEC. MIN	DEPTH TO WATER IN CASING H FEET
0	5.941
0.025	5.960
0.1	5.948
0.2	6.023
0.3	6.042
0.5	6.055
1	6.067
2	6.067
3	6.074
4.5	6.080



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

HYDRAULIC CONDUCTIVITY CALCULATIONS FOR B-12L2

HEAD RATIO = $\frac{H_{@t} - H_G}{H_i - H_G}$ WHERE: H_G = DEPTH TO GROUND WATER BELOW TOC BEFORE SLUG IS ADDED

H_i = INITIAL DEPTH TO GROUND WATER BELOW TOC AFTER SLUG IS ADDED

$H_{@t}$ = DEPTH TO GROUND WATER BELOW TOC AT TIME = t

HR

0.001 MIN: $\frac{5.947-6.08}{5.941-6.08} = \frac{.133}{.139} = .957$

0.05 MIN: $\frac{5.967-6.08}{5.941-6.08} = \frac{.113}{.139} = .813$

0.1 MIN: $\frac{5.998-6.08}{5.941-6.08} = \frac{0.082}{.139} = .590$

1 MIN: $\frac{6.067-6.08}{5.941-6.08} = \frac{0.013}{.139} = .094$

HYDRAULIC CONDUCTIVITY = $K = \frac{r^2}{2(L_1-L_2)(t_2-t_1)} \ln\left[\frac{L_1-L_2}{R}\right] \ln\left[\frac{H_1-H_G}{H_2-H_G}\right]$

$\Rightarrow K = \frac{(0.0833)^2}{2(\cancel{16-6.08}\ 16.6-6.6)(1-.001)} \ln\left[\frac{\cancel{16-6.08}\ 16.6-6.6}{.333}\right] \ln\left[\frac{5.947-6.08}{6.067-6.08}\right]$

$= (0.00035)(3.394)(2.325)$

$= 2.76 \times 10^{-3}$ FT/MIN

$= 4.6 \times 10^{-5}$ FT/SEC

FOR t: 0.1 to 1 : $K = \frac{(0.0833)^2}{2(\cancel{16-6.08}\ 16.6-6.6)(1-.1)} \ln\left[\frac{\cancel{16-6.08}\ 16.6-6.6}{.333}\right] \ln\left[\frac{5.98-6.08}{6.067-6.08}\right]$

$= (0.00039)(\cancel{3.394}\ 3.402)(1.64)$

$= \cancel{2.44 \times 10^{-3}\ FT/MIN}$ $= 2.44 \times 10^{-5}$ F/M

$= \cancel{4.06 \times 10^{-5}\ FT/SEC}$ $= 4.07 \times 10^{-5}$ F/S

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1213
WELL NUMBER: 1213

FIELD ENG./GEO.: M. SLUSARSKI DATE: 06/04/89
CHECKED BY : BD DATE: 07/02/89
N,E COORDINATES: 480519.86, 1380217.8
DATE OF INSTAL.: 06/04/89

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: AUGER (HOLLOW STEM)
IS CASING TEMPORARY?: No
CASING TYPE : PIEZOMETER
CASING DIAM.: 2.0 In. ID
CASING SIZE(S) USED: (in Feet)
SIZE: 4 1 FROM: 0.0 TO: 10.5
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL

RISER PIPE MATERIAL: PVC - SCHEDULE 40

DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: .020 (In.)
TOTAL PERFORATED AREA: 4.8 Ft.
NOTES/COMMENTS:

RISER PIPE DIAMETERS:
O.D.: 2 5/16 In. I.D.: 2.0 In.
LENGTH OF 1ST PIPE SECTION:
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: SCREW TYPE FLUSH JOINT THREADED

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 7.0 In.
PROTECTIVE PIPE O.D.: 4 3/ In.
* NONE

OTHER PROTECTION (* NOTED BELOW)

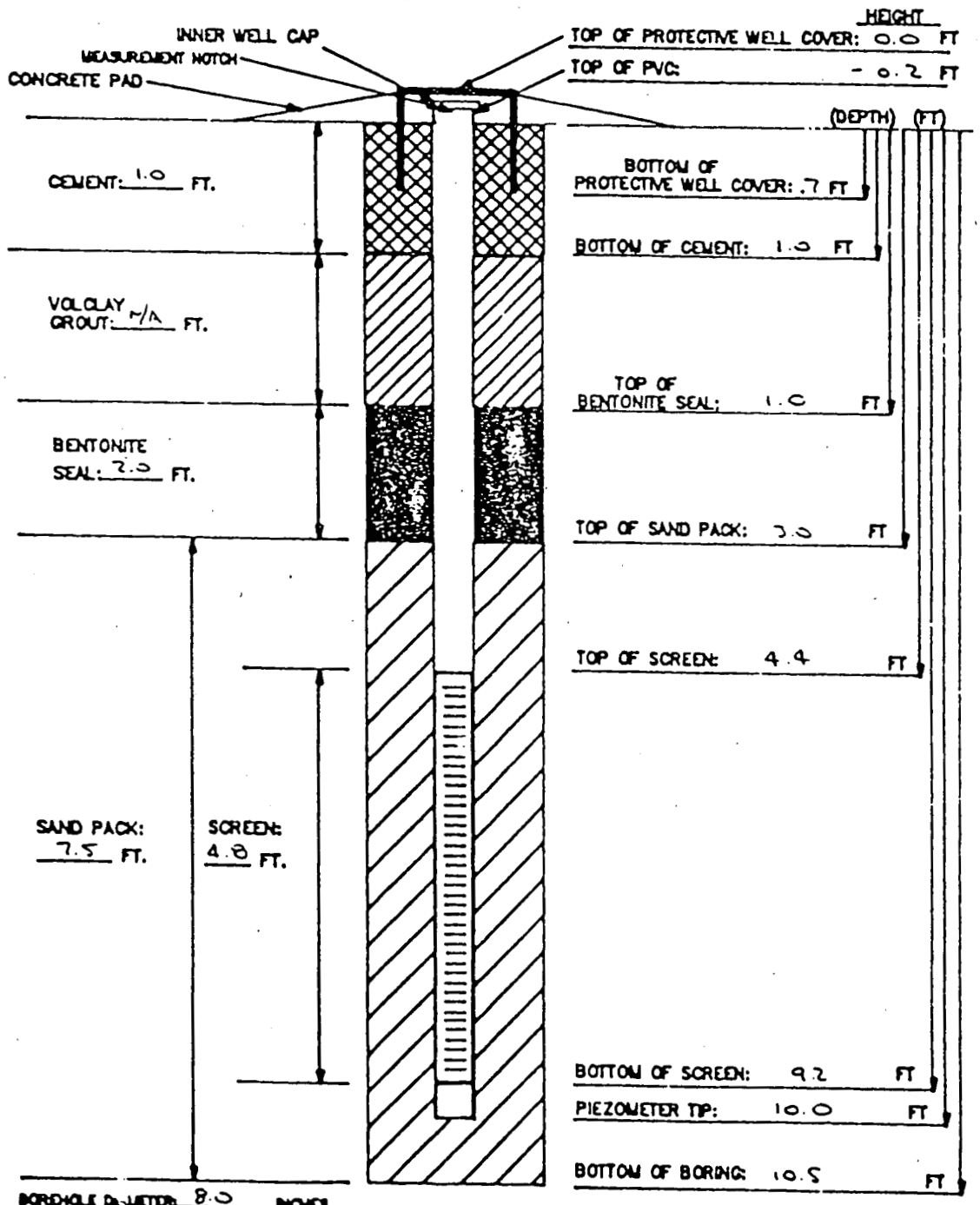
ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	0.2 Ft.		579.39	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	0.7 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
	0.0	1.0	N/A	N/A
Bentonite Pellets	1.0	3.0	N/A	N/A
Sand	3.0	10.5	N/A	N/A
PERFORATED SECTION	4.4	9.2	N/A	N/A
WELL TIP	10.0		N/A	
BOTTOM OF BOREHOLE	10.5		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
#1213

INSTALLATION DATE: 06-04-87



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:

SAND TYPE AND QUANTITY: 2-10/20 SOUTH OAKS
BENTONITE PELLETS (5-GALLON BUCKETS): 1
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: ½ 50-LB BAG
AMOUNT OF WATER USED: 25 GAL
OTHER:

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602 77.1 GEOLOGIST/ENGINEER: E. [illegible]

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1213	COORDINATES: NORTH 480,519.86 EAST 1,380,217.86	DATE: 06/04/89
GROUND ELEVATION: 579.60	GWL: Depth N/A Date/Time N/A	DATE STARTED: 06/04/89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth N/A Date/Time N/A	DATE COMPLETED: 06/04/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
0.5	17255 06/04/89 0817	2	2	MEDIUM DENSE, GREY/BROWN (10 YR 5/2) WELL GRADED GRAVEL-SAND MIXTURE, SOME GRAVEL (.50 - 1.0 IN) DAMP.	GW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-90 cpm
1.0	17256 06/04/89 0817	3		NO RECOVERY OVER INTERVAL (.5 - 1.0 FT).			
1.5	17257 06/04/89 0817	20		NO RECOVERY OVER INTERVAL (1.0 - 1.5 FT).			
2.0	17258 06/04/89 0847	8	6	VERY STIFF, BROWN (10 YR 4/4) SILTY CLAY, TRACE GRAVEL (.25 - .50 IN) DAMP 1.7 FT. VERY STIFF, DARK GREY (10 YR 3/2) SILTY CLAY, TRACE GRAVEL (.25 - .50 IN.) DAMP.	CL	3.25 3.25	Hnu= 0 ppm α = 0 cpm βΓ = 80-90 cpm
2.5	17259 06/04/89 0847	13		NO RECOVERY OVER INTERVAL (2.0 - 2.5 FT).			
3.0	17260 06/04/89 0847	14		NO RECOVERY OVER INTERVAL (2.5 - 3.0 FT.).			
3.5	17261 06/04/89 0852	12	6	STIFF, DARK GREY (10 YR 3/1) SILTY CLAY, DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-90 cpm
4.0	17262 06/04/89 0852	14		NO RECOVERY OVER INTERVAL (3.5 - 4.0 FT).			
4.5	17263 06/04/89 0852	15		NO RECOERY OVER INTERVAL (4.0 - 4.5 FT).			
5.0	17264 06/04/89 0904	3	6	MEDIUM STIFF, OLIVE-BROWN (5 Y 4/3) SILTY CLAY, DAMP.	CL	1.0	Hnu= 4 ppm α = 0 cpm βΓ = 100-120cpm
5.5	17265 06/04/89 0904	4		NO RECOVERY OVER INTERVAL (5.0 - 5.5 FT).			
6.0	17266 06/04/89 0904	4		NO RECOVERY OVER INTERVAL (5.5 - 6.0 FT).			
6.5	17267 06/04/89 0906	3	12	STIFF, OLIVE-GREY (5 Y 4/2) SILTY CLAY, DAMP.	CL	1.5	Hnu= 20+ ppm α = 0 cpm βΓ = 120-140cpm
7.0	17268 06/04/89 0906	3	12	STIFF, OLIVE-GREY/BROWN (5Y 5/2) SILTY CLAY, DAMP.	CL	1.5	Hnu= 20+ ppm α = 0 cpm βΓ = 120-140cpm
7.5	17269 06/04/89 0906	4		NO RECOVERY OVER INTERVAL (7.0 - 7.5 FT).			
8.0	17270 06/04/89 0908	5	18	MEDIUM DENSE, YELLOW-BROWN (10 YR 4/4) SAND-SILT MIXTURE, WET.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1213	COORDINATES: NORTH 480,519.86 EAST 1,380,217.86	DATE: 06/04/89
GROUND ELEVATION: 579.60	GWL: Depth N/A Date/Time N/A	DATE STARTED: 06/04/89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth N/A Date/Time N/A	DATE COMPLETED: 06/04/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	17271 06/04/89 0908	7	18	MEDIUM DENSE, YELLOW-BROWN (10 YR 4/4) SAND-SILT MIXTURE, WET.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm
9.0	17272 06/04/89 0908	4	18	MEDIUM DENSE, YELLOW-BROWN (10 YR 4/4) SAND-SILT MIXTURE, WET.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm
9.5	17273 06/04/89 0946	4	12	MEDIUM DENSE, YELLOW-BROWN (10 YR 4/4) SAND-SILT MIXTURE, WET.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm
10.0	17274 06/04/89 0946	3	12	MEDIUM DENSE, YELLOW-BROWN (10 YR 4/4) SAND-SILT MIXTURE, WET. STIFF, GREY (10 YR 5/1) SILTY CLAY DAMP.	SM CL	NA NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm
6.5							

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1213	COORDINATES: NORTH 480,519.86 EAST 1,380,217.86	DATE: 06/04/89
GROUND ELEVATION: 579.60	GWL: Depth N/A Date/Time N/A	DATE STARTED: 06/04/89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth N/A Date/Time N/A	DATE COMPLETED: 06/04/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
7.0	17276 06/04/89 0906	3	12	STIFF, OLIVE-GREY/BROWN (5Y 5/2) SILTY CLAY, DAMP.	CL	1.5	Hnu= 20+ ppm α = 0 cpm Bγ = 120-140cpm

BOTTOM OF BORING 10.5

NOTES:
Hnu RAPIDLY DISSAPATED TO 0-2 PPM, 4-VOA SAMPLES COLLECTED FROM INTERVAL 6.5 - 7.0 FT.
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

1213

FIELD PERMEABILITY TESTS
FALLING HEAD*

3637

PROJECT FMPC RI/FS
PROJECT NO. 602 3.7.4
BORING NO. 1213

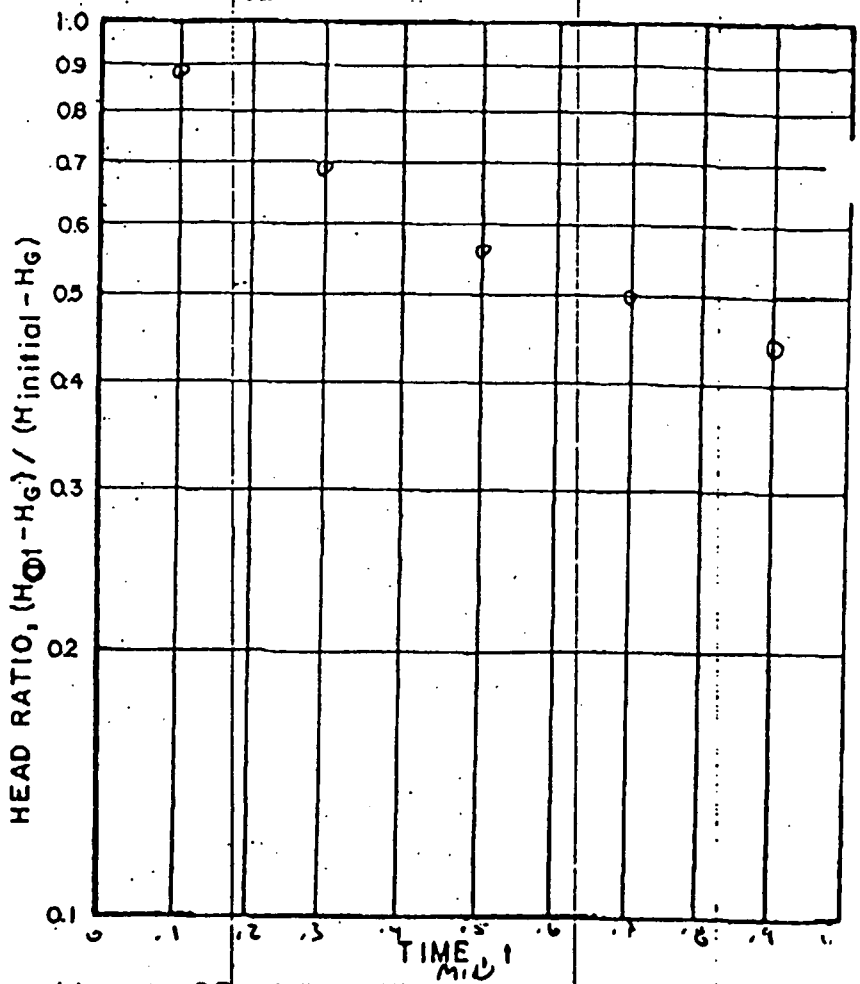
TESTED BY MS/SA DATE 8-08-90
CALCULATED BY MS DATE 10-20-90
CHECKED BY CB DATE 11/2/90 11/6/90

RADIUS OF WELL, r = 1 IN = 0.0833 FT
RADIUS OF TEST BORING, R = 4 IN = .333 FT
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C 0.0 FT
DEPTH TO BOTTOM OF TEST POCKET, L_1 10.0 FT
DEPTH TO TOP OF TEST POCKET, L_2 ~~5.75 FT~~ 5.75 1565
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 5.75 FT

HYDRAULIC CONDUCTIVITY, K ~~3.44×10⁻⁵ FT/SEC~~ 9.27×10^{-6} FT/SEC MS 11-19-90 AND 8.58×10^{-6} FT/SEC

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t SEC/MIN	DEPTH TO WATER IN CASING H FEET
0	5.65
1	5.713
2	5.725
3	5.732
4	5.738
5	5.744
6	5.744
7	5.744
8	5.744
8.5	5.750



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

HYDRAULIC CONDUCTIVITY CALCULATIONS FOR B-1213

3637

HEAD RATIO = $\dfrac{H_{@t} - H_G}{H_i - H_G}$ WHERE: H_G = DEPTH TO GROUND WATER BELOW TOC BEFORE SLUG IS ADDED

H_i = INITIAL DEPTH TO GROUND WATER BELOW TOC AFTER SLUG IS ADDED

$H_{@t}$ = DEPTH TO GROUND WATER BELOW TOC AT TIME = t

HR

.1 MIN: $\dfrac{5.662 - 5.75}{5.650 - 5.75} = \dfrac{0.088}{.100} = .880$

.3 MIN: $\dfrac{5.681 - 5.75}{5.65 - 5.75} = \dfrac{0.064}{.100} = .690$

.5 MIN: $\dfrac{5.694 - 5.75}{5.65 - 5.75} = \dfrac{0.056}{.100} = .560$

.7 MIN: $\dfrac{5.7 - 5.75}{5.65 - 5.75} = \dfrac{0.05}{.100} = .500$

.9 MIN: $\dfrac{5.706 - 5.75}{5.65 - 5.75} = \dfrac{0.044}{.100} = .440$

1 MIN: $\dfrac{5.713 - 5.75}{5.650 - 5.75} = \dfrac{.037}{.100} = .37$

8 MIN: $\dfrac{5.744 - 5.75}{5.650 - 5.75} = \dfrac{.006}{.100} = .06$

HYDRAULIC CONDUCTIVITY = $K = \dfrac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\dfrac{L_1 - L_2}{R}\right] \ln\left[\dfrac{H_1 - H_G}{H_2 - H_G}\right]$

$\Rightarrow K = \dfrac{(0.0833)^2}{2(10 - 5.75)(.9 - .1)} \ln\left[\dfrac{10 - 5.75}{.333}\right] \ln\left[\dfrac{5.662 - 5.75}{5.706 - 5.75}\right]$

$= (0.001^{0.204})(2.547)(.693)$

$= 1.77 \times 10^{-3}$ FT/MIN

~~$T = 2.94 \times 10^{-5}$ FT/SEC~~ MS 11-19-90

FOR t = 1 & 8 MIN: $K = \dfrac{(0.0833)^2}{2(\cancel{10 - 5.75})(8 - 1)} \ln\left[\dfrac{\cancel{10 - 5.75}\ 10 - 5.75}{.333}\right] \ln\left[\dfrac{5.713 - 5.75}{5.744 - 5.75}\right]$

$= (.0002)(2.547)(1.82)$

$= 5.56 \times 10^{-4}$ FT/MIN

$= 9.27 \times 10^{-6}$ FT/SEC =

ALSO

$\dfrac{(0.0833)^2}{2(10 - 5.65)(8 - 1)} \ln\left[\dfrac{10 - 5.65}{.333}\right] \ln\left[\dfrac{5.713 - 5.75}{5.744 - 5.75}\right]$

$= (0.00011)(2.57)(1.82)$

$= 5.15 \times 10^{-4}$ FT/MIN

$= 8.58 \times 10^{-6}$ FT/

340

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1224
WELL NUMBER: 1224

FIELD ENG./GEO.: L. SINFIELD DATE: 05/23/89
CHECKED BY : BD DATE: 06/05/89
N,E COORDINATES: 480359.18, 1380267.4
DATE OF INSTAL.: 05/24/89

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: AUGER BIT
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING WELL
CASING DIAM.: 2 In. ID
CASING SIZE(S) USED: (Units N/A)
SIZE: N/A FROM: N/A TO: N/A
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: 0.020 (In.)
TOTAL PERFORATED AREA: 10. Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: SCHEDULE 40 PVC
RISER PIPE DIAMETERS:
O.D.: 2 1/4 In. I.D.: 2 In.
LENGTH OF 1ST PIPE SECTION: 10.0 Ft.
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: FLUSH - THREADED JOINT

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5 Ft.
PROTECTIVE PIPE O.D.: 4 3/ In.
* LOCKING - HINGED COVER

OTHER PROTECTION (* NOTED BELOW)

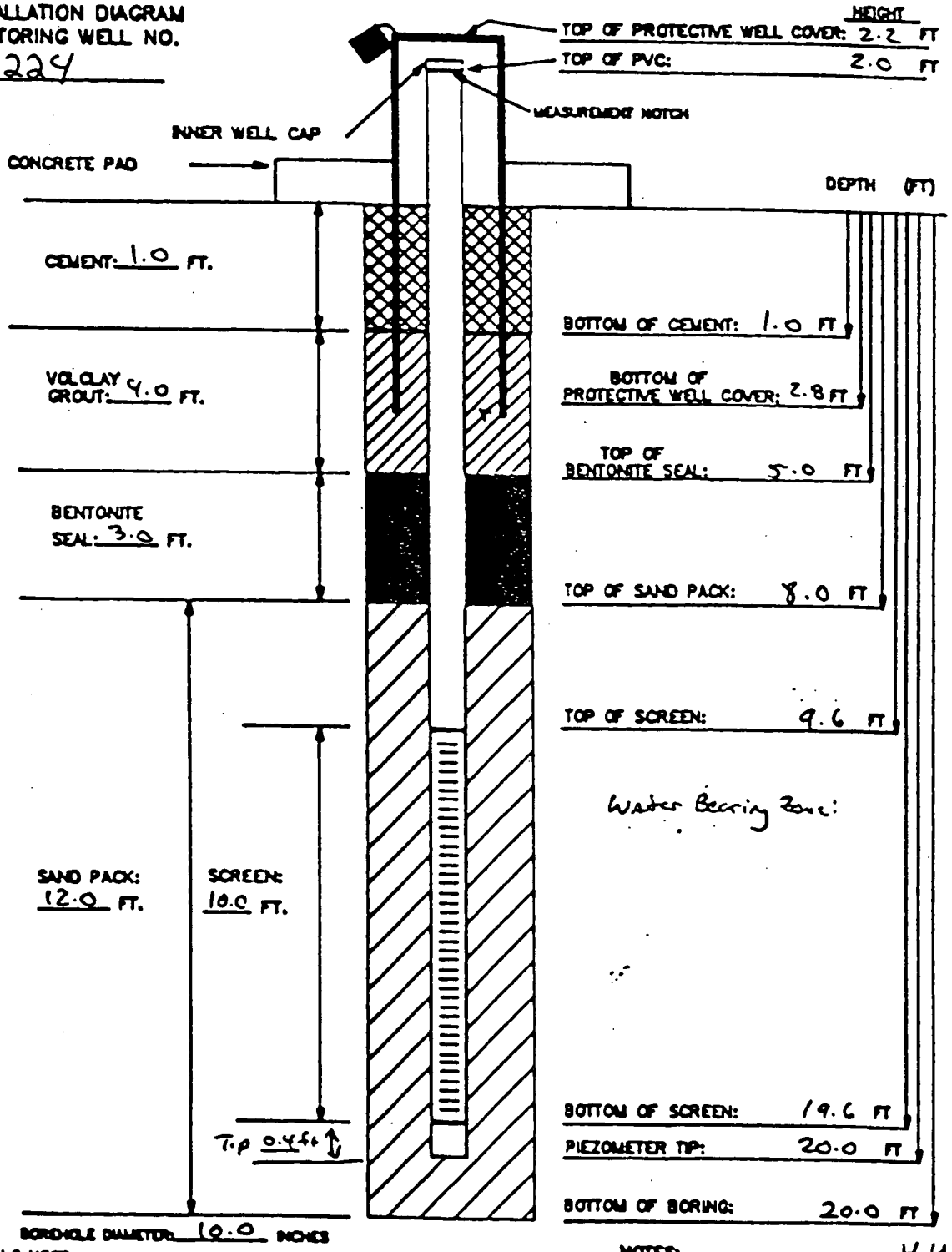
ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	2 Ft.		581.87	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	2.8 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
	0.0	1.0	N/A	N/A
Grout/Slurry	1.0	5.0	N/A	N/A
Bentonite Pellets	5.0	8.0	N/A	N/A
Sand	8.0	20.0	N/A	N/A
PERFORATED SECTION	9.6	19.6	N/A	N/A
WELL TIP	20.0		N/A	
BOTTOM OF BOREHOLE	20.0		N/A	
GWL AFTER INSTALLATION	8.22		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1224

INSTALLATION DATE: 5-24-89



BOREHOLE DIAMETER: 10.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 8 Bags 10/20 80lb
BENTONITE PELLETS (5-GALLON BUCKETS): 2
BAGS OF VOLCLAY GROUT: 1 Bag (50lb)
AMOUNT OF CEMENT: 1 Bag (80lb)
AMOUNT OF WATER USED: 40 gallons
OTHER: Protector Cover 5' x 4 1/2"

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE: 8.22 TOC 5/24/89 @ 1000 (8.22 grad)

Hold 15.00
Cut 6.78
8.22

TASK: 607 3.7.1

GEOLOGIST/ENGINEER: L. Sinfield

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1224	COORDINATES: NORTH 480,359.18 EAST 1,380,267.48	DATE: 05/16/89
GROUND ELEVATION: 580.50	GWL: Depth N/A Date/Time N/A	DATE STARTED: 05/15/89
ENGINEER/GEOLOGIST: L. SINFIELD	Depth N/A Date/Time N/A	DATE COMPLETED: 05/16/89
DRILLING METHODS: B-45, HOLLOW STEM AUGER WITH SPLIT SPOON		PAGE 1 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
0.5	17497 05/15/89 1515	5	6	LOOSE, GRAVEL, WET, MASSIVE.	GW	NA	Hnu= 0 ppm α = 0 cpm βγ = 700 cpm
1.0	17498 05/15/89 1515	6	6	VERY STIFF, BROWNISH YELLOW (10 YR 6/6) LEAN CLAY, CL-DRY, MASSIVE MEDIUM PLASTIC, WITH SILT, MOTTLED.	CL	3.9	Hnu= 0 ppm α = 0 cpm βγ = 700 cpm
1.5	17499 05/15/89 1515	10		NO RECOVERY, NO SAMPLE TAKEN.			
2.0	17500 05/15/89 1530	6	6	VERY STIFF, BROWNISH YELLOW (10 YR, 6/6), LEAN CLAY, CL-DRY, MASSIVE, MEDIUM PLASTIC WITH SILT, MOTTLED TO GRAYISH BROWN (2	CL	2.7	Hnu= 0 ppm α = 0 cpm βγ = 750-800cpm
2.5	17501 05/15/89 1530	8	6	VERY STIFF, BROWNISH YELLOW (10 YR, 6/6), LEAN CLAY, CL-DRY, MASSIVE, MEDIUM PLASTIC WITH SILT, MOTTLED TO GRAYISH BROWN (2	CL	2.7	Hnu= 0 ppm α = 0 cpm βγ = 750-800cpm
3.0	17502 05/15/89 1530	9		NO RECOVERY, NO SAMPLE TAKEN.			
3.5	17503 05/15/89 1540	7	8	VERY STIFF, GRAYISH BROWN (2.5 Y, 5/2) MOTTLED, LEAN CLAY, CL-DRY, MASSIVE, MEDIUM PLASTIC TO OLIVE GRAY (5 Y, 4/2).	CL	2.0-2.4	Hnu= 0 ppm α = 0 cpm βγ = 320-380cpm
4.0	17504 05/15/89 1540	4	8	VERY STIFF, GRAYISH BROWN (2.5 Y, 5/2) MOTTLED, LEAN CLAY, CL-DRY, MASSIVE, MEDIUM PLASTIC TO OLIVE GRAY (5 Y, 4/2).	CL	2.0-2.4	Hnu= 0 ppm α = 0 cpm βγ = 320-380cpm
4.5	17505 05/15/89 1540	10		NO RECOVERY, NO SAMPLE TAKEN.			
5.0	17506 05/15/89 1545	7	6	STIFF TO VERY STIFF, OLIVE GRAY (5 Y, 4/2) TO BROWNISH YELLOW (10 YR, 6/8) LEAN CLAY, DRY MASSIVE, MEDIUM PLASTIC.	CL	1.2-2.4	Hnu= 0 ppm α = 0 cpm βγ = 320-380cpm
5.5	17507 05/15/89 1545	8		NO RECOVERY, NO SAMPLE TAKEN.			
6.0	17508 05/15/89 1545	9		NO RECOVERY, NO SAMPLE TAKEN.			
6.5	17509 05/15/89 1610	2	12	STIFF, DRY, OLIVE GRAY (5 Y, 4/2) TO BROWNISH YELLOW (10 YR, 6/8) LEAN CLAY, MASSIVE, MEDIUM PLASTIC.	CL	1.5-1.7	Hnu= 0 ppm α = 5 cpm βγ = 280-320cpm
7.0	17510 05/15/89 1610	3	12	STIFF, DRY, OLIVE GRAY (5 Y, 4/2) TO BROWNISH YELLOW (10 YR, 6/8) LEAN CLAY, MASSIVE, MEDIUM PLASTIC.	CL	1.5-1.7	Hnu= 0 ppm α = 5 cpm βγ = 280-320cpm
7.5	17511 05/15/89 1610	5		NO RECOVERY, NO SAMPLE TAKEN.			
8.0	17512 05/15/89 1615	4	12	STIFF, OLIVE GRAY (5 Y, 4/2) TO BROWNISH YELLOW (10 YR, 6/8) LEAN CLAY, DRY, MASSIVE, MEDIUM PLASTIC.	CL	1.1-1.7	Hnu= 0 ppm α = 0 cpm βγ = 300-340cpm

NOTES:

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1224	COORDINATES: NORTH 480,359.18 EAST 1,380,267.48	DATE: 05/16/89
GROUND ELEVATION: 580.50	GWL: Depth N/A Date/Time N/A	DATE STARTED: 05/15/89
ENGINEER/GEOLOGIST: L. SINFIELD	Depth N/A Date/Time N/A	DATE COMPLETED: 05/16/89
DRILLING METHODS: B-45, HOLLOW STEM AUGER WITH SPLIT SPOON		PAGE 2 OF 3

DEPTH	SAMPLE / DATE / TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	17513 05/15/89 1615	7	12	STIFF, OLIVE GRAY (5 Y, 4/2) TO BROWNISH YELLOW (10 YR, 6/8) LEAN CLAY, DRY, MASSIVE, MEDIUM PLASTIC.	CL	1.1-1.7	Hnu= 0 ppm α = 0 cpm βΓ = 300-340cpm
9.0	17514 05/15/89 1615	7		NO RECOVERY, NO SAMPLE TAKEN.			
9.5	17515 05/15/89 1630	8	18	STIFF, OLIVE GRAY (5 Y, 4/2) TO BROWNISH YELLOW (10 YR, 6/8) LEAN CLAY, DRY, MASSIVE, MEDIUM PLASTIC.	CL	1.1-1.8	Hnu= 0 ppm α = 0 cpm βΓ = 300-340cpm
10.0	17516 05/15/89 1630	12	18	STIFF, OLIVE GRAY (5 Y, 4/2) TO BROWNISH YELLOW (10 YR, 6/8) LEAN CLAY, DRY, MASSIVE, MEDIUM PLASTIC.	CL	1.1-1.8	Hnu= 0 ppm α = 0 cpm βΓ = 300-340cpm
10.5	17517 05/15/89 1630	14	18	MEDIUM DENSE, SILT, WET, MASSIVE.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 300-340cpm
11.0	17518 05/16/89 0830	6	18	VERY STIFF, BROWNISH YELLOW (10 YR, 6/8) TO GRAY (10 YR, 4/1) LEAN CLAY, DRY, WITH THIN (1/4 IN) SILT LAYERS-MOIST.	CL	2.6-3.3	Hnu= 0 ppm α = 0 cpm βΓ = 300-400cpm
11.5	50792 05/16/89 0830	11	18	VERY STIFF, BROWNISH YELLOW (10 YR, 6/8) TO GRAY (10 YR, 4/1) LEAN CLAY, DRY, WITH THIN (1/4 IN) SILT LAYERS-MOIST.	CL	2.6-3.3	Hnu= 0 ppm α = 0 cpm βΓ = 300-400cpm
12.0	50793 05/16/89 0830	11	18	VERY STIFF, BROWNISH YELLOW (10 YR, 6/8) TO GRAY (10 YR, 4/1) LEAN CLAY, DRY, WITH THIN (1/4 IN) SILT LAYERS-MOIST.	CL	2.6-3.3	Hnu= 0 ppm α = 0 cpm βΓ = 300-400cpm
12.5	50794 05/16/89 0840	10	18	VERY STIFF, GRAY (10 YR, 4/1) LEAN CLAY, DRY, MASSIVE, MEDIUM PLASTIC.	CL	2.6-3.0	Hnu= 0 ppm α = 0 cpm βΓ = 300-400cpm
13.0	50795 05/16/89 0840	14	18	VERY STIFF, GRAY (10 YR, 4/1) LEAN CLAY, DRY, MASSIVE, MEDIUM PLASTIC.	CL	2.6-3.0	Hnu= 0 ppm α = 0 cpm βΓ = 300-400cpm
13.5	50796 05/16/89 0840	16	18	MEDIUM DENSE, SILTY SAND, WET, MASSIVE.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 300-400cpm
14.0	50797 05/16/89 0850	6	12	LOOSE, COARSE SAND, WET, MASSIVE WITH SILT.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 300-400cpm
14.5	50798 05/16/89 0850	7	12	LOOSE, COARSE SAND, WET, MASSIVE WITH SILT.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 300-400cpm
15.0	50799 05/16/89 0850	11	12	LOOSE, COARSE SAND, WET, MASSIVE WITH SILT.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 300-400cpm
15.5	50800 05/16/89 0915	10	18	VERY STIFF, BROWNISH YELLOW (10 YR, 6/8).	CL	3.7	Hnu= 0 ppm α = 0 cpm βΓ = 320-380cpm

NOTES:

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1224	COORDINATES: NORTH 480,359.18 EAST 1,380,267.48	DATE: 05/16/89
GROUND ELEVATION: 580.50	GWL: Depth N/A Date/Time N/A	DATE STARTED: 05/15/89
ENGINEER/GEOLOGIST: L. SINFIELD	Depth N/A Date/Time N/A	DATE COMPLETED: 05/16/89
DRILLING METHODS: B-45, HOLLOW STEM AUGER WITH SPLIT SPOON		PAGE 3 OF 3

DEPTH	SAMPLE	DATE	TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.0	50801	05/16/89	0915	14	18	MEDIUM DENSE, SILTY COARSE SAND, WET, MASSIVE.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 320-380cpm
16.5	50802	05/16/89	0915	17	18	MEDIUM DENSE, SILTY COARSE SAND, WET, MASSIVE.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 320-380cpm
17.0	50803	05/16/89	0925	14	18	MEDIUM DENSE, SILTY COARSE SAND, MASSIVE, WET GRADING TO MEDIUM DENSE, SILT, MASSIVE, GRAY (10 YR, 4/1).	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 320-380cpm
17.5	50804	05/16/89	0925	14	18	MEDIUM DENSE, SILTY COARSE SAND, MASSIVE, WET GRADING TO MEDIUM DENSE, SILT, MASSIVE, GRAY (10 YR, 4/1).	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 320-380cpm
18.0	50805	05/16/89	0925	15	18	MEDIUM DENSE, SILTY COARSE SAND, MASSIVE, WET GRADING TO MEDIUM DENSE, SILT, MASSIVE, GRAY (10 YR, 4/1).	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 320-380cpm
18.5	50806	05/16/89	1008	14	18	MEDIUM DENSE TO DENSE, SILTY COARSE SAND, MASSIVE, WET.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 320-380cpm
19.0	50807	05/16/89	1008	32	18	MEDIUM DENSE TO DENSE, SILTY COARSE SAND, MASSIVE, WET.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 320-380cpm
19.5	50808	05/16/89	1008	35	18	MEDIUM DENSE TO DENSE, SILTY COARSE SAND, MASSIVE, WET.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 320-380cpm
20.0	50809	05/16/89	1008	50	6	MEDIUM DENSE TO DENSE, SILTY COARSE SAND, MASSIVE, WET.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 320-380cpm

BOTTOM OF BORING 20.0

NOTES:

1224

3637

CORPORATION

FIELD PERMEABILITY TESTS
FALLING HEAD*

PROJECT FMPC RI/FS
PROJECT NO. 602 3.7.4
BORING NO. 1224

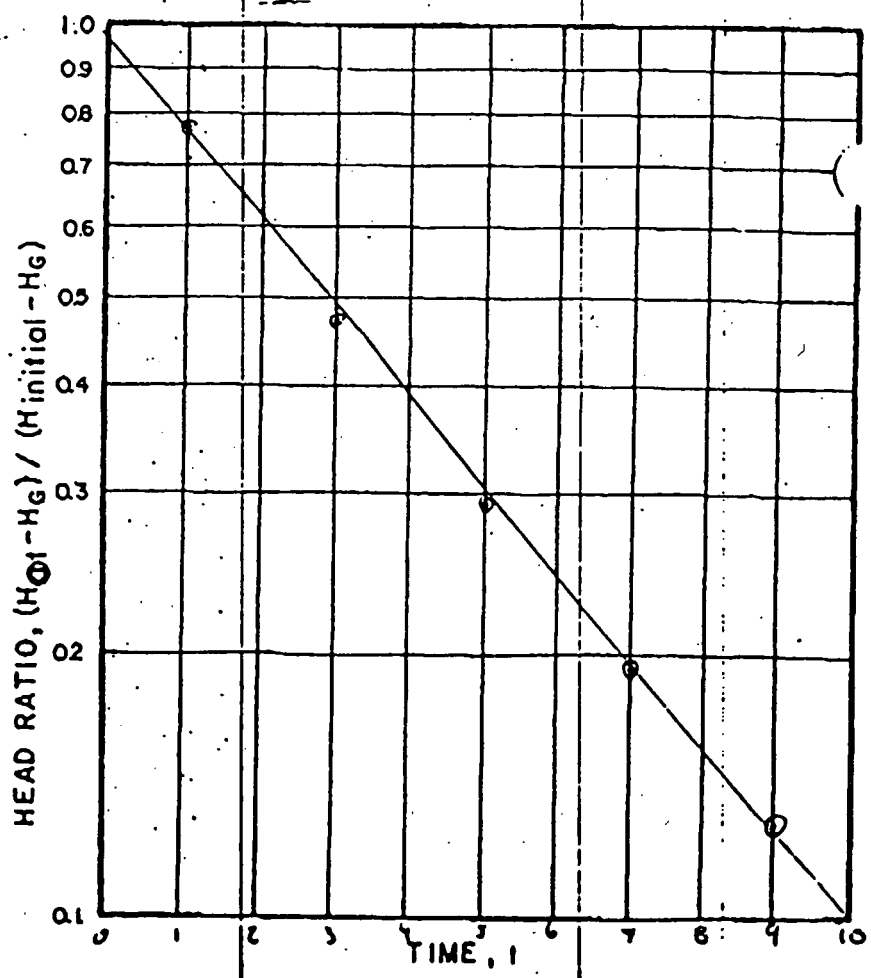
TESTED BY MS/SA DATE 8-07-90
CALCULATED BY MS DATE 10-20-90
CHECKED BY RLJ DATE ~~4.4x10^-6 FT/S~~ 11/2/90

RADIUS OF WELL, r = 4in = ~~.333 FT~~ (1in = 0.0833 FT)
RADIUS OF TEST BORING, R = ~~8in = 2.667 FT~~ 4in = .333 FT
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C 2.0 FT
DEPTH TO BOTTOM OF TEST POCKET, L_1 ~~20.0 FT~~ 22.0 FT
DEPTH TO TOP OF TEST POCKET, L_2 ~~8.0 FT~~ 11.0 FT
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 8.78 FT

HYDRAULIC CONDUCTIVITY, K 4.4×10^{-6} FT/SEC

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t SEC. MIN	DEPTH TO WATER IN CASING H FEET
0	8.181
.1	8.194
1	8.320
2	8.421
3	8.447
4	8.553
5	8.604
6	8.635
7	8.667
8	8.686
9	8.705
10	8.724
11	8.736
13	8.749
15	8.755
17	8.766
19	~~8.774~~ 8.768
21	~~8.774~~ 8.774
23	~~8.780~~ 8.774
25	8.780



$$K = \frac{r^2}{2t_1 - t_0} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_0 - H_G}\right]$$

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1
H_0 = DEPTH TO WATER IN CASING FROM TOP

HYDRAULIC CONDUCTIVITY CALCULATIONS FOR B-1224

$$\text{HEAD RATIO} = \frac{H_{@t} - H_G}{H_i - H_G}$$

WHERE: H_G = DEPTH TO GROUND WATER BELOW TOC BEFORE SLUG IS ADDED

H_i = INITIAL DEPTH TO GROUND WATER BELOW TOC AFTER SLUG IS ADDED

$H_{@t}$ = DEPTH TO GROUND WATER BELOW TOC AT TIME = t

	HR
1 MIN: $\frac{8.520 - 8.78}{8.181 - 8.78} = \frac{.460}{.594}$	= .768
3 MIN: $\frac{8.447 - 8.78}{8.181 - 8.78} = \frac{.283}{.594}$	= .472
5 MIN: $\frac{8.604 - 8.78}{8.181 - 8.78} = \frac{.176}{.594}$	= .294
7 MIN: $\frac{8.667 - 8.78}{8.181 - 8.78} = \frac{.113}{.594}$	= .189
9 MIN: $\frac{8.705 - 8.78}{8.181 - 8.78} = \frac{.075}{.594}$	= .125

$$\text{HYDRAULIC CONDUCTIVITY} = K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

$$\Rightarrow K = \frac{(0.0833)^2}{2(\cancel{20-9.6}\ 11.6)(9-1)} \ln\left[\frac{\cancel{20-9.6}\ 11.6}{.333}\right] \ln\left[\frac{8.32 - 8.78}{8.705 - 8.78}\right]$$

$$= (0.00042)(3.414)(1.814)$$

$$= 2.62 \times 10^{-4}\ \text{FT/MIN}$$

$$= 4.4 \times 10^{-6}\ \text{FT/SEC}$$

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1228
WELL NUMBER: 1228

FIELD ENG./GEO.: L. SINFIELD DATE: 05/24/89
CHECKED BY : BD DATE: 06/05/89
N,E COORDINATES: 480301.15, 1380298.9
DATE OF INSTAL.: 05/25/89

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: AUGER BIT
IS CASING TEMPORARY?: No
CASING TYPE : MONITERING WELL
CASING DIAM.: 2 In. ID
CASING SIZE(S) USED: (Units N/A)
SIZE: N/A FROM: N/A TO: N/A
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: 0.020 (In.)
TOTAL PERFORATED AREA: 4.8 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: SCHEDULE 40 PVC
RISER PIPE DIAMETERS:
O.D.: 2 1/4 In. I.D.: 2 In.
LENGTH OF 1ST PIPE SECTION: 9.8 Ft.
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: FLUSH - THREADED JOINTS

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 1.0 Ft.
PROTECTIVE PIPE O.D.: 4 3/ In.
• T-TYPE LOCKING TOP WITH RUBBER

OTHER PROTECTION (* NOTED BELOW)

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE	ELEVATION MSL
TOP OF RISER PIPE	-0.2 Ft.	579.52
GROUND SURFACE	0.0	N/A
BOTTOM OF PROTECTIVE PIPE	1.0 Ft.	

BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
Grout/Slurry	1.0	5.0	N/A	N/A
Bentonite Pellets	5.0	7.5	N/A	N/A
Sand	7.5	15.0	N/A	N/A
PERFORATED SECTION	9.8	14.6	N/A	N/A

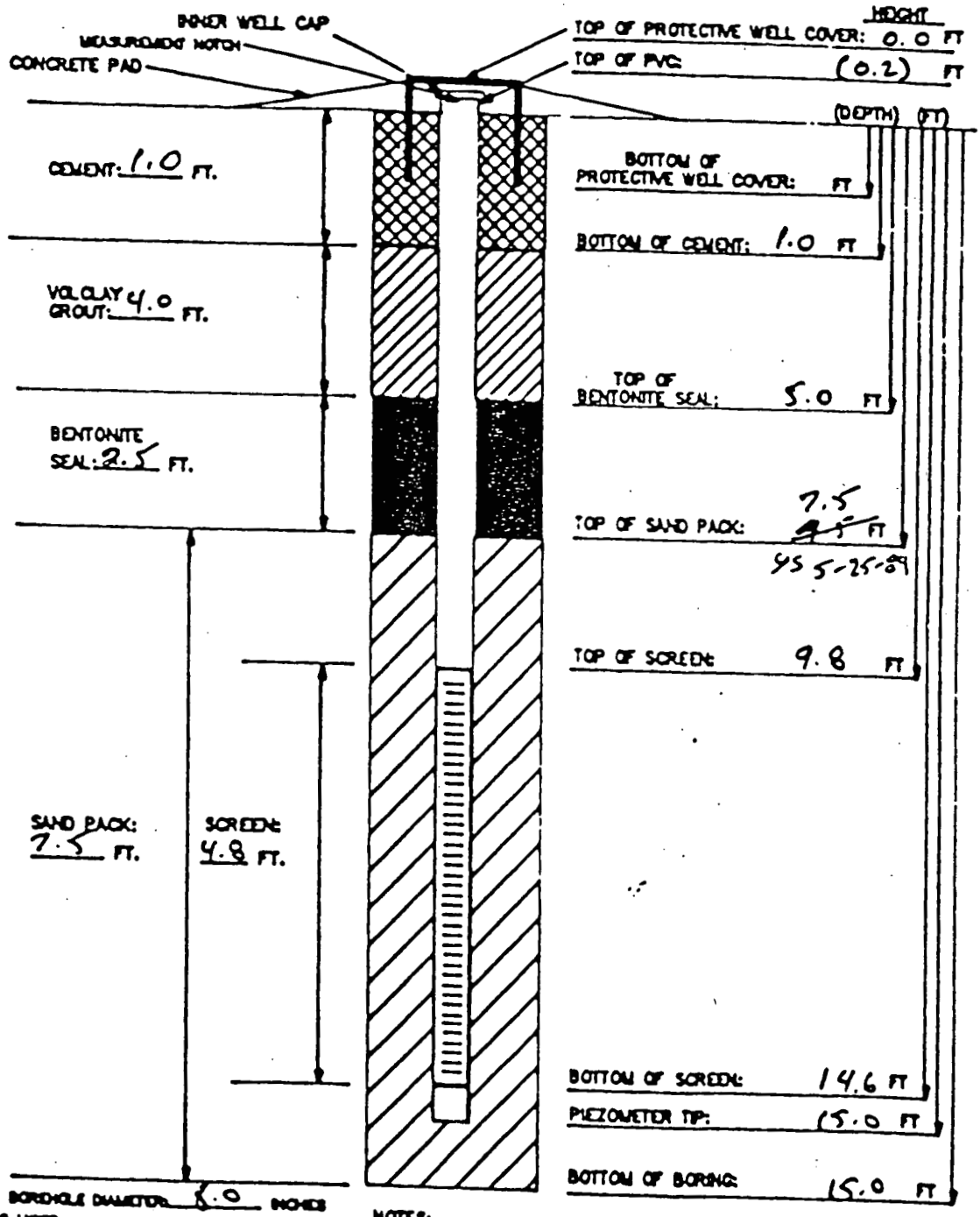
WELL TIP	15.0	N/A
BOTTOM OF BOREHOLE	15.0	N/A
GWL AFTER INSTALLATION	N/A	N/A

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1228

INSTALLATION DATE: 5-25-89



MATERIALS USED:
SAND TYPE AND QUANTITY: 2 bags 10/20 (50 lb)
BENTONITE PELLETS (5-GALLON BUCKETS): 1
BAGS OF VOLCLAY GROUT: 1/2 bag
AMOUNT OF CEMENT: 1 bag
AMOUNT OF WATER USED: 20 gallons
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602 3.7.1 GEOLOGIST/ENGINEER: L. Sinfield

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

3637

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1228	COORDINATES: NORTH 480,301.15 EAST 1,380,298.90	DATE: 05/24/89
GROUND ELEVATION: 579.79	GWL: Depth N/A Date/Time N/A	DATE STARTED: 05/24/89
ENGINEER/GEOLOGIST: L. SINFIELD	Depth N/A Date/Time N/A	DATE COMPLETED: 05/24/89
DRILLING METHODS: B-45, HOLLOW STEM AUGER WITH SPLIT SPOON		PAGE 1 OF 2

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
0.5	17585 05/24/89 1200			CONCRETE.			Hnu= 0 ppm α = 0 cpm Bγ = 400-440cpm
1.0	17586 05/24/89 1200			NO RECOVERY, NO SAMPLE TAKEN.			
1.5	17587 05/24/89 1200			LOOSE, GRAVEL, MASSIVE, CLASS II BASE. GRAB SAMPLE.			Hnu= 0 ppm α = 0 cpm Bγ = 400-440cpm
2.0	17588 05/24/89 1340	9 9 9	18	VERY STIFF, DARK GRAYISH BROWN (2.5 Y 4/2) TO DARK GRAY (2.5 Y N4), LEAN CLAY, DRY, MEDIUM PLASTIC, MASSIVE, WOOD FRAGMENTS.	CL	2.2- 3.2	Hnu= 0 ppm α = 10 cpm Bγ = 100-200cpm
2.5	17589 05/24/89 1340	9 9 9	18	VERY STIFF, DARK GRAYISH BROWN (2.5 Y 4/2) TO DARK GRAY (2.5 Y N4), LEAN CLAY, DRY, MEDIUM PLASTIC, MASSIVE, WOOD FRAGMENTS.	CL	2.2- 3.2	Hnu= 0 ppm α = 10 cpm Bγ = 100-200cpm
3.0	17590 05/24/89 1340	9 9 9	18	VERY STIFF, DARK GRAYISH BROWN (2.5 Y 4/2) TO DARK GRAY (2.5 Y N4), LEAN CLAY, DRY, MEDIUM PLASTIC, MASSIVE, WOOD FRAGMENTS.	CL	2.2- 3.2	Hnu= 0 ppm α = 10 cpm Bγ = 100-200cpm
3.5	17591 05/24/89 1350	5 7 10	12	VERY STIFF, VERY DARK GRAYISH BROWN, (2.5 Y 3/2) TO OLIVE BROWN (2.5 Y 4/4) MOTTLED, DRY, MASSIVE, MEDIUM PLASTIC. LEAN CLAY.	CL	2.7- 3.0 2.7-	Hnu= 0 ppm α = 0 cpm Bγ = 100-120cpm
4.0	17592 05/24/89 1350	5 7 10	12	VERY STIFF, VERY DARK GRAYISH BROWN, (2.5 Y 3/2) TO OLIVE BROWN (2.5 Y 4/4) MOTTLED, DRY, MASSIVE, MEDIUM PLASTIC. LEAN CLAY.	CL	2.7- 3.0 2.7-	Hnu= 0 ppm α = 0 cpm Bγ = 100-120cpm
4.5	17593 05/24/89 1350	5 7 10		NO RECOVERY, NO SAMPLE TAKEN.			
5.0	17594 05/24/89 1400	5 11 16	12	STIFF, LIGHT OLIVE BROWN (2.5 Y 5/6) TO LIGHT BROWNISH GRAY, (2.5 Y 6/2) LEAN CLAY, DRY MASSIVE, MEDIUM PLASTIC, MOTTLED.	CL	1.5- 1.6	Hnu= 0 ppm α = 0 cpm Bγ = 80-100 cpm
5.5	17595 05/24/89 1400	5 11 16	12	STIFF, LIGHT OLIVE BROWN (2.5 Y 5/6) TO LIGHT BROWNISH GRAY, (2.5 Y 6/2) LEAN CLAY, DRY MASSIVE, MEDIUM PLASTIC, MOTTLED.	CL	1.5- 1.6	Hnu= 0 ppm α = 0 cpm Bγ = 80-100 cpm
6.0	17596 05/24/89 1400	5 11 16		NO RECOVERY, NO SAMPLE TAKEN.			
6.5	17597 05/24/89 1420	4 6 9	18	VERY STIFF TO HARD, BROWNISH YELLOW (10 YR 6/8) TO GRAY (2.5 Y N5) DRY, LEAN CLAY, MASSIVE, MEDIUM PLASTIC.	CL	2.5- 4.5	Hnu= 0 ppm α = 0 cpm Bγ = 100-120cpm
7.0	17598 05/24/89 1420	4 6 9	18	VERY STIFF TO HARD, BROWNISH YELLOW (10 YR 6/8) TO GRAY (2.5 Y N5) DRY, LEAN CLAY, MASSIVE, MEDIUM PLASTIC.	CL	2.5- 4.5	Hnu= 0 ppm α = 0 cpm Bγ = 100-120cpm
7.5	17599 05/24/89 1420	4 6 9	18	VERY STIFF TO HARD, BROWNISH YELLOW (10 YR 6/8) TO GRAY (2.5 Y N5) DRY, LEAN CLAY, MASSIVE, MEDIUM PLASTIC.	CL	2.5- 4.5	Hnu= 0 ppm α = 0 cpm Bγ = 100-120cpm
8.0	17600 05/24/89 1430	11 14 17	18	VERY STIFF TO HARD, BROWNISH YELLOW (10 YR 6/8) TO LIGHT GRAY (10 YR 7/1) SILTY CLAY, DRY, MEDIUM PLASTIC, 1/4 IN MOIST SILT	CL	3.3- 4.3	Hnu= 0 ppm α = 0 cpm Bγ = 100-120cpm

NOTES:

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1228	COORDINATES: NORTH 480,301.15 EAST 1,380,298.90	DATE: 05/24/89
GROUND ELEVATION: 579.79	GWL: Depth N/A Date/Time N/A	DATE STARTED: 05/24/89
ENGINEER/GEOLOGIST: L. SINFIELD	Depth N/A Date/Time N/A	DATE COMPLETED: 05/24/89
DRILLING METHODS: B-45, HOLLOW STEM AUGER WITH SPLIT SPOON		PAGE 2 OF 2

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	17601 05/24/89 1430	11 14 17	18	VERY STIFF TO HARD, BROWNISH YELLOW (10 YR 6/8) TO LIGHT GRAY (10 YR 7/1) SILTY CLAY, DRY, MEDIUM PLASTIC, 1/4 IN MOIST SILT	CL	3.3-4.3	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
9.0	17602 05/24/89 1430	11 14 17	18	VERY STIFF TO HARD, BROWNISH YELLOW (10 YR 6/8) TO LIGHT GRAY (10 YR 7/1) SILTY CLAY, DRY, MEDIUM PLASTIC, 1/4 IN MOIST SILT	CL	3.3-4.3	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
9.5	17603 05/24/89 1440	17 24 24	18	VERY STIFF, YELLOWISH BROWN (10 YR 5/4) SILTY CLAY, VERY SLIGHTLY MOIST, MASSIVE, MEDIUM PLASTIC, 1/4 IN SILT LAYERS- M	CL	2.6-3.2	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm
10.0	17604 05/24/89 1440	17 24 24	18	VERY STIFF, YELLOWISH BROWN (10 YR 5/4) SILTY CLAY, VERY SLIGHTLY MOIST, MASSIVE, MEDIUM PLASTIC, 1/4 IN SILT LAYERS- M	CL	2.6-3.2	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm
10.5	17605 05/24/89 1440	17 24 24	18	VERY STIFF, YELLOWISH BROWN (10 YR 5/4), SILTY CLAY, VERY SLIGHTLY MOIST, MASSIVE, MEDIUM PLASTIC, 1/4 IN SILT LAYERS - SAND - WET.	SM	2.6-3.2 2.6-	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm
11.0	17606 05/24/89 1500	5 8 10	12	LOOSE, GRAY (10 YR 6/1) SILT, MASSIVE, WET.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm
11.5	52475 05/24/89 1500	5 8 10	12	LOOSE, GRAY (10 YR 6/1) SILT, MASSIVE, WET.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm
12.0	52476 05/24/89 1500	5 8 10		NO RECOVERY, NO SAMPLE TAKEN.			
12.5	52477 05/24/89 1505	5 10 18	12	LOOSE TO MEDIUM DENSE, GRAY (10 YR 6/1), SILT, MASSIVE, WET, GRADES TO SILTY SAND AT BASE, MASSIVE WET.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
13.0	52478 05/24/89 1505	5 10 18	12	LOOSE TO MEDIUM DENSE, GRAY (10 YR 6/1), SILT, MASSIVE, WET, GRADES TO SILTY SAND AT BASE, MASSIVE WET.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
13.5	52479 05/24/89 1505	5 10 18		NO RECOVERY, NO SAMPLE TAKEN.			
14.0	52480 05/24/89 1515	14 16 18	18	MEDIUM DENSE, COARSE SAND, WITH SILT, WET, MASSIVE, GRAY (10 YR 6/1).	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm
14.5	52481 05/24/89 1515	14 16 18	18	MEDIUM DENSE, COARSE SAND, WITH SILT, WET, MASSIVE, GRAY (10 YR 6/1).	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm
15.0	52482 05/24/89 1515	14 16 18	18	STIFF, GRAY (10 YR 6/1) LEAN CLAY, WITH SILT, DRY WITH GRAVEL.	CL	1.2	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm

BOTTOM OF BORING 15.0

NOTES:

1228
3637

FIELD PERMEABILITY TESTS
FALLING HEAD*

PROJECT FMPC RI/FS
PROJECT NO. 602 3.7.4
BORING NO. 1228

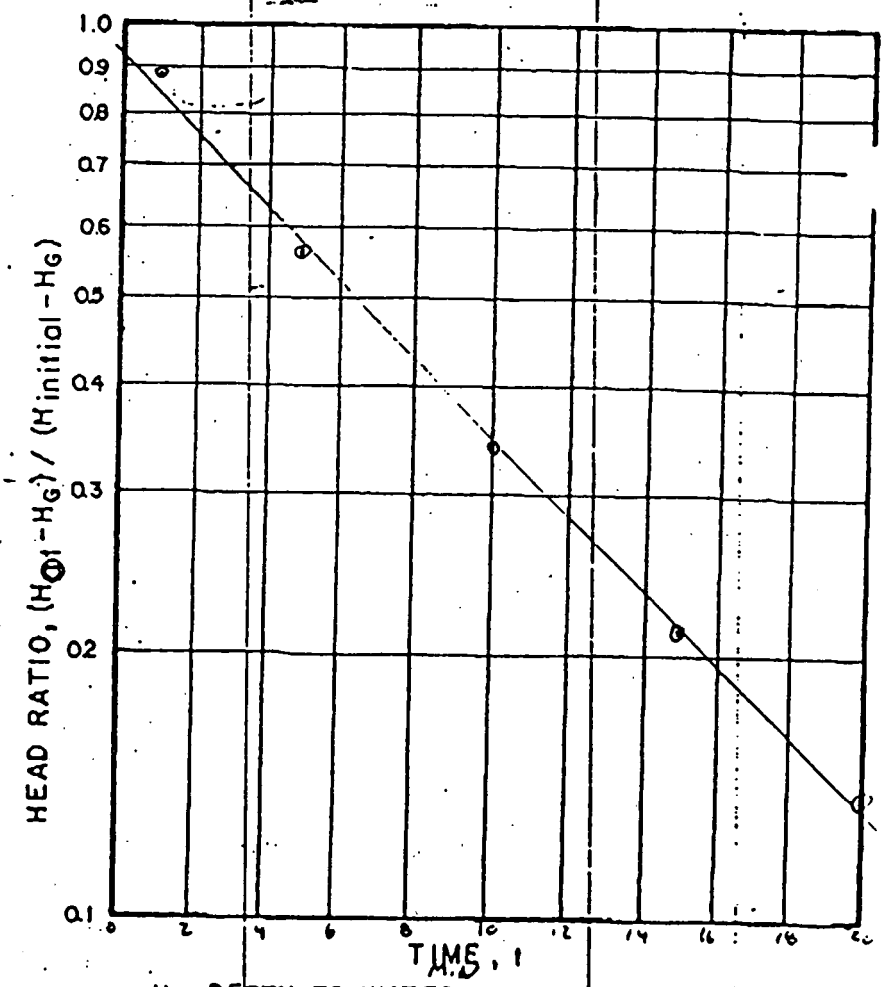
TESTED BY MS/GA DATE 8-07-90
CALCULATED BY MS DATE 10-20-90
CHECKED BY CG DATE 11/3/90

RADIUS OF WELL, r = 1 in = 0.0833 FT
RADIUS OF TEST BORING, R = 4 in = .333 FT
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C 0.0
DEPTH TO BOTTOM OF TEST POCKET, L_1 15.0 FT
DEPTH TO TOP OF TEST POCKET, L_2 7.5 FT
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 7.3 FT

HYDRAULIC CONDUCTIVITY, K 2.3×10^{-6} FT/sec

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t SEC. MIN	DEPTH TO WATER IN CASING H FEET
0	6.575
1	6.663
2	6.732
3	6.795
4	6.846
5	6.890
6	6.940
7	6.972
8	7.003
9	7.034
10	7.054
15	7.142
20	7.144
25	7.243
30	7.281
34	7.30



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

HYDRAULIC CONDUCTIVITY CALCULATIONS FOR B-122B

$$\text{HEAD RATIO} = \frac{H_{@t} - H_G}{H_i - H_G}$$

WHERE: H_G = DEPTH TO GROUND WATER BELOW TOC BEFORE SLUG IS ADDED

H_i = INITIAL DEPTH TO GROUND WATER BELOW TOC AFTER SLUG IS ADDED

$H_{@t}$ = DEPTH TO GROUND WATER BELOW TOC AT TIME = t

	HR
1 min:	$\frac{6.663 - 7.3}{6.575 - 7.3} = \frac{.637}{.725} = .879$
5 min:	$\frac{6.890 - 7.3}{6.575 - 7.3} = \frac{.410}{.725} = .566$
10 min:	$\frac{7.054 - 7.3}{6.575 - 7.3} = \frac{.246}{.725} = .339$
15 min:	$\frac{7.142 - 7.3}{6.575 - 7.3} = \frac{.158}{.725} = .218$
20 min:	$\frac{7.194 - 7.3}{6.575 - 7.3} = \frac{.101}{.725} = .139$

$$\text{HYDRAULIC CONDUCTIVITY} = K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

$$\Rightarrow K = \frac{(0.833)^2}{2(15 - 7.5)(20 - 1)} \ln\left[\frac{15 - 7.5}{.333}\right] \ln\left[\frac{6.663 - 7.3}{7.194 - 7.3}\right]$$

$$= (0.000024)(3.115)(1.842)$$

$$= 1.38 \times 10^{-4} \text{ FT/MIN}$$

$$= 2.3 \times 10^{-6} \text{ FT/SEC}$$

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1231
WELL NUMBER: 1231

FIELD ENG./GEO.: M. SLUSARSKI DATE: 10/19/89
CHECKED BY : BD DATE: 10/26/89
N,E COORDINATES: 480236.98, 1380209.4
DATE OF INSTAL.: 10/18/89

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: 8.0 IN. HOLLOW STEM
IS CASING TEMPORARY?: No
CASING TYPE : PIEZOMETER
CASING DIAM.: 2.0 In.
CASING SIZE(S) USED: (in Feet)
SIZE: 4.2 FROM: 0.0 TO: 20.0
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: .020 (in.)
TOTAL PERFORATED AREA: 12. Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: PVC
RISER PIPE DIAMETERS:
O.D.: 2 5/16 In. I.D.: 2.0 In.
LENGTH OF 1ST PIPE SECTION: 2.0 Ft.
2ND PIPE SECTION: 10.0 Ft.
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: SCREW TYPE FLUSH JOINT THREADED

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5.0 Ft.
PROTECTIVE PIPE O.D.: 4 5/ In.
OTHER PROTECTION (* NOTED BELOW)
* HINGED LOCKING COVER W/ PADLOC

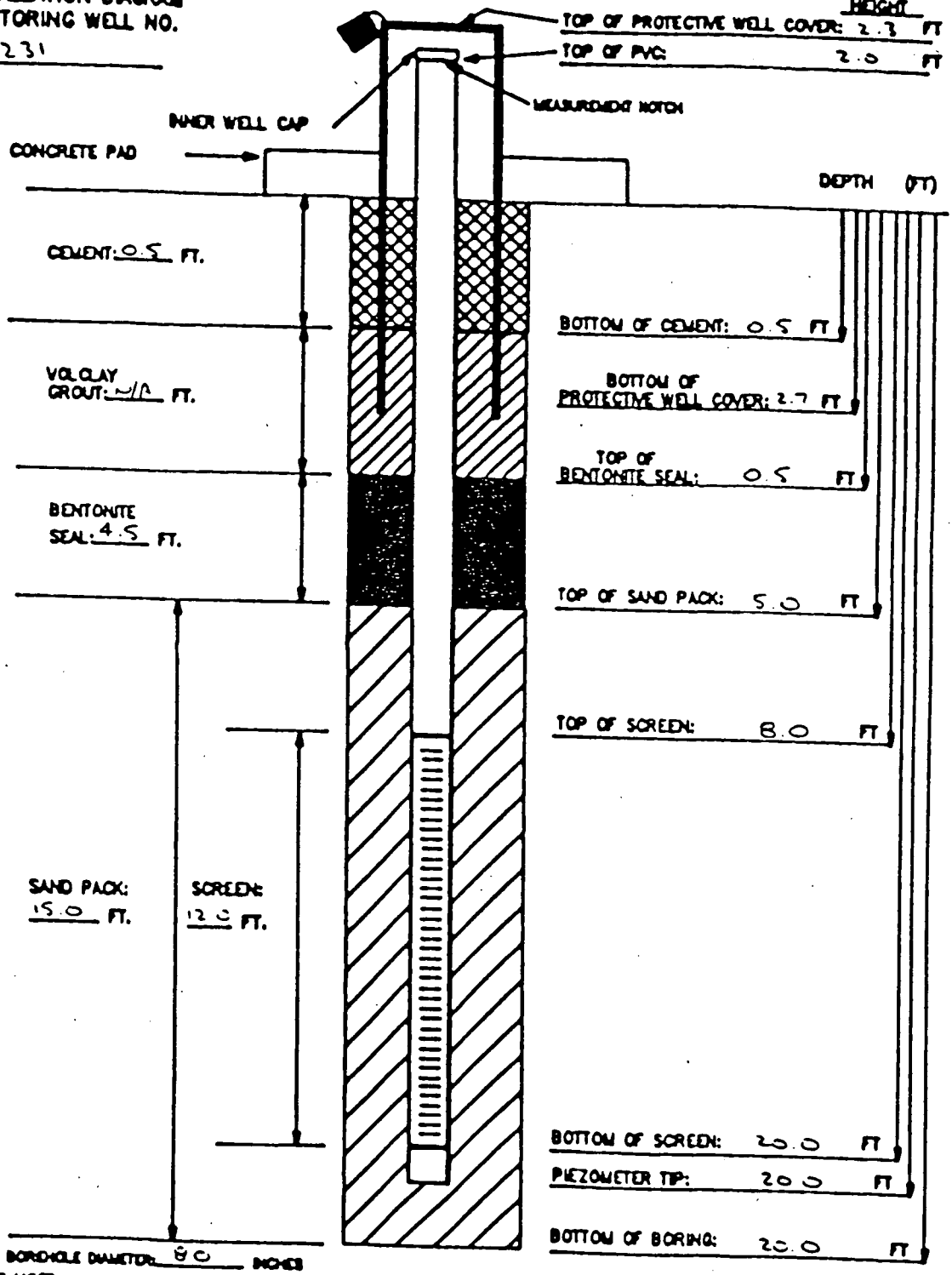
ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	2.0 Ft.		581.83	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	2.7 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
Grout/Slurry	0.0	0.5	N/A	N/A
Bentonite Pellets	0.5	5.0	N/A	N/A
Sand	5.0	20.0	N/A	N/A
PERFORATED SECTION	8.0	20.0	N/A	N/A
WELL TIP	20.0		N/A	
BOTTOM OF BOREHOLE	20.0		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1231

INSTALLATION DATE: 10-18-89



MATERIALS USED:

SAND TYPE AND QUANTITY: (10-20) - 3.00 LB SACKS
BENTONITE PELLETS (5-GALLON BUCKETS): 2.5 GAL. BUCKETS
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: .5 - 94 LB BAG
AMOUNT OF WATER USED: 10 GAL
OTHER:

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602 3 7.1

GEOLOGIST/ENGINEER: M. SLUSARSKI

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1231	COORDINATES: NORTH 480,236.98 EAST 1,380,209.43	DATE: 10/17/89
GROUND ELEVATION: 580.09	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/17/89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth N/A Date/Time N/A	DATE COMPLETED: 10/18/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 3

DEPTH	SAMPLE	DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
1.0								
1.5	17651 10/18/89 1357		3	6	VERY STIFF, OLIVE-GREY (5 Y 4/1) SILTY CLAY, TRACE SAND, TRACE FINE GRAVEL (.25 IN), ROOTLETS, DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 150-200cpm
2.0	17652 10/18/89 1357		5	6	VERY STIFF, OLIVE-GREY (5 Y 4/1) SILTY CLAY, TRACE SAND, TRACE FINE GRAVEL (.25 IN), ROOTLETS, DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 150-200cpm
2.5	17653 10/18/89 1404		6		NO RECOVERY.			
3.0	17654 10/18/89 1404		8		NO RECOVERY.			
3.5	17655 10/18/89 1407		5	6	VERY STIFF, OLIVE-GREY (5 Y 4/1) SILTY CLAY, TRACE SAND, TRACE FINE GRAVEL (.25 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 150-200cpm
4.0	17656 10/18/89 1407		6	6	VERY STIFF, OLIVE-GREY (5 Y 4/1) SILTY CLAY, TRACE SAND, TRACE FINE GRAVEL (.25 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 150-200cpm
4.5	17657 10/18/89 1407		11	6	VERY STIFF, OLIVE-GREY (5 Y 4/1) SILTY CLAY, TRACE SAND, TRACE FINE GRAVEL (.25 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 150-200cpm
5.0	17658 10/18/89 1412		12	6	VERY STIFF, OLIVE-GREY (5 Y 4/1) SILTY CLAY, TRACE SAND, TRACE FINE GRAVEL (.25 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 150-200cpm
5.5	17659 10/18/89 1412		15	6	VERY STIFF OLIVE-GREEN-BROWN (2.5 Y 4/4) SILTY CLAY, TRACE SAND, TRACE FINE GRAVEL (.25 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 150-200cpm
6.0	17660 10/18/89 1412		17		NO RECOVERY.			
6.5	17661 10/18/89 1445		7	6	MEDIUM STIFF, OLIVE-GREEN (5 Y 4/2) SILTY CLAY, TRACE SAND, DAMP.	CL	1.0	Hnu= 0 ppm α = 0 cpm βΓ = 150-200cpm
7.0	17662 10/18/89 1445		6	6	MEDIUM STIFF, OLIVE-GREEN (5 Y 4/2) SILTY CLAY, TRACE SAND, DAMP.	CL	1.0	Hnu= 0 ppm α = 0 cpm βΓ = 150-200cpm
7.5	17663 10/18/89 1445		6	6	MEDIUM STIFF, OLIVE-BROWN (2.5 Y 5/4) SILTY CLAY, SOME SAND, MOIST.	CL	1.0	Hnu= 0 ppm α = 0 cpm βΓ = 150-200cpm
8.0	17664 10/18/89 1450		7		NO RECOVERY.			

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1231	COORDINATES: NORTH 480,236.98 EAST 1,380,209.43	DATE: 10/17/89
GROUND ELEVATION: 580.09	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/17/89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth N/A Date/Time N/A	DATE COMPLETED: 10/18/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	17665 10/18/89 1450	6		NO RECOVERY.			
9.0	17666 10/18/89 1450	10		NO RECOVERY.			
9.5	17667 10/18/89 1455	5	6	SOFT, GREEN-BROWN (5 Y 5/2) GRAVELLY CLAY, SOME SILT, WET.	CL	.50	Hnu= 0 ppm α = 0 cpm βΓ = 150-200cpm
10.0	17668 10/18/89 1455	5		NO RECOVERY.			
10.5	17669 10/18/89 1455	6		NO RECOVERY.			
11.0	17670 10/18/89 1506	3	6	MEDIUM STIFF, OLIVE-GREY (5 Y 4/1) SILTY CLAY, TRACE SAND, TRACE FINE GRAVEL (.25 IN) DAMP.	CL	1.0	Hnu= 0 ppm α = 0 cpm βΓ = 150-200cpm
11.5	17671 10/18/89 1506	2	6	MEDIUM STIFF, OLIVE-GREY (5 Y 4/1) SILTY CLAY, TRACE SAND, TRACE FINE GRAVEL (.25 IN) DAMP.	CL	1.0	Hnu= 0 ppm α = 0 cpm βΓ = 150-200cpm
12.0	17672 10/18/89 1506	2	2	VERY LOOSE, GREENISH-BROWN (2.5 Y 5/4) POORLY GRADED SAND, TRACE GRAVEL (.25 IN) WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 150-200cpm
12.5	52495 10/18/89 1515	1	6	VERY LOOSE, GREENISH-BROWN (2.5 Y 5/4) POORLY GRADED SAND, TRACE GRAVEL (.25 IN) WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 150-200cpm
13.0	52496 10/18/89 1515	1	6	VERY LOOSE, GREENISH-BROWN (2.5 Y 5/4) POORLY GRADED SAND, TRACE GRAVEL (.25 IN) WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 150-200cpm
13.5	52497 10/18/89 1515	2		NO RECOVERY.			
14.0	52498 10/18/89 1517	2	6	LOOSE, GREENISH-YELLOW-BROWN (2.5 Y 5/4) WELL SORTED SAND, TRACE GRAVEL (.25 IN) WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm
14.5	52499 10/18/89 1517	3	6	LOOSE, GREENISH-YELLOW-BROWN (2.5 Y 5/4) POORLY GRADED SAND, TRACE GRAVEL (.25 IN) WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm
15.0	52500 10/18/89 1517	5	6	LOOSE, GREENISH-YELLOW-BROWN (2.5 Y 5/4) POORLY GRADED SAND, TRACE GRAVEL (.25 IN) WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-120 cpm
15.5	52501 10/18/89 1525	2	6	LOOSE, GREENISH-YELLOW-BROWN (2.5 Y 5/4) POORLY GRADED SILTY SAND, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-150 cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1231	COORDINATES: NORTH 480,236.98 EAST 1,380,209.43	DATE: 10/17/89
GROUND ELEVATION: 580.09	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/17/89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth N/A Date/Time N/A	DATE COMPLETED: 10/18/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.0	52502 10/18/89 1525	2	6	LOOSE, GREENISH-YELLOW-BROWN (2.5 Y 5/4) POORLY GRADED SILTY SAND, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-150 cpm
16.5	52503 10/18/89 1525	8	6	LOOSE, GREENISH-YELLOW-BROWN (2.5 Y 5/4) POORLY GRADED SILTY SAND, WET. MEDIUM STIFF, GREY (5 Y 5/2) CLAYEY SILT SOME SAND WET.	SP ML	NA NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-150 cpm
17.0	52504 10/18/89 1532	6	6	MEDIUM STIFF, GREY (5 Y 5/2) CLAYEY SILT SOME SAND, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-150 cpm
17.5	52505 10/18/89 1532	12	6	MEDIUM STIFF, GREY (5 Y 5/2) CLAYEY SILT SOME SAND, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-150 cpm
18.0	52506 10/18/89 1532	18	6	MEDIUM STIFF, GREY (5 Y 5/2) POORLY GRADED SAND, TRACE GRAVEL (.25 - .75 IN) WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-150 cpm
18.5	52507 10/18/89 1547	18	6	VERY STIFF, GREY (5 Y 5/2) SILTY CLAY, SOME SAND, TRACE GRAVEL (.25 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-150 cpm
19.0	52508 10/18/89 1547	10	6	MEDIUM DENSE, GREY (5 Y 5/2) WELL GRADED SAND, TRACE GRAVEL (.25 IN) WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-150 cpm
19.5	52509 10/18/89 1547	6	6	MEDIUM DENSE, GREY (5 Y 5/2) WELL GRADED SAND, TRACE GRAVEL (.25 IN) WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-150 cpm
20.0	52510 10/18/89 1547	7	6	MEDIUM DENSE, GREY (5 Y 5/2) WELL GRADED SAND, TRACE GRAVEL (.25 IN) WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-150 cpm

BOTTOM OF BORING 20.0

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

1231 3637

FIELD PERMEABILITY TESTS
FALLING HEAD*

PROJECT: FMPC RI/FS
PROJECT NO.: 602 3.7.4
BORING NO.: 1231

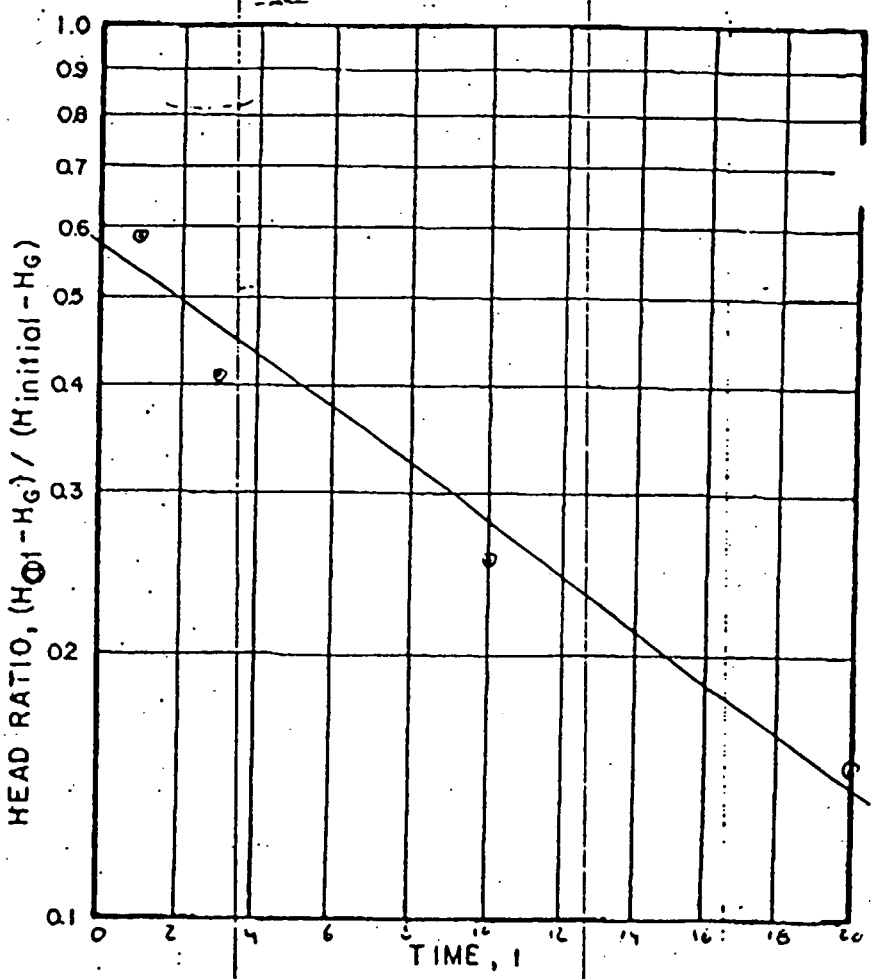
TESTED BY: MS/BA DATE: 8-02-90
CALCULATED BY: MS DATE: 10-20-90
CHECKED BY: CJ DATE: 11/2/90

RADIUS OF WELL, r = 1 in = 0.0833 ft
RADIUS OF TEST BORING, R = 4 in = .333 ft
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C = 2.0 ft
DEPTH TO BOTTOM OF TEST POCKET, L_1 = 22.0 ft
DEPTH TO TOP OF TEST POCKET, L_2 = ~~9.70 ft~~ 10.0 ft
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G = 9.70 ft

HYDRAULIC CONDUCTIVITY, K = 1.2×10^{-6} ft/sec
1.19×10^{-6} ft/sec

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t SEC. MIN	DEPTH TO WATER IN CASING H FEET
0	9.404
1	9.529
2	9.567
3	9.580
4	9.586
5	9.592
6	9.599
7	9.605
8	9.605
9	9.618
10	9.624
12	9.630
14	9.636
16	9.643
18	9.649
20	9.655
25	9.668
30	9.681
40	9.693
50	9.70



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1
H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

HYDRAULIC CONDUCTIVITY CALCULATIONS FOR 1231

$$\text{HEAD RATIO} = \frac{H_{@t} - H_G}{H_i - H_G}$$

WHERE:

H_G = DEPTH TO GROUND WATER BELOW TOC BEFORE SLUG IS ADDED

H_i = INITIAL DEPTH TO GROUND WATER BELOW TOC AFTER SLUG IS ADDED

$H_{@t}$ = DEPTH TO GROUND WATER BELOW TOC AT TIME = t

	HR
1 min: $\frac{9.524 - 9.7}{9.404 - 9.7} = \frac{.171}{.291}$	.588
3 min: $\frac{9.58 - 9.7}{9.404 - 9.7} = \frac{.12}{.291}$	.412
6 min: $\frac{9.549 - 9.7}{9.404 - 9.7} = \frac{.101}{.291}$	.347
10 min: $\frac{9.624 - 9.7}{9.404 - 9.7} = \frac{.076}{.291}$	.261
20 min: $\frac{9.655 - 9.7}{9.404 - 9.7} = \frac{0.045}{.291}$	.155

$$\text{HYDRAULIC CONDUCTIVITY} = K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

$$\Rightarrow K = \frac{(0.0833)^2}{2(\cancel{22.3 - 9.7}\ 22 - 10)(20 - 1)} \ln\left[\frac{\cancel{22.3 - 9.7}\ 22 - 10}{.333}\right] \ln\left[\frac{9.524 - 9.7}{9.655 - 9.7}\right]$$

$$= (0.000015)(\cancel{3.653}\ 3.58)(1.335)$$

$$= \cancel{7.26 \times 10^{-5}\ FT/MIN} \quad = 7.17 \times 10^{-5}\ FT/M$$

$$= \cancel{1.2 \times 10^{-6}\ FT/SEC} \quad = 1.19 \times 10^{-6}\ FT/S$$

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1233
WELL NUMBER: 1233

FIELD ENG./GEO.: L. SINFIELD DATE: 06/01/89
CHECKED BY : BD DATE: 07/02/89
N,E COORDINATES: 480245.01, 1380269.3
DATE OF INSTAL.: 06/01/89

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: AUGER BIT
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING WELL
CASING DIAM.: 2 In. ID
CASING SIZE(S) USED: (Units N/A)
SIZE: N/A FROM: N/A TO: N/A
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: 0.020 (In.)
TOTAL PERFORATED AREA: 13. Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: SCHEDULE 40 PVC
RISER PIPE DIAMETERS:
O.D.: 2 1/4 In. I.D.: 2 In.
LENGTH OF 1ST PIPE SECTION: 7.0 Ft.
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: FLUSH - THREADED JOINTS

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 0.5 Ft.
PROTECTIVE PIPE O.D.: 4 3/ In.
OTHER PROTECTION (* NOTED BELOW)
* LOCKING RUBBER PLUG - T-TYPE C

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	0.2 Ft.		579.49	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	0.5 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
Bentonite Pellets	1.0	5.0	N/A	N/A
Sand	5.0	20.0	N/A	N/A
PERFORATED SECTION	6.8	19.8	N/A	N/A
WELL TIP	20.0		N/A	
BOTTOM OF BOREHOLE	20.0		N/A	
GWL AFTER INSTALLATION	7.2		N/A	

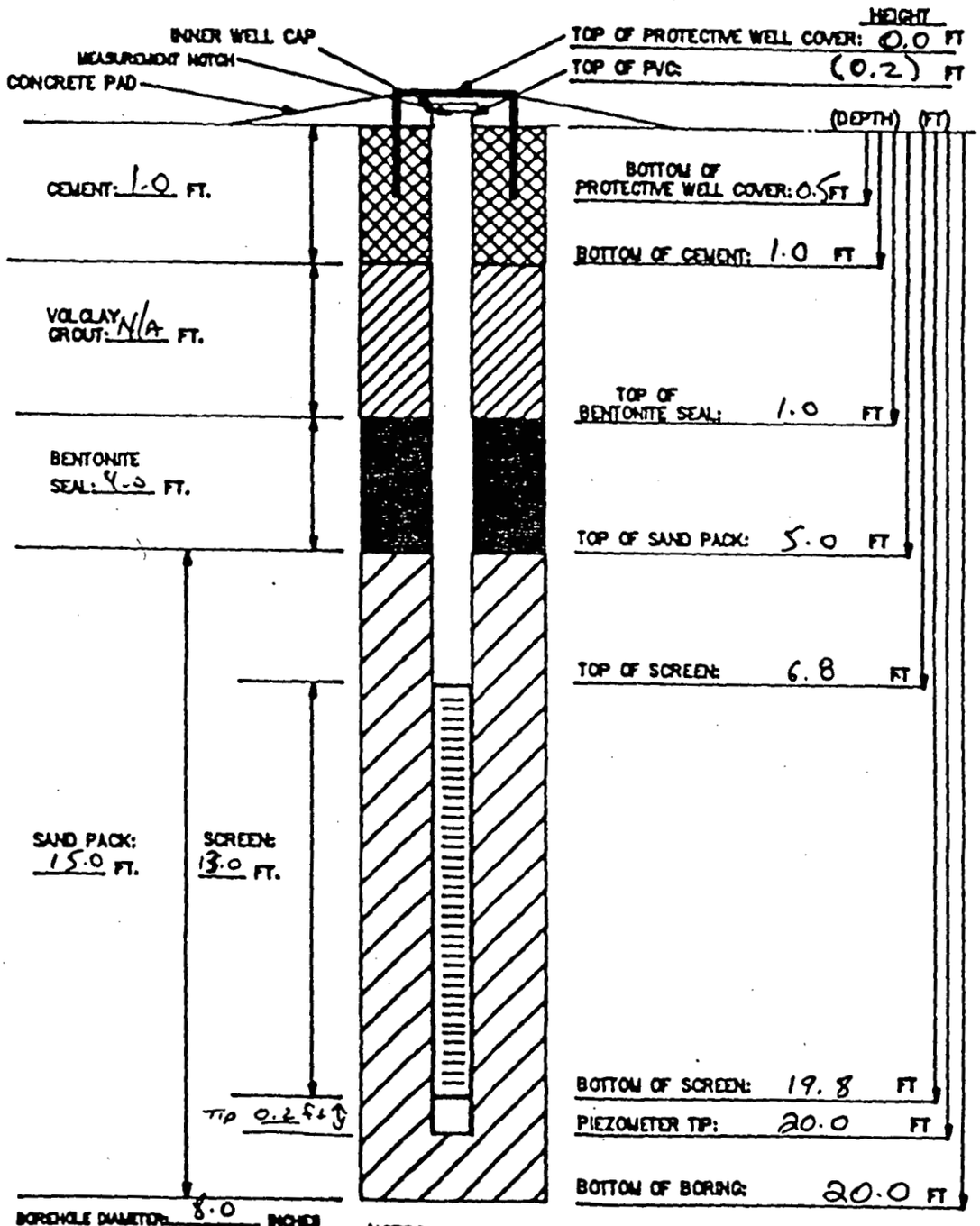
WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

3637

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1233

INSTALLATION DATE: 6-1-89



MATERIALS USED:
SAND TYPE AND QUANTITY: 10/20 Sand - 80 lb bags
BENTONITE PELLETS (5-GALLON BUCKETS): 2
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: ½ Bag
AMOUNT OF WATER USED: 20 gallons
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED BUMP.
4) WATER DEPTH/DATE: 7.2 ground surface / 5-1-89 0930
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602 3.7.1 GEOLOGIST/ENGINEER: L. Sinfield

VISUAL CLASSIFICATION OF SOILS

3637

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1233	COORDINATES: NORTH 480,245.01 EAST 1,380,269.37	DATE: 06/01/89
GROUND ELEVATION: 579.85	GWL: Depth N/A Date/Time N/A	DATE STARTED: 05/31/89
ENGINEER/GEOLOGIST: L. SINFIELD	Depth N/A Date/Time N/A	DATE COMPLETED: 06/01/89
DRILLING METHODS: B-45 RIG: HOLLOW STEM AUGER WITH SPLIT S		PAGE 1 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
0.5	17695 05/31/89 1150			CONCRETE.			Hnu= 0 ppm α = 10 cpm βΓ = 140-180cpm
1.0	17696 05/31/89 1150			CONCRETE.			Hnu= 0 ppm α = 10 cpm βΓ = 140-180cpm
1.5	17697 05/31/89 1150			SOFT, SILTY SANDY GRAVELLY CLAY DRY, MASSIVE.	CL	NA	Hnu= 0 ppm α = 10 cpm βΓ = 140-180cpm
2.0	17698 05/31/89 1150	6 7 15		NO RECOVERY, NO SAMPLE TAKEN.			
2.5	17699 05/31/89 1350	6 7 15	12	STIFF TO VERY STIFF, BROWNISH YELLOW (10 YR 6/8) LEAN CLAY WITH SILT, DRY, MASSIVE MEDIUM PLASTIC, RARE GRAVEL.	CL	1.6-2.6	Hnu= 0 ppm α = 0 cpm βΓ = 280-320cpm
3.0	17700 05/31/89 1350	6 7 15	12	STIFF TO VERY STIFF, BROWNISH YELLOW (10 YR 6/8) LEAN CLAY WITH SILT, DRY, MASSIVE MEDIUM PLASTIC, RARE GRAVEL.	CL	1.6-2.6	Hnu= 0 ppm α = 0 cpm βΓ = 280-320cpm
3.5	17701 05/31/89 1350	12 8 8		NO RECOVERY, NO SAMPLE TAKEN.			
4.0	17702 05/31/89 1355	12 8 8	12	STIFF TO HARD, DARK GRAY (10 YR N4) LEAN CLAY, DRY, MASSIVE, MEDIUM PLASTIC, MOTTLED.	CL	1.6-4.5	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
4.5	17703 05/31/89 1355	12 8 8	12	STIFF TO HARD, DARK GRAY (10 YR N4) LEAN CLAY, DRY, MASSIVE, MEDIUM PLASTIC, MOTTLED.	CL	1.6-4.5	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
5.0	17704 05/31/89 1355	8 11 11		NO RECOVERY, NO SAMPLE TAKEN.			
5.5	17705 05/31/89 1355	8 11 11		NO RECOVERY, NO SAMPLE TAKEN.			
6.0	17706 05/31/89 1400	8 11 11	6	STIFF, BROWNISH YELLOW (10 YR 6/6 - 6/8) MOTTLED LEAN CLAY WITH SILT, DRY MASSIVE, MEDIUM PLASTIC.	CL	1.7	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
6.5	17707 05/31/89 1430	3 3 3	18	STIFF, MOTTLED DARK GRAY (10 YR N4) TO BROWNISH YELLOW (10 YR 6/8) LEAN CLAY WITH SILT AND SAND, DRY, MASSIVE, BASE=SILTY SA	CL	1.7	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
7.0	17708 05/31/89 1430	3 3 3	18	STIFF, MOTTLED DARK GRAY (10 YR N4) TO BROWNISH YELLOW (10 YR 6/8) LEAN CLAY WITH SILT AND SAND, DRY, MASSIVE, BASE=SILTY SA	CL	1.7	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
7.5	17709 05/31/89 1430	3 3 3	18	STIFF, MOTTLED DARK GRAY (10 YR N4) TO BROWNISH YELLOW (10 YR 6/8) LEAN CLAY WITH SILT AND SAND, DRY, MASSIVE, BASE=SILTY SA	ML	1.7	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
8.0	17710 05/31/89 1430	2 7 8	6	LOOSE, BROWNISH YELLOW (10 YR 6/8) SILTY SAND, WET, MASSIVE.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm

NOTES:

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1233	COORDINATES: NORTH 480,245.01 EAST 1,380,269.37	DATE: 06/01/89
GROUND ELEVATION: 579.85	GWL: Depth N/A Date/Time N/A	DATE STARTED: 05/31/89
ENGINEER/GEOLOGIST: L. SINFIELD	Depth N/A Date/Time N/A	DATE COMPLETED: 06/01/89
DRILLING METHODS: B-45 RIG: HOLLOW STEM AUGER WITH SPLIT S		PAGE 2 OF 3

DEPTH	SAMPLE / DATE / TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	17711 05/31/89 1430	2 7 8		NO RECOVERY, NO SAMPLE TAKEN.			
9.0	17712 05/31/89 1440	2 7 8	6	LOOSE, BROWNISH YELLOW (10 YR 6/8) SILTY SAND, WET, MASSIVE.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
9.5	17713 05/31/89 1450	7 8 10	18	LOOSE, BROWNISH YELLOW (10 YR 6/8) SILTY SAND, WET, MASSIVE.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
10.0	17714 05/31/89 1450	7 8 10	18	LOOSE, BROWNISH YELLOW (10 YR 6/8) SILTY SAND, WET, MASSIVE.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
10.5	17715 05/31/89 1450	7 8 10	18	LOOSE, BROWNISH YELLOW (10 YR 6/8) COARSE SILTY SAND, WET, MASSIVE.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
11.0	17716 05/31/89 1450	6 8 9		NO RECOVERY, NO SAMPLE TAKEN.			
11.5							
12.0	52536 05/31/89 1520	6 8 9	6	LOOSE, BROWNISH YELLOW (10 YR 6/8) SILTY SAND (COARSE) WET, MASSIVE. 0.5 FT. THICK GRAY (10 YR N5) LEAN CLAY, WET, STIFF, MEDIUM PLASTIC.	SM	1.6 1.6	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
12.5	52537 05/31/89 1540	3 5 8	18	LOOSE, BROWNISH YELLOW (10 YR 6/8) SILTY SAND (COARSE) WET, MASSIVE. 0.5 FT. THICK GRAY (10 YR N5) LEAN CLAY, WET, STIFF, MEDIUM PLASTIC.	SM	NA NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
13.0	52538 05/31/89 1540	3 5 8	18	LOOSE, BROWNISH YELLOW (10 YR 6/8) SILTY SAND (COARSE) WET, MASSIVE. 0.5 FT. THICK GRAY (10 YR N5) LEAN CLAY, WET, STIFF, MEDIUM PLASTIC.	CL	1.7 1.7	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
13.5	52539 05/31/89 1540	3 5 8	18	LOOSE, BROWNISH YELLOW (10 YR 6/8) SILTY SAND (COARSE) WET, MASSIVE. 0.5 FT. THICK GRAY (10 YR N5) LEAN CLAY, WET, STIFF, MEDIUM PLASTIC.	SM	NA NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
14.0	52540 05/31/89 1555	10 13 15	18	MEDIUM DENSE, BROWNISH YELLOW (10 YR 6/8) SILTY SAND WITH GRAVEL, MASSIVE, WET.	SM	NA	Hnu= 0 ppm α = 0 cpm
14.5	52541 05/31/89 1555	10 13 15	18	MEDIUM DENSE, BROWNISH YELLOW (10 YR 6/8) SILTY SAND WITH GRAVEL, MASSIVE, WET.	SM	NA	Hnu= 0 ppm α = 0 cpm
15.0	52542 05/31/89 1555	10 13 15	18	MEDIUM DENSE, BROWNISH YELLOW (10 YR 6/8) SILTY SAND WITH GRAVEL, MASSIVE, WET.	SM	NA	Hnu= 0 ppm α = 0 cpm
15.5	52543 05/31/89 1620	5 7 9	18	LOOSE, BROWNISH YELLOW (10 YR 6/8) TO GRAY (10 YR 6/1) SILTY SAND/COARSE, WET, MASSIVE.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm

NOTES:

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1233	COORDINATES: NORTH 480,245.01 EAST 1,380,269.37	DATE: 06/01/89
GROUND ELEVATION: 579.85	GWL: Depth N/A Date/Time N/A	DATE STARTED: 05/31/89
ENGINEER/GEOLOGIST: L. SINFIELD	Depth N/A Date/Time N/A	DATE COMPLETED: 06/01/89
DRILLING METHODS: B-45 RIG: HOLLOW STEM AUGER WITH SPLIT S		PAGE 3 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.0	52544 05/31/89 1620	5 7 9	18	LOOSE, BROWNISH YELLOW (10 YR 6/8) TO GRAY (10 YR 6/1) SILTY SAND/COARSE, WET, MASSIVE.	SM	NA	Hnu= 0 ppm α = 0 cpm Bγ = 100-120cpm
16.5	52545 05/31/89 1620	5 7 9	18	LOOSE, BROWNISH YELLOW (10 YR 6/8) TO GRAY (10 YR 6/1) SILTY SAND/COARSE, WET, MASSIVE.	SM	NA	Hnu= 0 ppm α = 0 cpm Bγ = 100-120cpm
17.0	52546 05/31/89 1630	8 9 10	18	LOOSE, GRAY (10 YR 6/1) COARSE SILTY SAND, WET MASSIVE WITH GRAVEL AND 1/2 IN. CLAY LAYERS.	SM	NA	Hnu= 0 ppm α = 0 cpm Bγ = 100-120cpm
17.5	52547 05/31/89 1630	8 9 10	18	LOOSE, GRAY (10 YR 6/1) COARSE SILTY SAND, WET MASSIVE WITH GRAVEL AND 1/2 IN. CLAY LAYERS.	SM	NA	Hnu= 0 ppm α = 0 cpm Bγ = 100-120cpm
18.0	52548 05/31/89 1630	8 9 10	18	LOOSE, GRAY (10 YR 6/1) COARSE SILTY SAND, WET MASSIVE WITH GRAVEL AND 1/2 IN. CLAY LAYERS.	SM	NA	Hnu= 0 ppm α = 0 cpm Bγ = 100-120cpm
18.5	52549 05/31/89 1640	7 7 8	24	LOOSE, GRAY (10 YR 6/1) COARSE SILTY SAND, WET MASSIVE WITH GRAVEL AND 1/2 IN. CLAY LAYERS.	SM	NA	Hnu= 0 ppm α = 0 cpm Bγ = 100-120cpm
19.0	52550 05/31/89 1640	7 7 8	24	LOOSE, GRAY (10 YR 6/1) COARSE SILTY SAND, WET MASSIVE WITH GRAVEL AND 1/2 IN. CLAY LAYERS.	SM	NA	Hnu= 0 ppm α = 0 cpm Bγ = 100-120cpm
19.5	52551 05/31/89 1640	7 7 8	24	LOOSE, GRAY (10 YR 6/1) COARSE SILTY SAND, WET MASSIVE WITH GRAVEL AND 1/2 IN. CLAY LAYERS.	SM	NA	Hnu= 0 ppm α = 0 cpm Bγ = 100-120cpm
20.0	52552 05/31/89 1640	9	24	LOOSE, GRAY (10 YR 6/1) COARSE SILTY SAND, WET MASSIVE WITH GRAVEL AND 1/2 IN. CLAY LAYERS.	SM	NA	Hnu= 0 ppm α = 0 cpm Bγ = 100-120cpm
11.5	53535 05/31/89 1450	6 8 9		NO RECOVERY, NO SAMPLE TAKEN.			

BOTTOM OF BORING 20.0

NOTES:

FIELD PERMEABILITY TESTS
FALLING HEAD*

PROJECT: FMPC R.I/FS
PROJECT NO.: 602 3.2.1
BORING NO.: 1233

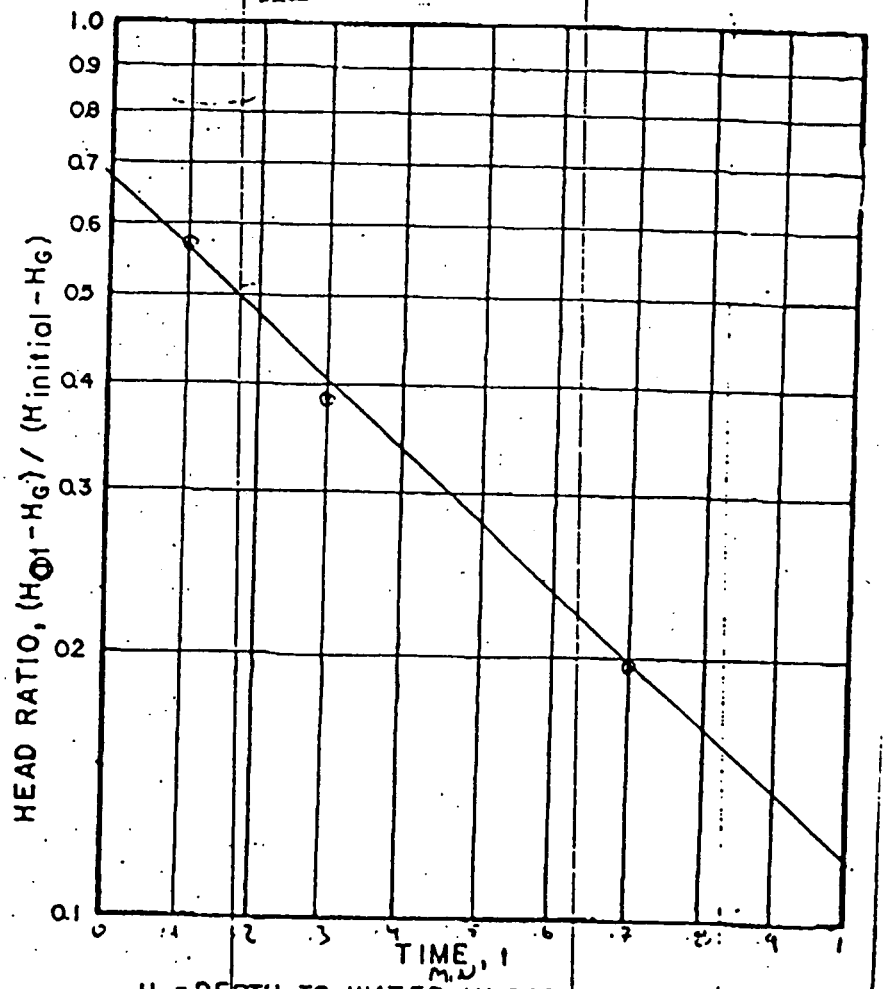
TESTED BY: MS/BA — DATE: 8-07-90
CALCULATED BY: MS — DATE: 10-20-90
CHECKED BY: CH — DATE: 11/2/90

RADIUS OF WELL, r = 1 in = 0.0833 FT
RADIUS OF TEST BORING, R = 4 in = .333 FT
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C = 0.0 FT
DEPTH TO BOTTOM OF TEST POCKET, L_1 = 20.0 FT
DEPTH TO TOP OF TEST POCKET, L_2 = 7.2 FT ; 7.169 FT
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G = 7.2 FT

HYDRAULIC CONDUCTIVITY, K: 3.01×10^{-5} FT/SEC AND 4.08×10^{-5} FT/SEC

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t SEC, MIN	DEPTH TO WATER IN CASING H FEET
0	7.169
.1	7.182
.2	7.183
.3	7.188
.4	7.188
.5	7.188
.6	7.191
.7	7.194
.8	7.194
.9	7.194
1	7.194
1.75	7.200



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

HYDRAULIC CONDUCTIVITY CALCULATIONS FOR B-1233

$$\text{HEAD RATIO} = \frac{H_{@t} - H_G}{H_i - H_G}$$

WHERE: H_G = DEPTH TO GROUND WATER BELOW TOC BEFORE SLUG IS ADDED

H_i = INITIAL DEPTH TO GROUND WATER BELOW TOC AFTER SLUG IS ADDED

$H_{@t}$ = DEPTH TO GROUND WATER BELOW TOC AT TIME = t

HR

.1 MIN: $\frac{7.192 - 7.200}{7.164 - 7.200} = \frac{0.018}{0.031} = .581$

.3 MIN: $\frac{7.188 - 7.200}{7.164 - 7.200} = \frac{0.012}{0.031} = .387$

.7 MIN: $\frac{7.144 - 7.200}{7.164 - 7.200} = \frac{0.006}{0.031} = .194$

$$\text{HYDRAULIC CONDUCTIVITY} = K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

$$\Rightarrow K = \frac{(0.0833\,FT)^2}{2(20 - 7.2)(.7 - .1)} \ln\left[\frac{20 - 7.2}{.333}\right] \ln\left[\frac{7.192 - 7.2}{7.144 - 7.2}\right]$$

$$= (0.00045)(3.649)(1.099)$$

$$= 1.8 \times 10^{-3}\ FT/MIN$$

$$= \cancel{3.012 \times 10^{-5}\ FT/SEC} = \cancel{3.012}$$

$$= 3.01 \times 10^{-5}\ FT/SEC$$

MS 11-19-90

ALSO:

$$K = \frac{(0.0833)^2}{2(20 - 7.164)(.7 - .1)} \ln\left[\frac{20 - 7.164}{.333}\right] \ln\left[\frac{7.192 - 7.2}{7.144 - 7.2}\right]$$

$$= (0.00061)(3.651)(1.099)$$

$$= 2.45 \times 10^{-3}\ FT/M$$

$$= 4.08 \times 10^{-5}\ FT/S$$

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1234
WELL NUMBER: 1234

FIELD ENG./GEO.: M. SLUSARSKI DATE: 07/27/89
CHECKED BY : B. DUNNING DATE: 07/29/89
N,E COORDINATES: 480207.90, 1380230.4
DATE OF INSTAL.: 07/27/89

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: N/A
IS CASING TEMPORARY?: No
CASING TYPE : GROUNDWATER MONITORI
CASING DIAM.: 2.0 In.
CASING SIZE(S) USED: (in Feet)
SIZE: 8 FROM: 0.0 TO: 10.5
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: 0.02 (In.)
TOTAL PERFORATED AREA: 3.0 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: SCHEDULE 40 PVC
RISER PIPE DIAMETERS:
O.D.: 2 5/16 In. I.D.: 2.0 In.
LENGTH OF 1ST PIPE SECTION: 9.0 Ft.
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: FLUSH JOINTED / THREADED

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5.0 Ft.
PROTECTIVE PIPE O.D.: 4 3/ In.
* LOCKED / PROTECTIVE LID.

OTHER PROTECTION (* NOTED BELOW)

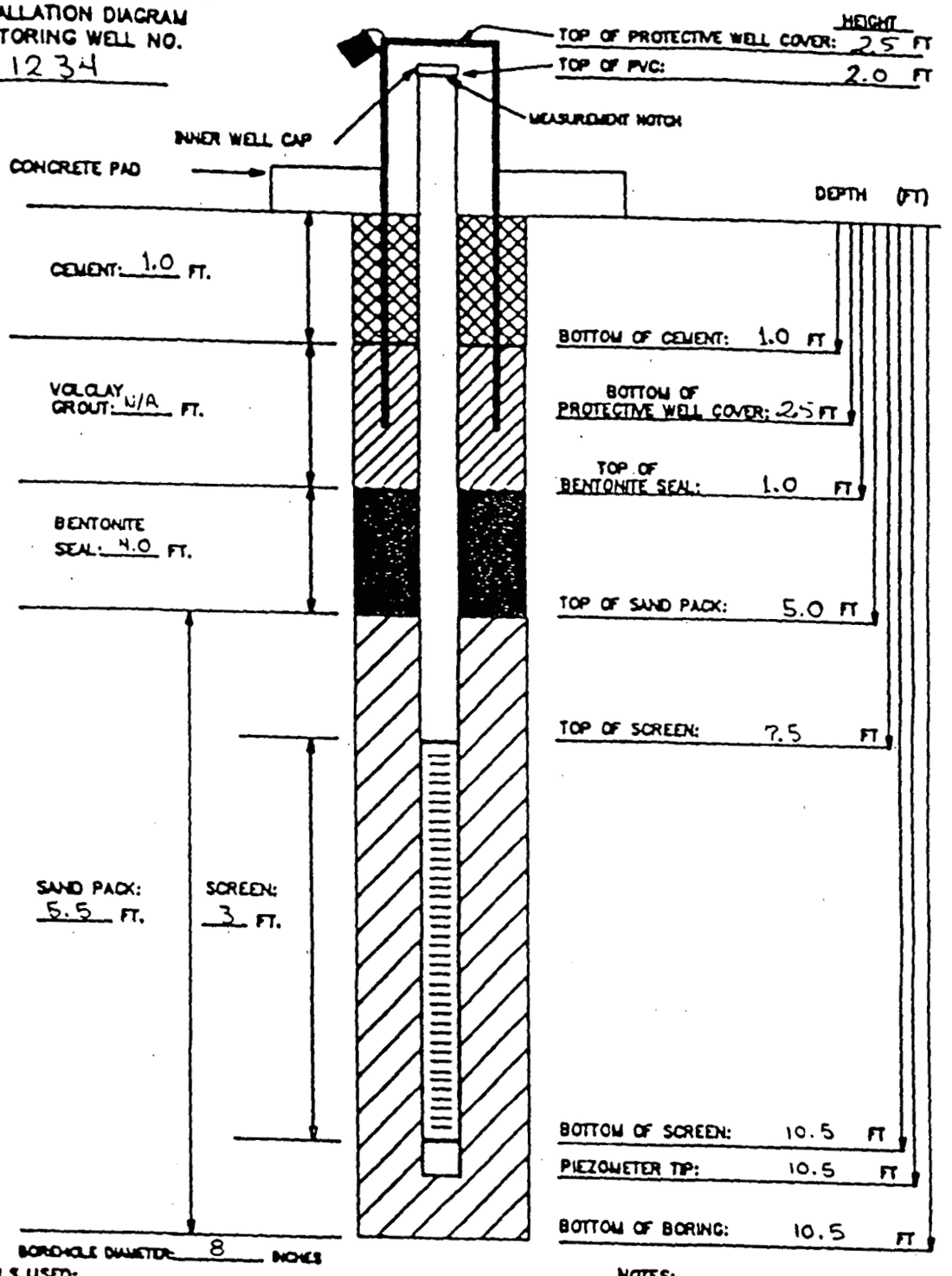
ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	2.0 Ft.		582.20	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	N/A			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
Bentonite Pellets	1.0	5.0	N/A	N/A
Sand	5.0	10.5	N/A	N/A
PERFORATED SECTION	7.5	10.5	N/A	N/A
WELL TIP	10.5		N/A	
BOTTOM OF BOREHOLE	10.5		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1234

INSTALLATION DATE: 7/27/89



BOREHOLE DIAMETER: 8 INCHES

MATERIALS USED:

SAND TYPE AND QUANTITY: 2 80 lb. sks (10-20 sand)
BENTONITE PELLETS (5-GALLON BUCKETS): 2 Buckets
BAGS OF VOLCLAY GROUT: None
AMOUNT OF CEMENT: ½ sk (40 lb sk)
AMOUNT OF WATER USED: ≈ 5 gallons
OTHER: None

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602.03.07.01

GEOLOGIST/ENGINEER: M. Sivarshi / B. Dunning

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1234	COORDINATES: NORTH 480,207.90 EAST 1,380,230.49	DATE: 07/27/89
GROUND ELEVATION: 580.54	GWL: Depth N/A Date/Time N/A	DATE STARTED: 07/26/89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth N/A Date/Time N/A	DATE COMPLETED: 07/27/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 2

DEPTH	SAMPLE DATE TIME	BLOWS DOWN	SAMPLE RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
0.5	17719 07/27/89 0925	6	4	MEDIUM DENSE, BROWN (10 YR 5/4) CLAYEY GRAVEL RANGING FROM (.25 - .75 IN) DRY.	GC	NA	Hnu= 7 ppm α = 0 cpm βΓ = 80-100 cpm
1.0	17720 07/27/89 0925	10		NO RECOVERY.			
1.5	17721 07/27/89 0925	8		NO RECOVERY.			
2.0	17722 07/27/89 0928	5	6	STIFF, BROWN (10 YR 4/4) SILTY CLAY, TRACE GRAVEL (.25 - 1.0), TRACE SAND, DAMP.	CL	2.0	Hnu= 5-6 ppm α = 0 cpm βΓ = 100-120cpm
2.5	17723 07/27/89 0928	7		NO RECOVERY.			
3.0	17724 07/27/89 0928	6		NO RECOVERY.			
3.5	17725 07/27/89 0932	8	6	STIFF, OLIVE BROWN (5 Y 4/1) SILTY CLAY, TRACE GRAVEL (.25 IN) DAMP.	CL	2.0	Hnu= 9 ppm α = 0 cpm βΓ = 140-160cpm
4.0	17726 07/27/89 0932	8	4	STIFF, OLIVE BROWN (5 Y 4/1) SILTY CLAY, TRACE GRAVEL (.25 IN) DAMP.	CL	2.0	Hnu= 9 ppm α = 0 cpm βΓ = 140-160cpm
4.5	17727 07/27/89 0932	8		NO RECOVERY.			
5.0	17728 07/27/89 0935	11	6	STIFF, YELLOW-BROWN (2.5 Y 4/4) SILTY CLAY, TRACE GRAVEL (.25 IN) DAMP.	CL	2.0	Hnu= 4-5 ppm α = 0 cpm βΓ = 100-120cpm
5.5	17729 07/27/89 0935	12	6	STIFF, YELLOW-BROWN (2.5 Y 4/4) SILTY CLAY, TRACE GRAVEL (.25 IN) DAMP.	CL	2.0	Hnu= 4-5 ppm α = 0 cpm βΓ = 100-120cpm
6.0	17730 07/27/89 0935	11	6	STIFF, YELLOW-BROWN (2.5 Y 4/4) SILTY CLAY, TRACE GRAVEL (.25 IN) DAMP.	CL	2.0	Hnu= 4-5 ppm α = 0 cpm βΓ = 100-120cpm
6.5	17731 07/27/89 1032	5	6	STIFF, YELLOW-BROWN (2.5 Y 5/4) SILTY CLAY, TRACE SAND, DAMP.	CL	1.0	Hnu= 2-3 ppm α = 0 cpm βΓ = 100 cpm
7.0	17732 07/27/89 1032	4	6	STIFF, YELLOW-BROWN (2.5 Y 5/4) SILTY CLAY, TRACE SAND, DAMP.	CL	1.0	Hnu= 2-3 ppm α = 0 cpm βΓ = 100 cpm
7.5	17733 07/27/89 1032	4	6	STIFF, YELLOW-BROWN (2.5 Y 5/4) SILTY CLAY, TRACE SAND, DAMP.	CL	1.0	Hnu= 2-3 ppm α = 0 cpm βΓ = 100 cpm
8.0	17734 07/27/89 1034	4	6	STIFF YELLOW-BROWN (2.5 Y 5/4) SILTY CLAY, DAMP.	CL	2.0	Hnu= 4 ppm α = 0 cpm βΓ = 100-120cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1234	COORDINATES: NORTH 480,207.90 EAST 1,380,230.49	DATE: 07/27/89
GROUND ELEVATION: 580.54	GWL: Depth N/A Date/Time N/A	DATE STARTED: 07/26/89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth N/A Date/Time N/A	DATE COMPLETED: 07/27/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 2

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	17735 07/27/89 1034	5	6	MEDIUM DENSE, YELLOW-BROWN (2.5 Y 5/4) POORLY GRADED FINE SAND, WET.	SP	NA	Hnu= 4 ppm α = 0 cpm βΓ = 100-120cpm
9.0	17736 07/27/89 1034	8	6	MEDIUM DENSE, YELLOW-BROWN (2.5 Y 5/4) SAND-SILT MIXTURE, WET.	SM	NA	Hnu= 4 ppm α = 0 cpm βΓ = 100-120cpm
9.5	17737 07/27/89 1039	7	6	MEDIUM DENSE, YELLOW-BROWN (2.5 Y 5/4) SAND-SILT MIXTURE, DAMP	SM	NA	Hnu= 4 ppm α = 0 cpm βΓ = 100-120cpm
10.0	17738 07/27/89 1039	11	6	MEDIUM DENSE, YELLOW-BROWN (2.5 Y 5/4) SAND-SILT MIXTURE, DAMP	SM	NA	Hnu= 4 ppm α = 0 cpm βΓ = 100-120cpm
10.5	52555 07/27/89 1039	15	6	MEDIUM DENSE, YELLOW-BROWN (2.5 Y 5/4) SAND-SILT MIXTURE, DAMP STIFF, OLIVE GREY (5 Y 4/1) SILTY CLAY DAMP.	SM CL	NA NA	Hnu= 4 ppm α = 0 cpm βΓ = 100-120cpm

BOTTOM OF BORING 10.5

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

1234
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FIELD PERMEABILITY TESTS
FALLING HEAD*

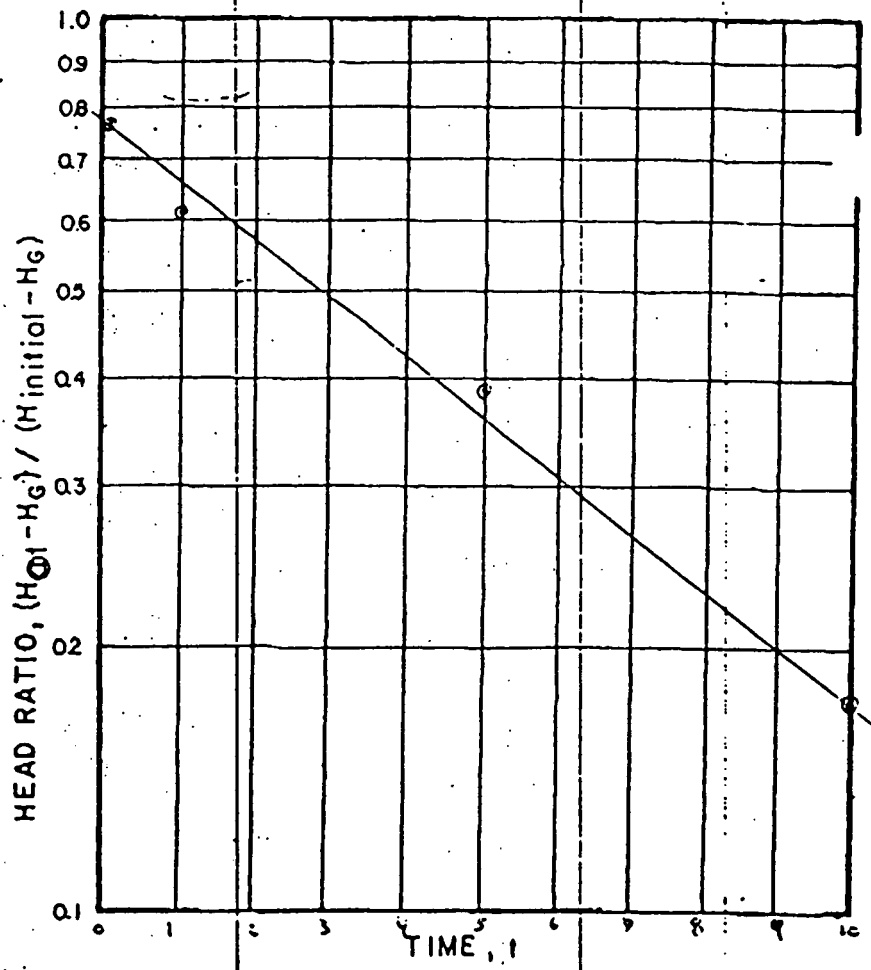
PROJECT FMPC RI/FS TESTED BY MS/BA DATE 8-01-90
PROJECT NO. 602 3.7.4 CALCULATED BY MS DATE 10-20-90
BORING NO. 1234 CHECKED BY [illegible] DATE 11/2/90

RADIUS OF WELL, ~~R~~ r = 1 IN = 0.0833 FT
RADIUS OF TEST BORING, R = 4 IN = .333 FT
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C 2.0 FT
DEPTH TO BOTTOM OF TEST POCKET, L_1 ~~12.3 FT~~ 12.5 FT
DEPTH TO TOP OF TEST POCKET, L_2 10.10 FT & 9.987
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 10.10 FT

HYDRAULIC CONDUCTIVITY, K ~~7.0×10^{-6} FT/SEC~~ 7.57×10^{-6} FT/SEC AND 7.23×10^{-6} FT/SEC

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t ~~SEC~~ MIN	DEPTH TO WATER IN CASING H FEET
0	9.987
.10	10.012
1	10.031
5	10.056
10	10.081
15	10.081
20	10.088
25	10.094
30	10.094
35	10.10



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1
H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

HYDRAULIC CONDUCTIVITY CALCULATIONS FOR B-1234

3637

$$\text{HEAD RATIO} = \frac{H_{@t} - H_G}{H_i - H_G}$$

WHERE: H_G = DEPTH TO GROUND WATER BELOW TOC BEFORE SLUG IS ADDED

H_i = INITIAL DEPTH TO GROUND WATER BELOW TOC AFTER SLUG IS ADDED

$H_{@t}$ = DEPTH TO GROUND WATER BELOW TOC AT TIME = t

HR

.1 min: $\frac{10.012 - 10.10}{9.987 - 10.10} = \frac{0.088}{.113} = .779$

1 min: $\frac{10.031 - 10.10}{9.987 - 10.10} = \frac{0.069}{.113} = .611$

5 min: $\frac{10.056 - 10.10}{9.987 - 10.10} = \frac{0.044}{.113} = .389$

10 min: $\frac{10.081 - 10.10}{9.987 - 10.10} = \frac{0.019}{.113} = .168$

$$\text{HYDRAULIC CONDUCTIVITY} = K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

$$\Rightarrow K = \frac{(0.0833\,ft)^2}{2(\cancel{12.0 - 10.10}\ 12.5 - 10.10)(10 - .1)} \ln\left[\frac{\cancel{12.8 - 10.1}\ 12.5 - 10.10}{.333}\right] \ln\left[\frac{10.012 - 10.10}{10.081 - 10.10}\right]$$

$$= \cancel{(0.00013)(2.043)(1.533)} \quad (0.00015)(1.98)(1.533)$$

$$= \cancel{4.17 \times 10^{-4}\ ft/min} \quad = 4.54 \times 10^{-4}\ ft/m$$

$$= \cancel{7.0 \times 10^{-6}\ ft/sec} \quad = 7.57 \times 10^{-6}\ ft/sec$$

ALSO

$$K = \frac{(0.0833)^2}{2(12.5 - 9.987)(10 - .1)} \ln\left[\frac{12.5 - 9.987}{.333}\right] \ln\left[\frac{10.012 - 10.10}{10.081 - 10.10}\right]$$

$$= (0.00014)(2.02)(1.533)$$

$$= \cancel{4.65 \times 10^{-4}} \quad 4.34 \times 10^{-4}\ ft/m$$

$$= 7.23 \times 10^{-6}\ ft/s$$

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1245
WELL NUMBER: 1245

FIELD ENG./GEO.: C. GRUBE
CHECKED BY : BD
N,E COORDINATES: 479951.92, 1380057.8
DATE OF INSTAL.: 10/10/89

DATE: 10/10/89
DATE: 10/11/89

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: HOLLOW AUGER
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING PIEZOMETE
CASING DIAM.: 2.0 In.
CASING SIZE(S) USED: (Units N/A)
SIZE: N/A FROM: N/A TO: N/A
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: 0.020 (In.)
TOTAL PERFORATED AREA: 5.0 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: SCHEDULE 40 PVC
RISER PIPE DIAMETERS:
O.D.: 2 5/16 In. I.D.: 2.0 In.
LENGTH OF 1ST PIPE SECTION: 10.0 Ft.
2ND PIPE SECTION: 3.5 Ft.
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: SCREW TYPE - FLUSH JOINT THREADED

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5.0 Ft.
PROTECTIVE PIPE O.D.: 4 3/ In.
* HINGED PROTECTIVE COVER WITH I

OTHER PROTECTION (* NOTED BELOW)

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	2.0 Ft.		580.66	
GROUND SURFACE	0.0		578.8	
BOTTOM OF PROTECTIVE PIPE	2.8 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
	0.0	1.0	N/A	N/A
Bentonite Pellets	1.0	9.0	N/A	N/A
Sand	9.0	16.5	N/A	N/A
PERFORATED SECTION	11.5	16.5	N/A	N/A
WELL TIP	16.5		N/A	
BOTTOM OF BOREHOLE	16.5		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

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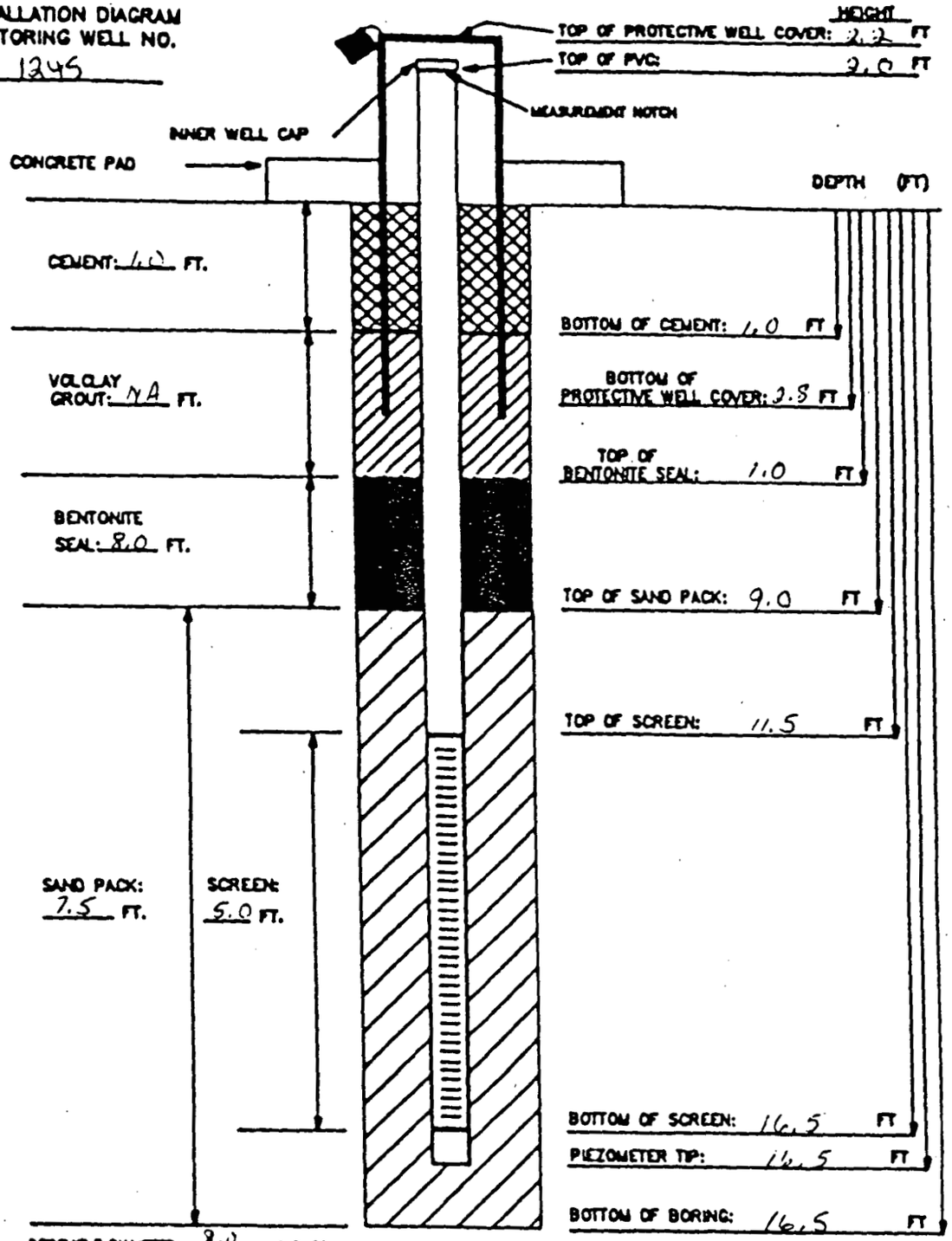
FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1245

INSTALLATION DATE: 10-10-89

3637



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 10/20 sand 2 80# sacks
BENTONITE PELLETS (5-GALLON BUCKETS): 3 1/2
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: 1/2 (94#) sk.
AMOUNT OF WATER USED: 10 gal water
OTHER: 5.0 FT Protective casing w/cover

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602 3.7

GEOLOGIST/ENGINEER: C. Grube

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1245	COORDINATES: NORTH 479,951.92 EAST 1,380,057.83	DATE: 10/10/89
GROUND ELEVATION: 578.8	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/10/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 10/10/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
0.5	17959 10/10/89 1010	6	6	HARD, (2.5 Y 4/4) OLIVE BROWN SILTY CLAY, LOW PLASTICITY, TRACE GRAVEL, MOIST.	CL	>4.5	Hnu= 0 ppm α = 0 cpm βΓ = 200-210cpm
1.0	17960 10/10/89 1010	12	6	HARD, (2.5 Y 4/4) OLIVE BROWN SILTY CLAY, LOW PLASTICITY, TRACE GRAVEL, MOIST.	CL	>4.5	Hnu= 0 ppm α = 0 cpm βΓ = 200-210cpm
1.5	17961 10/10/89 1010	17		NO RECOVERY.			
2.0	17962 10/10/89 1015	6	6	VERY STIFF (2.5 Y 5/4) LIGHT OLIVE BROWN SILTY CLAY TRACE FINE GRAVEL, LOW PLASTICITY, MOIST.	CL	3.5	Hnu= 0 ppm α = 0 cpm βΓ = 180-200cpm
2.5	17963 10/10/89 1015	5	2	VERY STIFF (2.5 Y 5/4) LIGHT OLIVE BROWN SILTY CLAY TRACE FINE GRAVEL, LOW PLASTICITY, MOIST.	CL	3.5	Hnu= 0 ppm α = 0 cpm βΓ = 180-200cpm
3.0	17964 10/10/89 1015	5		NO RECOVERY.			
3.5	17965 10/10/89 1017	6	6	MEDIUM STIFF (2.5 Y 5/4) LIGHT OLIVE BROWN CLAY, SOME SILT, TRACE FINE GRAVEL, MEDIUM PLASTICITY, MOIST.	CL	.75	Hnu= 0 ppm α = 0 cpm βΓ = 220-240cpm
4.0	17966 10/10/89 1017	5		NO RECOVERY.			
4.5	17967 10/10/89 1017	4		NO RECOVERY.			
5.0	17968 10/10/89 1020	4	6	MEDIUM STIFF (2.5 Y 5/4) LIGHT OLIVE BROWN CLAY, TRACE OF FINE GRAVEL, MEDIUM PLASTICITY, MOIST.	CL	.75	Hnu= 0 ppm α = 0 cpm βΓ = 200-210cpm
5.5	17969 10/10/89 1020	5	2	SOFT, (2.5 Y 5/4) LIGHT OLIVE BROWN CLAY, TRACE OF FINE GRAVEL, MEDIUM PLASTICITY, MOIST.	CL	.25	Hnu= 0 ppm α = 0 cpm βΓ = 200-210cpm
6.0	17970 10/10/89 1020	6		NO RECOVERY.			
6.5	17971 10/10/89 1140	4	5	MEDIUM STIFF (5 Y 5/3) OLIVE SILTY CLAY, TRACE OF FINE GRAVEL, MEDIUM PLASTICITY, MOIST.	CL	.5	Hnu= 0 ppm α = 0 cpm βΓ = 180-190cpm
7.0	17972 10/10/89 1140	4		NO RECOVERY.			
7.5	17973 10/10/89 1140	5		NO RECOVERY.			
8.0	17974 10/10/89 1150	3	6	VERY SOFT (5 Y 4/3) OLIVE SILTY CLAY, TRACE FINE GRAVEL MEDIUM PLASTICITY MOIST.	CL	<.25	Hnu= 0 ppm α = 0 cpm βΓ = 170-180cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1245	COORDINATES: NORTH 479,951.92 EAST 1,380,057.83	DATE: 10/10/89
GROUND ELEVATION: 578.8	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/10/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 10/10/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	17975 10/10/89 1150	5	6	MEDIUM STIFF (5 Y 4/1) DARK GRAY, CLAY, SOME SILT, LOW PLASTICITY MOIST.	CL	.75	Hnu= 0 ppm α = 0 cpm βΓ = 170-180cpm
9.0	17976 10/10/89 1150	6	6	MEDIUM STIFF (5 Y 4/2) OLIVE GRAY, SILTY CLAY, MEDIUM PLASTICITY MOIST.	CL	.75	Hnu= 0 ppm α = 0 cpm βΓ = 170-180cpm
9.5	17977 10/10/89 1407	3	3	SOFT (5 Y 4/1) DARK GRAY, CLAY, TRACE OF FINE TO MEDIUM GRAVEL, MEDIUM PLASTICITY, MOIST.	CL	.50	Hnu= 0 ppm α = 0 cpm βΓ = 170-180cpm
10.0	17978 10/10/89 1407	4		NO RECOVERY.			
10.5	17979 10/10/89 1407	5		NO RECOVERY.			
11.0	17980 10/10/89 1420	4	6	STIFF (2.5 Y 4/4) OLIVE BROWN SILTY CLAY, TRACE FINE TO MEDIUM GRAVEL, LOW PLASTICITY MOIST.	CL	1.0	Hnu= 0 ppm α = 0 cpm βΓ = 160-170cpm
11.5	52595 10/10/89 1420	5	6	STIFF (2.5 Y 4/4) OLIVE BROWN SILTY CLAY, TRACE FINE TO MEDIUM GRAVEL, LOW PLASTICITY MOIST. LOOSE (5 Y 5/2) OLIVE GRAY CLAYEY SILT MOIST.	CL ML	1.75 1.75	Hnu= 0 ppm α = 0 cpm βΓ = 160-170cpm
12.0	52596 10/10/89 1420	5	6	LOOSE (5 Y 5/2) OLIVE GRAY CLAYEY SILT MOIST. LOOSE (10 YR 4/6) DARK YELLOWISH BROWN SILTY SAND, WET.	ML SM	NA NA	Hnu= 0 ppm α = 0 cpm βΓ = 160-170cpm
12.5	52597 10/10/89 1428	10	6	MEDIUM DENSE (5 Y 5/2) OLIVE GRAY CLAYEY SILT, MOIST.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 180-200cpm
13.0	52598 10/10/89 1428	9	6	MEDIUM DENSE (10 YR 4/6) DARK YELLOWISH BROWN SILTY SAND, WET.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 180-200cpm
13.5	52599 10/10/89 1428	14	6	MEDIUM DENSE (10 YR 4/6) DARK YELLOWISH BROWN SILTY SAND, WET. MEDIUM DENSE (5 Y 4/1) DARK GRAY, SILT, WET.	SM ML	NA NA	Hnu= 0 ppm α = 0 cpm βΓ = 180-200cpm
14.0	52600 10/10/89 1435	7	6	MEDIUM DENSE (10 YR 4/6) DARK YELLOWISH BROWN CLAYEY SAND, WET	SC	NA	Hnu= 0 ppm α = 0 cpm βΓ = 180-190cpm
14.5	52601 10/10/89 1435	7	6	MEDIUM DENSE (10 YR 4/6) DARK YELLOWISH BROWN SILTY SAND, WET.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 180-190cpm
15.0	52602 10/10/89 1435	9	6	MEDIUM DENSE (5 Y 5/1) GRAY CLAYEY SILT, TRACE SAND WET.	ML	NA	Hnu= 0 ppm α = 0 cpm βΓ = 180-190cpm
15.5	52603 10/10/89 1440	9	6	MED. DENSE (2.5 Y 5/4) LIGHT OLIVE BROWN, CLAYEY TO SILTY SAND, WET.	SC	NA	Hnu= 0 ppm α = 0 cpm βΓ = 180-190cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1245	COORDINATES: NORTH 479,951.92 EAST 1,380,057.83	DATE: 10/10/89
GROUND ELEVATION: 578.8	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/10/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 10/10/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.0	52604 10/10/89 1440	6	6	MED. DENSE (2.5 Y 5/4) LIGHT OLIVE BROWN, CLAYEY TO SILTY SAND, WET.	SC	NA	Hnu= 0 ppm α = 0 cpm βΓ = 180-190cpm
16.5	52605 10/10/89 1440	5	6	MEDIUM DENSE (5 Y 5/1) GRAY CLAYEY SILT, MOIST. SOFT (5 Y 5/1) GRAY SILTY CLAY, LOW PLASTICITY MOIST.	ML CL	NA NA	Hnu= 0 ppm α = 0 cpm βΓ = 180-190cpm

BOTTOM OF BORING 16.5

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

1245 1250 1

FIELD PERMEABILITY TESTS
FALLING HEAD*

3637

PROJECT Fern. 1 RI/FS
PROJECT NO. [illegible]
BORING NO. 1047

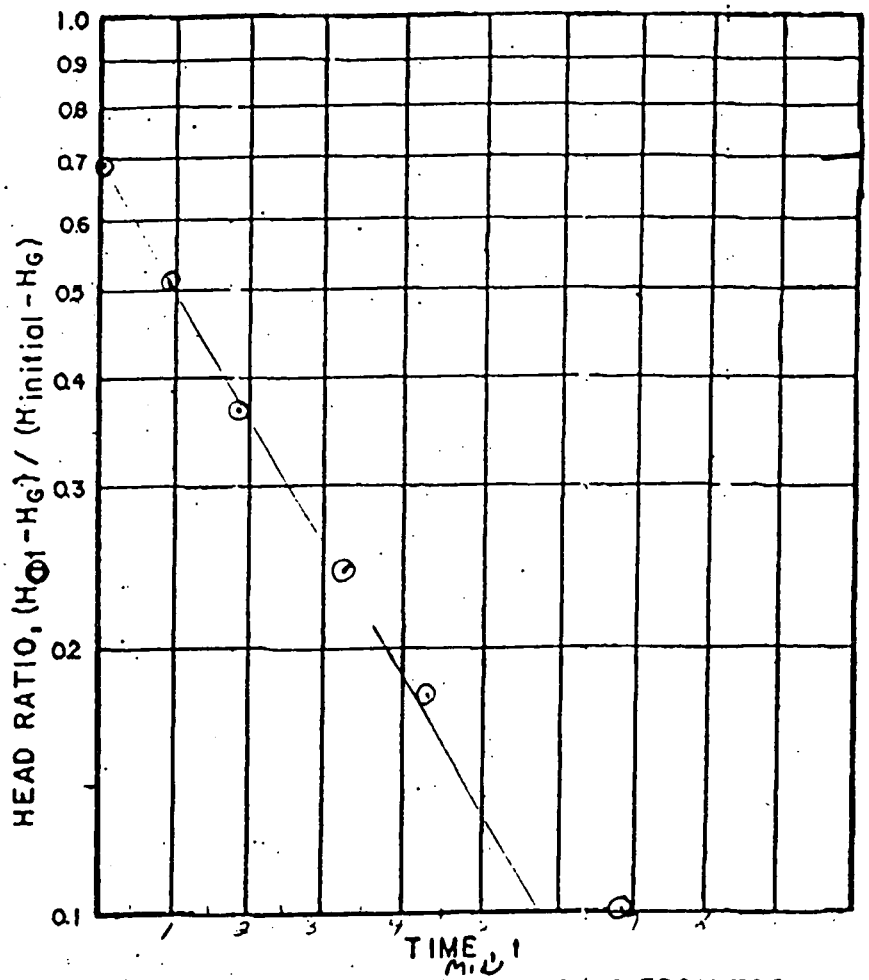
TESTED BY CG/CM DATE 03-02-91
CALCULATED BY CG DATE 03-12-91
CHECKED BY EG DATE

RADIUS OF WELL, r = 1.0 in = 0.0833 FT
RADIUS OF TEST BORING, R = 4.0 in = 0.3333 FT
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C 2.2 FT
DEPTH TO BOTTOM OF TEST POCKET, L_1 16.5 FT
DEPTH TO TOP OF TEST POCKET, L_2 11.5 FT
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 11.33 FT

HYDRAULIC CONDUCTIVITY, K 2.212×10^{-3} ft/sec

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t SEC MIN	DEPTH TO WATER IN CASING H FEET
0.000	[illegible]
0.017	[illegible]
0.067	[illegible]
0.117	[illegible]
0.217	10.417
0.417	[illegible]
0.917	[illegible]
1.167	10.737
1.667	[illegible]
1.917	10.863
3.417	11.027
4.417	[illegible]
6.917	[illegible]
8.917	[illegible]
13.917	11.311
18.917	[illegible]
22.917	[illegible]
25.917	[illegible]
28.917	[illegible]



H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1
H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

1300 hrs
1333 hrs

FIELD PERMEABILITY TESTS
FALLING HEAD*

TEST # 1

Field Copy 3637

PROJECT Fernald RI/FS
PROJECT NO. 602 3.7
BORING NO. 1245

TESTED BY CG/CM DATE 3/2/91
CALCULATED BY _____ DATE _____
CHECKED BY _____ DATE _____

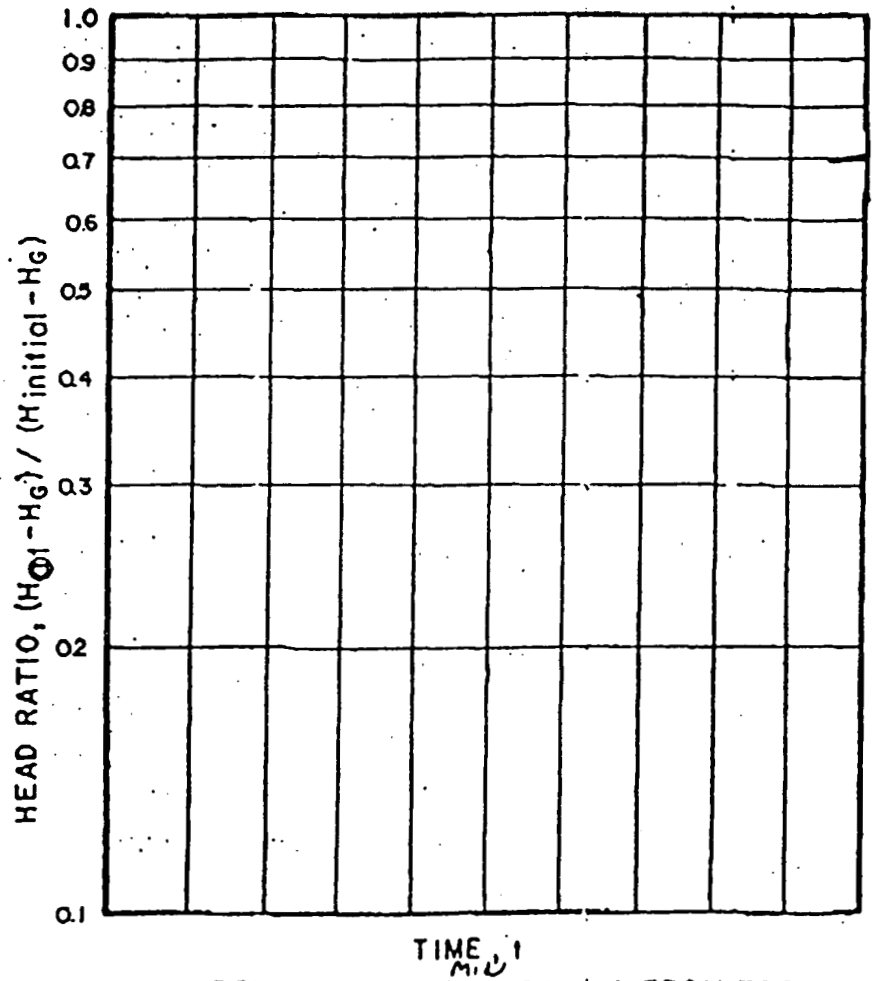
RADIUS OF WELL, r 1.0" 0.0833 FT
RADIUS OF TEST BORING, R 0.333 FT
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C 0.2 FT
DEPTH TO BOTTOM OF TEST POCKET, L_1 16.5
DEPTH TO TOP OF TEST POCKET, L_2 11.5
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G _____

HYDRAULIC CONDUCTIVITY, K _____

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

Initial water level = 11.33 FT To Top of Casing
4.630 - From Datalogger

ELAPSED TIME t SEC/MIN	DEPTH TO WATER IN CASING H FEET



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1
H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

IT CORPORATION

By CR Date [illegible]/11 Subject Slug Test #1 Sheet No. ___ of ___

Chkd. By ___ Date ___ Hydraulic Conductivity Calculations for 1245 Proj. No. [illegible]

3637

HR Head Ratio $= \dfrac{H_{@t} - H_G}{H_i - H_G}$

Where: H_G = Depth to Groundwater below TOC before slug was added

H_i = Initial Depth to Groundwater below TOC after slug is added

$H_{@t}$ = Depth to Groundwater below TOC at time = t

HR	
0.067 min	$\dfrac{10.440 - 11.33}{10.055 - 11.33} = \dfrac{.890}{1.275} = .698$
0.917 min	$\dfrac{10.686 - 11.33}{10.055 - 11.33} = \dfrac{.644}{1.275} = .505$
1.917 min	$\dfrac{10.863 - 11.33}{10.055 - 11.33} = \dfrac{.467}{1.275} = .366$
3.417 min	$\dfrac{11.031 - 11.33}{10.055 - 11.33} = \dfrac{.303}{1.275} = .238$
4.417 min	$\dfrac{11.102 - 11.33}{10.055 - 11.33} = \dfrac{.228}{1.275} = .179$
6.917 min	$\dfrac{11.202 - 11.33}{10.055 - 11.33} = \dfrac{.127}{1.275} = .100$
13.417 min	$\dfrac{11.33 - 11.33}{10.055 - 11.33} = \dfrac{.019}{1.275} = .015$

Hydraulic Conductivity $K = \dfrac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\dfrac{L_1 - L_2}{R}\right] \ln\left[\dfrac{H_1 - H_G}{H_2 - H_G}\right]$

$K = \dfrac{(0.0833)^2}{2(10.0 - 11.5)(3.417 - 0.067)} \ln\left[\dfrac{10.0 - 11.5}{0.3333}\right] \ln\left[\dfrac{10.440 - 11.33}{11.027 - 11.33}\right]$

$K = \dfrac{0.00694}{2(5)(3.35)} \ln\left[15.002\right] \ln\left[\dfrac{.890}{.372}\right]$

$= (2.0716 \times 10^{-4})(2.708)(2.3863)$

$K = 1.411$ FT/day

$K = 2.312 \times 10^{-5}$ FT/sec

$K = 1.411$ FT/day

[redacted]

SE2000
Environmental Logger
03/04 11:00

[redacted]it# 0000000 Test# 1

3637

INPUT 1: Level (F) TOC

Reference	11.330
Scale factor	19.982
Offset	0.018
SG	1.000

Step 0 03/02 13:03:42

Elapsed Time		Value
0.0000		11.374
0.0083		11.361
0.0166		11.355
0.0250		11.348
0.0333		11.355
0.0416		11.348
0.0500		11.355
0.0583		11.361
0.0666		9.475
0.0750		10.560
0.0833		10.055
[redacted] 0.1000	.0167	10.421
0.1166		10.415
0.1333		10.434
[redacted] 0.1500	.0667	10.440
0.1666		10.453
0.1833		10.459
[redacted] 0.2000	.1167	10.459
0.2166		10.465
0.2333		10.478
0.2500		10.478
0.2666		10.484
0.2833		10.491
[redacted] 0.3000	.2167	10.497
0.3166		10.503
0.3333		10.510
0.4166		10.535
[redacted] 0.5000	.4167	10.560
0.5833		10.585
0.6666		10.604
0.7500		10.629
0.8333		10.648
0.9166		10.667
[redacted] 1.0000	.9167	10.686
1.0833		10.705
1.1666		10.724
[redacted] 1.2500	1.1667	10.737
1.3333		10.756
1.4166		10.768
1.5000		10.781
1.5833		10.800
1.6666		10.812
[redacted] 1.7500	1.6667	10.825
1.8333		10.838
1.9166		10.850

3.0000		10.983
3.5000	3.4167	11.027
4.0000		11,065
4.5000	4.4167	11.102
5.0000		11.128
5.5000		11.153
6.0000		11.172
6.5000		11.191
7.0000	6.9167	11.203
7.5000		11.222
8.0000		11.235
8.5000		11.241
9.0000	8.4167	11.254
9.5000		11.260
10.0000		11.266
11.0000		11.279
12.0000		11.292
13.0000		11.298
14.0000	13.4167	11.311
15.0000		11.317
16.0000		11.323
17.0000		11.323
18.0000		11.330
19.0000	18.4167	11.336
20.0000		11.336
21.0000		11.342
22.0000		11.342
23,0000	22.4167	11.348
24.0000		11.348
25.0000		11.348
26.0000	25.4167	11.355
27.0000		11.355
28.0000		11.355
29.0000	28.4167	11.361
30.0000		11.361

END

2.0	10.863
2.5	10.869

3637

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1287
WELL NUMBER: 1287

FIELD ENG./GEO.: L. ADAMS DATE: 07/18/89
CHECKED BY : W.A. HERTEL DATE: 07/20/89
N,E COORDINATES: 481634.92, 1380992.2
DATE OF INSTAL.: 07/18/89

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: HOLLOW STEM AUGER (8
IS CASING TEMPORARY?: No
CASING TYPE : MONITOR WELL
CASING DIAM.: 2.0 In. ID
CASING SIZE(S) USED: (in Feet)
SIZE: 4.2 FROM: 0.0 TO: 15.0
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: 0.02 (In.)
TOTAL PERFORATED AREA: 9.7 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: PVC
RISER PIPE DIAMETERS:
O.D.: 2 5/16 In. I.D.: 2.0 In.
LENGTH OF 1ST PIPE SECTION: 25 Ft.
2ND PIPE SECTION: 9.75 Ft.
3RD PIPE SECTION: 7.0 Ft.
COMMENTS

RISER JOINING METHOD: SCREW TYPE FLUSH JT. THREADED

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5.0 Ft.
PROTECTIVE PIPE O.D.: 4 5/ In.
* HINGE TOP W/PADLOCK

OTHER PROTECTION (* NOTED BELOW)

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	2.0 Ft.		589.80	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	2.5 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
	0.0	1.0	N/A	N/A
Bentonite Pellets	1.0	3.0	N/A	N/A
Sand	3.0	15.0	N/A	N/A
PERFORATED SECTION	5.0	14.75	N/A	N/A
WELL TIP	15.0		N/A	
BOTTOM OF BOREHOLE	15.0		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

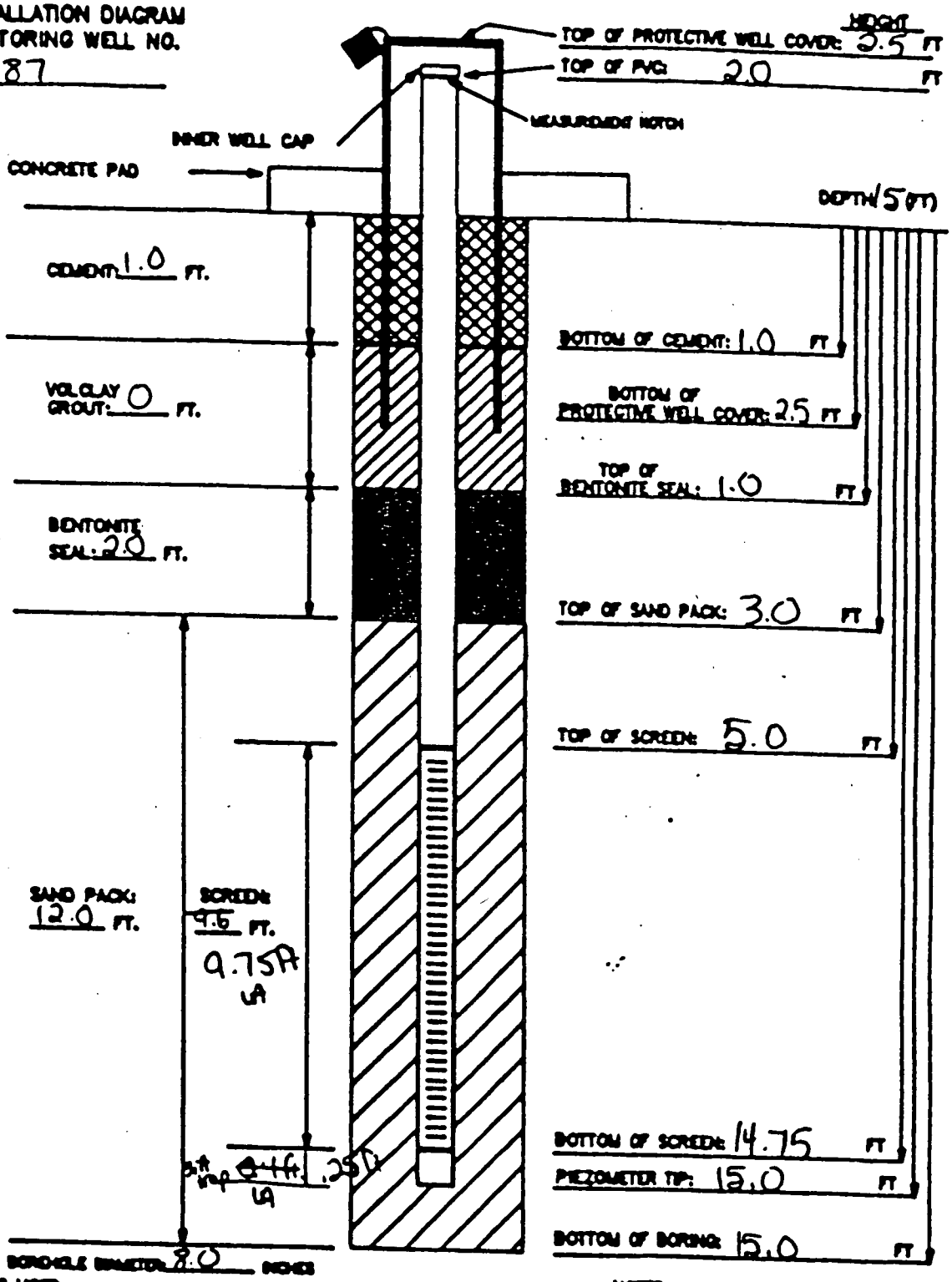
WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1287

INSTALLATION DATE: 7/18/89

3637



MATERIALS USED:
SAND TYPE AND QUANTITY: 2 bags 10/20
BENTONITE PELLETS (5-GALLON BUCKETS): 1 bucket
BAGS OF VOLCLAY GROUT: none
AMOUNT OF CEMENT:
AMOUNT OF WATER USED:
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH LA SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED PLUG.
4) WATER DEPTH/DATE:

TASK: 602 3.7.1

GEOLOGIST/ENGINEER: L. Adams

Water zone: 7.5 - 14.5 ft.

QA/QC 7-20-89 by WAH

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS 3637	
BORING NUMBER: 1287	COORDINATES: NORTH 481,634.92 EAST 1,380,992.27	DATE: 07/17/89
GROUND ELEVATION: 588.15	GWL: Depth N/A Date/Time N/A	DATE STARTED: 07/17/89
ENGINEER/GEOLOGIST: L. ADAMS	Depth N/A Date/Time N/A	DATE COMPLETED: 07/18/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 2

DEPTH	SAMPLE	DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	18901 07/17/89 1635		13	6	MED. DENSE, BROWN (10 YR 5/3) SILTY SAND AND GRAVEL. SOME SMALL LENSES OF CLAY (APPROX. 2.0 IN CLAY). WET.	SM	NA NA NA	
9.0	18902 07/17/89 1635		13	6	MED. DENSE, BROWN (10 YR 5/3) VERY FINE SILTY SAND. WELL SORTED. WET.	SM	NA NA NA	
9.5	18903 07/17/89 1640		8	6	MED. DENSE, YELLOWISH BROWN (10 YR 5/6) VERY FINE SILTY SAND. WELL SORTED. WET.	SM	NA NA NA	
10.0	18904 07/17/89 1640		12	6	MED. DENSE, YELLOWISH BROWN (10 YR 5/6) VERY FINE SILTY SAND. WELL SORTED. WET.	SM	NA NA NA	
10.5	53435 07/17/89 1640		9	3	MED. DENSE, YELLOWISH BROWN (10 YR 5/6) VERY FINE SILTY SAND. WELL SORTED. WET.	SM	NA NA NA	
11.0	53436 07/18/89 0845		9	5	MED. DENSE, SILTY SAND AND GRAVEL. BROWN TO GRAY (10 YR 5/3 TO 5/1) SOME CLAY. SOME ROOTS.	GC	NA NA NA	
11.5	53437 07/18/89 0845		8	0	NO RECOVERY.			
12.0	53438 07/18/89 0845		7	0	NO RECOVERY.			
12.5	53439 07/18/89 0848		5	2	LOOSE, SILTY SAND AND LARGE PIECE OF GRAVEL. BROWN TO GRAY (10 YR 5/3 TO 5/1) SOME CLAY. SOME ROOTS.	GC	NA NA NA	
13.5								
14.0	53440 07/18/89 0848		5	0	NO RECOVERY.			
13.5	53441 07/18/89 0848		1	0	NO RECOVERY.			
14.0	53442 07/18/89 0856		3	6	LOOSE. SILTY SAND AND LARGE PIECE OF GRAVEL. BROWN TO GRAY (10 YR 5/3 TO 5/1) SOME CLAY.	GC	NA NA NA	
14.5	53443 07/18/89 0856		2	6	LOOSE. SILTY SAND AND LARGE PIECE OF GRAVEL. BROWN TO GRAY (10 YR 5/3 TO 5/1) SOME CLAY.	GC	NA NA NA	
15.0	53444 07/18/89 0856		5	6	SOFT, GRAY (10 YR 5/1) CLAY. SOME GRAVEL, SAND. HIGH PLASTICITY.	CL	.25 .25 .25	

BOTTOM OF BORING 15.0

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

FIELD PERMEABILITY TESTS
FALLING HEAD*

Test 6

3637 1287

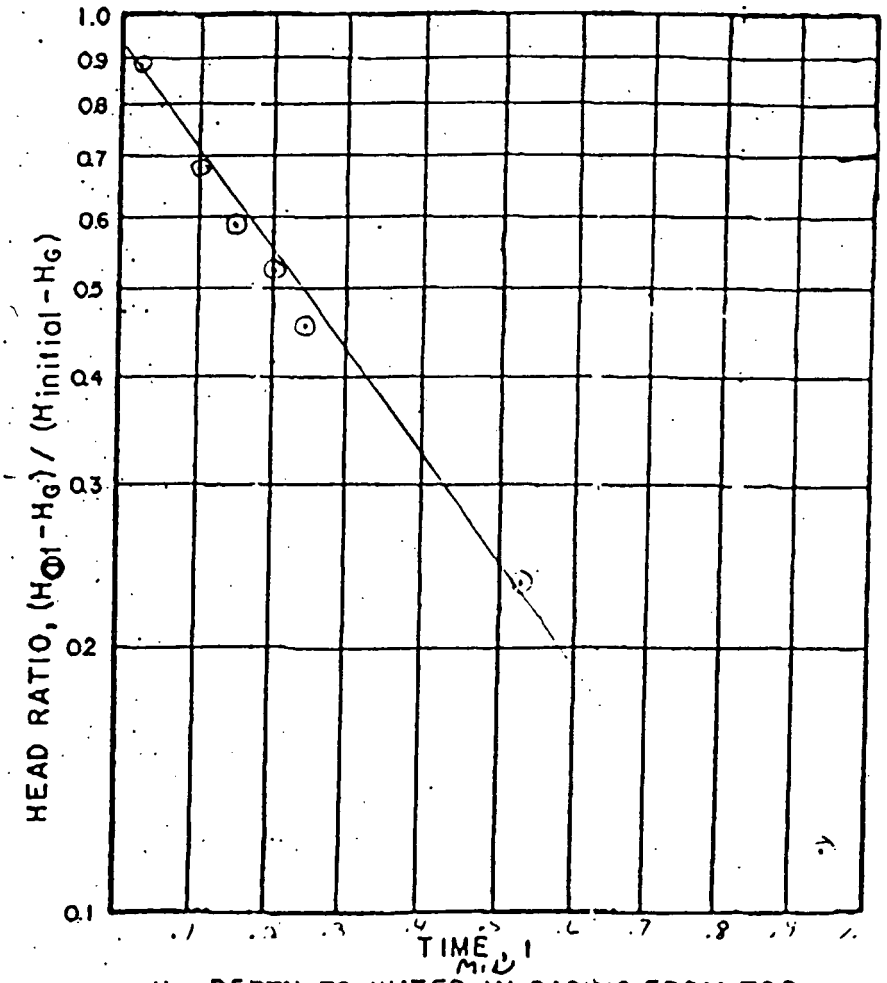
PROJECT Fernald RI/FS — TESTED BY [illegible] — DATE [illegible]
PROJECT NO. [illegible] — CALCULATED BY [illegible] — DATE 03-12-91
BORING NO. [illegible] — CHECKED BY _____ — DATE _____

RADIUS OF WELL, r = [illegible] FT
RADIUS OF TEST BORING, R = 4.0 in = .3333 FT
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C 2.5 FT
DEPTH TO BOTTOM OF TEST POCKET, L_1 14.75 FT
DEPTH TO TOP OF TEST POCKET, L_2 5.0 FT
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 5.46 FT

HYDRAULIC CONDUCTIVITY, K 5.307×10^{-5} FT/sec

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t SEC/MIN	DEPTH TO WATER IN CASING H FEET
0.000	4.766
0.008	4.810
0.025	4.848
0.067	4.930
0.100	4.986
0.150	5.050
0.200	5.110
0.250	5.150
0.283	5.182
0.533	5.302
1.617	5.304
0.950	5.324
1.200	5.409
1.450	5.432
1.700	5.448
1.950	5.434
2.950	5.417
4.450	5.453
6.950	5.46



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

IT CORPORATION

3637

By CJ Date 03/12/91 Subject Slug Test #6 Sheet No. ___ of ___

Chkd. By ___ Date Hydraulic Conductivity Calculation for #1987 Proj. No. 602 3.7

Head Ratio $H_R = \frac{H_{(t)e} - H_G}{H_i - H_G}$ Where: H_G = Depth to Groundwater below Top before slug is added

H_i = Initial Depth to Groundwater below [illegible] after slug is added

$H_{(t)e}$ = Depth [illegible]

HR

$H_1 \rightarrow$ .025 mins: $\frac{[illegible] - 5.46}{[illegible]} = \frac{.612}{.94} = .332$

.100 min: $\frac{[illegible] - 5.46}{[illegible] - 5.46} = \frac{.174}{.94} = .183$

.150 min: [illegible] $= \frac{.110}{.94} = .[illegible]$

.200 min: [illegible] $= \frac{.[illegible]}{.94} = .[illegible]$

1.200 min: $\frac{[illegible] - 5.46}{[illegible] - 5.46} = \frac{[illegible]}{.694} = .0[illegible]$

.250 min: [illegible] $= \frac{.[illegible]10}{.94} = .4[illegible]7$

$H_2 \rightarrow$ .533 min: [illegible] $= \frac{.158}{.694} = .[illegible]$

.950 min: [illegible] $= \frac{.076}{.694} = .110$

Hydraulic [illegible] $= K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)}$ [illegible]

$K = \frac{(0.0833)^2}{2([illegible] .533 - .025)}$ [illegible] $\frac{[illegible] - 5.46}{[illegible] - 5.46}$

$K = \frac{0.[illegible]}{2([illegible] .[illegible])}$ [illegible] $\left[\frac{.612}{.158} \quad .[illegible]\right]$

$K = (.0006[illegible])(3.[illegible]76)([illegible])$

$K = 3.184 \times 10^{-3}$ ft/min

$= 5.307 \times 10^{-[illegible]}$ FT/[illegible]

$K = 4.585$ FT/Day

388

SE2000 Boom/Piezometer = 1.087
Environmental Logger
03/04 12:11

Unit# 0000000 Test# 6

INPUT 1: Level (F) TOC

3637

Reference	5.460
Scale factor	19.982
Offset	0.018
SG	1.000

Step 0 03/02 16:48:38

Elapsed Time		Value
0.0000		5.441
0.0083		5.409
0.0166		0.647
0.0250		5.327
[illegible]		[illegible]
0.0416		4.867
[illegible]		4.766
0.0583	0.0083	4.810
0.0666		4.822
0.0750	0.0250	4.848
0.0833		4.860
0.1000		4.898
0.1166	0.0666	4.930
0.1333		4.961
0.1500	0.1000	4.986
0.1666		5.012
0.1833		5.031
0.2000	0.1500	5.050
0.2166		5.068
0.2333		5.087
0.2500	0.2000	5.106
0.2666		5.125
0.2833		5.138
0.3000	.2500	5.150
0.3166		5.163
0.3333	[illegible]	5.182
0.4166		5.239
0.5000		5.277
0.5833	.5333	5.302
0.6666	[illegible]	5.340
0.7500		5.346
0.8333		5.359
0.9166		5.384
1.0000	[illegible]	5.384
1.0833		5.390
1.1666		5.409
1.2500	1.2000	5.409
1.3333		5.403
1.4166		5.422
1.5000	1.4500	5.422
1.5833		5.415
1.6666		5.428
1.7500	1.7000	5.428
1.8333		5.422
1.9166		5.434
2.0000	[illegible]	5.434

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1339
WELL NUMBER: 1339

FIELD ENG./GEO.: C. GRUBE DATE: 10/05/89
CHECKED BY : BD DATE: 10/10/89
N,E COORDINATES: 481614.27, 1380504.3
DATE OF INSTAL.: 10/05/89

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: HOLLOW AUGER
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING PIEZOMETE
CASING DIAM.: 2.0 In. ID
CASING SIZE(S) USED: (Units N/A)
SIZE: N/A FROM: N/A TO: N/A
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: 0.020 (In.)
TOTAL PERFORATED AREA: 7.0 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: SCHEDULE 40 PVC
RISER PIPE DIAMETERS:
O.D.: 2 5/16 In. I.D.: 2.0 In.
LENGTH OF 1ST PIPE SECTION: 5.0 Ft.
2ND PIPE SECTION: Not Noted
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: SCREW TYPE - FLUSH JOINT THREADED

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 0.5 Ft.
PROTECTIVE PIPE O.D.: 4 3/ In.
• FLUSH MOUNT PROTECTIVE COVER

OTHER PROTECTION (* NOTED BELOW)

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE	ELEVATION MSL
TOP OF RISER PIPE	0.2 Ft.	584.86
GROUND SURFACE	0.0	N/A
BOTTOM OF PROTECTIVE PIPE	0.4 Ft.	

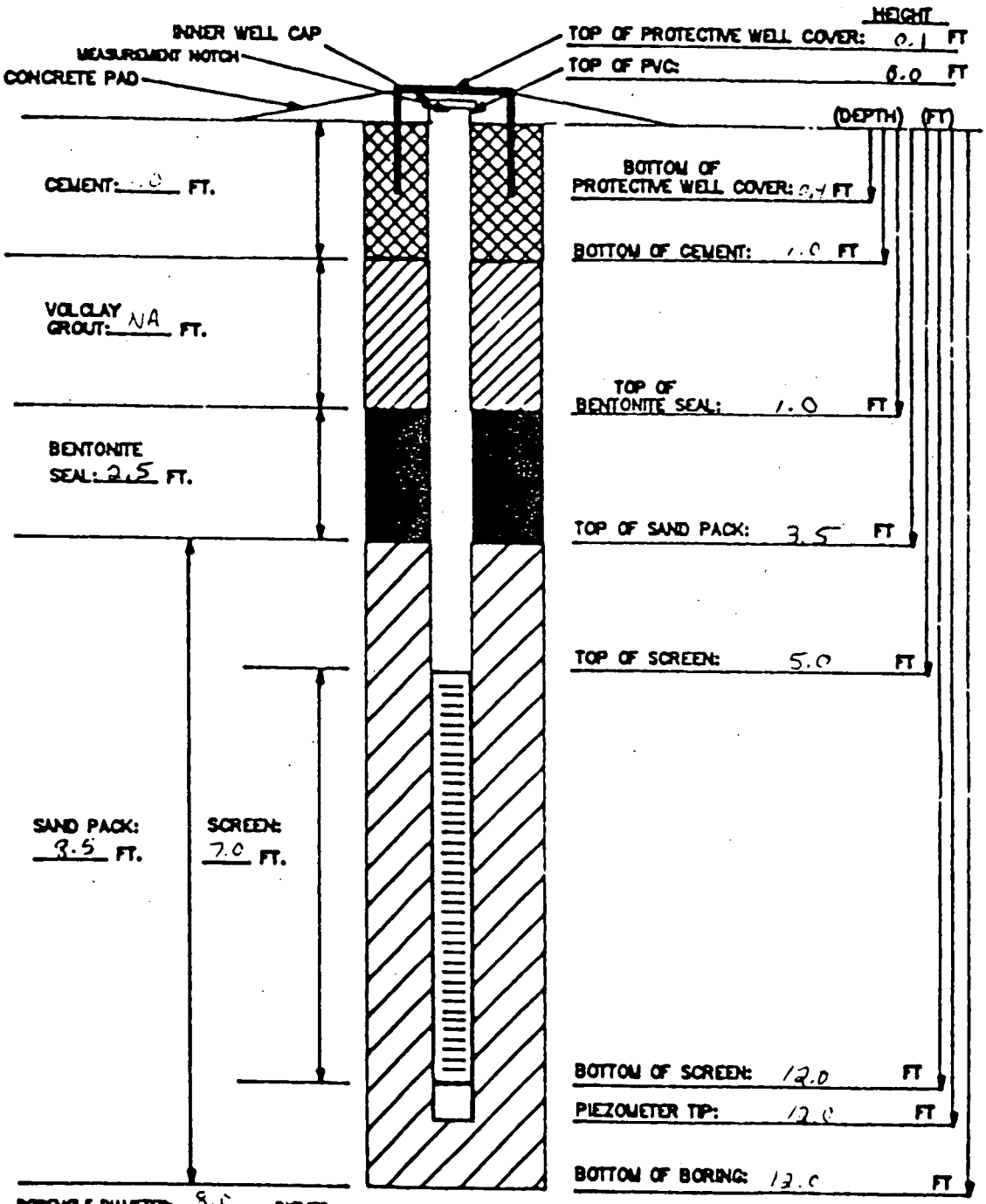
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
	0.0	1.0	N/A	N/A
Bentonite Pellets	1.0	3.5	N/A	N/A
Sand	3.5	12.0	N/A	N/A
PERFORATED SECTION	5.0	12.0	N/A	N/A
WELL TIP	12.0		N/A	
BOTTOM OF BOREHOLE	12.0		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1339

INSTALLATION DATE: 10-5-89



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 10/20 sand/(1.5 (8.0) sk
BENTONITE PELLETS (5-GALLON BUCKETS): 2 1/2
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: 1/2 (1/40) sack
AMOUNT OF WATER USED: 10 gal
OTHER: Protective flushmount cover

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESIS INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 1-02-2-57 GEOLOGIST/ENGINEER: P. Grabe

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1339	COORDINATES: NORTH 481,614.27 EAST 1,380,504.33	DATE: 10/04/89
GROUND ELEVATION: 585.09	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/04/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 10/05/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 2

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
1.0							
1.5	50027 10/04/89 1520	3	6	DENSE (10 YR 4/3) BROWN CLAYEY SAND, TRACE FINE GRAVEL MOIST.	SC	NA	Hnu= 0 ppm α = 0 cpm βΓ = 300-310cpm
2.0	50028 10/04/89 1520	17	6	DENSE (10 YR 5/4) YELLOWISH BROWN SILTY SAND, TRACE FINE-MED GRAVEL & CLAY, MOIST.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 300-310cpm
2.5	50029 10/04/89 1520	18	6	DENSE (10 YR 5/4) YELLOWISH BROWN SILTY SAND, TRACE FINE-MED GRAVEL & CLAY, MOIST.	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 300-310cpm
3.0	50030 10/04/89 1520	16		NO RECOVERY.			
3.5	50031 10/04/89 1555	10	6	MED DENSE (10 YR 5/4) YELLOWISH BROWN POORLY GRADED GRAVELLY SAND, TRACE SILT & CLAY, MOIST.	SP	NA	Hnu= 0.2 ppm α = 0 cpm βΓ = 300 cpm
4.0	50032 10/04/89 1555	12	3	MED DENSE (10 YR 5/4) YELLOWISH BROWN, WELL GRADED SAND, TRACE FINE TO COARSE GRAVEL, TRACE SILT, V. MOIST.	SW	NA	Hnu= 0.2 ppm α = 0 cpm βΓ = 300 cpm
4.5	50033 10/04/89 1555	12		NO RECOVERY.			
5.0	50034 10/04/89 1602	6	6	MED DENSE (10 YR 5/4) YELLOWISH BROWN SILTY GRAVEL, SOME SAND, VERY MOIST.	GM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 200-240cpm
5.5	50035 10/04/89 1602	4	6	MED DENSE (10 YR 5/4) YELLOWISH BROWN WELL GRADED SAND, TRACE CLAY & SILT, WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 200-240cpm
6.0	50036 10/04/89 1602	8		NO RECOVERY.			
6.5	50037 10/04/89 1608	6	6	MED DENSE (10 YR 5/4) YELLOWISH BROWN WELL GRADED SAND, TRACE FINE-COARSE GRAVEL, TRACE SILT, WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 200-220cpm
7.0	50038 10/04/89 1608	6	5	MED DENSE (10 YR 5/4) YELLOWISH BROWN WELL GRADED SAND, TRACE FINE-COARSE GRAVEL, TRACE SILT, WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 200-220cpm
7.5	50039 10/04/89 1608	6		NO RECOVERY.			
8.0	50040 10/04/89 1623	6	6	MED DENSE (10 YR 5/4) YELLOWISH BROWN WELL GRADED SAND, TRACE FINE-COARSE GRAVEL, TRACE SILT, WET.	SW	NA	Hnu= 0.1 ppm α = 0 cpm βΓ = 300-320cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1339	COORDINATES: NORTH 481,614.27 EAST 1,380,504.33	DATE: 10/04/89
GROUND ELEVATION: 585.09	GWL: Depth N/A Date/Time N/A	DATE STARTED: 10/04/89
ENGINEER/GEOLOGIST: C. GRUBE	Depth N/A Date/Time N/A	DATE COMPLETED: 10/05/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 2

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	50041 10/04/89 1623	6	6	MED DENSE (10 YR 5/4) YELLOWISH BROWN WELL GRADED SAND, TRACE FINE-COARSE GRAVEL, TRACE SILT, WET.	SW	NA	Hnu= 0.1 ppm α = 0 cpm βΓ = 300-320cpm
9.0	50042 10/04/89 1623	8	6	MED DENSE (10 YR, 3/6) DARK YELLOWISH BROWN, POORLY GRADED SAND, TRACE SILT, WET.	SP	NA	Hnu= 0.1 ppm α = 0 cpm βΓ = 300-320cpm
9.5	50043 10/04/89 1630	12	6	MED DENSE (10 YR 5/4) YELLOWISH BROWN WELL GRADED SAND, SOME FINE-MED GRAVEL, WET.	SW	NA	Hnu= 0.1 ppm α = 0 cpm βΓ = 180-190cpm
10.0	50044 10/04/89 1630	13	5	MED DENSE (10 YR, 5/4) YELLOWISH BROWN POORLY GRADED SAND, TRACE FINE GRAVEL, WET. MED DENSE (7.5 YR, 4/6) STRONG BROWN, POORLY GRADED SAND, TRACE FINE GRAVEL, WET.	SP SP	NA NA	Hnu= 0.1 ppm α = 0 cpm βΓ = 180-190cpm
10.5	50045 10/04/89 1630	8		NO RECOVERY.			
11.0	50046 10/04/89 1640	3	6	MED DENSE (10 YR 5/4) YELLOWISH BROWN WELL GRADED SAND, TRACE FINE TO MED GRAVEL, WET.	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 210-230cpm
11.5	50047 10/04/89 1640	6	6	MED DENSE (10 YR 5/4) YELLOWISH BROWN TO (7.5 YR, 4/6) STRONG BROWN, POORLY GRADED SAND, TRACE FINE GRAVEL, WET.	SP	NA	Hnu= 0 ppm α = 0 cpm βΓ = 210-230cpm
12.0	50048 10/04/89 1640	8	6	STIFF (5 Y, 4/1) DARK GREY SILTY CLAY TRACE FINE GRAVEL, MED. PLASTIC, MOIST.	CL	1.25	Hnu= 0 ppm α = 0 cpm βΓ = 210-230cpm

BOTTOM OF BORING 12.0

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

FIELD PERMEABILITY TESTS
FALLING HEAD*

1339 (CS/C)

Ind. 3697

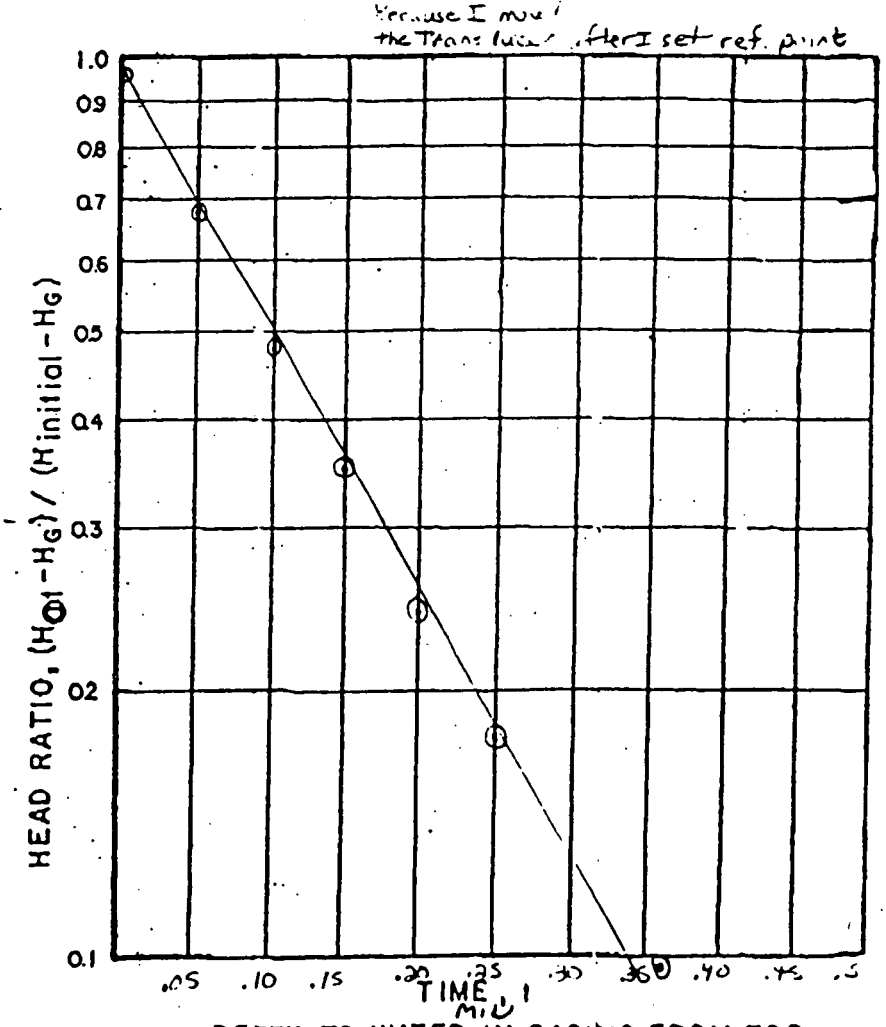
PROJECT Fernald RI/FS — TESTED BY CG/CM — DATE 03-02-91
PROJECT NO. [illegible] — CALCULATED BY CG — DATE 03-12-91
BORING NO. 1339 — CHECKED BY FG — DATE

RADIUS OF WELL, r = 1.0 in. = 0.0833 FT
RADIUS OF TEST BORING, R = 4.0 in = 0.3333 FT
HEIGHT OF CASING (REF. LEVEL)
ABOVE GROUND SURFACE, Hc 0.0 FT (Flush mount)
DEPTH TO BOTTOM OF TEST POCKET, L_1 12.0 FT
DEPTH TO TOP OF TEST POCKET, L_2 5.0 FT
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 2.62 FT (1.48) FT ← [illegible] Level From End of Test because I move the Transducer after I set ref. point

HYDRAULIC CONDUCTIVITY, K 1.700 × 10⁻⁴ FT/s

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t SEC/MIN	DEPTH TO WATER IN CASING H FEET
0.000	0.702
0.008	0.752
0.025	0.[illegible]
0.050	0.[illegible]
0.100	1.112
0.150	1.219
0.200	1.275
0.250	1.347
0.283	1.371
0.367	1.408
0.533	1.446
0.700	1.459
0.950	1.465
1.200	1.472
5.450	1.478



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

SE2000
Environmental Logger
03/04 10:58

3637

Unit# 0000000 Test# 0

INPUT 1: Level (F) TOC

Reference	2.620
Scale factor	19.982
Offset	0.018
SG	1.000

Step 0 03/02 09:15:10

Elapsed Time		Value
0.0000		1.509
0.0083		1.509
0.0166		0.387
0.0250		0.216
0.0333		0.986
~~0.0416~~		~~0.595~~
~~0.0500~~	~~0.0000~~	0.702
0.0583	0.0083	0.752
0.0666		0.797
0.0750	.0250	0.841
0.0833		0.885
0.1000	0.050	0.954
0.1166		1.017
0.1333		1.068
0.1500	0.100	1.112
0.1666		1.156
0.1833		1.131
0.2000	0.150	1.219
0.2166		1.244
0.2333		1.270
0.2500	0.200	1.295
0.2666		1.314
0.2833		1.326
0.3000	0.250	1.345
0.3166		1.358
0.3333	0.2833	1.371
0.4166	0.3666	1.408
0.5000		1.427
0.5833	0.5333	1.446
0.6666		1.446
0.7500	0.7000	1.459
0.8333		1.459
0.9166		1.459
1.0000	[illegible]	1.465
1.0833		1.465
1.1666		1.465
1.2500	1.2000	1.472
1.3333		1.472
1.4166		1.472
1.5000		1.472
1.5833		1.472
1.6666		1.472
1.7500		1.472
1.8333		1.472
1.9166		1.472
2.0000		[illegible]

3.0000		1.472
3.5000		1.472
4.0000		1.472
4.5000		1.472
5.0000		1.472
5.5000	5.4500	1.478
6.0000		1.478
6.5000		1.478
7.0000		1.478
7.5000		1.478
8.0000		1.478
8.5000		1.484
9.0000		1.478
9.5000		1.478
10.0000		1.478
11.0000		1.478
12.0000		1.478
13.0000		1.478
14.0000		1.478
15.0000		1.478
16.0000		1.478
17.0000		1.478
18.0000		1.478
19.0000		1.478

END

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1340
WELL NUMBER: 1340

FIELD ENG./GEO.: M. SLUSARSKI DATE: 08/08/89
CHECKED BY : B. DUNNING DATE: 08/17/89
N,E COORDINATES: 481618.58, 1380734.9
DATE OF INSTAL.: 08/08/89

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: 8.0 IN. HOLLOW STEM
IS CASING TEMPORARY?: No
CASING TYPE : PIEZOMETER
CASING DIAM.: 2.0 In. ID
CASING SIZE(S) USED: (in Feet)
SIZE: 4.2 FROM: 0.0 TO: 20.0
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: .020 (In.)
TOTAL PERFORATED AREA: 10. Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: PVC
RISER PIPE DIAMETERS:
O.D.: 2 5/16 In. I.D.: 2.0 In.
LENGTH OF 1ST PIPE SECTION: .4 Ft.
2ND PIPE SECTION: 10.0 Ft.
3RD PIPE SECTION: 1.6 Ft.
COMMENTS

RISER JOINING METHOD: SCREW TYPE FLUSH JOINT THREADED

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5.0 Ft.
PROTECTIVE PIPE O.D.: 4 5/ In.
OTHER PROTECTION (* NOTED BELOW)
* HINGED LOCKING COVER W/ PADLOC

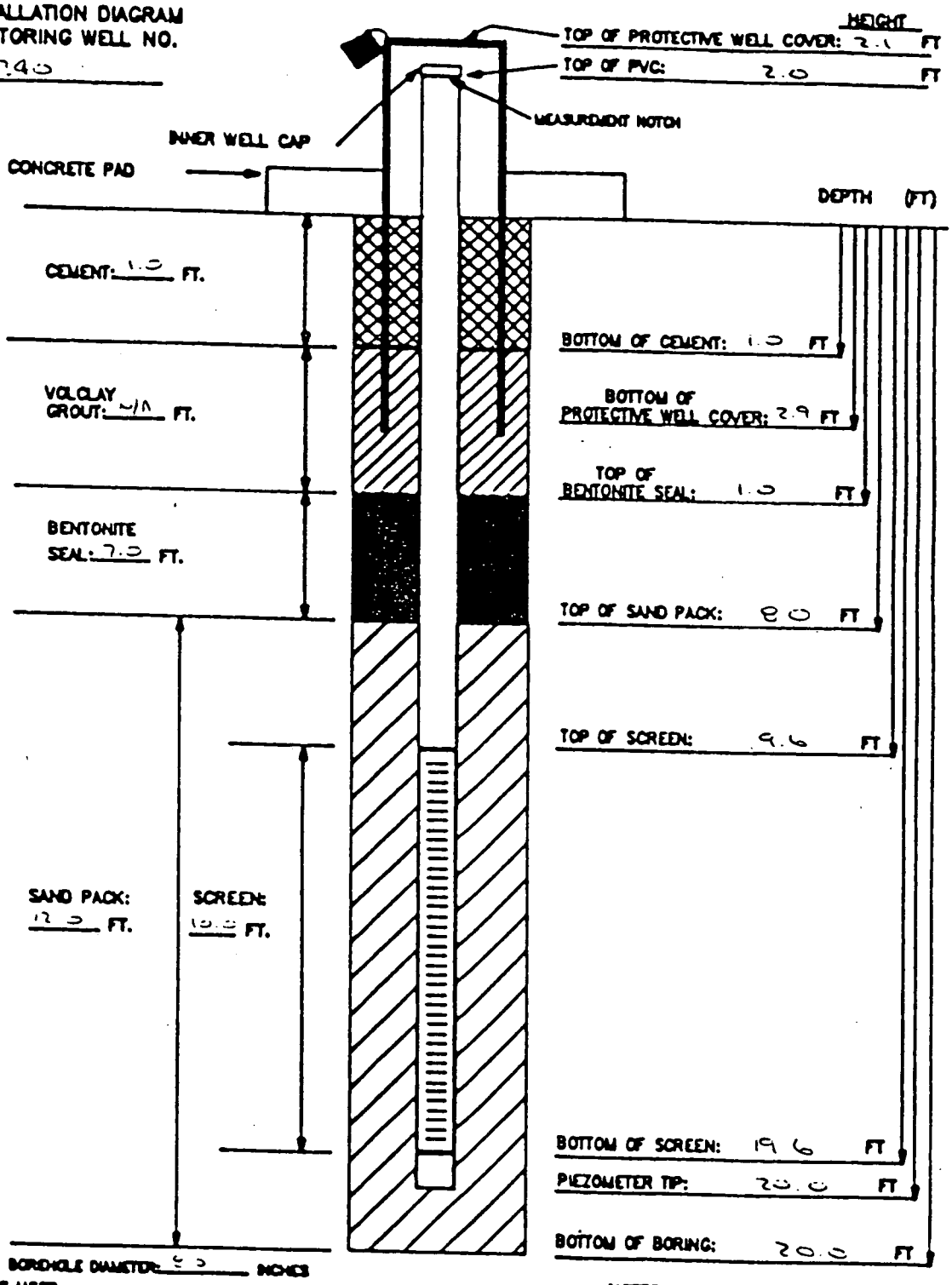
ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	2.0 Ft.		589.71	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	2.9 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
	0.0	1.0	N/A	N/A
Bentonite Pellets	1.0	8.0	N/A	N/A
Sand	8.0	20.0	N/A	N/A
PERFORATED SECTION	9.6	19.6	N/A	N/A
WELL TIP	20.0		N/A	
BOTTOM OF BOREHOLE	20.0		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1240

INSTALLATION DATE: 08-04-89



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 10-20 3.5 - 80 LB SACKS
BENTONITE PELLETS (5-GALLON BUCKETS): 4 5 GAL BUCKETS
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: 5 - 96 LB BAG
AMOUNT OF WATER USED: 40 GAL
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602 [illegible]

GEOLOGIST/ENGINEER: M. [illegible]

VISUAL CLASSIFICATION OF SOILS

3637

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1340	COORDINATES: NORTH 481,618.58 EAST 1,380,734.93	DATE:
GROUND ELEVATION: 587.95	GWL: Depth N/A Date/Time N/A	DATE STARTED: 08/08/89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth N/A Date/Time N/A	DATE COMPLETED:
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 3

DEPTH	SAMPLE	DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
0.5	50049	08/08/89 1003	4	6	VERY STIFF, DARK BROWN (10 YR 4/3) SILTY CLAY, TRACE GRAVEL (.25 - .75 IN) TRACE ORGANIC MATERIAL, ROOTLETS, DRY.	CL	2.5	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
1.0	50050	08/08/89 1003	18	3	VERY STIFF, DARK BROWN (10 YR 4/3) SILTY CLAY, TRACE GRAVEL (.25 - .75 IN) TRACE ORGANIC MATERIAL, ROOTLETS, DRY.	CL	2.5	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
1.5	50051	08/08/89 1003	18		NO RECOVERY.			
2.0	50052	08/08/89 1006	14	6	VERY STIFF, BROWN (10 YR 5/3) SILTY CLAY, TRACE COARSE GRAVEL (1.0 IN) DRY.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 100-140cpm
2.5	50053	08/08/89 1006	15		NO RECOVERY.			
3.0	50054	08/08/89 1006	17		NO RECOVERY.			
3.5	50055	08/08/89 1009	13	6	VERY STIFF, BROWN (10 YR 5/3) SILTY CLAY, TRACE GRAVEL (1.0 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
4.0	50056	08/08/89 1009	15	6	VERY STIFF, BROWN (10 YR 5/3) SILTY CLAY, TRACE GRAVEL (1.0 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
4.5	50057	08/08/89 1009	18		NO RECOVERY.			
5.0	50058	08/08/89 1014	14	6	VERY STIFF, BROWN (10 YR 5/3) SILTY CLAY, TRACE GRAVEL (.25 - .75 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
5.5	50059	08/08/89 1014	23	6	VERY STIFF, BROWN (10 YR 5/3) SILTY CLAY, TRACE GRAVEL (.25 - .75 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
6.0	50060	08/08/89 1014	27	6	VERY STIFF, BROWN (10 YR 5/3) SILTY CLAY, TRACE GRAVEL (.25 - .75 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
6.5	50061	08/08/89 1025	7	6	VERY STIFF, BROWN (10 YR 5/3) SILTY CLAY, TRACE GRAVEL (.25 - .75 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
7.0	50062	08/08/89 1025	11	6	VERY STIFF, BROWN (10 YR 5/3) SILTY CLAY, TRACE GRAVEL (.25 - .75 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
7.5	50063	08/08/89 1025	13	6	VERY STIFF, BROWN (10 YR 5/3) SILTY CLAY, TRACE GRAVEL (.25 - .75 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
8.0	50064	08/08/89 1028	13	6	VERY STIFF, BROWN (10 YR 5/4) SILTY CLAY, TRACE GRAVEL (.25 - .50 IN) DAMP.	CL	2.5	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1340	COORDINATES: NORTH 481,618.58 EAST 1,380,734.93	DATE:
GROUND ELEVATION: 587.95	GWL: Depth N/A Date/Time N/A	DATE STARTED: 08/08/89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth N/A Date/Time N/A	DATE COMPLETED:
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 3

DEPTH	SAMPLE	DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	50065	08/08/89 1028	14	6	VERY STIFF, BROWN (10 YR 5/4) SILTY CLAY, TRACE GRAVEL (.25 - .50 IN) DAMP.	CL	2.5	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
9.0	50066	08/08/89 1028	16	6	VERY STIFF, GREY (5 Y 4/1) SILTY CLAY, TRACE GRAVEL (.25 IN) DAMP.	CL	2.5	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
9.5	50067	08/08/89 1032	12	6	VERY STIFF, GREY (5 Y 4/1) SILTY CLAY, TRACE COARSE GRAVEL (1.0 - 1.5 IN) DAMP.	CL	2.5	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
10.0	50068	08/08/89 1032	12	4	VERY STIFF, GREY (5 Y 4/1) SILTY CLAY, TRACE COARSE GRAVEL (1.0 - 1.5 IN) DAMP.	CL	2.5	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
10.5	50069	08/08/89 1032	14		NO RECOVERY.			
11.0	50070	08/08/89 1040	9	6	VERY STIFF, GREY (5 Y 4/1) SILTY CLAY, TRACE GRAVEL (.25 - .50 IN) DAMP.	CL	2.5	Hnu= 0 ppm α = 0 cpm βΓ = 100-140cpm
11.5	54495	08/08/89 1040	9	4	VERY STIFF, GREY (5 Y 4/1) SILTY CLAY, TRACE GRAVEL (.25 - .50 IN) DAMP.	CL	2.5	Hnu= 0 ppm α = 0 cpm βΓ = 100-140cpm
12.0	54496	08/08/89 1040	9		NO RECOVERY.			
12.5	54497	08/08/89 1043	8	6	VERY STIFF, GREY (5 Y 4/1) GRAVELLY CLAY, GRAVEL (.25 - .50 IN) WET.	CL	2.5	Hnu= 0 ppm
13.0	54498	08/08/89 1043	6	6	MEDIUM DENSE, GREY (5 Y 4/1) WELL GRADED, GRAVEL-SAND, MIXTURE, WET.	GW	NA	Hnu= 0 ppm
13.5	54499	08/08/89 1043	6		NO RECOVERY.			
14.0	54500	08/08/89 1048	11	6	MEDIUM DENSE, GREY (5 Y 4/1) WELL GRADED GRAVEL-SAND MIXTURE, WET, TRACE COARSE GRAVEL (1.5 IN).	GW	NA	
14.5	54501	08/08/89 1048	11		NO RECOVERY.			
15.0	54502	08/08/89 1048	12		NO RECOVERY.			
15.5	54503	08/08/89 1055	2	6	LOOSE, GREY (5 Y 4/1) CLAYEY GRAVEL, WET.	GC	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1340	COORDINATES: NORTH 481,618.58 EAST 1,380,734.93	DATE:
GROUND ELEVATION: 587.95	GWL: Depth N/A Date/Time N/A	DATE STARTED: 08/08/89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth N/A Date/Time N/A	DATE COMPLETED:
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 3

DEPTH	SAMPLE	DATE	TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.0	54504	08/08/89	1055	3		NO RECOVERY.			
16.5	54505	08/08/89	1055	3		NO RECOVERY.			
17.0	54506	08/08/89	1100	6	6	MEDIUM DENSE, GREY (5 Y 4/1) CLAYEY GRAVEL-SAND-CLAY MIXTURE WET.	GC	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
17.5	54507	08/08/89	1100	6	6	MEDIUM DENSE, GREY (5 Y 4/1) CLAYEY GRAVEL-SAND-CLAY MIXTURE WET.	GC	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
18.0	54508	08/08/89	1100	7		NO RECOVERY.			
18.5	54509	08/08/89	1117	5	6	MEDIUM DENSE, GREY (5 Y 4/1) CLAYEY GRAVEL-SAND-CLAY MIXTURE WET.	GC	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
19.0	54510	08/08/89	1117	5	6	MEDIUM DENSE, GREY (5 Y 4/1) CLAYEY GRAVEL-SAND-CLAY MIXTURE WET.	GC	NA	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
19.5	54511	08/08/89	1117	5	6	VERY STIFF, GREY (5 Y 4/1) GRAVELLY CLAY, DAMP.	CL	2.5	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm
20.0	54512	08/08/89	1117	5	6	VERY STIFF, GREY (5 Y 4/1) GRAVELLY CLAY, DAMP.	CL	2.5	Hnu= 0 ppm α = 0 cpm βΓ = 100-120cpm

BOTTOM OF BORING 20.0

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

FIELD PERMEABILITY TESTS
FALLING HEAD*

1340

3637

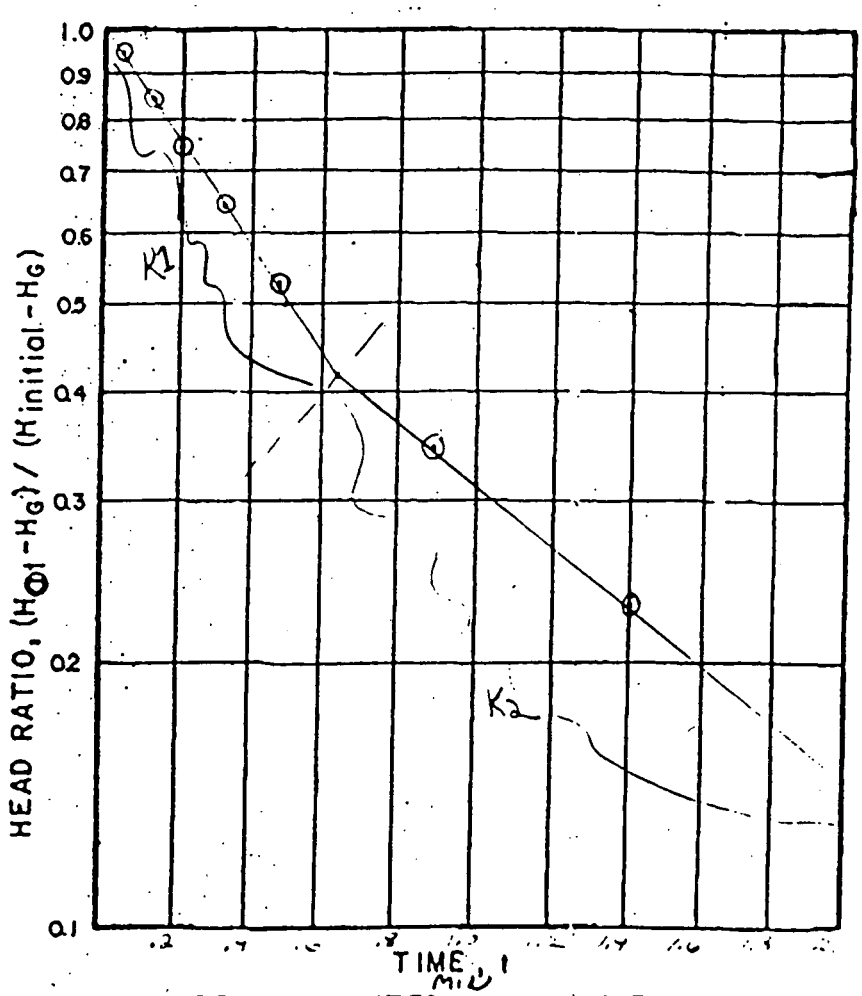
PROJECT [illegible] TESTED BY [illegible] DATE 03/02/[illegible]
PROJECT NO. [illegible] CALCULATED BY [illegible] DATE 03/12/91
BORING NO. [illegible] CHECKED BY FG DATE

RADIUS OF WELL, r = [illegible] = 0.0833 FT
RADIUS OF TEST BORING, R = 4.[illegible] = 0.3[illegible] FT
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C 2.1 FT
DEPTH TO BOTTOM OF TEST POCKET, L_1 19.6 FT
DEPTH TO TOP OF TEST POCKET, L_2 9.6 FT
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 9.04 FT

HYDRAULIC CONDUCTIVITY, K $K1 = 2.72[illegible] \times 10^{-5}$ FT/ $K2 = 1.067 \times 10^{-5}$ FT/

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t SEC/MIN	DEPTH TO WATER IN CASING H FEET
0.000	8.245
0.0[illegible]	8.27[illegible]
0.050	8.30[illegible]
0.083	8.[illegible]
0.117	8.377
0.150	8.415
0.200	8.451
0.317	8.541
0.483	8.6[illegible]
0.900	8.775
1.400	8.857
1.650	8.888
1.900	8.907
2.900	8.951
3.900	8.976
5.400	8.995
6.900	9.008
8.400	9.014
12.900	9.021
18.900	9.[illegible]7
20.900	9.033
26.400	9.040



H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1
H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

490-5-87

test 3

≈ 1430

FIELD PERMEABILITY TESTS
FALLING HEAD*

Field Copy

3637

PROJECT Fernald RI/FS
PROJECT NO. 602 3.7
BORING NO. 1340

TESTED BY CG/CM DATE 03/02/91
CALCULATED BY _____ DATE _____
CHECKED BY _____ DATE _____

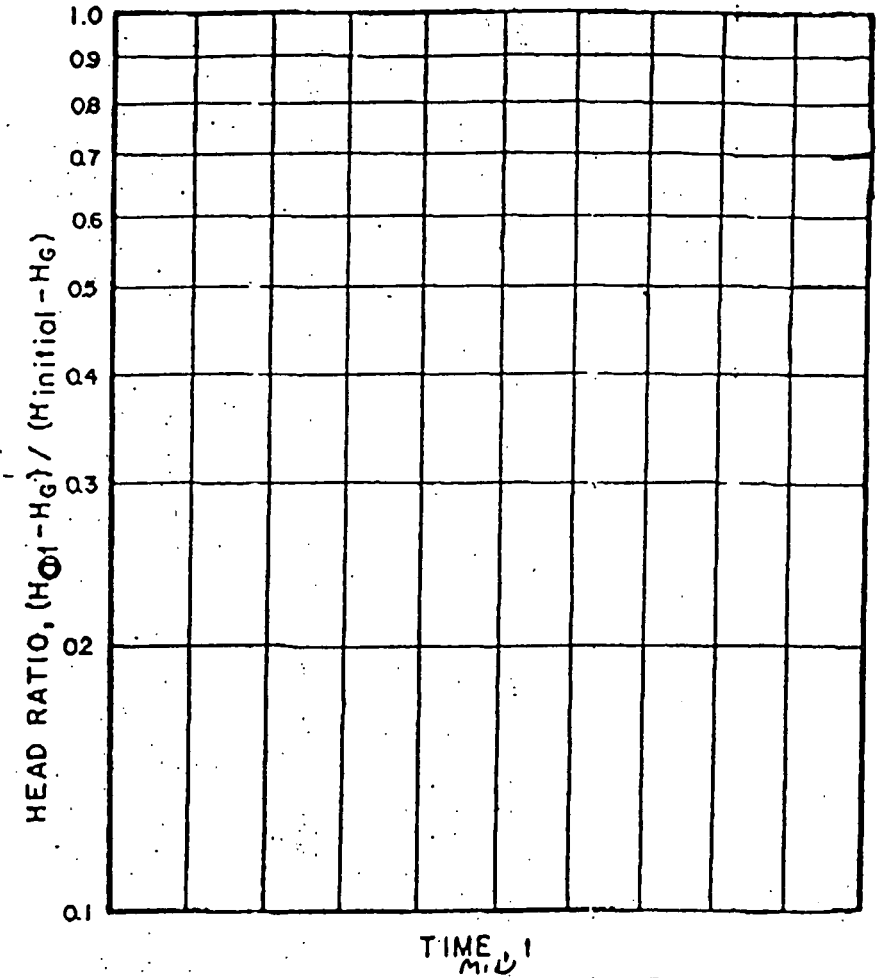
RADIUS OF WELL, r 0.0833
RADIUS OF TEST BORING, R 0.333
HEIGHT OF CASING (REF. LEVEL) ABOVE GROUND SURFACE, H_C 2.1 FT
DEPTH TO BOTTOM OF TEST POCKET, L_1 19.6
DEPTH TO TOP OF TEST POCKET, L_2 9.6
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G _____

Initial WL = 9.04 FT (7.182)

HYDRAULIC CONDUCTIVITY, K _____

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t sec/min	DEPTH TO WATER IN CASING H FEET



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

IT CORPORATION

3637

By CJ Date 03/[illegible]/91 Subject Slug Test #3 Sheet No. ___ of ___

Chkd. By ___ Date Hydraulic Conductivity Calculations for 1340 Proj. No. 602 3.7

Head Ratio = HR = $\frac{H_{@t} - H_G}{H_i - H_G}$ where: H_G = Depth to Groundwater below TOC before slug was added

H_i = Initial Depth to Groundwater below TOC after slug was added

$H_{@t}$ = Depth to Groundwater below TOC at time t

HR

$H_1 \rightarrow$ 0.050 min: [illegible] $= \frac{.738}{.795} = .928$

0.117 min: [illegible] $= \frac{.[illegible]}{.795} = .834$

0.200 min: [illegible] $\frac{.581}{.795} = .731$

0.317 min: [illegible] $= \frac{.[illegible]}{.795} = .628$

$H_2 \rightarrow$ 0.483 min: [illegible] $= \frac{.404}{.795} = .508$

$L_1 \rightarrow$ 0.900 min: [illegible] $\frac{.[illegible]}{.795} = .333$

1.400 min: [illegible] $= \frac{.183}{.795} = .230$

L_2 H_2 2.700 min: [illegible] $= \frac{.089}{.795} = .112$

6.400 min: [illegible] $\frac{.032}{.795} = .040$

Hydraulic Conductivity: $K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{(L_1 - L_2)}{R}\right] \ln\left[\frac{H_1 - H_2}{H_2 - H_1}\right]$

$K = \frac{0.0069}{20(2.9 - 0.9)} \ln[30.00] \ln\left[\frac{[illegible]}{[illegible]}\right]$

$K = (1.725 \times 10^{-4})(3.401)(1.091)$

$K = 6.401 \times 10^{-4}$ FT/min

$K = 1.067 \times 10^{-5}$ FT/sec

.922 FT/day

K2

$K = \frac{(0.0833)^2}{2(1.6 - 1.6)(.483 - .050)} \ln\left[\frac{(1.6 - 1.6)}{.[illegible]}\right] \ln\left[\frac{8.302 - 9.04}{8.636 - 9.04}\right]$

$K = \frac{[illegible]}{2(1.6)(.433)} \ln[30.00] \ln\left[\frac{.[illegible]}{.404}\right]$ 1.827

$K = (7.967 \times 10^{-7})(3.4[illegible] \; .[illegible]3)$

$K = 1.634 \times 10^{-3}$ FT/min

$K = 2.723 \times 10^{-5}$ FT/sec

K = 2.353 FT/Day

K1

404

SE2000
Environmental Logger
03/04 12:04

3637

t# 0000000 Test# 3

INPUT 1: Level (F) TOC

Reference	9.040
Scale factor	19.982
Offset	0.018
SG	1.000

Step 0 03/02 14:31:34

Elapsed Time		Value
0.0000		9.040
0.0083		9.040
0.0166		9.065
0.0250		8.207
0.0333		9.443
0.0416		7.311
0.0500		8.894
0.0583		7.715
0.0666		8.434
0.0750		8.068
0.0833		8.270
0.1000	0.0833	8.245
0.1166		8.257
0.1333	0.0333	8.276
0.1500	0.0500	8.302
0.1666		8.320
0.1833	0.0833	8.339
0.2000		8.365
0.2166	0.1166	8.377
0.2333		8.396
0.2500	0.1500	8.415
0.2666		8.428
0.2833		8.447
0.3000	0.2000	8.459
0.3166		8.472
0.3333		8.484
0.4166	0.3166	8.541
0.5000		8.592
0.5833	0.4833	8.636
0.6666		8.667
0.7500		8.705
0.8333		8.730
0.9166		8.756
1.0000	1.0000	8.775
1.0833		8.794
1.1666		8.812
1.2500		8.825
1.3333		8.838
1.4166		8.850
1.5000	1.4000	8.857
1.5833		8.869
1.6666		8.876
1.7500	[illegible]	8.888
1.8333		8.894
1.9166		8.901
2.0000		8.907

3.0000	2.700	8.951
3.5000		8.964
4.0000	3.700	8.976
4.5000		8.983
5.0000		8.989
5.5000	5.400	8.995
6.0000		8.995
6.5000		9.002
7.0000	6.700	9.008
7.5000		9.008
8.0000		9.008
8.5000	8.4000	9.014
9.0000		9.014
9.5000		9.014
10.0000		9.014
11.0000		9.021
12.0000		9.027
13.0000	12.100	9.021
14.0000		9.021
15.0000		9.021
16.0000		9.021
17.0000		9.021
18.0000		9.021
19.0000	18.100	9.027
20.0000		9.027
21.0000	20.7[illegible]	9.033
22.0000		9.033
23.0000		9.033
24.0000		9.033
25.0000		9.033
26.0000		9.033
27.0000	26.9000	9.040
28.0000		9.040
29.0000		9.040
30.0000		9.040

END

3637

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1344
WELL NUMBER: 1344

FIELD ENG./GEO.: M. SLUSARSKI DATE: 08/12/89
CHECKED BY : B. DUNNING DATE: 08/17/89
N,E COORDINATES: 481363.02, 1380728.3
DATE OF INSTAL.: 08/12/89

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: 8.0 IN. HOLLOW STEM
IS CASING TEMPORARY?: No
CASING TYPE : PIEZOMETER
CASING DIAM.: 2.0 In. ID
CASING SIZE(S) USED: (in Feet)
SIZE: 4.2 FROM: 0.0 TO: 20.0
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: .020 (In.)
TOTAL PERFORATED AREA: 3.0 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: PVC
RISER PIPE DIAMETERS:
O.D.: 2 5/16 In. I.D.: 2.0 In.
LENGTH OF 1ST PIPE SECTION: 3.0 Ft.
2ND PIPE SECTION: 9.0 Ft.
3RD PIPE SECTION: 10.0 Ft.
COMMENTS

RISER JOINING METHOD: SCREW TYPE FLUSH JOINT THREADED

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5.0 Ft.
PROTECTIVE PIPE O.D.: 4 5/ In.
* HINGED LOCKING COVER W/ PADLOC

OTHER PROTECTION (* NOTED BELOW)

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE	ELEVATION MSL
TOP OF RISER PIPE	2.0 Ft.	586.81
GROUND SURFACE	0.0	584.6
BOTTOM OF PROTECTIVE PIPE	2.9 Ft.	

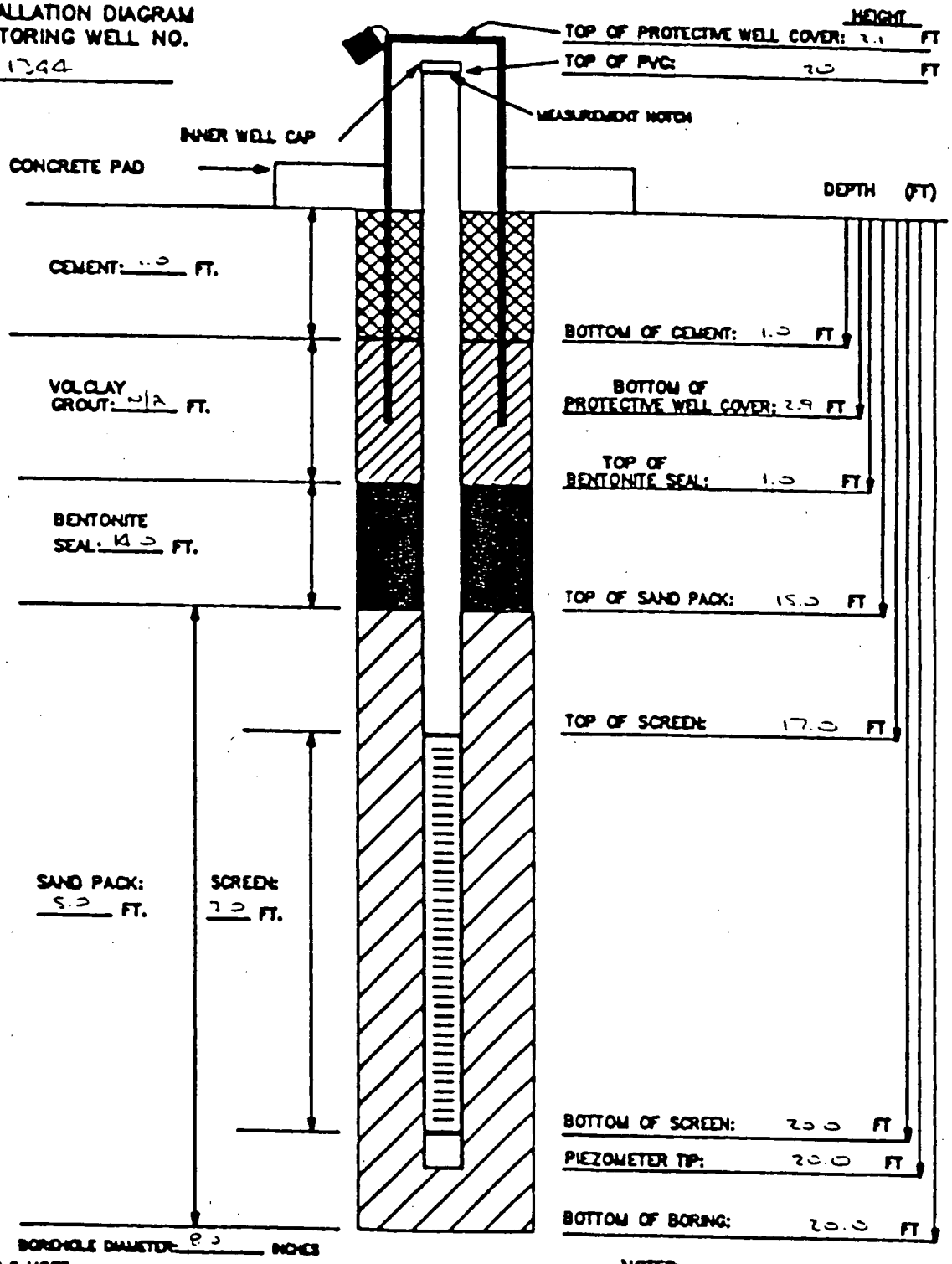
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
	0.0	1.0	N/A	N/A
Bentonite Pellets	1.0	15.0	N/A	N/A
Sand	15.0	20.0	N/A	N/A
PERFORATED SECTION	17.0	20.0	N/A	N/A
WELL TIP	20.0		N/A	
BOTTOM OF BOREHOLE	20.0		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1344

INSTALLATION DATE: [illegible] 3637



MATERIALS USED:
SAND TYPE AND QUANTITY: 10-20: 2 - 50LB SACKS
BENTONITE PELLETS (5-GALLON BUCKETS): 6 : 5-GAL BUCKETS
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: .5 - 94LB BAG
AMOUNT OF WATER USED: 40 GAL
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602 3 7 1

GEOLOGIST/ENGINEER: [illegible]

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1344	COORDINATES: NORTH 481,363.02 EAST 1,380,728.33	DATE: 08/12/89
GROUND ELEVATION: 584.6	GWL: Depth N/A Date/Time N/A	DATE STARTED: 08/12/89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth N/A Date/Time N/A	DATE COMPLETED: 08/12/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 3

DEPTH	SAMPLE / DATE / TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
0.5	50137 08/12/89 0956	6	6	VERY STIFF, BROWN (10 YR 5/3) SILTY CLAY, SOME GRAVEL (.25 - 1.0 IN), TRACE ROOTLETS, DAMP.	CL	2.5	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
1.0	50138 08/12/89 0956	12		NO RECOVERY.			
1.5	50139 08/12/89 0956	14		NO RECOVERY.			
2.0	50140 08/12/89 0959	15	6	VERY STIFF, BROWN (10 YR 5/3) SILTY CLAY, TRACE GRAVEL (.25 - .50 IN) DAMP.	CL	2.5	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
2.5	50141 08/12/89 0959	13		NO RECOVERY.			
3.0	50142 08/12/89 0959	11		NO RECOVERY.			
3.5	50143 08/12/89 1002	11	6	VERY STIFF, BROWN (10 YR 5/3) SILTY CLAY, TRACE SAND, TRACE GRAVEL (.25 - .50 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
4.0	50144 08/12/89 1002	11	6	VERY STIFF, BROWN (10 YR 5/3) SILTY CLAY, TRACE SAND, TRACE GRAVEL (.25 - .50 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
4.5	50145 08/12/89 1002	9	6	VERY STIFF, BROWN (10 YR 5/3) SILTY CLAY, TRACE SAND, TRACE GRAVEL (.25 - .50 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
5.0	50146 08/12/89 1005	14	6	VERY STIFF, BROWN (10 YR 5/3) SILTY CLAY, TRACE SAND, TRACE GRAVEL (.25 - .50 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
5.5	50147 08/12/89 1005	12	6	VERY STIFF, BROWN (10 YR 5/3) SILTY CLAY, TRACE SAND, TRACE GRAVEL (.25 - .50 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
6.0	50148 08/12/89 1005	12	6	VERY STIFF, BROWN (10 YR 5/3) SILTY CLAY, TRACE SAND, TRACE GRAVEL (.25 - .50 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-100 cpm
6.5	50149 08/12/89 1035	3	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY, TRACE GRAVEL (.25 - .75 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-140 cpm
7.0	50150 08/12/89 1035	4	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY TRACE GRAVEL (.25 - .75) TRACE SAND, DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-140 cpm
7.5	50151 08/12/89 1035	6		NO RECOVERY.			
8.0	50152 08/12/89 1037	7	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY TRACE GRAVEL (.25 - .50) TRACE SAND, DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-140 cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1344	COORDINATES: NORTH 481,363.02 EAST 1,380,728.33	DATE: 08/12/89
GROUND ELEVATION: 584.6	GWL: Depth N/A Date/Time N/A	DATE STARTED: 08/12/89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth N/A Date/Time N/A	DATE COMPLETED: 08/12/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 3

DEPTH	SAMPLE	DATE	TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	50153	08/12/89	1037	20	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY TRACE GRAVEL (.25 - .50) TRACE SAND, DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-140 cpm
9.0	50154	08/12/89	1037	11		NO RECOVERY.			
9.5	50155	08/12/89	1039	11	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY, TRACE GRAVEL (.25 - .50) TRACE SAND, DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 140 cpm
10.0	50156	08/12/89	1039	12	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY, TRACE GRAVEL (.25 - .50) TRACE SAND, DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 140 cpm
10.5	50157	08/12/89	1039	12	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY, TRACE GRAVEL (.25 - .50) TRACE SAND, DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 140 cpm
11.0	50158	08/12/89	1050	4	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY, TRACE GRAVEL (.25 - .50) TRACE SAND, DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 90-140 cpm
11.5	54575	08/12/89	1050	5	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY, TRACE GRAVEL (.25 - .50) TRACE SAND, DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 90-140 cpm
12.0	54576	08/12/89	1050	9	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY, TRACE GRAVEL (.25 - .50) TRACE SAND, DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 90-140 cpm
12.5	54577	08/12/89	1100	5	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY, TRACE GRAVEL (.25 - .50) TRACE SAND, DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 90-140 cpm
13.0	54578	08/12/89	1100	7	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY, TRACE GRAVEL (.25 - .50) TRACE SAND, DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 90-140 cpm
13.5	54579	08/12/89	1100	8	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY, TRACE GRAVEL (.25 - .50) TRACE SAND, DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 90-140 cpm
14.0	54580	08/12/89	1104	9	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY, TRACE GRAVEL (.25 - .50) TRACE SAND, DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 100-160cpm
14.5	54581	08/12/89	1104	12	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY, TRACE GRAVEL (.25 - .50) TRACE SAND, DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 100-160cpm
15.0	54582	08/12/89	1104	15	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY, TRACE GRAVEL (.25 - .50) TRACE SAND, DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 100-160cpm
15.5	54583	08/12/89	1115	4	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY TRACE GRAVEL (.25 - .50 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-140 cpm

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1344	COORDINATES: NORTH 481,363.02 EAST 1,380,728.33	DATE: 08/12/89
GROUND ELEVATION: 584.6	GWL: Depth N/A Date/Time N/A	DATE STARTED: 08/12/89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth N/A Date/Time N/A	DATE COMPLETED: 08/12/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.0	54584 08/12/89 1115	5	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY TRACE GRAVEL (.25 - .50 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-140 cpm
16.5	54585 08/12/89 1115	8	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY TRACE GRAVEL (.25 - .50 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-140 cpm
17.0	54586 08/12/89 1126	5	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY TRACE GRAVEL (.25 - .50 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-140 cpm
17.5	54587 08/12/89 1126	8	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY TRACE GRAVEL (.25 - .50 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-140 cpm
18.0	54588 08/12/89 1126	12	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY TRACE GRAVEL (.25 - .50 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-140 cpm
18.5	54589 08/12/89 1130	22	6	VERY STIFF, GREY (5 Y 5/1) SILTY CLAY TRACE GRAVEL (.25 - .50 IN) DAMP.	CL	2.0	Hnu= 0 ppm α = 0 cpm βΓ = 80-140 cpm
19.0	54590 08/12/89 1130	25	6	DENSE, GREY (5 Y 5/1) SILTY SAND WET TRACE GRAVEL (.25 - .75 IN).	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-140 cpm
19.5	54591 08/12/89 1130	21	6	DENSE, GREY (5 Y 5/1) SILTY SAND WET TRACE GRAVEL (.25 - .75 IN).	SM	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-140 cpm
20.0	54592 08/12/89 1130	20	6	DENSE, GREY (5 Y 5/1) WELL GRADED SAND, WET, TRACE GRAVEL (.25 - .75 IN).	SW	NA	Hnu= 0 ppm α = 0 cpm βΓ = 80-140 cpm

BOTTOM OF BORING 20.0

NOTES:
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST. COLORS IDENTIFIED USING MUNSELL COLOR CHART.

FIELD PERMEABILITY TESTS
FALLING HEAD*

1344

3637

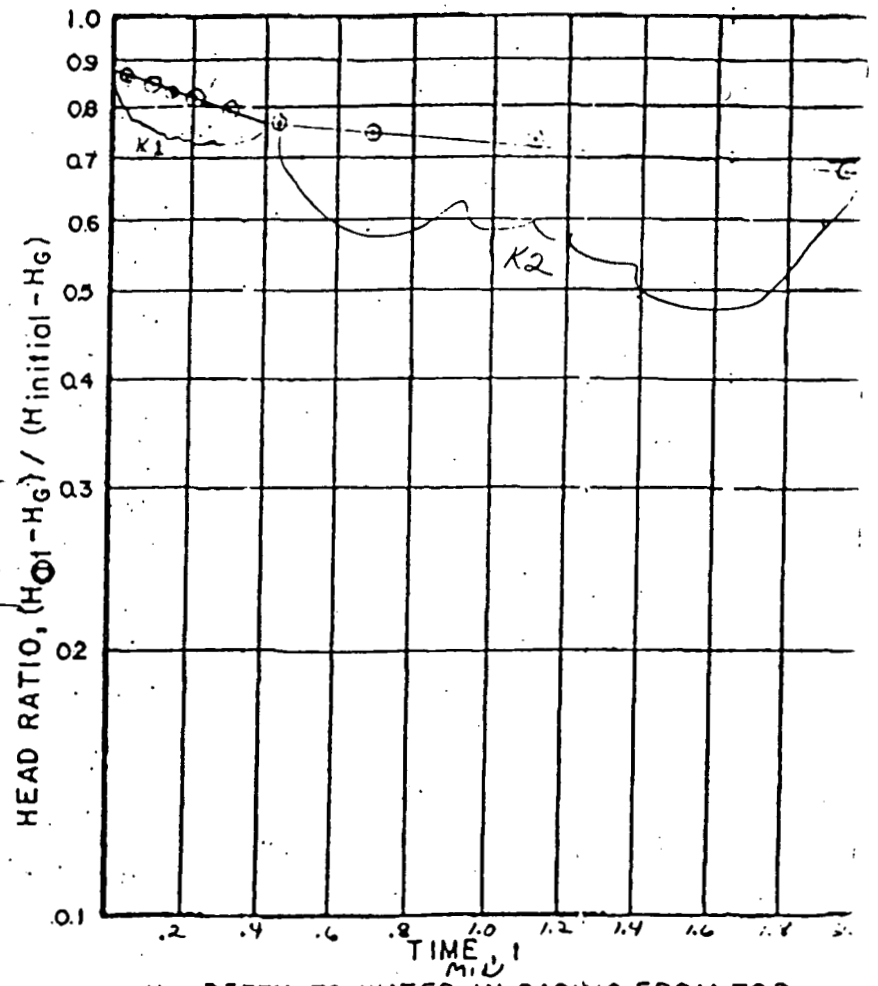
PROJECT [illegible] TESTED BY [illegible] DATE [illegible]
PROJECT NO. [illegible] CALCULATED BY [illegible] DATE 03/12/[illegible]
BORING NO. 1344 CHECKED BY [illegible] DATE

RADIUS OF WELL, r [illegible]
RADIUS OF TEST BORING, R [illegible] FT
HEIGHT OF CASING (REF. LEVEL)
ABOVE GROUND SURFACE, H_C [illegible] FT
DEPTH TO BOTTOM OF TEST POCKET, L_1 [illegible] FT
DEPTH TO TOP OF TEST POCKET, L_2 [illegible] FT
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 14.55 FT

HYDRAULIC CONDUCTIVITY, K $K1 = 1.301 \times 10^{-3}$ FT
$K2 = 3.705 \times 10^{-4}$ FT

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t SEC/MIN	DEPTH TO WATER IN CASING H FEET
0.000	[illegible]
0.008	13.357
0.017	13.385
0.033	13.45[illegible]
0.058	13.433
0.108	[illegible]
0.158	[illegible]
0.208	[illegible]
0.292	[illegible]
0.458	[illegible]
0.708	13.5[illegible]7
0.958	13.5[illegible]2
1.125	13.5[illegible]1
1.458	13.[illegible]6
1.958	13.[illegible]48
3.958	13.730
5.958	13.780
7.958	13.824
11.958	13.875
15.958	13.912
19.958	13.944
23.958	13.963
27.958	13.132
31.958	13.974
34.958	14.007
37.958	14.013
39.958	14.020
42.958	14.026



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

SE2000
Environmental Logger
03/04 12:06

Unit# 0000000 Test# 4

INPUT 1: Level (F) TOC

Reference	14.550
Scale factor	19.982
Offset	0.018
SG	1.000

Step 0 03/02 15:14:49

Elapsed Time		Value
0.0000		14.568
0.0083		14.556
0.0166		14.499
0.0250		9.384
0.0333		14.631
0.0416	0.000	13.225
0.0500	.0084	13.357
0.0583	.0167	13.383
0.0666		13.395
0.0750	.0334	13.408
0.0833		13.414
0.1000	.0584	13.433
0.1166		13.439
0.1333		13.446
0.1500	.1084	13.452
0.1666		13.458
0.1833		13.465
0.2000	.1584	13.471
0.2166		13.471
0.2333		13.477
0.2500	.2084	13.484
0.2666		13.484
0.2833		13.484
0.3000		13.490
0.3166		13.490
0.3333	.2917	13.496
0.4166		13.509
0.5000	.4584	13.521
0.5833		13.534
0.6666		13.540
0.7500	.7084	13.547
0.8333		13.559
0.9166		13.566
1.0000	.9584	13.572
1.0833		13.584
1.1666	1.125	13.591
1.2500		13.597
1.3333		13.603
1.4166		13.610
1.5000	1.4584	13.616
1.5833		13.622
1.6666		13.629
1.7500		13.629
1.8333		13.635
1.9166		13.641
2.0000	[illegible]	13.648

3.0000		13.692
3.5000		13.711
4.0000	3.9584	13.730
4.5000		13.748
5.0000		13.761
5.5000		13.774
6.0000	5.9584	13.780
6.5000		13.793
7.0000		13.805
7.5000		13.812
8.0000	7.9584	13.824
8.5000		13.830
9.0000		13.837
9.5000		13.843
10.0000		13.856
11.0000		13.868
12.0000	11.9584	13.875
13.0000		13.887
14.0000		13.894
15.0000		13.906
16.0000	[illegible]	13.912
17.0000		13.925
18.0000		13.931
19.0000		13.938
20.0000	19.9584	13.944
21.0000		13.950
22.0000		13.950
23.0000		13.957
24.0000	23.9584	13.963
25.0000		13.969
26.0000		13.969
27.0000		13.976
28.0000	27.9584	13.982
29.0000		13.982
30.0000		13.988
31.0000		13.988
32.0000	31.9584	13.994
33.0000		14.001
34.0000		14.001
35.0000	34.9584	14.007
36.0000		14.007
37.0000		14.007
38.0000	37.9584	14.013
39.0000		14.013
40.0000	39.9584	14.020
41.0000		14.020
42.0000		14.020
43.0000	43.9584	14.026

END

MONITORING WELL INSTALLATION RECORD

PROJECT NAME: Fernald RI/FS
PROJECT NO. : 602.3.2
BORING NO. : 1356
WELL NUMBER: 1356

FIELD ENG./GEO.: E. TROLLINGER DATE: 08/25/89
CHECKED BY : BD DATE: 09/01/89
N,E COORDINATES: 480828.63, 1380037.7
DATE OF INSTAL.: 08/25/89

BOREHOLE DRILLING

DRILLING METHOD: AUGER
DRILLING FLUID(S) USED: NONE NOTED
NOTES COMMENTS:

TYPE OF BIT: AUGER
IS CASING TEMPORARY?: No
CASING TYPE : MONITORING
CASING DIAM.: 2.0 In. ID
CASING SIZE(S) USED: (Units N/A)
SIZE: N/A FROM: N/A TO: N/A
SIZE: N/A FROM: N/A TO: N/A

WELL DESCRIPTION

TYPE: MONITORING WELL
DIAMETER OF PERFORATED SECTION:
PERFORATION TYPE: Slots
AVG. SIZE OF PERFORATIONS: 0.020 (In.)
TOTAL PERFORATED AREA: 9.8 Ft.
NOTES/COMMENTS:

RISER PIPE MATERIAL: SCH 40 PVC
RISER PIPE DIAMETERS:
O.D.: 2.5 In. I.D.: 2.0 In.
LENGTH OF 1ST PIPE SECTION: 2.0 Ft.
2ND PIPE SECTION: 10 Ft.
3RD PIPE SECTION: Not Noted
COMMENTS

RISER JOINING METHOD: SCREW TYPE, FLUSH JOINTED

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH: 5.0 Ft.
PROTECTIVE PIPE O.D.: 4 5/ In.
• LID COVER WITH LOCK INSTALLED

OTHER PROTECTION (* NOTED BELOW)

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE		ELEVATION MSL	
TOP OF RISER PIPE	2.0 Ft.		583.07	
GROUND SURFACE	0.0		N/A	
BOTTOM OF PROTECTIVE PIPE	2.5 Ft.			
BOREHOLE FILL MATERIALS	TOP	BOTTOM	TOP	BOTTOM
	0.0	1.0	N/A	N/A
Bentonite Pellets	1.0	7.0	N/A	N/A
Sand	7.0	20.0	N/A	N/A
PERFORATED SECTION	10.0	19.8	N/A	N/A
WELL TIP	20.0		N/A	
BOTTOM OF BOREHOLE	20.0		N/A	
GWL AFTER INSTALLATION	N/A		N/A	

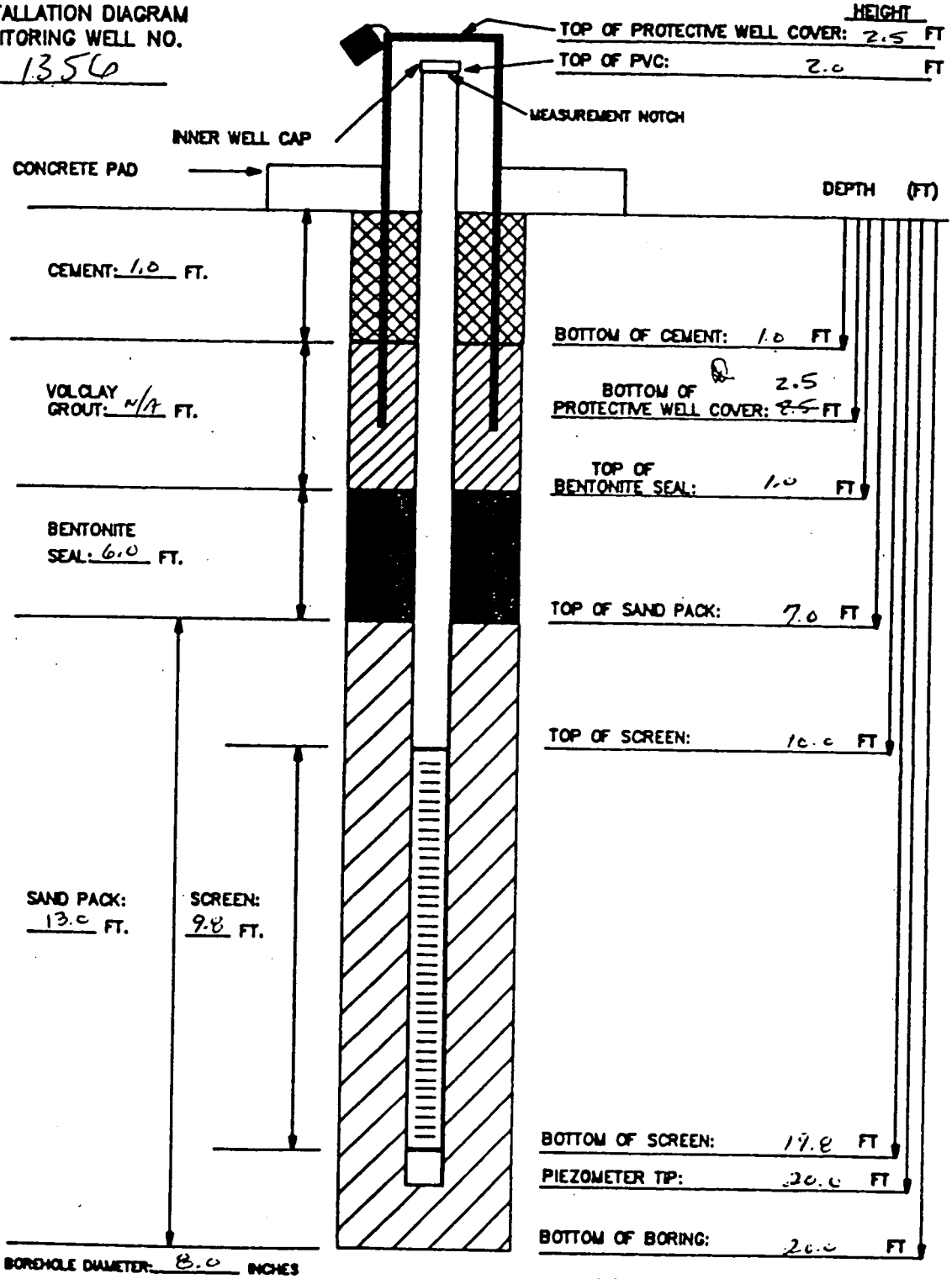
WAS THE WELL FLUSHED AFTER INSTALLATION? : No
WAS A SENSITIVITY TEST PERFORMED ON THE WELL : No

4/5
3637

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1356

INSTALLATION DATE: 8-25-89



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 10/20 3 BAGS
BENTONITE PELLETS (5-GALLON BUCKETS): 2 BUCKETS
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: 1/2 BAG
AMOUNT OF WATER USED: 5 gals
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 2.7.1

GEOLOGIST/ENGINEER: E. Trollinger

SW 1/14/92

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FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1356	COORDINATES: NORTH 480,828.63 EAST 1,380,037.72	DATE: 08/25/89
GROUND ELEVATION: 581.55	GWL: Depth N/A Date/Time N/A	DATE STARTED: 08/25/89
ENGINEER/GEOLOGIST: E. TROLLINGER	Depth N/A Date/Time N/A	DATE COMPLETED: 08/25/89
DRILLING METHODS: MOBILE DRILL HSA 8 IN		PAGE 1 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
0.5	50401 08/25/89 1024	2	6	VERY STIFF, DARK BROWN (10 YR 3/2) SILT, TRACE OF CLAY, NON COHESIVE, MOIST.	ML	2.0	Hnu= 0.6 ppm α = 0 cpm βΓ = 600-800cpm
1.0	50402 08/25/89 1024	2	0	NO RECOVERY.			
1.5	50403 08/25/89 1024	5	0	NO RECOVERY.			
2.0	50404 08/25/89 1027	5	6	VERY STIFF, DARK OLIVE GRAY (5 Y 3/2) CLAY, LOW PLASTICITY, MOIST.	CL	3.0	Hnu= 0.6 ppm α = 0 cpm βΓ = 600 cpm
2.5	50405 08/25/89 1027	8	6	VERY STIFF, DARK OLIVE GRAY (5 Y 3/2) CLAY, LOW PLASTICITY, MOIST.	CL	3.0	Hnu= 0.6 ppm α = 0 cpm βΓ = 600 cpm
3.0	50406 08/25/89 1027	10	0	NO RECOVERY.			
3.5	50407 08/25/89 1035	10	6	VERY STIFF, GRAYISH BROWN (10 YR 3/2) CLAY, LOW TO MEDIUM PLASTICITY, MOIST.	CL	3.5	Hnu= 0.6 ppm α = 0 cpm βΓ = 400-500cpm
4.0	50408 08/25/89 1035	10	3	VERY STIFF, GRAYISH BROWN (10 YR 3/2) CLAY, LOW TO MEDIUM PLASTICITY, MOIST.	CL	3.5	Hnu= 0.6 ppm α = 0 cpm βΓ = 400-500cpm
4.5	50409 08/25/89 1035	8	0	NO RECOVERY.			
5.0	50410 08/25/89 1045	6	6	VERY STIFF, DARK GRAY (10 YR 4/1) CLAY, LOW PLASTICITY, SOME SILT, MOIST.	CL	3.0	Hnu= 0.6 ppm α = 0 cpm βΓ = 400-500cpm
5.5	50411 08/25/89 1045	7	6	VERY STIFF, DARK GRAY (10 YR 4/1) CLAY, LOW PLASTICITY, SOME SILT, MOIST.	CL	3.0	Hnu= 0.6 ppm α = 0 cpm βΓ = 400-500cpm
6.0	50412 08/25/89 1045	8	0	NO RECOVERY.			
6.5	50413 08/25/89 1310	4	6	VERY STIFF, DARK GRAY, (10 YR 3/1) SILTY CLAY, LOW PLASTICITY, TRACE OF SAND, MOIST.	CL	2.5	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm
7.0	50414 08/25/89 1310	5	6	VERY STIFF, DARK GRAY, (10 YR 3/1) SILTY CLAY, LOW PLASTICITY, TRACE OF SAND, MOIST.	CL	2.5	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm
7.5	50415 08/25/89 1310	9	4	VERY STIFF, DARK GRAY, (10 YR 3/1) SILTY CLAY, LOW PLASTICITY, TRACE OF SAND, MOIST.	CL	2.5	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm
8.0	50416 08/25/89 1317	5	6	STIFF, DARK GRAY, (10 YR 4/2) CLAY, TRACE OF COARSE SAND, MEDIUM PLASTICITY, VERY MOIST.	CL	1.5	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm

NOTES:
SAMPLES TAKEN FOR WMCO AT INTERVALS 0.0 - .5 FT., 2 - 2.5 FT., 5 - 5.5 FT., 10 - 10.5 FT., 15 - 15.5 FT.
SAMPLING IN ACCORDANCE WITH ASTM STANDARDS, DESCRIPTION OF SOIL COLOR BY MUNSELL COLOR CHART.

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1356	COORDINATES: NORTH 480,828.63 EAST 1,380,037.72	DATE: 08/25/89
GROUND ELEVATION: 581.55	GWL: Depth N/A Date/Time N/A	DATE STARTED: 08/25/89
ENGINEER/GEOLOGIST: E. TROLLINGER	Depth N/A Date/Time N/A	DATE COMPLETED: 08/25/89
DRILLING METHODS: MOBILE DRILL HSA 8 IN		PAGE 2 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
8.5	50417 08/25/89 1317	6	6	STIFF, DARK GRAY, (10 YR 4/2) CLAY, TRACE OF COARSE SAND, MEDIUM PLASTICITY, VERY MOIST.	CL	1.5	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm
9.0	50418 08/25/89 1317	6	0	NO RECOVERY.			
9.5	50419 08/25/89 1330	2	6	MEDIUM STIFF, GRAYISH BROWN, (10 YR 4/3) CLAY, MEDIUM PLASTICITY.	CL	1.0	Hnu= 0.6 ppm α = 0 cpm βΓ = 300-400cpm
10.0	50420 08/25/89 1330	2	4	MEDIUM STIFF, GRAYISH BROWN, (10 YR 4/3) CLAY, MEDIUM PLASTICITY.	CL	1.0	Hnu= 0.6 ppm α = 0 cpm βΓ = 300-400cpm
10.5	50421 08/25/89 1330	2	0	NO RECOVERY.			
11.0	50422 08/25/89 1340	2	6	MEDIUM STIFF, BROWN (10 YR 4/3) CLAY, SOME SILT THROUGHOUT, LOW PLASTICITY, MOIST.	CL	1.0	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm
11.5	54815 08/25/89 1340	2	6	MEDIUM STIFF, BROWN (10 YR 4/3) CLAY, SOME SILT THROUGHOUT, LOW PLASTICITY, MOIST.	CL	1.0	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm
12.0	54816 08/25/89 1340	4	0	NO RECOVERY.			
12.5	54817 08/25/89 1342	2	6	LOOSE, BROWN (10 YR 4/3) TO (10 YR 4/4) SAND WITH CONSIDERABLE CLAY, NON TO LOW COHESION WET.	SC	NA	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm
13.0	54818 08/25/89 1342	2	6	LOOSE, BROWN (10 YR 4/3) TO (10 YR 4/4) SAND WITH CONSIDERABLE CLAY, NON TO LOW COHESION WET.	SC	NA	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm
13.5	54819 08/25/89 1342	4	3	LOOSE, BROWN (10 YR 4/3) TO (10 YR 4/4) SAND WITH CONSIDERABLE CLAY, NON TO LOW COHESION WET.	SC	NA	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm
14.0	54820 08/25/89 1350	2	6	LOOSE, BROWN (10 YR 4/3) TO (10 YR 4/4) SAND WITH CONSIDERABLE CLAY, NON TO LOW COHESION, WET! LESS CLAY BECOMING POORLY SOR	SC	NA	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm
14.5	54821 08/25/89 1350	4	6	LOOSE, BROWN (10 YR 4/3) TO (10 YR 4/4) SAND WITH CONSIDERABLE CLAY, NON TO LOW COHESION, WET! LESS CLAY BECOMING POORLY SOR	SC	NA	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm
15.0	54822 08/25/89 1350	5	6	LOOSE, BROWN (10 YR 4/3) TO (10 YR 4/4) SAND WITH CONSIDERABLE CLAY, NON TO LOW COHESION, WET! LESS CLAY BECOMING POORLY SOR	SC	NA	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm
15.5	54823 08/25/89 1500	4	6	MEDIUM DENSE, BROWN (10 YR 4/3) POORLY GRADED SAND, SOME SILT, TRACE OF FINE GRAVEL, WET.	SP	NA	Hnu= 0.6 ppm α = 0 cpm βΓ = 400-500cpm

NOTES:
SAMPLES TAKEN FOR WMCO AT INTERVALS 0.0 - 0.5 FT., 2.0 - 2.5 FT., 5.0 - 5.5 FT., 10.0 - 10.5 FT., 15.0 - 15.5 FT.
SAMPLING IN ACCORDANCE WITH ASTM STANDARDS, DESCRIPTION OF SOIL COLOR BY MUNSELL COLOR CHART.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1356	COORDINATES: NORTH 480,828.63 EAST 1,380,037.72	DATE: 08/25/89
GROUND ELEVATION: 581.55	GWL: Depth N/A Date/Time N/A	DATE STARTED: 08/25/89
ENGINEER/GEOLOGIST: E. TROLLINGER	Depth N/A Date/Time N/A	DATE COMPLETED: 08/25/89
DRILLING METHODS: MOBILE DRILL HSA 8 IN		PAGE 3 OF 3

DEPTH	SAMPLE DATE TIME	BLOWS ON SAMPLE	RECOVERY INCHES		USCS SYMBOL	TSF	REMARKS
16.0	54824 08/25/89 1500	5	0	NO RECOVERY.			
16.5	54825 08/25/89 1500	7	0	NO RECOVERY.			
17.0	54826 08/25/89 1503	4	6	MEDIUM DENSE BROWN (10 YR 4/2) WELL GRADED SAND BECOMING SILTY AT 18.0 FT., TRACE OF FINE GRAVELLY (.5 IN), WET.	SW	NA	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm
17.5	54827 08/25/89 1503	8	6	MEDIUM DENSE BROWN (10 YR 4/2) WELL GRADED SAND BECOMING SILTY AT 18.0 FT., TRACE OF FINE GRAVELLY (.5 IN), WET.	SW	NA	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm
18.0	54828 08/25/89 1503	6	6	MEDIUM DENSE BROWN (10 YR 4/2) WELL GRADED SAND BECOMING SILTY AT 18.0 FT., TRACE OF FINE GRAVELLY (.5 IN), WET.	SW	NA	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm
18.5	54829 08/25/89 1513	21	6	MEDIUM DENSE BROWN (10 YR 4/2) WELL GRADED SAND BECOMING SILTY AT 18.0 FT., TRACE OF FINE GRAVELLY (.5 IN), WET.	SP	NA	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm
19.0	54830 08/25/89 1513	22	6	MEDIUM DENSE BROWN (10 YR 4/2) WELL GRADED SAND BECOMING SILTY AT 18.0 FT., TRACE OF FINE GRAVELLY (.5 IN), WET.	SP	NA	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm
19.5	54831 08/25/89 1513	23	6	MEDIUM DENSE BROWN (10 YR 4/2) WELL GRADED SAND BECOMING SILTY AT 18.0 FT., TRACE OF FINE GRAVELLY (.5 IN), WET.	SP	NA	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm
20.0	54832 08/25/89 1513	20	6	STIFF, GRAY (10 YR 3/3) CLAY, SOME SAND AND GRAVEL, LOW PLASTICITY, MOIST.	CL	2.0	Hnu= 0.6 ppm α = 0 cpm βΓ = 400 cpm

BOTTOM OF BORING 20.0

NOTES:
SAMPLES TAKEN FOR WMCO AT INTERVALS 0.0 - 0.5 FT., 2.0 - 2.5 FT., 5.0 - 5.5 FT., 10.0 - 10.5 FT., 15.0 - 15.5 FT.
SAMPLING IN ACCORDANCE WITH ASTM STANDARDS, DESCRIPTION OF SOIL COLOR BY MUNSELL COLOR CHART.

FIELD PERMEABILITY TESTS
FALLING HEAD*

1356 Test #2

3637

PROJECT Fernald RI/FS
PROJECT NO. 10.37
BORING NO. 135

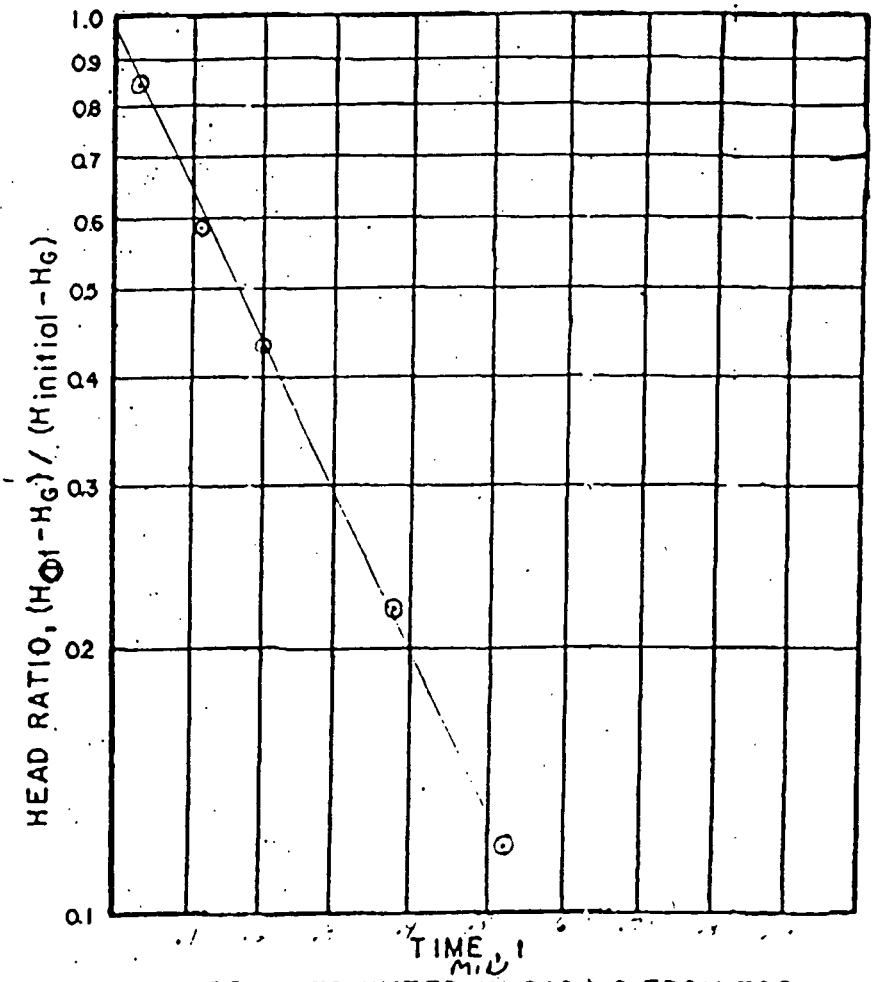
TESTED BY CG/CM DATE 03/02/91
CALCULATED BY CG DATE 03/12/91
CHECKED BY FG DATE

RADIUS OF WELL, r = 1.0 in = 0.0833 FT
RADIUS OF TEST BORING, R = 4.0 in = 0.3333 FT
HEIGHT OF CASING (REF. LEVEL)
ABOVE GROUND SURFACE, H_C 2.5 FT
DEPTH TO BOTTOM OF TEST POCKET, L_1 19.8 FT
DEPTH TO TOP OF TEST POCKET, L_2 10.0 FT
DEPTH TO GROUNDWATER TABLE FROM TOP OF CASING, H_G 8.34 FT

HYDRAULIC CONDUCTIVITY, K 7.965×10^{-5} FT/min

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$.

ELAPSED TIME t SEC/MIN	DEPTH TO WATER IN CASING H FEET
0.000	7.[illegible]
0.033	[illegible]
0.067	[illegible]
0.117	7.87[illegible]
0.167	[illegible]
0.200	8.[illegible]
0.367	[illegible]
0.533	[illegible]
0.733	8.[illegible]
0.950	8.[illegible]
1.117	8.[illegible]
1.283	8.[illegible]
4.367	[illegible]



$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_G}{H_2 - H_G}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL.

H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1
H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

IT CORPORATION

By CL Date [illegible] Subject Slug Test # 2 Sheet No. ___ of ___

Chkd. By ___ Date [illegible] Calculations for 1956 Proj. No. [illegible]

$HR = \text{Head Ratio} = \dfrac{H_{@t} - H_G}{H_i - H_G}$

Where: H_G - Depth to Groundwater below TOC before slug was added

H_i = Initial Depth to Groundwater below TOC after slug was added

$H_{@t}$ = Depth to Groundwater below TOC at time t

HR

$H_1 \rightarrow$ .033 min $\dfrac{7.677 - 8.34}{7.545 - 8.34} = \dfrac{.663}{.795} = .834$

.117 min $\dfrac{7.873 - 8.34}{7.545 - 8.34} = \dfrac{.467}{.795} = .587$

.200 min $\dfrac{8.005 - 8.34}{7.545 - 8.34} = \dfrac{.335}{.795} = .421$

.367 min $\dfrac{8.169 - 8.34}{7.545 - 8.34} = \dfrac{.171}{.795} = .215$

$H_2 \rightarrow$ .533 min $\dfrac{8.251 - 8.34}{7.545 - 8.34} = \dfrac{.089}{.795} = .112$

.783 min $\dfrac{8.308 - 8.34}{7.545 - 8.34} = \dfrac{.032}{.795} = .040$

.950 min $\dfrac{8.321 - 8.34}{7.545 - 8.34} = \dfrac{.019}{.795} = .024$

1.117 min $\dfrac{8.307 - 8.34}{7.545 - 8.34} = \dfrac{.013}{.795} = .016$

Hydraulic Conductivity: $K = \dfrac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\dfrac{L_1 - L_2}{R}\right] \ln\left[\dfrac{H_1 - H_2}{H_2 - H_3}\right]$

$K = \dfrac{[illegible]}{[illegible]} \dfrac{[illegible]}{(.533 - .033)} \ln\left[\dfrac{[illegible]}{[illegible]}\right] \ln\left[\dfrac{7.677 - [illegible]}{8.251 - [illegible]}\right]$

$K = \dfrac{0.[illegible]9}{[illegible](.5)} \ln\left[\dfrac{[illegible]}{[illegible]}\right] \ln\left[\dfrac{.663}{.089} \quad 7.[illegible]\right]$

$K = (7.040 \times 10^{-4})(3.321)(2.008)$

4.779×10^{-3} FT/min

$K = 7.965 \times 10^{-5}$ FT/sec

$K = 6.882$ FT/Day

SE2000
Environmental Logger
03/04 12:02

Unit# 0000000 Test# 2

3637

INPUT 1: Level (F) TOC

Reference	8.340
Scale factor	19.982
Offset	0.018
SG	1.000

Step 0 03/02 13:58:34

Elapsed Time	Value
0.0000	8.327
0.0083	8.333
0.0166	8.403
0.0250	8.314
0.0333	8.327
0.0416	8.314
0.0500	8.333
0.0583	8.314
0.0666	7.532
0.0750	7.393
0.0833	6.901
0.1000	7.198
0.1166	7.690
0.1333	7.545
0.1500	7.633
0.1666	7.677
0.1833	7.721
0.2000	7.766
0.2166	7.803
0.2333	7.835
0.2500	7.873
0.2666	7.898
0.2833	7.930
0.3000	7.955
0.3166	7.980
0.3333	8.005
0.4166	8.100
0.5000	8.169
0.5833	8.220
0.6666	8.251
0.7500	8.276
0.8333	8.295
0.9166	8.308
1.0000	8.314
1.0833	8.321
1.1666	8.321
1.2500	8.327
1.3333	8.327
1.4166	8.333
1.5000	8.333
1.5833	8.333
1.6666	8.333
1.7500	8.333
1.8333	8.333
1.9166	8.333
2.0000	8.333

3.0000	8.333
3.5000	8.333
4.0000	8.333
4.5000	8.340
5.0000	8.340
5.5000	8.340
6.0000	8.340
6.5000	8.340
7.0000	8.340
7.5000	8.340
8.0000	8.340

END