FINAL REPORT
CONTRACT 222.01

INSTALLATION OF A DEDICATED GROUND WATER MONITORING SYSTEM

Prepared for

Kawecki Berylco Inc.
Boyertown, Pennsylvania

Prepared by

Rogers, Golden & Halpern
1427 Vine Street
Philadelphia, Pennsylvania

DECEMBER 1985

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1427 Vine Street
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215/563-4220

Reston, Virginia

RGH

December 23, 1985

Frank Coyle
Kawecki Berylco, Inc. (KBI)
County Line Road
Boyertown, Pa. 19512

Re: Final Report for RGH Project 222.01

Dear Mr. Coyle,

Enclosed are two copies of the final report for project 222.01, Installation Of A Dedicated Ground Water Monitoring System. The report contains a detailed summary of the monitoring system, including a hydrologic evaluation of the monitor wells. The construction of the monitoring wells has also been carefully documented.

On October 29, 1985 RGH conducted the first sampling of the monitor wells. The results of the laboratory analyses of these samples are discussed. The methodology for sampling the wells is included in the report.

It has been our intent to provide a complete and fully tested ground water monitoring system which can be reliably operated by personnel at KBI. If RGH can be of any further service in satisfying your environmental monitoring requirements please feel free to give me a call. We also have extensive expertise in the area of ground water and surface water contamination abatement should the need arise.

It has been a pleasure serving you. We at RGH would like to wish you a very prosperous New Year.

Sincerely,

Charles Miller

Charles Miller

cc: 222.01

FINAL REPORT

Contract 222.01

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for

Kawecki Berylco Inc.
Boyertown, Pennsylvania

Rogers, Golden & Halpern
1427 Vine Street
Philadelphia, Pennsylvania 19102

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Contents

I. INTRODUCTION

During the month of October, 1985, Rogers, Golden and Halpern (RGH) installed and tested a five-point ground water monitoring system for Kawecki Berylco Inc. (KBI). The monitoring system serves the mausoleum vault storage site at the KBI facility in Boyertown, Pennsylvania.

The project involved the completion of seven (7) test wells into the Brunswick Formation. These wells were used to develop detailed information about the direction and velocity of ground water movement in the vicinity of the vaults. The test wells were of a sufficient diameter (6 inches) to permit conventional pump tests to be conducted. Each was furnished with a steel outer casing and a locking cap to preserve it for future applications.

On the basis of hydraulic data collected from the test wells, five (5) wells were selected for conversion to monitor points. The location and construction of the monitor wells were optimized to intercept ground water migrating from the vault storage site. The monitor well installations consisted of flush threaded two-inch (internal diameter) polyvinyl chloride (PVC) casings and screens in which dedicated sampling pumps were suspended. The pumps were intended to be a permanent part of each monitor well installation. In this way the potential for cross-contamination between the wells is virtually eliminated. Furthermore, the pumps are conveniently operated by a lightweight portable compressor and controller. Time-consuming pump emplacement, removal, and decontamination procedures are avoided with this system.

The first sampling round was conducted by RGH on October 29, 1985, with KBI personnel in attendance. As part of the services provided under its contract with KBI, RGH also furnished a detailed sampling protocol incorporating sampler operation, sampling methodology, and documentation. Operational procedures have been streamlined to make operation of the monitoring system by KBI personnel simple and reliable.

The results of the initial sampling round indicate that no deterioration of ground water is occurring in the vicinity of the vaults.

II. TEST WELLS

Seven test wells were drilled from October 7 through October 10, 1985 (Figure 1). All wells were completed to a final depth of 101 feet below ground level. The locations of these wells were selected to intersect the anticipated pathways of ground water migration at the site. Initial estimates of migration direction assumed that the piezometric surface would be a subdued reflection of surface topography.

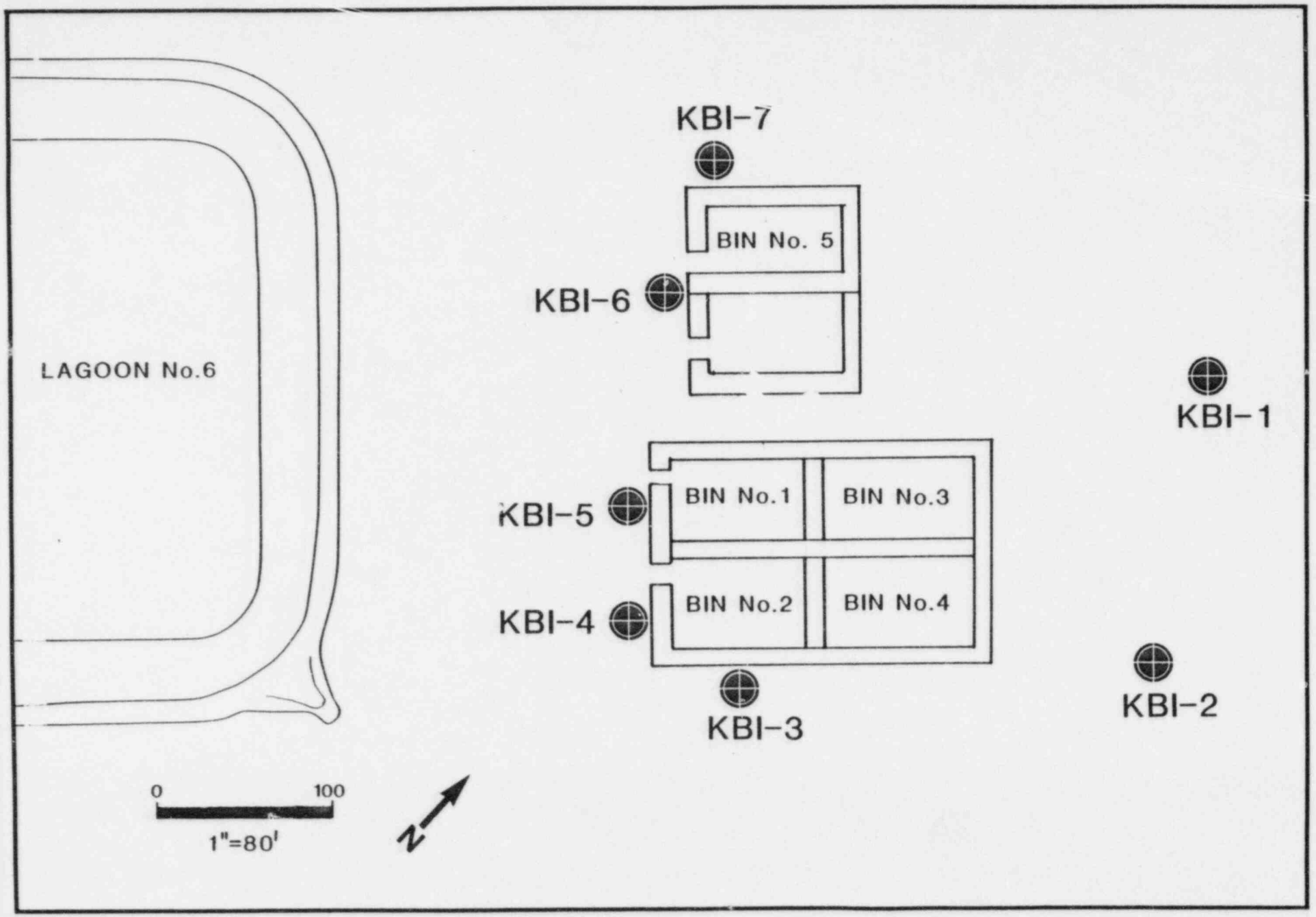
The drilling procedure involved completion of an eight (8) inch bore to a depth of 18 feet. A 6.25-inch steel surface casing was then grouted into the bore before drilling was continued using a six (6) inch bit. The functions of the surface casing were to:

(1) protect the bore from caving in the unconsolidated weathered zone
(2) seal off the well from infiltration derived from surface runoff

Shallow production of water (less than 40 feet) was observed in only four (4) of the seven (7) test bores at the time of drilling. In the other wells the only suggestion that a water table had been penetrated consisted of damp soil or shale. The yield from bore holes with depths of 40 feet or less was never observed to exceed 1.5 gallon per minute. However, after standing for 24 hours the static water level rose to within 10 feet of the surface in all completed wells. Subsequent pump tests of the wells indicated that the observed static levels were in equilibrium with the local water table. These results indicate that the permeability within the water table is very low.

The geologist's logs for each of the test wells are presented in Appendix D.

FIGURE 1:
KBI Test Wells



III. HYDROGEOLOGIC ANALYSIS

A. Hydraulic Gradient

Static water elevations were measured in each of the seven (7) test wells on October 14, 1985. A map of the piezometric (potentiometric) surface was generated from this information. The map indicates that ground water flow is generally eastward beneath the mausoleum vaults (Figure 2). However, a ground water divide has been identified which extends beneath bins 2 and 4. Ground water flow on the southeastern side of this divide is in a southerly or southwesterly direction toward test well KBI-3. The divide is believed to occupy a zone in which fracture permeability is less well developed than elsewhere at the site. The typical hydraulic gradient beneath the vaults is three (3) percent.

Based on the pattern of ground water flow inferred from the piezometric surface, five (5) test wells were selected to implement the monitoring system. These were test wells KBI-2, KBI-3, KBI-5, KBI-6, and KBI-7. Monitor wells installed at these locations represent the optimal five-point monitoring system. Potential leakage from any one of the bins should be intercepted by one of the four downgradient monitor wells. Figure 3 presents the installed monitoring grid. Note that the monitor wells have been renumbered.

B. Hydraulic Testing

Pumping analyses of the test wells were conducted on October 14, 1985. The investigation incorporated the pumping of test wells KBI-1, KBI-5, and KBI-6. A commercial electric submersible pump was used to provide a maximum steady discharge rate of 20 gallons per minute. Drawdown response of the pumped well, in addition to the surrounding wells, was recorded for each pumping test. The resulting data were interpreted using the Walton (1962) and Cooper- Jacob (1946) solutions to the transient radial confined flow equation. Analysis of pump test data collected from both pumped and observation wells results in estimated transmissivities which range between 0.004 and 0.02 [ft.]2/min. (Figures 4,5,6,7, and 8). The best estimate of the average

FIGURE 2:
KBI Test Wells

Showing piezometric surface
(determined from measurements taken Oct. 14, 1985)

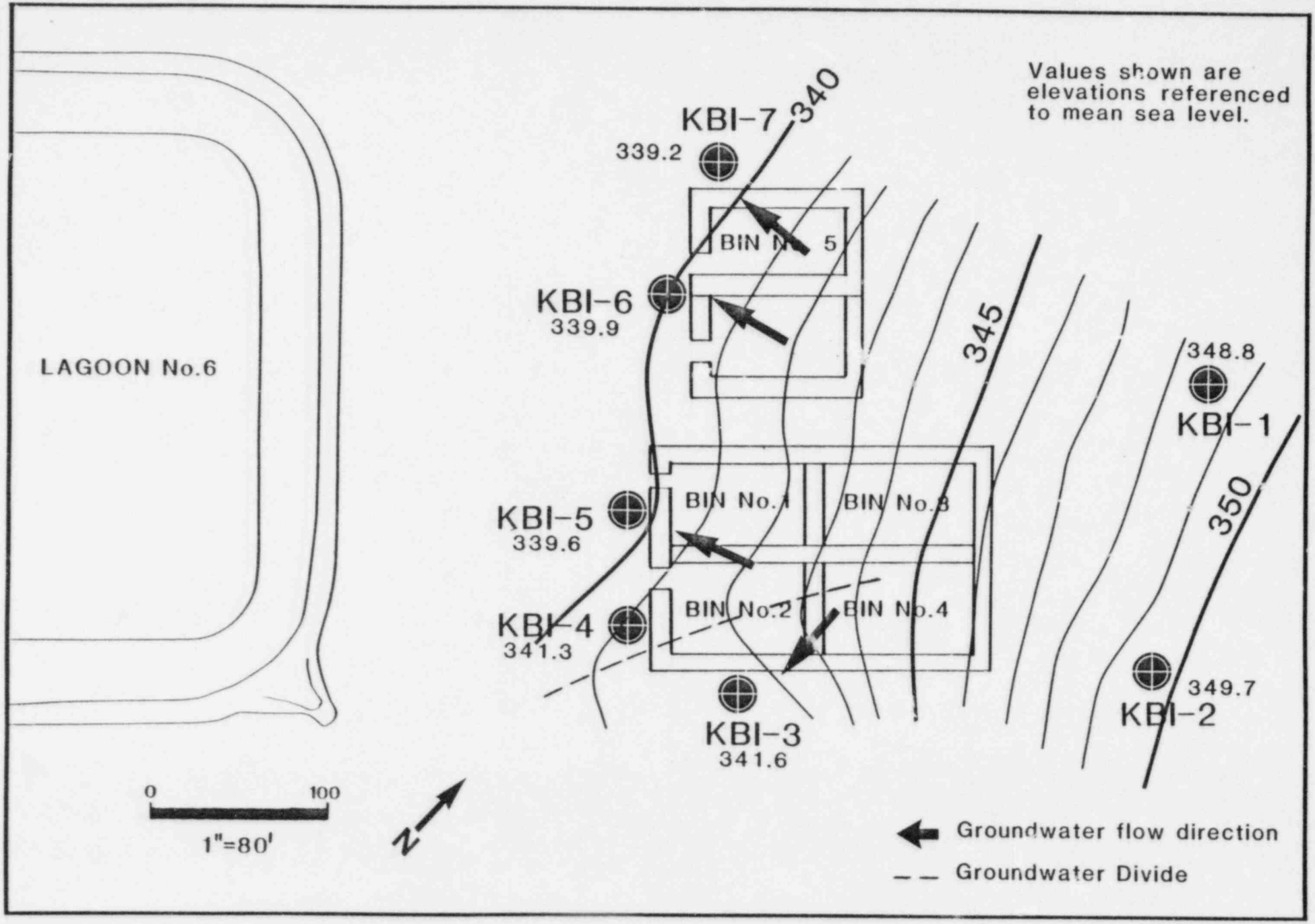


FIGURE 3:
KBI Monitor Wells

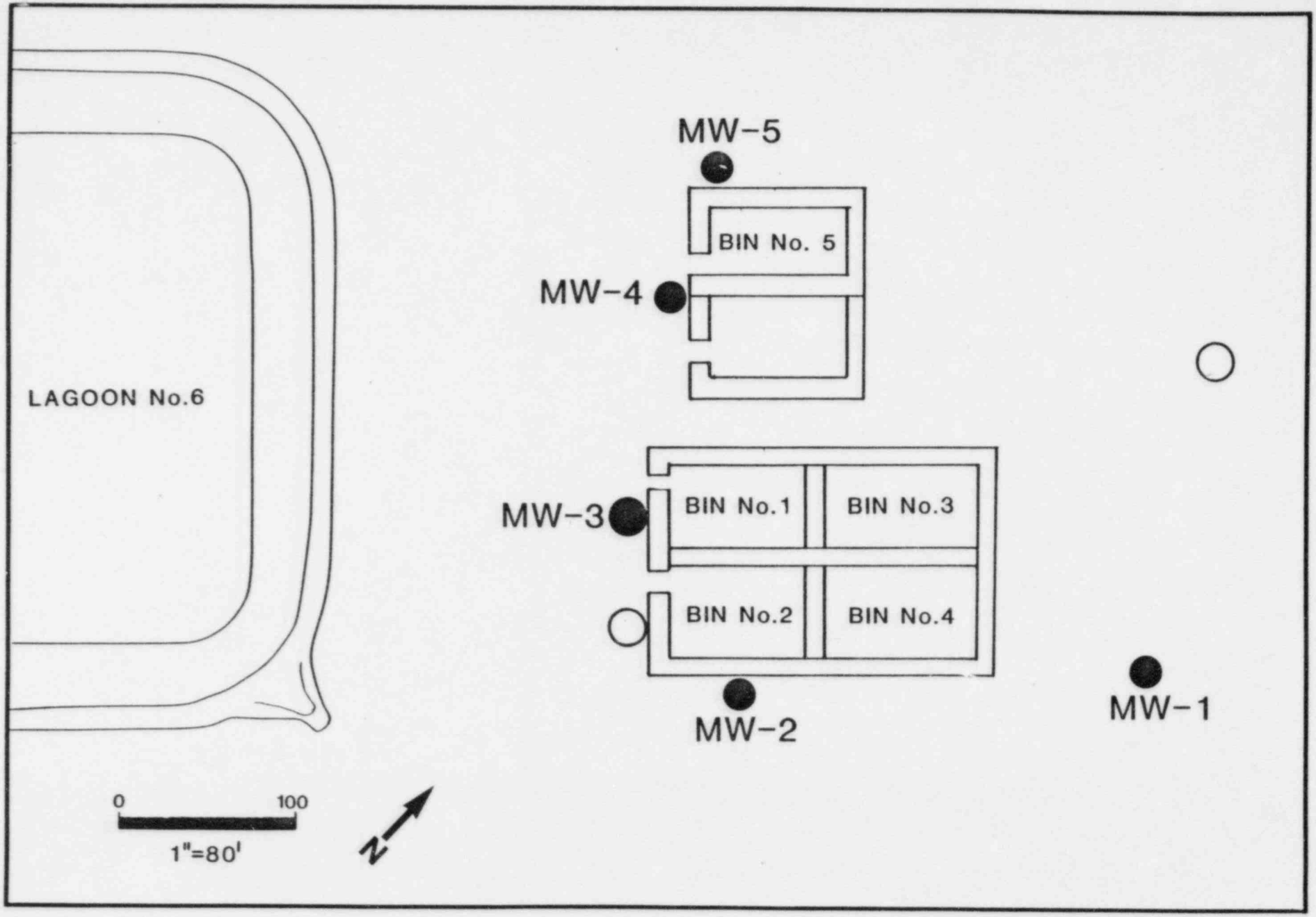


FIGURE 4:

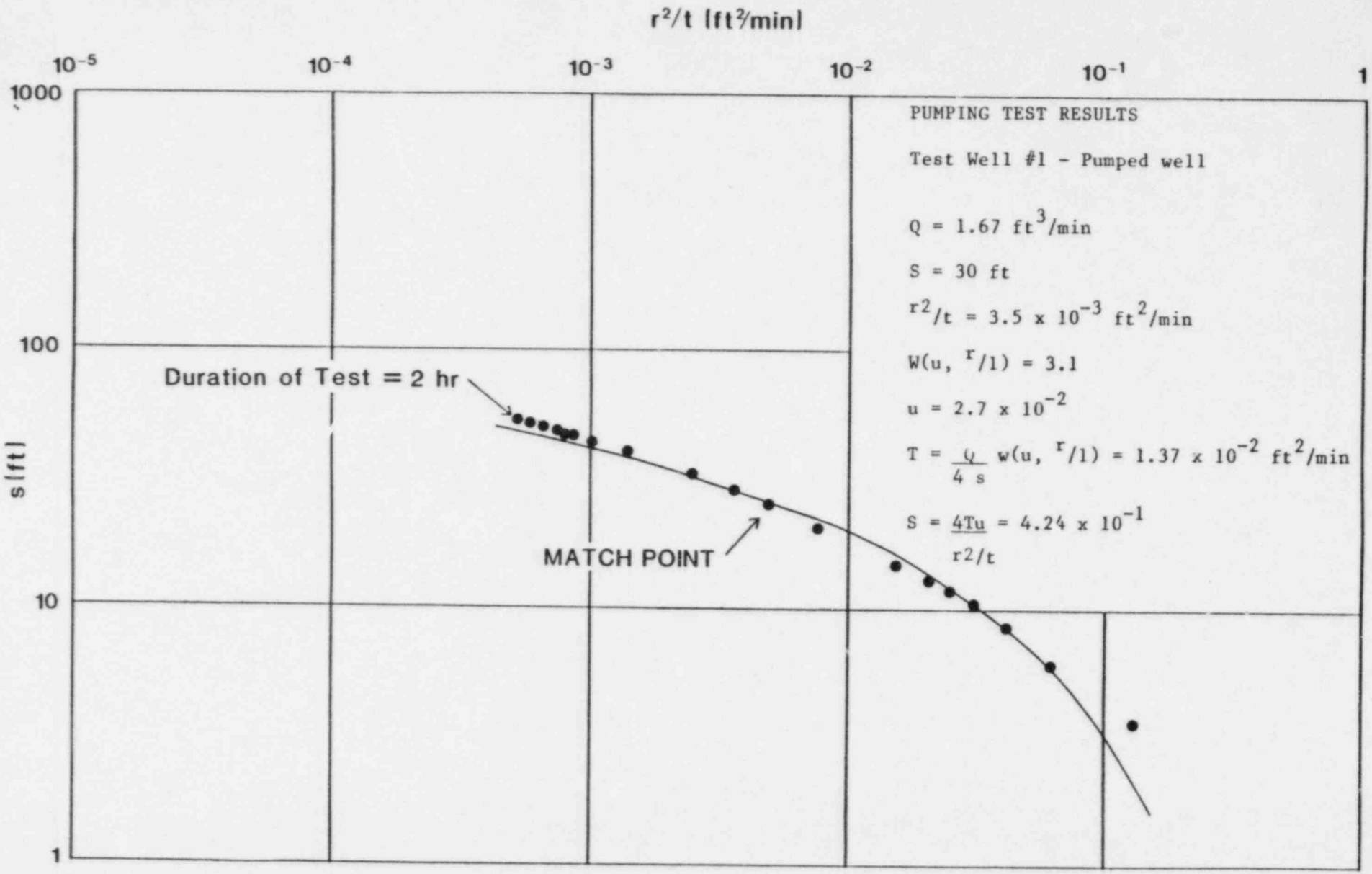

r²/t (ft²/min)
10⁻⁵
10⁻⁴
10⁻³
10⁻²
10⁻¹
1
1000
100
10
1
s (ft)
Duration of Test = 2 hr
MATCH POINT
PUMPING TEST RESULTS
Test Well #1 - Pumped well
Q = 1.67 ft³/min
S = 30 ft
r²/t = 3.5 x 10⁻³ ft²/min
W(u, r/1) = 3.1
u = 2.7 x 10⁻²
T = Q/4s w(u, r/1) = 1.37 x 10⁻² ft²/min
S = 4Tu/r²/t = 4.24 x 10⁻¹

FIGURE 5:

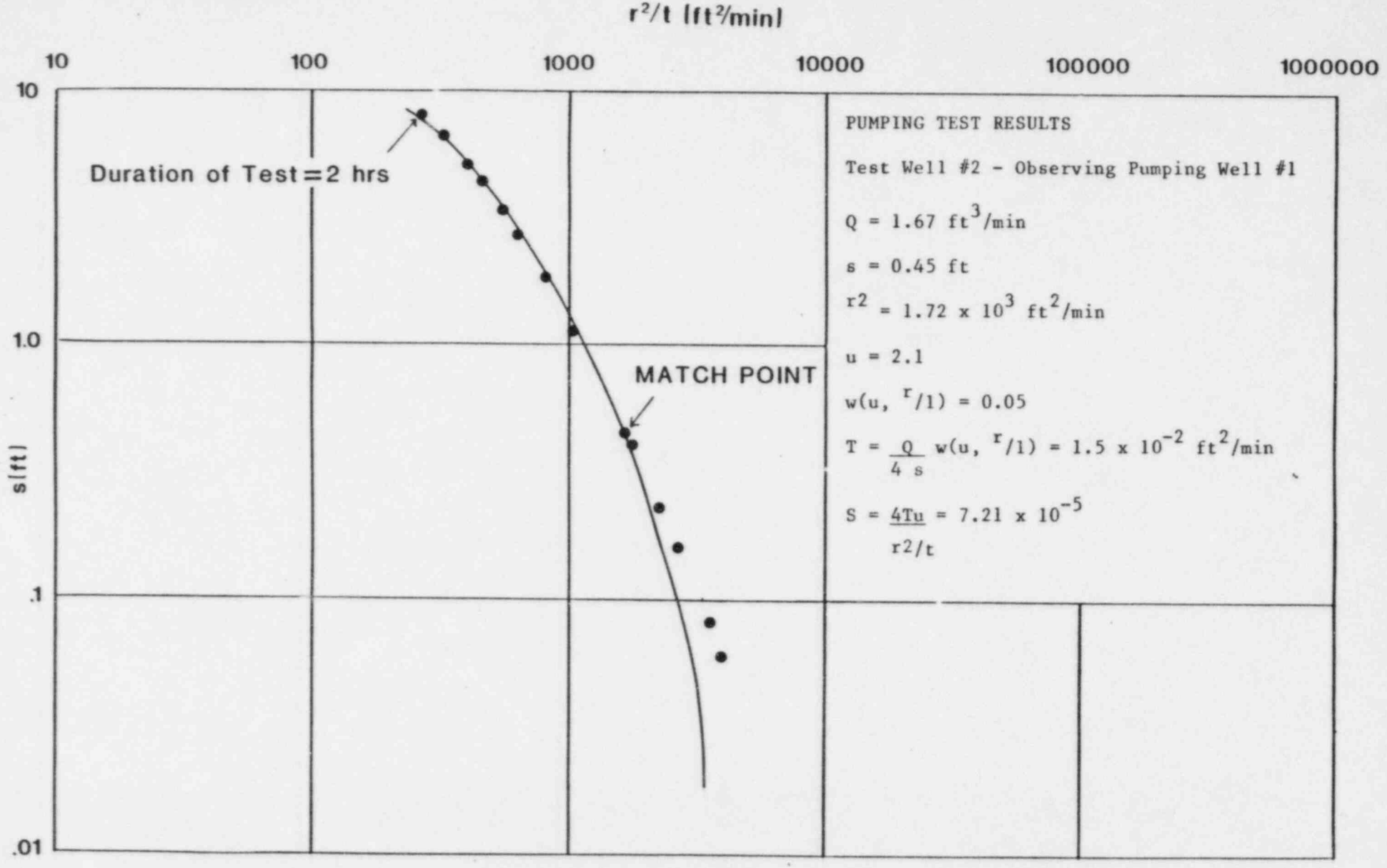

r²/t (ft²/min)
10
100
1000
10000
100000
1000000
10
1.0
.1
.01
s(ft)
Duration of Test = 2 hrs
MATCH POINT
PUMPING TEST RESULTS
Test Well #2 - Observing Pumping Well #1
Q = 1.67 ft³/min
s = 0.45 ft
r2 = 1.72 x 10³ ft²/min
u = 2.1
w(u, r/1) = 0.05
T = Q/4s w(u, r/1) = 1.5 x 10⁻² ft²/min
S = 4Tu/r2/t = 7.21 x 10⁻⁵

FIGURE 6:

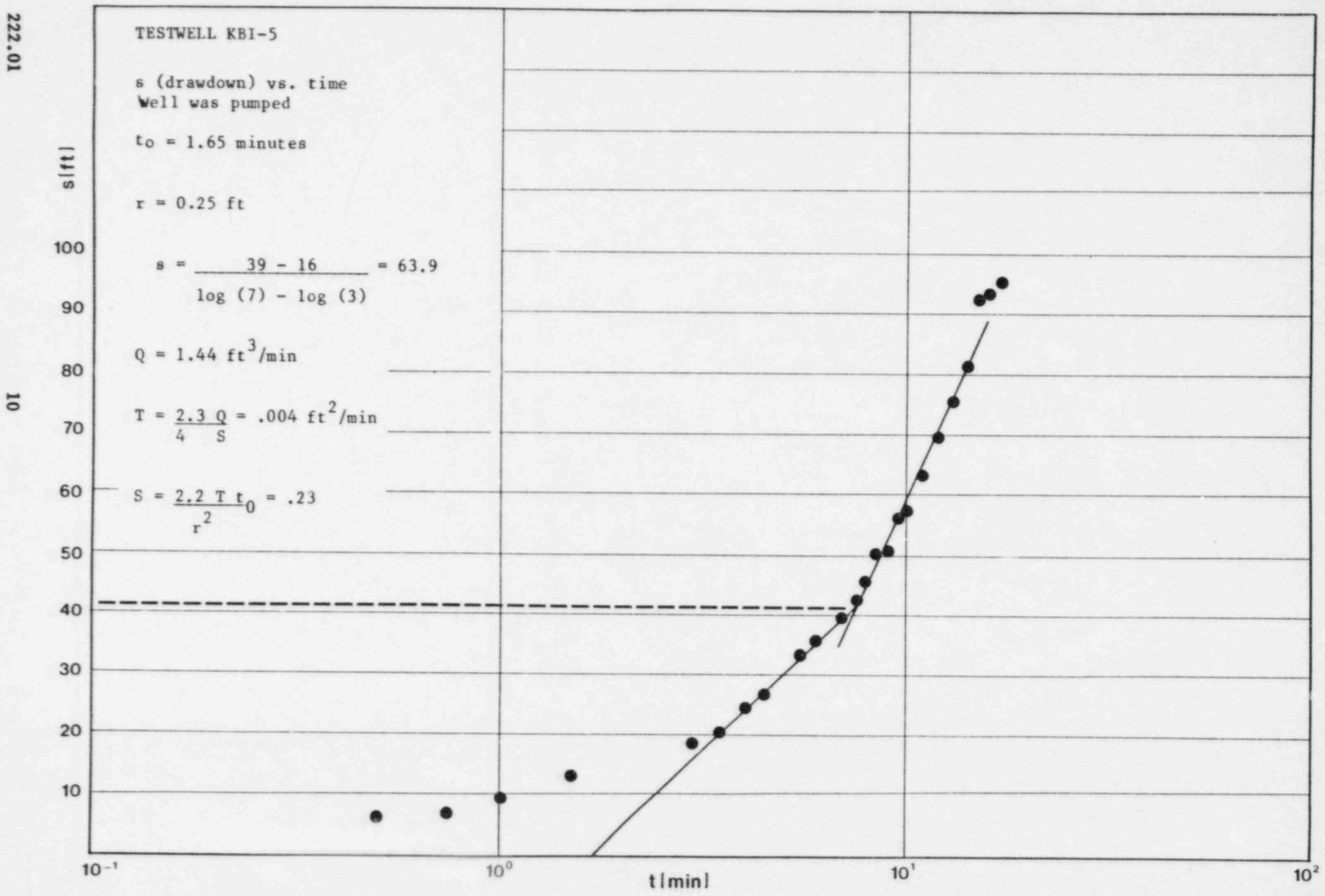

222.01
10
TESTWELL KBI-5
s (drawdown) vs. time
Well was pumped
t_o = 1.65 minutes
r = 0.25 ft
$s = \frac{39 - 16}{\log (7) - \log (3)} = 63.9$
Q = 1.44 ft^3/min
$T = \frac{2.3\ Q}{4\ S} = .004\ ft^2/min$
$S = \frac{2.2\ T\ t_0}{r^2} = .23$
s(ft)
100
90
80
70
60
50
40
30
20
10
10^{-1}
10^0
10^1
10^2
t[min]

FIGURE 7:

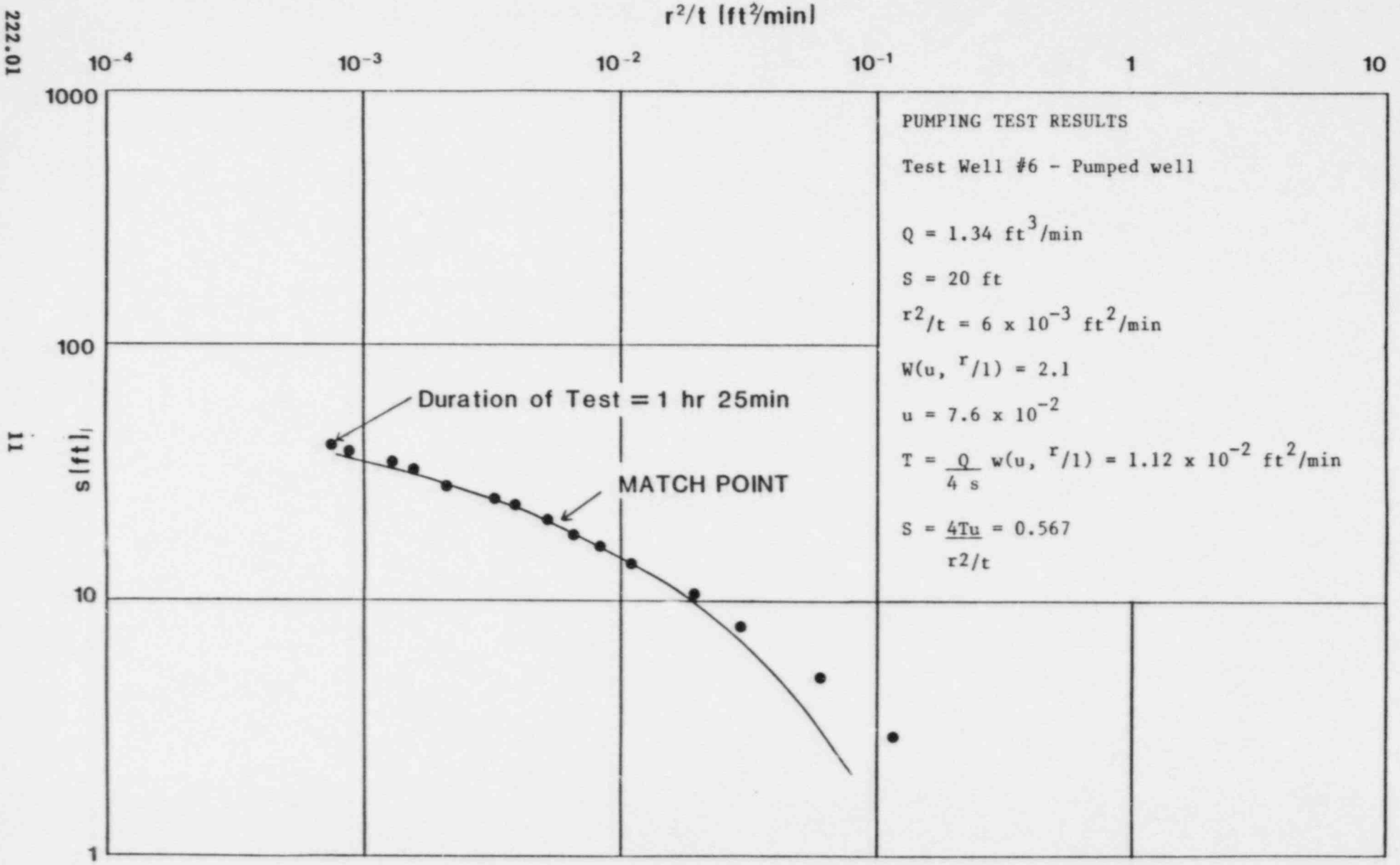
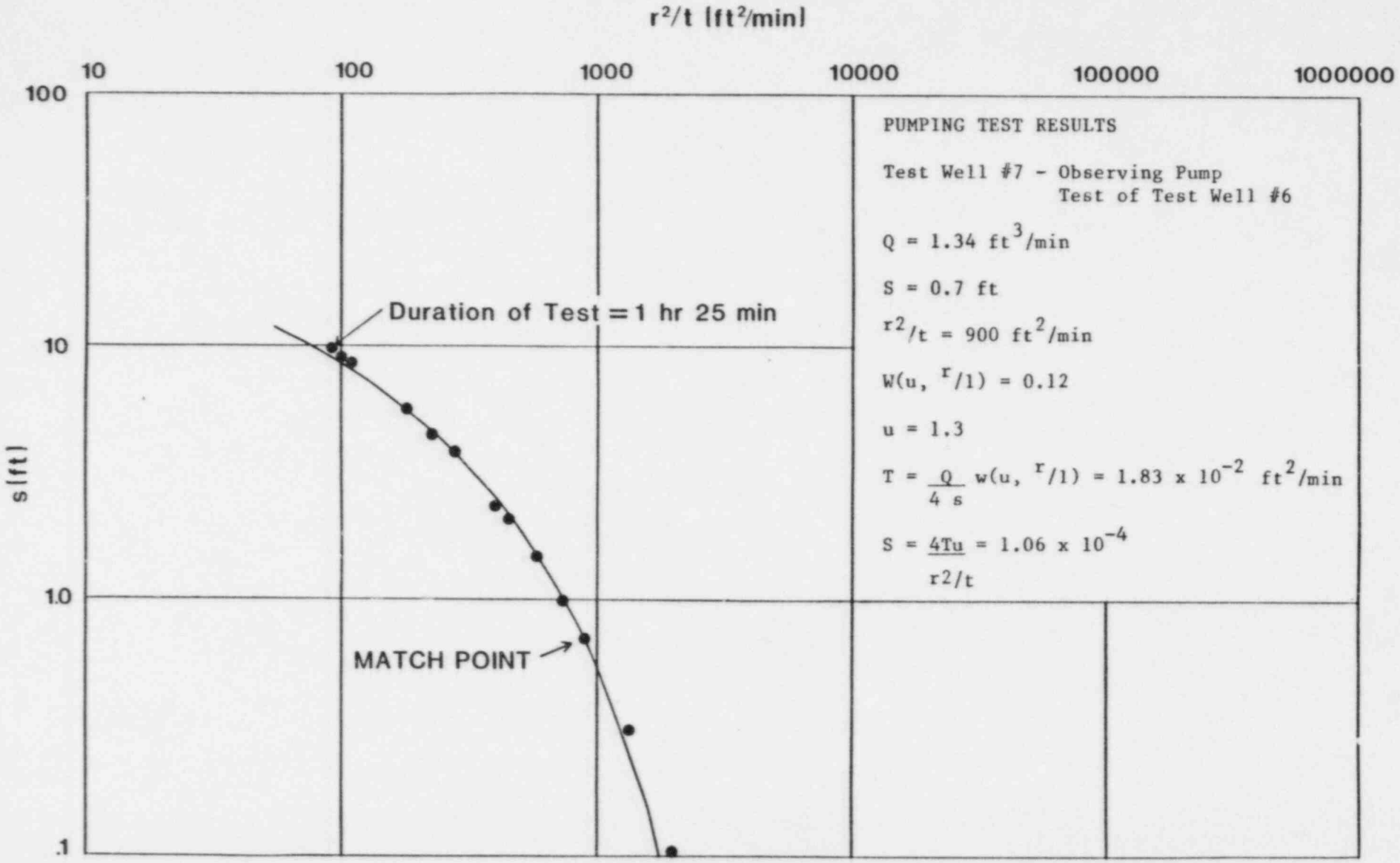

222.01
r²/t (ft²/min)
10⁻⁴
10⁻³
10⁻²
10⁻¹
1
10
1000
100
10
1
s (ft)
Duration of Test = 1 hr 25min
MATCH POINT
PUMPING TEST RESULTS
Test Well #6 - Pumped well
Q = 1.34 ft³/min
S = 20 ft
r²/t = 6 x 10⁻³ ft²/min
W(u, r/1) = 2.1
u = 7.6 x 10⁻²
T = Q/4s w(u, r/1) = 1.12 x 10⁻² ft²/min
S = 4Tu/r²/t = 0.567

FIGURE 8:


r²/t (ft²/min)
10
100
1000
10000
100000
1000000
100
10
1.0
.1
s (ft)
Duration of Test = 1 hr 25 min
MATCH POINT
PUMPING TEST RESULTS
Test Well #7 - Observing Pump
Test of Test Well #6
Q = 1.34 ft³/min
S = 0.7 ft
r²/t = 900 ft²/min
W(u, r/1) = 0.12
u = 1.3
T = Q/4s w(u, r/1) = 1.83 x 10⁻² ft²/min
S = 4Tu/r²/t = 1.06 x 10⁻⁴

transmissivity of the aquifer is 0.02 [ft.]2/min. (220 gallon/minute/day) which was derived from data collected from observation wells KBI-2 and KBI-7. The associated average Darcy permeability is 0.3 ft./day for the penetrated aquifer.

The response of the test wells to pumping suggests that the observed transmissivity is due primarily to fractures in bedrock. The importance of fracture porosity is illustrated best by the drawdown response of well KBI-5 (Figure 6). The drawdown rate abruptly steepened in this well as the drawdown dropped below 42 feet. This discontinuity has been interpreted as resulting from the water level in the well falling below a major water bearing fracture which penetrates the well at about 40. Well KBI-5, together with wells KBI-3 and KBI-4, appears to lie in a zone in which fractures are sparsely distributed. Wells in this zone are poorly connected hydraulically.

Storage coefficients measured at **observation wells** range between 0.00007 and .0001. This result indicates that ground water movement is almost exclusively through confined fractures. However, large storage coefficients (0.2 to 0.6) measured at **pumped wells** indicate that the fractures intersected by these wells are directly connected to the water table. The aquifer can be interpreted as consisting of a semi-confined fractured bedrock system which is overlain by a water table.

The water table occupies the shallow weathered zone which is developed in this area to a depth of less than 20 feet. The weathered zone has significantly lower permeability than the fractured bedrock and, for this reason, is not important as a pathway of horizontal ground water movement. Ground water migration velocities in the water table are believed to be negligible compared to velocities in the semi-confined system which occupies the bedrock. However, the water table provides recharge to the underlying fractured rock system. This interpretation is consistent with the results of other investigations of the Brunswick aquifer (Pendleton, 1969).

The fracture porosity of the bedrock was not measured directly at the site. However, published literature on the Brunswick Formation indicates that a porosity of 0.05 is typical (USGS Open-File No. 80-1295). The velocity of ground water movement in the fractured bedrock beneath the vaults can be estimated on the basis of this porosity value, the measured Darcy permeability, and the observed piezometric gradient. The resulting velocity is:

$$[0.03 \times 0.3 \text{ ft./day}] / 0.05 = 0.2 \text{ ft./day}$$

Based on this velocity it should take less than four (4) years for a leak under one of the bins to be detected by one of the monitor wells.

IV. MONITOR WELL INSTALLATION

A. Objectives

From October 21 through 25, 1985, monitor installations were completed in five of the seven test wells. These were wells KBI-2, KBI-3, KBI-5, KBI-6, and KBI-7. The installations consisted of flush threaded two-inch (internal diameter) polyvinyl chloride (PVC) casings and screens in which dedicated sampling pumps were suspended. The pumps were intended as a permanent part of the monitor well installations. In this way the potential for cross-contamination between the wells is virtually eliminated. Furthermore, the pumps are conveniently operated by a lightweight portable compressor and controller.

The installations provided approximately 55 feet of penetration in each well extending downward from the bottom of the outer steel casing. The upper 20 feet of each well is sealed with the grouted steel casing to prevent infiltration of surface runoff into the well. The effective penetration of the wells was shortened from 80 feet to 55 feet by installing a bentonite seal beneath the well screen. This was done to enhance recharge of the wells from the shallow water table during purging and sampling.

The monitor wells utilize a filter pack of washed Ottowa sand (20-40 mesh) in conjunction with slotted PVC screens with a slot width of 0.010 inch. The pack and screen combination is inert with respect to materials suspected of being present. Furthermore it will prevent "silting up" of the casing by clays and silt derived from the formation. The sand, gravel, and bentonite used in the construction of the monitor wells were tamped as they were emplaced to enhance compaction and prevent any subsequent settling of the sand pack.

The monitor wells are intended to accomplish two functions. These are:

(1) intercept ground water migrating from the site in the fractured rock system (approximately 20-75 feet)

(2) induce recharge to the well from the water table during purging and sampling of the well (approximately 10-20 feet)

B. Construction

The construction of all wells was similar. Each well was gravel packed to within 80 feet of the surface. The gravel consisted of well graded crushed granite gneiss. A grain size analysis of the gravel is provided in Appendix C. The gravel was tamped to enhance compaction, after which a layer of ottowa sand was emplaced and tamped. A bentonite seal of at least one (1) foot thickness was then emplaced using bentonite pellets and tamped. Ottowa sand was added to create a layer of at least one (1) foot thickness before the screen and casings were inserted into the hole. Thirty (30) feet of screen with a slot opening of 0.010 inch was installed in each monitor well. Ottowa sand was then added to within 23 feet of the surface. The sand was tamped as it was added to enhance compaction and to insure proper centering of the screen. A bentonite seal was then emplaced and tamped. Seals were a minimum of three (3) feet in thickness. Bentonite pellets were added as needed to insure that the seal extended inside the outer steel casing. A layer of gravel was added to protect the completed seal. Cement grout was then pumped onto the steel casing using a treme tube until the grout reached above the ground surface.

The sampling pumps were assembled and suspended in the PVC casings. The pumps were fabricated from PVC with the exception of the pressure and sample delivery tubes, which were constructed of high density polyethylene (HDPE). The pumps are accessed through a removable PVC utility cap. The pump assembly is protected by a locking metal cap which is attached to the outer steel casing. With the exception of MW-5 all pumps are set six (6) inches off the bottom of the screen cap. The pump in MW-5 is 62 inches above the screen cap.

Detailed well construction diagrams are provided for each monitor well in Appendix B.

V. SAMPLING METHODOLOGY

A. Monitoring Equipment

1. Description.

a. Pump and Sampling Equipment: The ground water monitoring system is equipped with a dedicated well purging and sampling system manufactured by Q.E.D. Environmental Systems, Inc. The bladder pumps are pneumatically actuated by a compressor and a time sequence controller which is connected to the well at the surface. The pump pressurization system is completely closed and is isolated from the water in the well and from samples being collected. Operation of the pump will not result in degassing of the sample due to lowered pressures in the pump or delivery tubing. Following the removal of an appropriate purging volume the sample may be discharged directly into previously prepared sample vessels. The pumps are set approximately six (6) inches above the bottom of the screened interval in each well. Under the conditions prevailing at the wells, the pumps should have a discharge capacity of 0.9 gallon per minute (GPM).

b. Water Level Probe: As provided to KBI, the monitor wells are provided with a port to insert an electrical conductance type water level probe (orange cap plug). RGH recommends the use of a battery operated electrical probe which uses a simple two-electrode water sensor. A visual or audible current indicator may be provided.

If KBI chooses, the wells may be fitted at a later date with an air line water level sensor. Compatible sensors are available from manufacturers of the sampling system as well as from independent vendors. Air line sensors can be operated with compressed air provided from the same compressor-controller equipment used to operate the pumps. This water level sensing method has the advantage that the air line tubing can be permanently installed in the wells, avoiding the need to introduce any equipment into the well.

2. Equipment Maintenance. The water level probe and any other equipment which may come in contact with water in the well or with samples should be stored in a clean, dry, protected area. Ideally this equipment should be enclosed in clean plastic bags. Before use this equipment should be rinsed thoroughly with tap water followed by a distilled water rinse. Under normal use it should not be necessary to wash sampling equipment with detergent. However, in the event that a water level probe or other equipment becomes fouled, it should be washed thoroughly with a strong alkaline detergent (e.g., Alconox or Liquinox). The probe should never be allowed to contact the ground.

A field-ready assemblage of sampling equipment should be maintained. A list of required equipment follows:

Plastic disposable gloves
Essential tools (for adjustments to the compressor, probe, etc.)
Tape measure (five (5) feet or longer)
Plastic sheeting
Chain-of-custody forms
Log book
Distilled or deionized water
Discharge tube extension (2)
Water level probe
Compressor and time sequence controller
5-gallon bucket

B. Preparation of the Well for Sampling

1. Initial Water Level Measurements. Prior to purging, sampling, or otherwise disturbing the well several preliminary measurements should be made. These are:

(1) Check the well for aboveground damage
(2) Measure the depth to ground water (static water level)

The upgradient well should be probed first. The remaining wells should be probed in order of ascending expected concentration. Consult the previous period's laboratory results to determine the concentrations of fluoride and gross alpha and beta concentrations in each well.

Before lowering the probe into the well, the circuitry can be checked by dipping the probe into a bucket of water and observing the indicator. Some water level probes also have self-check functions built into them. The probe should be lowered slowly into the well until the contact with the water surface is indicated. The electrical tape should be marked at the measuring point (top of the outer protective casing) and partly withdrawn. The distance from the mark to the nearest tape band is measured and added to (or subtracted from) the band reading to obtain the depth to water. Additional measurements should be made until two sequential measurements agree to within one-half inch (0.04 feet).

The volume of water standing in the casing can then be calculated for each well. A satisfactory estimate can be obtained by subtracting the depth to water (measured from the top of the outer protective casing) from 80 feet (the maximum depth of the monitor wells) and multiplying by 0.163 gallons per foot of standing water. The quantity of water which must be removed from each well is three times this quantity or 0.490 gallons per foot of standing water.

The probe wire should never be allowed to rest on the ground. We recommend spreading a plastic sheet next to the well casing for the probe housing to rest on while measurements are being made.

C. Sampling Protocol

1. Laboratory Tests. Three (3) tests should be run on samples collected from the monitoring network. These are:

(1) fluoride ion [ion selective electrode: EPA Method 340.2]
(2) pH [electrometric: EPA Method 150.1]
(3) gross alpha and beta [EPA Method 900.0, Publication 600/4-80-032, August 1980]

The laboratory should be given instructions to hold any sample in which alpha radiation exceeds 2 pica curies per liter (PCL). KBI may then elect to have the samples run for specific radionuclides including Radium 226 (EPA Method 903.0) and Radium 228 (EPA Method 9C4.0).

2. Containers and Preservation. One week prior to each sampling round (but not more than one month before) KBI should have the appropriately prepared and labeled sample vessels delivered by the participating laboratory. Six sets of containers are required, one for each monitor well plus one field blank. Each sample set consists of:

(1) One-half (0.5) gallon polyethylene bottle with sufficient nitric acid reagent added to acidify the sample to pH 2.
(2) 250 milliliter (ML) polyethylene bottle with no preservative added.

The laboratory will use the one-half gallon container to determine gross alpha and beta radiation. Fluoride ion and pH will be measured in samples collected in the 250 ML vessel.

3. Purging. After the static water levels have been measured at each of the wells they may be purged and sampled. The upgradient well should be sampled first. The remaining wells should be sampled in order of ascending expected concentration. Consult the previous period's laboratory results to determine the concentrations of fluoride and the gross alpha and beta concentrations in each well.

Before withdrawing a sample, a volume of water should be removed from the well equal to at least three times the volume of standing water in the well. This volume should have been calculated immediately following the measurement of static water levels. In some instances the transmissivity of a well may be so low that pumping completely dewaters the well before three standing volumes can be removed. When this occurs, the well may sampled immediately after it recovers to 90 percent of the initial static water column height.

The well is purged by connecting the compressor and time sequence controller to the well head via the quick-connect pressure coupling. The discharge tube extension should be thoroughly rinsed with distilled or deionized water and attached to the sampling elbow connector. The discharge tube should be directed into a five-gallon bucket or other suitable container in order to measure the discharge rate of the pump. The required purge time can then be computed. It should take between 30 and 45 minutes for each well to be purged. During this time the sample containers can be labeled and the chain-of-custody forms completed.

4. Sample Collection. Immediately after the well has been properly purged the sample may be collected by directing the discharge tube into each of the two previously prepared sample vessels. The containers should be filled to the top but not overfilled. We recommend spreading a plastic sheet to provide a clean and dry working surface on which to rest the sample bottles and any sampling equipment. It is also good practice to wear disposable gloves while collecting the samples.

The filled sample containers should be placed inside plastic bags to protect them from moisture and packaged into a picnic cooler containing ice. If possible the samples should be delivered to the laboratory the same day of the sampling. If this cannot be done the samples should be refrigerated until they can be transported in a picnic cooler to the laboratory.

The sampling technician may wish to measure certain field parameters such as temperature, pH, or specific conductance at the time of sampling. The associated equipment can be organized on the plastic sheet as required.

5. Field Blanks. One field blank should be incorporated in each sample round. The purpose of the field blank is to verify the reliability of the laboratory results and to document the quality assurance of the field sampling program. The blank should be created by filling one set of sample containers with distilled or deionized water obtained from a chemical supply company or a reputable environmental laboratory. The sample should be created in the field under typical field conditions.

It is important that the field blank be labeled in such a manner that it cannot be distinguished by the laboratory. For purposes of this program the field blank will be identified as Monitor Well 6 on labels and chain-of-custody forms.

D. Chain-Of-Custody Documentation

A chain-of-custody document (Appendix A) should be completed for each sample. The form should be completely filled out. All individuals through whose possession the samples pass should sign the document and provide date and time of the custody transfer. This document is your insurance that the sample transportation, storage, and handling conforms to good environmental sampling practices. You should keep a copy of each chain-of-custody form after you deliver the sample to the laboratory. The laboratory should return the original with the sample results.

VI. RESULTS OF INITIAL SAMPLING ROUND

The initial sampling round was conducted on October 29, 1985 with William Ganin, representing KBI, in attendance. Samples were collected, packaged and delivered to the laboratory along with the appropriate documentation. The samples were submitted to the Spots, Stevens and McCoy (SSM) laboratory for analysis. The radiological samples were sent on by SSM to the NUS laboratory in Pittsburgh. The NUS lab was given instructions to hold any sample in which alpha radiation exceeded 2 pica curies per liter (PCL) and await further instructions from KBI.

RGH personnel measured pH and temperature of the water purged from the well in order to verify that the discharge had stabilized prior to collecting the samples. In all cases the discharge had stabilized prior to the removal of three (3) standing volumes of water from the wells. None of the wells were dewatered in the process of purging.

The laboratory reports for the samples are provided in Appendix C. The results are summarized below:

MONITOR WELL	FLUORIDE ION mg/L	GROSS ALPHA p.curie/L	GROSS BETA p.curie/L	pH field
1 (upgradient)	.36	< 5	14	7.8
2	.27	< 3	12	9.4
3	.23	< 4	6.1	7.4
4	.58	< 3	5.3	8.0
5	.34	< 3	< 3	7.8
BLANK	<.02	< 3	< 3	*NM

*NM: not measured

The variations in fluoride concentration and gross alpha and beta radioactivity noted above are not considered significant. The existing data indicates that no deterioration of ground water quality related to the mausoleum vaults has occurred.

The pH values are uncharacteristically high for the Brunswick aquifer. The pH is believed to have been influenced by cement used in the construction of the monitor wells. After the cement is fully cured the pH of the water is expected to return to more typical levels.

The high detection limit for the gross alpha analyses (3-5 pica curies per liter) is due to matrix effects in the sample. No practical method for improving the sensitivity of the test is available.

The distribution of gross beta activity among the samples appears to be random, with the highest activity reported for the upgradient well. The gross beta activity in all wells is within levels recommended in the EPA's National Primary Drinking Water Standards (1976). Plausible sources of the beta signature are isotopes of potassium and strontium associated with fertilizer and agricultural lime. This hypothesis is supported by the occurrence of the highest beta activity in those wells which are closest to the tilled field.

APPENDIX A

CHAIN-OF-CUSTODY FORM

CHAIN-OF-CUSTODY

KAWECKI BERYLCO INC.
COUNTY LINE ROAD
BOYERTOWN, PA. 19512
(215) 367 - 2181

PROJECT NAME _____
PROJECT NUMBER _____

DATE: _____ TIME: _____

MONITOR WELL _____ SAMPLED BY _____

DEPTH TO WATER SURFACE BELOW TOP OF CASING: _____ ft.

PURGE: 3 standing volumes (_____) volume purged _____ gal.

APPEARANCE OF SAMPLE (ie., turbidity) _____

FIELD PARAMETERS (optional): pH_____ T(C)_____ Sp. Cond. _____

SAMPLE SPLIT ? ___ YES ___ NO
WITH WHOM ? _____

CONTAINER NO.:	_____	_____
TYPE:	PE	PE
PRESERVATION:	NITRIC ACID	UNPRESERVED
VOLUME:	0.5 GALLON	250 ML
PARAMETERS ANALYZED:	1. GROSS ALPHA [EPA 900.0] 2. GROSS BETA [EPA 900.0]	1. pH [EPA 150.1] 2. FLUORIDE ION [EPA 340.2]

SPECIAL INSTRUCTIONS:
If gross alpha exceeds 2 pica curies per liter hold sample for possible determination of radium isotopes. Consult KBI (Bill Ganin, [215] 367-2181) for further instructions.

TRANSFER OF CUSTODY:

CONTAINERS:_____ RELINQUISHED BY: _____(signature)
TO:_____ _____(signature) DATE:_____TIME:_____

CONTAINERS:_____ RELINQUISHED BY: _____(signature)
TO:_____(signature) DATE:_____TIME:_____

CONTAINERS:_____ RELINQUISHED BY: _____(signature)
TO:_____(signature) DATE:_____TIME:_____

.....

CONTAINERS:_____ SHIPPED VIA COURIER:_____(name)
SHIPPERS REFERENCE NO. _____ SHIPPERS ACCOUNT NO._____
SHIPPED: DATE _____ TIME _____ BY _____(signature)
RECEIVED: DATE _____ TIME _____ BY _____(signature)

APPENDIX B

SAMPLING RECORD AND LABORATORY REPORTS

SSM
SPOTTS, STEVENS and McCOY, INC
ENGINEERS • PLANNERS • SCIENTISTS

CERTIFICATE OF ANALYSIS

CLIENT: RGH
1427 Vine St.
Philadelphia, PA 19102

DATE REPORTED: 12/18/85

SAMPLE NO: 46393-98

CONTACT PERSON: Charles Miller

DATE SAMPLED: 10/29/85

SAMPLE TYPE: Monitoring Well Water

DATE RECEIVED: 10/29/85

SAMPLED BY: CDM/EPR

ORDER NO

SAMPLE IDENTIFICATION: KBI Project No. 222.01
46393 - Monitoring Well #1&2
46394 - Monitoring Well #3&4
46395 - Monitoring Well #5&6
46396 - Monitoring Well #7&8
46397 - Monitoring Well #9&10
46398 - Monitoring Well #11&12

- - - - - - - - -

COMPLETED REPORT

Lab. No.		46393	46394	46395
Gross Alpha (EPA 900.0)	pCi/L	< 5	< 3	< 4
Gross Beta (EPA 900.0)	pCi/L	14 ± 3	12 ± 2	6.1 ± 2.5
pH (EPA 150.1)		7.8	8.6	7.6
Fluoride (EPA 340.2)	mg/L F^-	0.360	0.274	0.230

Lab. No.		46396	46397	46398
Gross Alphs (EPA 900.0)	pCi/L	< 3	< 3	< 3
Gross Beta (EPA 900.0)	pCi/L	5.3 ± 2.4	< 3	< 3
pH (EPA 150.1)		8.0	8.0	8.0
Fluoride (EPA 340.2)	mg/L F^-	0.580	0.336	<0.020

Respectfully submitted,

R. M. Large, Program Supervisor
Chemistry Laboratory

MAH
cc: Charles Miller

REPLY TO:

☐ HOME OFFICE
345 N. Wyomissing Blvd.,
P.O. Box 6307
Reading, PA 19610-0307
(215) 376-6581

☐ INDUSTRIAL HYGIENE LABORATORY
345 N. Wyomissing Blvd.,
P.O. Box 6307
Reading, PA 19610-0307
(215) 376-6581

☐ CHEMISTRY LABORATORY
30 Noble Street,
P.O. Box 6527,
Reading, PA 19611-0527
(215) 376-4595

☐ LEHIGH VALLEY OFFICE
R.D.#6, Box 347,
Blakeslee Boulevard,
Lehighton, PA 18235-8751
(215) 377-5210

☐ BALTIMORE OFFICE
698 Fairmount Avenue
Suite 105
Towson, MD 21204-2819
(301) 494-0500

SSM
SPOTTS, STEVENS and McCOY, INC.
ENGINEERS • PLANNERS • SCIENTISTS

CERTIFICATE OF ANALYSIS

CLIENT: RGH
1427 Vine St.
Philadelphia, PA 19102

CONTACT PERSON: Charles Miller

SAMPLE TYPE: Soil

SAMPLED BY: CDM

SAMPLE IDENTIFICATION: KBI-1

DATE REPORTED: 12/18/85

SAMPLE NO: 46322

DATE SAMPLED: 10/29/85, 9:30 AM

DATE RECEIVED: 10/29/85, 9:30 AM

ORDER NO

- - - - - - - -

SIEVE ANALYSIS

% retained on US No. 4 Mesh	4.0
% retained on US No. 10 Mesh	39.2
% retained on US No. 20 Mesh	23.0
% retained on US No. 50 Mesh	13.8
% retained on US No.100 Mesh	6.6
% retained on US No.200 Mesh	4.2
% passing US No.200 Mesh	9.2

Respectfully submitted,

R. M. Large, Program Supervisor
Chemistry Laboratory

MAH

cc: Charles Miller

REPLY TO:

☐ HOME OFFICE
345 N. Wyomissing Blvd.,
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Blakeslee Boulevard,
Lehighton, PA 18235-8751
(215) 377-5210

☐ BALTIMORE OFFICE
698 Fairmount Avenue
Suite 105
Towson, MD 21204-2819
(301) 494-0500

CHAIN-OF-CUSTODY

PROJECT NAME KBI
PROJECT NUMBER 222.01
DATE: 10/29/85 TIME: 12:45P

RGH
1427 VINE ST.
PHILA., PA. 19102
(215) 563-4226

Field pH = 7.8
Temp. = 12.0°C

MONITOR WELL 1

DEPTH TO WATER SURFACE BELOW TOP OF CASING 5'-1/2"

VOLUME PURGED (37 gal) 40 gallons

APPEARANCE OF SAMPLE (ex.: turbidity) slightly turbid (gray)

SAMPLE FILTERED? ___ YES X NO
WATER WHICH?

WELL SAMPLED BY: COM/EPR

SAMPLE CONTAINER NO.:	1	2
TYPE:	PE	PE
PRESERVATION:	NITRIC ACID	UNPRESERVED
VOLUME:	0.5 GALLON	250 ML
PARAMETERS ANALYSED:	1. GROSS ALPHA (EPA 900.0) 2. GROSS BETA (EPA 900.0)	1. pH (EPA 150.1) 2. FLUORIDE ION (EPA 340.2)

SPECIAL INSTRUCTIONS: If gross alpha exceeds 2 pico curies per liter hold sample for possible determination of radium isotopes. Consult RGH (Bill Gavin, (215) 563-4181) for further instructions.

TRANSFER OF CUSTODY:

SAMPLE: 1 & 2 RELINQUISHED BY: Charles D Nalle (signature)
TO: A. J. M. (signature) DATE: 10-29-85 TIME: 6.00 P

SAMPLE: 1 & 2 RELINQUISHED BY: A. J. M. (signature)
TO: K. M. Jang (signature) DATE: 10/30/85 TIME: 8:30 A

SAMPLE: 1 RELINQUISHED BY: K. M. Jang (signature)
TO: U.P.S (signature) DATE: 10/30/85 TIME: 3:30 P

SAMPLE: 1 RELINQUISHED BY: UPS (signature)
TO: _____ (signature) DATE: _____ TIME: _____

SAMPLE: 2 miles RELINQUISHED BY: _____ (signature)
TO: _____ (signature) DATE: _____ TIME: _____

SAMPLE: _____ RELINQUISHED BY: _____ (signature)
TO: _____ (signature) DATE: _____ TIME: _____

CHAIN-OF-CUSTODY

RGH
1427 Vine St.
Phila, Pa. 19102
(215) 563-4220

PROJECT NAME: KBI
PROJECT NUMBER: 222.01

DATE: 10/29/85 TIME: 1:55P

MONITOR WELL 2

DEPTH TO WATER SURFACE BELOW TOP OF CASING: 8'-6½"

VOLUME PURGED: (36 gal) 40 gal

APPEARANCE OF SAMPLE (i.e., turbidity): clear @ most gray sediment

SAMPLE SPLIT: ___ EE X

WATER WHEN ?

WELL SAMPLED BY: COM/EPR

pH = 9.4
T = 13°C

SAMPLE CONTAINER NO.:	3	4
TYPE:	PE	PE
PRESERVATION:	NITRIC ACID	UNPRESERVED
VOLUME:	0.5 GALLON	250 ML
PARAMETERS ANALYSED:	1. GROSS ALPHA (EPA 900.0) 2. GROSS BETA (EPA 900.0)	1. pH (EPA 150.1) 2. FLUORIDE ION (EPA 340.2)

SPECIAL INSTRUCTIONS: If gross alpha exceeds 2 pico curies per liter acid sample for possible determination of radium isotopes. Consult KBI (Bill Gamin, (215) 367-2161) for further instructions.

TRANSFER OF CUSTODY:

SAMPLE: 3&4 RELINQUISHED BY: Charles D. Miller (signature)
TO: a.j.m (signature) DATE: 10-29-85 TIME: 6.00 P

SAMPLE: 3 & 4 RELINQUISHED BY: a.j.m (signature)
TO: ~~R.M.~~ Jan (signature) DATE: ~~10/30/85~~ TIME: 8:30 A

SAMPLE: 3 RELINQUISHED BY: R.M. Jan (signature)
TO: UPS (signature) DATE: ~~10/30/85~~ TIME: 3:30 P

SAMPLE: 3 RELINQUISHED BY: UPS (signature)
TO: _____ (signature) DATE: _____ TIME: _____

SAMPLE: 2 Miller RELINQUISHED BY: _____ (signature)
TO: _____ (signature) DATE: _____ TIME: _____

SAMPLE: _____ RELINQUISHED BY: _____ (signature)
TO: _____ (signature) DATE: _____ TIME: _____

RGH
1427 VINE ST
PHILA. PA 19102
(215) 563-4220

CHAIN-OF-CUSTODY:

PROJECT NAME: KBI
PROJECT NUMBER: 222.01

DATE: 10/29/85 TIME: 3:00P

MONITOR WELL: 3

DEPTH TO WATER SURFACE BELOW TOP OF CASING: 7'-2½"

VOLUME PURGED: (37gal) 40 gallons

APPEARANCE OF SAMPLE (i.e., turbidity): V. slightly turbid

Field pH = 7.35
T = 12.8

SAMPLE SPLIT WITH WHOM: ___ YES X NO

WELL SAMPLED BY: CDM/EPR

SAMPLE CONTAINER NO.:	5	6
TYPE:	PE	PE
PRESERVATION:	NITRIC ACID	UNPRESERVED
VOLUME:	0.5 GALLON	250 ML
PARAMETERS ANALYSED:	1. GROSS ALPHA (EPA 900.0) 2. GROSS BETA (EPA 900.0)	1. pH (EPA 150.1) 2. FLUORIDE ION (EPA 340.2)

SPECIAL INSTRUCTIONS: If gross alpha exceeds 2 pico curies per liter hold sample for possible determination of radium isotopes. Consult KBI (Bill Gavin, (215) 367-2191) for further instructions.

TRANSFER OF CUSTODY:

SAMPLE: 5&6 RELINQUISHED BY: Claude D. Miller (signature)
TO: G.J.M. (signature) DATE: 10-29-85 TIME: 6.00 P

SAMPLE: 5&6 RELINQUISHED BY: G.J.M.
TO: K.M. Jange (signature) DATE: 10/30/85 TIME: 8:30 A

SAMPLE: 5 RELINQUISHED BY: K.M. Jange
TO: UPS (signature) DATE: 10/30/85 TIME: 3:30 P

SAMPLE: 5 RELINQUISHED BY: UPS
TO: _____ (signature) DATE: _____ TIME: _____

SAMPLE: C. Miller RELINQUISHED BY: _____
TO: _____ (signature) DATE: _____ TIME: _____

SAMPLE: _____ RELINQUISHED BY: _____
TO: _____ (signature) DATE: _____ TIME: _____

CHAIN-OF-CUSTODY

RGH
1427 VINE ST
PHILA PA 19102
(215) 563-4220

PROJECT NAME KBI
PROJECT NUMBER 222.01

DATE: 10/29/85 TIME: 4:05 P

MONITOR WELL 4

DEPTH TO WATER SURFACE BELOW TOP OF CASING 4' - 3½"

VOLUME PURGED (38 Gal) 40 gallons.

APPEARANCE OF SAMPLE (i.e., turbidity) clear @ slight tan cast

FIELD pH = 7.95
T = 13°C

SAMPLE SPLIT WITH ANOTHER: ___ YES X NO

WELL SAMPLED BY: CDM / EPA

SAMPLE CONTAINER NO.:	7	8
TYPE:	PE	PE
PRESERVATION:	NITRIC ACID	UNPRESERVED
VOLUME:	0.5 GALLON	250 ML
PARAMETERS ANALYSED:	1. GROSS ALPHA [EPA 900.0] 2. GROSS BETA [EPA 900.0]	1. pH [EPA 150.1] 2. FLUORIDE ION [EPA 340.2]

SPECIAL INSTRUCTIONS: If gross alpha exceeds 2 pico curies per liter hold sample for possible determination of radium isotopes. Consult KDI (Bill Gavin, (215) 367-2181) for further instructions.

TRANSFER OF CUSTODY:

SAMPLE: 7&8 RELINQUISHED BY: Claude D. Miller (signature)
TO: A.J.M. (signature) DATE: 10-29-85 TIME: 6:00 P

SAMPLE: 7&8 RELINQUISHED BY: A.J.M. (signature)
TO: M. Jans (signature) DATE: 10/30/85 TIME: 8:30 A

SAMPLE: 7 RELINQUISHED BY: M. Jans (signature)
TO: UPS (signature) DATE: 10/30/85 TIME: 3:30 P

SAMPLE: 7 RELINQUISHED BY: UPS (signature)
TO: _____ (signature) DATE: _____ TIME: _____

SAMPLE: C. Miller RELINQUISHED BY: _____ (signature)
TO: _____ (signature) DATE: _____ TIME: _____

SAMPLE: _____ RELINQUISHED BY: _____ (signature)
TO: _____ (signature) DATE: _____ TIME: _____

CHAIN-OF-CUSTODY

RGH
1427 VINE ST
PHILA PA 19102
(215) 563-4220

PROJECT NAME KBI

PROJECT NUMBER 222.01

DATE: 10/29/85 TIME: 5:05 P

MONITOR WELL 5

DEPTH TO WATER SURFACE BELOW TOP OF CASING 3' - 10½"

VOLUME PURGED (39 gal) 40 gallons

APPEARANCE OF SAMPLE (i.e., turbidity) clear

SAMPLE SPILT? ___ YES X NO
WITH WHOM?

WELL SAMPLED BY: COM/EPA

Flow
pH = 7.8
T = 12°C

	9	10
SAMPLE CONTAINER NO.:		
TYPE:	PE	PE
PRESERVATION:	NITRIC ACID	UNPRESERVED
VOLUME:	0.5 GALLON	250 ML
PARAMETERS ANALYSED:	1. GROSS ALPHA (EPA 900.0) 2. GROSS BETA (EPA 900.0)	1. pH (EPA 150.1) 2. FLUORIDE ION (EPA 340.2)

SPECIAL INSTRUCTIONS: If gross alpha exceeds 2 pico curies per liter acid sample for possible determination of radium isotopes. Consult KBI (Bill Gavin, (215) 367-2181) for further instructions.

TRANSFER OF CUSTODY:

SAMPLE: 9 & 10 RELINQUISHED BY: Charles D. Miller (signature)
TO: A.J.M. (signature) DATE: 10-27-85 TIME: 6:00 P

SAMPLE: 9 & 10 RELINQUISHED BY: A.J.M. (signature)
TO: R.M. Jay (signature) DATE: 10/30/85 TIME: 8:30 A

SAMPLE: 9 RELINQUISHED BY: R.M. Jay (signature)
TO: UPS (signature) DATE: 10/30/85 TIME: 3:30 P

SAMPLE: 9 RELINQUISHED BY: UPS (signature)
TO: _____ (signature) DATE: _____ TIME: _____

SAMPLE: R. Miller RELINQUISHED BY: _____ (signature)
TO: _____ (signature) DATE: _____ TIME: _____

SAMPLE: _____ RELINQUISHED BY: _____ (signature)
TO: _____ (signature) DATE: _____ TIME: _____

CHAIN-OF-CUSTODY

RGH
1427 VINE ST.
PHILA PA 19102
(215) 563-4220

PROJECT NAME KBI
PROJECT NUMBER 222.01

DATE: 10/29/05 TIME: 4:15 P

MONITOR WELL 6

DEPTH TO WATER SURFACE BELOW TOP OF CASING 8'-2½"

VOLUME PURGED (35gal) 40gal

APPEARANCE OF SAMPLE (ie., turbidity) clear

SAMPLE SPLIT WITH ANOTHER LAB? YES X NO

WELL SAMPLED BY: COM/EDIZ

Field pH = 7.90
T = 12.5°C

SAMPLE CONTAINER NO.:	11	12
TYPE:	PE	PE
PRESERVATION:	NITRIC ACID	UNPRESERVED
VOLUME:	0.5 GALLON	250 ML
PARAMETERS ANALYSED:	1. GROSS ALPHA (EPA 900.0) 2. GROSS BETA (EPA 900.0)	1. pH (EPA 150.1) 2. FLUORIDE ION (EPA 340.2)

SPECIAL INSTRUCTIONS: If gross alpha exceeds 2 pica curies per liter hold sample for possible determination of radium isotopes. Consult KBI (Dill Gamin, (215) 367-2181) for further instructions.

TRANSFER OF CUSTODY:

SAMPLE: 11, 12 RELINQUISHED BY: _____ (signature)
TO: _____ (signature) DATE: 10-29-05 TIME: 6:00 PM

SAMPLE: 11, 12 RELINQUISHED BY: _____ (signature)
TO: _____ (signature) DATE: 10/30/05 TIME: 8:30 A

SAMPLE: 11 RELINQUISHED BY: _____ (signature)
TO: UPS (signature) DATE: 10/30/05 TIME: 3:30 P

SAMPLE: 11 RELINQUISHED BY: UPS (signature)
TO: _____ (signature) DATE: _____ TIME: _____
Swales

SAMPLE: _____ RELINQUISHED BY: _____ (signature)
_____ (signature) DATE: _____ TIME: _____

_____ RELINQUISHED BY: _____ (signature)
_____ (signature) DATE: _____ TIME: _____

APPENDIX C

MONITOR WELL INSTALLATION DIAGRAMS

WATER MONITOR WELL INSTALLATION

Project #: 222.01

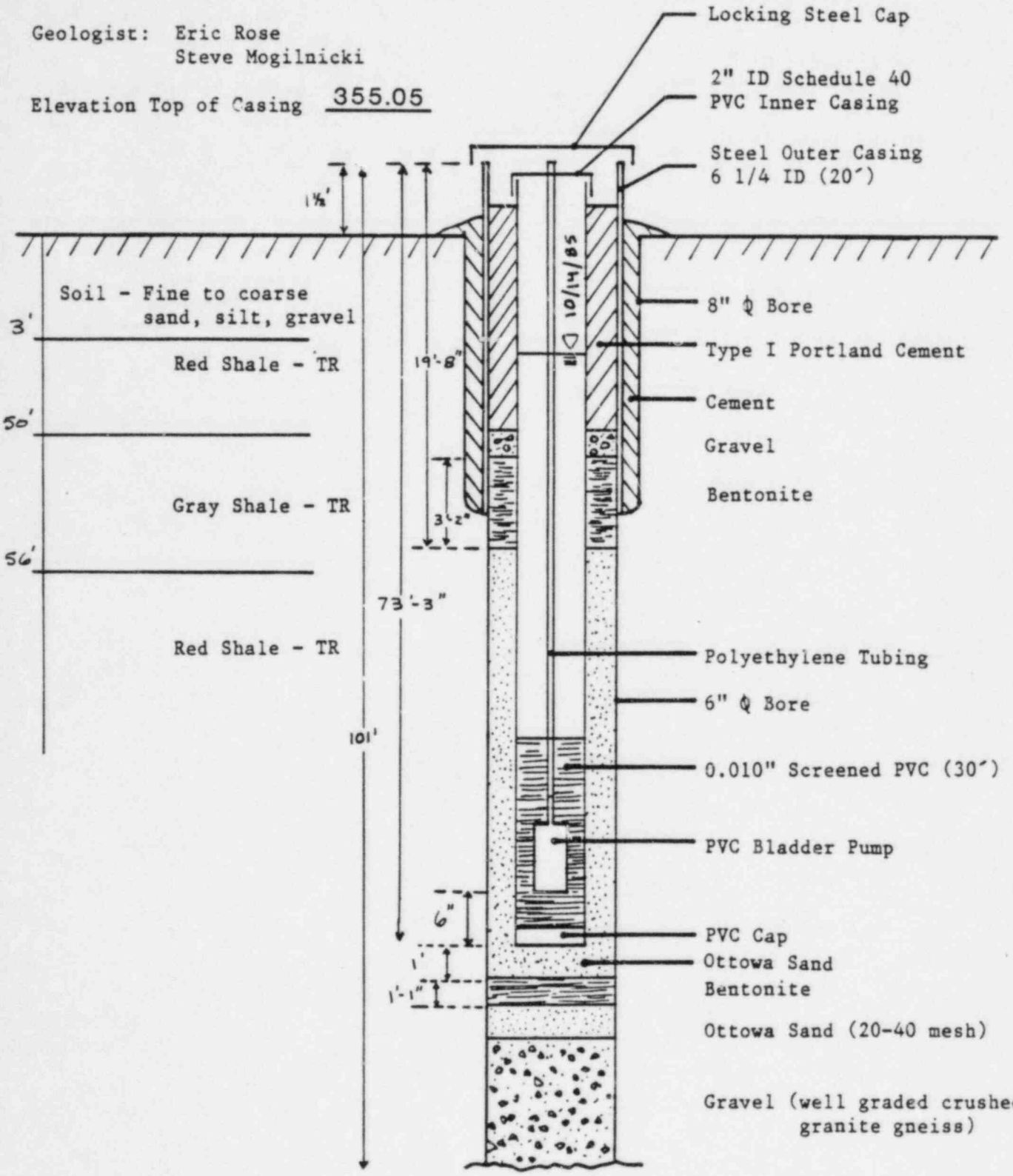
KBI

Well No. 1 Date: 10/8/85

Well Contractor: C.S. Garber & Sons, Inc.

Geologist: Eric Rose
Steve Mogilnicki

Elevation Top of Casing 355.05



Note: Not to scale
Lithology does not match well diagram

WATER MONITOR WELL INSTALLATION

Project #: 222.01

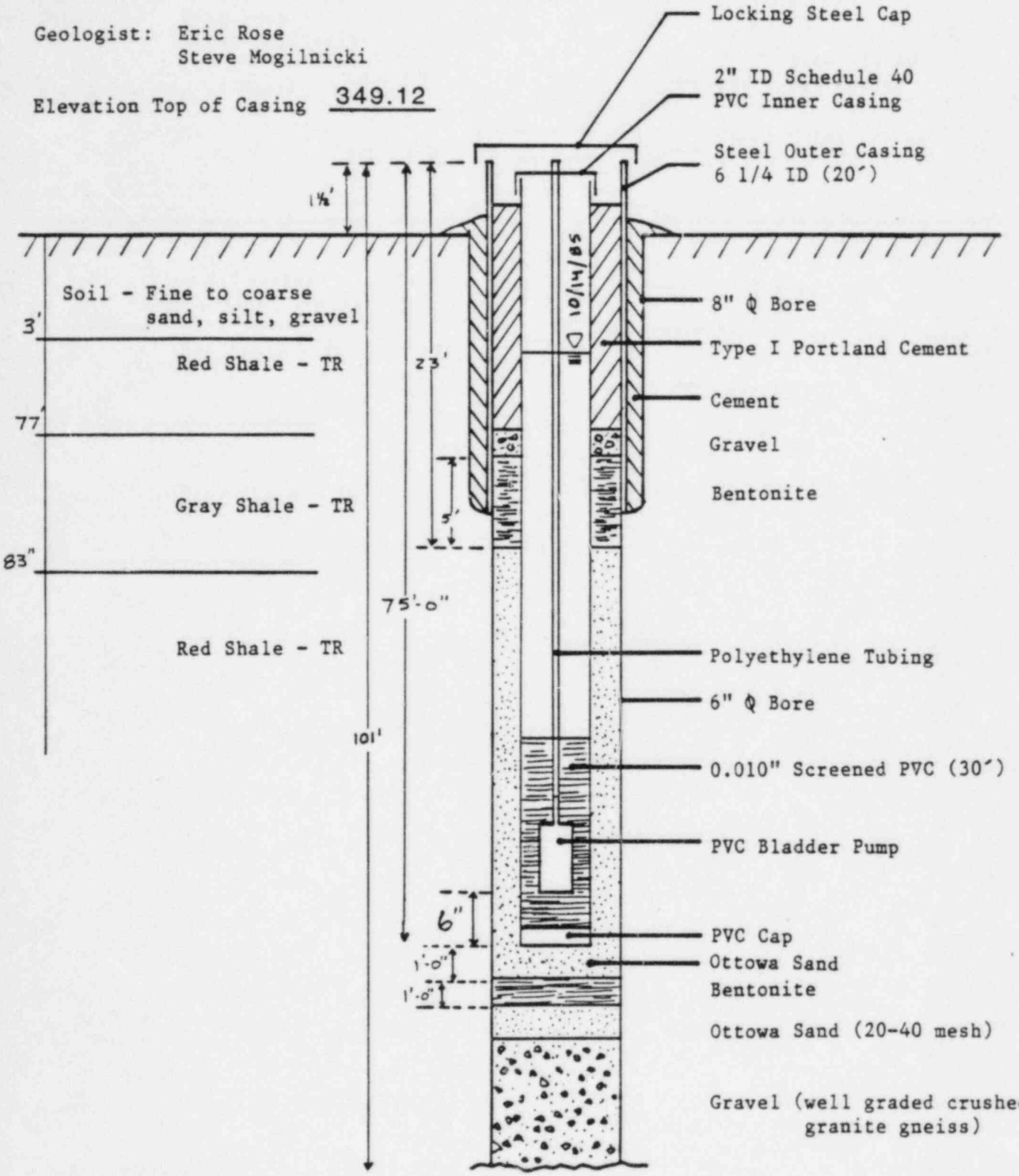
KBI

Well No. 2 Date: 10/9/85

Well Contractor: C.S. Garber & Sons, Inc.

Geologist: Eric Rose
Steve Mogilnicki

Elevation Top of Casing 349.12



Note: Not to scale
Lithology does not match well diagram

WATER MONITOR WELL INSTALLATION

Project #: 222.01

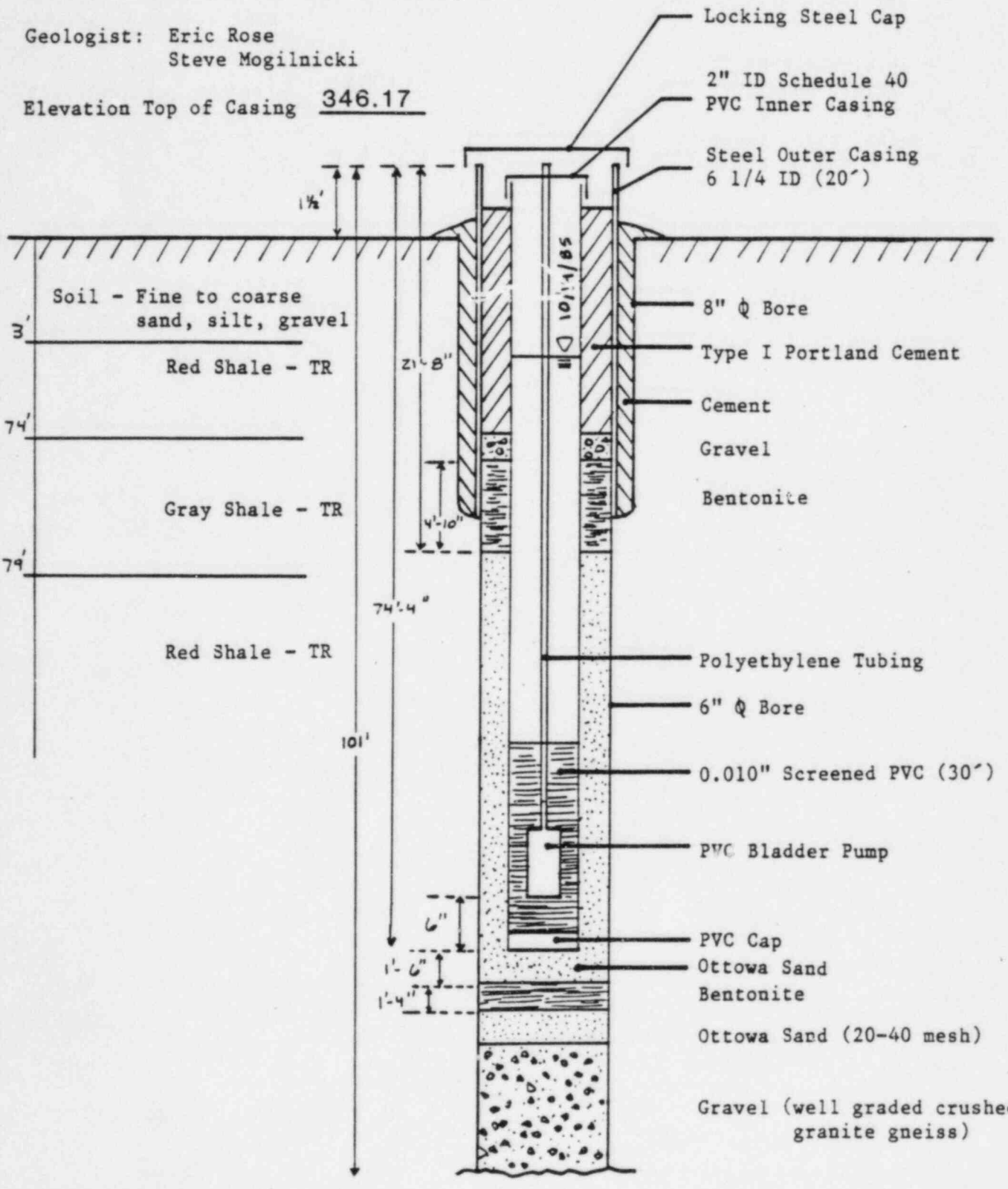
KBI

Well No. 3 Date: 10/9/85

Well Contractor: C.S. Garber & Sons, Inc.

Geologist: Eric Rose
Steve Mogilnicki

Elevation Top of Casing 346.17



Note: Not to scale
Lithology does not match well diagram

WATER MONITOR WELL INSTALLATION

Project #: 222.01

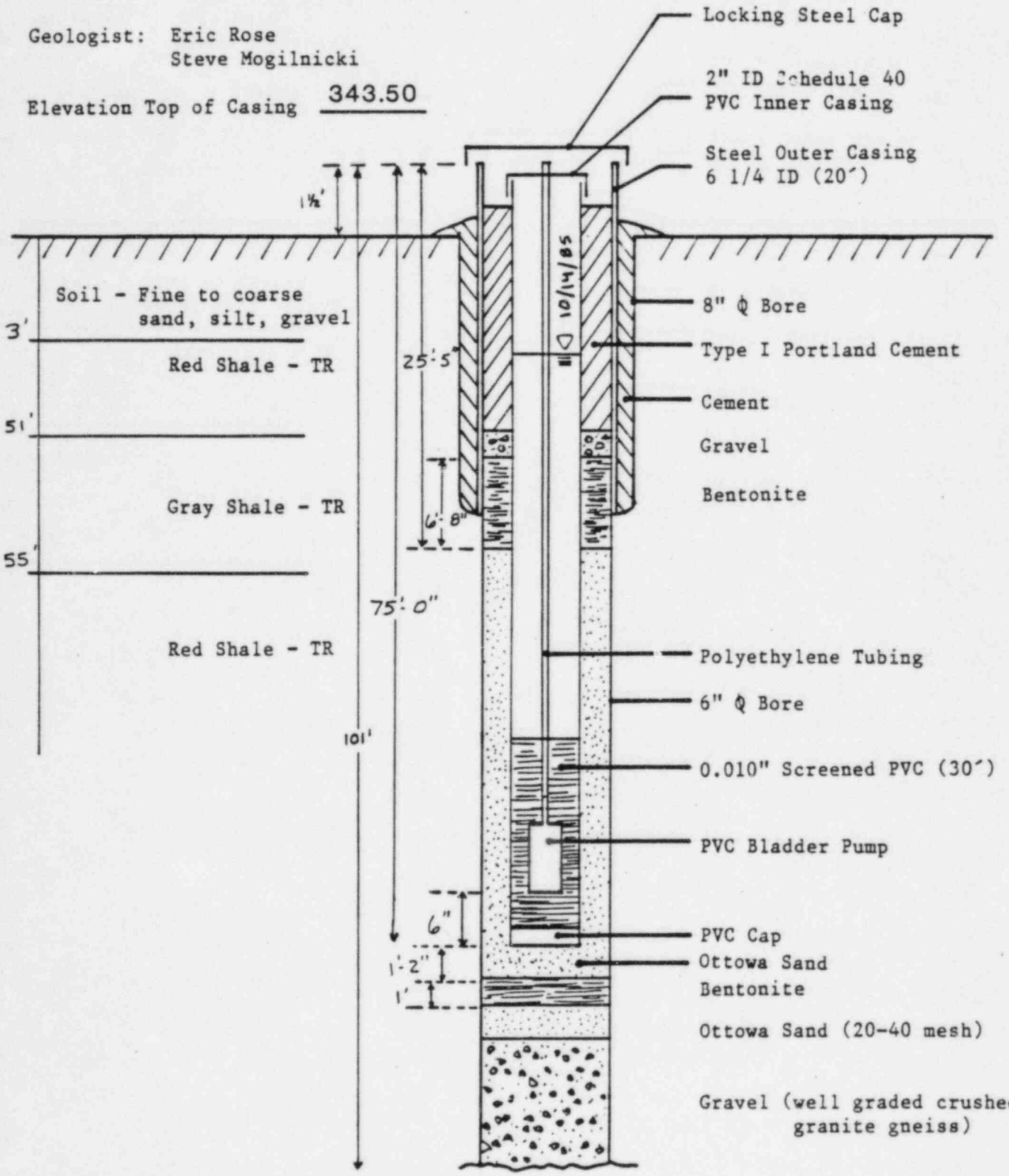
KBI

Well No. 4 Date: 10/7/85

Well Contractor: C.S. Garber & Sons, Inc.

Geologist: Eric Rose
Steve Mogilnicki

Elevation Top of Casing 343.50



Note: Not to scale
Lithology does not match well diagram

WATER MONITOR WELL INSTALLATION

Project #: 222.01

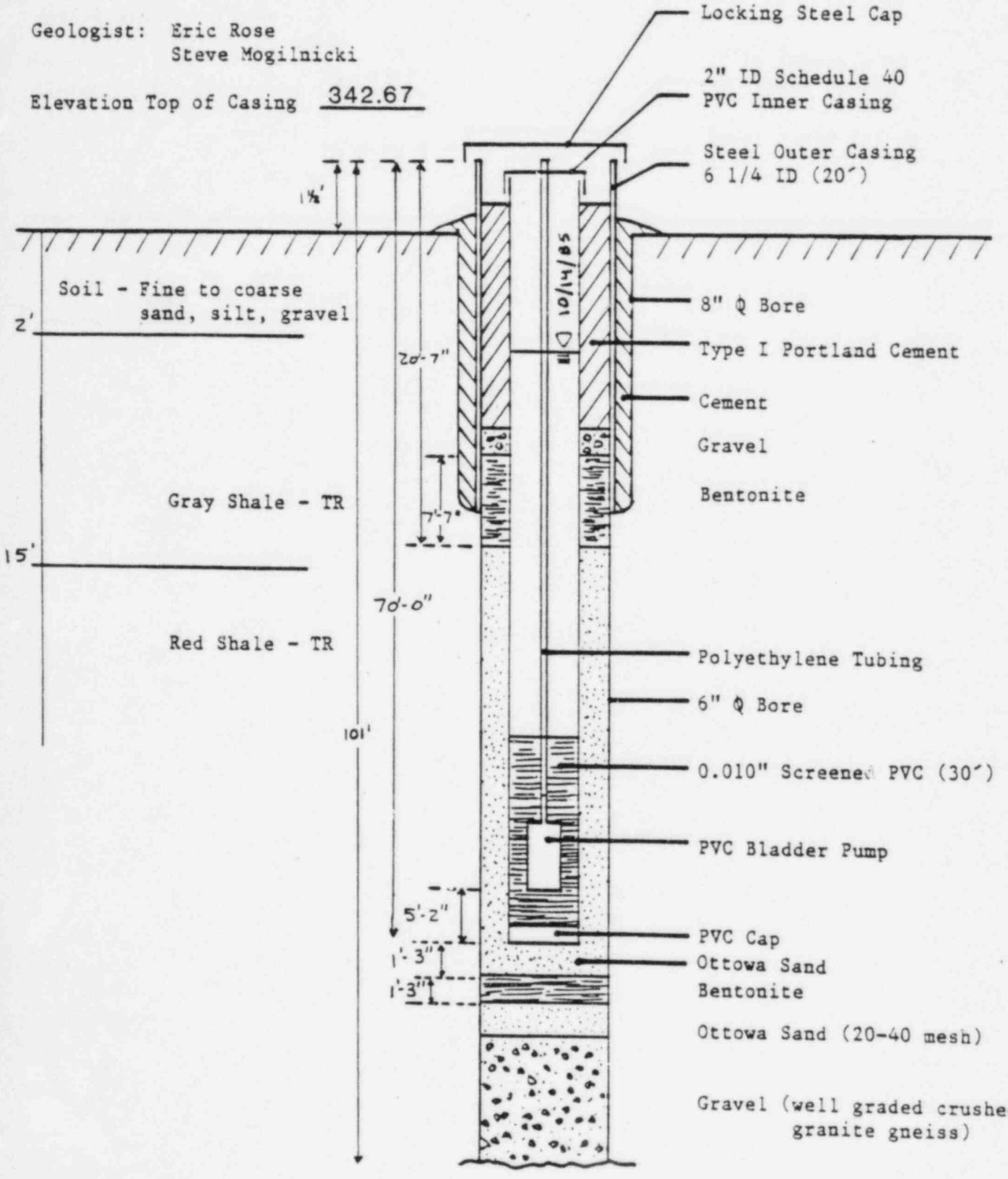
KBI

Well No. 5 Date: 10/8/85

Well Contractor: C.S. Garber & Sons, Inc.

Geologist: Eric Rose
Steve Mogilnicki

Elevation Top of Casing 342.67



Note: Not to scale
Lithology does nor match well diagram

APPENDIX D

WELL DRILLING LOGS

RGH

DRILLING ADMINISTRATION

Project: KBI Well KBI-1

Well Contractor C. S. GARBER Page 1

Address Box 75 RD 2, Boyertown, PA Phone 367-2181

Name of Driller Smith Helper (s) Harry Martin

Rig air hydraulic Make IR Model

Reference Point

Geologist Stephen Mogilnicki Other Persons on Site Paul Garber

Casing & Grouting Summary (Amounts, Lengths, Diameters)

19' of 6¼" rd casing, cement pressure grout (3 bags)

Diary of Drilling

Date	Time	What was Done & (Problems if any)	Weather
10-9-85	2:30 pm	Began drilling	clear skies warm
	3:00 pm	Driller has been drilling one rod length (20') below casing to insure stability. On this hole he will go only 3-4 ft. to make sure that he has enough time to cement this evening. He assures me result is identical.	
	3:05 to 3:20	Driller worked on equipment. Paul Garber was present	
	3:20	Resumed drilling	
	3:55	At 26', 1½ gpm	
	5:00 pm	Drillers at 45 ft., quitting time	
		3 bags cement	

RGH

DRILLING ADMINISTRATION

Project: _____ Well KBI 1

Well Contractor C. S. Garber page 2

Address Box 75 RD2, Boyertown, PA Phone 367-2181

Name of Driller Smith Helper (s) Harry Martin

Rig air hydraulic Make IR Model _____

Reference Point _____

Geologist Stephen Mogilnicki Other Persons on Site S. Capiotis of KBI

Casing & Grouting Summary (Amounts, Lengths, Diameters)

19' casing. cement pressure grout, 6¼" id

Diary of Drilling

Date	Time	What was Done & (Problems if any)	Weather
10-10-85	7:35	Resume drilling last (upgradient) well	clear, cool
	8:45	Capiotis gave me receipts for materials received	
	8:50	Blow hole	
	9:00 am	Took WL for all wells	
	9:25	Drillers are finished with rig	
		Where driller 26' 1½	
		hit water 74' 2	
		85' 20 gpm at soft spot	
	9:35 to 9:45	Put down concrete apron	
	9:50	Drillers and geologist left site	

RGH

BORING LOG

PROJECT KBI

PROJECT NO. 222:01

LOCATION Boyertown, PA

BORING NO. 1

DRILLING CO. C. S. Garber

SURFACE ELEV. 354.35' T.O.C.

EQUIPMENT air hydraulic

BORING DIA. 6"

DATE:

BORING LENGTH 101'

START 10/9/85 2:30 pm FINISH 10/10/85 9:50 am

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
5				5'- 7 1/8			silty, clayey soil & decayed corn stalks
10				10/14			3
15							
20				19' 8½"			
25				10/14			Red Brunswick Shale
30				1½gpm			
35							
40							
45							

RGH

BORING LOG

PROJECT KBI

LOCATION Boyertown, PA

DRILLING CO. C. S. Garber

EQUIPMENT air hydraulic

DATE:

START 10-9-85 2:30 pm FINISH 10-10-85 9:50 a.m.

PROJECT NO. 222:01

BORING NO. 1

SURFACE ELEV. 354.35' T.O.C.

BORING DIA. 6"

BORING LENGTH 101'

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
50							
55							
60							
65							Red Brunswick Shale
70							
75				2 gpm			
80							
85				20 gpm			

RGH

BORING LOG

PROJECT KBI

PROJECT NO. 222:01

LOCATION Boyertown, PA

BORING NO. 1

DRILLING CO. C. S. Garber

SURFACE ELEV. 354.35' T.O.C.

EQUIPMENT air hydraulic

BORING DIA. 6"

DATE:

BORING LENGTH 101'

START 10/9/85 2:30 pm FINISH 10/10/85 9:50 am

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
85							Red Brunswick Shale
90							
95							
100							101'

RGH

DRILLING ADMINISTRATION

Project: 222:01 **Well** KBI-2

Well Contractor Garber

Address Box 75, RD 2, Boyertown, PA **Phone** 367-2181

Name of Driller Smith **Helper (s)** Harry Martin

Rig air hydraulic **Make** IR **Model**

Reference Point

Geologist Stephen Mogilnicki **Other Persons on Site**

Casing & Grouting Summary (Amounts, Lengths, Diameters)

20' 6¼", i.d. casing, grouted w/cement

then drill 6" hole through casing to 101'

Diary of Drilling

Date	Time	What was Done & (Problems if any)	Weather
10-8-85 Tues.	10:00 am	Arrived 10:00 am, drillers working on bore #2, the 1st up-gradient well	clear skies, cool
		Charlie Miller's notes:	
	8:30 am	Arrived, drillers setting steel casing. Began 7:30 at 19'	
	9:00 am	6 bags added	
	9:00-9:10	Blow hole, push casing	
	9:23	drilling	
	10:50	Driller's note: #2 yields much less water than #6 (15 gpm) or #4 (25 gpm)	
	11:00 am	Yield = 1½ gpm	
	11:00 to 11:20	Develop for 20 min.	
	11:00 - 11:30	Took water levels at #6 and #4 (both rose since Monday)	
		Amt. casing = 21' steel #bags cement =	

RGH

BORING LOG

PROJECT KBI

PROJECT NO. 222_01

LOCATION Boyertown, PA

BORING NO. 2

DRILLING CO. Garber

SURFACE ELEV. 355.05'

EQUIPMENT Air hydraulic

BORING DIA. 6"

DATE: October 8, 1985

BORING LENGTH 101'

START 7:30 am FINISH 11:30 am

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
							silty, clayey soil
5				5 - 4 1/8' 10/14			3
10							
15							Red Brunswick Shale
20							
25							
30							
35							
40							

RGH

BORING LOG

PROJECT KBI

LOCATION Boyertown, PA

DRILLING CO. Garber

EQUIPMENT air hydraulic

DATE:

START 7:30 am FINISH 11:30 am

PROJECT NO. 222:01

BORING NO. 2

SURFACE ELEV. 355.05' T.O.C.

BORING DIA. 6"

BORING LENGTH 101'

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
45							Red Brunswick Shale
50							50
55							Grey Brunswick Shale
							56
60							
65							Red Brunswick Shale
70							
75							
80							
85							
90							

RGH

BORING LOG

PROJECT KBI

LOCATION Boyertown, PA

DRILLING CO. Garber

EQUIPMENT air hydraulic

DATE:

START 7:30 am FINISH 11:30 am

PROJECT NO. 222:01

BORING NO. 2

SURFACE ELEV. 355.05' T.O.C.

BORING DIA. 6"

BORING LENGTH 101'

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
95							↑ Red Brunswick Shale
100							↓ 101

RGH

DRILLING ADMINISTRATION

Project: KBI Well KBI -3

Well Contractor C. S. Garber

Address Box 75 RD2, Boyertown, PA Phone 367-2181

Name of Driller _____ Helper (s) Harry Martin

Rig air hydraulic Make IR Model _____

Reference Point _____

Geologist Stephen Mogilnicki Other Persons on Site Strat Capiotis of KBI

Casing & Grouting Summary (Amounts, Lengths, Diameters)

19' of 6¼" id casing, cement pressure grout

Diary of Drilling

Date	Time	What was Done & (Problems if any)	Weather
10-9-85	10:45 am	Began drilling	clear, temps in 70's
	11:40	Capiotis arrived and informed me that PVC pipe was delivered So was the bentonite	
	11:50	Casing lifted, set in hole	
	11:55 to 12:15	Cement added	
	1:00 pm	Called Charlie Miller at RGH	
		Driller: Water 26' 1 qt = .25 gpm 56' 6 gpm 77' 10 gpm 101' 10 gpm	
	1:40 to 2:00	Blow hole	
	2:00 to 2:25 pm	Pull rods out	
		3 bags, 21' casing	

RGH

BORING LOG

PROJECT KBI

LOCATION Boyertown, PA

DRILLING CO. Garber

EQUIPMENT air hydraulic

DATE: October 9, 1985

START 10:45 am FINISH 2:25 pm

PROJECT NO. 222:01

BORING NO. 3

SURFACE ELEV. 349.12'

BORING DIA. 6"

BORING LENGTH 101'

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
5							silty, clayey soil
10				7' - 5 3/4'			
15				10/14			Red Brunswick Shale
20		19		202"			
25				at			
30				2:30 pm			
35				10/9	Oct. 1		
40							
45							

RGH

BORING LOG

PROJECT KBi

LOCATION Boyertown, PA

DRILLING CO. C. S. Garber

EQUIPMENT air hydraulic

DATE: 10/9/85

START 10:45 am FINISH 2:25 pm

PROJECT NO. 222:01

BORING NO. 3

SURFACE ELEV. 349.12' T.O.C.

BORING DIA. 6"

BORING LENGTH 101'

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
50							
55							
60				6 gpm			Red Brunswick Shale
65							
70							
75				10 gpm			
77							Grey Brunswick Shale
80							
83							Red Brunswick Shale
85							

RGH

BORING LOG

PROJECT KBI

PROJECT NO. 222:01

LOCATION Boyertown, PA

BORING NO. 3

DRILLING CO. C. S. Garber

SURFACE ELEV. 349.12' T.O.C.

EQUIPMENT air hydraulic

BORING DIA. 6"

DATE: 10/9/85

BORING LENGTH 101'

START 10:45 am FINISH 2:25 pm

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
90							
95							Red Brunswick Shale
100							
				10 gpm			101

RGH

DRILLING ADMINISTRATION

Project: 222:01 Well KBI -4

Well Contractor C. S. Garber

Address Box 75, RD 2, Boyertown, PA Phone 367-2181

Name of Driller Smith Helper (s) Harry Martin

Rig air hydraulic Make I R Model

Reference Point 10' to west from b.n #2

Geologist Stephen Mogilnicki Other Persons on Site Strat Capiotis ~~Paul Garber~~

Casing & Grouting Summary (Amounts, Lengths, Diameters)

19' of 6¼" casing i.d., cement pressure grout

Diary of Drilling

Date	Time	What was Done & (Problems if any)	Weather
10-7-85	12:05 pm	Began drilling bore hole #4	high -65°F clear skies
	12:40	reached 25' by 12:40 pm	
		Damp at 33'	
	3:30	develop well with air	

RGH

BORING LOG

PROJECT KBI

LOCATION Boyertown, PA

DRILLING CO. Garber

EQUIPMENT air hydraulic

DATE:

START 12:05 FINISH 3:30 pm

PROJECT NO. 222:01

BORING NO. 4

SURFACE ELEV. 374.37'

BORING DIA. 6"

BORING LENGTH 101'

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
							fine to coarse sand, some salt, trace gravel
5				6'0"			
				10/10			
10							Red Brunswick Shale
15							
20							
25							
30							
33				33'			Dampness at 33'
				Damp			
				10/7			
35							

RGH

BORING LOG

PROJECT KBI

PROJECT NO. 222:01

LOCATION Boyertown, PA

BORING NO. 4

DRILLING CO. C. S. Garber

SURFACE ELEV. 374.37' T.O.C.

EQUIPMENT air hydraulic

BORING DIA. 6"

DATE: October 7, 1985

BORING LENGTH 101'

START 12:05 pm FINISH 3:30 pm

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
35							Grey Brunswick Shale
40							
				42'			
45				10/7			
50							
55							
							Red Shale
60							
65							

RGH

BORING LOG

PROJECT KBI

LOCATION Boyertown, PA

DRILLING CO. C. S. Garber

EQUIPMENT air hydraulic

DATE:

START 12:05 pm FINISH 3:30 pm

PROJECT NO. 222:01

BORING NO. 4

SURFACE ELEV. 374.37' T.O.C.

BORING DIA. 6"

BORING LENGTH 101'

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
70							Brunswick Shale
75							
80							
85							
90							
95							
100							
							101

RGH

DRILLING ADMINISTRATION

Project: KBI

Well KBI -5

Well Contractor C. S. Garber

Address Box 75, RD 2, Boyertown, PA Phone 367-2181

Name of Driller Smith Helper (s) Harry Martin

Rig air hydraulic Make IR Model

Reference Point

Geologist Stephen Mogilnicki Other Persons on Site Capiotios of KBI

Casing & Grouting Summary (Amounts, Lengths, Diameters)

Diary of Drilling

Date	Time	What was Done & (Problems if any)	Weather
10-8-85	3:46 pm	Began drilling	clear & cool
	4:15	Reached 5' at this time	
	5:15	By quitting time, casing set and cement added	
10-9-85	7:30 - 10:00 am	Uneventful drilling through Brunswick	clear w/ temps in 70's
	10:00 to 10:20	Blow the hole	
		Drillers Note: Water at 34' was "the first and only water" Water level at 11 am NOTE: On way to Boyertown, noticed small outcrop of Brunswick on Rt. 100N about 1 to 2 miles before County Line Road. Might be usefui to record strike/drp + trend of fractures at this spot with a Brunton compass. Cement = 2 bags pressure grout - amt. casing = 21'	

RGH

BORING LOG

PROJECT KBI

PROJECT NO. 222:01

LOCATION Boyertown, PA

BORING NO. 5

DRILLING CO. C. S. Barber

SURFACE ELEV. 346.17'

EQUIPMENT air hydraulic

BORING DIA. 6"

DATE:

BORING LENGTH 101'

START 10/8/85 3:46 pm FINISH 10/9/85

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
5				6' - 6½" 10/14			3 silty, clayey soil
10							
15							
20							
25							Red Brunswick Shale
30				1st H_2O -34- 2 gpm			
35							
40				35' - 8" 10/9			

RGH

BORING LOG

PROJECT KBI

PROJECT NO. 222:01

LOCATION Boyertown, PA

BORING NO. 5

DRILLING CO. C. S. Garber

SURFACE ELEV. 346.17' T.O.C.

EQUIPMENT air hydraulic

BORING DIA. 6"

DATE:

BORING LENGTH 101'

START 10/8/85 3:46 pm FINISH 10/9/85

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
45							Red Brunswick Shale
50							
55							
60							
65							
70							
75							74 ✓
							Grey Brunswick Shale
80							79 ↓
85							Red Brunswick Shale

RGH

BORING LOG

PROJECT KBI

LOCATION Boyertown, PA

DRILLING CO. C. S. Garber

EQUIPMENT air hydraulic

DATE:

START 10/8/85 3:46 pm FINISH 10/9/85

PROJECT NO. 222:01

BORING NO. 5

SURFACE ELEV. 346.17' T.O.C.

BORING DIA. 6"

BORING LENGTH 101'

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
90							Red Brunswick Shale
95							
100							101'

RGH

DRILLING ADMINISTRATION

Project: KBI **Well** KBI -6

Well Contractor C. S. Garber

Address Box 75, RD 2, Boyertown, PA **Phone** 367-2181

Name of Driller Warren Smith **Helper (s)** Harry Martin

Rig air hyraulic **Make** IR **Model**

Reference Point fee from

Geologist Stephen Mogilnicki **Other Persons on Site** Strat Capiotis of KBI, Paul Garber

Casing & Grouting Summary (Amounts, Lengths, Diameters)

diam. casing 6¼" i.d.

Diary of Drilling

Date	Time	What was Done & (Problems if any)	Weather
10-7-85	8:00 am	Met Mr. Capiotis at Security Desk	High -65°F clear skies
	8:15	Sited boring #6; moved hole towards building since Capiotis raised objection to 2 ft. of casing in middle of dirt road Discussed specs. with Mr. Garber	
	8:20	Started drilling	
	8:30	Hollenback Home Center delivered 20 bags Type 2 Portland Cement, as per order of 10/3.	
	8:45	Damp at 13'	
	9:00	Water flows casing to 19'; drilling - 20' of 6" hole to eliminate water by filling casing with some cuttings.	
	9:30	Casing lifted and set in hole, 2 ft. above surface	
	9:35	Cement pumped into 8" hole	
	9:51	Begin drilling 6" bore through casing	
	10:22	Machine shunt down to add oil	
	10:30	resumed drilling	
	11:18	Began to develop well with air for 15 minutes	
	Noon	Took water level - 30' 6"	

RGH

BORING LOG

PROJECT KBI

LOCATION Boyertown, PA

DRILLING CO. C. S. Garber

EQUIPMENT air hydraulic

DATE: Mon..October 7, 1985

START 8:00 am FINISH 11:30 am

PROJECT NO. 222:01

BORING NO. 6

SURFACE ELEV. 343.50'

BORING DIA. 6"

BORING LENGTH 101'

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
							tan, silty clay, little rock fragments easily broken
5							grey silt with little rock fragments (of Brunswick probably) still trace clay
				3' - 7¼"			
10							
13				Damp at 13'			grey (almost black) slit and fine sand with little rock fragments
15							
19		19'					
20							
25							
30				30'6" at Noon			Red Brunswick Shale
34				2 gpm at 34'			

RGH

BORING LOG

PROJECT KBI

PROJECT NO. 222:01

LOCATION Boyertown PA

BORING NO. 6

DRILLING CO. Garber

SURFACE ELEV. 343.50' T.O.C.

EQUIPMENT air hydraulic

BORING DIA. 6"

DATE:

BORING LENGTH 101'

START 8:00 am FINISH 11:30 am

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
35							
40					20 ft hr at 10 am		
45							Red Brunswick Shale
50							
51				7 gpm at 51'			51'
55				10 gpm at 57'			Grey Brunswick Shale 55'
60							Red Brunswick Shale
65							
70							

RGH

BORING LOG

PROJECT KBI

LOCATION Boyertown, PA

DRILLING CO. C. S. Garber

EQUIPMENT air hydraulic

DATE: 10/7/85

START 8:00 am FINISH 11:30

PROJECT NO. 222:01

BORING NO. 6

SURFACE ELEV. 343.50' T.O.C.

BORING DIA. 6"

BORING LENGTH 101'

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
80							Red Brunswick Shale
85							
90							
95				15 gpm			
100							101'

RGH

DRILLING ADMINISTRATION

Project: 222:01 **Well** KBI -7

Well Contractor C. S. Garber

Address Box 75, RD 2, Boyertown, PA **Phone** 367-2181

Name of Driller Smith **Helper (s)** Harry Martin

Rig air hydraulic **Make** IR **Model** _____

Reference Point _____

Geologist Stephen Mogilnicki **Other Persons on Site** Charlie Miller

Casing & Grouting Summary (Amounts, Lengths, Diameters)
19' of 6¼" steel, cement pressure grout

Diary of Drilling

Date	Time	What was Done & (Problems if any)	Weather
10-8-85	11:40 am	Cleared ground with KBI Bulldozer at Boring #7	Clear & cool
	12:00	Began drilling	
	1:10	Casing lifted	
		Cement added until 1:40	
		Difference from other holdes; encountered grey shale first 15', then all red shale (others had grey at 50-55')	
	2:30	Driller took gpm measurement	
		Water at 35' ½ gpm	
		77' 10 gpm	
	3:05 to 3:20	Blow the hole	
	3:41	Took water level - 35' 5"	
	3:45	Moved Rig to location of #5	
	4:00	Mr. Capiotis indicated that site of proposed well #1 would not interfer with plans for new structure on that area.	
		# of bags cement = 4 amt. casing = 21.1 ft.	

RGH

BORING LOG

PROJECT KBI

LOCATION Boyertown, PA

DRILLING CO. C. S. Garber

EQUIPMENT air hydraulic

DATE:

START 12:10 pm FINISH 3:45 pm

PROJECT NO. 222:01

BORING NO. 7

SURFACE ELEV. 342.67'

BORING DIA. 6"

BORING LENGTH 101'

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
							silty, clayey soil, much of it removed by bulldozer
5				3' - 5¼" 10/14			
10							Grey Brunswick Shale
15							▽
20							
25							
30				WL= 35' 5" at 3:41			
35							Red Brunswick Shale
40							
45							▽

RGH

BORING LOG

PROJECT KBI

LOCATION Boyertown, PA

DRILLING CO. C. S. Garber

EQUIPMENT air hydraulic

DATE:

START 12:10 pm FINISH 3:45 pm

PROJECT NO. 222:01

BORING NO. 7

SURFACE ELEV. 342.67' T.O.C.

BORING DIA. 6"

BORING LENGTH 101'

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
50							
55							
60							
65							
70							Red Brunswick Shale
75							
80				10gpm			
85							
90							

RGH

BORING LOG

PROJECT KBI

LOCATION Boyertown, PA

DRILLING CO. C. S. Garber

EQUIPMENT air hydraulic

DATE:

START 12:10 pm FINISH 3:45 pm

PROJECT NO. 222:01

BORING NO. 7

SURFACE ELEV. 342.67' T.O.C.

BORING DIA. 6"

BORING LENGTH 101'

GEOLOGIST Stephen Mogilnicki

Depth	Lith.	Casing	Sample	Water	Rate	Other	Description and Remarks
95							Red Brunswick Shale
100							101 ft.