171030
138

WARZYN

Draft Report
Project No. 60251

Volume 2 of 5
Remedial Investigation Report
ACS NPL Site
Griffith, Indiana

Prepared for:
Steering Committee
ACS PRP Group

Prepared by:
Warzyn Inc.
Chicago, Illinois

June 1991

LEGEND

----	GEOPHYSICS INVESTIGATION AREA
SB-01	SOIL BORING LOCATION & NUMBER
AP-01	AUGER PROBE LOCATION & NUMBER
TP-1	TEST PIT LOCATION & NUMBER
SA01	SOIL AREA LOCATION & NUMBER

NOTES

1. INITIAL BASE MAP WAS DEVELOPED FOR CAMP DRESSER & MCKEE INC ON NOVEMBER 8, 1986. MAP HAS BEEN UPDATED FROM AN AERIAL PHOTOGRAPH OF THE SITE FLOWN ON NOVEMBER 3, 1986 BY GEONEX CHICAGO AERIAL SURVEY, INC. THE BASE MAP WAS UPDATED BASED ON THE AERIAL PHOTOGRAPH BY GEONEX.
2. VERTICAL DATUM IS USGS DATUM. CONTOUR INTERVAL IS (1) ONE FOOT.
3. SOIL BORINGS SB01 TO SB18 AND AUGER PROBES AP-1 TO AP-44 FOR PHASE I WERE DRILLED BY EXPLORATION TECHNOLOGY INC. (ETI) UNDER THE SUPERVISION OF WARZYN IN AUGUST AND SEPTEMBER 1989.
4. SOIL BORINGS SB20 TO SB75 AND AUGER PROBES AP-45 TO AP-63 FOR PHASE II WERE DRILLED BY EXPLORATION TECHNOLOGY INC. (ETI) UNDER THE SUPERVISION OF WARZYN IN MAY AND JUNE 1990.
5. LOCATIONS FOR SOIL BORINGS WITH SAMPLING AND TEST PITS WERE FIELD LOCATED BY EWI ENGINEERING ASSOC. SURVEYORS.
6. LOCATIONS OF AUGER PROBES ARE APPROXIMATE.
7. SOIL BORING NUMBERS SB19 AND SB34 DO NOT EXIST.

north

0 150 300

SCALE IN FEET

FIGURE 5-11

Designed by
Drawn by JC
Checked by JDD
Approved by
Date 11/2/90
Reference
Revisions

WARZYN
WARZYN ENGINEERING INC.

LEAD OFF-SITE BASE MAP
REMEDIAL INVESTIGATION
AMERICAN CHEMICAL SERVICES
NPL SITE
GRIFFITH, INDIANA

Project Number
60251 B25

WARZYN

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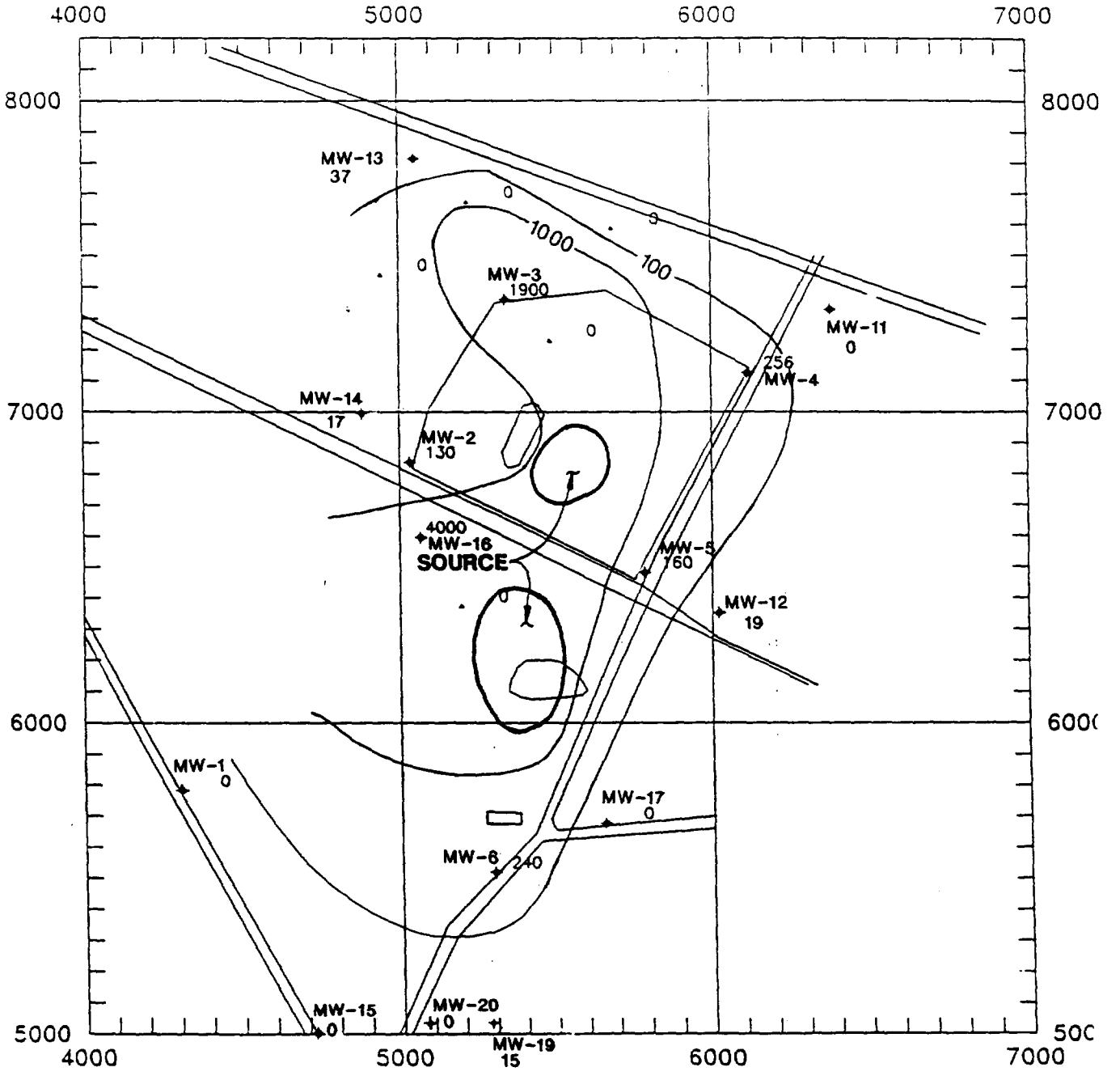


LEGEND

- ◆ UPPER AQUIFER MONITORING WELL LOCATION
- ~ ISO-CONCENTRATION LINE
- ▲ AQUIFER MATRIX SAMPLE

NOTES

1. SAMPLES WERE COLLECTED FROM MW-11, M MW13, MW-15, MW-19 AND MW-20 IN JANU 1991. ALL OTHER SAMPLES WERE COLLECTE DURING PHASE II OF THE INVESTIGATION.

north

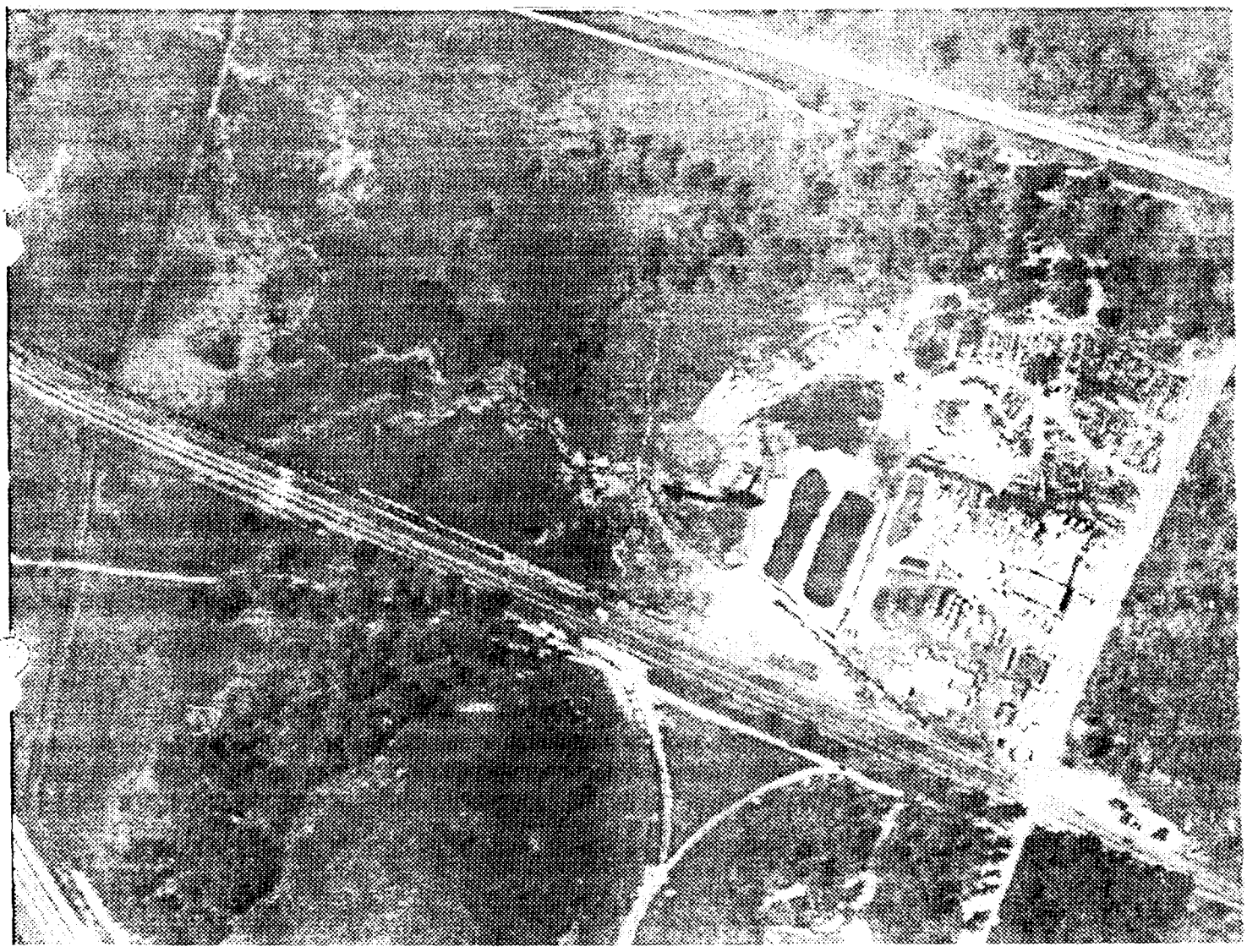
0 500 1000

SCALE IN FEET

FIGURE

WARZYN	UPPER AQUFER CHLORINATED ETHANE DISTRIBUTION (ug/l)	Drawn DLL, TJM, JAW	Checked
	REMEDIAL INVESTIGATION AMERICAN CHEMICAL SERVICES NPL SITE GRIFFITH, INDIANA	Revisions	App'd. PJL
			Date 6/13/91
			60251

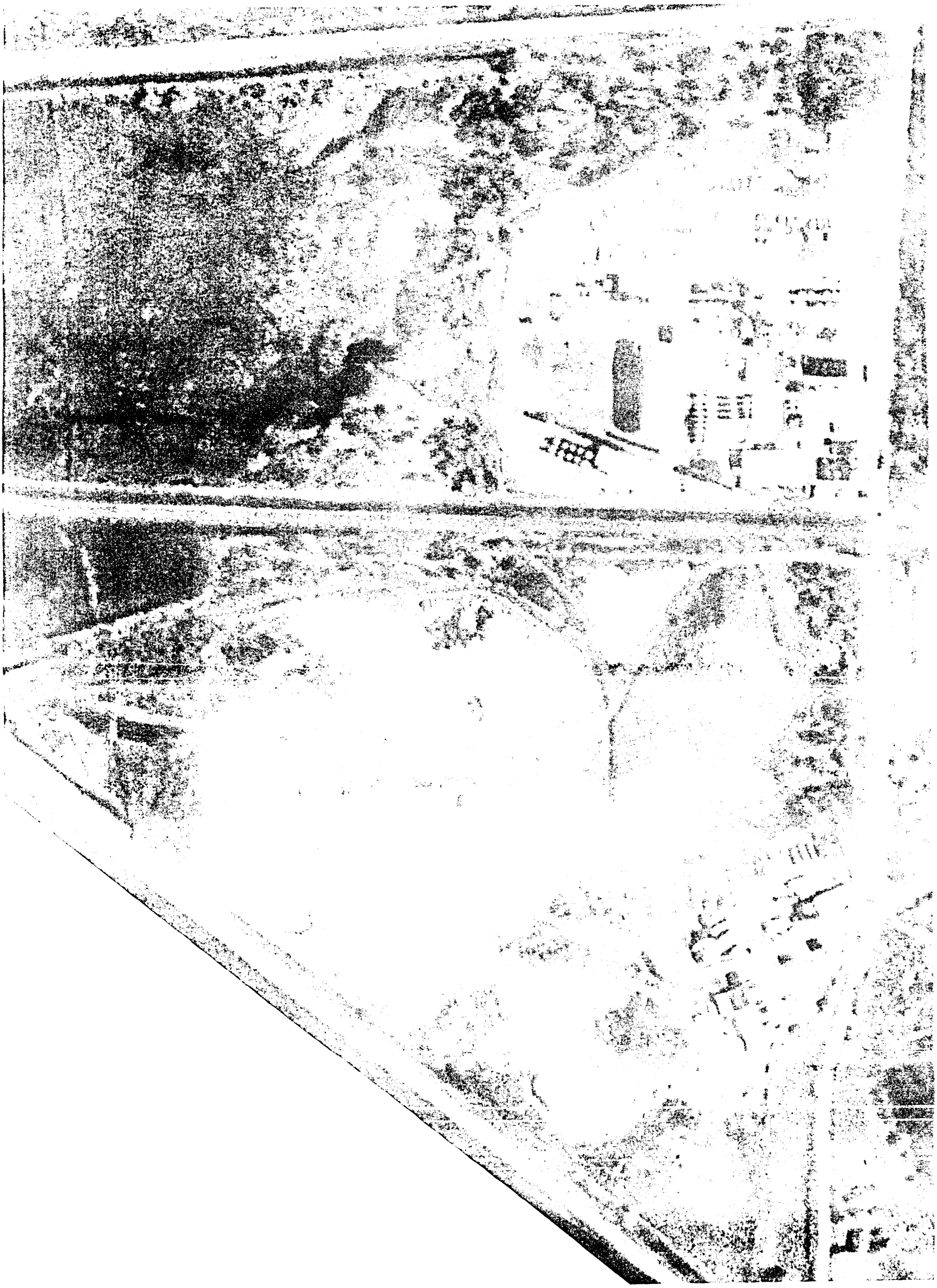
TELEDYNE POST



SEC-DZEPPA

APPENDIX A

Aerial Photographs



1981

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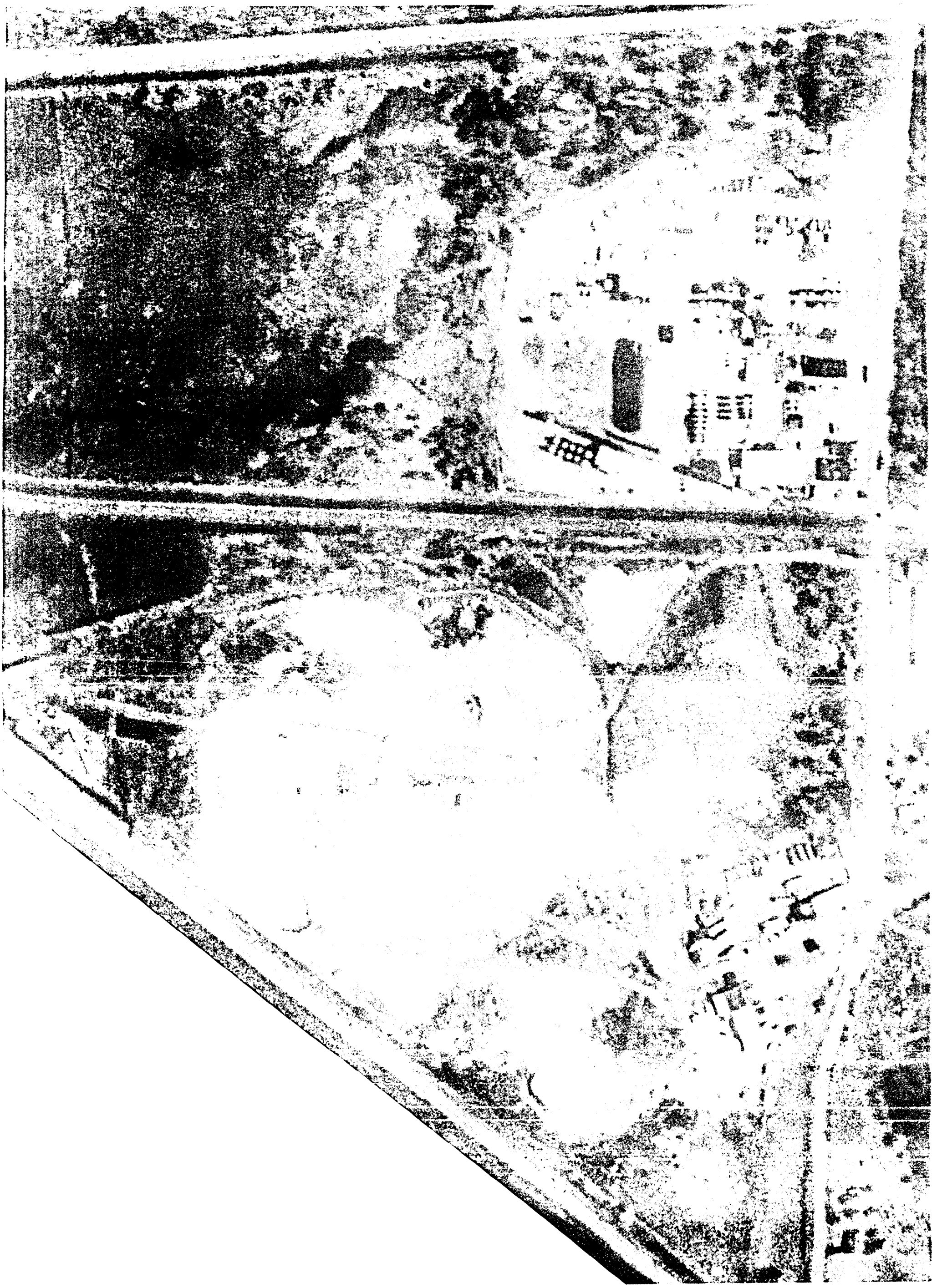
WARZYN ENGINEERING, INC.

OF



1981

WARZYN

WARZYN ENGINEERING INC.
Madison • Milwaukee
Minneapolis • Chicago
Detroit

Designed By | Drawn By | Checked By
Approved By | Date
Scale | Reference

WARZYN

OF

BLUE INC.

1956

Revisions Date By Appd

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Project Number

Sheet Number

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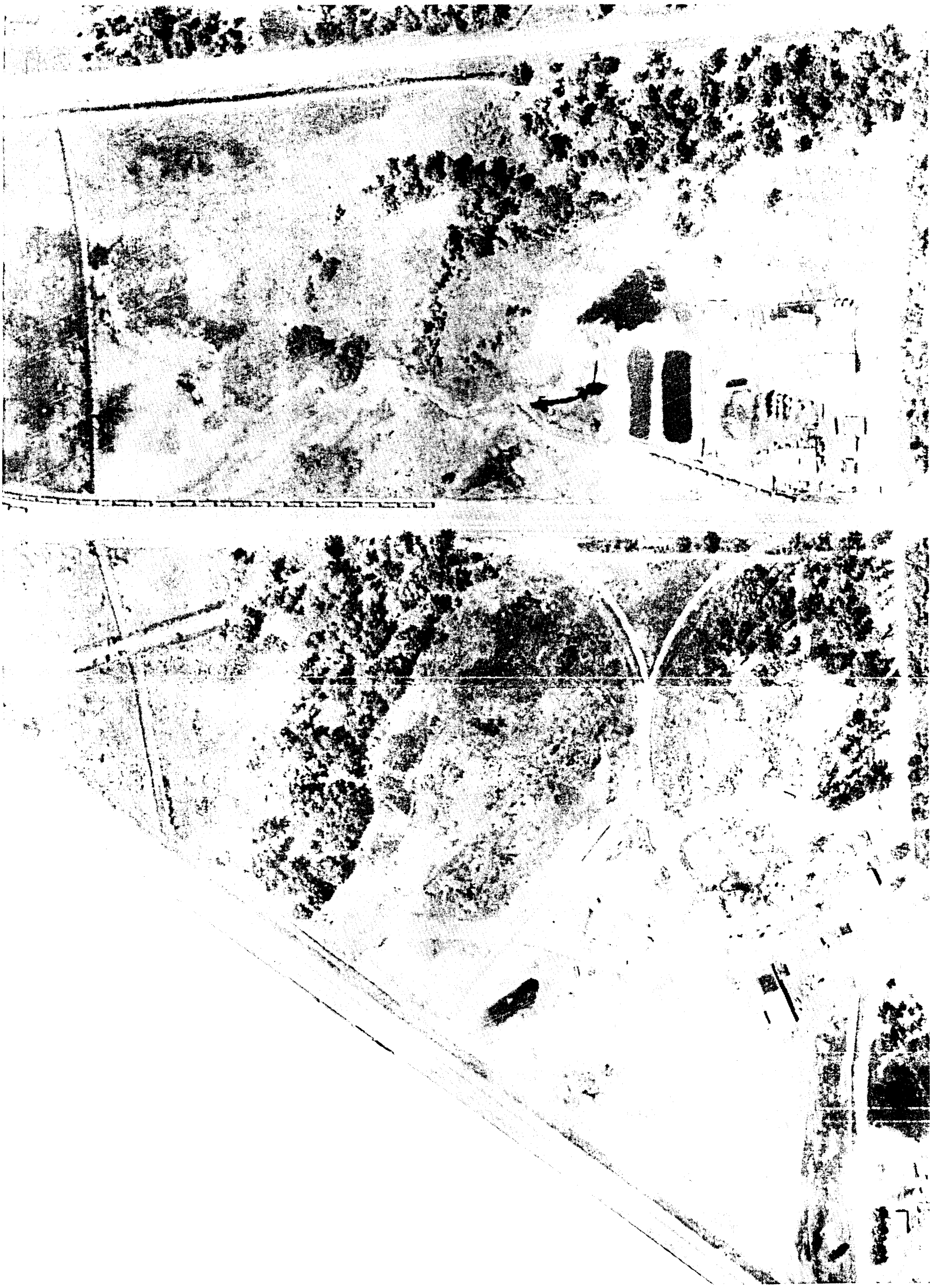

WARZYN

Sheet Number 0F

1970

Revision: Date • By • Appd

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1973

Revisions

Date · By · Appr'd

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Sheet Number

OF

APPENDIX B

Environmental Audit of ACS

FIELD NOTES FROM NOVEMBER 14 AND 15 AUDIT OF AMERICAN CHEMICAL SERVICES

Prepared by:

WARZYN ENGINEERING INC.
2100 Corporate Drive
Addison, Illinois

December 1989

SECTION 1
INTRODUCTION

American Chemical Services (ACS) is a solvent reclamation and chemical manufacturing facility located at 420 South Colfax in Griffith, Indiana. ACS began operations in 1955 solely as a solvent reclaimer. In the late 1960's to early 1970's, ACS began to manufacture small batches of specialty chemicals. An on-site incinerator for still bottoms and non-reclaimable waste streams was operated by ACS between 1966 and 1970. On-site processes basically include batch distillation, small batch reactors, blending and drum and tank storage and material handling. A half-buried heating oil tank used to fuel the boilers was located near the office building and removed in 1979.

SECTION 2
SITE INTERVIEW

The following information regarding site history and processes was supplied to Warzyn Engineering Inc. (Warzyn) by Mr. James Tarpo, President of ACS, and Mr. John Murphy, Vice President of ACS, during interviews conducted on November 14 and 15, 1989 by Mr. Mark Rothas and Mr. Peter Vagt of Warzyn. Also in attendance were Mr. Robert Swale and Mr. Steve Siegel, representatives from the United States Environmental Protection Agency (U.S. EPA), Mr. Bruce Clark and Ms. Maureen Grimmer, attorneys for ACS, and Mr. John Weaver and Mr. Roger Berkowitz, technical consultants for ACS. The information obtained from the interview has been organized by time periods of interest and process areas. Mr. Tarpo started at ACS in 1966 and Mr. Murphy in 1970. Information supplied by these individuals concerning activities at ACS prior to these time periods is to the best of their knowledge.

Reclamation Operation

Pre-1970

ACS began operations in 1955. Reclamation of spent solvent waste streams has always been the primary operation performed at the facility. Prior to the late 1960's, reclamation was the only operation performed on-site. The original buildings included an office with adjoining boiler room and the reclamation building. Neither of these buildings still exist. The reclamation building was located in the same proximate area as the present one. A cooling water reservior was located adjacent to the reclamation building.

Distillation operations were performed in six to seven pot stills (i.e. batch evaporation units) varying in capacity between 500 and 2,000 gallons. These units were located on a concrete pad outside of the reclamation building. Approximately 5,000 to 10,000 gallons per day of spent solvent were processed. Except for one pot still being an azeotropic steam distillation unit, the remaining pot stills were conventional batch evaporation units. Spent solvents were almost exclusively stored in 55-gallon drums. Storage areas were located throughout the site. The distillation units were charged by placing 55-gallon drums on the concrete pad adjacent to the pot stills and pumping them directly into the units. The still bottoms were unloaded from the pot stills using steam and

landfilled in the former still bottoms pond located east of the present spent solvent tank farm.

1970 to 1975

The time period between 1970 and 1975 represented a transition period where a large percentage of spent solvent shipments were received in bulk tanker trucks. A spent and reclaimed solvent tank farm was built just east of the existing spent solvent tank farm. The original tank farm is no longer in existence. Drummed solvent wastes were still believed to have been pumped directly into the distillation units as before. The basic distillation operation remained relatively unchanged except for the addition of a fractional distillation column. Still bottoms were landfilled off-site during this time period. ACS did not have production capacity data for this time period available during the interview.

1975 to Present

All of the distillation units were replaced, but the types of units remained basically the same. ACS does not presently use any azeotropic steam distillation units. The present spent solvent and reclaimed solvent tank farms were built. The majority of spent solvent waste streams are presently shipped in bulk tanker trucks. An elevated hazardous waste drum unloading dock and storage area was built in the early 1970's. The overhang roof and spill containment curbing and sump area were subsequently added. Drum shipments are presently pumped from the unloading dock area to the spent solvent tank farm via aboveground piping. Still bottoms are presently pumped to the secondary fuel blending tank farm for off-site disposal. No underground storage tanks (USTs) or underground piping have ever been associated with the reclamation operations. ACS did not have production capacity data for this time period available during the interview.

<u>Small Batch Manufacturing Operations</u>

Pre-1970

In the late 1960's to early 1970's, ACS began to manufacture small batches of specialty chemicals. Early manufacturing operations included rope treating with a fungicide, bromination and ski cable treating. The chemical used in the ski cable treatment operation and production capacities for each of the manufacturing operations were not discussed.

1970 to 1975

A lard oil process, using tallow and animal renderings as raw materials, was used to manufacture a lubricant product. The operation was located in the additive blending facility and involved a chiller unit, receiving vessel and dryer unit. The process basically consisted of the separation of solids from the light oil fraction via crystallization in the chiller unit and subsequent settling. The light oil fraction was then sold for further processing. ACS did not have production capacity data available for the time period during the interview. Raw materials and finished products were transported to and from the facility by rail car and stored in the blending area tank farm. A water/solids by-product was heated to create another product which was sold. The resulting wastewater was discharged to the sewer system.

The additive manufacturing area was built in 1971. Two hot oil reactors are located east of the additive manufacturing building. Ancillary equipment for these operations are also located outdoors in the same area. A saponification reaction of various solvents and waxes are performed in the hot oil reactors to make various detergents, lubricants and chemical additives. Soldering flux, made by dissolving gum resin in a petroleum-based solvent, was also manufactured. Primary raw materials and finished products are stored in the additive area tank farm. Small volume liquid raw materials are pumped out of drums into the reactors from pumping stations outside of the building. Solid raw materials are manually added into the tops of the reactors from a mezzanine platform. An 8,000-gallon UST, used to store a furfural alcohol mixture prior to reclamation, was removed in the mid-1980's. The UST was located near the reclamation building.

Primary raw materials used in the operations include xylene, furfural alcohol, various amines, methanol, formaldehyde, sodium hydroxide and maleic anhydride. Reflux solvents used in the reactions include various high boiling aromatic solvent blends (i.e., boiling points higher than xylene and toluene). A methanol/water mixture, generated from the reaction of formaldehyde, is collected in a storage tank in the area and pumped to the distillation units to reclaim the methanol. Other sources of wastewater are discharged to the sewer system. ACS reported that the reactors do not need to be flushed and cleaned between batches. ACS did not have production capacity data available for this time period during the interview.

1975 to Present

The operations, equipment and product lines have remained basically the same. The lard oil and soldering flux manufacturing operations were discontinued during this time period. ACS did not have production capacity data available for the time period during the interview.

Epoxidation Operations

Pre 1970

The epoxidation plant did not exist during this time period.

1970 to 1975

The epoxidation plant was built in 1974. The process consists of the oxidation of hydrogen peroxide in a reactor vessel to create a plastisizer. Hydrogen peroxide, linseed oil, formic acid (a catalyst), a reaction solvent and butanol (minor ingredient) are other raw materials used in the reaction. Benzene was the reaction solvent used until 1976. An aqueous phase, generated during the reaction, is separated and discharged to the sewer system. The reactant solvent is recovered as part of the process and a portion is reused. The remainder is transported to another part of the facility for off-site disposal. The primary raw materials and finished products are stored in the epoxidation area tank farm. Linseed oil is presently stored in a separate underground storage tank. Formic acid is stored in drums and manually added to the reactors. ACS did not have production capacity data available for this time period during the interview.

1975 to Present

The process and equipment has remained relatively unchanged. Toluene replaced benzene as the reaction solvent. A bromination operation used to produce a flavoring was added to the building in 1975. Soybean oil is brominated via an addition reaction in a glass lined reactor. Hexane is the carrier solvent used in the reaction. The spent hexane is disposed of in ACS's secondary fuel blending program. ACS did not have production capacity data available for this time period during the interview.

Incineration Operations

ACS incinerated its still bottoms and non-reclaimable materials on-site between 1966 and 1970. The first incinerator was installed in 1966, and a second in 1969. The former still bottoms pond was used to blend materials prior to incineration. Waste streams from off-site sources were stored in the injection area tank farm. Approximately 2 million gallons per year of waste was incinerated according to Roy F. Weston's December, 1984 site assessment report. The incinerators were removed from the site when operations were discontinued.

Secondary Fuel Blending Operations

Pre-1970

Secondary fuel blending operations were not performed during this time period. Settled solids that remained at the bottoms of 55-gallon spent solvent drums were probably left in the drums when they were shipped to a solvent reclaimer.

1970 to 1975

Secondary fuel blending operations were not performed during this time period. The disposition of the settled solids that remained in 55-gallon drums was not discussed for this time period.

1975 to Present

The injection area tank farm, previously used for the former on-site incinerators, is now used to store and blend waste streams for ACS's secondary fuel program. Bulk tanker truck shipments are unloaded directly into tanks. Drums are pumped from the previously discussed drum unloading area via aboveground piping to the secondary fuel tank farm. Secondary fuels are loaded from the storage tanks into railcars or bulk tanker trucks for off-site disposal. ACS reported that underground concrete pits were never used to dump and blend drum shipments. A 300-gallon open-top tank, which was partially buried, was used to blend solvent with an adhesive waste from a single customer in order to reduce its viscosity. The tank was located near the hot oil units and was subsequently removed (no date was given). ACS did not have production capacity data available for the time period during the interview.

Settled solids remaining at the bottom of 55-gallon drums are presently manually (or using a hoist) transferred into a metal holding trough. The solids are then gravity fed from the trough into five gallon pails for off-site disposal. Material transfer activities are also performed in the drum unloading dock area. As mentioned earlier, the drum unloading dock area is presently curbed with a collection sump in the middle of it.

Spill Collection Procedures and History

Spill Collection Procedures

An API separator located west of the reclamation building was used in the past to collect indoor spills from that area. Floating product from the API separator would be recovered and reclaimed. Resulting wastewater was discharged to one of two on-site treatment ponds between 1967 and 1972. A trench/tile system connected the treatment ponds. Effluent from the treatment ponds was discharged to the neighboring swamp area. ACS reported that the API separator was pumped out following the closure of the treatment ponds if any spills collected in it. The pumped out material was sent for off-site disposal. The API separator is reportedly no longer needed.

Based on a review of ACS's Spill Prevention, Control and Countermeasure plan (SPCC), spills from other areas of the site would either be immediately contained and cleaned up using absorbent materials, or routed to either one of two surface retention areas or one of the storm sewer collection basins. The storm sewer catch basins are routed to a large holding pond. A compartment located at the outfall to the holding pond is designed to hold any spilled materials until it can be pumped out. Overflow from the holding pond is discharged to the sewer system. ACS has not had to open the discharge valve from the holding pond to the sewer system for four months.

Spill History

ACS reported knowledge of the following past on-site spill incidents:

- Several hundred gallons of spent solvents were spilled on the leased property immediately north of the site (but within the currently fenced area) in 1968 due to a punctured drum and subsequent fire. The waste drums were believed to have contained acetone. No records exist concerning resulting cleanup actions, if any, that occurred.

- On one or two occasions, employees were reprimanded for spill incident(s) of several gallons. ACS said they would send Warzyn additional information regarding the volume, date, location and cleanup procedures.

Wastewater Discharges

Process wastewater presently originates from the reclamation, small batch and epoxidation operations, as well as from non-contact cooling water and boiler blowdown activities. The wastewater discharges from the small batch and epoxidation operations are by-products of the corresponding reactions, while wastewater from the reclamation plant is the resulting distillation bottoms from a solvent/water mixture (e.g. methanol/water from the small batch area) originating from both on and off-site sources. All of the wastewater discharge sources are routed to the City of Griffith sewer system. ACS reported that it did not know of process wastewaters ever being discharged to the current holding pond. The wastewater from the epoxidation operation is neutralized prior to being discharged to the sewer system.

The ACS facility is presently subject to U.S. EPA pretreatment regulations and has filed a baseline monitoring report with the City of Griffith. A copy of the latest sampling report was forwarded to Warzyn. ACS had exceeded either the average or maximum discharge standard for benzene, 1,1,1-trichloroethane, 1,1-dichloroethylene, trans-1,2-dichloroethylene, methylene chloride, toluene and trichloroetheylene. Toluene was present in the highest concentrations (average = 7433 and maximum = 9000 parts per billion).

SECTION 3
OBSERVATIONS DURING SITE WALKTHROUGH

The following observations were made by Mr. Mark Rothas of Warzyn during the site walkthrough:

- The API separator (constructed into an underground concrete pit) appeared to still be hooked up to the spill collection trenches inside of the reclamation building. An underground metal (appeared to be aluminum) conveyance pipe, approximately three feet in diameter, is used to gravity feed indoor spills to the separator. Since the treatment ponds have been closed, any overflows from the separator would discharge onto the ground. A small volume of unknown liquid(s) was observed inside of the separator pit. ACS believed it was accumulated rainwater. Any accumulation of spills inside of the separator unit reportedly would be pumped out for off-site disposal;

- The concrete pad underneath the distillation units was observed to be in deteriorated condition. In the past, 55-gallon drums of spent solvents were pumped into the distillation units from this pad;

- The bases and berms of all of the tank farms were reportedly of a gravel and clay construction and were built by the same private contractor. ACS does not have any design drawings or specifications for the containment systems. Most of the tanks (including secondary fuel blending and spent solvent tanks) located in the tank farm areas sit directly on top of the bases. ACS reported that rainwater is capable of percolating through the bases and does not accumulate. No surface evidence of spills was observed. If rainwater is capable of percolating through the bases, any spills in the tank farm areas would also be capable of percolating through the bases. ACS did not report any incidents of past spills in the tank farm areas;

- Truck loading and unloading hookup areas do not have secondary containment for spills. A gravel base was observed in most of those areas. Some evidence of surface discoloration was observed. The loading and unloading pumps were located on concrete platforms. Evidence of discoloration on the concrete surfaces was observed, which probably resulted from pump leaks and small spills from the cleaning of pump filter screens;

- ACS reported that the gravel base used throughout most of the site is predominantly an industrial slag fill material;

- 55-gallon drums of raw materials used in the small batch manufacturing and epoxidation operations are stored outdoors along the southern property line behind the additive blending building. Approximately 60 55-gallon drums were observed in this area. The drums were stored on pallets which sit on bare ground. The identification labels on the majority of drums were not legible. The drums that could be identified were various oils, amines and petroleum distillate solvents. Several of the drums appeared aged and evidence of corrosion was observed. No leaking drums were observed;

- The methanol/water by-product storage tank located in the small batch manufacturing area sits on bare ground. Evidence of corrosion was observed at the base of the bare steel tank. No visible evidence of a tank leak was observed;

- Two vertical, steel aboveground holding tanks, located outside of the epoxidation building, are used to collect and treat the wastewater from the epoxidation process. An oil layer is allowed to gravity separate in one of the tanks, which is subsequently skimmed, drummed and pumped into the secondary fuel tanks. The remaining wastewater is then automatically neutralized with acid and discharged to the sewer system;

  Two concrete separation pits are situated next to the wastewater treatment tanks. These pits are reportedly used to collect indoor spills from the epoxidation building, as well as blowdown from the epoxidation processes. Contents collected in these pits reportedly are not discharged to the sewer system. A couple of feet of liquid, believed to be rainwater, was observed in the concrete pits;

- The reactors, hot oil systems and other ancillary equipment used in the small batch manufacturing operations are situated outdoors on a concrete pad. An oil sheen and residue was evident on the surface of the concrete pad. Oil stains were evident on gravel areas immediately adjacent to the concrete pad;

- Piping clusters used for the railcar filling of products stored in the additive tank farm area run several hundred feet along the ground from the tank farm to the railcar loading area. There is no spill or leak containment system in place for the piping run. No visible evidence of piping leaks from the system was observed;

- Secondary fuels are presently shipped off-site by railcar. An aboveground piping system is used to pump the secondary fuels from the tank farm area into the railcars. A hose is placed through manways located on top of the railcars for loading purposes. No visible evidence of leaks or spills was observed along the piping run or in the railcar loading area;

Secondary fuels were shipped off-site by bulk tanker truck in the past. The loading pipe from the secondary fuel tank farm was observed to be underground. The tanker truck hookup stuck out of the wall of the eastern berm of the tank farm, approximately four inches off of the ground (gravel base). There was no secondary spill containment observed in this area;

- Toluene, various oils, formic acid, sodium hydroxide etc. used in the epoxidation process are stored in the epoxidation area tank farm;

- Formaldehyde, sodium hydroxide, xylene, furfural alcohol, various oils, high flash petroleum solvent blends and various amines are stored in the small batch manufacturing area tank farm;

- Approximately 100 hazardous waste drums were observed on the concrete unloading dock area outside of the protective roof overhang. Most of these drums appeared to be either empty or partially full. ACS reported that this area was used to store empty drums and drums awaiting manual removal of settled solids. In addition, approximately 25 55-gallon drums labeled as "trichloroethene" were also observed in this storage area. ACS reported that it did not use trichloroethene in its operations, and that these drums must have been used to ship spent solvents, which subsequently had their hazardous waste labels removed;

- Empty raw material drums were observed being stored on their sides on bare ground in numerous locations throughout the site. The largest number of empty drums were observed being stored in the open area west of the blending area tank farm; and

- Approximately 20 steel tanks were observed being stored on the grounds outside of the fenced areas of the site. ACS reported that they had obtained these tanks for use in the past. The tanks were not needed, however, and have not been used to date. ACS is still storing the tanks on its grounds.

SECTION 4
REVIEW OF OTHER INFORMATION SOURCES

The following information is contained in ACS's Resource Conservation and Recovery Act (RCRA) Part B permit application (Part B) submitted to the U.S. EPA on August 18, 1982, as well as various documents pertaining to past RCRA inspections of the facility:

- Reference is made in the Part B to a "drum dumping" operation in the area of the elevated drum unloading dock. Settled solids from the bottoms of 55-gallon drums, as well as other non-pumpable waste materials, were manually dumped from the top of the unloading dock into three "solid waste boxes" located along the western base of the dock. The solid waste boxes were transported by forklift to the former solids mixing area. Approximately 20,000 gallons per year of material was handled in this manner.

  Material from the solid waste boxes were often pumped into an adjacent blending tank. Thinning solvents, in turn, would be dumped into the solid waste boxes and pumped into the blending tank to reduce the viscosity of viscous materials. Materials from the blending tank were pumped to the secondary fuel tank farm.

- Reference is also made in the Part B to a "Solids Blending Bin- Location D". This area is referred to as the "Former Solids Mixing Area" on the site map. Based on schematic drawings contained in the Part B, it appears that the solids blending area was a rectangular concrete pad which was divided into three compartments by earthen berms. Each of the compartments was lined with sand used to absorb liquid components of solids to be landfilled. Waste materials were dumped from a solid waste box into a solids blending compartment and mixed with the sand.

  The sand/waste mixture was tractor loaded into a dump box for off-site landfilling. Settled solids and non-pumpable waste streams from the drum dumping operation were the primary materials mixed in this area. According to an October 19, 1984 correspondence between ACS and the U.S. EPA, settled solids from the bulk storage tanks, captured solids from pump filter screens and spill cleanup residues were also reportedly mixed in the solids blending area.

- Handwritten notes and U.S. EPA correspondences pertaining to RCRA inspections of the facility conducted on October 12, 1983 and April 10, 1984 also make references to the drum dumping and solids mixing operations.

- Handwritten notes from an April 10, 1984 RCRA inspection of the facility reference the following:

  - a sump, believed to be the API separator discussed previously. Approximately 2,500 gallons per month of the aqueous phase from the distillation operations were drained to this sump from the reclamation building. The sump is concrete, 5 to 6,000 gallons in capacity and was installed in 1968. Material from the sump was pumped to the secondary fuel blending tank farm;

  - another sump located in the drum dumping area near the solid waste boxes. Approximately 100 gallons of material was in this sump at the time of the inspection; and

  - comments by ACS stating that small volumes of hazardous waste spill cleanup residues were collected in drums. Spill cleanup residues were also transferred to the former solids mixing area.

V251R03MSR/gmg/dms/PJV

C

X	Y	millimhos/meter
-4	4	12
-4	5	12
-4	6	12
-4	7	12
-4	8	12
-4	9	11
-4	10	11
-4	11	11
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-3	24	0
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-3	26	0
-3	27	15
-3	28	12
-3	29	12
-3	30	23

DRAFT

DRAFT

X	Y	millimhos/meter
-3	31	0
-3	32	0
-3	33	0
-3	34	0
-3	35	0
-3	36	0
-3	37	0
-3	38	13
-3	39	0
-3	40	15
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-2	20	0
-2	21	0
-2	22	0
-2	23	0
-2	24	0
-2	25	0
-2	26	0
-2	27	0
-2	28	0
-2	29	24
-2	30	0
-2	31	0
-2	32	0
-2	33	0
-2	34	0
-2	35	0
-2	36	0
-2	37	0
-2	38	0
-2	39	0
-1	0	21
-1	1	21
-1	2	22
-1	3	18
-1	4	16
-1	5	16
-1	6	14
-1	7	14
-1	8	14
-1	9	14
-1	10	14
-1	11	14
-1	12	14

DRAFT

X	Y	millimhos/meter
-1	13	13
-1	14	14
-1	15	0
-1	16	13
-1	17	0
-1	18	0
-1	19	0
-1	20	0
-1	21	0
-1	22	0
-1	23	0
-1	24	0
-1	25	0
-1	26	0
-1	27	0
-1	28	0
-1	29	0
-1	30	0
-1	31	0
-1	32	0
-1	33	0
-1	34	0
-1	35	0
-1	36	0
-1	37	0
-1	38	0
-1	39	0
-1	40	0
0	0	22
0	1	24
0	2	23
0	3	20
0	4	18
0	5	16
0	6	16
0	7	15
0	8	15
0	9	15
0	10	15
0	11	15
0	12	14
0	13	14
0	14	15
0	15	15
0	16	0
0	17	0
0	18	0
0	19	0
0	20	0
0	21	0
0	22	0
0	23	0
0	24	0
0	25	0
0	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0

DRAFT

X	Y	millimhos/meter
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
1	0	22
1	1	20
1	2	21
1	3	20
1	4	19
1	5	17
1	6	16
1	7	15
1	8	14
1	9	15
1	10	17
1	11	17
1	12	16
1	13	16
1	14	14
1	15	17
1	16	0
1	17	0
1	18	0
1	19	0
1	20	0
1	21	0
1	22	0
1	23	0
1	24	0
1	25	0
1	26	0
1	27	0
1	28	0
1	29	0
1	30	0
1	31	0
1	32	0
1	33	0
1	34	0
1	35	0
1	36	0
1	37	0
1	38	0
1	39	0
1	40	0
2	0	22
2	1	20
2	2	20
2	3	19
2	4	18
2	5	20
2	6	22
2	7	24
2	8	27
2	9	20
2	10	12
2	11	21
2	12	19
2	13	19
2	14	18
2	15	21

DRAFT

X	Y	millimhos/meter
2	16	24
2	17	0
2	18	0
2	19	15
2	20	0
2	21	0
2	22	0
2	23	0
2	24	0
2	25	0
2	26	0
2	27	0
2	28	0
2	29	0
2	30	0
2	31	15
2	32	0
2	33	0
2	34	0
2	35	0
2	36	0
2	37	0
2	38	0
2	39	0
2	40	0
2	41	0
3	0	20
3	1	21
3	2	20
3	3	16
3	4	19
3	5	22
3	6	27
3	7	32
3	8	29
3	9	28
3	10	0
3	11	0
3	12	28
3	13	32
3	14	36
3	15	22
3	16	36
3	17	0
3	18	0
3	19	0
3	20	0
3	21	0
3	22	0
3	23	0
3	24	0
3	25	0
3	26	0
3	27	0
3	28	0
3	29	0
3	30	0
3	31	0
3	32	0
3	33	0
3	34	0
3	35	0
3	36	0

DRAFT

X	Y	millimhos/meter
3	37	0
3	38	0
3	39	0
3	40	0
4	0	21
4	1	23
4	2	24
4	3	21
4	4	23
4	5	28
4	6	34
4	7	34
4	8	36
4	9	36
4	10	0
4	11	0
4	12	0
4	13	0
4	14	0
4	15	0
4	16	85
4	17	0
4	18	0
4	19	0
4	20	0
4	21	100
4	22	110
4	23	0
4	24	0
4	25	0
4	26	0
4	27	0
4	28	0
4	29	0
4	30	0
4	31	0
4	32	0
4	33	0
4	34	0
4	35	0
4	36	0
4	37	0
4	38	0
4	39	0
4	40	0
5	0	20
5	1	24
5	2	24
5	3	24
5	4	25
5	5	30
5	6	32
5	7	42
5	8	55
5	9	0
5	10	0
5	11	0
5	12	0
5	13	0
5	14	0
5	15	0
5	16	0
5	17	0

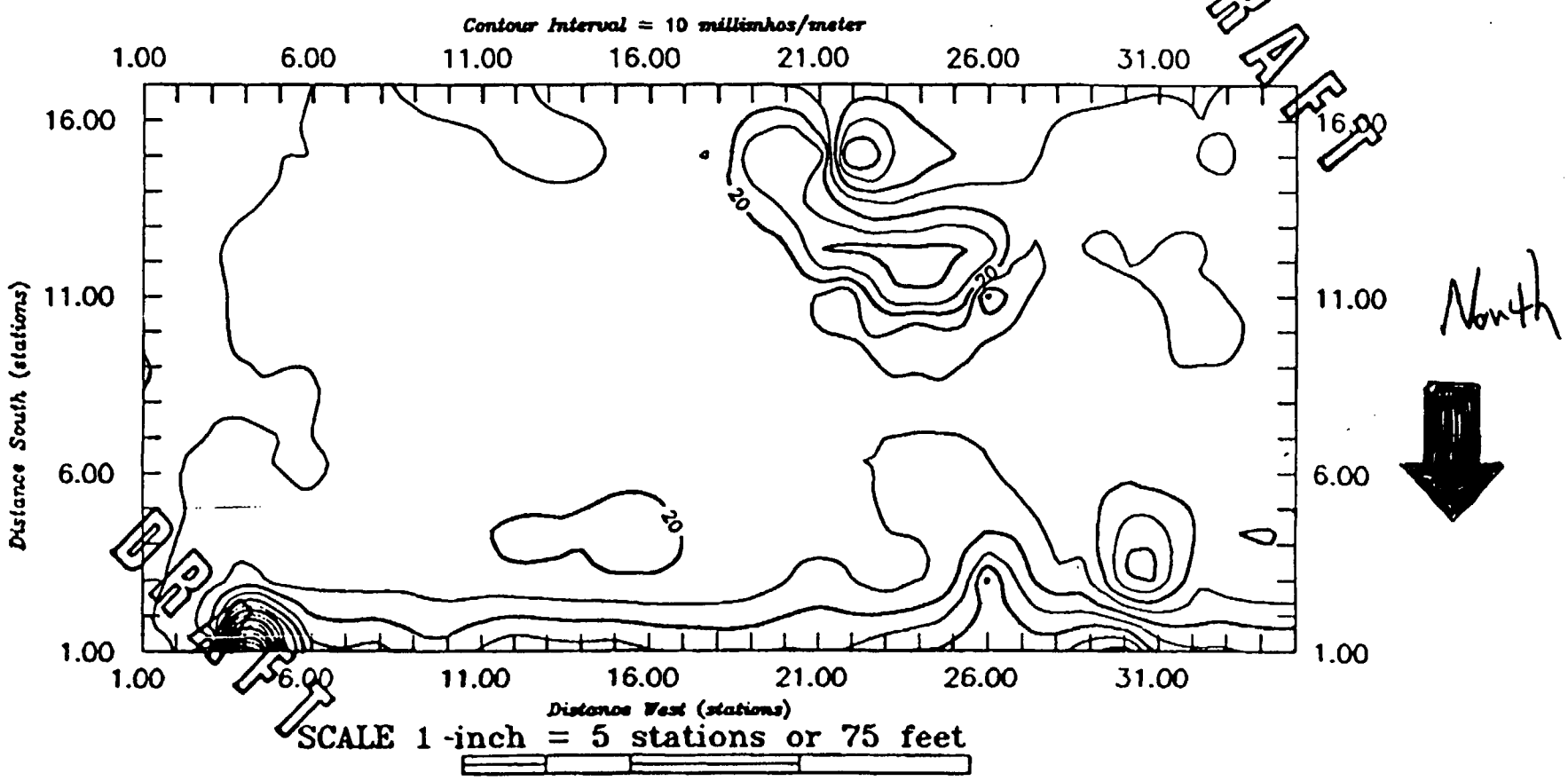
DRAFT

X	Y	millimhos/meter
5	18	0
5	19	0
5	20	0
5	21	0
5	22	425
5	23	390
5	24	160
5	25	105
5	26	0
5	27	56
5	28	0
5	29	0
5	30	0
5	31	33
5	32	16
5	33	26
5	34	0
5	35	0
5	36	0
5	37	0
5	38	0
5	39	0
5	40	0
5	41	270
5	42	180
5	43	0
5	44	0
5	45	0
5	46	0
5	47	44
6	0	21
6	1	20
6	2	20
6	3	24
6	4	23
6	5	32
6	6	37
6	7	48
6	8	85
6	9	42
6	10	0
6	11	0
6	12	0
6	13	0
6	14	0
6	15	0
6	16	150
6	17	0
6	18	0
6	19	0
6	20	0
6	21	0
6	22	0
6	23	140
6	24	58
6	25	60
6	26	0
6	27	0
6	28	0
6	29	60
6	30	0
6	31	0
6	32	0

DRAFT

X	Y	millimhos/meter
6	33	0
6	34	0
6	35	0
6	36	0
6	37	36
6	38	0
6	39	0
6	40	0
6	41	0
6	42	0
6	43	140
6	44	75
6	45	0
6	46	0
7	0	21
7	1	21
7	2	22
7	3	25
7	4	30
7	5	36
7	6	50
7	7	0
7	8	0
7	9	0
7	10	0
7	11	0
7	12	0
7	13	0
7	14	0
7	15	0
7	16	0
7	17	170
7	18	0
7	19	0
7	20	0
7	21	0
7	22	0
7	23	0
7	24	0
7	25	0
7	26	0
7	27	0
7	28	0
7	29	0
7	30	0
7	31	0
7	32	0
7	33	0
7	34	0
7	35	0
7	36	0
7	37	0
7	38	0
7	39	0
7	40	0
7	41	0
7	42	0
7	43	0
7	44	80
7	45	54
8	0	21
8	1	20
8	2	22

ACS Onsite - Draft Contour Map of EM Values (0 to 169 mmhos/m)



SCALE 1 -inch = 5 stations or 75 feet

DRAFT

X	Y	millimhos/meter
8	3	24
8	4	31
8	5	45
8	6	54
8	7	0
8	8	0
8	9	0
8	10	0
8	11	170
8	12	0
8	13	0
8	14	0
8	15	0
8	16	210
8	17	290
8	18	200
8	19	0
8	20	0
8	21	0
8	22	0
8	23	0
8	24	0
8	25	60
8	26	110
8	27	90
8	28	85
8	29	170
8	30	130
8	31	0
8	32	0
8	33	0
8	34	0
8	35	80
8	36	75
8	37	80
8	38	0
8	39	0
8	40	0
8	41	0
8	42	0
8	43	0
8	44	60
8	45	50
8	46	40
8	47	35
9	1	18
9	2	20
9	3	25
9	4	100
9	5	50
9	6	0
9	7	0
9	8	0
9	9	0
9	10	0
9	11	180
9	12	0
9	13	0
9	14	0
9	15	0
9	16	0
9	17	0
9	18	140

DRAFT

X	Y	millimhos/meter
9	19	105
9	20	115
9	21	0
9	22	0
9	23	0
9	24	0
9	25	140
9	26	160
9	27	215
9	28	160
9	29	190
9	30	0
9	31	0
9	32	0
9	33	0
9	34	0
9	35	0
9	36	0
9	37	0
9	38	0
9	39	0
9	40	0
9	41	0
9	42	0
9	43	0
9	44	0
9	45	0
9	46	33
9	47	36
10	2	23
10	3	28
10	4	52
10	5	0
10	6	0
10	7	0
10	8	0
10	9	0
10	10	0
10	11	0
10	12	0
10	13	[illegible]
10	14	0
10	15	0
10	16	0
10	17	0
10	18	0
10	19	0
10	20	0
10	21	0
10	22	0
10	23	0
10	24	150
10	25	240
10	26	125
10	27	0
10	28	0
10	29	0
10	30	100
10	31	0
10	32	0
10	33	0
10	34	0
10	35	0

DRAFT

X	Y	millimhos/meter
10	36	0
10	37	0
10	38	0
10	39	0
10	40	0
10	41	0
10	42	0
10	43	0
10	44	0
10	45	0
10	46	0
10	47	46
10	48	0
11	1	23
11	2	25
11	3	29
11	4	54
11	5	0
11	6	0
11	7	0
11	8	0
11	9	0
11	10	0
11	11	58
11	12	0
11	13	0
11	14	0
11	15	0
11	16	0
11	17	0
11	18	0
11	19	0
11	20	0
11	21	0
11	22	0
11	23	0
11	24	
11	25	0
11	26	145
11	27	0
11	28	85
11	29	0
11	30	70
11	31	0
11	32	0
11	33	0
11	34	0
11	35	0
11	36	0
11	37	0
11	38	0
11	39	0
11	40	0
11	41	0
11	42	0
11	43	0
11	44	0
11	45	0
11	46	0
11	47	0
11	48	0
12	2	27
12	3	34

DRAFT

X	Y	millimhos/meter
12	4	38
12	5	34
12	6	0
12	7	0
12	8	0
12	9	0
12	10	0
12	11	0
12	12	90
12	13	130
12	14	0
12	15	0
12	16	0
12	17	0
12	18	0
12	19	0
12	20	0
12	21	0
12	22	0
12	23	0
12	24	0
12	25	0
12	26	0
12	27	80
12	28	0
12	29	80
12	30	0
12	31	0
12	32	0
12	33	70
12	34	0
12	35	0
12	36	0
12	37	0
12	38	0
12	39	65
12	40	0
12	41	0
12	42	0
12	43	72
12	44	80
12	45	0
12	46	0
12	47	0
13	2	28
13	3	28
13	4	40
13	5	0
13	6	0
13	7	0
13	8	0
13	9	0
13	10	0
13	11	0
13	12	0
13	13	0
13	14	0
13	15	0
13	16	0
13	17	0
13	18	0
13	19	70
13	20	0

DRAFT

X	Y	millimhos/meter
13	21	0
13	22	0
13	23	0
13	24	0
13	25	0
13	26	0
13	27	0
13	28	0
13	29	90
13	30	90
13	31	0
13	32	0
13	33	0
13	34	0
13	35	0
13	36	0
13	37	0
13	38	0
13	39	0
13	40	0
13	41	0
13	42	0
13	43	0
13	44	0
13	45	0
13	46	0
13	47	0
14	2	27
14	3	29
14	4	38
14	5	30
14	6	50
14	7	44
14	8	0
14	9	0
14	10	0
14	11	0
14	12	0
14	13	110
14	14	0
14	15	0
14	16	0
14	17	0
14	18	0
14	19	0
14	20	0
14	21	0
14	22	0
14	23	0
14	24	0
14	25	0
14	26	120
14	27	0
14	28	0
14	29	120
14	30	0
14	31	140
14	32	0
14	33	90
14	34	0
14	35	0
14	36	0
14	37	0

DRAFT

X	Y	millimhos/meter
14	38	0
14	39	0
14	40	0
14	41	0
14	42	0
14	43	0
14	44	0
14	45	0
14	46	0
14	47	0
15	2	26
15	3	31
15	4	36
15	5	46
15	6	42
15	7	48
15	8	48
15	9	0
15	10	0
15	11	0
15	12	0
15	13	0
15	14	0
15	15	150
15	16	200
15	17	140
15	18	130
15	19	0
15	20	80
15	21	0
15	22	0
15	23	0
15	24	0
15	25	0
15	26	110
15	27	90
15	28	70
15	29	130
15	30	0
15	31	0
15	32	0
15	33	0
15	34	0
15	35	0
15	36	0
15	37	0
15	38	0
15	39	0
15	40	0
15	41	0
15	42	0
15	43	0
15	44	0
15	45	0
15	46	0
15	47	0
16	3	27
16	4	34
16	5	0
16	6	0
16	7	0
16	8	0
16	9	0

DRAFT

X	Y	millimhos/meter
16	10	0
16	11	0
16	12	0
16	13	0
16	14	0
16	15	0
16	16	220
16	17	180
16	18	140
16	19	70
16	20	0
16	21	0
16	22	0
16	23	0
16	24	0
16	25	0
16	26	130
16	27	0
16	28	100
16	29	90
16	30	95
16	31	90
16	32	0
16	33	0
16	34	0
16	35	0
16	36	0
16	37	0
16	38	0
16	39	0
16	40	0
16	41	0
16	42	0
16	43	0
16	44	0
16	45	85
16	46	110
16	47	80
17	1	23
17	2	25
17	3	28
17	4	42
17	5	44
17	7	0
17	8	0
17	9	0
17	10	0
17	11	0
17	12	0
17	13	48
17	14	0
17	15	0
17	16	0
17	17	80
17	18	0
17	19	0
17	20	0
17	21	0
17	22	110
17	23	160
17	24	120
17	25	100
17	26	110

DRAFT

X	Y	millimhos/meter
17	27	120
17	28	0
17	29	100
17	30	98
17	31	60
17	32	64
17	33	0
17	34	0
17	35	0
17	36	0
17	37	0
17	38	0
17	39	0
17	40	0
17	41	0
17	42	0
17	43	0
17	44	0
17	45	90
17	46	82
17	47	80
17	48	60
18	1	24
18	2	24
18	3	27
18	4	32
18	5	34
18	6	20
18	7	0
18	8	0
18	9	0
18	10	40
18	11	0
18	12	0
18	13	0
18	14	0
18	15	44
18	16	0
18	17	72
18	18	100
18	19	90
18	20	80
18	21	100
18	22	120
18	23	0
18	24	140
18	25	110
18	26	0
18	27	0
18	28	140
18	29	130
18	30	95
18	31	80
18	32	70
18	33	44
18	34	0
18	36	0
18	37	0
18	38	0
18	39	80
18	40	0
18	41	0
18	42	0

DRAFT

X	Y	millimhos/meter
18	43	0
18	44	0
18	45	0
18	46	90
18	47	85
19	2	24
19	3	26
19	4	29
19	5	35
19	6	44
19	7	0
19	8	0
19	9	0
19	10	0
19	11	0
19	12	0
19	13	0
19	14	0
19	15	48
19	16	76
19	17	44
19	18	68
19	19	0
19	20	0
19	21	60
19	22	90
19	23	145
19	24	105
19	25	160
19	26	0
19	27	195
19	28	180
19	29	170
19	30	0
19	31	43
19	32	0
19	33	0
19	34	0
19	35	0
19	36	0
19	37	0
19	38	0
19	39	0
19	40	78
19	41	0
19	42	0
19	43	0
19	44	78
19	45	78
19	46	84
19	47	92
20	2	29
20	3	25
20	4	27
20	5	32
20	6	42
20	7	65
20	8	57
20	9	0
20	10	0
20	11	0
20	12	55
20	13	90

DRAFT

X	Y	millimhos/meter
20	14	0
20	15	0
20	16	0
20	17	88
20	18	95
20	19	0
20	20	0
20	21	90
20	22	130
20	23	120
20	24	120
20	25	130
20	26	0
20	27	0
20	28	170
20	29	0
20	30	140
20	31	0
20	32	0
20	33	0
20	34	0
20	35	0
20	36	0
20	37	0
20	38	0
20	39	0
20	40	50
20	41	0
20	42	0
20	43	70
20	44	81
20	45	80
20	46	72
20	47	90
21	1	24
21	2	30
21	3	31
21	4	29
21	5	29
21	6	36
21	7	38
21	8	0
21	9	44
21	10	48
21	11	0
21	12	0
21	13	90
21	14	64
21	15	60
21	16	0
21	17	100
21	18	125
21	19	0
21	20	0
21	21	70
21	22	100
21	23	100
21	24	105
21	25	84
21	26	0
21	27	120
21	28	140
21	29	120

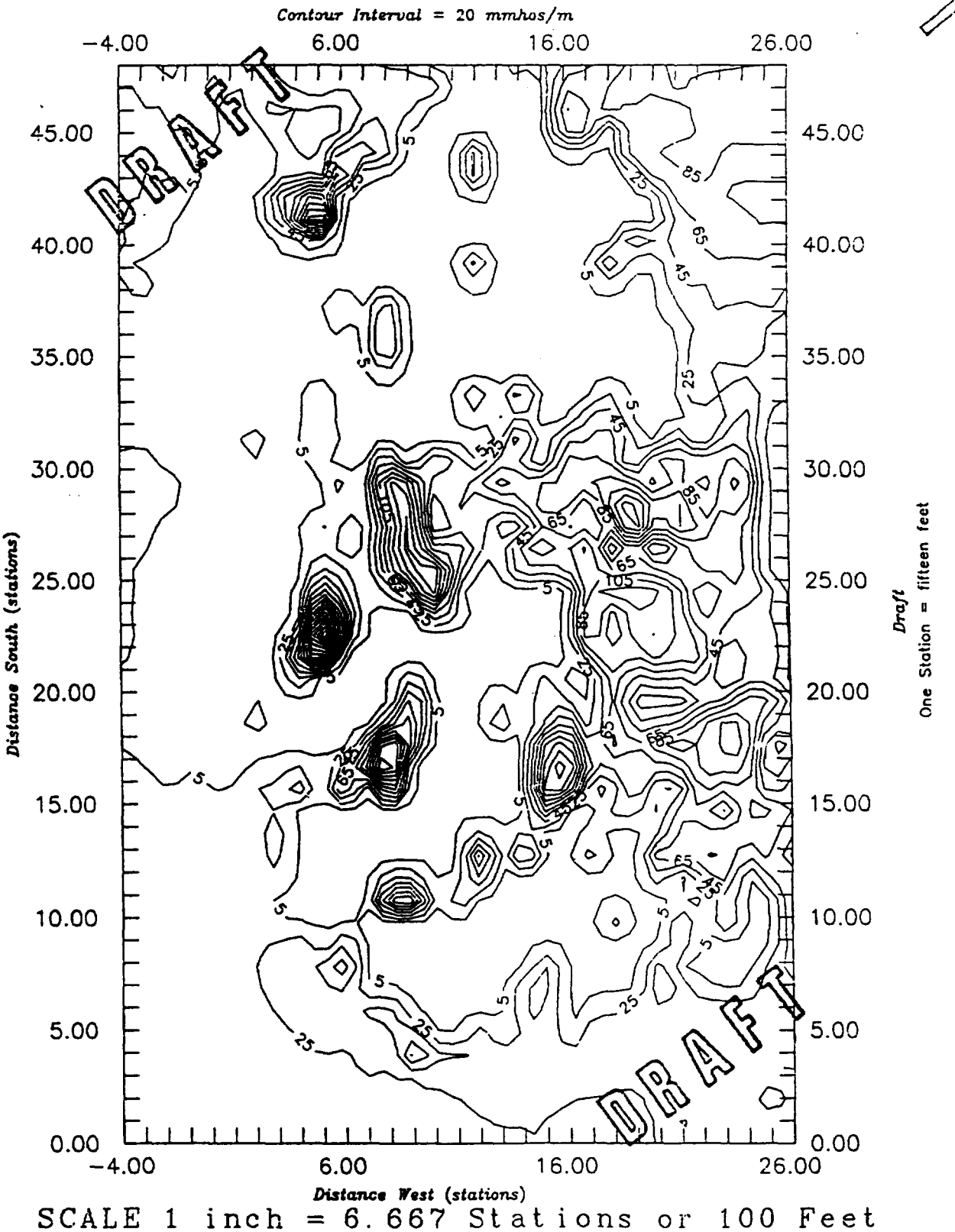
DRAFT

X	Y	millimhos/meter
21	30	82
21	31	88
21	32	0
21	33	0
21	34	0
21	35	0
21	36	0
21	38	44
21	39	42
21	40	48
21	41	48
21	42	66
21	43	78
21	44	92
21	45	80
21	46	70
21	47	110
22	1	32
22	2	24
22	3	32
22	4	30
22	5	30
22	6	45
22	7	0
22	8	0
22	9	0
22	10	0
22	11	0
22	12	65
22	13	98
22	14	55
22	15	62
22	16	115
22	17	115
22	18	90
22	19	95
22	20	0
22	21	110
22	22	80
22	23	65
22	24	0
22	25	50
22	26	88
22	27	78
22	28	120
22	29	0
22	30	120
22	31	0
22	32	0
22	33	48
22	34	42
22	35	48
23	1	27
23	2	30
23	3	32
23	4	25
23	5	37
23	6	38
23	7	0
23	8	0
23	9	0
23	10	60
23	11	38

DRAFT

X	Y	millimhos/meter
25	6	41
25	7	46
25	8	30
25	9	0
25	10	0
25	11	0
25	12	62
25	13	80
25	14	76
25	15	92
25	16	0
25	17	0
25	18	0
25	19	74
25	20	92
25	21	0
25	22	84
25	23	0
25	24	66
25	25	0
25	26	0
25	27	0
25	28	0
25	29	0
25	30	0
25	31	0
25	32	0
26	1	29
26	2	29
26	3	28
26	4	29
26	5	29
26	6	33
26	7	41
26	8	56
26	9	62
26	10	71
26	11	72
26	12	64
26	13	0
26	14	68
26	15	58
26	16	53
26	17	36
26	18	0
26	19	72
26	20	0
26	21	0
26	22	0
26	23	0
26	24	0
26	25	0
26	26	0
26	27	0
26	28	0
26	29	0
26	30	62

ffsite – Draft Contour Map of High EM Values (5 to 350 mmhos/m)

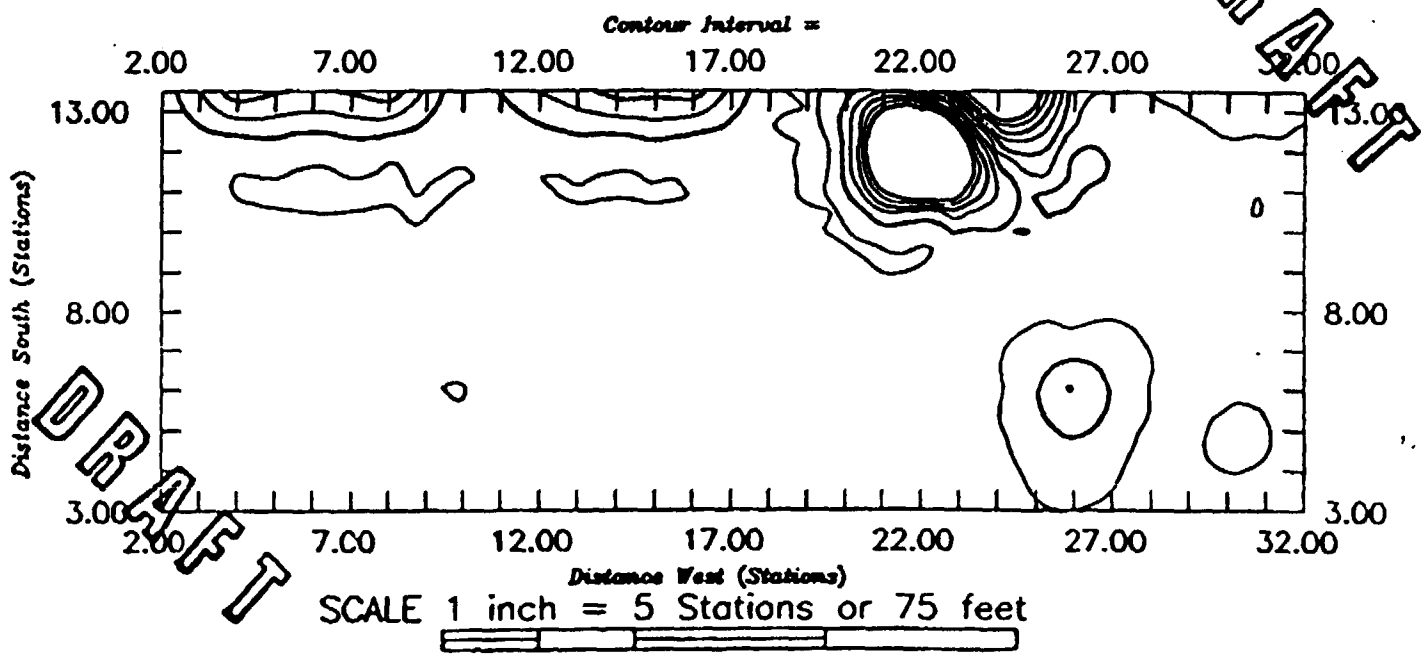


SCALE 1 inch = 6.667 Stations or 100 Feet

STANDARD DISCLAIMER

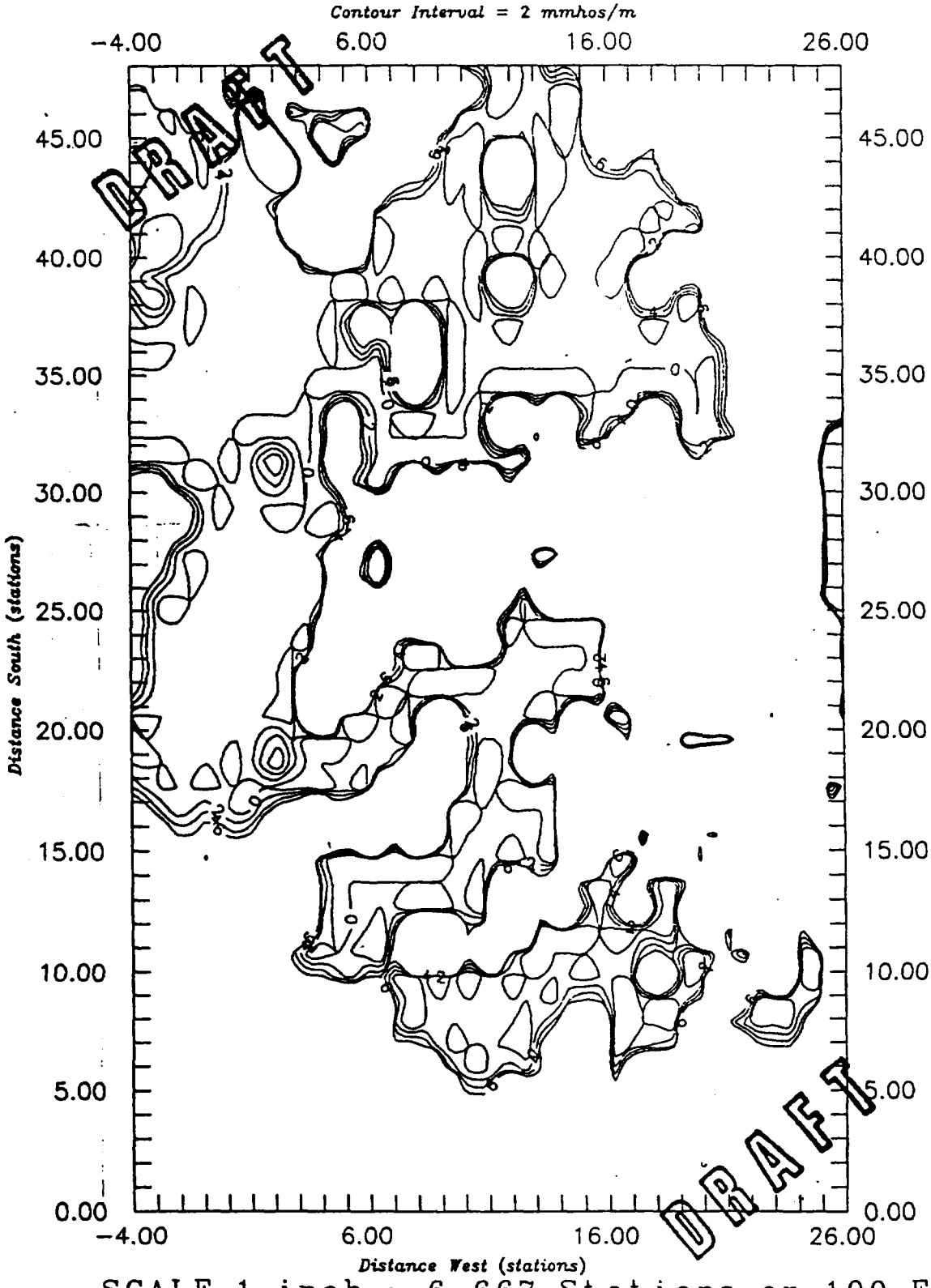
The objective of any geophysical survey is to define the existence and configuration of features at depth. However, these features may bear a highly complex relationship to the geophysical measurements recorded. Therefore, conclusions drawn, no matter how logically deduced, should not be misconstrued as fact. We shall not and will not, except in the case of gross or willful negligence on our part, be liable or responsible for any losses, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, employees and agents or by anyone else not related to Fromm Applied Technology or Wooddell Logging, Inc. who might base interpretations and opinions on our geophysical surveys.

ACS Onsite – Draft Contour Map of Total Field Magnetic Values (gammas)



DRAFT
DRAFT

ACS Offsite – Draft Contour Map of Low EM Values (0 to 6 mmhos/m)



SCALE 1 inch = 6.667 Stations or 100 Feet

APPENDIX D

Boring Logs for Soil Borings Monitoring Wells and Leachate Wells

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. LW-2
Surface Elevation 647.4
Job No. 60251.03
Sheet 1 of 2

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth		qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monotox
						FILL: Black Sandy CLAY		0.0			
					5	LANDFILL REFUSE: Gray Sandy Fill with various paper Debris.		0.0			
					10			0.0			
					15			0.0			
					20						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 16.5 16.5 Upon Completion of Drilling
Time After Drilling 8/17/89 14.81'
Depth to Water 14.5' ▼
Depth to Cave in 9/8/89

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 7/13/89 End 7/13/89
Driller ETI Chief JJK Rig D 50
Logger TWP Editor TJM
Drill Method 4 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. LW-2
Surface Elevation 647.4
Job No. 60251.03
Sheet 2 of 2

ONE PIERCE PLACE · SUITE 1110, ITASCA, ILL. 60143 · TEL(312) 773-8484

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth		qu (qa) (tsf)	Hnu	Explo-sive Gas	Field VOC Water	Mo tox
1		6	W	100	25	Soft Silty Fine SAND, Runny.		0.0			
						Dense Gray Silty CLAY, Trace Sand.					
						End Boring at 27.5' Installed Well at 27.5'					
					30						
					35						
					40						

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. LW-3
Surface Elevation 643.3
Job No. 60251.03
Sheet 1 of 2

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Type	Rec (in.)	Moist	N	Depth		qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monotox
						FILL: Gray Silty Fine to Coarse Sand.					
								0.0			
						LANDFILL REFUSE:					
					5						
								1.0			
					10						
								0.0			
					15						
								0.0			
					20						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 8.312'	Upon Completion of Drilling			8.3'
Time After Drilling			8/17/89	9/8/89
Depth to Water	10.5'		9.49'	10.70' ▼
Depth to Cave in				

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 7/13/89 End 7/13/89
Driller ETI Chief JJK Rig D 50
Logger TWP Editor TJM
Drill Method 4 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. LW-3
Surface Elevation 643.3
Job No. 60251.03
Sheet 2 of 2

ONE PIERCE PLACE · SUITE 1110, ITASCA, ILL. 60143 · TEL(312) 773-8484

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth		qu (qa) (tsf)	Hnu	Explo-sive Gas	Field VOC Water	Mon to
						End Boring at 23' Installed Well at 23.5'					
					25						
					30						
					35						
					40						

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. LW-4
Surface Elevation 641.5
Job No. 60251.03
Sheet 1 of 2

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Type	Rec (in.)	Moist	N	Depth		qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monotox
					Brown Sandy Surface						
					LANDFILL REFUSE:						
								0.0			
					5						
								0.0			
					10						
								0.0			
					15						
								0.0			
					20						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 20.020' Upon Completion of Drilling _____

Time After Drilling	7/17/89		8/17/89	9/8/89
Depth to Water	20.2'		8.20'	8.71' ▽
Depth to Cave in				

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 7/14/89 End 7/14/89
Driller ETI Chief JJK Rig D 50
Logger TWP Editor TJM
Drill Method 4 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. LW-4
Surface Elevation 641.5
Job No. 60251.03
Sheet 2 of 2

ONE PIERCE PLACE · SUITE 1110, ITASCA, ILL. 60143 · TEL(312) 773-8484

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Type	Rec (in.)	Moist	N	Depth		qu (qa) (tsf)	Hnu	Explo-sive Gas	Field VOC Water	Mo to
								0.0			
					25						
					Soft CLAY at 27'			0.0			
					End Boring at 28.5' Installed Well at 27'						
					30						
					35						
					40						

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. MW-1
Surface Elevation 635.7
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monotox
						Black and Brown Fine to Medium SAND.					
1		15	D	12				0.0			
2		14	M/W	11				0.0			
					5						
3		15	W	14		Increasing Finer Sand Brown and Gray poorly sorted Coarse SAND.		0.0			
4		17	W	16		Gray Fine to Medium SAND, Well Sorted.		0.0			
					10						
5		18	W	15				0.0			
						Silty CLAY Seam (0.5') at 12', Trace Fine to Medium Sand.					
6		18	W	17		Gray Fine to Medium SAND, Well Sorted		0.0			
					15						
7		18	W/M			Dense Gray Silty CLAY, Trace Fine Sand. (CL) Collected Shelby Tube at 15-17'					
						End Boring at 17' Installed Well at 14.5'					
					20						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 3.54' Upon Completion of Drilling 2.8'

Time After Drilling			8/17/89	9/8/89
Depth to Water			1.58'	3.05' ▼
Depth to Cave in				

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 7/25/89 End 7/25/89
Driller ETI Chief KKT Rig D 50
Logger TWP Editor TJM
Drill Method 4 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. MW-2
Surface Elevation 634.8
Job No. 60251.03
Sheet 1 of 2

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Mo t
						FILL: Road Gravel and Sand		0.0			
1		3	D	6		Brown Fine Silty SAND					
2		15	W	14				0.0			
					5	Increasing Gray Coarse SAND and GRAVEL					
3		10	W	7				0.0			
						Gray Coarse SAND, Poorly Sorted.					
4		17	W	16				0.0			
					10						
5		18	W	42				0.0			
						Dense Gray Silty CLAY Seam (5") at 12'					
						Gray Fine to Coarse SAND, Poorly Sorted.					
6		18	W	8				0.0			
					15						
7		18	W	15				0.0			
8		18	W	77				0.0			
					20	Dense Gray Silty CLAY, Trace Fine Sand. (CL)					

WATER LEVEL OBSERVATIONS

While Drilling	▽ 4.0	Upon Completion of Drilling		6'
Time After Drilling			8/17/89	9/8/89
Depth to Water			2.70'	3.92' ▼
Depth to Cave in				

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 7/24/89 End 7/24/89
Driller ETI Chief KKT Rig D 50
Logger TWP Editor TJM
Drill Method 4 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. MW-2
Surface Elevation 634.8
Job No. 60251.03
Sheet 2 of 2

ONE PIERCE PLACE · SUITE 1110, ITASCA, ILL. 60143 · TEL(312) 773-8484

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth		qu (qa) (tsf)	Hnu	Explo-sive Gas	Field VOC Water	Mono-tox
9		18	M								
						End Boring at 22' Installed Well at 16.5'					
					25						
					30						
					35						
					40						

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. MW-3
Surface Elevation 634.1
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Mor to
						Yellow Silty Fine SAND					
1		18	D	11		Black to Brown Fine SAND, (Solvent-like Odor)		0.0			
2		14	W	12	5	Dark Gray at 4'		0.0			
3		18	W	18		Dark Staining at 6-6.5' Becomes Gray Fine SAND		0.0			
4		18	W	41	10	Increasing Coarse Sand at 9'		40.0			
5		18	W	52				65.0			
6		18	W	55		Black Staining at 13.5-14'		40.0			
7		18	M		15	Dense Gray Silty CLAY, Trace Fine Sand. (CL) Collected Shelby Tube at 15-17'					
					20	End Boring at 17' Installed Well at 14.5'					

WATER LEVEL OBSERVATIONS

While Drilling	▽ 1.5	Upon Completion of Drilling		2.0
Time After Drilling			8/17/89	9/8/89
Depth to Water	1.3'		1.08'	2.08' ▼
Depth to Cave in				

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 7/20/89 End 7/20/89
Driller ETI Chief KKT Rig D 50
Logger TWP Editor TJM
Drill Method 4 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. MW-4
Surface Elevation 638.2
Job No. 60251.03
Sheet 1 of 2

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monotox
						Light Brown Fine SAND, Well Sorted.					
1		12	M	14				0.0			
2		18	M	9				0.0			
					5	Coarse Brown SAND, Poorly Sorted					
						Light Brown Fine to Medium SAND, Trace Coarse Sand. Poorly Sorted					
3		18	W	6				0.0			
4		18	W	13				0.0			
					10	Dark Gray Fine to Coarse SAND, Trace Pebbles. (Solvent-like Odor)					
5		18	W	64				0.0			
6		18	W	20				0.0			
					15	Grades into Gray Fine to Medium Silty SAND, Trace Coarse Sand and Pebbles. (Fuel-like Odor)					
7		18	W	21				0.0			
						Gray Fine to Medium SAND, Trace Black Specs (possible Shale)					
8		18	M					0.0			
					20	Dense Gray Silty CLAY, Trace Fine					

WATER LEVEL OBSERVATIONS

While Drilling ▽		Upon Completion of Drilling		
Time After Drilling			8/17/89	9/8/89
Depth to Water	3.5'		3.71'	4.28' ▼
Depth to Cave in				

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 7/20/89 End 7/20/89
Driller ETI Chief KKT Rig D 50
Logger TWP Editor TJM
Drill Method 4 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. MW-4
Surface Elevation 638.2
Job No. 60251.03
Sheet 2 of 2

ONE PIERCE PLACE · SUITE 1110, ITASCA, ILL. 60143 · TEL(312) 773-8484

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth		qu (qa) (tsf)	Hnu	Explosive Gas	Field VOC Water	Mon to
						Sand. (CL) Collected Shelby Tube at 18-20'					
						End Boring at 20'					
					25						
					30						
					35						
					40						

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. MW-5
Surface Elevation 639.4
Job No. 60251.03
Sheet 1 of 2

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monotox
						FILL: Road Gravel and Sand					
1		15	M	30		Black Fine to Medium Silty SAND		0.0			
2		13	M/W	12	5	Dark Gray Coarse SAND, Trace Fine Gravel. Poorly Sorted		0.0			
3		15	W	6				0.0			
						Becomes Fine Gray SAND, Some Coarse Sand.					
4		14	W	30	10			4.0			
5		18	W	15				0.0			
						Trace Fine Gravel at 13'					
6		18	W	25	15			0.0			
7		18	W	80		Grades into Gray Silty Fine SAND		0.0			
8		18	W	54	20			0.0			

WATER LEVEL OBSERVATIONS

While Drilling	7.3	Upon Completion of Drilling		4.3'
Time After Drilling			8/17/89	9/8/89
Depth to Water	4.3'		4.78'	5.14'
Depth to Cave in				

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 7/19/89 End 7/19/89
Driller ETI Chief KKT Rig D 50
Logger TJM Editor TWP
Drill Method 4 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. MW-5
Surface Elevation 639.4
Job No. 60251.03
Sheet 2 of 2

ONE PIERCE PLACE · SUITE 1110, ITASCA, ILL. 60143 · TEL(312) 773-8484

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth		qu (qa) (tsf)	Hnu	Explosive Gas	Field VOC Water	Mo t
9		18	W/M			Dense Gray Silty CLAY, Trace Fine Sand. (CL) Collected Shelby Tube at 21-23'		0.0			
					25	End Boring at 23' Installed Well at 17.5'					
					30						
					35						
					40						

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. MW-6
Surface Elevation 653.0
Job No. 60251.03
Sheet 1 of 2

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE / VISUAL CLASSIFICATION and Remarks / SOIL PROPERTIES

No.	Type	Rec (in.)	Moist	N	Depth	Visual Classification and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monotox
						FILL: Dark Gray to Gray Silty Sand, Trace to Little Gravel and Crushed Stone.					
1		14	D	23		Brown Fine SAND, Trace to Little Silt		0.0			
2		14	D	11	5			0.0			
3		12	D	10				0.0			
4		18	D/M	12	10	Slight Iron Stained Band at 9', Trace Medium Sand. Increasing Coarser Sand		0.0			
5		18	M	15		Brown-Gray Silty Clay Layer (4") at 12'		0.0			
6		18	M	24	15			0.0			
7		14	M/W	16		Becomes Wet at 17', Trace Silt and Clay at 17'		0.0			
8		16	W	31	20	Brown and Gray Fine to Coarse SAND, Little to Some Fine to Coarse Gravel, Trace Silt		0.0			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 19.0	Upon Completion of Drilling		19.2	
Time After Drilling	7/19/89		8/17/89	9/8/89
Depth to Water	19.2'		19.88'	19.97' ▼
Depth to Cave in				

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 7/18/89 End 7/18/89
Driller ETI Chief KKT Rig D 50
Logger TJM Editor TWP
Drill Method 4 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. MW-6
Surface Elevation 653.0
Job No. 60251.03
Sheet 2 of 2

ONE PIERCE PLACE · SUITE 1110, ITASCA, ILL. 60143 · TEL(312) 773-8484

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	Hnu	Explosive Gas	Field VOC Water	Moisture
						Becomes Gray Fine to Coarse SAND, Little to Some Fine to Medium Gravel					
9		16	W	17				0.0			
10		16	W	74		Trace Thin Gray Silty Clay Layers (1/4") at 24'		6.5			
					25						
11		18	W	20				4.0			
12		18	W	79				3.0			
					30						
13		18	W/M	80				1.0			
14		18	M			Dense Gray Silty CLAY, Trace Fine Sand and Gravel. (CL) (Push Shelby Tube (3" dia.) at 32-34'					
					35	End Boring at 34' Installed Well at 30'					
					40						

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW7
Surface Elevation 638.7
Job No. 60251.12
Sheet 1 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Vegetated Surface Near Marsh Brown to Gray Fine SAND, Rust Color at 5-6'		
1		16	W	8	5			0.4
						Grades into Gray Fine to Coarse SAND, Trace to Some Fine Gravel, Trace Pebbles, Wet, No Odor (SP)		
2		24	W	36	10	At 9' grades into Gray Fine SAND, Well to Medium Sorted Trace Fine Gravel, No Odor, Wet (SW)		0.1
3		3	W	14	15	Grades into Dark Gray Fine to Medium SAND, Trace to Some Silt, Trace Clay, Increased Silt and Clay at 18.5', Decreased Medium Sand and Gravel, Trace Thin (1/2") Silty Clay and Clayey Silt Layers		0.0
4		20	W	42				3.0
5		18	W/M	29	20			0.8
						Grades to Gray Silty Fine SAND to 20.5' (SP-SM)		
6		14	W/M	39				0.0
7		2	M			Set 6" permanent casing to 21' Gray Silty CLAY, Trace to Some Fine Sand, Trace Interbedding of Clay and Silt (CL)		
8		22	M	22	25		(4.5+)	0.0
9		20	M	38		Decreased Silt and Sand, Trace Fine Gravel at 27'	(2.5-3.5)	0.0
10		22	M	35	30		(3.0-4.5+)	0.0
11		18	M	57		Becomes Very Dense and Slightly		0.0
						Gravel at 32'		

WATER LEVEL OBSERVATIONS

While Drilling ▽ 4.0 Upon Completion of Drilling ▼ 15.3
Time After Drilling 7/19/90
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 3/7/90 End 3/14/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor
Drill Method 25" HSA 2" s (0-21') RWB (21-50')

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW7
Surface Elevation 638.7
Job No. 60251.12
Sheet 2 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	PID (ppm)
12		22	M	47			(2.80)	0.0
					35			
13		24	M	53		Trace Fine Sand at 35'	(4.5+)	0.0
14		24	M/W	18				0.0
15		14	W	51	40	Gray Fine to Coarse SAND, Some Gravel, Trace to Little Silt and Pebbles (SP-SM)		0.0
16		0		25		Grades to Dark Gray, Poorly Sorted, Medium SAND, Trace to Some Fine Sand, Trace Coarse Sand and Fine Gravel and Silt, Occasional Limestone Pebbles, Wet, No Odor		0.0
					45			
17		12	W	245		Increased Fine Sand and Coarse Shale Gravel at 45' (SP-SM)		0.0
18		14	W	98				0.0
					50	End of Boring at 50.0 Feet Install Monitoring Well to 47.8 Feet		
					55			
					60			
					65			
					70			

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW8
Surface Elevation 638.2
Job No. 60251.12
Sheet 1 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Vegetated Sandy Surface Black Sandy Loam to Brown Fine Sand, Trace Silt (SM)		
1		20	W	22	5	Brown to Gray Fine SAND, (SP-SM), Trace Fine Gravel, No Odor		0.0
2		20	W	12	10	Trace Medium Sand and Fine to Coarse Gravel (SP), Wet, Very Slight Odor at 10'		6.0
						Becomes Gray to Dark Gray Fine to Coarse SAND, Trace Fine to Coarse Gravel (SP)		
3		16	W	29	15	Slight Odor and Dark Staining at 16' Trace Silty Clay at 17' At 18', Grades to Gray Silty Fine SAND, Trace Gray Silty Clay and Fine Gravel (SM)		22.0
4		14	W/M	21	20			0.2
						Set 6" permanent casing to 22.5' Dense Gray Silty CLAY, Trace Fine Gravel (CL-ML)		
5		18	M/W	45				1.0
6		22	M	48	25	Gray Fine to Coarse SAND, Trace to Some Silt (SM)	(4.5+)	0.0
7		24	M	61		Very Dense Gray Silty CLAY, Trace Fine to Medium Gravel, (CL-ML) Decreased Silt at 30'	(4.5+)	0.0
8		24	M	51	30		(4.5+)	0.0
9		16	M/W	27		Gray Fine to Coarse SAND, Some Gravel		0.0

WATER LEVEL OBSERVATIONS

While Drilling	▽ 4.0	Upon Completion of Drilling	▼ 15.9	
Time After Drilling				7/19/90
Depth to Water				
Depth to Cave in				

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 3/9/90 End 3/16/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor
Drill Method 4.25" HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW8
Surface Elevation 638.2
Job No. 60251.12
Sheet 2 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
10		24	W	42	35	(GP)		
						Gray Fine SAND, Trace Silt and Medium Sand, Well Sorted, Wet (SM)		
11		20	M/W	70		Gray Silty CLAY and Clayey SILT (interbedded), Trace to Some Fine Sand (CL-ML)	(2.5-4.0)	0.0
12		16	W	175+	40			0.0
						Gray Silty Fine SAND, Trace Clay and Silt (laminated) (SM)		
13		14	W	165+		Gray Silty CLAY, Trace Fine Sand (CL-ML)		0.0
14		0	W	170+	45	Gray Silty Fine SAND and Sandy SILT, Trace Clay, (SM-SC)		0.0
						Gray, Very Silty, CLAY Layer (CL-ML)		
					50	Gray Fine SAND, Trace Medium Sand and Fine Gravel (SP) At 44' Gray Fine to Coarse SAND, with 2" Fine to Coarse Gravel Layer		
					55	End of Boring at 47.0 Feet Installed Well to 45.0 Feet		
					60			
					65			
					70			

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW9
Surface Elevation 635.9
Job No. 60251.12
Sheet 1 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Vegetated Surface Underlain by 1.5' of Black Sandy Loam		
1		18	W	17	5	Brown and Gray Fine SAND, Trace Silt (SM)		0.0
2		24	W	10	10	At 10.3' Becomes Dark Gray to Gray Silty Fine SAND, Trace to Little Clay and Fine Gravel (SM), Very Slight Odor At 11.0' Grades to Gray Fine SAND, Trace Silt and Fine Gravel (SP-SM)		2.5
3		24	W/M	32	15			0.4
4		12	M	12		Set 6" permanent casing to 18.5' Dense Gray Silty CLAY, Trace Fine to Medium Sand and Gravel (CL-ML) Thin Clayey Fine to Coarse Sand Seam (1/2") at 19.2'		0.0
5		22	M	29	20		(3.3)	2.0
6		24	M				(4.5+)	2.0
7		24	M/W	64	25		(4.5+)	2.5
8		20	W	33		Dark Gray and Black Fine SAND, Trace Medium Sand, Wet with Slight Odor (SP-SM)		2.0
9		12	W	105		At 26', Grades to Gray Fine SAND, Trace Silt and Medium Sand (SP-SM)		2.0
10		16	W	121	30	Gray Silty Clay Layer (1/4") at 27' Trace to Little Medium to Coarse Sand at 30'		1.0
						Trace Fine Gravel at 33'		

WATER LEVEL OBSERVATIONS

While Drilling ▽ 4.0 Upon Completion of Drilling ▼ 14.2
Time After Drilling 7/19/90
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 3/12/90 End 3/20/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor
Drill Method 4.25" HSA 0-17' 8.25" HSA 0-17.5'

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LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW9
Surface Elevation 635.9
Job No. 60251.12
Sheet 2 of 2

2100 CORPORATE DRIVE · ADDISON, ILLINOIS 60101 · TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)			
11		18	W	69				0.2			
					35	End of Boring at 35.0 Feet Installed Well to 35.0 Feet					
					40						
					45						
					50						
					55						
					60						
					65						
					70						

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW10
Surface Elevation 633.0
Job No. 60251.12
Sheet 1 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Straight Drill to 5' Black Silty Fine SAND (SM)		
1		20	W	26	5	Gray Fine to Coarse SAND, Trace to Some Gravel, 4.0' to 5.5' Grades to Gray Fine SAND, Trace Silt and Medium Sand, Wet (SM-SP)		13.0
2		24	W	55	10	Trace to Some Silt at 11-12', Some Gradational Fine to Coarse Sand Layering with Trace Fine to Coarse Sand and Fine Gravel, Trace Organics (roots)		20.0
3		24	W	36				8.0
4		8	M	25		Increased Silt and Fine to Coarse Gravel to 13.8'		10.0
5		20	M	61	15	Dense Gray Silty CLAY, Trace Fine Sand and Fine Gravel, Moist Set 6" permanent casing to 15' Trace Coarse Pebbles at 17.5'		8.0
6		22	M	65				15.0
7		21	M/W	84	20	Gray Silty CLAY to 20.2'		25.0
8		5	W	125		Gray Fine to Coarse SAND, Trace to Some Silt (SM)		20.0
9		16	W	186				22.0
10		16	W	78	25	Gray Fine SAND, Trace Medium Sand and Silt, Wet (SP)		13.0
11		20	W	84		Gray Silty SAND and GRAVEL, Trace Shale Pebbles (GM)		13.0
12		14	W	157	30	Gray Fine Sandy CLAY, Very Silty, Trace of Shale Gravel (SC)		13.0
13		14	W	149		Grades to Gray Silty Fine SAND, Trace Clay, Trace of Thin Silt-Clay		12.0

WATER LEVEL OBSERVATIONS

While Drilling ▽ 4.0 Upon Completion of Drilling ▼ 12.0
Time After Drilling _____ _____ _____ 7/19/90
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 4/26/90 End 5/2/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor
Drill Method

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW10
Surface Elevation 633.0
Job No. 60251.12
Sheet 2 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES		
No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)	
14		14	W	149		Laminations at 27.3-28' (SM)		14.0	
					35	Gray Fine to Medium SAND, Trace Fine to Medium Gravel (SP), Trace to Little Silty Layers at 29-29.5' Trace Coarse Sand			
					40	End of Boring at 35.0 Feet Install Well MW10 to 35.0 Feet			
					45				
					50				
					55				
					60				
					65				
					70				

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LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW10A
Surface Elevation 634.3
Job No. 60251.12
Sheet 1 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						2" Black Sandy Silt TOPSOIL		
						Loose Reddish-Brown Silty Fine SAND (SM)		
1		24	M	7	5	Grades into Loose Gray Fine to Medium SAND, Little to Some Silt, Sandy Silt Seam at 7', occasional thin (1/4" to 1/2") silt seams (SM)		6.0
2		24	W	35	10	Medium Dense Gray Fine to Medium SAND, Little to Some Silt, occasional thin silt layers (SM)		40.0
3		18	W	23				40.0
4		24	W	53	15			35.0
5			W	28				5.0
6		24	M	129		Very Stiff to Hard Gray Lean CLAY, Trace Gravel (CL) Trace of Clayey Sand and Gravel at 19.0'		4.0 2.5
7		16	W	153	20	Gray Fine to Medium SAND, Trace Silt and Fine to Coarse Gravel, Trace of Silt Laminations, wet with chemical-like odors (SP-SM)		2.0
8		12	W	132				13.0
9		15	W/M	92		Grades into Gray Fine SAND		9.0 0.4
10		18	M/W	121	25	Gray Clayey SILT and Silty CLAY (layered), Trace to Some Fine Sand and Gravel (ML)		0.0
						Increased Amount of Gray Silty CLAY, Trace Fine Sand and Fine to Medium (Shale and Limestone) Gravel		0.0 0.0
					30	Grades to Gray Clayey SILT, Trace to Little Fine Sand (laminated) (CL-ML)		

WATER LEVEL OBSERVATIONS

While Drilling ▽ 7.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 3/21/90 End 3/27/90
Driller ETI Chief KKT Rig D-50
Logger PMS Editor TJM
Drill Method 4.25" HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW10A
Surface Elevation 634.3
Job No. 60251.12
Sheet 2 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES			
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)		
					35	Gray Fine to Medium SAND, Slight Trace of Clayey Pockets (1/4" layers) at 26.8' (SP)				
					40	End of Boring at 27.0 Feet Abandoned Location for Deep Monitoring Well Tremmie Grout Borehole				
					45					
					50					
					55					
					60					
					65					
					70					

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LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW10B
Surface Elevation 634.2
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Straight Drill to 5' 6" of Dark Organic SILT on Surface		
1			W	18	5	Light Brown Fine to Coarse SAND (SM)		
2			W	42	10	Light Brown and Gray Fine to Coarse SAND, Trace Gravel (SP-SM)		
3			W	40				
4			W	62	15			30.0
5			M	104		Light Brown to Gray Silty CLAY, Trace of Fine to Coarse Gravel (CL-ML)		20.0
6			M/W	115	20			30.0
						Gray Silty to Sandy CLAY (SC)		10.0
						End of Boring at 21.0 Feet Abandoned Location for Deep Monitoring Well Tremmie Grout Borehole		
					25			
					30			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 5.5 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 3/28/90 End 3/28/90
Driller ETI Chief KKT Rig D-50
Logger PMS Editor TJM
Drill Method 4.25" HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW10C
Surface Elevation 634.7
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Straight Drill to 5' Brown Medium to Coarse Silty SAND, Trace of Shale and Coarse Gravel (SP-SM)		
1		18	W	8	5			3.0
						Gray Fine Dark SAND, Trace of Silt (SM)		
2		24	M	43	10	Silty Clay Layer (2") at 10.2' Becomes Dark Gray to Brown Fine to Coarse SAND, Trace Coarse Sand (SP-SM)		50.0
3		18	M	42				15.0
4		20	M	54	15	Dark Gray to Brown Fine SAND, Interbedded with Coarse Sand and Gravel Layers (SP-SM)		2.5
5		20	M	90		Brown Silty CLAY Layer (3") at 13.6' Light Brown Fine SAND Layer (4") at 14.2'		0.0
6		18	W	92	20	Dense Gray Lean CLAY, Trace of Shale and Gravel (CL) Set 6" permanent steel casing to 17.0		2.0
7		18	W	260				3.0
8		15	W/M	118	25	Gray Silty CLAY, Trace Fine to Coarse Sand and Fine Gravel		1.0
						Gray Fine to Coarse SAND, Trace Fine to Coarse GRAVEL, Silt and Clay, Odor Present (SP-SM)		
					30	Gray Silty CLAY, Trace Fine to Coarse Sand (CL-ML)		
						End of Boring at 25.0 Feet Well Venting Gas		

WATER LEVEL OBSERVATIONS

While Drilling ▽ 6.0 Upon Completion of Drilling ▼ Unk
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 3/28/90 End 4/3/90
Driller ETI Chief KKT Rig D-5
Logger SJB Editor TJM/SJC
Drill Method 4.25" I.D. HSA, 5.875" RWB

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW11
Surface Elevation 637.5
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Straight Drilled to 5'		
1		8	W	13	5	Light Brown Fine to Medium SAND, Trace of Fine Gravel (SP)		0.0
2		24		19	10			0.0
						Light Gray Fine SAND, Trace Coarse Sand and Fine Gravel (SM) Fine to Coarse Gravel Layer (2") at 11.2' and 11.8'		
3		18		36	15	Gray Silty CLAY Layer (1") at 15.5' Grades into Gray Fine to Medium SAND, Trace to Some Silt, Trace Clay (SM)		0.0
4		18		35				0.0
5		24		41	20	Gray Fine to Medium Silty SAND, Some Coarse Sand and Fine Gravel (SM)		0.0
						Dense Gray Silty CLAY, Trace Gravel (CL-ML)		
					25	End of Boring at 21 Feet Installed Well to 17.5 Feet		
					30			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 3.0 Upon Completion of Drilling ▼ 2.4
Time After Drilling 4/6/90
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 3/29/90 End 3/29/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor
Drill Method 4.25" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW12
Surface Elevation 639.7
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Straight Drilled to 5'		
1		18	W	7	5	Light Brown Medium to Coarse SAND, Some Medium to Coarse Gravel (SP)		<1.0
2		24	W	33	10	Light Gray Fine to Coarse SAND, Trace to Some Fine to Coarse Gravel (SM)		0.0
3		22	W	24	15	Grades into Medium Coarse Gray SAND, Trace Silt		0.0
						Light Gray Silty SAND, Some Medium Sand, Trace Gravel, (SM-SP)		
4		24	W	97	20	Trace Clay Layers at 16.7'		0.0
5		13	W/M	56		Trace of Coarse Sand and Fine Gravel at 20'		0.0
						Gray Silty CLAY, Trace Fine to Coarse Gravel, Moist (CL-ML)		
					25	End of Boring at 22.5 Feet Installed Well to 17.5 Feet		
					30			

WATER LEVEL OBSERVATIONS

While Drilling	▽ 3.0	Upon Completion of Drilling	▼ 3.9	
Time After Drilling				4/6/90
Depth to Water				
Depth to Cave in				

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 3/30/90 End 3/30/90
Driller ETI Chief KKT Rig D-50
Logger PMS Editor TJM/SJC
Drill Method 4.25" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW13
Surface Elevation 631.9
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	PID (ppm)
						Marshy Surface, Black Sandy Loam and Peat Topsoil (OL)		
1		24	W	23	5	Gray Fine SAND, Trace Silt (SM). Wet with No Odors. Some Organics at 4.5' and Some Thin Silty Layering at 6.5'		2.0
2		24	W	37	10			7.0
						Gray SILT Layer, Trace Fine Sand and Organics (ML)		
3		18	M	51		Gray Fine SAND, Trace Silt (SM)		1.5
					15	Gray SILT Layer, Trace Fine Sand and Clay, Laminated and Moist (ML)		
						Gray Fine to Coarse SAND, Trace Fine Gravel, Wet (SP)		
					20	Dense Gray Silty CLAY, Trace Fine Gravel, Moist (CL-ML)		
						End of Boring at 15.0 Feet Installed Well to 13.3 Feet		
					25			
					30			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 3.0 Upon Completion of Drilling ▼ 1.0
Time After Drilling _____ _____ _____ 4/6/90
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 4/3/90 End 4/3/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor TJM/SJC
Drill Method 4.25" HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW14
Surface Elevation 636.0
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Black Sandy Loam Surface Brown to Gray Fine SAND, Trace Silt, Wet, No Odor		
1		18	W	13	5	Grades to Dark Gray Fine SAND		0.2
2		14	W/M	7	10	Trace to Some Silt to 11.1'		0.0
						Soft Dark Gray Clayey SILT and Silty CLAY, Some Fine Sand Seams, Wet to Moist with natural organic odors, Trace Organics and Fine to Coarse Gravel (CL-ML)		
3		24	W	35	15			0.1
						Grades into Silty SAND and GRAVEL at 12' (SP)		
					20	Grades into Gray Silty Fine SAND at 14' (SM)		
						Gray Silty CLAY, Trace Fine Sand (CL-ML)		
					25	End of Boring at 17.0 Feet Installed Well to 15.5 Feet		
					30			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 4.0 Upon Completion of Drilling ▼ 4.2
Time After Drilling 4/6/90
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 4/4/90 End 4/4/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJC
Drill Method 4.25" HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW15
Surface Elevation 635.2
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						FILL: Black and Brown Silty Sand and Coarse Gravel Surface Fill (near buried Pipeline Easement Area)		
1		14	W	9	5	Brown Fine to Medium SAND, Trace to Little, Fine to Coarse Gravel (SP)		0.0
						Brown SAND and GRAVEL, Trace Pebbles (GP)		
2		18	W	30	10	Brown Fine SAND, Trace Silt (SM)		0.0
3		16	W/M	29	15	Gray Silty CLAY, Trace to Some Fine Sand (some thin Silty Fine Sand and Sandy Silt seams present) (CL-ML)	(1.5-2.5)	0.0
					20	End of Boring at 17.0 Feet Installed Well to 14.5 Feet		
					25			
					30			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 3.0 Upon Completion of Drilling ▼ 1.5
Time After Drilling 4/6/90
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 4/4/90 End 4/4/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJC
Drill Method 4.25" HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW16
Surface Elevation 636.6
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Possible FILL: Black Sandy Loam and Brown Fine Sand		
						Gray-Dark to Gray Silty Fine SAND, Trace Sandy Silt Layers (1/4") and organics, (roots at 5.8') (SM). Water perched at 6' above silty layers with leachate-like odors		
1		24	M/W	10	5			0.2
2		20	W	21	10	Becomes Gray Fine SAND, Trace to Some Silt and Medium to Coarse Sand (SM-SP), Little Fine Gravel at 10.5', Some Silt Layers at 10.7', Coarse Sand Seams at 11.6', Some Odors, Wet		2.0
3		18	W	30	15	Some Gray Fine to Coarse SAND to 15.3' then Gray and Dark Gray Sandy Silt layers interbedded with Fine Sand (SM-SP)		2.0
					20	Gray Fine SAND, Trace Fine Gravel (SP)		
						Gray Gravelly SILT, Trace to Some, Fine to Medium Sand (GM)		
					25	Gray Silty CLAY, Trace Fine Sand (CL-ML)		
						End of Boring at 17.0 Feet Installed Well to 16 Feet		
					30			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 6.0 Upon Completion of Drilling ▼ 4.3
Time After Drilling _____ _____ _____ 4/6/90
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 4/5/90 End 4/5/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJC
Drill Method 4.25" HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW17
Surface Elevation 648.3
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Residential Yard: Black Sand Loam to Loose Brown and Rust Color Brown Fine SAND, No Odors, Trace to Little Silt, Dry (OL-SM)		
1		24	D	13	5	Brown Fine SAND, Trace to Little Silt (SM)		0.0
2		22	M	11	10	Brown and Gray Mottled Clayey SILT, Trace to Little Fine Sand, Trace Organics (ML)		0.0
3		12	W	5	15	Dark Brown Fine to Coarse SAND, Trace Fine to Coarse Gravel, Trace Silt, increased Gravel and Pebbles with depth (SP)		0.0
4		12	W	43	20			0.0
					25	Brown SAND and GRAVEL, Trace Silt (GM-GP)		
						Gray Fine to Coarse SAND, Trace Silt (SP)		
					30	Gray Fine SAND, interbeds of Silt (1/4"), Trace Clay (SM-SP)		
						End of Boring at 25.0 Feet Installed Well to 23.0 Feet		

WATER LEVEL OBSERVATIONS

While Drilling	▽ 13.5	Upon Completion of Drilling	▼ 13.3	
Time After Drilling				4/6/90
Depth to Water				
Depth to Cave in				

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 4/5/90 End 4/5/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJC
Drill Method 4.25" HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW18
Surface Elevation 645.4
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Straight Drilled to Install Well		
1			M		5, 10	Brown Fine SAND, Trace Silt (SM) Dry, No Odor		0.0
2			W		15	Dark Brownish Gray Fine SAND (SM) Wet, No Odor		0.0
3			M		20	Gray Silty CLAY, Trace Gravel (CL-ML)		0.0
					25, 30	End of Boring at 23.5 Feet Installed Well at 22.0 Feet		

WATER LEVEL OBSERVATIONS

While Drilling ▽ 8.8 Upon Completion of Drilling ▼ 10.3
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/29/90 End 6/29/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor
Drill Method 4.25" HSA

WARZYN

LOG OF TEST BORING

Project: American Chemical Services RI Phase III
Location: Griffith, Indiana

Boring No. MW19
Surface Elevation 634.0
Job No. 60251.22
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL. (708) 691-5000

SAMPLE						PROFILE	VISUAL CLASSIFICATION and Remarks	BOREHOLE / BACKFILL	SOIL PROPERTIES				
Number	TYPE	Rec. (in.)	Mois-ture	N Value	Depth (ft.)				qu (qa) (tsf)	PID (ppm)			
							Straight Drilled with Hollow Stem Augers for Shallow Well Placement. See MW22 Log for Stratigraphic Details Between 0-14' Log Based on Cuttings: Brown to Gray Fine SAND, Increased Sand and Gravel With Depth. (SW)						
					5								
					10								
					15		End of Boring at 15.0' Installed Well to 14.5'						
					20								
					25								
					30								
					35								
					40								

WATER LEVEL OBSERVATIONS

While Drilling	▽ 3.0	Upon Completion of Drilling	▼	
Time After Drilling	12/28/90			
Depth to Water	0.8'			
Depth to Cave In				

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

GENERAL NOTES

Begin 12/15/90 End 12/15/90 Drill
Driller Mathes Chief CSH Rig CME
Logger TJM Editor DSP 550
Drill Method 4 1/4" HSA

WARZYN

LOG OF TEST BORING

Project: American Chemical Services
RI Phase III
Location: Griffith, Indiana

Boring No. MW20
Surface Elevation 641.0
Job No. 60251.22
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL. (708) 691-5000

SAMPLE						PROFILE	VISUAL CLASSIFICATION and Remarks	BORE HOLE BACKFILL	SOIL PROPERTIES			
Number	TYPE	Rec. (in.)	Mois-ture	N Value	Depth (ft.)				qu (qa) (tsf)	PID (ppm)		
							Straight Drilled with Hollow Stem Augers for Shallow Well Placement. Log Based on Cuttings: Brown Fine SAND, Trace Gravel with Depth. (SW)					
					5							
					10							
					15							
					20		End of Boring at 19.0' Installed Well to 18.8'					
					25							
					30							
					35							
					40							

WATER LEVEL OBSERVATIONS

While Drilling	▽ 8.0	Upon Completion of Drilling	▼	
Time After Drilling	12/20/90			
Depth to Water	7.2'			
Depth to Cave In				

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

GENERAL NOTES

Begin 12/16/90 End 12/16/90 Drill
Driller Mathes Chief CSH Rig CMI
Logger TJM Editor DSP 55(
Drill Method 4 1/4" HSA

WARZYN

LOG OF TEST BORING

Project: American Chemical Services RI Phase III
Location: Griffith, Indiana

Boring No. MW21
Surface Elevation 631.3
Job No. 60251.22
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL. (708) 691-5000

SAMPLE Number	Type	Rec. (in.)	Moisture	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	PID (ppm)
						Southeast Edge of Marsh Area Black Organic Sand on Surface. Straight Drilled to 4.5'		
1		14	W	8	5	Black to Gray Fine SAND, Trace Silt (SW) Wet and Runny. No Odor		
2		14	W	12	10	Increased Silt, Trace Clay.		
3		14	W/M	20				
						Dense Gray Silty CLAY, Trace Fine Gravel. (CL-ML) Set 6" Permanant Casing to 14.5' Trace Fine to Coarse Gravel at 15-17'		
4		18	M	30	15			
5		4	M	35		Trace Fine Sandy Silt at 18-19'		
6		22	M	41	20			
7		24	M	18		Very Dense and Slightly Darker Gray at 23'		
8		24	M/W	16	25			
9		18	W	15		Gray Fine to Medium SAND, Trace Fine Gravel (SW) Trace Silt at 27-29'		
10		15	W	15	30			
					35	End of Boring at 33.1' Installed Well to 33.1'		
					40			

WATER LEVEL OBSERVATIONS

While Drilling	▽ 0.0	Upon Completion of Drilling	▽	
Time After Drilling	12/28/90			
Depth to Water	8.5'			
Depth to Cave In				

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

GENERAL NOTES

Begin 12/13/90 End 12/18/90 Drill
Driller Mathes Chief CSH Rig CME 550
Logger TJM Editor DSP
Drill Method 3 7/8" RWB

WARZYN

LOG OF TEST BORING

Project: American Chemical Services
RI Phase III
Location: Griffith, Indiana

Boring No. MW22
Surface Elevation 634.
Job No. 60251.22
Sheet 1 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL. (708) 691-5000

SAMPLE Number	Type	Rec. (in.)	Moisture	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	PID (ppm)
						Grassy Surface Underlain by Brown Fine SAND. (SW) Straight Drilled to 12.0'		
					5	Becomes Gray Fine SAND at 4'		
					10	At 9-10' Grades back to Brown Fine SAND, Trace Fine to Coarse Gravel (SW)		
1		16		19		At 12' Brown and Gray Fine SAND, Trace to Some Silt and Silty Clay Layering. (SM) Increasingly Siltier with Depth. All Gray at 16' with Increased Silt and Clay Layering.		
2		18		18	15			
3		20						
4		20			20	Gray Silty Fine SAND, Trace to Some Medium Dense Gray Silt, Trace to Little Clay. (SM)		
5		18		19				
6		20		20		Gray Silty CLAY Layered with Gray Silty Fine Sand at 20-24' (0.2 to 0.8' thick) (CL-ML)		
					25			
7		24		20		Set 6" Permanant Casing to 25.0' Gray Fine to Medium SAND, Trace Silt and Fine Gravel. (SM)		
8		21		25				
					30			
9		24		25		Gray Clayey SILT, Trace to Some Fine Sand. (ML)		
10		20		35		Gray Fine to Medium SAND, Trace Silt. (SM)		
					35			
11		24				Gray Silty Fine SAND, Trace Clay. (SM)		
12		22				Gray Clayey SILT, Trace Fine Sand. (ML)		
					40			

WATER LEVEL OBSERVATIONS

While Drilling	▽ 4.0	Upon Completion of Drilling	▼	
Time After Drilling	12/28/90			
Depth to Water	9.5'			
Depth to Cave In				

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

GENERAL NOTES

Begin 12/14/90 End 12/20/90 Drill
Driller Mathes Chief CSH Rig C
Logger TJM Editor DSP 5
Drill Method 3 7/8" RWB

WARZYN

LOG OF TEST BORING

Project: American Chemical Services RI Phase III
Location: Griffith, Indiana

Boring No. MW22
Surface Elevation 634.3
Job No. 60251.22
Sheet 2 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - - TEL. (708) 691-5000

SAMPLE Number	Type	Rec. (in.)	Moisture	N Value	Depth (ft)	PROFILE	VISUAL CLASSIFICATION and Remarks	BORE HOLE BACKFILL	SOIL PROPERTIES qu (qa) (tsf)	PID (ppm)
13		20		40						
							Gray Silty CLAY, Trace Fine SAND. (CL-ML)			
14		22								
					45		Gray Fine SAND, Layered. (SW-SM)			
15		18								
							Gray Silty CLAY, Trace to Some Fine Sand (CL-ML)			
16		18								
					50		Gray Fine SAND, Trace Medium Sand. (SW)			
							Gray Fine SAND and SILT, Interbedded (1" to 6") (SM-ML)			
17		16								
					55		Gray Fine to Coarse SAND and GRAVEL (SP)			
							Dense Gray Silty CLAY, Trace Fine to Coarse Gravel (CL-ML) Trace Pebbles at 42'			
					60					
							Gray Fine to Medium SAND, Trace Fine to Medium Gravel and Pebbles. (SM) Increased Medium to Coarse Sand at 53-55'			
					65					
							End of Boring at 55' Installed Well to 54.5'			
					70					
					75					
					80					
					85					

WARZYN

LOG OF TEST BORING

Project: American Chemical Services RI Phase III
Location: Griffith, Indiana

Boring No. MW23
Surface Elevation 631.1
Job No. 60251.22
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL. (708) 691-5000

SAMPLE Number	Type	Rec. (in.)	Moisture	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	PID (ppm)
						Dark Gray Silty Fine SAND, Trace Coarse Sand. (SM) (Based on Cuttings)		
					5			
					10	Medium Dense Gray Fine to Coarse SAND, Trace Silt. (SP)		
1		18	M	13				
						Dense Gray Silty CLAY, Trace Fine to Coarse Sand. (CL-ML)		
2		11	M	32				
					15	Seat 6" Permenant Casing to 15'		
3		15	M	65				
						Trace Fine Sand and Pebbles at 16-18'		
4		14	W	50		Gray Fine to Medium SAND layer, Trace Silt and Fine Gravel. (SM)		
					20			
5		14	M/W	77		Very Dense Gray Silty CLAY, Trace Fine Sand. (CL-ML)		
6		18	M	108				
					25	Grades to Dense Gray SILT, Trace to Some Clay, Trace Fine Sand.		
7		18	W	95				
						Gray and Dark Gray Fine to Medium SAND. (SM)		
8		13	W	88	30			
						Layer (1.5") of Fine to Coarse SAND and GRAVEL at 29.8'		
						End of Boring at 31' Install Well to 30.3'		
					35			
					40			

WATER LEVEL OBSERVATIONS

While Drilling	▽ 1.5	Upon Completion of Drilling	▽	
Time After Drilling	1/15/91			
Depth to Water	12.3'			
Depth to Cave In				

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

GENERAL NOTES

Begin 1/9/91 End 1/15/91 Drill
Driller ETI Chief MES Rig D 50
Logger DP/TM Editor DSP
Drill Method 4 7/8" RWB

WARZYN

LOG OF TEST BORING

Project: American Chemical Services RI Phase III
Location: Griffith, Indiana

Boring No. MW24
Surface Elevation 633.1
Job No. 60251.22
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL. (708) 691-5000

SAMPLE Number	Type	Rec. (in.)	Moisture	N Value	Depth (ft.)	Profile	VISUAL CLASSIFICATION and Remarks	Borehole Backfill	SOIL PROPERTIES qu (qa) (tsf)	PID (ppm)
					5, 10		Dark Gray Fine Sandy SILT, Trace Coarse Sand. (SM-ML) (Based on Cuttings)			
1		14	W	23			Medium Dense Gray Fine SAND, Trace Silt and Coarse Sand. (SM-SP)			
2		18	M/W	28	15		Gray SILT and Fine to Medium SAND. (Interbedded Layer) (ML-SM)			
3		18	M	39						
4		14	M	38			Medium Dense Gray SILT. Little to Some Clay, Trace Fine Sand. (ML)			
5		16	M	39	20		Dense Gray Silty CLAY, Trace Fine to Coarse Sand. (CL-ML) Seat 6" Permenant Casing to 16'			
6		16	W							
7		4	W		25		Gray Fine SAND, Trace Medium Sand and Silt. (SM) Gray Silty CLAY Layer (2.5") at 23.3'			
8		10	W				Trace to Little Silt at 27.5'			
					30, 35, 40		End of Boring at 31' Install Well to 31'			

WATER LEVEL OBSERVATIONS

While Drilling	▽ 4.5	Upon Completion of Drilling	▽	
Time After Drilling	1/15/91			
Depth to Water	12.2'			
Depth to Cave in				

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

GENERAL NOTES

Begin 1/8/91 End 1/11/91 Drill
Driller ETI Chief MES Rig D 50
Logger DSP Editor TM/DS
Drill Method 4 7/8" RWB

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB-P7
Surface Elevation 641.5
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Vegetated Sandy Surface about 30' south of Piezometer P-7 Straight Drill to 5', Begin Sampling with 2" spoon at 5'		
1		20	M/W	10	5	Brown to Gray Fine SAND, Trace Fine Gravel and Shells, Rust Colored at 7', No Odor (SM)		0.0
2		24	W	2	10	Becomes Gray Fine to Medium to Coarse SAND, Little to Some Fine to Medium Gravel (SM-SP)		0.0
3		24	W	89	15			7.0
						Black Fine to Coarse SAND Layer (1.5") Odorous and possibly stained (SP)		
4		4	W	77				15.0
5		8	W	49	20	Gray Fine SAND, Trace Silt (SP-SM) Silt Layer (1/4") at 16.45' Slight Odors		1.5
6		12	W	43		Increased Amount of Silt at 21' Silty Layers (1/2") at 21.5' Decreased Silt at 22' Silty Clay Layer (1") at 23'		1.0
					25	End of Boring at 23.5 Feet Abandoned Location for Deep Monitoring Well MW07 Tremmie Grout Borehole		
					30			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 7.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 3/7/90 End 3/7/90
Driller ETI Chief KKT Rig D-5
Logger TJM Editor
Drill Method 4.25" HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Remedial Investigation
Location Griffith, Indiana

Boring No. ATMW-4D
Surface Elevation 635.2
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE

No.	Type	Rec (in.)	Moist	N	Depth (ft.)
1		18		7	
2		18		14	5
3		18		5	
4		18		14	
5		18		20	10
6		18		31	15
7		18		57	20
8		12		25	25
9		8		46	30
10		8		35	35
11		8		58	40

VISUAL CLASSIFICATION and Remarks

Pavement and Gravel 1.0'

Loose Brown SAND

Medium-Dense Gray Medium SAND, Trace Silt.
2" Seam of Fine Gravel at 9.0'

Also Trace Fine Gravel from 12.5'

Hard Gray Silty CLAY

Dense Gray Medium SAND

Very Dense Gray Fine to Coarse SAND, Trace Shale and Fine Gravel

End of Boring at 40.0'

SOIL PROPERTIES

qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monitox
4.5				

WATER LEVEL OBSERVATIONS

While Drilling ▽ 7.0' Upon Completion of Drilling ▼
Time After Drilling 10/21/85
Depth to Water 17.88'
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 9/25/85 End 9/27/85
Driller ATEC Chief BS Rig CME 55
Logger BS Editor
Drill Method 3 1/4" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-1
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water
						FILL: Coarse Gravel		15.0		
1		18	M	21		FILL: Black cinder-like Fine to Medium Sand, Trace Gravel		30.0		
						Dark Gray Fine to Medium SAND				
2		20	M	23	5	Some Black Staining from 4 to 5'		35.0		
3		20	M	26		Becomes Brown Fine to Medium SAND at 7'				
					10	End Boring at 9'				
					15					
					20					

WATER LEVEL OBSERVATIONS

While Drilling ▽ Dry Upon Completion of Drilling
Time After Drilling Dry
Depth to Water
Depth to Cave in 8.5

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 8/1/89 End 8/1/89
Driller ETI Chief KKT Rig D 50
Logger TJM Editor TWP
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-2
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Mono-tox
						FILL: Dark Gray (Some Gray and Purple Stained) Fine to Medium Sand, Trace of Drum Lids and Solid Paint Fragments, Trace of Silt.					
1		6	D	60	5			140.0			
2		20	D/W	25		Fill and Waste to 7'					
						Brown Fine to Medium SAND		70.0			
					10	End Boring at 8.5'					
					15						
					20						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 8.5 Upon Completion of Drilling
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 8/1/89 End 8/1/89
Driller ETI Chief KKT Rig D 50
Logger TJM Editor TWP
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-2A
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Mo tox
						Sandy Surface FILL: Brown Sandy					
1		0				Tried to collect a split spoon from 1-3' but had sample refusal, many drum lids at 1-2' Dark Gray Fine to Medium Sand with Trace of Silt and Paint		130.0			
2		0				Strong Odor, Attempt to sample at 3' and again at 4', both had spoon refusal (drum lids), decided to abandon hole and relocate. Two additional unsuccessful attempts, SB-2B and SB-2C		100.0			
					5						
					10	End Boring at 4'					
					15						
					20						

WATER LEVEL OBSERVATIONS

While Drilling ▽ Dry Upon Completion of Drilling _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____ ▼
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 8/1/89 End 8/1/89
Driller ETI Chief KKT Rig D 50
Logger TJM Editor TWP
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-3
Surface Elevation
Job No. 60251.03
Sheet 1 of 2

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monotox
						Well Vegetated Surface		0.0			
1		14	D/M	12		FILL: Brown Sandy Clay, Trace of Debris and Gravel		0.0			
						FILL: Black Sand, Trace to Some Clay, Trace Debris like glass, wood (burnt odor) plastic. Spoon Refusal at 4' Drill to 5'					
2		20	M	50	5			4.0			
						FILL: Brown Fine to Medium Sand. Various Debris and Waste encountered during sampling. Black (stained) rag stuck in tip of split spoon from 8'.					
3				17				10.0			
4		6	M	22	10			65.0			
5		18	W	38		Yellow granular resin-like substance collected from 12' Substance began to melt at the surface and had a pH of <1. Stained Sands (Gray, Dark Brown, and Purple) encountered at 14'		100.0			
6		16	W	93	15	Some Debris like stenciled paper, phone book pages, cardboard, paint solids, more yellow resin-like substance, and glass fragments.		200.0			
						Fill and/or Waste to approx. 18'					
7		18	W	101	20	Gray Fine to Medium SAND which Grades into Gray Fine to Coarse SAND, Trace of Fine to Medium Gravel (Wet)					

WATER LEVEL OBSERVATIONS

While Drilling ▽ 18' Upon Completion of Drilling
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 8/2/89 End 8/2/89
Driller ETI Chief KKT Rig D 50
Logger TJM Editor TWP
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-3
Surface Elevation
Job No. 60251.03
Sheet 2 of 2

ONE PIERCE PLACE · SUITE 1110, ITASCA, ILL. 60143 · TEL(312) 773-8484

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth		qu (qa) (tsf)	Hnu	Explosive Gas	Field VOC Water	Meb-tox
						End Boring at 20'					
					25						
					30						
					35						
					40						

3

KEY TO BORING LOGS

Sample Type

- Unsampled interval
- Auger cuttings sample
- Drilled by hollow stem augers; not sampled; logged by cuttings
- Hand sample from surface
- 4" outside diameter core barrel sampler
- Drilled by rotary wash bore; not sampled; logged by cuttings
- 5' continuous sampler
- 3" outside diameter split spoon sampler
- 3" shelby tube
- 2" outside diameter split spoon sampler

Lithologic Description

- Unknown lithology
- Lean clay
- Silty clay or clayey silt
- Sandy clay
- Concrete
- Construction debris-laden fill material
- Gravel
- Clayey gravel
- Silty gravel
- Sandy gravel
- Limestone or dolomitic limestone
- Silt
- Gravelly silt
- Silty sand
- Peat
- Sand
- Gravelly sand
- Sandy silt
- Topsoil

Borehole Material Graphics

- Concrete around flush-mounted protective casing
- Concrete surface seal around well casing
- Bentonite slurry or cement-bentonite grout around well casing
- Bentonite pellet seal around well casing
- Bentonite pellet seal around well screen
- Sand backfill around well casing
- Sand filter pack around well screen
- Sand backfill or natural soil collapse in borehole
- Concrete surface seal over borehole
- Bentonite slurry or bentonite-cement grout backfill in borehole
- Cuttings backfill in borehole
- Bentonite seal in borehole

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Description of Boring Log Headings

No. = Sample number within the boring

Rec. = Amount of sample recovery

Moist = Visual estimate of the amount of moisture in the sample.

Type = Sampler type and sample interval

N Value = The penetration resistance, N, is the summation of the number of blows required to effect two successive 6" penetrations of the 2" split-spoon sampler. The sampler is driven with a 140 lb. weight falling 30" and is seated to a depth of 6" before commencing the standard penetration test.

Depth = Depth below ground surface

Visual Classification = Lithology symbol of stratigraphy; Description of stratigraphy; Borehole material graphics

qu(qa) = Unconfined compressive strength of the sample

PID = Photoionization detector reading

Description of Soil Samples

General Terminology

Relative Density (of noncohesive soils) or consistency (of cohesive soils)
Color
Grain Size (of noncohesive soils)
Major soil constituent
Minor proportions
Other characteristics or features
Unified Soil Classification System (USCS) Symbol

Descriptive Terms

NM = Not measured
ND = Not detected
M = Moist
F = Frozen
D = Dry
W = Wet
-- = Measurement not possible

Relative Density

Term	"N" Value
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

Consistency

Term	qa.-tons/s
Very Soft	0.0 to 0.25
Soft	0.25 to 0.5
Medium	0.50 to 1.0
Stiff	1.0 to 2.0
Very Stiff	2.0 to 4.0
Hard	Over 40

Grain Size Terminology

Soil Fraction		Particle Size	U.S. Standard Sieve Size
Boulders		Larger than 12"	Larger than 12"
Cobbles		3" to 12"	3" to 12"
Gravel:	Coarse	3/4" to 3"	3/4" to 3"
	Fine	4.76 mm to 3/4"	#4 to 3/4"
Sand:	Coarse	2.00 mm to 4.76 mm	#10 to #4
	Medium	0.42 mm to 2.00 mm	#40 to #10
	Fine	0.074 mm to 0.42 mm	#200 to #40
Silt		0.005 mm to 0.074 mm	Smaller than #200
Clay		Smaller than 0.005 mm	Smaller than #200

Plasticity characteristics differentiate between silt and clay.

WARZYN

LOG OF TEST BORING

General Notes

Descriptive Soil Classification

GRAIN SIZE TERMINOLOGY

Soil Fraction	Particle Size	U.S. Standard Sieve Size
Boulders	Larger than 12"	Larger than 12"
Cobbles	3" to 12"	3" to 12"
Gravel: Coarse	¾" to 3"	¾" to 3"
Fine	4.76 mm to ¾"	#4 to ¾"
Sand: Coarse	2.00 mm to 4.76 mm	#10 to #4
Medium	0.42 mm to 2.00 mm	#40 to #10
Fine	0.074 mm to 0.42 mm	#200 to #40
Silt	0.005 mm to 0.074 mm	Smaller than #200
Clay	Smaller than 0.005 mm	Smaller than #200

Plasticity characteristics differentiate between silt and clay.

GENERAL TERMINOLOGY

Physical Characteristics
Color, moisture, grain shape, fineness, etc.

Major Constituents
Clay, silt, sand, gravel

Structure
Laminated, varved, fibrous, stratified, cemented, fissured, etc.

Geologic Origin
Glacial, alluvial, eolian, residual, etc.

RELATIVE DENSITY

Term	"N" Value
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

RELATIVE PROPORTIONS OF COHESIONLESS SOILS

Proportional Term	Defining Range By Percentage of Weight
Trace	0%- 5%
Little	5%-12%
Some	12%-35%
And	35%-50%

CONSISTENCY

Term	q_u-tons/sq. ft.
Very Soft	0.0 to 0.25
Soft	0.25 to 0.50
Medium	0.50 to 1.0
Stiff	1.0 to 2.0
Very Stiff	2.0 to 4.0
Hard	Over 4.0

ORGANIC CONTENT BY COMBUSTION METHOD

Soil Description	Loss on Ignition
Non Organic	Less than 4%
Organic Silt/Clay	4-12%
Sedimentary Peat	12-50%
Fibrous and Woody Peat	More than 50%

PLASTICITY

Term	Plastic Index
None to Slight	0-4
Slight	5-7
Medium	8-22
High to Very High	Over 22

The penetration resistance, N, is the summation of the number of blows required to affect two successive 6" penetrations of the 2" split-barrel sampler. The sampler is driven with a 140 lb. weight falling 30" and is seated to a depth of 6" before commencing the standard penetration test.

Symbols

DRILLING AND SAMPLING

CS—Continuous Sampling
RC—Rock Coring: Size AW, BW, NW, 2" W
RQD—Rock Quality Designator
RB—Rock Bit
FT—Fish Tail
DC—Drove Casing
C—Casing: Size 2½", NW, 4", HW
CW—Clear Water
DM—Drilling Mud
HSA—Hollow Stem Auger
FA—Flight Auger
HA—Hand Auger
COA—Clean-Out Auger
SS—2" Diameter Split-Barrel Sample
2ST—2" Diameter Thin-Walled Tube Sample
3ST—3" Diameter Thin-Walled Tube Sample
PT—3" Diameter Piston Tube Sample
AS—Auger Sample
WS—Wash Sample
PTS—Peat Sample
PS—Pitcher Sample
NR—No Recovery
S—Sounding
PMT—Borehole Pressuremeter Test
VS—Vane Shear Test
WPT—Water Pressure Test

LABORATORY TESTS

q_p—Penetrometer Reading, tons/sq. ft.
q_u—Unconfined Strength, tons/sq. ft.
W—Moisture Content, %
LL—Liquid Limit, %
PL—Plastic Limit, %
SL—Shrinkage Limit, %
LI—Loss on Ignition, %
D—Dry Unit Weight, lbs./cu. ft.
pH—Measure of Soil Alkalinity or Acidity
FS—Free Swell, %

WATER LEVEL MEASUREMENT

▽—Water Level at time shown
NW—No Water Encountered
WD—While Drilling
BCR—Before Casing Removal
ACR—After Casing Removal
CW—Caved and Wet
CM—Caved and Moist

Note: Water level measurements shown on the boring logs represent conditions at the time indicated and may not reflect static levels, especially in cohesive soils.

UNIFIED SOIL CLASSIFICATION SYSTEM

COARSE-GRAINED SOILS

(More than half of material is larger than No. 200 seive size.)

GRAVELS More than half of coarse fraction larger than No. 4 sieve size	**Clean Gravels** (Little or no fines)	
	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
	Gravels with Fines (Appreciable amount of fines)	
	GM[d u]	Silty gravels, gravel-sand-silt mixtures
	GC	Clayey gravels, gravel-sand-clay mixtures
SANDS More than half of coarse fraction smaller than No. 4 sieve size	**Clean Sands** (Little or no fines)	
	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with Fines (Appreciable amount of fines)	
	SM[d u]	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures

FINE-GRAINED SOILS

(More than half of material is smaller than No. 200 sieve.)

SILTS AND CLAYS Liquid limit less than 50%	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit greater than 50%	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	CH	Inorganic clays of high plasticity, fat clays
	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	PT	Peat and other highly organic soils

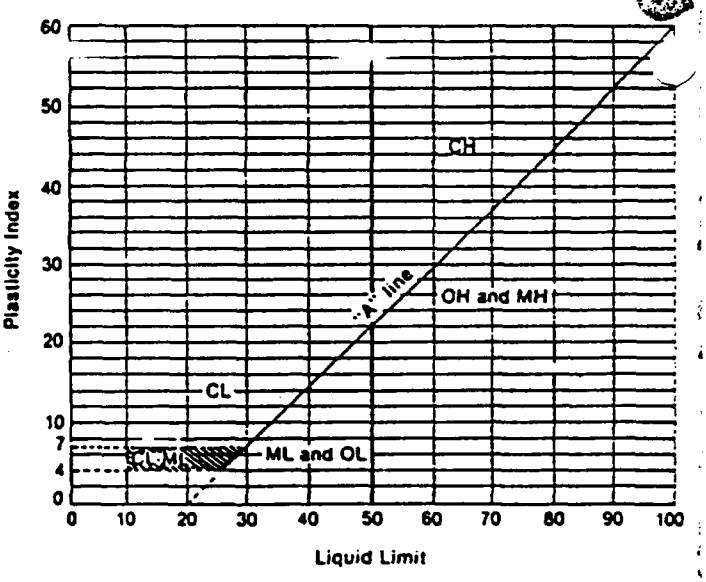
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for SW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in hatched zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 per cent ..... GW, GP, SW, SP
More than 12 per cent ..... GM, GC, SM, SC
5 to 12 per cent ..... Borderline cases requiring dual symbols

PLASTICITY CHART



For classification of fine-grained soils and fine fraction of coarse-grained soils.

Atterberg Limits plotting in hatched area are borderline classifications requiring use of dual symbols.

Equation of A-line: PI = 0.73 (LL - 20)

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. LW-1
Surface Elevation 642.4
Job No. 60251.03
Sheet 1 of 2

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth		qu (qa) (tsf)	HNu	Explo-sive Gas	Field VOC Water	Mono-tox
						FILL: Grassy Vegetated Surface Brown Sand					
						LANDFILL REFUSE: Brown and Black Fine to Medium Sandy Fill with Debris Like paint cans, scrap metal, car parts, railroad ties, rebar, wire, newspaper, and cloth.		1.0			
								1.0			
					5			1.0			
								1.0			
								1.0			
					10						
					15	Gray Fine to Medium SAND, Trace to Little Silt.					
					20						

WATER LEVEL OBSERVATIONS

While Drilling	▽ 15.015'	Upon Completion of Drilling		12'
Time After Drilling	7/12/89		8/17/89	9/8/89
Depth to Water	13.9'		10.21'	10.62' ▼
Depth to Cave in				

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 7/12/89 End 7/12/89
Driller ETI Chief JJK Rig D 50
Logger TJM Editor TWP
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. LW-1
Surface Elevation 642.4
Job No. 60251.03
Sheet 2 of 2

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SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES			
No.	TYPE	Rec (in.)	Moist	N	Depth		qu (qa) (tsf)	Hnu	Explosive Gas	Field VOC Water
						Gray Sandy CLAY, Trace to Some Silt, Soft				
					25					
						End Boring at 25' Installed Well at 24.5'				
					30					
					35					
					40					

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-7
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monotox
						FILL: Brown Fine to Medium Sand, Trace of Silt and Fine to Coarse Gravel					
1		14	M	100	5	Black Silty Sand at 5', Possible Staining, Moist to Wet		80.0			
2		0		65		No recovery, continue drilling to 8'					
3		0		21	10	No recovery and spoon wet with solvent odor, continue drilling to 10'		25.0			
4		0		90		No recovery, strong solvent odor, attempt sample again at 12-14' interval		90.0			
5		1		2				130.0			
6		14	W	31	15	Poor recovery, apparent waste material, recovery revealed black sludge-like substance with strong odor and oil sheen FILL to 15'		90.0			
7		18		50 /4"		Good revoery, Dark Brown to Gray (some heavy oily staining) Fine to Coarse Sand with Fine to Coarse Gravel, Trace of Pebbles, Wet		150.0			
					20	End Boring at 16'					

WATER LEVEL OBSERVATIONS

While Drilling ▽ 7.0 Upon Completion of Drilling
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 8/4/89 End 8/4/89
Driller ETI Chief KKT Rig D 50
Logger TJM Editor TWP
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-8
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water
						Straight drill to 4'				
1		18	W	12						
						Brown Fine SAND, Trace of Silt				
					5	Black Fine to Coarse SAND and GRAVEL, Slight Odor.		6.5		
						Black to Dark Gray Fine to Medium SAND, Trace of Fine Gravel.		14.0		
						Grades into Gray Fine to Medium SAND, Trace of Silt and Fine Gravel.				
					10	End Boring at 10'				
					15					
					20					

WATER LEVEL OBSERVATIONS

While Drilling ▽ 3.8 Upon Completion of Drilling _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____ ▼
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 8/8/89 End 8/8/89
Driller ETI Chief KKT Rig D 50
Logger TJM Editor TWP
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-9
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monotox
						Sandy Surface Straight drill to 2', collect 3" spoon at 2-4'					
1		18	M	23		Brown Fine SAND, Trace of Medium Gravel at 4'		1.0			
2		18	M/W	9	5	Brown Fine to Medium SAND, Trace of Fine to Medium Gravel.		0.0			
3		18	W	49							
					10	Gray Silty SAND Layer, Trace of Silty Clay Gray-Dark and Gray Laminated		20.0			
						Brown-Gray Medium to Coarse SAND, Some Fine Gravel					
						End Boring at 10'					
					15						
					20						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 4.0 Upon Completion of Drilling
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 8/8/89 End 8/8/89
Driller ETI Chief KKT Rig D 50
Logger TJM Editor TWP
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-9A
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Mc t
						Sandy Surface Straight drill to 4', collect first spoon from 4 to 6'					
1		18		26	5			14.0			
					10	Split spoon sample revealed wet Gray SAND, decide to abandon hole because of low HNu readings and no obvious waste interval, relocate approximately 50' east. End Boring at 8.0'					
					15						
					20						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 4.0 Upon Completion of Drilling _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____ ▼
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 8/8/89 End 8/8/89
Driller ETI Chief KKT Rig D 50
Logger TJM Editor TWP
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-10
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monotox
						Sandy Surface					
1		18	M	26		Brown Fine SAND, Trace to Little Fine to Medium Gravel at 3'					
						Grades into Brown to Gray Fine to Coarse SAND, Trace of Fine Gravel and Silt.		9.0			
2		24	M/W	9		Wet at 3.5', Strong Solvent-like Odor		180.0			
					5						
3		18	W	4				150.0			
4		18	W	23				110.0			
					10	End Boring at 10'					
					15						
					20						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 3.5 Upon Completion of Drilling
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 8/9/89 End 8/9/89
Driller ETI Chief KKT Rig D 50
Logger TJM Editor TWP
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-11
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Mt
						FILL: Sand and Gravel Surface					
1		24	M	15		Dark Brown to Brown Fine SAND, Trace of Silt		3.0			
2		24	M	19		Brown to Gray Fine SAND, Some Mottling at 4'		20.0			
					5						
3		24	W	36		Brown-Gray Fine to Coarse SAND, Trace to Little Fine to Coarse Gravel Trace of Silt at 8'		170.0			
4		24	W	43							
						Brown-Gray Fine SAND, Trace of Coarse Sand and Fine Gravel		35.0			
					10						
						End Boring at 10'					
					15						
					20						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 3.5 Upon Completion of Drilling _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____ ▼
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 8/9/89 End 8/9/89
Driller ETI Chief KKT Rig D 5
Logger TJM Editor TWP
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-12
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monotox
						Sandy Surface					
1		24	M	24		Dark Brown to Brown Fine SAND, Trace of Silt		10.0			
2		24	M	21		Brown Fine SAND		200.0			
					5	Black and Dark Gray (Some Stained) Fine to Medium SAND at 4.5 to 4.8'					
3		20	W	8		Brown and Gray Fine to Coarse SAND and GRAVEL, Trace of Silt		190.0			
4			W	38				140.0			
					10	End Boring at 10'					
					15						
					20						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 6.5' Upon Completion of Drilling
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 8/9/89 End 8/9/89
Driller ETI Chief KKT Rig D 50
Logger TJM Editor TWP
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-13
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Moisture
						FILL: Road Gravel					
1		20	M	48		Dark Brown to Brown Fine SAND, Trace Silt.		150.0			
2		20	M/W	14							
					5	Black and Gray to Brown Fine to Coarse SAND, Trace Gravel.		10.0			
4		22	W	33		Trace of Layered Staining at 7'		20.0			
5		22	W	41		Gray Fine to Coarse SAND, Little Fine Gravel.		40.0			
					10	End Boring at 10'					
					15						
					20						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 4.5' Upon Completion of Drilling
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 8/9/89 End 8/9/89
Driller ETI Chief KKT Rig D 50
Logger TJM Editor TWP
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-14
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPRORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monotox
						Brown Fine to Medium SAND					
						Grades into Gray Fine to Medium SAND at 3'					
					5						
					10						
1				117				80.0			
						End Boring at 12'					
					15						
					20						

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____ ▼
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 9/6/89 End 9/6/89
Driller ETI Chief KKT Rig D 50
Logger TWP Editor TJM
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-15
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water
						Brown Fine to Medium SAND				
						Grades into Gray Fine to Medium SAND at 2'				
					5					
						Solvent-like Odors				
					10					
1		24		22		Possible Fill Material Present		130.0		
						Reddish Brown and Black Staining.				
						End Boring at 14'				
					15					
					20					

WATER LEVEL OBSERVATIONS

While Drilling ▽ Upon Completion of Drilling
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 9/6/89 End 9/6/89
Driller ETI Chief KKT Rig D 5
Logger TWP Editor TJM
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-16
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monotox
						Brown Fine to Medium SAND					
						Black Fine to Medium SAND at 2'					
					5						
1		15		13		Grades into Brown and Gray Fine to Medium SAND, Trace Coarse Sand.		140.0			
						End Boring at 7'					
					10						
					15						
					20						

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____ ▼
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 9/6/89 End 9/6/89
Driller ETI Chief KKT Rig D 50
Logger TWP Editor TJM
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-17
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Mo to
						Gray Fine to Medium SAND					
1		15		29	5	Black and Gray Staining between 4 and 5'		60.0			
						Reddish Brown color at 7'					
						End Boring at 8'					
					10						
					15						
					20						

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____ ▼
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 9/6/89 End 9/6/89
Driller ETI Chief KKT Rig D 50
Logger TWP Editor TJM
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-18
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monotox
						Brown Fine to Medium SAND Black at 1'					
1		18		29	5	Grades back into Brown Fine to Medium SAND, Trace Gravel		45.0			
						End Boring at 8'					
					10						
					15						
					20						

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____ ▼
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 9/6/89 End 9/6/89
Driller ETI Chief KKT Rig D 50
Logger TWP Editor TJM
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB20
Surface Elevation 639.0
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES	
No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)
						Brown Sandy FILL on Surface Straight Drill to 5' Cuttings: Black and Dark Gray Silty Fine Sand (FILL)		
					5			210
1		24	M	10		Black and Dark Brown Fine to Medium SAND, Trace to some Peat and Organics at 5-6'		80
								25
						End of Boring 7.0 Feet Borehole Backfilled with Bentonite Holeplug		
					10			
					15			
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 7.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water 7.0
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 5/8/90 End 5/8/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB21
Surface Elevation 639.4
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	PID (ppm)
						Straight Drill to 5' Log Based on Cuttings: 0-1' FILL: Crushed Stone Road Gravel 1-2' FILL: Brown to Dark Brown Fine Sand		140
1		24	M/W	35	5	Brown to Grayish Brown Fine to Medium SAND, Traces of Black Staining at 5-6'		90 60
								40
2		24	W	51	10	Grades to Brown and Gray Fine to Coarse SAND at 11', Trace to Some Fine to Medium Gravel, Fine to Medium SAND and GRAVEL Layer at 11.3 to 11.6' (possibly stained). Grades to Brown to Gray Fine SAND, Trace to Little Silt (Laminated)		50
					15	End of Boring at 12.0 Feet Borehole Backfilled with Bentonite Holeplug		
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 6.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 5/8/90 End 5/8/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB22
Surface Elevation 640.9
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Gravel Roadway Between Tank Farms and Between TP-6 and TP-7 Straight Drill to 10' Cuttings: Brown to Dark Brown Silty Fine Sand (FILL)		10
					5			200
						Grades Black to Brown Fine to Medium SAND at 6'		220
					10			
1		24	W	32		Becomes Brown Fine to Coarse SAND, Trace to Little Fine to Coarse Gravel, Trace of Oily Product at 10.5' (1/2" thick) At 10.7' Gray and Dark Gray Fine to Coarse SAND and GRAVEL, Trace Pebbles, Wet Traces of Oily Sheen and Oily Product at 11' NOTE: Some Olive Green Stained Sand on Augers		300
					15			
						End of Boring at 12.0 Feet Borehole Backfilled with Bentonite Holeplug		
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 4.5 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 5/8/90 End 5/8/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB23
Surface Elevation 638.6
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES	
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)
						Road Gravel Surface (0-1') Straight Drill to 10' Log Based on Cuttings: 1-3' Brown Fine SAND 3-10' Brown to Gray Fine SAND, Trace to Some Fine to Coarse Sand and Gravel		150
1		24	W	36	10	Brown Fine to Coarse SAND, Trace to Little Gravel At 10.5', Grades to Brown and Gray SAND and GRAVEL, Trace to Little Pebbles, Trace of Silt At 11.8', Gray and Dark Gray Fine SAND, Trace SilT		200
					15	End of Boring at 12.0 Feet Borehole Backfilled with Bentonite Holeplug		
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 5.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 5/8/90 End 5/8/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB24
Surface Elevation 646.6
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE · ADDISON, ILLINOIS 60101 · TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Grassy Surface of Off-Site Containment Area Straight Drill to 9.5' Cuttings: (0-5') FILL: Black and Brown Sandy Clay, Dry and Loose		140
					5			
					10			
1		6	W	12		Buried Objects and Waste From 5-18'. Log of Material from Waste Sample at 11-13'		250
					15	Mostly Waste; Wet, Dark Gray and Black Sandy Clay Matrix with Paint-Like Solids. Various Colors of Blue, Green, and Purple. Trace of Plastic Bags, Metal Debris and Paper. Water has Oily Sheen. Continue Straight Drill to 19'		
2		24	W	94	20	Native Material at 18'. Brown Fine to Medium SAND, Trace Fine to Medium Gravel		100
					25	End of Boring at 21.0 Feet Borehole Backfilled with Bentonite Holeplug		

WATER LEVEL OBSERVATIONS

While Drilling ▽ 7.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 5/9/90 End 5/9/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB24R
Surface Elevation 646.6
Job No. 60251.12
Sheet 1 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES	
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)
						Redrill at SB24 Straight Drill through Bentonite Backfill to 22' Refer to Log SB24 for Stratigraphic Details 0-22'		
					5			
								120
					10			
					15			
					20			
1		14	W	35		Brown and Gray Fine to Medium SAND, (stained oily brown) with Traces of Oily Sheen		110
2		18	W/M	30				260
					25	At 24.5', Grades into Gray Silty Fine SAND with Seams of Silt and Clay. Becomes Dark Gray Fine to Coarse		10

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/5/90 End 6/5/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB24R
Surface Elevation 646.6
Job No. 60251.12
Sheet 2 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES			
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)		
						SAND, Trace to Little Gravel at 25.4'				
					30	Gray Silty CLAY, Trace to Some Sand and Gravel, Layering of Silt and Fine Sand in Clay				
						End of Boring at 26.0 Feet Borehole Backfilled with Bentonite Holeplug				
					35					
					40					
					45					
					50					
					55					

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB25
Surface Elevation 645.6
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)			
						Grassy Surface of Off-Site Containment Area Straight Drill to 9' Cuttings: (0-2') FILL: Black Sandy Clayey FILL		80			
					5						
1		20	W	22	10	FILL: Brown Fine to Coarse Sand and Gravel, Black Oily Waste Material in Sand and Gravel with Trace to Some Green Paint-Like Solids and Trace of Metal. Estimate Buried Drums to 10' Continue Drilling to 19'		150			
					15						
2		24	W	45	20	Gray to Dark Gray (slightly Black staining) Fine SAND, Trace Medium Sand and Fine Gravel, Wet		85			
					25	End of Boring at 21.0 Feet Borehole Backfilled with Bentonite Holeplug					

WATER LEVEL OBSERVATIONS

While Drilling ▽ 6.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 5/9/90 End 5/9/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB25R
Surface Elevation 645.6
Job No. 60251.12
Sheet 1 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)			
						Redrill at SB25, Straight Drill through Bentonite Backfill to 23' Refer to Log SB25 for Stratigraphic Details 0-23'					
					5						
					10						
					15						
					20						
1		18	W	15		Gray Fine to Medium SAND, Trace Silt, Trace of Clayey Silt Layer (1/4") at 24.1'		4			
					25						
2		2	W	24		At 26' Trace Coarse Sand and Fine		20			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/5/90 End 6/5/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB25R
Surface Elevation 645.6
Job No. 60251.12
Sheet 2 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)			
3		18	M	40		Gravel. Decreased Silt					
						Grades into Gray Silty CLAY, Trace Fine Sand and Fine Gravel at 28'		10			
					30	End of Boring at 29.0 Feet Borehole Backfilled with Bentonite Holeplug					
					35						
					40						
					45						
					50						
					55						

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB26
Surface Elevation 647.2
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	PID (ppm)
						Straight Drill to 9' Encountered Metal Objects (possible drums) at 2' Below Ground. Saturated with Thin Black Liquid		100
1		12	W	10	10	FILL: Brown Fine Sand, Mostly Saturated Oily Liquid, Trace Wood and Twigs		85
2		18	W	51	20	Gray and Brown Fine to Medium SAND, Trace Fine Gravel (slight dark staining)		30
					25	End of Boring at 21.0 Feet Borehole Backfilled with Bentonite Holeplug		

WATER LEVEL OBSERVATIONS

While Drilling ▽ UNK Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 5/9/90 End 5/9/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB26R
Surface Elevation 647.2
Job No. 60251.12
Sheet 1 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Redrill at SB26 Straight Drill through Bentonite Backfill to 24' Refer to SB26 Log for Stratigraphic Details 0-24'		
					5			
					10			15
						FILL: Dark Brown (looks oily stained) Sand, Moist/Wet		
					15			
					20			150
1		18	W	26	25	Brown and Gray Fine to Medium SAND, Trace Silt Seams at 25.5' - 26.0' (1/4"), Trace Oily Sheen in Wet Sand and Brownish Oil-Like Staining		40

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/6/90 End 6/6/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB26R
Surface Elevation 647.2
Job No. 60251.12
Sheet 2 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)			
					30	End of Boring at 26.0 Feet Borehole Backfilled with Bentonite Holeplug					
					35						
					40						
					45						
					50						
					55						

WARZYN

LOG OF TEST BORING

Project: American Chemical Services
RI/FS Phase II
Location: Griffith, Indiana

Boring No. SB27
Surface Elevation 644.5
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	PID (ppm)
						Straight Drill to 9' Cuttings: FILL: Black and Dark Gray Sandy Clay Encountered Buried Objects at 2.5'-3'		
					5			
1		18	M/W	11	10	FILL: Brown Sand and Gravel Matrix with Various Waste Materials such as Black Oily Liquids, Solid Paint-Like Solids, Stained Sand, Pebbles, and Twigs		90
					15			
						Continue Drilling to 19'		
2		24	W	46	20	Brown, Gray, and Dark Gray Fine SAND, Trace Medium Sand, Trace Medium Sand and Fine Gravel, Some Black Staining Throughout		44
						End of Boring at 21.0 Feet Borehole Backfilled with Bentonite Holeplug		
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 3.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 5/10/90 End 5/10/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB27R
Surface Elevation 644.5
Job No. 60251.12
Sheet 1 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)			
						Redrill at SB27 Straight Drill through Bentonite Backfill to 24' Refer to Log SB27 for Stratigraphic Details 0-24'					
					5						
					10						
					15						
					20	Abandoned Borehole Due to Poor Sample Recovery on Several Attempts. Relocate Borehole to SB27RR and Attempt Sampling for Sand above Clay Sample.		20			
					25						
						End of Boring at 26.0 Feet					

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/6/90 End 6/6/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB27R
Surface Elevation 644.5
Job No. 60251.12
Sheet 2 of 2

2100 CORPORATE DRIVE · ADDISON, ILLINOIS 60101 · TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)			
						Borehole Backfilled with Bentonite Holeplug					
					30						
					35						
					40						
					45						
					50						
					55						

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB27RR
Surface Elevation 644.3
Job No. 60251.12
Sheet 1 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)			
						Move SB27R(R) 5' North and Redrill Straight to 22' FILL: Black and Brown Silty Fine Sand, Trace of Oily-Like Staining (Drillers Notes: possibly encountered buried objects at 4' and again at 7')					
					5						
					10						
					15						
					20						
1		16	W	21		Brown Fine to Medium SAND, Trace of Oily Staining		150 70			
					25	Gray SILT Layer (1/2"), Trace Clay Gray Fine to Medium SAND with Intermitten Gray Silt and Clayey Silt		25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/7/90 End 6/7/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB27RR
Surface Elevation 644.3
Job No. 60251.12
Sheet 2 of 2

2100 CORPORATE DRIVE · ADDISON, ILLINOIS 60101 · TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)			
						Layers (1/4" to 1")					
						End of Boring at 24.0 Feet Borehole Backfilled with Bentonite Holeplug					
					30						
					35						
					40						
					45						
					50						
					55						

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB28
Surface Elevation 645.9
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Straight Drill to 2'		
1		4	W	4		FILL: Mostly Refuse Saturated with Black Thick Liquids. Various Cloth, Wood, and Fibrous Material Throughout		60
					5			
2		8	W	9		FILL: Light Brown Clay and Sand Mixed with Black Oily Liquid and Sludge Like Material. Traces of Gravel, Wire, and Twigs		80
					10	End of Boring at 8.0 Feet Borehole Backfilled with Bentonite Holeplug		
					15			
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 2.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 5/10/90 End 5/10/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB29
Surface Elevation 647.3
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)			
						Straight Drill to 2'					
1		3		44		FILL: Refuse Consisting of Plastic, Paper, Grass Clippings, Wood, and Metal Debris.		5			
					5						
2		20		65		FILL: Greenish-Gray to Brown Silty Clay, Trace of Fine Gravel and Twigs, Slight Trace of Oily Waste in Fractures		55			
						End of Boring at 8.0 Feet Borehole Backfilled with Bentonite Holeplug					
					10						
					15						
					20						
					25						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 2.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 5/10/90 End 5/10/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB30
Surface Elevation 646.3
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES	
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)
						Straight Drill to 8' FILL: Brown and Black Sand, Trace to Some Debris such as wood, paper and plastic bags		15
1		20	M	27	5	FILL: Dark Blue Thick Paint-Like Rubbery Liquid, Some Grayish-Blue Sludge, Trace Oily Brown Liquid, Heavy Solvent-Like Odors		250
					10	FILL: Brown Sand and Gravel, Heavy Solvent-Like Odor		
					15	End of Boring at 10.0 Feet Borehole Backfilled with Bentonite Holeplug		
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 5/11/90 End 5/11/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB30A
Surface Elevation 646.0
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Straight Drill to 8'		
						Cuttings:		
						(0-2') Black Sandy Fill, Trace Debris (cloth and plastic bags)		150
						(3-6') Dark Purple Sandy Fill (stained), Trace of Metal Debris		
					5	(6-10+) Brown to Brown Fine Sand Fill		230
1		1	M	59		No Recovery - Drill to 10' and Attempt to Sample but Plug Stuck in Lead Auger. Pull Entire String of Augers and Decide to Abandoned Boring and Relocate 5' East AP58		
					10			
						End of Boring at 10.0 Feet Borehole Backfilled with Bentonite Holeplug		
					15			
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 5/11/90 End 5/11/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB31
Surface Elevation 648.5
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES	
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)
1		18	M	18		Break Ground 6" Below Surface, Pound 2" SPT to 2'		
						FILL: Dark Brown and Dark Gray Sand and Gravel		6
					5	End of Boring at 2.0 Feet Borehole Backfilled with Bentonite Holeplug		
					10			
					15			
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 5/11/90 End 5/11/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB32
Surface Elevation 647.0
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES	
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)
1	■	18	M	55		Break Ground 6" Below Surface, Pound 2" SPT to 2.5' FILL: Black, Dark Gray, Dark Brown Sand and Gravel, Trace Coarse Gravel and Debris, Slight Trace of Stained Sand		10
					5	End of Boring at 2.0 Feet Borehole Backfilled with Bentonite Holeplug		
					10			
					15			
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 5/11/90 End 5/11/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB33
Surface Elevation 646.3
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES	
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)
1		12	M	54		Break Ground 6" Below Surface, Pound 2" SPT to 2.0' FILL: Black Sandy and Gravel, Trace Coarse Limestone Gravel and Debris SPT Refusal at 2', spoon bounced probably rubber object buried		7
					5	End of Boring at 2.0 Feet Borehole Backfilled with Bentonite Holeplug		
					10			
					15			
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 5/11/90 End 5/11/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB35
Surface Elevation 638.0
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE · ADDISON, ILLINOIS 60101 · TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	PID (ppm)
						Sandy FILL On Mounded Surface Approximately 15' North-Northeast of TP-2 Straight Drill to 15' FILL: Brown Fine to Coarse Sand		
					5			
					10			150
1		18	M	32	15			240 80
						Brown and Gray Fine to Coarse SAND and GRAVEL Grades to Gray Silty Fine to Coarse SAND at 16.1' to 16.4'		40
					20	Gray Silty CLAY, Trace to Little Fine to Medium Sand, Trace Gravel, Moist		
						End of Boring at 17.0 Feet Borehole Backfilled with Bentonite Holeplug		
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 5/8/90 End 5/8/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB36
Surface Elevation 647.1
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Straight Drill to 8.5 Feet		
					5			<1.0
						Encountered Refuse such as wire, bed-springs, and cloth in a Silty Sand Matrix		150
1		18	M	12		Cuttings from 7-8' Moist to Wet, and Black with Slight Oily Appearance		50
					10	WASTE: Orangish-Brown, Tarry Substance, Very Cohesive and Gummy, Trace of Grayish-Purple Clay and Debris		
					15			
2		12	W	19		Black and Dark Gray (mostly oily stained) Medium to Coarse SAND and Fine to Coarse Gravel, Some Oily Substance in Silt at 16' to 17'		170
					20	Grades to Brown and Gray Fine to Coarse SAND, Trace to Little Fine to Coarse Gravel, Trace of Oily Staining at 22'		
3		10	W	27				70
					25	End of Boring at 23.5 Feet Borehole Backfilled with Bentonite Holeplug		

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/7/90 End 6/7/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB37
Surface Elevation 648.6
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Straight Drill to 8.5' Log Based on Cuttings: (0-3') FILL: Black and Brown Silty Sand (3-7') Buried Objects Encountered While Drilling Through Fill		
					5			
1		2	M	68		Log of Spoon Sample: WASTE and FILL: (8.5-8.7') Black Rubbery Solid Waste, Trace to Some Tarry Solids Incorporated in Rubbery Solid (possible layers) (8.7-9.0') Dark Purple Paint-Like Solid Mixed in a Sand and Gravel Matrix (mostly consolidated) (9.0-10.0+) Black (stained) Fine to Medium Sand, Trace Silt, Possible Cinders and wood and paint solids Debris Estimate FIll to 12.5'		50
					10			
					15			
2		16	W	32				90
						Continue Drilling to 15.5' Brown and Gray, Fine to Medium SAND, Trace to Some Brown and Black Oily Saturation, Trace Roots. Continue Drilling to 22'		
					20			
3		16	W	53		Grayish-Brown Fine to Medium SAND, Trace Silt.		20
						End of Boring at 23.5' Borehole Backfilled with Bentonite Holeplug		
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/8/90 End 6/8/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB38
Surface Elevation 647.0
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Straight Drill to 8.5'		
					5			0
1		8	W	70		FILL and REFUSE: Metal Scrap and Wire, Trace of Paper and Plastic in a Black Clayey Sand Matrix		150
					10			
					15	Poor Recovery of FILL: Light Brown Sandy Clay with Traces of Black and Dark Brown Oily Staining, Trace Metal Fragments. Slight Rubbery and Sticky Texture, Trace Fine to Coarse Sand and Gravel.		
2		3	W	23				100
						Estimate Fill to 17'		
3		16	W	60				55
					20	Continue Drilling to 18.5' Brown to Fine SAND, Trace to Some Medium to Coarse Sand and Gravel, Trace to Little Silt, Trace Oily Staining		
4		14	W	93		Grades to Brown Fine to Medium SAND at 22', Trace to Little Silt		65
					25	End of Boring at 23.5 Feet Borehole Backfilled with Bentonite Holeplug		

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/8/90 End 6/8/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB39
Surface Elevation 644.9
Job No. 60251.12
Sheet 1 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Straight Drill to 8.5' (0-5') FILL: Dark Gray Clayey and Silty Fine SAND, Traces of Debris such as paper, plastic, and rubber.		0
					5			
1		18	W	10		FILL: Black Silty Fine Sand (Stained with Solvent Odors)		40
					10	Becomes WASTE: Black, Brown and Dark Gray Waste in Sandy Matrix, Traces of Rubbery Glue-Like Material and Oily Saturated Sandy Fill		150
					15			
2		18	W	21		Estimate Fill to 16'		60
					20	Brown and Gray Silty Fine SAND, Trace Medium Sand, Trace of Thin Silt Layers (1/4") at 16.0-16.7' Continue Drilling to 22'		
3		20	W	63		Grades to Brown and Gray Fine SAND, Trace to Some Silt, Trace to Some Gray Silt Layers at 23-23.3' (1/4-1/2" thick) Trace of Possible Discoloration in Sand above Silt Layers		65
					25	Gray Silty Fine SAND with Silt Layers,		

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/11/90 End 6/11/90
Driller ETI Chief KKT Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB39
Surface Elevation 644.9
Job No. 60251.12
Sheet 2 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)			
						Grades into Gray Clayey Silt, Wet to Moist and Becoming Dense					
					30	End of Boring at 23.5 Feet Borehole Backfilled with Bentonite Holeplug					
					35						
					40						
					45						
					50						
					55						

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB40
Surface Elevation 644.2
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES	
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)
						FILL: Brown and Black Silty Fine to Coarse Sand, Traces of Plastic and Paper Material.		5
					5	Grades to Black Fill Material with Plastic, Wood, Metal Fragments and Refuse		40
1	■	14	W	10		At 8' Material Becomes Brown Fine to Medium Silty Sand, Black Stained Patches, Trace of Wood, Roots and Petroleum Sheen to 10'		120
					10	End of Boring at 10.0 Feet Borehole Backfilled with Bentonite Holeplug		
					15			
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/13/90 End 6/13/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB41
Surface Elevation 644.9
Job No. 60251.12
Sheet 1 of 2

2100 CORPORATE DRIVE · ADDISON, ILLINOIS 60101 · TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
1		14	M	14	5	FILL: Black and Brown Sandy Matrix with Wood, Paper, Metal, Plastic		0
					10	Cuttings Range From Garbage Refuse in a Gray Sand Matrix		
					15			
					20			
2		12	W	56		Becomes Same FILL Refuse Material with Silty Sand Layers with Varying Amounts of Silty Clay Layers and Coarse Sand, Yellow Staining at 23.5'		2
					25	End of Boring at 23.5' Borehole Backfilled with		

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/13/90 End 6/13/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-3A
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monotox
						Crushed Stone and Sandy Surface					
						FILL: Dark Gray, Gray, and Brown Fine to Medium Sand. Trace of Silt and Clay. Several attempts to drive split spoon for soil samples. All unsuccessful due to obstructions and refusal.		3.0			
1		4	M/W	40		SB-3A and SB-3B are additional unsuccessful boring locations which were abandoned due to similar conditions of obstructive material near the surface. Field decisions were made to abandone the entire boring location for a test pit (TP-1). Relocate SB-3 to the Off-Site Containment Area.		12.0			
					5						
					10	End Boring at 5'					
					15						
					20						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 2.5 Upon Completion of Drilling _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____ ▼
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 8/1/89 End 8/1/89
Driller ETI Chief KKT Rig D 50
Logger TJM Editor TWP
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-4
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Moisture
						Vegetated Surface FILL: Black Silty Sand, Trace of Slag					
1		18	D	27		FILL: Brown and Black Silty Sand		2.0			
2		4	M	40	5	Spoon from 4-6' sample interval returns to surface covered with tar like substance. Open spoon to reveal poor recovery of brown sandy fill. Discover black liquid present inside hollow stem augers approximately 5' below ground surface. Innovate sampling device using a 4 oz jar taped to a tremmie pipe Collect sample of black liquid. Terminate boring.		8.0			
					10	End Boring at 6'					
					15						
					20						

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____ ▼
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 8/1/89 End 8/1/89
Driller ETI Chief KKT Rig D 50
Logger TJM Editor TWP
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-4A
Surface Elevation
Job No. 60251.03
Sheet 1 of 2

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monotox
						Straight drill to 10' at boring location 10' south of SB-4 Strong solvent-like odor					
					5						
								140.0			
					10						
1		0	W			Attempt sample interval at 10-12'. Spoon refusal, no sample. Continue drilling to 13'					
2		0	W			13-15' poor recovery. Solid paint and paint like resin (spongy). Continue drilling to 17'		100.0			
					15						
3		20	W	57		Traces of samples obtained during split spoon attempts revealed Dark Brown Silty Sand with Traces of Black Oily Waste, Orange and Blue Paint Pigments, and a Cloudy Liquid. Fill and/or Waste to 18'		190.0			
					20	Blueish (possible stained) Gray Fine to					

WATER LEVEL OBSERVATIONS

While Drilling ▽ 6.0 Upon Completion of Drilling
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 8/10/89 End 8/10/89
Driller ETI Chief KKT Rig D 50
Logger TJM Editor TWP
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-4A
Surface Elevation
Job No. 60251.03
Sheet 2 of 2

ONE PIERCE PLACE · SUITE 1110, ITASCA, ILL. 60143 · TEL(312) 773-8484

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth		qu (qa) (tsf)	Hnu	Explo-sive Gas	Field VOC Water	Mon to
						Medium SAND.					
						End Boring at 20'					
					25						
					30						
					35						
					40						

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-5
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monotox
						Well Vegetate Surface					
1		16	D	42		FILL: Black to Brown Fine to Medium Sand, Trace of Silt and Fine Gravel		7.0			
2		0	W		5	Solvent-like odor		4.0			
3		18	W	50/3"				8.0			
4		4	W	60	10	FILL: Black-Dark Gray Silty Sand, Some Debris like paint, rags, plastic, sludge, oily		120.0			
5		18	W	85				100.0			
6		18	W	29	15	Brown Fine to Coarse SAND, Trace to Little Fine to Coarse Gravel, Trace of Silt		80.0			
					20	End Boring at 17'					

WATER LEVEL OBSERVATIONS

While Drilling ▽ 7.0 Upon Completion of Drilling
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 8/3/89 End 8/3/89
Driller ETI Chief KKT Rig D 50
Logger TJM Editor TWP
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
Phase I RI/FS
Location Griffith, Indiana

Boring No. SB-6
Surface Elevation
Job No. 60251.03
Sheet 1 of 1

2100 CORPORATE DRIVE ADDISON, IL 60101 TEL(312) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Mo to
						FILL: Black to Brown Fine to Medium Sand					
1		18	D	26				3.0			
2		12	D/M	78	5	Spoon refusal at 5.5', sample reveals Brown Fine to Medium Sand to 5', then distinctive color change to black at 5.7', strong solvent/glue-like odor, moist		210.0			
3		2	W	100 /5"		Poor Recovery, strong solvent odor with black heavy oily sheen in water, trace of solid paint pigment and cardboard waste to 11.5'		225.0			
					10	Black wet silty sandy fill with trace of paint, oil, foam, wood from 11.5' to 15'					
4		22	W	44				150.0			
						Brown-Gray Silty Fine to Coarse SAND, Trace to Little Fine to Coarse Gravel					
5		10	W	22				80.0			
					15						
						End Boring at 15'					
					20						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 6.0 Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 8/3/89 End 8/3/89
Driller ETI Chief KKT Rig D 50
Logger TJM Editor TWP
Drill Method 3 1/4" I.D. HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB41
Surface Elevation 644.9
Job No. 60251.12
Sheet 2 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)			
						Bentonite Holeplug					
					30						
					35						
					40						
					45						
					50						
					55						

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB42
Surface Elevation 641.5
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES	
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)
						Clayey Material at Surface, Possible Cap		
1		12	M	100	5	FILL: Garbage Refuse Material Including Glass, Metal, Wood, Burn -----, Plastic in a Brown, Black, and Gray Sandy Clay Matrix		0.0
					10			
					15	Estimate Fill to 15'		
						Gray and Brown Fine to Medium Silty SAND, Trace Silty Clay Layers		
2		8	W	87	20			4.0
						End of Boring at 20.5 Feet Borehole Backfilled with Bentonite Holeplug		
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/14/90 End 6/14/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB43
Surface Elevation 650.2
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES	
No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)
1		10	M	6		FILL: Dark Brown Silty Fine Sand Fill with Traces of Solid Paint Pieces At 0.5' Grades to Brown and Dark Brown Silty Fine Sand Fill, No Odor		0
2		10	M	10		Becomes Brown Fine SAND, Trace Silt		0
					5	End of Boring at 4.5 Feet Borehole Backfilled with Bentonite Holeplug		
					10			
					15			
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/14/90 End 6/14/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB44
Surface Elevation 649.1
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
1		10	M	21		FILL: Dark Brown Silty Fine Sand At 0.7', Becomes Waste: Paint Solids in a Sandy Matrix at 1-2' below surface, Strong Solvent Odor, Paint Solids Include Yellow Purple, White, and Red Pigments, Dry/Moist with a Slight Rubbery Texture		
								80
2		10	M	121		Becomes Dark Gray Silty Fine Sand Fill, Traces of Dark Staining, (Some Oily) and Solid Paint-Like Pigments, Trace Fine Gravel. Strong Solvent Odor		
					5			145
					10	End of Boring at 4.5 Feet Borehole Backfilled with Bentonite Holeplug		
					15			
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/14/90 End 6/14/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB45
Surface Elevation 650.5
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES	
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)
1		10	M	22		FILL: Brown and Dark Brown (some Black staining) Silty Fine Sand, Trace Fine to Coarse Gravel, Slight Solvent Odor		125
2		18	M	7		Becomes FILL: Brown to Dark Brown Silty Fine Sand, Trace Fine to Coarse Gravel, Moist		120
					5			
					10	End of Boring at 4.5 Feet Borehole Backfilled with Bentonite Holeplug		
					15			
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/14/90 End 6/14/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB46
Surface Elevation 648.2
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
1		12	M	8		FILL: Brown Silty Fine SAND, Stained Various Colors (green, purple, and red) Drum Lids Encountered at 1-2'		1.0
2		10	M	79				<1.0
					5	End of Boring at 4.5 Feet Borehole Backfilled with Bentonite Holeplug		
					10			
					15			
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/14/90 End 6/14/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB47
Surface Elevation 647.3
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
1		8	M	5		FILL: Brown and Black Silty Fine Sand, Trace of Refuse Including Paper, Plastic and Color Staining (red and blue), Trace Fine to Medium Gravel, Dry with Slight Odor		
								5
2		5	M	35		Becomes Black Fill with Wood, Trace to Some Sandy Matrix, Paper and Glass, Slight Odor.		
								19
					5			
					10	End of Boring at 4.5 Feet Borehole Backfilled with Bentonite Holeplug		
					15			
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/14/90 End 6/14/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB48
Surface Elevation 650.6
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
1	■	10	M	10		FILL: Brown Silty Fine Sand with Trace to Some Paint-Like Staining (red, orange, green, blue and white), Slight Solvent Odors, Dry with Trace Grayish Staining Becomes Brown Silty Fine Sand Fill with Fine to Coarse Gravel and Trace to Some Light Chocolate Colored Staining and Traces of Paint-Like Color Staining, Grades to Black (stained) Fine Sand at 4.3'		
								14
2	■	16	W	40				
					5			40
					10	End of Boring at 4.5 Feet Borehole Backfilled with Bentonite Holeplug		
					15			
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/14/90 End 6/14/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB49
Surface Elevation 648.6
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES	
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)
1		12	M	54		FILL: Black and Dark Brown Fine Sandy Sand and Gravel, Trace Coarse Limestone Gravel, Metal, Solid Paint Pigments and Black (stained) Fine Sand Wet in Coarse Sand and Gravel, Slight Odors		3.0
					5			
					10	End of Boring at 4.5 Feet Borehole Backfilled with Bentonite Holeplug		
					15			
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/19/90 End 6/19/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB50
Surface Elevation 645.4
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
1	■	8	M	7		FILL: Brown Silty Fine Sand, Trace of Black Stained Fine Sand, Fine Gravel, Roots, Paint Staining, and Perfume Odor		
								0.5
2	■	3	M	100		Becomes Dark Brown and Black Fine to Medium Sand and Fine Gravel Fill, Trace Coarse Gravel and Debris Like Glass, Wood, Plastic, Paper, and Aluminum Foil. Moist to Wet		
					5			20
						End of Boring at 4.5 Feet Borehole Backfilled with Bentonite Holeplug		
					10			
					15			
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/19/90 End 6/19/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB52
Surface Elevation 644.8
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE · ADDISON, ILLINOIS 60101 · TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
1		8	M	7		FILL: Brown Silty Fine Sand, Trace Fine to Medium Gravel, Some Light Green Paint-Like Staining at 0.7', Becomes Black Stained Fine Sand at 0.9', No Odors		
								1.0
2		5	W	18		FILL: Black Sand with Much Debris Like Plastic, Paper, Wood and Glass, Wet, Trace of Light Green Paint Like Substance and Olive-Green Stained Sand		
					5			
					10	End of Boring at 4.5 Feet Borehole Backfilled with Bentonite Holeplug		
					15			
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/19/90 End 6/19/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB51
Surface Elevation 646.8
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
1		12	M	23		FILL: Black and Brown Silty Fine Sand with Debris Like Wood and Plastic, Becomes Brown Fine Sand with Various Colors of Paint-Like Staining with Heavy Solvent Odors, Traces of Black Oily Like Staining, Metal, Plastic Pellets, and Glass		200
					5			
					10	End of Boring at 4.5 Feet Borehole Backfilled with Bentonite Holeplug		
					15			
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/19/90 End 6/19/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB53
Surface Elevation 645.0
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)			
1		10	M	24		FILL: Brown Silty Fine Sand, Becomes Black Silty Fine Sand, Some Fine to Coarse Gravel					
								1.0			
2		14	M	8		Becomes Black Fine to Medium Sand and Fine Gravel, Trace to Little Silt, Trace Coarse Gravel and Limestone Cobbles					
					5			1.5			
						End of Boring at 4.5 Feet Borehole Backfilled with Bentonite Holeplug					
					10						
					15						
					20						
					25						

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/19/90 End 6/19/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB54
Surface Elevation 646.5
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	PID (ppm)
						Straight Drill to 3'		
1		10	M	108		FILL: Black Silty Fine Sand, Trace to Some Debris Like Paper, Cloth and Plastic and Drum Lids		2.0
					5			
						End of Boring at 4.5 Feet Borehole Backfilled with Bentonite Holeplug		
					10			
					15			
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/19/90 End 6/19/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB55
Surface Elevation 637.4
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	PID (ppm)
						Brown Fine SAND on Surface, Becomes Brown Fine to Coarse SAND, Trace to Little Fine to Medium Gravel, Trace Rust Coloration Throughout, Trace to Little Grayish-Black/Grayish-Green Staining at 6.8', Odorous	
					5			
1		18	W	14				170
					10			
2		14	W/M	23	15			45
						Gray Silty CLAY, Trace Fine Sand and Fine Gravel		4
						End of Boring at 10.0 Feet Borehole Backfilled with Bentonite Holeplug		
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/19/90 End 6/19/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB56
Surface Elevation 637.9
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Sandy Fill on Surface		
						Brown Fine SAND		
					5	Becomes Brown Fine to Coarse SAND, Trace Silt and Fine to Medium Gravel, Wet, Slight Odor, Trace of Greenish-Gray Staining at 6.7'		
1		12	W	5				3
					10			
2		16	W	21	15	Brown Fine to Medium SAND, Trace to Some Coarse Sand and Fine Gravel (at Base) at 14.5-15.2'		0
								1.0
						Gray Silty CLAY, Trace to Some Fine to Medium Sand, Trace Thin Seams of (1/4"-1") Fine to Medium Sand		
					20	End of Boring at 16.0 Feet Borehole Backfilled with Bentonite Holeplug		
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 4.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/20/90 End 6/20/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB57
Surface Elevation 637.6
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Straight Drill to 5.5'		
						Log Based on Cuttings: Brown and Gray Fine to Medium SAND, Trace to Little Coarse Sand and Fine Gravel		
					5			
1		14	W	8		At 6' Becomes Brown to Gray Fine to Coarse SAND, Trace Silt and Fine to Coarse Gravel, Slight Odor with Trace Dark Staining		8
					10			
2		16	W	25	15			30
						Trace of Silt at 15.8'		
						End of Boring at 16.0 Feet Borehole Backfilled with Bentonite Holeplug		
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 4.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/20/90 End 6/20/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB58
Surface Elevation 637.0
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Straight Drill to 5.5'		
					5			
1		18	W			Rust Brown to Gray to Dark Gray and Black Fine SAND, Grades to Silty Fine Sand at 6.5' Very Slight Trace of Thin Silty Seams (1/8") at 6.8'		50
					10			
2		8	W/M	12	15	Grades to Brown Fine to Medium SAND to 15.1' then Brown and Gray Silty Fine to Coarse SAND, Trace to Some Fine to Coarse Gravel, Trace Coarse Glacial Erratic (3" dia) Cobble on Top of Clay		30 5.0
					20	Gray Silty CLAY, Trace Fine to Medium Sand and Fine Gravel.		
						End of Boring at 16.0 Feet Borehole Backfilled with Bentonite Holeplug		
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 4.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/20/90 End 6/20/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB59
Surface Elevation 638.4
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						FILL: Crushed Stone Road Gravel FILL, Gray Fine to Medium Sand, Trace Silt		
						Gray Fine to Medium SAND, Trace Silt		
					5	Grades to Dark Brownish Gray Fine to Coarse SAND, Trace to Some Fine to Coarse Gravel, Trace Silt and Cobbles, Thin Black Stained Layers at 6.5' and 6.9' (1/4"), Odorous		
1		14	W	13				20
					10			
2		12	W	25	15	Becomes Dark Gray Fine to Medium SAND, Trace Coarse Sand and Fine Gravel, Hint of Black Staining Throughout		8
						End of Boring at 16.0 Feet Borehole Backfilled with Bentonite Holeplug		
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 4.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/20/90 End 6/20/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB60
Surface Elevation 638.0
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Straight Drill to 5.5'		
						FILL: Crushed Stone Road Gravel		
						Brown and Gray Fine SAND		
					5			
1		14	W	10		Becomes Brown and Gray Fine to Coarse SAND, Trace Silt and Fine to Coarse Gravel, Odorous		120
						Continue Drilling to 14.5'		
					10			
2		10	W	40	15	Becomes Dark Gray Fine to Coarse SAND and GRAVEL, Trace Silt and Pebbles, Traces of Black Staining Throughout		30
						End of Boring at 16.0 Feet Borehole Backfilled with Bentonite Holeplug		
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 4.5 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/20/90 End 6/20/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB61
Surface Elevation 636.8
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Brown Sand FILL		
						Brown Fine to Medium SAND, Trace Silt and Fine Gravel Wet at 3.5'		
					5			
1		4	W	21		Brown to Black Fine to Medium SAND, Odorous with Staining, Oily Sheen on Water Trace Coarse Cobble		35
					10	Becomes Black (mostly stained) Fine to Coarse SAND and GRAVEL, Trace Pebbles, Strong Odor		
2		14	W	37	15	Grades to Gray Fine to Medium SAND, Trace Coarse Sand and Fine Gravel to 15.0		25
						Gray Silty CLAY, Trace to Little Fine to Medium Sand, Trace Fine to Coarse Gravel		
					20	End of Boring at 16.0 Feet Borehole Backfilled with Bentonite Holeplug		
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 3.5 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/20/90 End 6/20/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB62
Surface Elevation 637.1
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Brown Fine to Coarse SAND, Trace Silt and Pebbles		
					5	Grades to Gray Fine to Coarse SAND, Trace to Little Fine to Medium Gravel, Slight Odor, Trace Silt		
1		15	W	5				40
					10			
2		14	W/M	51	15	Grades to Brown and Gray Fine to Medium SAND, Trace to Some Coarse Sand and Fine Gravel		50
								0.5
						Dense Gray Silty CLAY, Trace Fine Sand and Fine Gravel, Moist		
					20	End of Boring at 16.0 Feet Borehole Backfilled with Bentonite Holeplug		
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 4.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/20/90 End 6/20/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB63
Surface Elevation 637.1
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Brown Fine SAND, Color Change to Dark Gray Fine to Medium Sand, Trace Gravel		
					5	Becomes Gray Fine to Coarse SAND, Trace Fine to Medium Gravel, Black Oily Stained Layer at 4.7' (1/2"), Interbedding of Fine to Coarse Sand Layers		
1		16	W	27				105
					10	Brownish-Gray Fine to Medium SAND, Trace Fine Gravel		
2		16	W	47				
					15	Gray Silty CLAY, Trace to Some Fine to Medium Sand and Fine Gravel (thin sand seams at top of clay, 1/4 to 1/2" thick) Clay Becomes More Dense with Depth, Trace Fine to Coarse Gravel		20
					20	End of Boring at 15.5 Feet Borehole Backfilled with Bentonite Holeplug		
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 4.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/21/90 End 6/21/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB64
Surface Elevation 637.4
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Brown to Gray Fine SAND		
					5	Dark Gray and Black Fine to Coarse SAND, Trace to Little Fine to Coarse Gravel, Wet with Strong Odors Continue Drill to 14.5'		
1		8	W	4				110
					10			
2		18	W	50	15	Becomes Brownish-Gray Fine to Coarse SAND, Trace Fine to Coarse Gravel, Trace Silt at 15.5-16.0'		18
						End of Boring at 16.0 Feet Borehole Backfilled with Bentonite Holeplug		
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 4.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/21/90 End 6/21/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB65
Surface Elevation 637.7
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						FILL: Crushed Stone Road Gravel		
						Brown Fine SAND		1.0
					5			
1		16	W	27		Grades to Dark Gray and Black Fine to Coarse SAND, Trace to Some Fine to Coarse Gravel, Trace Cobbles, Blackish Staining Throughout to 6.7', Then Gray Fine Sand, Trace Thin Silt Seam at 6.8' (1/4")		40
					10			
2		14	W	37	15			
						Becomes Gray Fine SAND with Alternating Layers of Gray SILT and Gray Fine SAND (1/2" each)		3
						End of Boring at 16.0 Feet Borehole Backfilled with Bentonite Holeplug		
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 4.5 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/21/90 End 6/21/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB66
Surface Elevation 637.8
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Crushed Stone Road Gravel		
						Brown Fine SAND		0.0
					5			
1		48	W	7		Brown Fine to Coarse SAND, Grades Coarse to Trace Fine to Coarse Gravel		1.0
						Gray Fine to Coarse SAND, Trace Fine to Medium Gravel, Wet with Odor, Trace Black Staining Throughout Continue Drilling to 14.5'		
					10			
2		14	W	37	15	Gray Fine SAND, Trace Silt, Laminated with Horizontal Banding of Gray and Dark Gray		1.0
						Gray SILT Layer, Trace Clay		
						Gray Fine SAND, Trace to Little Silt		
					20	Dense Gray Silty CLAY, Trace Fine Gravel Trace Fine to Coarse Sand and Gravel on Top of Clay		
						End of Boring at 16.0 Feet Borehole Backfilled with Bentonite Holeplug		
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 4.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/21/90 End 6/21/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB67
Surface Elevation 637.4
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE · ADDISON, ILLINOIS 60101 · TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						FILL: Crushed Stone and Sand Fill Roadway.		
						Brown Fine SAND to Dark Gray Fine to Coarse SAND		
					5			
1		14	W	15		Becomes Dark Gray to Jet Black, Fine to Coarse SAND, Trace to Some Fine Gravel, Odorous		5.0
						At 6.8' Grades to Dark Gray to Gray Fine SAND, Trace to Little Medium Sand, Trace of Silt and Fine Gravel at 6.9'		
					10			5.5
2		16	W	58	15	Becomes Gray Fine to Medium SAND, Trace Fine Gravel, Moist		
						Gray Silty CLAY, Trace Fine Gravel		
						Grades into Brownish-Gray Silty CLAY, Trace to Little Fine to Medium Sand, Less Dense		
					20			
						End of Boring at 16.0 Feet Borehole Backfilled with Bentonite Holeplug		
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/21/90 End 6/21/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB68
Surface Elevation 637.0
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Sandy Fill on Surface		
						Straight Drill to 5.5'		
1		8	W	9	5	Brown Fine to Medium SAND to 5.7' then Black and Dark Gray Fine to Coarse SAND, Trace Fine Gravel, Black Staining and Odor Throughout		13.0
						Continue Drill to 14.5'		
					10			
2		18	W	40	15	Grades to Gray Fine to Medium SAND, Trace Fine to Medium Gravel to 14.6'		9.0
						Gray Silty CLAY, Trace Fine to Medium Sand and Fine Gravel, Trace Fine to Medium Sand Seams (1/2") at 15'-15.5' Grades to Gray Silty CLAY, Trace to Little Fine to Coarse Sand and Fine Gravel, Increasingly Sandy with Depth		
					20			
						End of Boring at 16.0 Feet Borehole Backfilled with Bentonite Holeplug		
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/22/90 End 6/22/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB69
Surface Elevation 638.3
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Crushed Stone Surface Fill		
					5	Dark Gray (some stained) Fine SAND with Solvent Odors to 3.5', then Brown Fine SAND Straight Drill to 6.5'		100
1		18	W	32		Brown (much oily stained) SAND and GRAVEL (possible fill), Trace to Some Fine to Coarse Gravel and Pebbles, Trace Silt, Wet at 6.5-7.0', Black Staining on Fine Sand at 6.5-6.8'		150
					10			
					15			
						Continue Drilling to 20'		
					20			
2		12	W	30		Gray Fine to Coarse SAND, Trace Silt that increases with depth		75 5.0
						Becomes Gray SILT and Fine SAND (layers) at 21.1', Trace Gray Clay		
					25	End of Boring at 21.5' Feet Borehole Backfilled with Bentonite Holeplug		

WATER LEVEL OBSERVATIONS

While Drilling ▽ 5.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/25/90 End 6/25/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB70
Surface Elevation 638.8
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Road Gravel Surface		
					5	Brown and Dark Gray Silty Fine SAND (possible Fill), Trace Fine to Coarse Gravel, wet at 5-6' Straight Drill to 6.5'		70
1		10	W	42		Brown and Dark Brown (stained) Fine to Coarse SAND and Fine to Medium Gravel, Trace Silt and Oily Staining (some in tiny droplets) throughout		120
					10			
					15			
2		14	W	35	20	Becomes Gray Fine to Coarse SAND, Trace Fine Gravel, Trace of Gray Silty Clay Pocket at 20'		15.0
						End of Boring at 20.5 Feet Borehole Backfilled with Bentonite Holeplug		
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ 5.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/25/90 End 6/25/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB71
Surface Elevation 638.7
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	Type	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Road Gravel Surface Underlain by FILL: Brown Silty Fine Sand and Gravel to Black Silty Fine Sand, Trace Gravel		
					5	Brown to Dark Brown Silty Fine SAND which Grades to Brown and Gray (much darker with Black Oily Stains) Fine to Coarse SAND and Fine Gravel, Trace of Fine Sand which Increases with Depth. Continue Drilling to 19'		
1		16	W	7				90
					10			
					15			
2		14	W	32	20	Gray Fine to Medium SAND, Trace Coarse Sand and Fine Gravel, Trace Silt Layers at 19.2' and 20.2' (1/4" to 1/2") Increasingly Finer Grained Sand with Depth		25
					25	End of Boring at 20.5 Feet Borehole Backfilled with Bentonite Holeplug		

WATER LEVEL OBSERVATIONS

While Drilling ▽ 6.0 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/27/90 End 6/27/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB72
Surface Elevation 638.4
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	PID (ppm)
						Crushed Stone Road Gravel Surface Underlain by FILL: Brown Fine Sand to Dark Gray Fine Sand		
					5	Straight Drill to 6.5'		
1		10	W	6		Brown Fine SAND which Grades into Gray Fine to Medium SAND at 6', Trace Silt, Increasing Coarse Sand to Trace Fine Gravel Wet with Slight Oily Sheen Continue Drilling to 19'		17
					10			
					15			
2		14	W	23	20	Gray Fine to Coarse SAND, Trace Fine to Medium Gravel, Trace Silt with Depth, Thin Silt Layer (1/2") at 20.3', Trace Clayey Silt Pockets at 19.9', Silt Layers Interbedded with Fine to Coarse Well Sorted Sand		50
					25	End of Boring at 20.5 Feet Borehole Backfilled with Bentonite Holeplug		

WATER LEVEL OBSERVATIONS

While Drilling ▽ 5.5 Upon Completion of Drilling ▼
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/28/90 End 6/28/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB73
Surface Elevation 641.7
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	PID (ppm)
						Gravel Surface Crushed Stone Underlain by FILL: Brown to Dark Gray and Black Silty Fine Sand with Strong Solvent Odors		
1		16	M	4	5	FILL: Brown, Dark Brown, and Black (staining throughout) Silty Fine Sand, Trace of Wood and Gravel		70
					10	Estimate Fill to 9.5'		
2		18	M/W	54	15	Gray and Dark Gray Fine SAND (slight trace of black staining), Trace Silt (increases with depth), Trace to Little Silt in thin layers (1/4") at 18.5-19.0, tip of spoon reveals black stained layer directly above Silty Clay Layer at 19.0'		35
					20	End of Boring at 19.0 Feet Borehole Backfilled with Bentonite Holeplug		
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/28/90 End 6/28/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB74
Surface Elevation 641.6
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	PID (ppm)
						Road Gravel Surface Underlain by FILL: Brown and Dark Gray Silty Fine Sand, Trace of Dark Staining		6
1		16	M/W	5		Brown Fine Sand, Trace Silt and Black Staining Throughout		20
					5	Driller's Note: Encountered Buried Object While Drilling at 11' (possible drums)		
					10			
						Estimate Fill to 12'		
					15			
2		10	W	63		Brown and Dark Gray Fine SAND, Trace Black Oily Staining Throughout, Trace Silt at 18.5-19.0'		
					20			85
						End of Boring at 19.0 Feet Borehole Backfilled with Bentonite Holeplug		
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 6/28/90 End 6/28/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
Location Griffith, Indiana

Boring No. SB75
Surface Elevation 641.5
Job No. 60251.12
Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES	
No.	TYPE	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)
						Crushed Stone Road Gravel Surface Underlain by FILL: Dark Gray Fine Sand with Solvent Odors		
					5			70
						Encountered Buried Objects Between 7 to 11'		
					10			
						Estimate Fill to 11'		
1		14	W	40		Brownish to Dark Gray Fine to Medium SAND, Trace to Little Fine to Coarse Gravel, Trace Silt		110
					15			
						End of Boring at 15.0 Feet Borehole Backfilled with Bentonite Holeplug		
					20			
					25			

WATER LEVEL OBSERVATIONS

While Drilling ▽ _____ Upon Completion of Drilling ▼ _____
Time After Drilling _____ _____ _____ _____
Depth to Water _____ _____ _____ _____
Depth to Cave in _____ _____ _____ _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

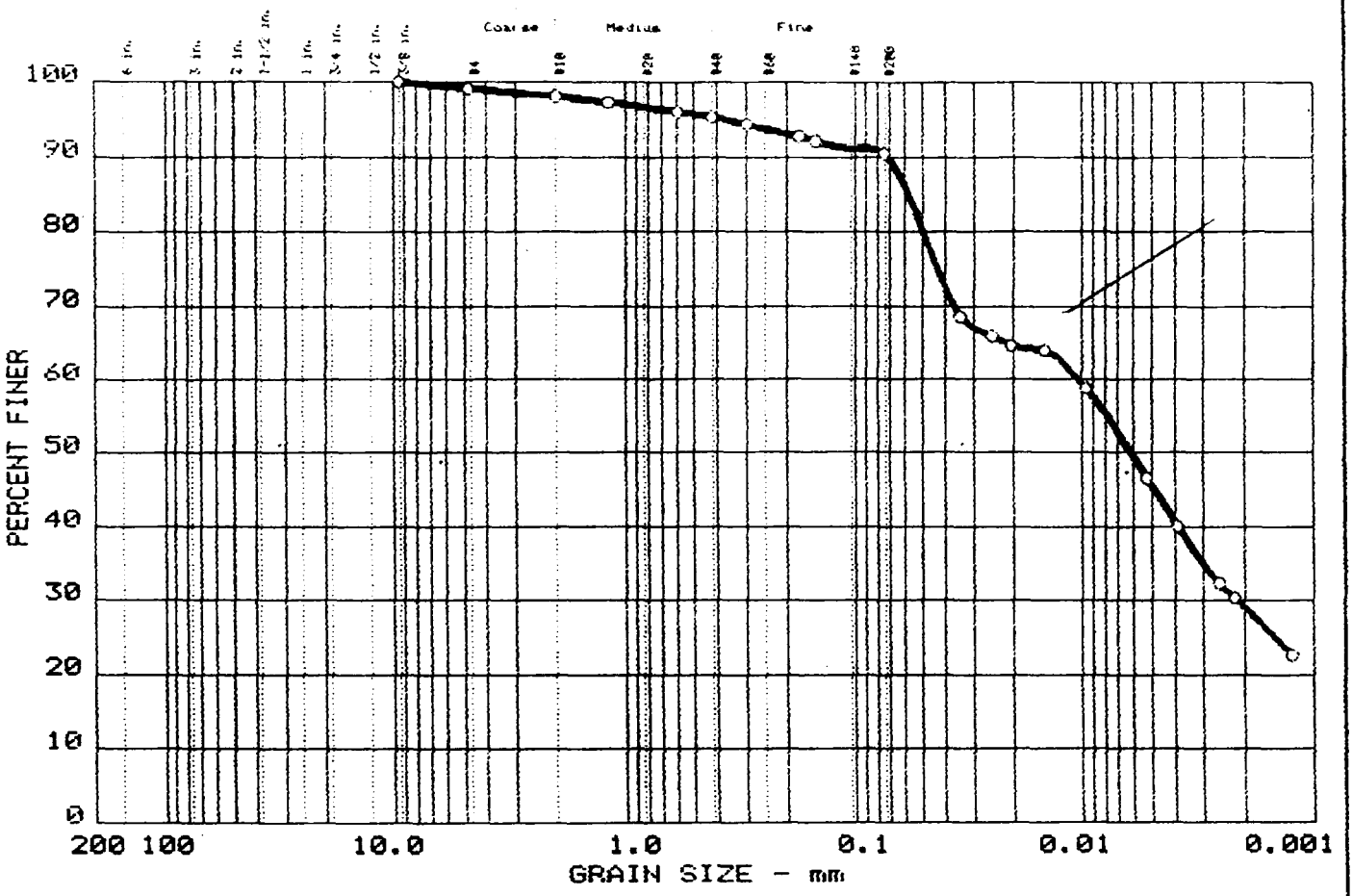
GENERAL NOTES

Start 6/28/90 End 6/28/90
Driller ETI Chief TJC Rig D-50
Logger TJM Editor SJB
Drill Method 4.25" ID HSA

APPENDIX F

Geotechnical Analysis Results

GRAIN SIZE DISTRIBUTION TEST REPORT



Symbol	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.9	8.6	45.1	45.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	33	19			0.01	0.002				

MATERIAL DESCRIPTION	USCS
○ Brown Lean CLAY, Little Sand, Trace Gravel	CL

Project No.: 15090.33
Project: ACS
○ Sample: BORING: MW7 @ 23.0-25.0 FT

Date: 03/21/90

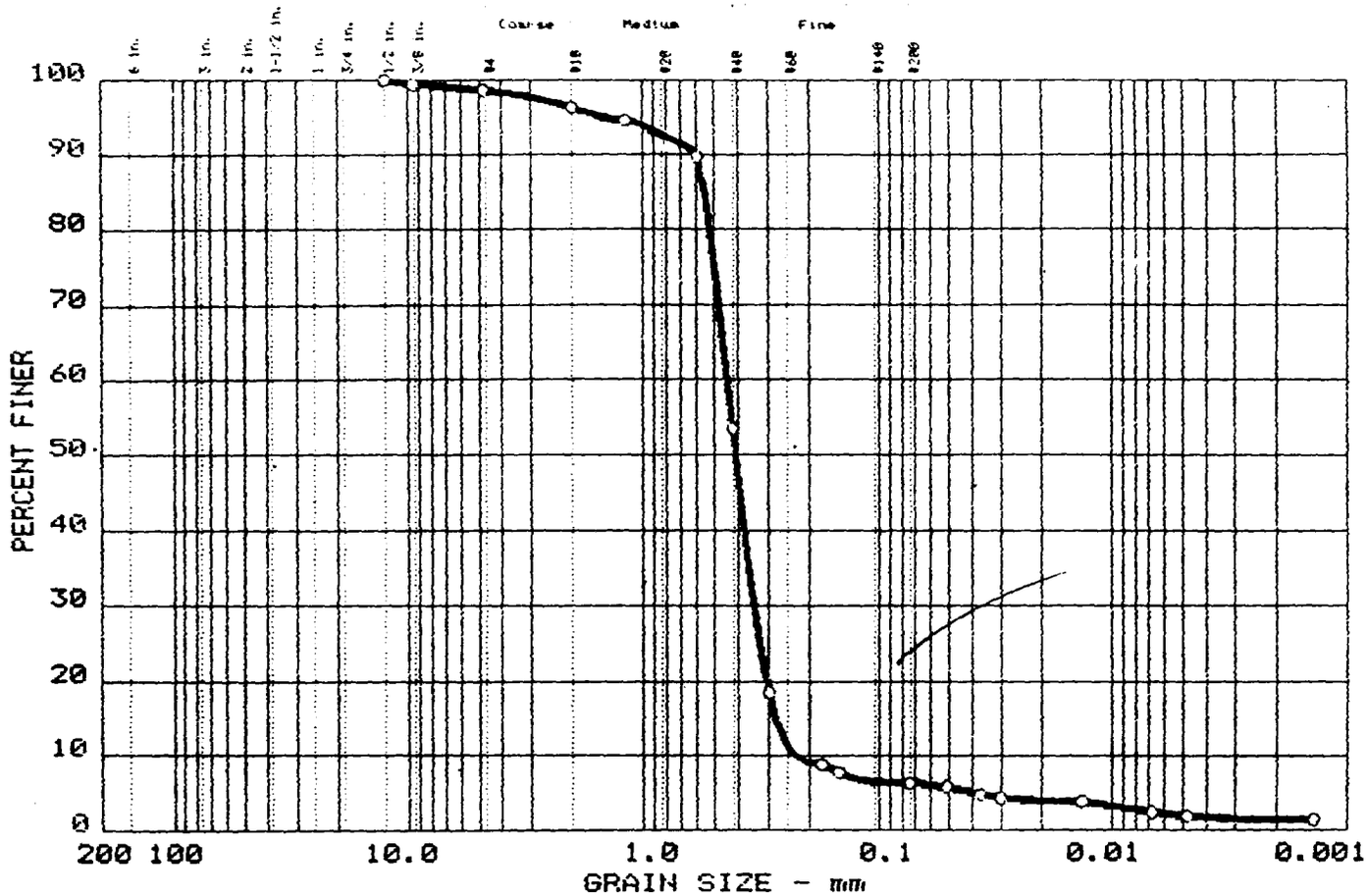
Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DJ2
APPROVED BY:

GRAIN SIZE DISTRIBUTION TEST REPORT
EWI, Engineering Associates, Inc.

Sheet No._____

EWI

GRAIN SIZE DISTRIBUTION TEST REPORT



Symbol	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O	0.0	1.4	92.3	4.4	1.9

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O	--	--	0.55	0.44	0.41	0.342	0.2780	0.2286	1.16	1.9

MATERIAL DESCRIPTION	USCS
O Brown Fine-Medium SAND, Trace Silt, Clay & Gravel	SP-SM

Project No.: 15090.33
Project: ACS
O Sample: BORING: MW7 @ 45.0-50.0 FT

Date: 03/21/90

GRAIN SIZE DISTRIBUTION TEST REPORT

EWI, Engineering Associates, Inc.

Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DA
APPROVED BY:

Sheet No._____

EWI

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 12

Date: 03/21/90
Project No.: 15090.33
Project: ACS

Sample Data

Sample number: BORING: MW9 @ 26.0-35.0 FT
Sample Des.: Brown Fine-Medium SAND, Little Silt, Trace Clay & Gravel
USCS Class: SP-SM
Liquid limit: --
Plasticity index: --

Notes

Remarks: TESTED BY: MML/DWA ENTERED BY: MML
CHECKED BY: APPROVED BY:
Set No.: DR

Mechanical Analysis Data

	Initial
Dry sample and tare=	725.21
Tare =	0.00
Dry sample weight =	725.21

Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.5 inches	0.00	100.0
0.375 inches	1.67	99.8
# 4	16.80	97.7
# 10	34.32	95.3
# 16	44.70	93.8
# 30	66.07	90.9
40	256.72	64.6
# 50	570.71	21.3
80	653.42	9.9
# 100	661.57	8.8
# 200	666.58	8.1

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 95.3
Weight of hydrometer sample: 100
Hygroscopic moisture correction:
Moist weight & tare = 641.82
Dry weight & tare = 641.71
Tare = 50.80
Hygroscopic moisture= 0.0 %
Calculated biased weight= 104.95
Automatic temperature correction
Composite correction at 20 deg C =-7

Meniscus correction only= 0
Specific gravity of solids= 2.65

EWI

Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294944 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	20.0	13.0	6.0	0.0136	13.0	14.3	0.0514	5.7
2.0	20.0	12.0	5.0	0.0136	12.0	14.4	0.0365	4.7
3.0	20.0	11.5	4.5	0.0136	11.5	14.4	0.0299	4.2
6.0	20.0	11.0	4.0	0.0136	11.0	14.5	0.0212	3.8
60.0	20.0	10.0	3.0	0.0136	10.0	14.7	0.0067	2.8
120.0	20.0	9.5	2.5	0.0136	9.5	14.7	0.0048	2.3
1440.0	20.0	9.0	2.0	0.0136	9.0	14.8	0.0014	1.9

Fractional Components

% + 3 in. = 0.0 % GRAVEL = 2.3 % SAND = 89.6
% SILT = 5.7 % CLAY = 2.4

D85= 0.52 D60= 0.406 D50= 0.378
D30= 0.3251 D15= 0.24378 D10= 0.17660
Cc = 1.4757 Cu = 2.2961

DR

EWI

Job No. 15090
Date: 03/21/90

FALLING HEAD PERMEABILITY TEST

EWI Engineering Associates, Inc., 8383 Greenway Blvd., Middleton, WI 53562 Phone: (608) 231-4770

PROJECT	ACS
LOCATION	GRIFFITH, INDIANA
SAMPLE (a)	BORING: MW9
DEPTH (ft)	21.0 - 23.0
SOIL DESCRIPTION	Brown Lean CLAY, Some Sand, Little Gravel (CL)
SAMPLE DIAMETER (cm)	7.4
SAMPLE AREA, A(cm^2)	42.6

	INITIAL	FINAL
SAMPLE LENGTH, L(cm)	19.3	19.3
MOISTURE CONTENT, %	18.8	18.5
DENSITY (lb/cu ft)	110.0	110.0
PERCENT COMPACTION	-	-

RUN	COEFFICIENT OF PERMEABILITY, k(cm/sec)
1	6.5E-08
2	9.4E-08
3	3.9E-08
4	6.0E-09
5	4.8E-09
6	1.6E-08
7	1.8E-08
8	1.3E-08
9	2.2E-08
10	3.4E-08
11	3.4E-08
12	3.0E-08

AVERAGE COEFFICIENT OF PERMEABILITY = 3.3E-08 cm/sec
(Based on run numbers 10 through 12)

FORMULA: $k = \frac{2.3aL}{At} \log_{10} \frac{h_0}{h_1}$, Where a = cross-sectional area of standpipe,
t = time for water level to fall from initial height, h_0, to final height, h_1
(All other terms are defined above)

FOOTNOTES: (a) This permeability test was performed on a relatively undisturbed 3-inch diameter Shelby tube sample.

CHECKED BY: _____ DATE: _____ APPROVED BY: _____ DATE: _____

EWI

Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294564 - 0.164 x Rm

Elapsed time, min	Temp. deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	20.0	15.0	8.0	0.0136	15.0	13.8	0.0508	7.7
2.0	20.0	14.5	7.5	0.0136	14.5	13.9	0.0360	7.2
3.0	20.0	14.0	7.0	0.0136	14.0	14.0	0.0295	6.7
15.0	20.0	13.0	6.0	0.0136	13.0	14.2	0.0133	5.8
60.0	20.0	12.0	5.0	0.0136	12.0	14.3	0.0067	4.8
120.0	20.0	11.5	4.5	0.0136	11.5	14.4	0.0047	4.3
300.0	20.0	11.0	4.0	0.0136	11.0	14.5	0.0030	3.8
420.0	20.0	10.5	3.5	0.0136	10.5	14.6	0.0025	3.4
1440.0	20.0	10.0	3.0	0.0136	10.0	14.7	0.0014	2.9

Fractional Components

% + 3 in. = 0.0 % GRAVEL = 1.1 % SAND = 88.9
% SILT = 5.5 % CLAY = 4.5

D85= 0.47 D60= 0.366 D50= 0.337
D30= 0.2729 D15= 0.16788 D10= 0.07499
Cc = 2.7164 Cu = 4.8753

EWI

Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.29495e4 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	20.0	13.0	6.0	0.0136	13.0	14.2	0.0514	5.7
2.0	20.0	12.0	5.0	0.0136	12.0	14.3	0.0365	4.8
3.0	20.0	11.5	4.5	0.0136	11.5	14.4	0.0299	4.3
15.0	20.0	11.0	4.0	0.0136	11.0	14.5	0.0134	3.8
60.0	20.0	9.5	2.5	0.0136	9.5	14.7	0.0068	2.4
120.0	20.0	9.0	2.0	0.0136	9.0	14.8	0.0048	1.9
1440.0	20.0	8.5	1.5	0.0136	8.5	14.9	0.0014	1.4

Fractional Components

% + 3 in. = 0.0 % GRAVEL = 1.4 % SAND = 92.3
% SILT = 4.4 % CLAY = 1.9

D85= 0.55 D60= 0.442 D50= 0.408
D30= 0.3424 D15= 0.27797 D10= 0.22856
Cc= 1.1614 Cu = 1.9320

DA

EWI

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 11

Date: 07/21/90
Project No.: 15070.33
Project: ACS

Sample Data

Sample number: BORING: MW9 @ 10.0-16.0 FT
Sample Des.: Brown Fine-Medium SAND, Little Silt, Trace Clay & Gravel
USCS Class: SP-SM Liquid limit: --
Plasticity index: --

Notes

Remarks: TESTED BY: MML/DWA ENTERED BY: MML
CHECKED BY: APPROVED BY:
Sheet No.: DA

Mechanical Analysis Data

	Initial
Dry sample and tare=	707.29
Tare =	0.00
Dry sample weight =	707.29

Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.5 inches	0.00	100.0
0.375 inches	1.47	99.8
# 4	8.07	98.9
# 10	21.93	96.9
# 16	29.90	95.8
# 30	43.90	93.8
# 40	172.32	75.6
# 50	448.90	36.5
# 80	591.81	16.3
# 100	615.[illegible]	12.4
# 200	637.19	9.9

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 96.9
Weight of hydrometer sample: 100
Hygroscopic moisture correction:
Moist weight & tare = 624.07
Dry weight & tare = 623.90
Tare = 38.51
Hygroscopic moisture= 0.0 %
Calculated biased weight= 103.17
Automatic temperature correction
Composite correction at 20 deg C =-7

Meniscus correction only= 0
Specific gravity of solids= 2.65

EWI

EWI

HYDROMETER AND SIEVE ANALYSIS : COMPUTER CALCULATION SHEET ONLY

DATE 03-21-90 TECH MML/BWA JOB ACS (NCI # 60251.20 JOB NO 15090.33

CHECKED BY: DA

SHEET 1 OF 2

REMARKS:

SAMPLE NUMBER:	MW7	MW7 [illegible]	MW7 [illegible]
PAN NUMBER:	37x	38x	40x
	LL 33 PI 19	LL 21 PI 10	LL — PI —
WET WT. gr=(W1)	406.91	483.37	793.00
DRY WT. gr=(W2)	406.68	482.97	792.69
TARE WT. gr=(W3)	16.48	16.60	16.41
TARE + R10 WT=(W4)	25.14	75.56	188.95
% MOIST OF SOIL=(W5) (W1-W2/W2-W4)	0.06	0.10	0.05
DRY WT(W2-W3)=(W6)	—	—	—
P10 SOIL SET UP WT=(W7)	75	75	100
DRY WT OF W7= (W8) (W7/1+W5)hyd soil wt	74.15	74.53	99.[illegible]
TOTAL SIEVE WT=(W9) (W6 + W8)	465.15	541.30	[illegible]
SPECIFIC GRAVITY (Gs) (assumed value)	2.70	2.70	[illegible]

NN-4 NN-4 NP NN-4

* OPTIONAL READINGS

HYDROMETER CORRECTION	TEMPERATURE CENTIGRADE	ELAPSED TIME, MINUTES	CLOCK TIME	UNCORRECTED HYD READING	SIEVE (W9)*	CLOCK TIME	UNCORRECTED HYD READING	SIEVE (W9)*	CLOCK TIME	UNCORRECTED HYD READING	SIEVE (W9)*
[illegible]	20	0 MIN	[illegible]	---------	2 1/2"	[illegible]	---------	2 1/2"	[illegible]	---------	2 1/2"
		1 MIN	01	60	2"	[illegible]	53	2"	[illegible]	16.5	2"
		2 MIN	02	58	1 1/2"	[illegible]	51	1 1/2"	[illegible]	15.5	1 1/2"
		3 MIN	03	57	1"	05	48	1"	[illegible]	14.5	1"
		* 4 MIN	*	*	3/4"	*	*	3/4" 0	*	*	3/4" 0
		6 MIN	06	56.5	1/2"	06	40	1/2" 27.49	[illegible]	[illegible]	1/2" [illegible]
		* 10 MIN	*	*	3/8" 0	*	*	3/8" 36.59	*	*	3/8" 15.05
		15 MIN	15	52.5	#4 4.07	17	33.5	#4 49.57	19	12.5	#4 66.30
		* 30 MIN	*	*	#10 8.66	*	*	#10 58.96	*	*	#10 172.54
		60 MIN	[illegible]	43	#16 12.37	[illegible]	25	#16 73.26	[illegible]	11	#16 242.31
		120 MIN	[illegible]	38	#30 18.11	[illegible]	22	#30 83.08	[illegible]	17.5	#30 266.01
		* 240 MIN	*	*	#40 21.42	*	*	#40 101.91	*	*	#40 328.19
		300 MIN	[illegible]	32	#50 26.38	[illegible]	19	#50 132.89	[illegible]	—	#50 559.[illegible]
		* 360 MIN	*	*	#80 33.74	*	*	#80 142.16	*	*	#80 757.31
		420 MIN	[illegible]	30.5	#100 36.50	[illegible]	8	#100 145.25	[illegible]	10.0	#100 783.0[illegible]
		1440 MIN									

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 10

Date: 03/21/90
Project No.: 15090.33
Project: HCS

Sample Data

Sample number: BORING: MW7 @ 45.0-50.0 FT
Sample Des.: Brown Fine-Medium SAND, Trace Silt, Clay & Gravel
USCS Class: SP-SM
Liquid limit: --
Plasticity index: --

Notes

Remarks: TESTED BY: MML/DWA ENTERED BY: MML
CHECKED BY: APPROVED BY:
Sheet No.:

Mechanical Analysis Data

	Initial
Dry sample and tare=	1006.04
Tare =	0.00
Dry sample weight =	1006.04

Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.5 inches	0.00	100.0
0.375 inches	5.39	99.5
# 4	13.73	98.6
# 10	36.46	96.4
# 16	54.03	94.6
# 30	103.04	89.8
# 40	468.20	53.5
# 50	819.66	18.5
# 80	916.95	8.9
# 100	928.23	7.7
# 200	942.51	6.3

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 96.4
Weight of hydrometer sample: 100
Hygroscopic moisture correction:
Moist weight & tare = 922.65
Dry weight & tare = 922.51
Tare = 52.91
Hygroscopic moisture= 0.0 %
Calculated biased weight= 103.74
Automatic temperature correction
Composite correction at 20 deg C =-7

Meniscus correction only= 0
Specific gravity of solids= 2.65

EWI

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 9

Date: 03/21/90
Project No.: 15173.00
Project: ACS

Sample Data

Sample number: BORING: MW7 @ 10.0-17.0 FT
Sample Des.: Brown Fine-Coarse SAND, Little Gravel & Silt, Trace Clay
USCS Class: SP-SM
Liquid limit: --
Plasticity index: --

Notes

Remarks: TESTED BY: MML/DWA ENTERED BY: MML
CHECKED BY: APPROVED BY:
Sheet No.: DB

Mechanical Analysis Data

	Initial
Dry sample and tare=	876.23
Tare =	0.00
Dry sample weight =	876.23

Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.75 inches	0.00	100.0
0.5 inches	2.86	99.7
0.375 inches	15.05	98.3
# 4	66.30	92.4
# 10	172.54	80.3
# 16	242.31	72.3
30	288.01	67.1
40	328.19	62.5
50	559.66	36.1
# 80	757.31	13.6
# 100	783.05	10.6
# 200	795.27	9.2

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 80.3
Weight of hydrometer sample: 100
Hygroscopic moisture correction:
Moist weight & tare = 793.00
Dry weight & tare = 792.69
Tare = 188.95
Hygroscopic moisture= 0.1 %
Calculated biased weight= 124.46
Automatic temperature correction
Composite correction at 20 deg C =-7

Meniscus correction only= 0

EWI

Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.29494 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	20.0	16.5	9.5	0.0136	16.5	13.6	0.0503	7.6
2.0	20.0	15.5	8.5	0.0136	15.5	13.8	0.0359	6.8
3.0	20.0	14.5	7.5	0.0136	14.5	13.9	0.0294	6.0
6.0	20.0	14.0	7.0	0.0136	14.0	14.0	0.0208	5.6
15.0	20.0	12.5	5.5	0.0136	12.5	14.2	0.0133	4.4
60.0	20.0	11.0	4.0	0.0136	11.0	14.5	0.0067	3.2
120.0	20.0	10.5	3.5	0.0136	10.5	14.6	0.0048	2.8
420.0	20.0	10.0	3.0	0.0136	10.0	14.7	0.0025	2.4
1440.0	20.0	9.5	2.5	0.0136	9.5	14.7	0.0014	2.0

Fractional Components

% + 3 in. = 0.0 % GRAVEL = 7.6 % SAND = 83.2
% SILT = 6.4 % CLAY = 2.8

D85= 2.69 D60= 0.401 D50= 0.351
D30= 0.2716 D15= 0.18793 D10= 0.13932
Cc = 1.3213 Cu = 2.8774

DA -

EWI

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 8

Date: 03/21/90
Project No.: 15070.33
Project: ACS

Sample Data

Sample number: BORING: MW9 @ 21.0-23.0 FT
Sample Des.: Brown Lean CLAY, Some Sand, Little Gravel
USCS Class: CL
Liquid limit: 21
Plasticity index: 10

Notes

Remarks: TESTED BY: MML/DWA ENTERED BY: MML
CHECKED BY: APPROVED BY:
Sheet No.: DR

Mechanical Analysis Data

	Initial
Dry sample and tare=	541.30
Tare =	0.00
Dry sample weight =	541.30

Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.75 inches	0.00	100.0
0.5 inches	27.49	94.9
0.375 inches	36.59	93.2
# 4	49.57	90.8
# 10	58.96	89.1
# 16	73.26	86.5
# 30	83.08	84.7
# 40	101.91	81.2
# 50	132.89	75.4
# 80	14[illegible]	73.7
# 100	145.25	73.2
# 200	163.80	69.7

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 89.1
Weight of hydrometer sample: 75
Hygroscopic moisture correction:
Moist weight & tare = 483.37
Dry weight & tare = 482.97
Tare = 75.56
Hygroscopic moisture= 0.1 %
Calculated biased weight= 84.09
Automatic temperature correction
Composite correction at 20 deg C =-7

Meniscus correction only= 0

EWI

Specific gravity of solids= 2.7
Specific gravity correction factor= 0.989
Hydrometer type: 152H Effective depth [illegible]

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Hr	Eff. depth	Diameter mm	Percent finer
1.0	20.0	53.0	46.0	0.0134	53.0	7.6	0.0371	54.1
2.0	20.0	51.0	44.0	0.0134	51.0	7.9	0.0268	51.7
3.0	20.0	48.0	41.0	0.0134	48.0	8.4	0.0225	48.2
6.0	20.0	40.0	33.0	0.0134	40.0	9.7	0.0171	38.8
15.0	20.0	33.5	26.5	0.0134	33.5	10.8	0.0114	31.1
60.0	20.0	25.0	18.0	0.0134	25.0	12.2	0.0061	21.1
120.0	20.0	22.0	15.0	0.0134	22.0	12.7	0.0044	17.6
300.0	20.0	19.0	12.0	0.0134	19.0	13.2	0.0028	14.1
420.0	20.0	18.0	11.0	0.0134	18.0	13.3	0.0024	12.9
1440.0	20.0	16.0	9.0	0.0134	16.0	13.7	0.0013	10.5

Fractional Components

% + 3 in. = 0.0 % GRAVEL = 9.2 % SAND = 21.1
% SILT = 50.9 % CLAY = 18.8

D85= 0.63 D60= 0.050 D50= 0.024
D30= 0.0106 D15= 0.00316

DA

EWI

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 7

Date: 03/21/90
Project No.: 15090.33
Project: ACS

Sample Data

Sample number: BORING: MW7 @ 23.0-25.0 FT
Sample Des.: Brown Lean CLAY, Little Sand, Trace Gravel
USCS Class: CL
Liquid limit: 33
Plasticity index: 19

Notes

Remarks: TESTED BY: MML/DWA ENTERED BY: MML
CHECKED BY: APPROVED BY:
Sheet No.: DA

Mechanical Analysis Data

	Initial
Dry sample and tare=	465.15
Tare =	0.00
Dry sample weight =	465.15

Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.375 inches	0.00	100.0
# 4	4.07	99.1
# 10	8.66	98.1
# 16	12.37	97.3
# 30	18.11	96.1
# 40	21.42	95.4
# 50	26.38	94.3
# 80	33.74	92.7
# 100	36.50	92.2
# 200	43.97	90.5

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 98.1
Weight of hydrometer sample: 75
Hygroscopic moisture correction:
Moist weight & tare = 406.91
Dry weight & tare = 406.68
Tare = 25.14
Hygroscopic moisture= 0.1 %
Calculated biased weight= 76.38
Automatic temperature correction
Composite correction at 20 deg C =-7

Meniscus correction only= 0
Specific gravity of solids= 2.7
Specific gravity correction factor= 0.989

EWI

Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	20.0	60.0	53.0	0.0134	60.0	6.5	0.0342	68.6
2.0	20.0	58.0	51.0	0.0134	58.0	6.8	0.0248	66.0
3.0	20.0	57.0	50.0	0.0134	57.0	6.9	0.0205	64.7
6.0	20.0	56.5	49.5	0.0134	56.5	7.0	0.0146	64.0
15.0	20.0	52.5	45.5	0.0134	52.5	7.7	0.0096	58.9
60.0	20.0	43.0	36.0	0.0134	43.0	9.2	0.0053	46.6
120.0	20.0	38.0	31.0	0.0134	38.0	10.1	0.0039	40.1
300.0	20.0	32.0	25.0	0.0134	32.0	11.0	0.0026	32.3
420.0	20.0	30.5	23.5	0.0134	30.5	11.3	0.0022	30.4
1440.0	20.0	24.5	17.5	0.0134	24.5	12.3	0.0012	22.6

Fractional Components

% + 3 in. = 0.0 % GRAVEL = 0.9 % SAND = 8.6
% SILT = 45.1 % CLAY = 45.4

D85= 0.06 D60= 0.010 D50= 0.006
D30= 0.0021

DA

EWI

WARZYN ENGINEERING INC.
MADISON, WISCONSIN

SHEET NO. 1 OF
JOB NO. 12580.22

BY DWA DATE 4-10-90 SUBJECT ACS
CHKD. BY SJC DATE 4/13/90 Porosity

Sample	Nm% (Proctor)	DIA	HT	VOL	WET WT	WET γ	DRY γ	VOL, H_2O		n
MW 7 10-17	16.34	4.00	4.584" 11.64 cm	1/30 CUFT 943.97 cc	4.24 lbs	127.2 pcf	109.3 pcf	270.12 cc		0.28
MW 7 45-50	16.22	4.00	3.05"	1/45.085 CUFT 628.08 cc	2.93 lbs	132.1 pcf	113.7 pcf	185.48 cc		0.29
MW 9 10-16	19.09	4.00	4.584" 11.64 cm	1/30 CUFT 943.97 cc ✓	4.04 lbs	121.2 pcf	101.8 pcf	293.75 cc ✓		0.311
MW 9 26-35	16.90	4.00	4.15" 10.54 cm	1/33.135 CUFT 854.59 cc	3.89 lbs	129 pcf	110.3 pcf	255.09 cc		0.298
** MW 7 22-25	13.0	2.90	8.12	1/32.218 CF 878.91 cc	4.322 lbs	139.2 pcf	123.2 pcf	225.52		0.257
** MW 9 21-22	18.5	2.90	7.61	1/34.377 CU FT 823.71 cc	3.80 lbs	130.67 pcf	110.2 pcf	269.16		0.32

** PERMEABILITY TEST SAMPLES

(n) POROSITY = $\frac{V_v}{V}$

VOL, H_2O = WET WT ÷ WET WT ÷ 1 + Nm × 453.59

*ASSUME ALL SAMPLES ARE 100% SATURATED. ALL SAMPLES WERE COMPACTED INTO A 1/30 CUFT MOLD TO DETERMINE WET UNIT WT.

E [illegible] JOB NAME [illegible]

DA

	MA7	NN9								
	[illegible]	[illegible]								
in.										
n.										
lbs.										
in.										
gms.										
WEIGHT										
, gms.										
, gms.										
gms.										
STURE.										
NO.	157	164								
WT, gms.	153.42	152.33								
WT, gms.	118.91	128.96								
E, gms.	15.60	15.96								
N MULT	99.0	102.2								
MOISTURE.	33	21								
N NO.	159	166								
T WT, gms.	61.52	81.36								
RY WT, gms.	56.05	74.96								
ARE. gms.	16.44	15.82								
MOISTURE	14	11								
CUP NO.										
START WT, gms.										
END WT, gms.										
TARE, gms.										
% LOSS.										

EWI

REMARKS:

WARZYN

Warzyn Engineering Inc.
One Science Court
University Research Park
P.O. Box 5385
Madison, Wisconsin 53705
(608) 273-0440

Pg 1/2

CHAIN OF CUSTODY RECORD

PROJ. NO. 60251.20

PROJECT NAME: AES

LOCATION: Griffith, IN

SAMPLERS: (Signature) Timothy J. Malz

LAB NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Grain Size	Atterberg Limits	Total Porosity	Total Organic Carbon (TOC)	Permeability		REMARKS
	3/7/90			X	MW7 (11-12)	1							
	↓			X	MW7 (17-19)	1	X	X	X	X			
	↓		X		MW7 (11-17)	1							use composite
	3/13/90			X	MW7 (23-25)	1	X	X	X	X	X		Shelby Tube
	↓			X	MW7 (28)	1							
	↓			X	MW7 (36)	1							
	3/13/90			X	MW7 (45-47)	1							
	3/14/90			X	MW7 (45-50)	1	X	X	X	X			use composite
	3/14/90		X		MW7 (45-52)	1							

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Timothy J. Malz	3/21/90 1:33	[signature]			
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)		Date / Time	
	3-21-90 0AM	[signature]			

Remarks

[illegible]

PROJECT MANAGER: Peter Vogt

EWI# 15090.33

EWI
Engineering Associates, Inc.

MOISTURE - DENSITY CURVE

PROJECT: AC S

LOCATION:

8383 GREENWAY BLVD. • MIDDLETON, WI 53562

Job No. 15090.22
Date 2-21-90
Sheet 1 of 1
Tech DA

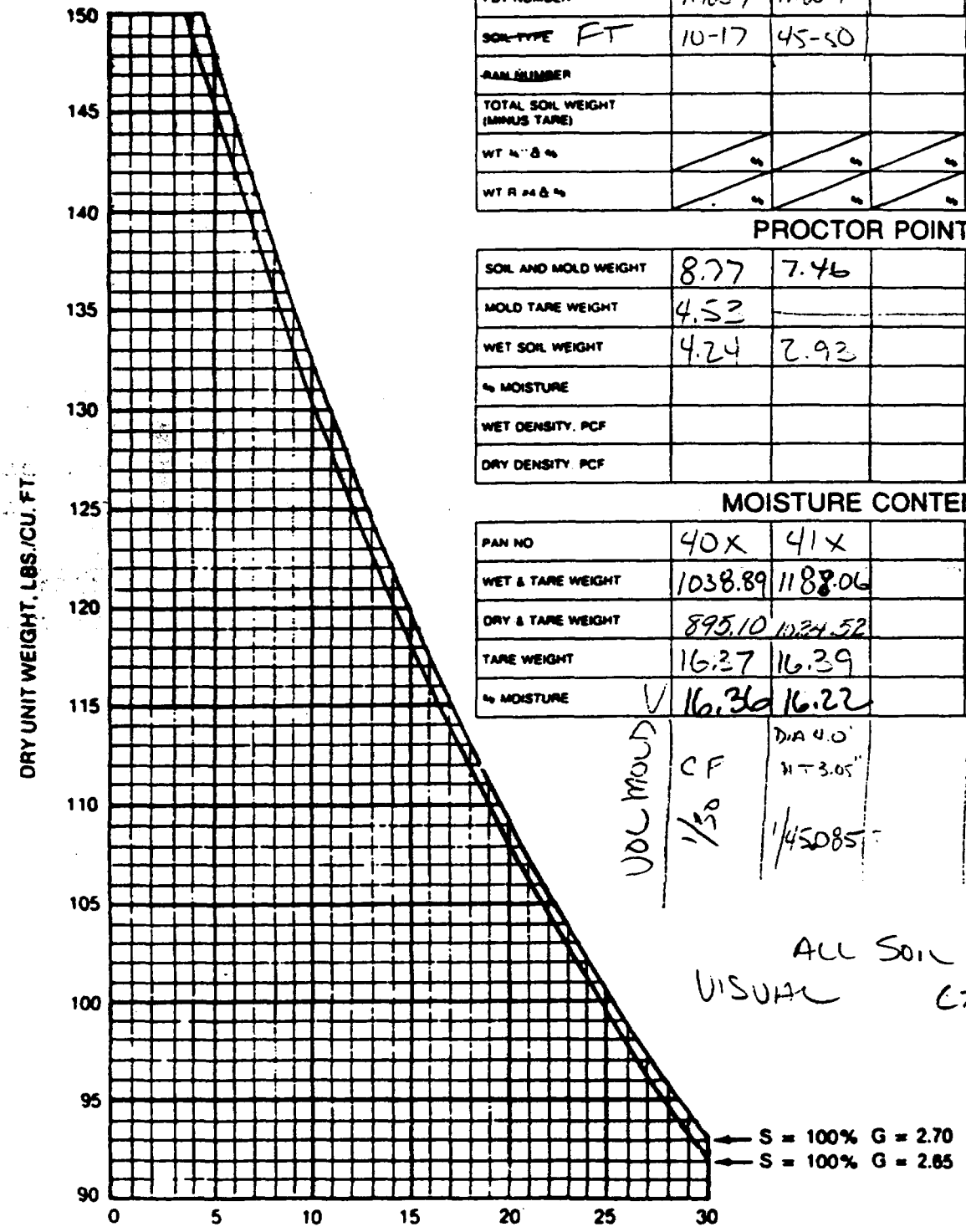
FDT NUMBER	MW7	MW7		MW9	MW9	
~~SOIL TYPE~~ FT	10-17	45-50		10-16	26-35	
~~PAN NUMBER~~						
TOTAL SOIL WEIGHT (MINUS TARE)						
WT #4 & %	%	%	%	%	%	%
WT R #4 & %	%	%	%	%	%	%

PROCTOR POINTS

SOIL AND MOLD WEIGHT	8.77	7.46		8.57	8.42	
MOLD TARE WEIGHT	4.53	—	—	—	—	
WET SOIL WEIGHT	4.24	2.93		4.04	3.89	
% MOISTURE						
WET DENSITY, PCF						
DRY DENSITY, PCF						

MOISTURE CONTENTS

PAN NO	40X	41X		43X	39X	
WET & TARE WEIGHT	1038.89	1188.06		860.30	867.35	
DRY & TARE WEIGHT	895.10	1024.52		725.05	744.31	
TARE WEIGHT	16.37	16.39		16.53	16.44	
% MOISTURE	16.36	16.22		19.09	16.90	
VOL MOLD	CF 1/30	DIA 4.0" HT = 3.05" 1/45.085		1/30 CF	DIA 4" HT = 4.15" 1/33.1348	



MOISTURE CONTENT, %

ALL SOIL F-C SAND, VISUAL CTR SI, TR CLAY & GRAVEL (SM) (SP)

TEST METHOD:
☐ MODIFIED PROCTOR
☑ STANDARD PROCTOR

* CIRCLE METHOD USED

1/30 CF MOLD	1/13.33 CF MOLD		
METHOD A	B	C	D
METHOD (A)	B	C	D

ACS

EWI 15090.33

WEI 60251.20

MEMO

Date : 3/20/90

To : Don Arenander ; Soils Lab

From : Tim Maley ; ACS Site Geologist

Subject : physical analysis of soil samples

Enclosed are six samples for geotechnical analysis. These samples were collected from alledged "clean" areas. The "SUPPLEMENTAL WORK PLAN PHASE II RI/FS ACS SITE" states

The physical and chemical characteristics of the three major geologic units will be further characterized by additional analyses. Two soil samples will be collected from the upper aquifer (Calumet Aquifer), the confining clay layer, and the lower aquifer (Valparaiso Aquifer). Analyses for each of the six samples will include (as appropriate): grain size, Atterberg Limits, total porosity, and total organic carbon (TOC).

I am assuming that the shelby tubes of the confining clay layer also be analyzed for Permeability.

During a phone conversation with you earlier this month, you stated needing a large volume of sample for the requested parameters. I have composited (*) the non-cohesive soils from the lower and upper materials. I have also included individual samples from all three geologic units which you may utilize. The following is a breakdown of all samples I am shipping and their respective parameters: See attached Table.

utilize composites

Any Questions call me or either P. Vagt. Chicago office

[illegible] 691-5069 [illegible] 691-5058 THANKS DON

EWI 15090.25

ACS

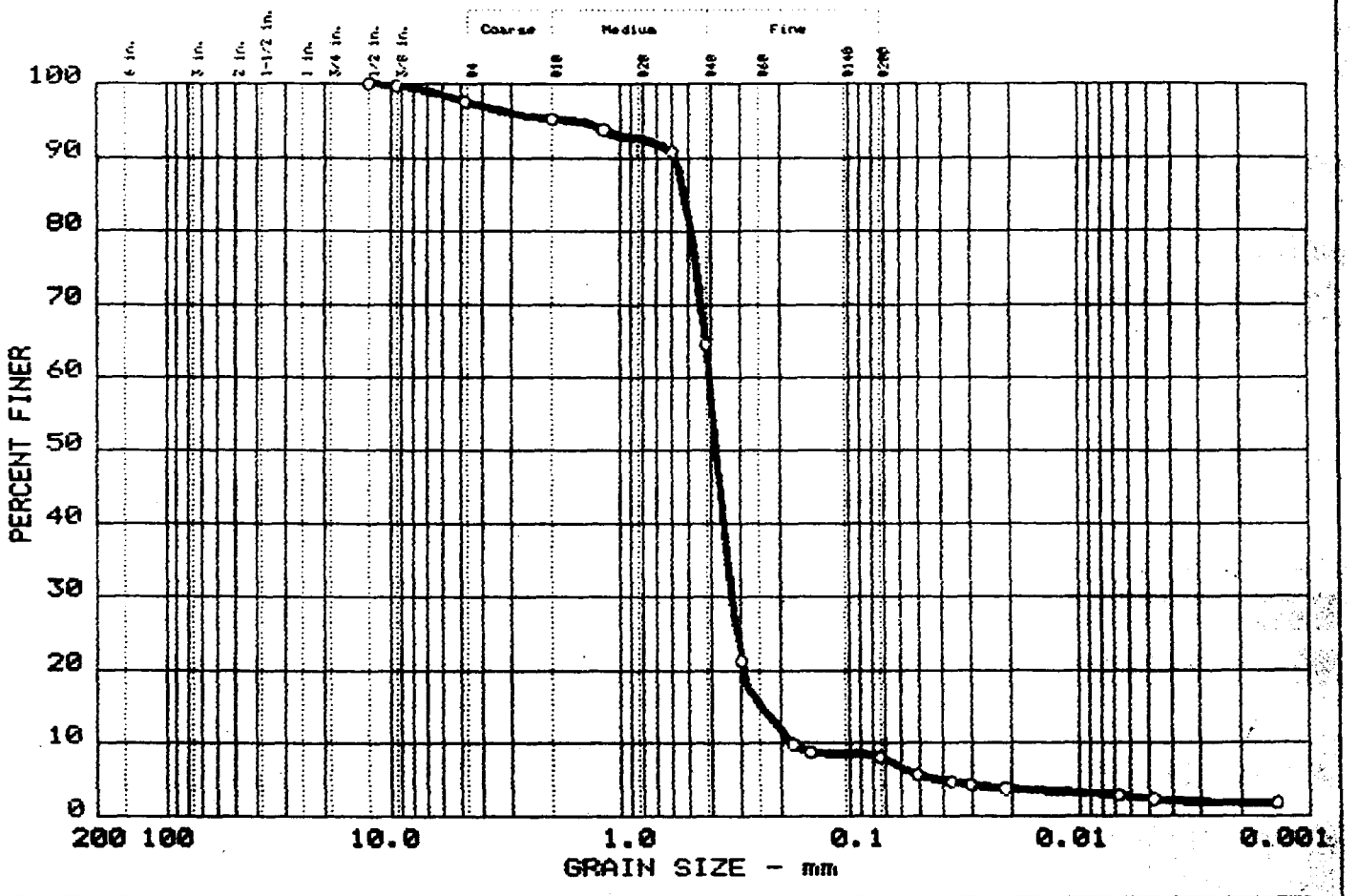
WEI 60251.20

#	(Depth) ft	Sample Type (a)	Geologic Unit (b)	Parameters (six samples)
7	(10-12)	SPT (X)	UA	Grain Size, Atterberg Limits, Total Porosity, TOC
7	(17-19)	SPT (X)	↓	
7	(10-17) Composite	SPT (B)	↓	
7	(23-25)	STUBE (ST)	CL	Grain Size, Atterberg Limits, Total Porosity, TOC, Permeability
7	(28)	SPT (B)	CL	
7	(36)	SPT (X)	CL	
7	(45-47)	SPT (X)	LA	Grain, Att Limit, Tot Por, TOC
7	(48-50)	SPT (X)	↓	
7	(45-50) Composite	SPT (B)	↓	
MW9	(10-12)	SPT (X)	UA	Grain, Att Limit, Tot Por, TOC
MW9	(15-16.5)	SPT (X)	↓	
MW9	(10-16) Composite	SPT (B)	↓	
MW9	(~~21-23~~) 20	SPT (X)	CL	Grain, Att Limit, Tot Por, TOC, Permeability
MW9	(~~20~~)(21-23)	STUBE (ST)	CL	
MW9	(29)	SPT (X)	LA	Grain, Att Limit, Tot Por, TOC
MW9	(31)	SPT (X)	↓	
MW9	(26-35) Composite	SPT (B)	↓	

(a) Sample Type : SPT = Standard 2" split spoon (X)
STUBE = 3" Shelby Tube (ST)

(b) Geologic Unit : UA = Upper Aquifer ; CL = Confining Clay Layer ;
LA = Lower Aquifer.

GRAIN SIZE DISTRIBUTION TEST REPORT



Symbol	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	2.3	89.6	5.7	2.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	--	--	0.52	0.41	0.38	0.325	0.2438	0.1766	1.48	2.3

MATERIAL DESCRIPTION	USCS
○ Brown Fine-Medium SAND, Little Silt, Trace Clay & Gravel	SP-SM

Project No.: 15090.33
Project: ACS
○ Sample: BORING: MW9 @ 26.0-35.0 FT
(Composite Bag Sample)

Date: 03/21/90

Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DWA
APPROVED BY: CAF

GRAIN SIZE DISTRIBUTION TEST REPORT
EWI, Engineering Associates, Inc.

Sheet No._____

EWI

Job No. 15090
Date: 03/21/90

FALLING HEAD PERMEABILITY TEST

WI Engineering Associates, Inc., 8383 Greenway Blvd., Middleton, WI 53562 Phone: (608) 231-4770

ROJECT	ACS
OCATION	GRIFFITH, INDIANA
AMPLE (a)	BORING: MW7
EPTH (ft)	23.0 - 25.0
OIL DESCRIPTION	Brown Lean CLAY, Little Sand, Trace Gravel (CL)
AMPLE DIAMETER (cm)	7.4
AMPLE AREA, A(cm^2)	42.6

	INITIAL	FINAL
AMPLE LENGTH, L(cm)	20.6	20.6
OISTURE CONTENT, %	13.0	13.0
RY DENSITY (lb/cu ft)	123.2	123.2
ERCENT COMPACTION	-	-

RUN	COEFFICIENT OF PERMEABILITY, k(cm/sec)
1	2.5E-07
2	1.1E-07
3	9.4E-08
4	7.3E-08
5	9.2E-08
6	9.9E-08
7	8.4E-08
8	7.6E-08
9	8.0E-08
10	8.4E-08
11	7.5E-08
12	7.8E-08

AVERAGE COEFFICIENT OF PERMEABILITY = 7.9E-08 cm/sec
(Based on run numbers 10 through 12)

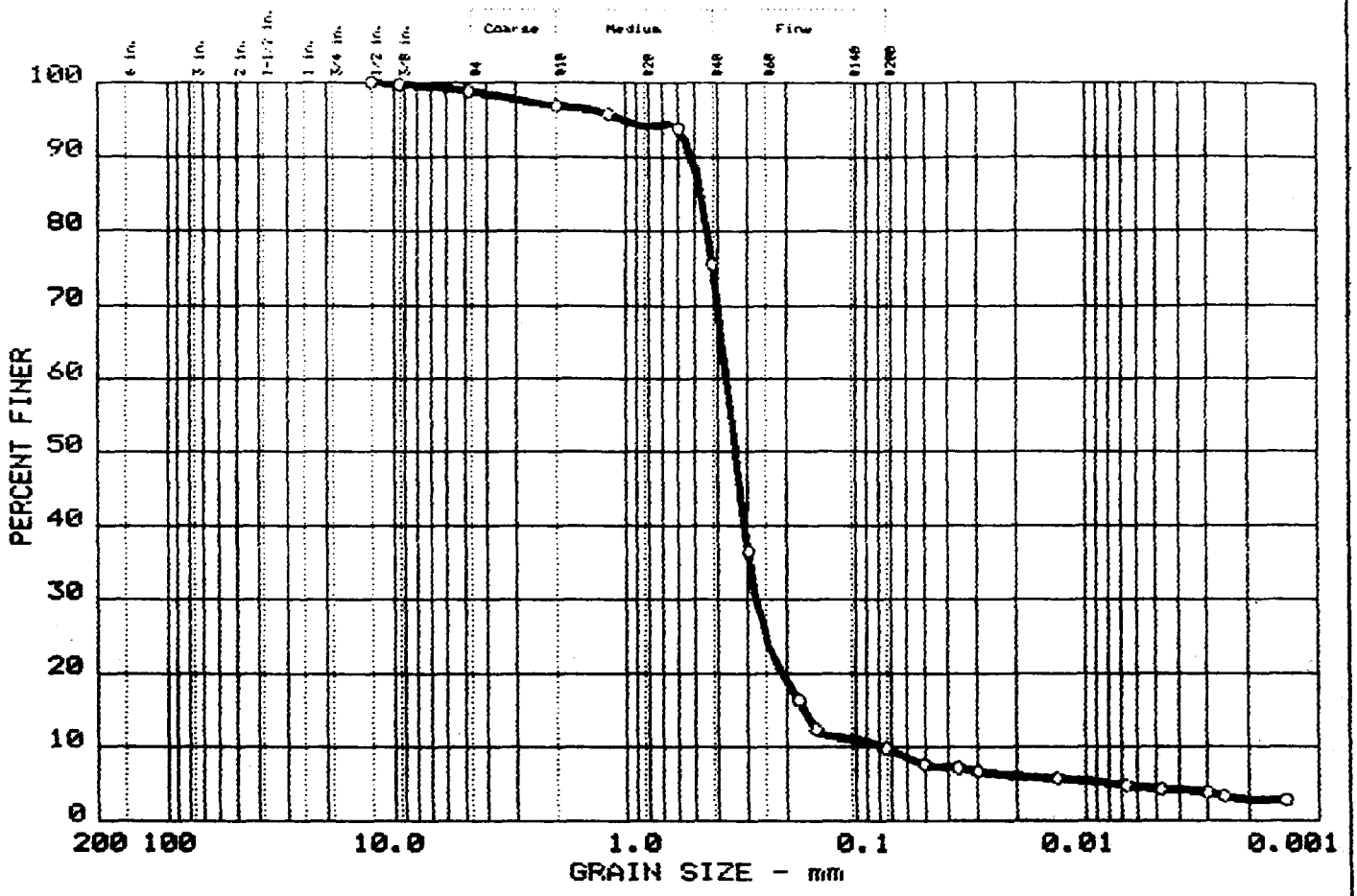
ORMULA: $k = \frac{2.3aL}{At} \log_{10} \frac{h_0}{h_1}$, Where a = cross-sectional area of standpipe,
t = time for water level to fall from initial height, h_0, to final height, h_1
(All other terms are defined above)

OOTNOTES: (a) This permeability test was performed on a relatively undisturbed 3-inch diameter Shelby tube sample.

HECKED BY: [signature] DATE: 4/10/90 APPROVED BY: CAF DATE: 4/11/90

FWI

GRAIN SIZE DISTRIBUTION TEST REPORT



Symbol	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	1.1	88.9	5.5	4.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	--	--	0.47	0.37	0.34	0.273	0.1679	0.0750	2.72	4.9

MATERIAL DESCRIPTION	USCS
○ Brown Fine-Medium SAND, Little Silt, Trace Clay & Gravel	SP-SM

Project No.: 15090.33
Project: ACS
○ Sample: BORING: MW9 @ 10.0-16.0 FT
(Composite Bag Sample)

Date: 03/21/90

Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DWA
APPROVED BY: CAF

GRAIN SIZE DISTRIBUTION TEST REPORT
EWI, Engineering Associates, Inc.

Sheet No._____

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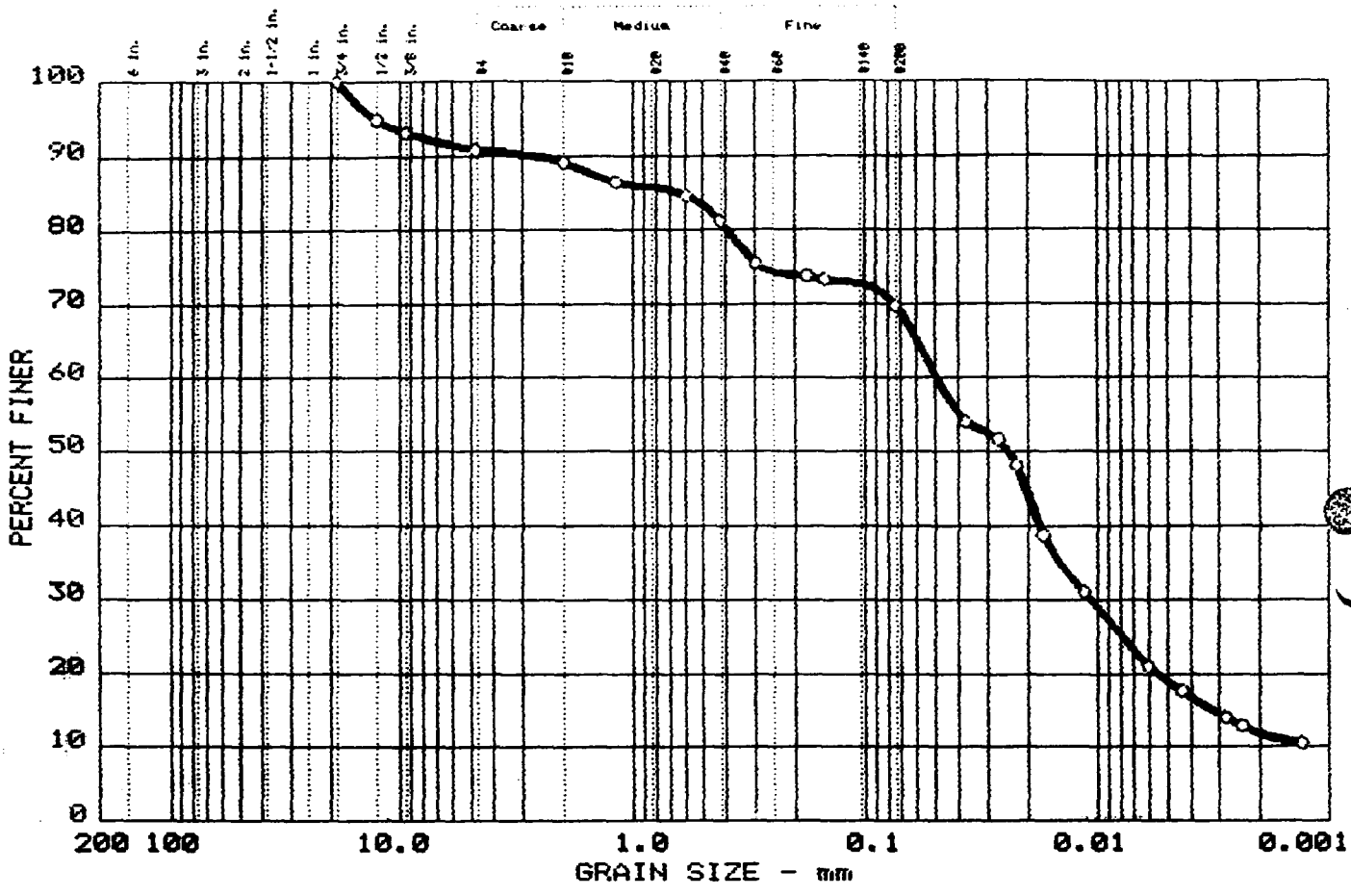
GRAIN SIZE DISTRIBUTION TEST REPORT



Symbol	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O	0.0	9.2	21.1	50.9	18.8

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O	21	10	0.63		0.02	0.011	0.0032			

MATERIAL DESCRIPTION	USCS
O Brown Lean CLAY, Some Sand, Little Gravel	CL

Project No.: 15090.33
Project: ACS
O Sample: BORING: MW9 @ 21.0-23.0 FT
(3-inch Diameter Shelby Tube Sample)
Date: 03/21/90

GRAIN SIZE DISTRIBUTION TEST REPORT
EWI, Engineering Associates, Inc.

Remarks:
TESTED BY: MML/DWA
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APPROVED BY: CAF
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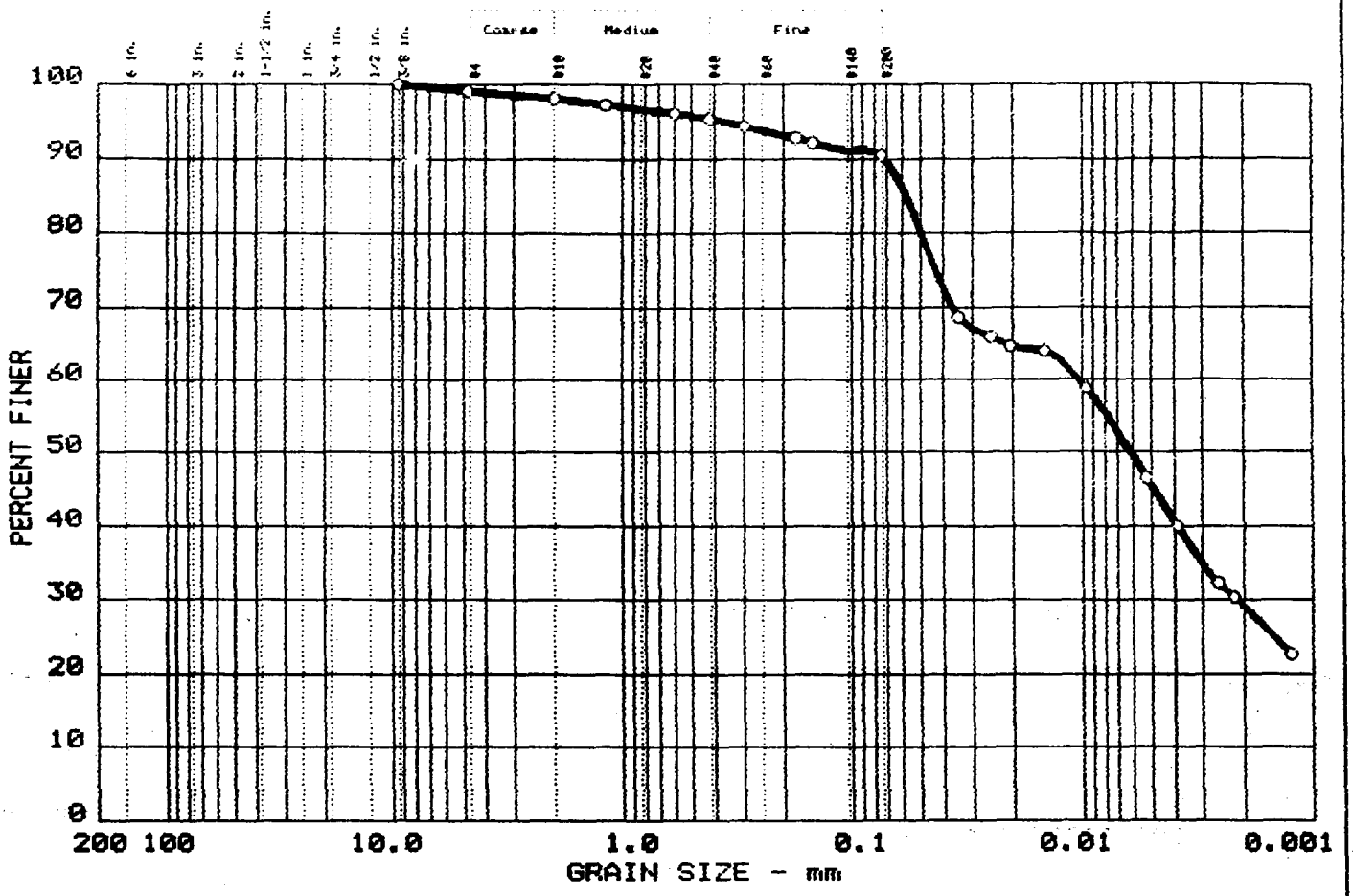

Symbol	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O	0.0	0.9	8.6	45.1	45.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O	33	19			0.01	0.002				

MATERIAL DESCRIPTION	USCS
O Brown Lean CLAY, Little Sand, Trace Gravel	CL

Project No.: 15090.33
Project: ACS
O Sample: BORING: MW7 @ 23.0-25.0 FT
(3-inch Diameter Shelby Tube Sample)

Date: 03/21/90

GRAIN SIZE DISTRIBUTION TEST REPORT

EWI, Engineering Associates, Inc.

Remarks:

TESTED BY: MML/DWA

ENTERED BY: MML

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Sheet No._____

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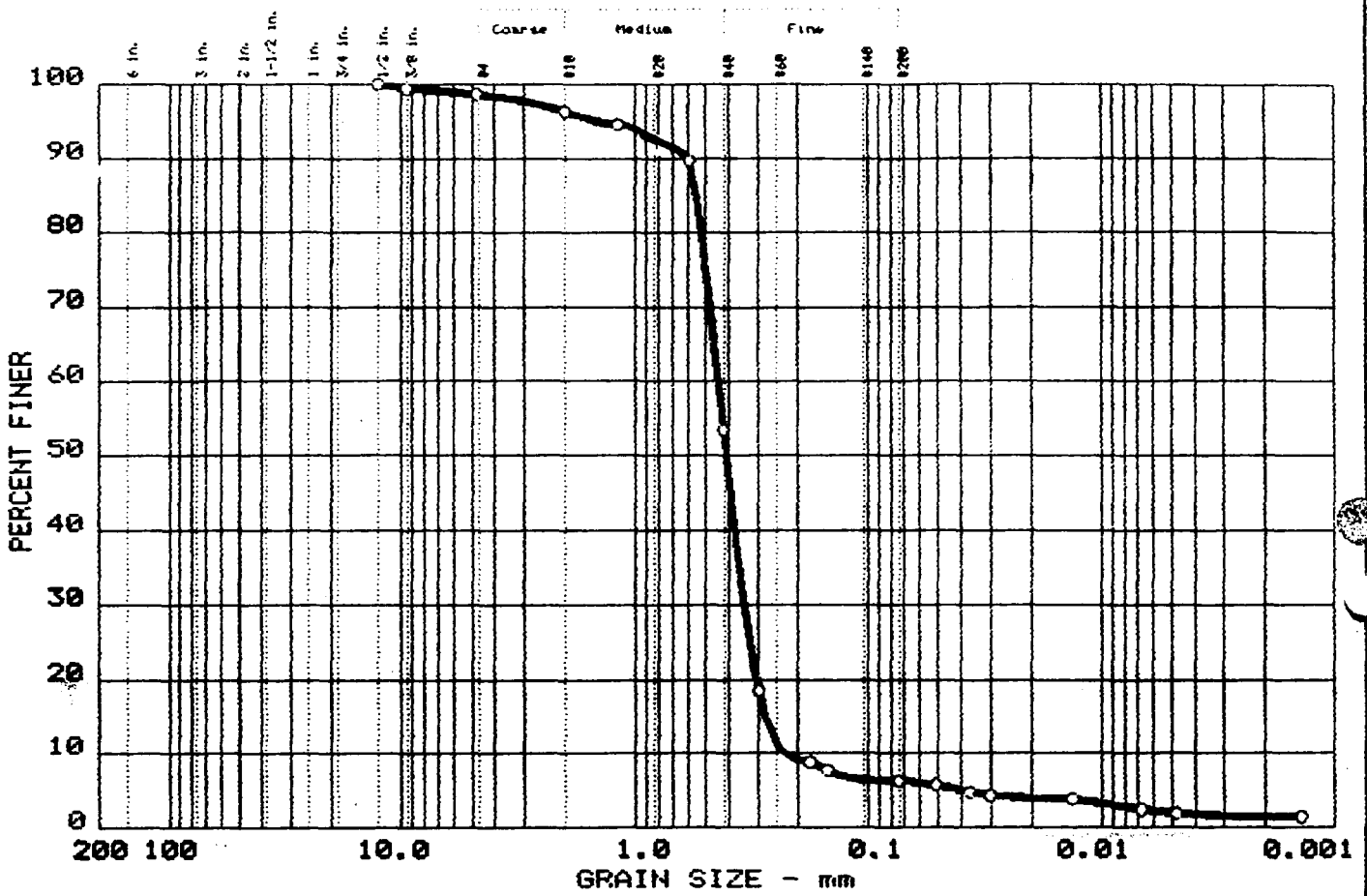
GRAIN SIZE DISTRIBUTION TEST REPORT



Symbol	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	1.4	92.3	4.4	1.9

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	--	--	0.55	0.44	0.41	0.342	0.2780	0.2286	1.16	1.9

MATERIAL DESCRIPTION	USCS
○ Brown Fine-Medium SAND, Trace Silt, Clay & Gravel	SP-SM

Project No.: 15090.33
Project: ACS
○ Sample: BORING: MW7 @ 45.0-50.0 FT
(Composite Bag Sample)

Date: 03/21/90

GRAIN SIZE DISTRIBUTION TEST REPORT

EWI, Engineering Associates, Inc.

Remarks:

TESTED BY: MML/DWA

ENTERED BY: MML

CHECKED BY: DWA

APPROVED BY: CAF

Sheet No._____

FWI

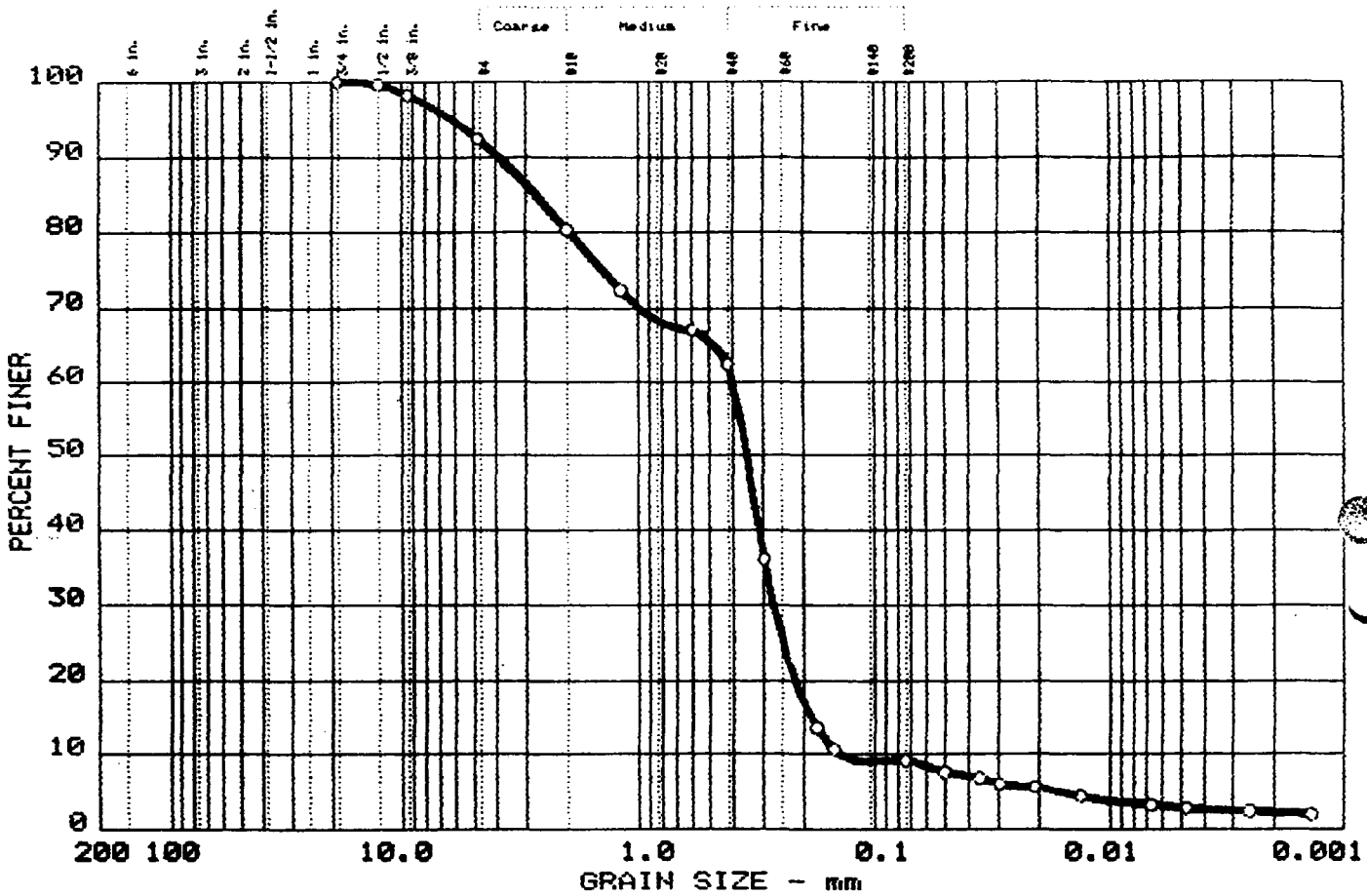
E W I
ENGINEERING ASSOCIATES
505 Science Drive
Madison, Wisconsin 53711
(608) 231-4773
FAX (608) 231-4769

SAMPLE POROSITY VALUES

BORING NUMBERS	DEPTH (FT)	TYPE	*POROSITY
MW7	10.0-17.0	COMPOSITE BAG SAMPLE	0.287
MW7	23.0-25.0	3-INCH DIAMETER SHELBY TUBE SAMPLE	0.257
MW7	45.0-50.0	COMPOSITE BAG SAMPLE	0.295
MW9	10.0-16.0	COMPOSITE BAG SAMPLE	0.311
MW9	21.0-23.0	3-INCH DIAMETER SHELBY TUBE SAMPLE	0.327
MW9	26.0-35.0	COMPOSITE BAG SAMPLE	0.298

*The porosity of the composite bag samples was determined by compacting the soil at natural moisture content, into a 1/30 cubic ft mold (modified Proctor), where by determining the maximum dry unit weight.

GRAIN SIZE DISTRIBUTION TEST REPORT



Symbol	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	7.6	83.2	6.4	2.8

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	--	--	2.69	0.40	0.35	0.272	0.1879	0.1393	1.32	2.9

MATERIAL DESCRIPTION	USCS
○ Brown Fine-Coarse SAND, Little Gravel & Silt, Trace Clay	SP-SM

Project No.: 15173.00
Project: ACS
○ Sample: BORING: MW7 @ 10.0-17.0 FT
(Composite Bag Sample)

Date: 03/21/90

Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DWA
APPROVED BY: CAF

GRAIN SIZE DISTRIBUTION TEST REPORT
EWI, Engineering Associates, Inc.

Sheet No._____

EWI

RMT INC
LABORATORIES

CLIENT: Warzyn
RMT PROJECT #: 91054.00
RMT WORK ORDER #: 900425-9105400

WARZYN P.O. #: 60251-20910
REPORT DATA: 05/01/90
SAMPLE COLLECTOR: CLIENT

COMPOSITIONAL ANALYSIS

RMT Sample No.	Warzyn Lab No.	Collection Date	PQL[1]	Total Organic Carbon[2] (mg/kg dry wt.)
49691	910-001	03/07/90	100	14,000
49692	910-002	03/13/90	100	>16,000
49693	910-003	03/13/90	100	6,800
49694	910-004	03/12/90	100	2,900
49695	910-005	03/19/90	100	12,000
49696	910-006	03/19/90	100	3,100

[1] Practical Quantitation Limit
[2] EPA Manual SW-846, Method 9060

Alan Doughty, Ph.D., Laboratory Director

744 Heartland Trail, P.O. Box 8923, Madison, WI 53708-8923 Ph: (608)831-4444

RMT INC
LABORATORIES

CLIENT: Warzyn
RMT PROJECT #: 91054.00
RMT WORK ORDER #: 900425-9105400

WARZYN P.O. #: 60251-20910
REPORT DATA: 05/01/90
SAMPLE COLLECTOR: CLIENT

Q.C. SUMMARY

Sample ID	Total Organic Carbon (mg/kg dry wt.)	
910-001	13,600	
910-001 Laboratory Duplicate	13,000	5% RPD
910-003	6,790	
910-003 Laboratory Spike 1000 mg/L	9,310	79% Recovery
Laboratory Control Sample	419.0	91% Recovery
Method (ICB) Blank	<100	

Alan Doughty, Ph.D., Laboratory Director

HYDROMETER AND SIEVE ANALYSIS : COMPUTER CALCULATION SHEET ONLY

TECH [illegible] JOB [illegible] # 60[illegible].20 JOB NO 15090.33

SHEET 2 OF 2

REMARKS:

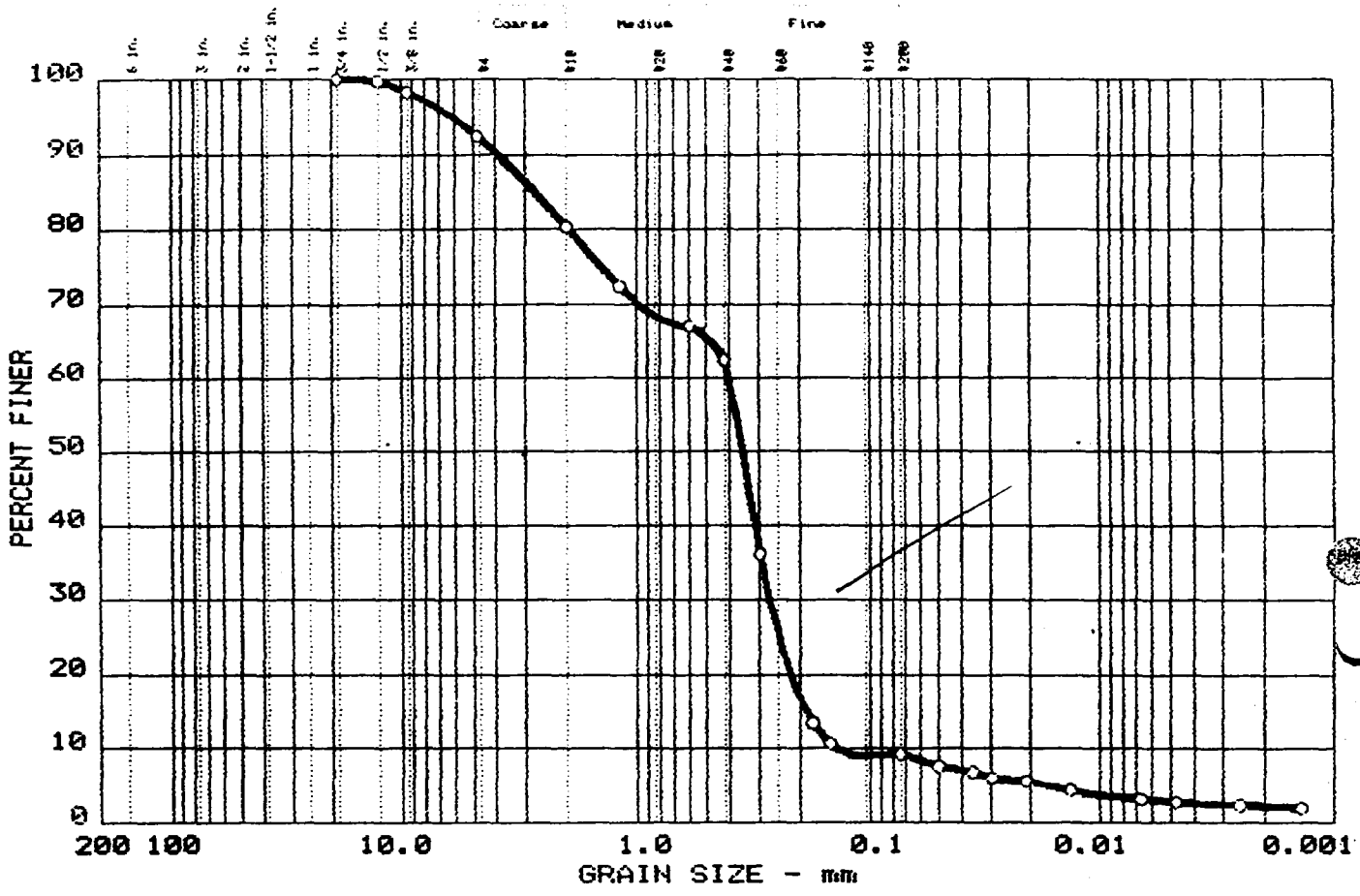
CHECKED BY:

SAMPLE NUMBER:	MW7 [illegible]	MW7 [illegible]	MW7 [illegible]
PAN NUMBER:	[illegible]	[illegible]	[illegible]
NP LL — PI —			
WET WT. gr=(W1)	[illegible]	[illegible]	[illegible]
DRY WT. gr=(W2)	[illegible]	683.90	[illegible]
TARE WT. gr=(W3)	[illegible]	16.58	[illegible]
TARE + R10 WT=(W4)	[illegible]	32.51	[illegible]
% MOIST OF SOIL=(W5) (W1-W2/W2-W4)	[illegible]	0.03	[illegible]
DRY WT(W2-W3)=(W6)	—	—	—
P10 SOIL SET UP WT=(W7)	100	100	100
DRY WT OF W7= (W8) (W7/1+W5)hyd soil wt	99.98	99.97	[illegible]
TOTAL SIEVE WT=(W9) (W6 + W8)	1006.04	[illegible]	[illegible]
SPECIFIC GRAVITY.(Gs) (assumed value)	[illegible]	[illegible]	[illegible]

* OPTIONAL READINGS

HYDROMETER CORRECTION	TEMPERATURE CENTIGRADE	ELAPSED TIME, MINUTES	CLOCK TIME	UNCORRECTED HYD READING	SIEVE (W9)=	CLOCK TIME	UNCORRECTED HYD READING	SIEVE (W9)=	CLOCK TIME	UNCORRECTED HYD READING	SIEVE (W9)=
[illegible]	[illegible]	0 MIN		---------	2 1/2"	[illegible]	---------	2 1/2"		---------	2 1/2"
		1 MIN		13	2"		15	2"		13	2"
		2 MIN		12	1 1/2"		14.5	1 1/2"		12	1 1/2"
		3 MIN	[illegible]	11.5	1"		14.0	1"		11.5	1"
		# 4 MIN	#	#	3/4"	#	#	3/4"	#	#	3/4"
		6 MIN	[illegible]	—	1/2" 0	[illegible]	—	1/2" 0	[illegible]	11.0	1/2"
		# 10 MIN	#	#	3/8" 5.39	#	#	3/8" 1.47	#	#	3/8" [illegible]
		15 MIN	[illegible]	11.0	#4 13.73	[illegible]	13.0	#4 8.07	[illegible]	—	#4 16.[illegible]
		# 30 MIN	#	#	#10 36.46	#	#	#10 21.93	#	#	#10 [illegible]
		60 MIN	[illegible]	9.5	#16 54.03	[illegible]	12.0	#16 29.90	[illegible]	10.0	#16 [illegible]
		120 MIN	[illegible]	9.0	#30 163.04	[illegible]	11.5	#30 43.90	[illegible]	[illegible]	#30 [illegible]
		# 240 MIN	#	#	#40 468.20	#	#	#40 172.32	#	#	#40 [illegible]
		300 MIN		—	#50 814.66	[illegible]	11.0	#50 448.90	[illegible]	—	#50 570.71
		# 360 MIN	#	#	#80 716.95	#	#	#80 571.81	#	#	#80 [illegible]
		420 MIN	[illegible]	—	#100 928.23	[illegible]	[illegible]	#100 619.81	[illegible]	—	#100 [illegible]

GRAIN SIZE DISTRIBUTION TEST REPORT



Symbol	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	7.6	83.2	6.4	2.8

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	--	--	2.69	0.40	0.35	0.272	0.1879	0.1393	1.32	2.9

MATERIAL DESCRIPTION	USCS
○ Brown Fine-Coarse SAND, Little Gravel & Silt, Trace Clay	SP-SM

Project No.: 15173.00
Project: ACS
○ Sample: BORING: MW7 @ 10.0-17.0 FT

Date: 03/21/90

Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DA
APPROVED BY:

GRAIN SIZE DISTRIBUTION TEST REPORT
EWI, Engineering Associates, Inc.

Sheet No._____

EWI

Job No. 60251
Date: 07/31/89

FALLING HEAD PERMEABILITY TEST

Engineering Inc., 1 Science Ct., University Research Park, PO Box 5385, Madison, WI 53705 (608) 273-0440

PROJECT	ACS
LOCATION	GRIFFITH, INDIANA
SAMPLE (a)	ACS - SSMW05
DEPTH (ft)	23 FT
SOIL DESCRIPTION (b)	Gray Lean CLAY, Trace Sand (CL) (VISUAL)
SAMPLE DIAMETER (cm)	7.4
SAMPLE AREA, A(cm²)	42.6

	INITIAL	FINAL
SAMPLE LENGTH, L(cm)	19.3	19.3
MOISTURE CONTENT, %	16.2	16.2
DRY DENSITY (lb/cu ft)	117.6	117.6
PERCENT COMPACTION	-	-

RUN	COEFFICIENT OF PERMEABILITY, k(cm/sec)
1	2.0E-07
2	6.7E-08
3	1.9E-08
4	8.1E-10
5	4.2E-09
6	2.6E-09
7	2.5E-09
8	1.7E-09
9	2.5E-09
10	2.3E-09
11	3.4E-09
12	6.8E-09
13	7.2E-09

AVERAGE COEFFICIENT OF PERMEABILITY = 5.8E-09 cm/sec
(Based on run numbers 11 through 13)

FORMULA: $k = \frac{2.3aL}{At} \log_{10} \frac{h_0}{h_1}$, Where a = cross-sectional area of standpipe,
t = time for water level to fall from initial height, h_0, to final height, h_1
(All other terms are defined above)

FOOTNOTES: (a) This permeability test was performed on a relatively undisturbed 3-in. diameter Shelby tube sample.
(b) Soil classification was based on visual observation only.

CHECKED BY: VJR DATE: 8-16-89 APPROVED BY: [signature] DATE: 8/16/89

WARZYN

Job No. 60251
Date: 07/31/89

ALLING HEAD PERMEABILITY TEST

n Engineering Inc., 1 Science Ct., University Research Park, PO Box 5385, Madison, WI 53705 (608) 273-0440

JECT	ACS
CATION	GRIFFITH, INDIANA
MPLE (a)	ACS - SSMW06
PTH (ft)	34 FT
IL DESCRIPTION (b)	Gray Lean CLAY, Trace Sand (CL) (VISUAL)
MPLE DIAMETER (cm)	7.4
MPLE AREA, A(cm²)	42.6

	INITIAL	FINAL
MPLE LENGTH, L(cm)	20.3	20.3
ISTURE CONTENT, %	16.5	16.6
Y DENSITY (lb/cu ft)	115.5	115.5
RCENT COMPACTION	-	-

RUN	COEFFICIENT OF PERMEABILITY, k(cm/sec)
1	1.8E-08
2	1.2E-07
3	2.0E-08
4	1.1E-08
5	1.8E-08
6	1.5E-08
7	1.1E-08
8	1.1E-08
9	8.0E-09
10	7.2E-09
11	2.5E-08
12	1.7E-08
13	6.7E-08

AVERAGE COEFFICIENT OF PERMEABILITY = 3.6E-08 cm/sec
(Based on run numbers 11 through 13)

$$\text{NULA: } k = \frac{2.3aL}{At} \log_{10} \frac{h_0}{h_1}$$

, Where a = cross-sectional area of standpipe,
t = time for water level to fall from initial height, h_0, to final height, h_1
(All other terms are defined above)

OTNOTES: (a) This permeability test was performed on a relatively undisturbed 3-in. diameter Shelby tube sample.
(b) Soil classification was based on visual observation only.

BY: VJR DATE: 8·16·89 APPROVED BY: [signature] DATE: 8/16/89

WARZYN

Job No. 60251
Date: 07/31/89

FALLING HEAD PERMEABILITY TEST

Warzyn Engineering Inc., 1 Science Ct., University Research Park, PO Box 5385, Madison, WI 53705 (608) 273-0440

PROJECT	ACS
LOCATION	GRIFFITH, INDIANA
SAMPLE (a)	ACS - SSMW03
DEPTH (ft)	17 FT
SOIL DESCRIPTION (b)	Gray Lean CLAY, Trace Sand (CL) (VISUAL)
SAMPLE DIAMETER (cm)	7.4
SAMPLE AREA, A(cm^2)	42.6

	INITIAL	FINAL
SAMPLE LENGTH, L(cm)	19.0	19.0
MOISTURE CONTENT, %	16.1	16.4
DRY DENSITY (lb/cu ft)	116.0	116.0
PERCENT COMPACTION	-	-

RUN	COEFFICIENT OF PERMEABILITY, k(cm/sec)
1	2.4E-08
2	5.7E-07
3	9.6E-09
4	4.0E-09
5	1.6E-08
6	2.9E-08
7	3.6E-08
8	3.9E-08
9	3.4E-08
10	2.2E-08
11	2.9E-08
12	1.6E-08
13	5.2E-08

AVERAGE COEFFICIENT OF PERMEABILITY = 3.2E-08 cm/sec
(Based on run numbers 11 through 13)

FORMULA: $k = \frac{2.3aL}{At} \log_{10} \frac{h_0}{h_1}$, Where a = cross-sectional area of standpipe,
t = time for water level to fall from initial height, h_0, to final height, h_1
(All other terms are defined above)

FOOTNOTES: (a) This permeability test was performed on a relatively undisturbed 3-in. diameter Shelby tube sample.
(b) Soil classification was based on visual observation only.

CHECKED BY: VJR DATE: 8-16-89 APPROVED BY: [illegible] DATE: 8/16/89

WARZYN

Job No. 60251
Date: 07/31/89

ALLING HEAD PERMEABILITY TEST

n Engineering Inc., 1 Science Ct., University Research Park, PO Box 5385, Madison, WI 53705 (608) 273-0440

OJECT	ACS
CATION	GRIFFITH, INDIANA
MPLE (a)	ACS - SSMW04
PTH (ft)	20 FT
IL DESCRIPTION (b)	Gray Lean CLAY, Trace Sand (CL) (VISUAL)
MPLE DIAMETER (cm)	7.4
MPLE AREA, A(cm^2)	42.6

	INITIAL	FINAL
MPLE LENGTH, L(cm)	19.6	19.6
ISTURE CONTENT, %	14.4	14.0
Y DENSITY (lb/cu ft)	121.5	121.5
RCENT COMPACTION	-	-

RUN	COEFFICIENT OF PERMEABILITY, k(cm/sec)
1	4.0E-09
2	6.8E-07
3	7.0E-07
4	6.9E-07
5	7.0E-07
6	7.0E-07
7	6.2E-07
8	6.3E-07
9	6.5E-07
10	5.5E-07
11	6.9E-07
12	5.4E-07
13	7.8E-07

AVERAGE COEFFICIENT OF PERMEABILITY = 6.7E-07 cm/sec
(Based on run numbers 11 through 13)

$$\text{MULA: } k = \frac{2.3aL}{At} \log_{10} \frac{h_0}{h_1}$$

, Where a = cross-sectional area of standpipe,
t = time for water level to fall from initial height, h_0, to final height, h_1
(All other terms are defined above)

OOTNOTES: (a) This permeability test was performed on a relatively undisturbed 3-in. diameter Shelby tube sample.
(b) Soil classification was based on visual observation only.

HECKED BY: VDR DATE: 8-16-89 APPROVED BY: KWA DATE: 8/16/89

WARZYN

Job No. 60251
Date: 07/31/89

FALLING HEAD PERMEABILITY TEST

Warzyn Engineering Inc., 1 Science Ct., University Research Park, PO Box 5385, Madison, WI 53705 (608) 273-0440

PROJECT	ACS
LOCATION	GRIFFITH, INDIANA
SAMPLE (a)	BORING: ACS - SSMW01
DEPTH (ft)	17.0 FT
SOIL DESCRIPTION (b)	Gray Lean CLAY, Trace Sand (CL) (VISUAL)
SAMPLE DIAMETER (cm)	7.4
SAMPLE AREA, A(cm^2)	42.6

	INITIAL	FINAL
SAMPLE LENGTH, L(cm)	18.3	18.3
MOISTURE CONTENT, %	22.0	22.5
DRY DENSITY (lb/cu ft)	103.2	103.2
PERCENT COMPACTION	-	-

RUN	COEFFICIENT OF PERMEABILITY, k(cm/sec)
1	2.8E-08
2	2.7E-06
3	1.6E-06
4	1.4E-07
5	1.1E-07
6	8.2E-08
7	6.8E-08
8	6.6E-08
9	6.3E-08
10	6.6E-08
11	6.9E-08
12	5.1E-08
13	6.0E-08

AVERAGE COEFFICIENT OF PERMEABILITY = 6.0E-08 cm/sec
(Based on run numbers 11 through 13)

FORMULA: $k = \frac{2.3aL}{At} \log_{10} \frac{h_0}{h_1}$, Where a = cross-sectional area of standpipe,
t = time for water level to fall from initial height, h_0, to final height, h_1
(All other terms are defined above)

FOOTNOTES: (a) This permeability test was performed on a relatively undisturbed 3-in. diameter Shelby tube sample.
(b) Soil classification was based on visual observation only.

CHECKED BY: JR DATE: 8·16·89 APPROVED BY: [illegible] DATE: 8/16/89

WARZYN

Job No. 60251
Date: 07/31/89

ALLING HEAD PERMEABILITY TEST

zyn Engineering Inc., 1 Science Ct., University Research Park, PO Box 5385, Madison, WI 53705 (608) 273-0440

ROJECT	ACS
OCATION	GRIFFITH, INDIANA
AMPLE (a)	ACS - SSMW02
EPTH (ft)	22 FT
OIL DESCRIPTION (b)	Gray Lean CLAY, Trace Sand (CL) (VISUAL)
AMPLE DIAMETER (cm)	7.4
AMPLE AREA, A(cm^2)	42.6

	INITIAL	FINAL
AMPLE LENGTH, L(cm)	19.8	19.8
OISTURE CONTENT, %	19.3	18.8
RY DENSITY (lb/cu ft)	106.6	106.6
ERCENT COMPACTION	-	-

RUN	COEFFICIENT OF PERMEABILITY, k(cm/sec)
1	2.7E-09
2	1.7E-07
3	1.7E-09
4	5.8E-09
5	1.9E-08
6	2.7E-08
7	2.7E-08
8	2.8E-08
9	2.5E-08
10	2.5E-08
11	3.6E-08
12	2.1E-08
13	5.6E-08

AVERAGE COEFFICIENT OF PERMEABILITY = 3.8E-08 cm/sec
(Based on run numbers 11 through 13)

ORMULA: $k = \frac{2.3aL}{At} \log_{10} \frac{h_0}{h_1}$, Where a = cross-sectional area of standpipe,
t = time for water level to fall from initial height, h_0, to final height, h_1
(All other terms are defined above)

OOTNOTES: (a) This permeability test was performed on a relatively undisturbed 3-in. diameter Shelby tube sample.
(b) Soil classification was based on visual observation only.

HECKED BY: VJR DATE: 8-16-89 APPROVED BY: [signature] DATE: 8/16/89

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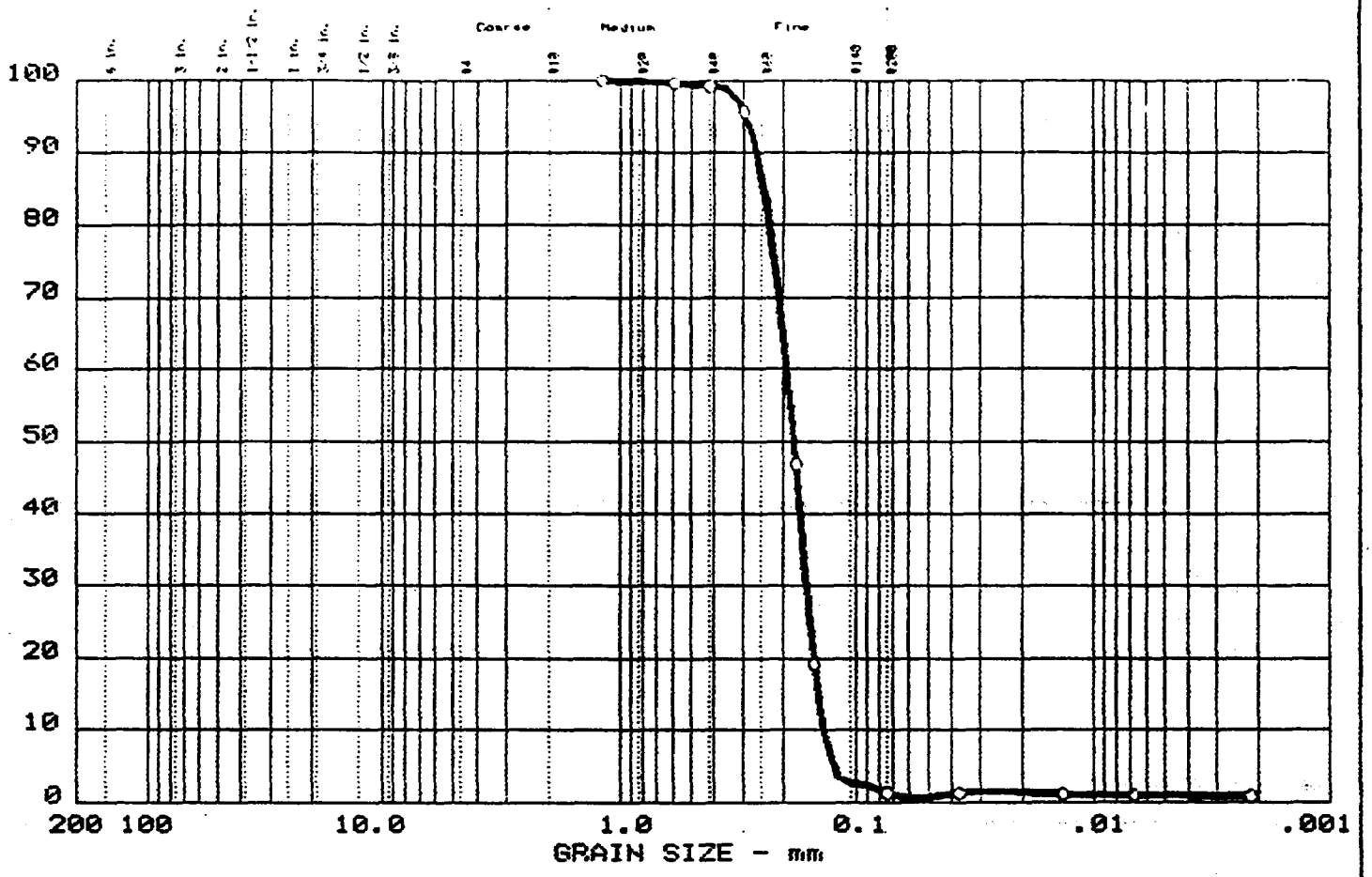
GRAIN SIZE DISTRIBUTION TEST REPORT



Symbol	%+3"	% GRAVEL	% SAND	% SILT	% CLAY
O	0.0	0.0	98.7	0.3	1.0

LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
--	--	0.24	0.19	0.18	0.160	0.1439	0.1361	0.98	1.4

MATERIAL DESCRIPTION	USCS
O Brown Fine SAND, Trace Clay	SP
Natural Moisture Content = 3.7 %	

Project No.: 60251.00
Project: ACS
O Sample: BORING: 06 @ DEPTH 7.5 FT

Date: 07-31-89

Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DWA
APPROVED BY: VJR

GRAIN SIZE DISTRIBUTION TEST REPORT
WARZYN ENGINEERING INC.

Sheet No.

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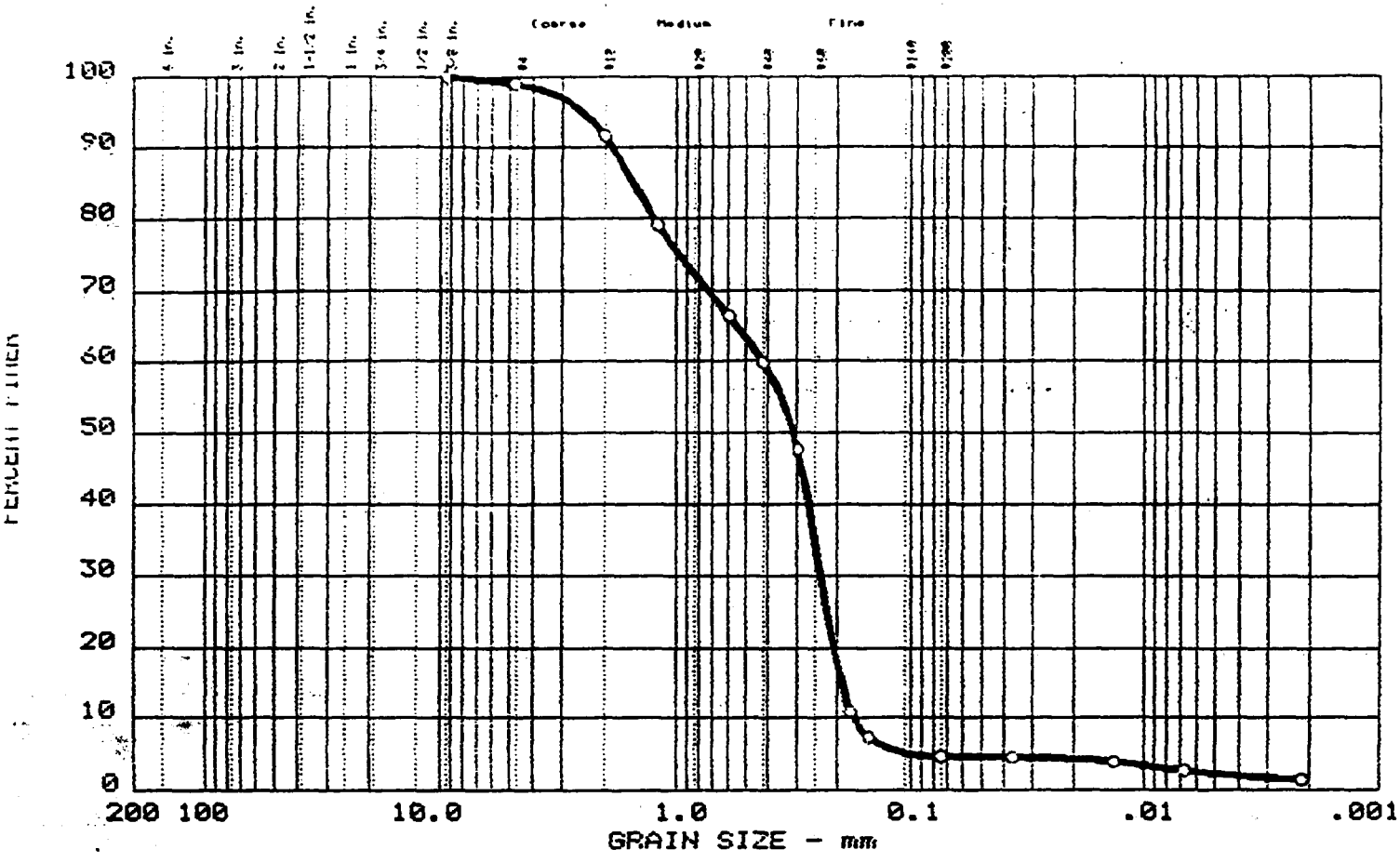
GRAIN SIZE DISTRIBUTION TEST REPORT



Symbol	%+3"	% GRAVEL	% SAND	% SILT	% CLAY
O	0.0	1.0	94.4	2.4	2.2

LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
--	--	1.51	0.42	0.31	0.235	0.1925	0.1728	0.76	2.4

MATERIAL DESCRIPTION	USCS
O Brown Fine-Coarse SAND, Trace Silt, Clay & Gravel	SP
Natural Moisture Content = 19.0 %	

Project No.: 60251.00
Project: ACS
O Sample: BORING: 06 @ DEPTH 22.5 FT

Date: 07-31-89

Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DWA
APPROVED BY: VJR

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WARZYN ENGINEERING INC.

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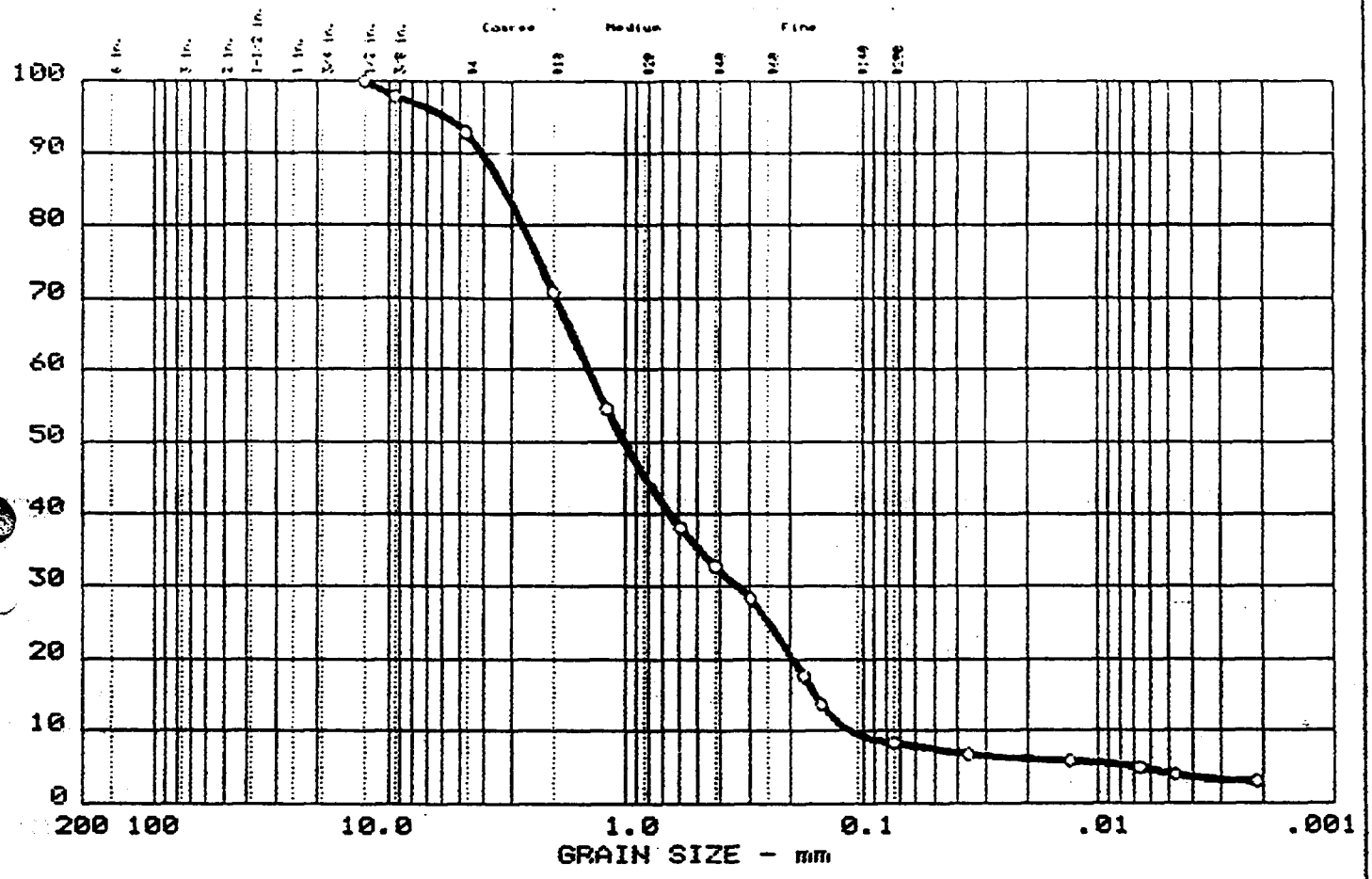

Symbol	%+3"	% GRAVEL	% SAND	% SILT	% CLAY
O	0.0	7.1	84.6	4.2	4.1

LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
--	--	3.24	1.42	1.01	0.333	0.1576	0.1128	0.69	12.6

MATERIAL DESCRIPTION	USCS
O Brown Fine-Coarse SAND, Little Gravel, Trace Silt & Clay	SP-SM
Natural Moisture Content = 21.0 %	

Project No.: 60251.00
Project: ACS
Sample: BORING: 04 @ DEPTH 5.0 FT

Date: 07-31-89

Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DWA
APPROVED BY: VDR

GRAIN SIZE DISTRIBUTION TEST REPORT
WARZYN ENGINEERING INC.

Sheet No.

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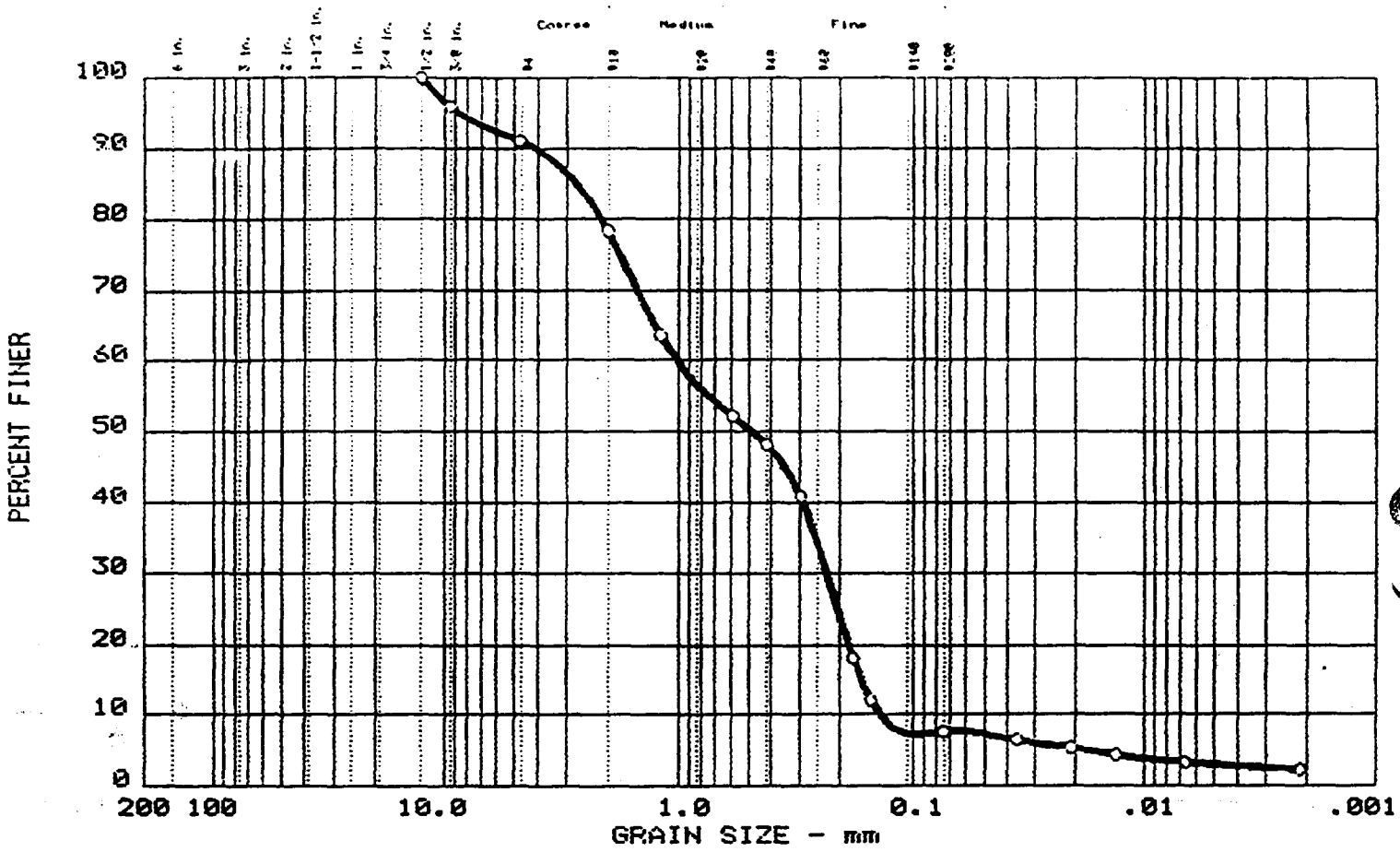


Symbol	%+3"	% GRAVEL	% SAND	% SILT	% CLAY
O	0.0	8.9	83.5	4.6	3.0

LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
--	--	2.72	1.01	0.48	0.229	0.1633	0.1358	0.38	7.4

MATERIAL DESCRIPTION	USCS
O Brown Fine-Coarse SAND, Little Gravel, Trace Silt & Clay Natural Moisture Content = 15.8 %	SP-SM

Project No.: 60251.00
Project: ACS
O Sample: BORING: 04 @ 12.0 FT

Date: 07-31-89

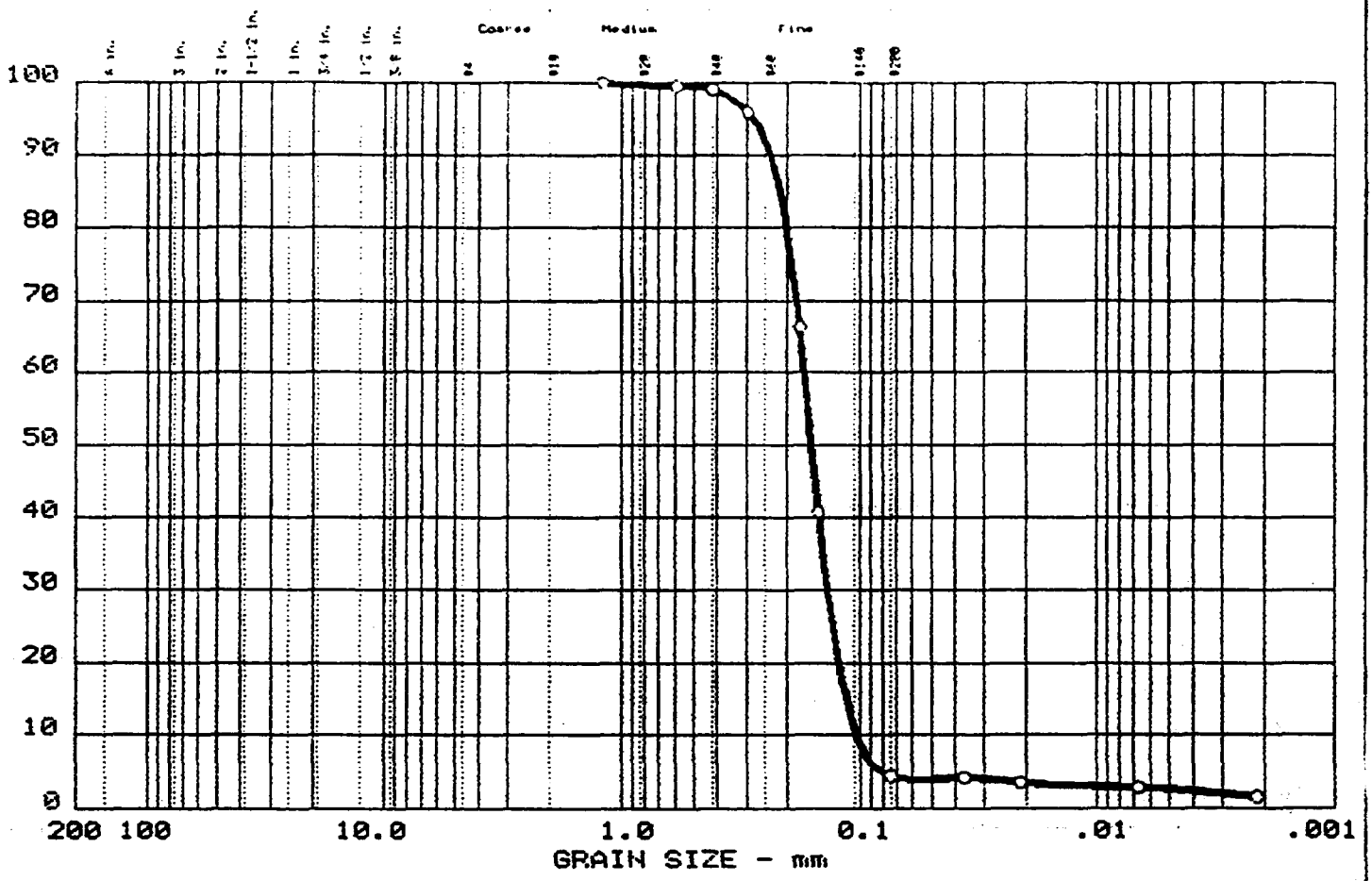
GRAIN SIZE DISTRIBUTION TEST REPORT
WARZYN ENGINEERING INC.

Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DWA
APPROVED BY: VR

Sheet No.

WARZYN

GRAIN SIZE DISTRIBUTION TEST REPORT



Symbol	%+3"	% GRAVEL	% SAND	% SILT	% CLAY
O	0.0	0.0	95.6	1.8	2.7

LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
--	--	0.21	0.17	0.16	0.137	0.1143	0.1030	1.07	1.6

MATERIAL DESCRIPTION	USCS
O Brown Fine SAND, Trace Silt & Clay Natural Moisture Content = 21.7 %	SP

Project No.: 60251.00
Project: ACS
O Sample: BORING: 03 @ DEPTH 2.5 FT

Date: 07-31-89

Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DWA
APPROVED BY: VR

GRAIN SIZE DISTRIBUTION TEST REPORT
WARZYN ENGINEERING INC.

Sheet No.

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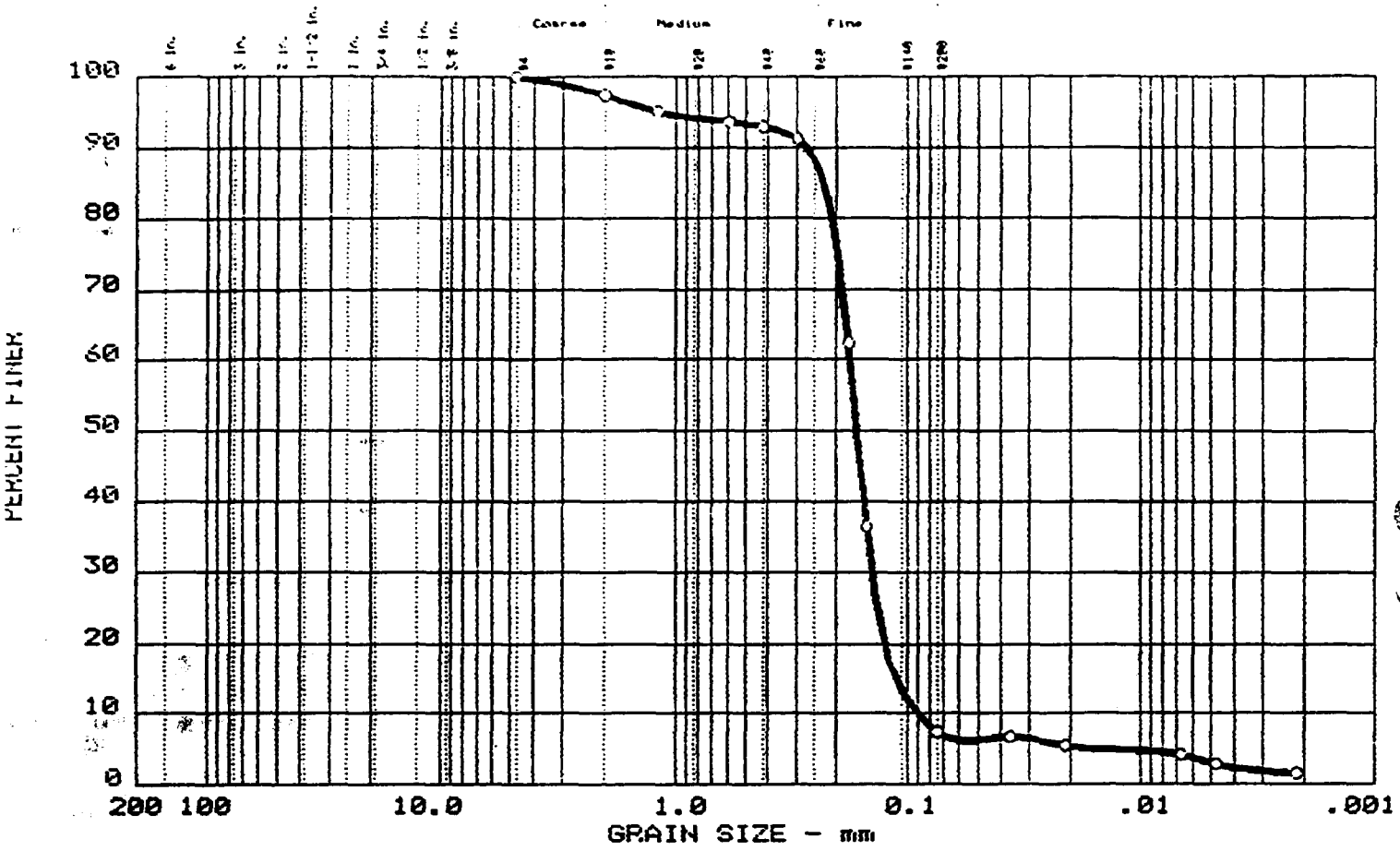

Symbol	%+3"	% GRAVEL	% SAND	% SILT	% CLAY
O	0.0	0.0	92.6	4.4	3.0

LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
--	--	0.23	0.17	0.16	0.141	0.1121	0.0890	1.29	2.0

MATERIAL DESCRIPTION	USCS
O Gray Fine-Medium SAND, Trace Silt & Clay	SP-SM
Natural Moisture Content = 22.1 %	

Project No.: 60251.00
Project: ACS
O Sample: BORING: 03 @ DEPTH 12.0 FT

Date: 07-31-89

Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DWA
APPROVED BY: KDR

GRAIN SIZE DISTRIBUTION TEST REPORT
WARZYN ENGINEERING INC.

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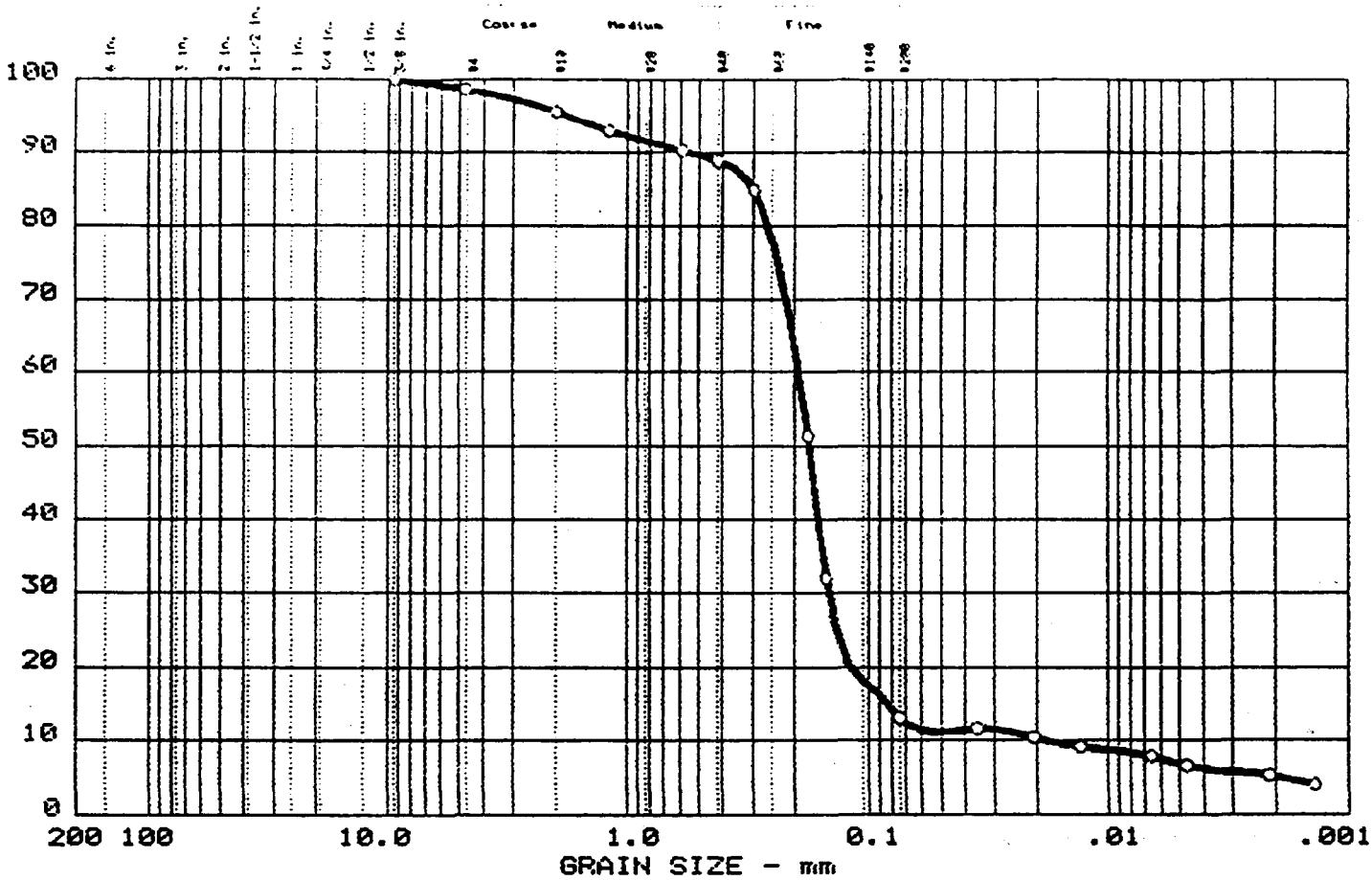


Symbol	%+3"	% GRAVEL	% SAND	% SILT	% CLAY
O	0.0	1.3	85.5	6.3	6.8

LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
--	--	0.30	0.19	0.17	0.145	0.0827	0.0179	6.14	10.8

MATERIAL DESCRIPTION	USCS
O Brown Fine-Medium SAND, Little Silt & Clay, Trace Gravel Natural Moisture Content = 16.4 %	SP-SM

Project No.: 60251.00
Project: ACS
O Sample: BORING: 02 @ DEPTH 5.0 FT

Date: 07-31-89

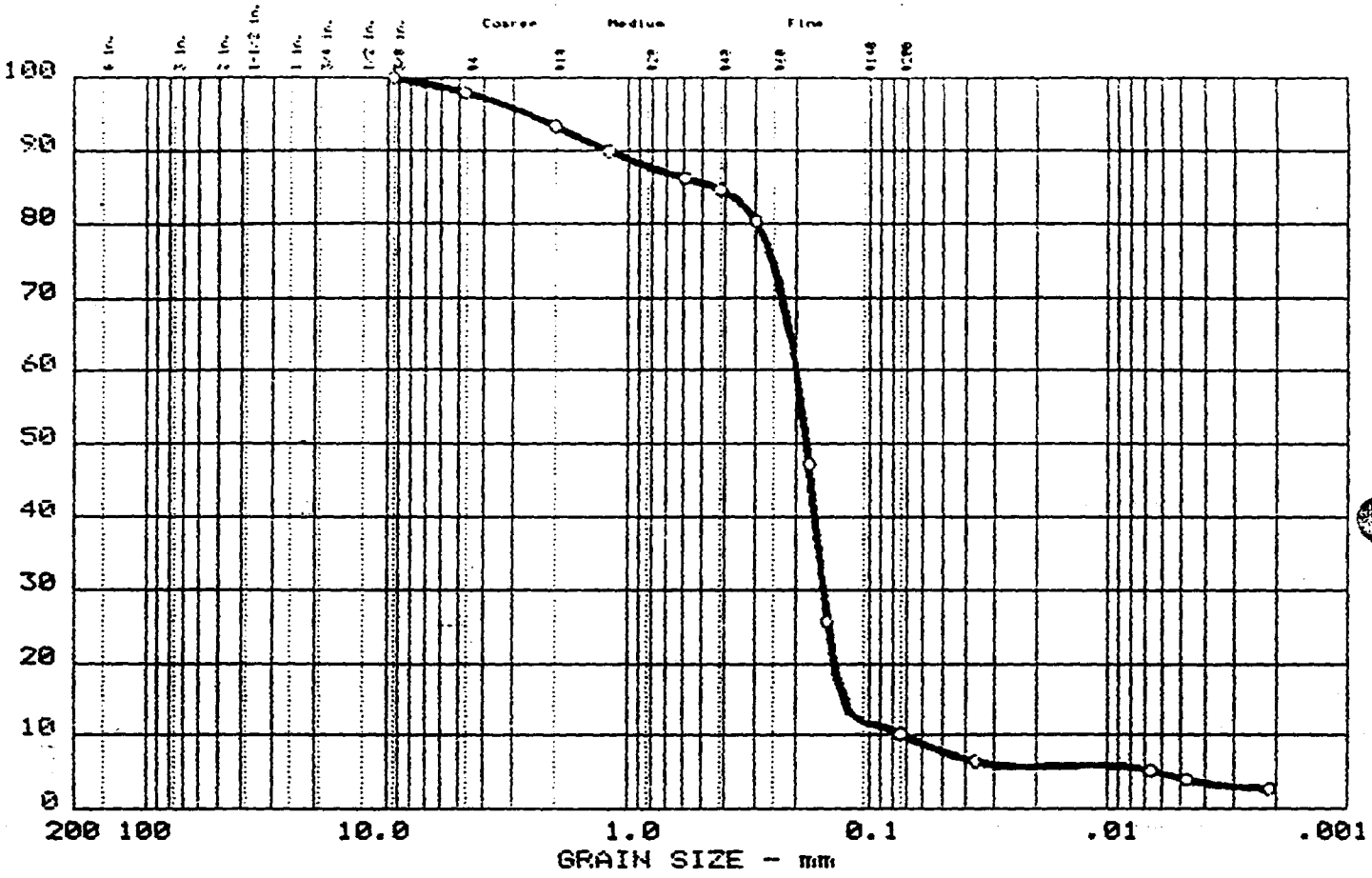
Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DWA
APPROVED BY: VDR

GRAIN SIZE DISTRIBUTION TEST REPORT
WARZYN ENGINEERING INC.

Sheet No.

WARZYN

GRAIN SIZE DISTRIBUTION TEST REPORT



Symbol	%+3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	2.0	87.8	6.0	4.2

LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
--	--	0.45	0.20	0.18	0.155	0.1272	0.0715	1.68	2.8

MATERIAL DESCRIPTION	USCS
○ Gray Fine-Coarse SAND, Little Silt, Trace Clay & Gravel Natural Moisture Content = 19.4 %	SP-SM

Project No.: 60251.00
Project: ACS
○ Sample: BORING: 02 @ DEPTH 12.5 FT

Date: 07-31-89

Remarks:

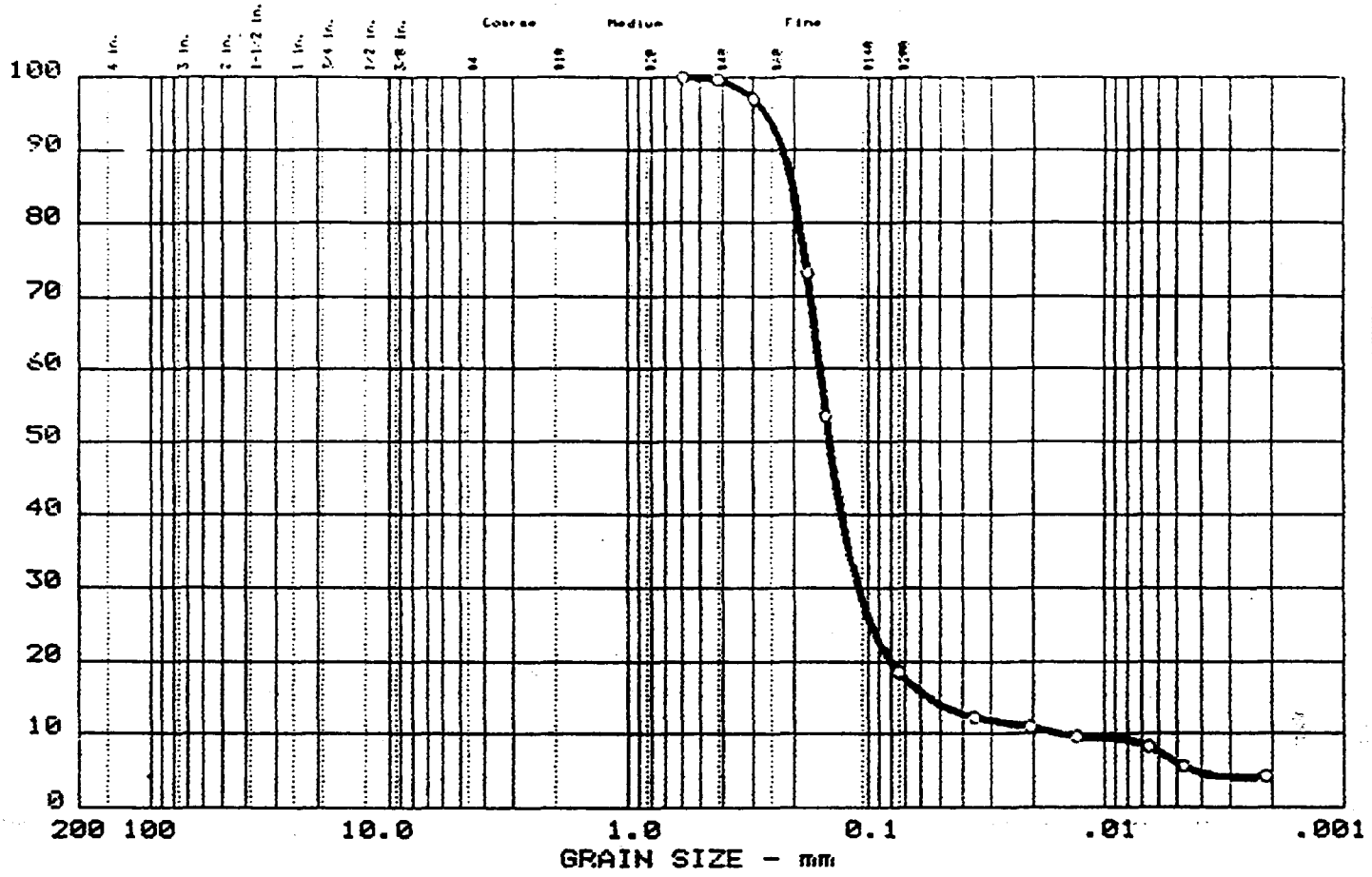
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DWA
APPROVED BY: VJR

GRAIN SIZE DISTRIBUTION TEST REPORT
WARZYN ENGINEERING INC.

Sheet No.

WARZYN

GRAIN SIZE DISTRIBUTION TEST REPORT



Symbol	%+3"	% GRAVEL	% SAND	% SILT	% CLAY
O	0.0	0.0	81.5	12.5	6.1

LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
--	--	0.20	0.16	0.14	0.110	0.0557	0.0145	5.28	10.9

MATERIAL DESCRIPTION	USCS
O Black Fine SAND, Some Silt, Little Clay	SM
Natural Moisture Content = 25.4 %	

Project No.: 60251.00
Project: ACS
O Sample: BORING: 01 @ DEPTH 5.0 FT

Date: 07-31-89

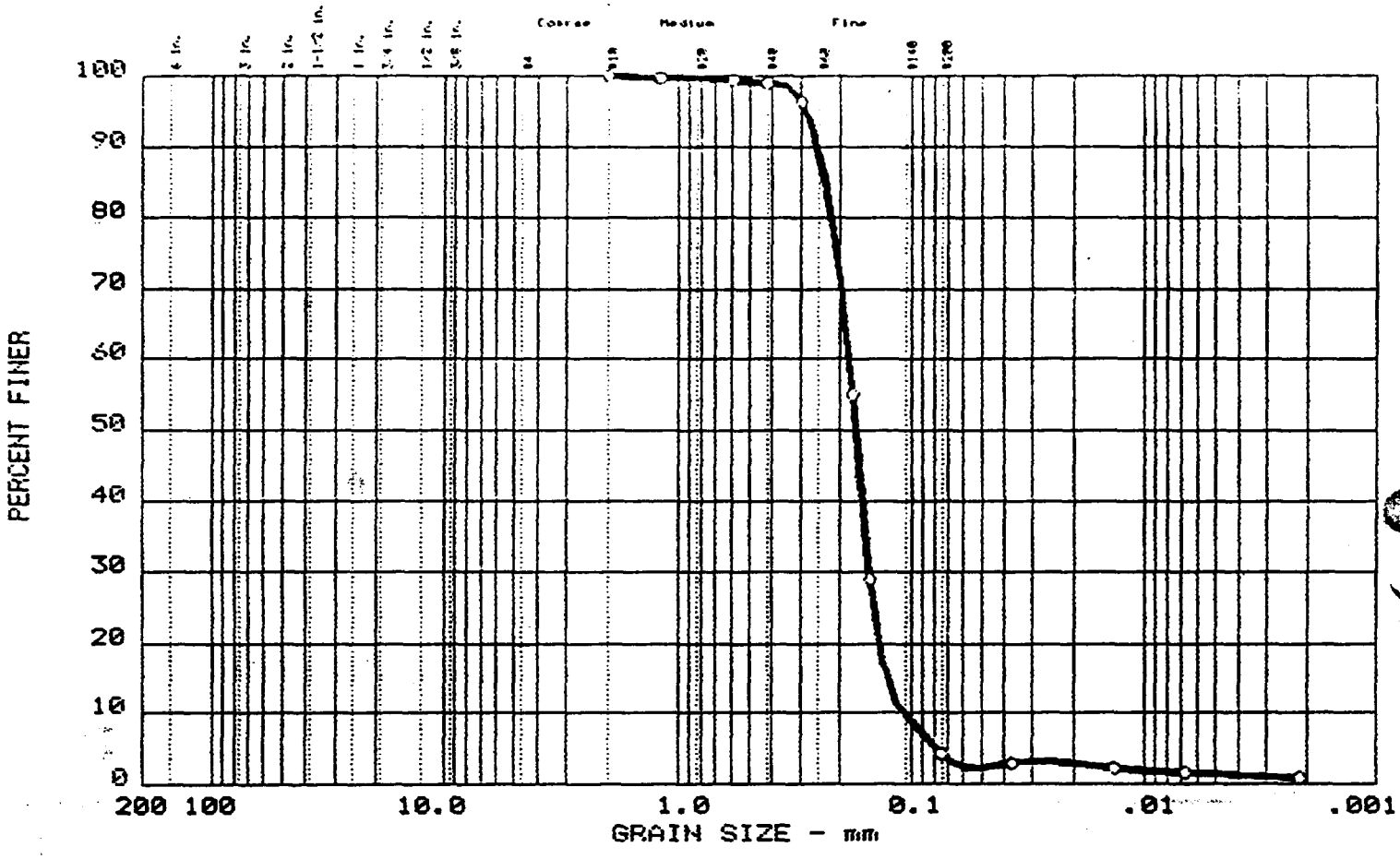
Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DWA
APPROVED BY: WR

GRAIN SIZE DISTRIBUTION TEST REPORT
WARZYN ENGINEERING INC.

Sheet No.

WARZYN

GRAIN SIZE DISTRIBUTION TEST REPORT



Symbol	%+3"	% GRAVEL	% SAND	% SILT	% CLAY
O	0.0	0.0	95.8	2.8	1.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O	--	--	0.23	0.18	0.17	0.150	0.1263	0.1075	1.15	1.7

MATERIAL DESCRIPTION	USCS
O Gray Fine SAND, Trace Silt & Clay Natural Moisture Content = 15.6 %	SP

Project No.: 60251.00
Project: ACS
O Sample: BORING: 01 @ DEPTH 15.0 FT

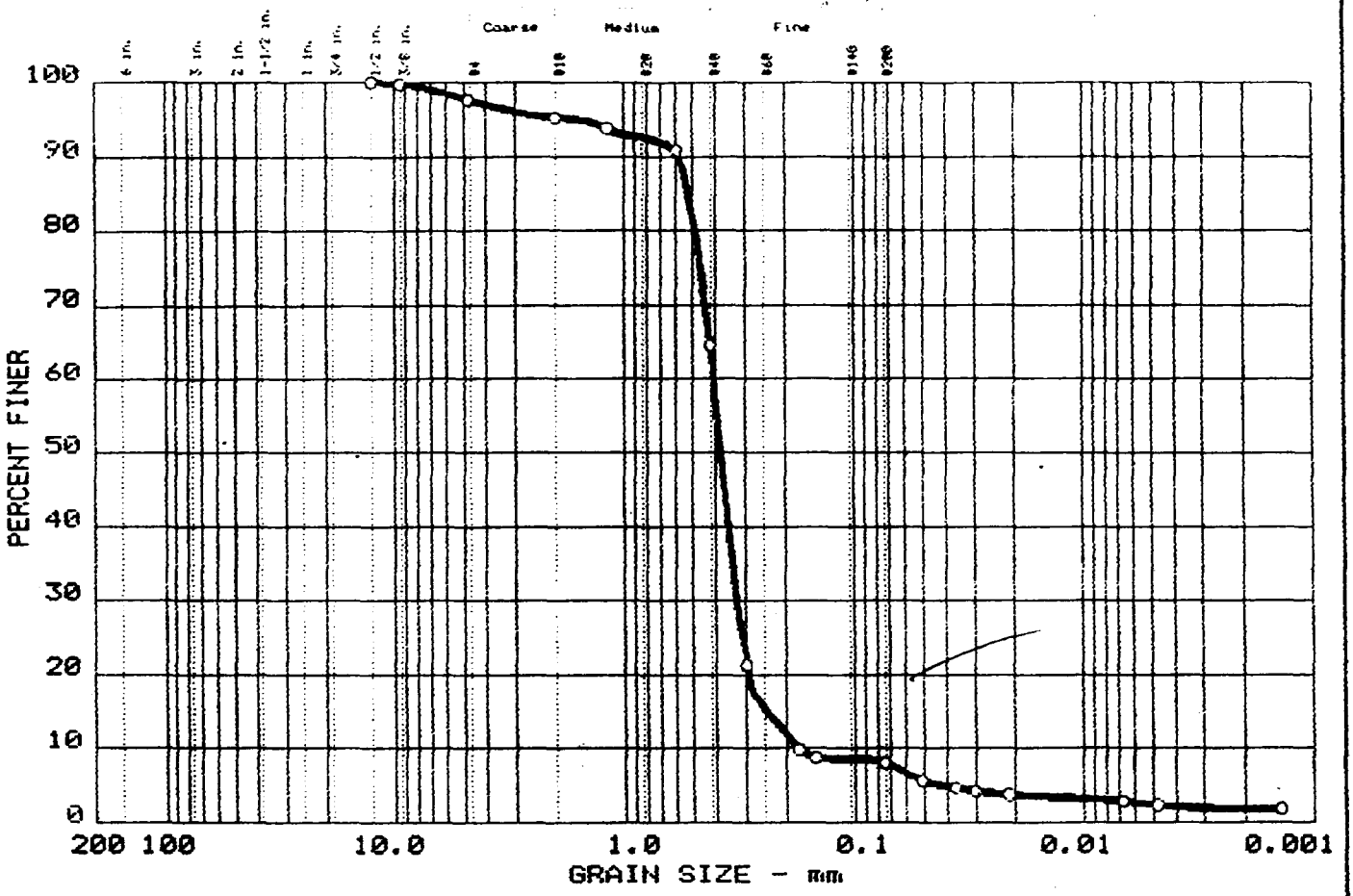
Date: 07-31-89

Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DWA
APPROVED BY: VJR

GRAIN SIZE DISTRIBUTION TEST REPORT
WARZYN ENGINEERING INC.

Sheet No.

GRAIN SIZE DISTRIBUTION TEST REPORT



Symbol	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O	0.0	2.3	89.6	5.7	2.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O	--	--	0.52	0.41	0.38	0.325	0.2438	0.1766	1.48	2.3

MATERIAL DESCRIPTION	USCS
O Brown Fine-Medium SAND, Little Silt, Trace Clay & Gravel	SP-SM

Project No.: 15090.33
Project: ACS
O Sample: BORING: MW9 @ 26.0-35.0 FT

Date: 03/21/90

Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DA
APPROVED BY:

GRAIN SIZE DISTRIBUTION TEST REPORT
EWI, Engineering Associates, Inc.

Sheet No._____

EWI

FALLING HEAD PERMEABILITY TEST DATA

DATE: 03/21/90
PROJECT NO. 15090
Filename: 1509021.903

INPUT BY: MML
CHECKED BY: DA
APPROVED BY: _____

SAMPLE ID: BORING: MW7

DEPTH (FT): 23.0 - 25.0
HEAD CORRECTION (CM): 3.00
STANDPIPE DIA. (IN): 0.270

SAMPLE DIAMETER (IN): 2.90
SAMPLE DIAMETER (CM): 7.366
AREA (SQ CM): 42.61

	INITIAL	FINAL
SAMPLE WEIGHT (GMS)	1960.60	1960.60
SAMPLE LENGTH (IN)	8.12	8.12
SAMPLE LENGTH (CM)	20.62	20.62
MOISTURE CONTENT (%)	13.00	13.00
DRY DENSITY (PCF)	123.24	123.24

RUN	TIME INITIAL	TIME FINAL	TIME ELAPSED	UNCORRECTED HEAD (CM) INITIAL	UNCORRECTED HEAD (CM) FINAL	PERM (CM/SEC)
1	27 1105	28 615	69000	235.0	213.9	2.47E-07
2	28 615	29 540	84300	235.0	223.4	1.09E-07
3	29 540	30 605	87900	235.0	224.5	9.42E-08
4	30 605	31 1200	107700	235.0	225.0	7.31E-08
5	31 1200	32 1300	90000	235.0	224.5	9.20E-08
6	1 1400	2 615	58500	235.0	227.6	9.91E-08
7	2 615	3 620	86700	235.0	225.7	8.44E-08
8	3 620	4 615	86100	235.0	226.7	7.56E-08
9	4 615	5 600	85500	235.0	226.3	7.99E-08
10	5 600	6 610	87000	235.0	225.7	8.41E-08
11	6 610	7 1245	110100	235.0	224.5	7.52E-08
12	7 1245	8 1400	90900	235.0	226.0	7.78E-08

AVERAGE COEFFICIENT OF PERMEABILITY = 7.90E-08 (cm/sec)
(Based on run numbers 10 through 12)

EWI

[illegible]

EWI
Engineering Associates, Inc.

FALLING HEAD OR
PRESSURE PERMEABILITY TEST

PROJECT: [illegible]
SAMPLE: [illegible]

Job No. [illegible]
Date 3/21/92
Sheet [illegible] of 2
Technician MM[illegible]/[illegible]
Checked By [illegible]

* INITIAL & FINAL DENSITY

	INITIAL	FINAL
MOLD & WET SOIL =	[illegible]	[illegible]
TARE OF MOLD =	575.0	
WET WT OF SOIL =	1960.6	[illegible]
VOLUME OF MOLD =		
WET DENSITY, PCF =		
% MOISTURE =		
DRY DENSITY, PCF =		
% COMPACTION =		
SAMPLE HT (L) =	[illegible]	[illegible]
CHANGE IN (L) =	0	0

SAMPLE DIA (D) = [illegible] IN _____ CM

STAND PIPE DIA (d) = [illegible] IN _____ CM

* INITIAL & FINAL MOISTURE CONTENTS

	INITIAL	FINAL
PAN # =		[illegible]
PAN & WET SOIL =		1615.2
PAN & DRY SOIL =		1431.1
TARE OF PAN =		[illegible]
% MOISTURE =		[illegible]

3" S.T. [illegible]
2" S.T. _____
PROCTOR MOLD _____
OTHER _____

MAXIMUM DENSITY = _____ lb/cu.ft.
OPTIMUM MOISUTRE = _____ %

SAMPLE LENGTH (L) _____ IN _____ CM

SAMPLE AREA (A) _____ IN^2 _____ CM^2

PERMEAMETER HEAD CORRECTION 3 CM

1 PSI = 70.317 CM WATER HEAD

☒ UNDISTURBED or ☐ REMOLDED SAMPLE

	Date and Time Start T_1	Date and Time End T_2	Elapsed Time, Sec. (T)	Pressure PSI (P)	Start Head (H_1)	End Head (H_2)	* $Kv = \frac{(d^2)(L)}{(D)^2(T)} \ln \frac{(P)+H_1}{(P)+H_2}$
1.	[illegible]	[illegible]		0	[illegible]	[illegible]	
2.	[illegible]	[illegible]				[illegible]	
3.	[illegible]	[illegible]				[illegible]	
4.	[illegible]	31 [illegible]				[illegible]	
5.	31 1200	32 1300				224.5	
6.	1 1400	[illegible]				[illegible]	
7.	[illegible]	[illegible]				[illegible]	
8.	[illegible]	[illegible]				[illegible]	
9.		[illegible]				[illegible]	
10.	[illegible]	[illegible]				[illegible]	
11.	[illegible]	[illegible]				[illegible]	
12.	[illegible]	[illegible]				[illegible]	
13.	[illegible]						
14.							

*See computer print out

15021995

EWI
Engineering Associates, Inc.

FALLING HEAD OR PRESSURE PERMEABILITY TEST

PROJECT: ACS
SAMPLE: MW9 @ 21.0-23.0 FT

Job No. 15090.33
Date
Sheet 2 of 2
Technician MK, DWA
Checked By DJ

* INITIAL & FINAL DENSITY

	INITIAL	FINAL
MOLD & WET SOIL =	2272.5	2268.0
TARE OF MOLD =	548.2	→
WET WT OF SOIL =	1724.3	1719.8
VOLUME OF MOLD =		
WET DENSITY, PCF =		
% MOISTURE =		
DRY DENSITY, PCF =		
% COMPACTION =		
SAMPLE HT (L) =	7.61"	7.61"
CHANGE IN (L) =	0	0

SAMPLE DIA (D) = 2.9 IN _____ CM

STAND PIPE DIA (d) = .27 IN _____ CM

* INITIAL & FINAL MOISTURE CONTENTS

	INITIAL	FINAL
PAN # =		94
PAN & WET SOIL =		1404.5
PAN & DRY SOIL =		1188.2
TARE OF PAN =		16.82
% MOISTURE =		18.5

3" S.T. MW9 @ 21.0-23.0 FT
2" S.T.
PROCTOR MOLD
OTHER

MAXIMUM DENSITY = _____ lb/cu.ft.

OPTIMUM MOISUTRE = _____ %

SAMPLE LENGTH (L) _____ IN _____ CM

SAMPLE AREA (A) _____ IN^2 _____ CM^2

PERMEAMETER HEAD CORRECTION 3 CM

1 PSI = 70.317 CM WATER HEAD

☒ UNDISTURBED or ☐ REMOLDED SAMPLE

	Date and Time Start T_1	Date and Time End T_2	Elapsed Time, Sec. (T)	Pressure PSI (P)	Start Head (H_1)	End Head (H_2)	* $Kv = \frac{(d^2)(L)}{(D)^2(T)} \ln \frac{(P)+H_1}{(P)+H_2}$
1.	29 1105	30 615		0	235.7	232.9	
2.	29 [illegible]	[illegible] 540				234.3	
3.	29 [illegible]	30 625				233.3	
4.	30 625	31 1200				234.1	
5.	31 1200	32 1300				234.4	
6.	1 1400	2 [illegible]				[illegible]	
7.	2 [illegible]	3 20				233.9	
8.	3 [illegible]	4 [illegible]				[illegible]	
9.	[illegible]	5 [illegible]				[illegible]	
10.	5 [illegible]	6 610				233.9	
11.	6 610	7 1245				234.9	
12.	7 1245	8 1400				231.2	
13.	8 1400						
14.							

*See computer print out

FALLING HEAD PERMEABILITY TEST DATA

DATE: 03/21/90
PROJECT NO. 15090
Filename: 1509021.903

INPUT BY: MML
CHECKED BY: DA
APPROVED BY: _____

SAMPLE ID: BORING: MW9

DEPTH (FT): 21.0 - 23.0
HEAD CORRECTION (CM): 3.00
STANDPIPE DIA. (IN): 0.270

SAMPLE DIAMETER (IN): 2.90
SAMPLE DIAMETER (CM): 7.366
AREA (SQ CM): 42.61

	INITIAL	FINAL
SAMPLE WEIGHT (GMS)	1724.30	1719.80
SAMPLE LENGTH (IN)	7.61	7.61
SAMPLE LENGTH (CM)	19.33	19.33
MOISTURE CONTENT (%)	18.81	18.50
DRY DENSITY (PCF)	109.99	109.99

RUN	TIME INITIAL	TIME FINAL	TIME ELAPSED	UNCORRECTED HEAD (CM) INITIAL	UNCORRECTED HEAD (CM) FINAL	PERM (CM/SEC)
1	27 1105	28 615	69000	235.0	228.9	6.47E-08
2	28 615	29 540	84300	235.0	224.3	9.38E-08
3	29 540	30 605	87900	235.0	230.3	3.90E-08
4	30 605	31 1200	107700	235.0	234.1	6.05E-09
5	31 1200	32 1300	90000	235.0	234.4	4.82E-09
6	1 1400	2 615	58500	235.0	233.7	1.61E-08
7	2 615	3 620	86700	235.0	232.9	1.76E-08
8	3 620	4 615	86100	235.0	233.5	1.26E-08
9	4 615	5 600	85500	235.0	232.4	2.21E-08
10	5 600	6 610	87000	235.0	230.9	3.43E-08
11	6 610	7 1245	110100	235.0	229.9	3.38E-08
12	7 1245	8 1400	90900	235.0	231.2	3.04E-08

AVERAGE COEFFICIENT OF PERMEABILITY = 3.29E-08 (cm/sec)
(Based on run numbers 10 through 12)

EWI

Job No. 15090
Date: 03/21/90

FALLING HEAD PERMEABILITY TEST

WI Engineering Associates, Inc., 8383 Greenway Blvd., Middleton, WI 53562 Phone: (608) 231-4770

ROJECT	ACS
OCATION	GRIFFITH, INDIANA
AMPLE (a)	BORING: MW7
EPTH (ft)	23.0 - 25.0
OIL DESCRIPTION	Brown Lean CLAY, Little Sand, Trace Gravel (CL)
AMPLE DIAMETER (cm)	7.4
AMPLE AREA, A(cm^2)	42.6

	INITIAL	FINAL
AMPLE LENGTH, L(cm)	20.6	20.6
OISTURE CONTENT, %	13.0	13.0
RY DENSITY (lb/cu ft)	123.2	123.2
ERCENT COMPACTION	-	-

RUN	COEFFICIENT OF PERMEABILITY, k(cm/sec)
1	2.5E-07
2	1.1E-07
3	9.4E-08
4	7.3E-08
5	9.2E-08
6	9.9E-08
7	8.4E-08
8	7.6E-08
9	8.0E-08
10	8.4E-08
11	7.5E-08
12	7.8E-08

AVERAGE COEFFICIENT OF PERMEABILITY = 7.9E-08 cm/sec
(Based on run numbers 10 through 12)

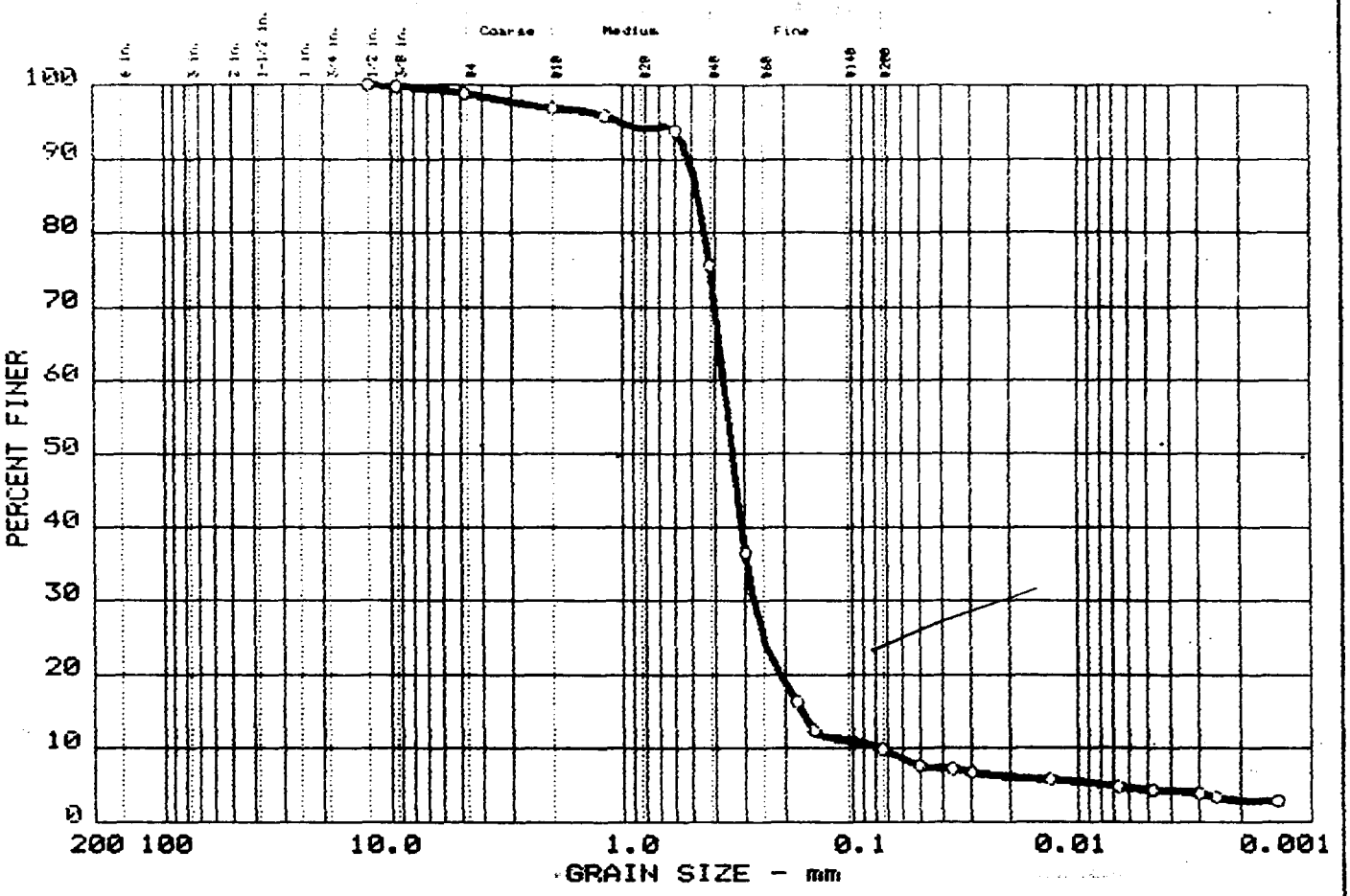
FORMULA: $k = \frac{2.3aL}{At} \log_{10} \frac{h_0}{h_1}$, Where a = cross-sectional area of standpipe,
t = time for water level to fall from initial height, h_0, to final height, h_1
(All other terms are defined above)

FOOTNOTES: (a) This permeability test was performed on a relatively undisturbed 3-inch diameter Shelby tube sample.

CHECKED BY: DA DATE: _____ APPROVED BY: _____ DATE: _____

EWI

GRAIN SIZE DISTRIBUTION TEST REPORT



Symbol	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	1.1	88.9	5.5	4.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	--	--	0.47	0.37	0.34	0.273	0.1679	0.0750	2.72	4.9

MATERIAL DESCRIPTION	USCS
○ Brown Fine-Medium SAND, Little Silt, Trace Clay & Gravel	SP-SM

Project No.: 15090.33
Project: ACS
○ Sample: BORING: MW9 @ 10.0-16.0 FT

Date: 03/21/90

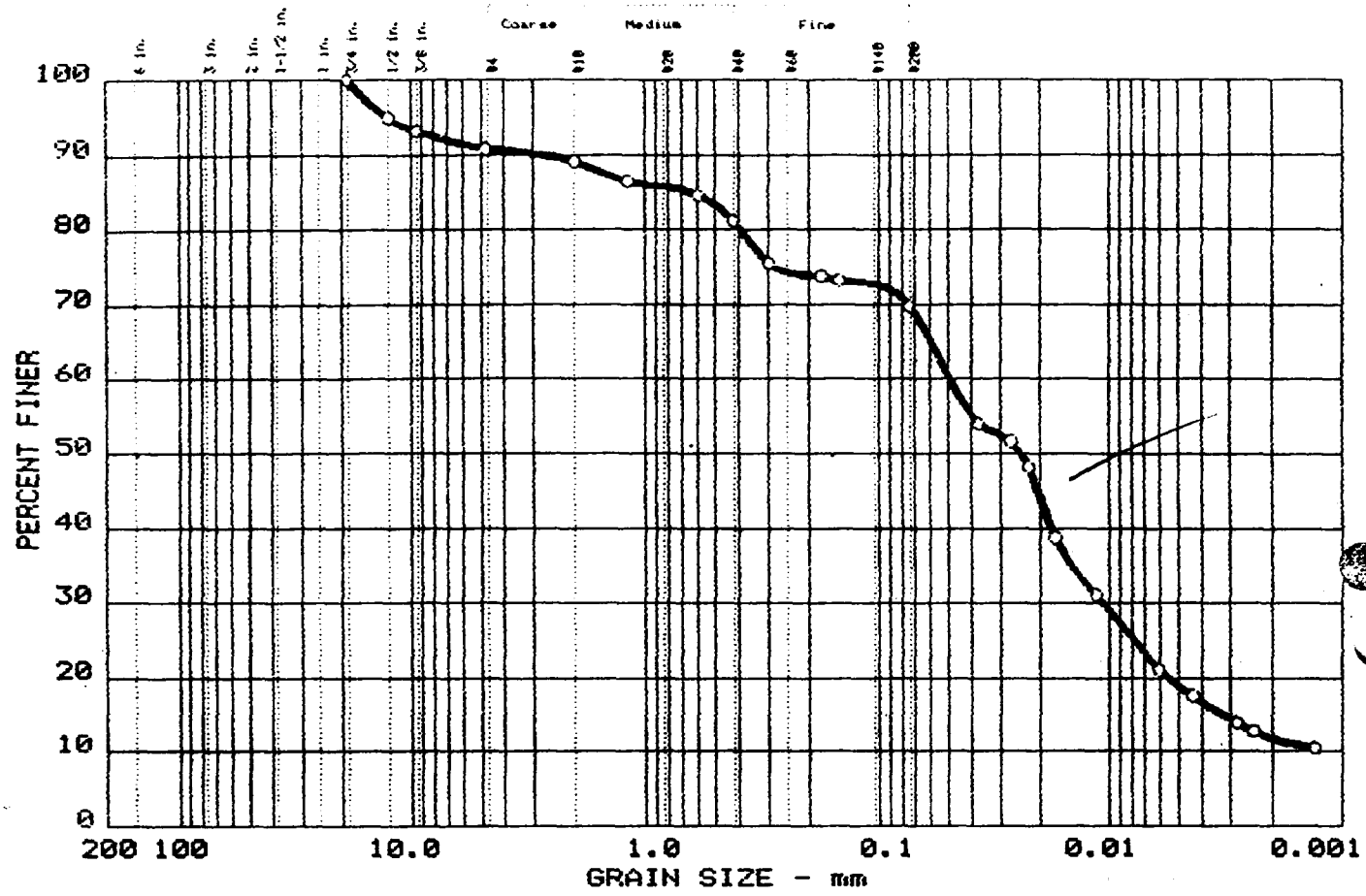
Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DJ
APPROVED BY:

GRAIN SIZE DISTRIBUTION TEST REPORT
EWI, Engineering Associates, Inc.

Sheet No._____

EWI

GRAIN SIZE DISTRIBUTION TEST REPORT



Symbol	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O	0.0	9.2	21.1	50.9	18.8

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O	21	10	0.63		0.02	0.011	0.0032			

MATERIAL DESCRIPTION	USCS
O Brown Lean CLAY, Some Sand, Little Gravel	CL

Project No.: 15090.33
Project: ACS
O Sample: BORING: MW9 @ 21.0-23.0 FT

Date: 03/21/90

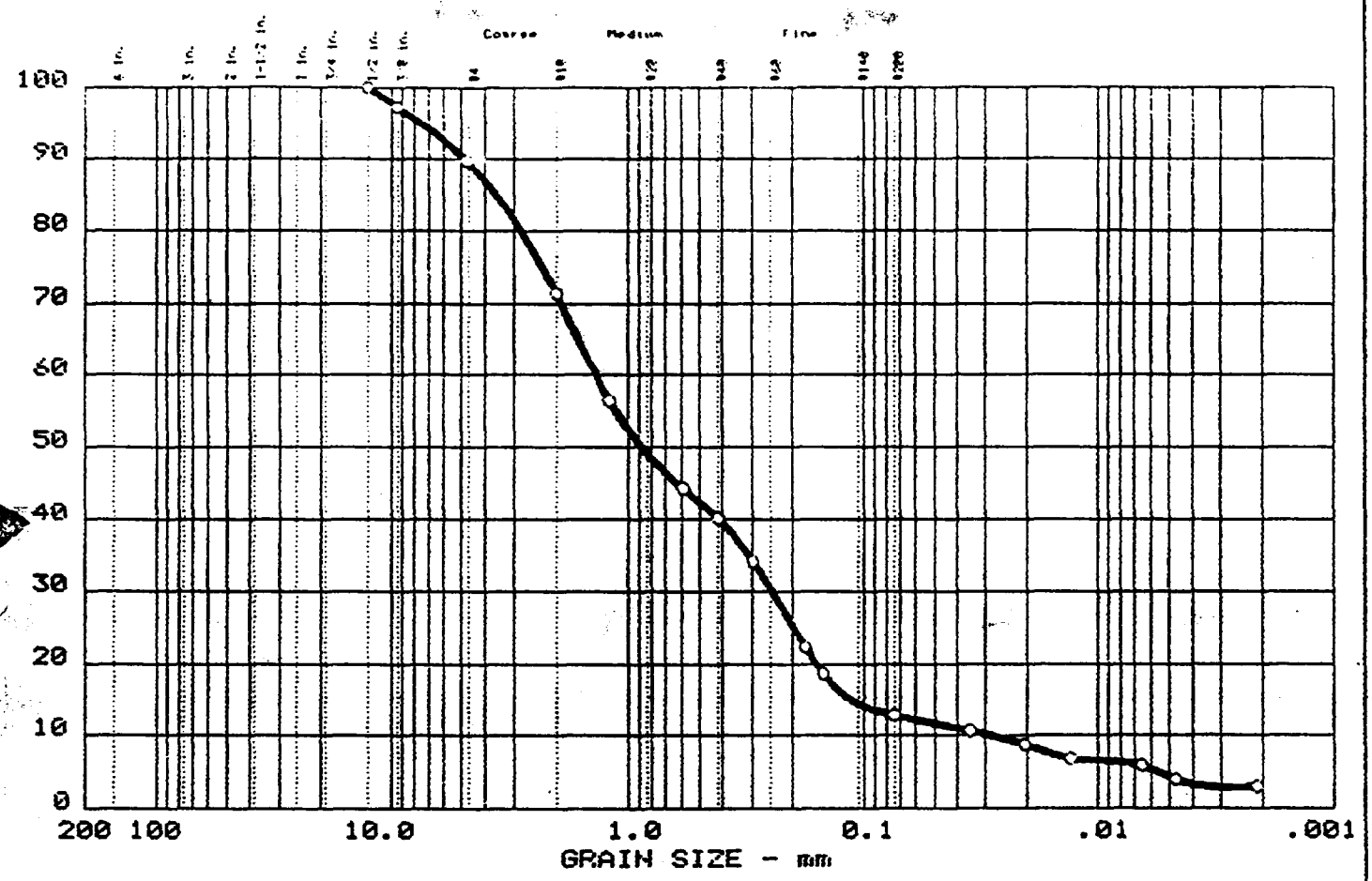
Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DA
APPROVED BY:

GRAIN SIZE DISTRIBUTION TEST REPORT
EWI, Engineering Associates, Inc.

Sheet No._____

EWI

GRAIN SIZE DISTRIBUTION TEST REPORT



Symbol	%+3"	% GRAVEL	% SAND	% SILT	% CLAY
O	0.0	10.2	76.9	8.5	4.3

LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
--	--	3.55	1.35	0.87	0.245	0.1134	0.0278	1.60	48.5

MATERIAL DESCRIPTION	USCS
O Brown Fine-Coarse SAND, Little Gravel & Silt, Trace Clay	SM
Natural Moisture Content = 13.0 %	

Project No.: 60251.00
Project: ACS
Sample: BORING: 05 @ DEPTH 5.0 FT

Date: 07-31-89

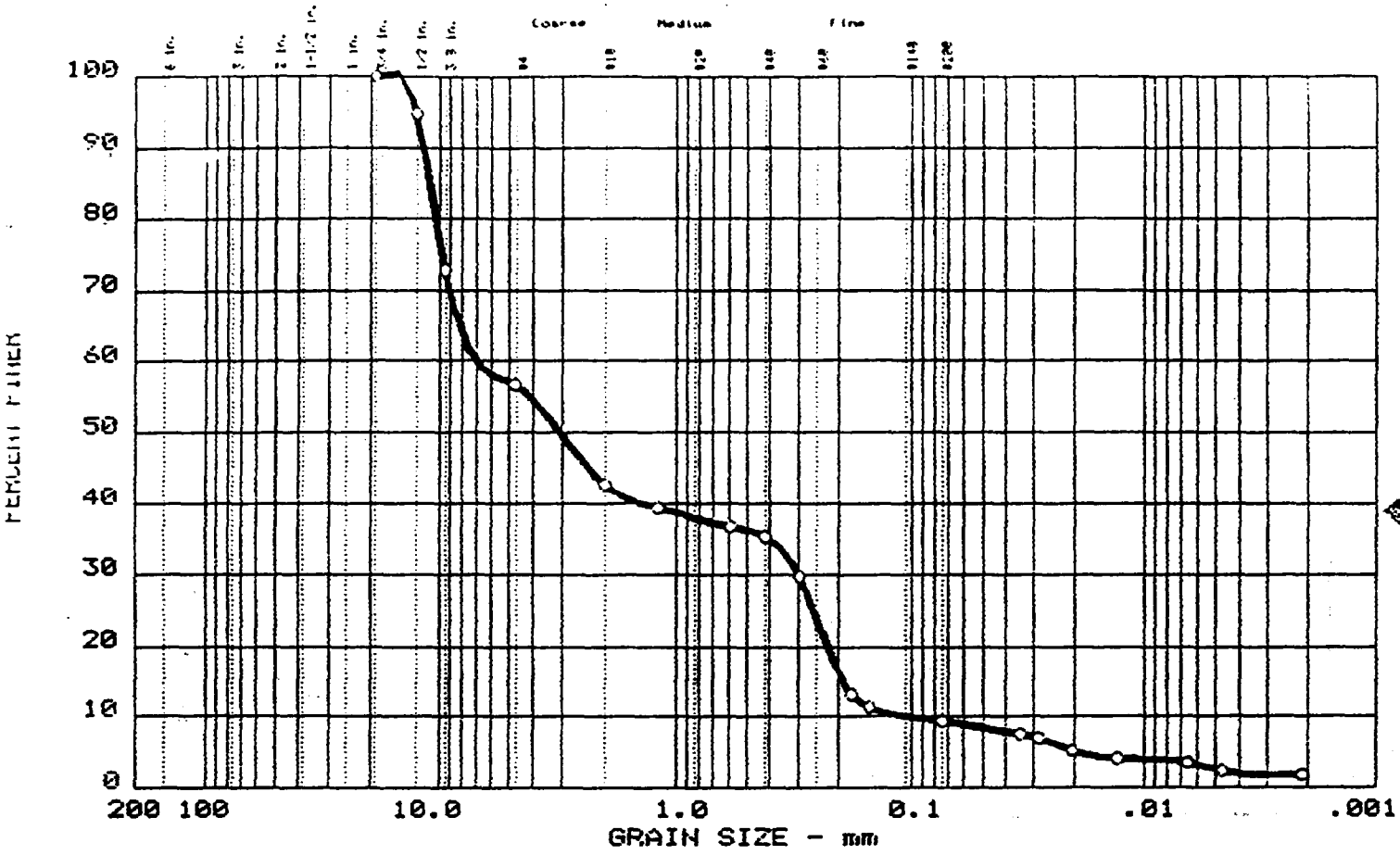
Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DWA
APPROVED BY: VDR

GRAIN SIZE DISTRIBUTION TEST REPORT
WARZYN ENGINEERING INC.

Sheet No.

WARZYN

GRAIN SIZE DISTRIBUTION TEST REPORT



Symbol	%+3"	% GRAVEL	% SAND	% SILT	% CLAY
O	0.0	43.2	47.4	6.8	2.6

LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
--	--	11.09	6.92	3.05	0.299	0.1925	0.1022	0.13	67.7

MATERIAL DESCRIPTION	USCS
O Gray Fine-Coarse SAND & GRAVEL, Little Silt, Trace Clay Natural Moisture Content = 16.4 %	SP-SM/GP-GM

Project No.: 60251.00
Project: ACS
O Sample: BORING: 05 @ DEPTH 10.0 FT

Date: 07-31-89

GRAIN SIZE DISTRIBUTION TEST REPORT
WARZYN ENGINEERING INC.

Remarks:
TESTED BY: MML/DWA
ENTERED BY: MML
CHECKED BY: DWA
APPROVED BY: KJR

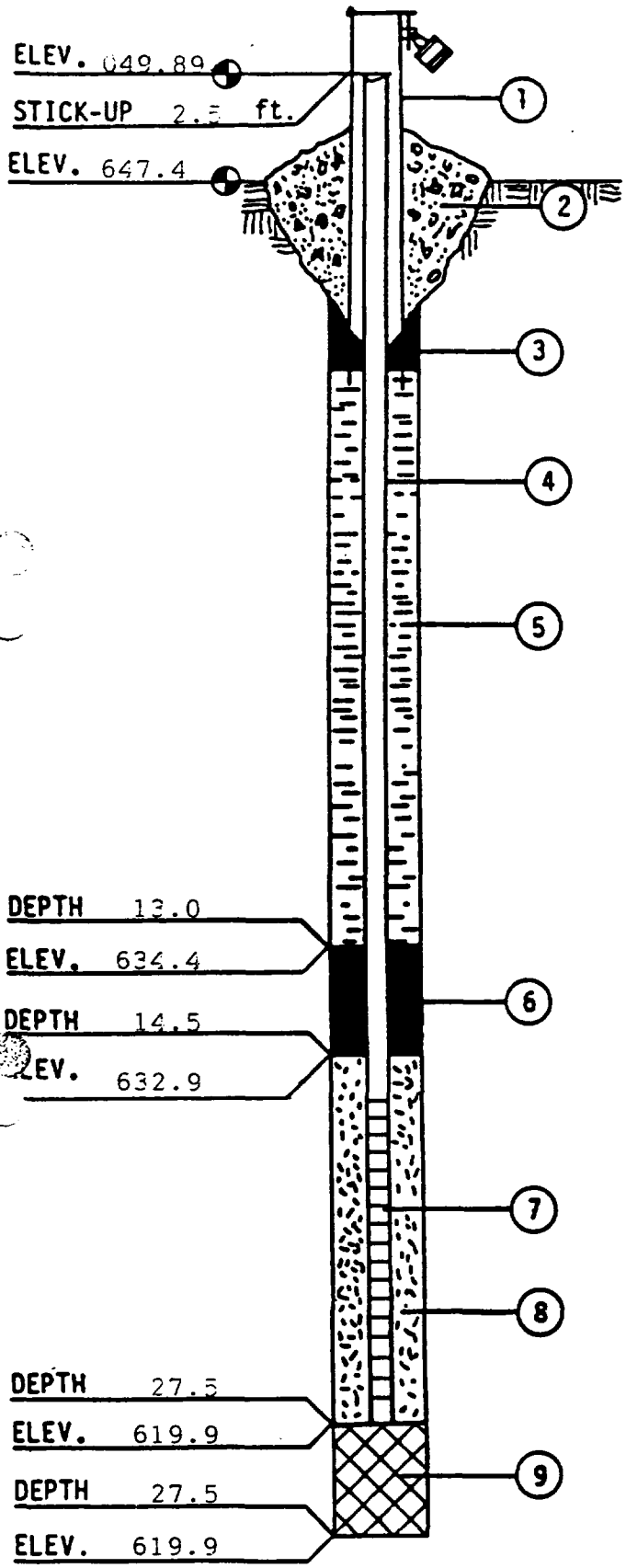
Sheet No.

WARZYN

G

APPENDIX E

Monitoring Well and Leachate Well Construction Details



WARZYN

V251.00-1TJM

Monitoring Well Construction Information

Project Number 60251.00

Description ACS

Boring/ Well No LW2 Date 7/13/89

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Grout

4. Solid Pipe Type Schedule 40 PVC

   Solid Pipe Length 7.5 feet

   Joint Type Threaded

5. Type of Backfill Grout

   Backfill Installed Tremie

6. Type of Lower Seal (if installed) Bentonite Pellets

7. Screen Type Schedule 40 PVC

   Screen Length 10 feet

   Slot Size 0.010 inches

   Slotted Interval Length 10 feet

   Screen Diameter 2 inches

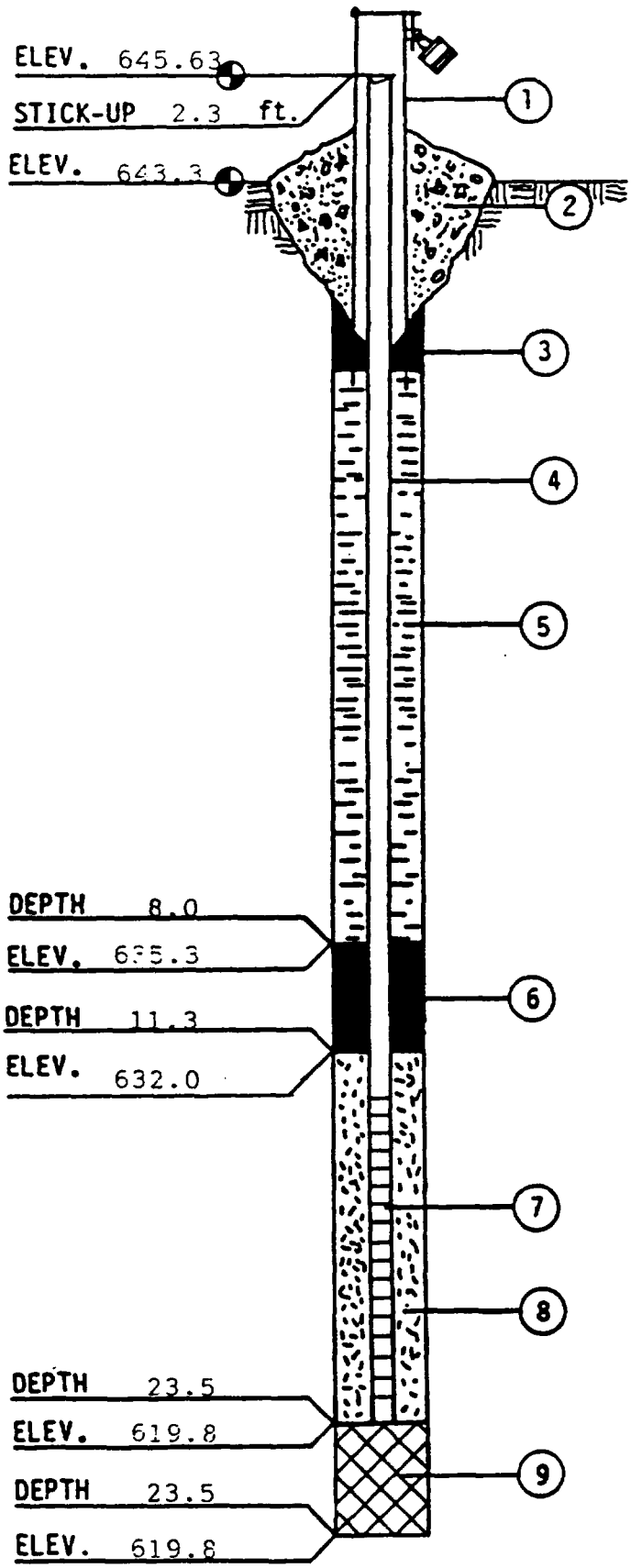
8. Type of Backfill around Screen Flint Sand with some Natural Cave

9. Type of Backfill Natural Cave-in

10. Drilling Method 4-1/4-in ID HSA

11. Additives Used (if any) None

All Depths Measured from Ground Surface



WARZYN

V251.00-1TJM

Monitoring Well Construction Information

Project Number 60251.00

Description ACS

Boring/ Well No LW3 Date 7/13/89

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Cement

4. Solid Pipe Type Schedule 40 PVC

   Solid Pipe Length 15 feet

   Joint Type Threaded

5. Type of Backfill Grout

   Backfill Installed Tremie

6. Type of Lower Seal (if installed) Bentonite Pellets

7. Screen Type Schedule 40 PVC

   Screen Length 10 feet

   Slot Size 0.010 inches

   Slotted Interval Length 10 feet

   Screen Diameter 2 inches

8. Type of Backfill around Screen Red Flint Filler Sand

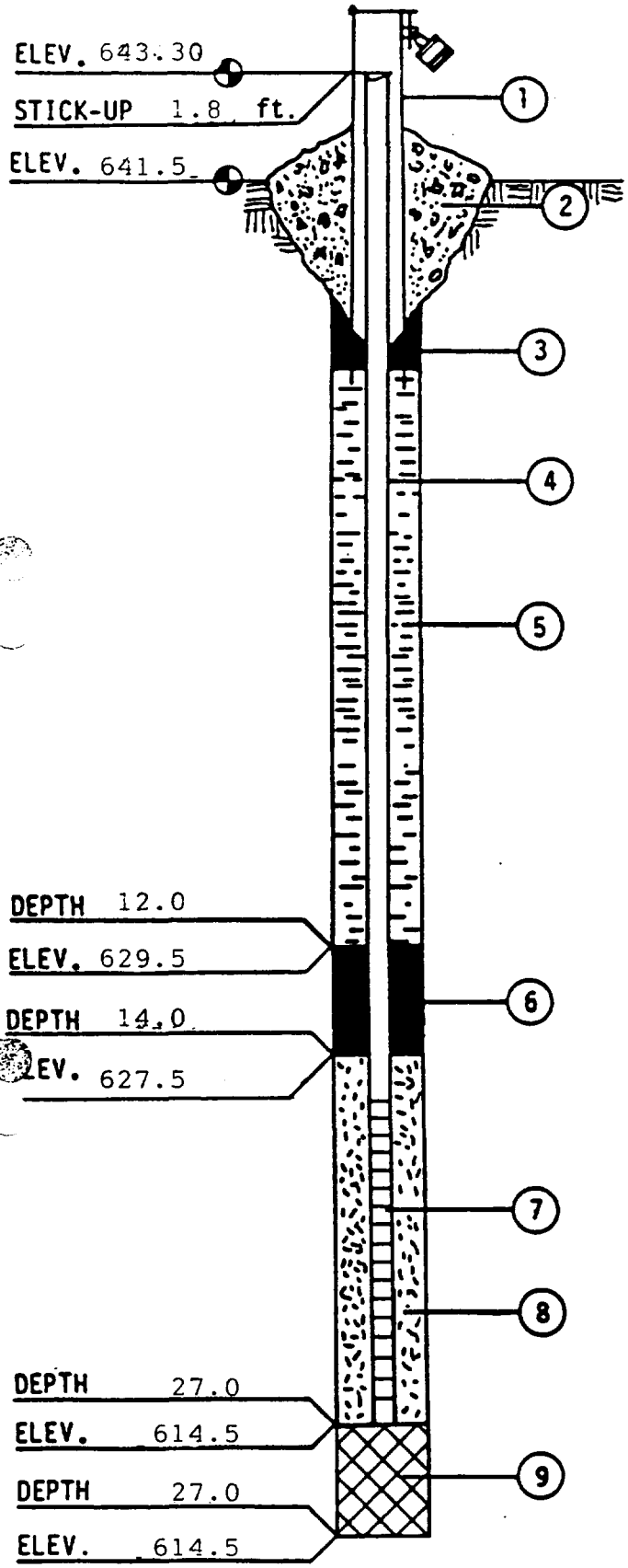
9. Type of Backfill Natural Cave-in

10. Drilling Method 4-1/4-in ID HSA

11. Additives Used (if any)

    None

All Depths Measured from Ground Surface



WARZYN

V251.00-1TJM

Monitoring Well Construction Information

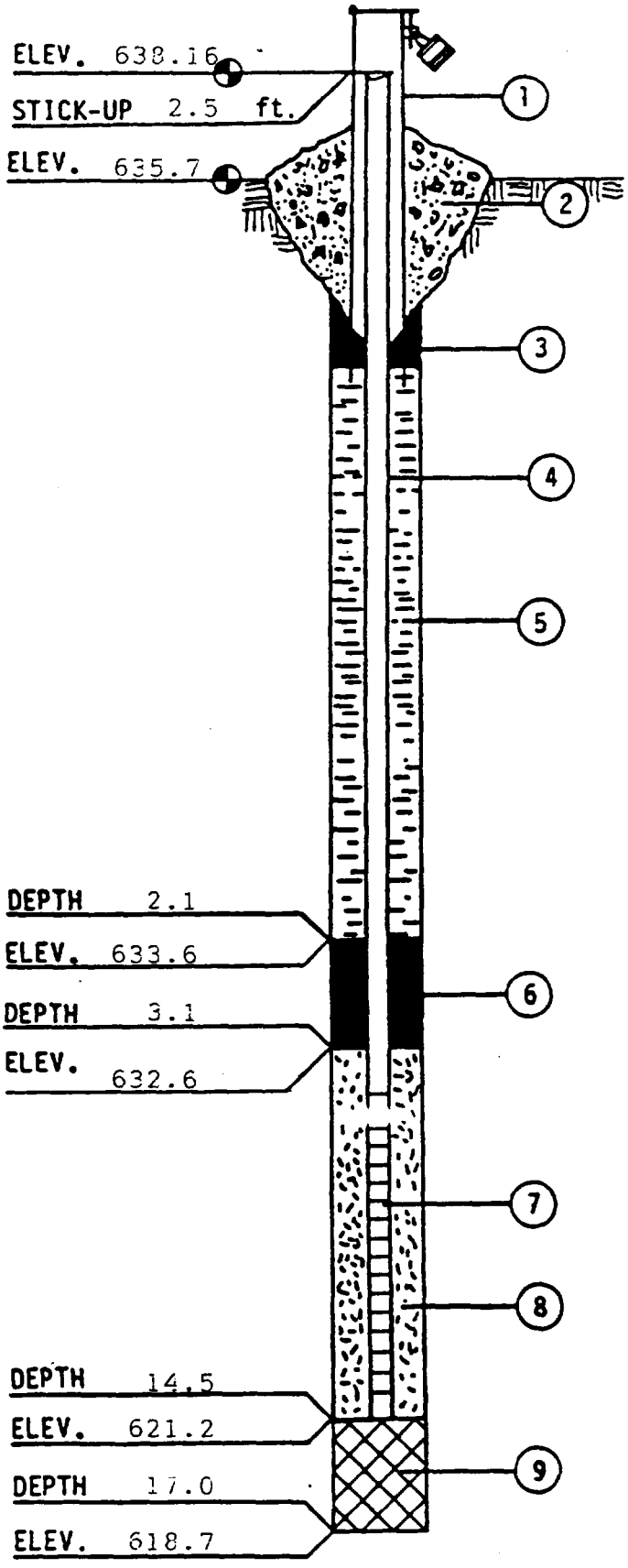
Project Number: 60251.00

Description: ACS

Boring/ Well No: LW4 Date: 7/14/89

1. Protective Casing: Yes
   Locking: Yes
2. Concrete Seal: Yes
3. Type of Surface Seal (if Installed): Cement
4. Solid Pipe Type: Schedule 40 PVC
   Solid Pipe Length: 17 feet
   Joint Type: Threaded
5. Type of Backfill: Grout
   Backfill Installed: Tremie
6. Type of Lower Seal (if installed): Bentonite Pellets
7. Screen Type: Schedule 40 PVC
   Screen Length: 10 feet
   Slot Size: 0.010 inches
   Slotted Interval Length: 10 feet
   Screen Diameter: 2 inches
8. Type of Backfill around Screen: Red Flint Filler Sand
9. Type of Backfill: Natural Cave-in
10. Drilling Method: 4-1/4-in ID HSA
11. Additives Used (if any): None

All Depths Measured from Ground Surface



WARZYN

V251.00-1TJM

Monitoring Well Construction Information

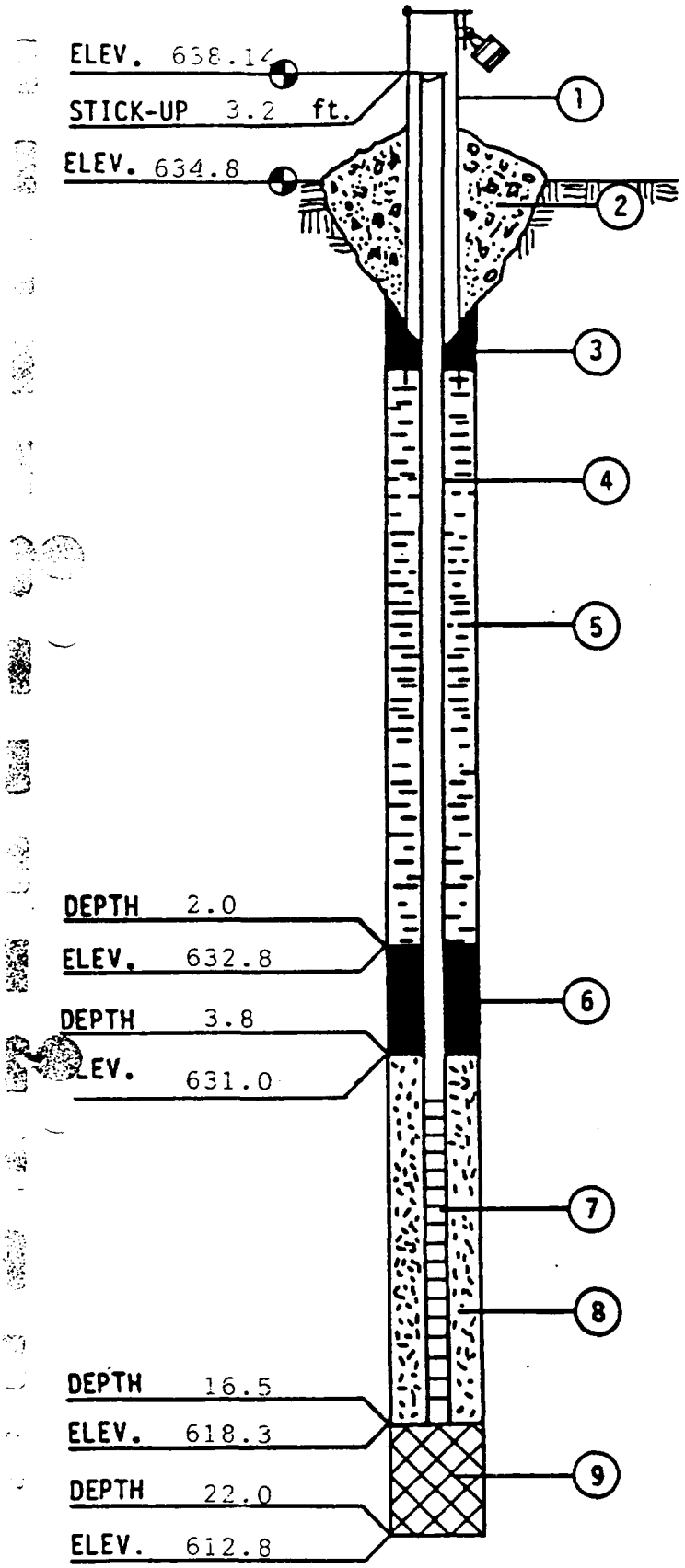
Project Number: 60251.00

Description: ACS

Boring/ Well No: MW01 Date: 7/25/89

1. Protective Casing: Yes
   Locking: Yes
2. Concrete Seal: Yes
3. Type of Surface Seal (if Installed): Cement
4. Solid Pipe Type: 304 Stainless Steel
   Solid Pipe Length: 7 feet
   Joint Type: Threaded
5. Type of Backfill: Cement to Surface
   Backfill Installed: From Surface
6. Type of Lower Seal (if installed): Bentonite Pellets
7. Screen Type: 304 Stainless Steel
   Screen Length: 10 feet
   Slot Size: 0.010 inches
   Slotted Interval Length: 10 feet
   Screen Diameter: 2 inches
8. Type of Backfill around Screen: Red Flint Filler Sand
9. Type of Backfill: Natural Cave-in
10. Drilling Method: 4-1/4-in ID HSA
11. Additives Used (if any): None

All Depths Measured from Ground Surface



WARZYN

V251.00-1TJM

Monitoring Well Construction Information

Project Number 60251.00

Description ACS

Boring/ Well No MW02 Date 7/24/89

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Cement

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 9 feet

   Joint Type Threaded

5. Type of Backfill Cement to Surface

   Backfill Installed From Surface

6. Type of Lower Seal (if installed) Bentonite Pellets

7. Screen Type 304 Stainless Steel

   Screen Length 10 feet

   Slot Size 0.010 inches

   Slotted Interval Length 10 feet

   Screen Diameter 2 inches

8. Type of Backfill around Screen Red Flint Filler Sand

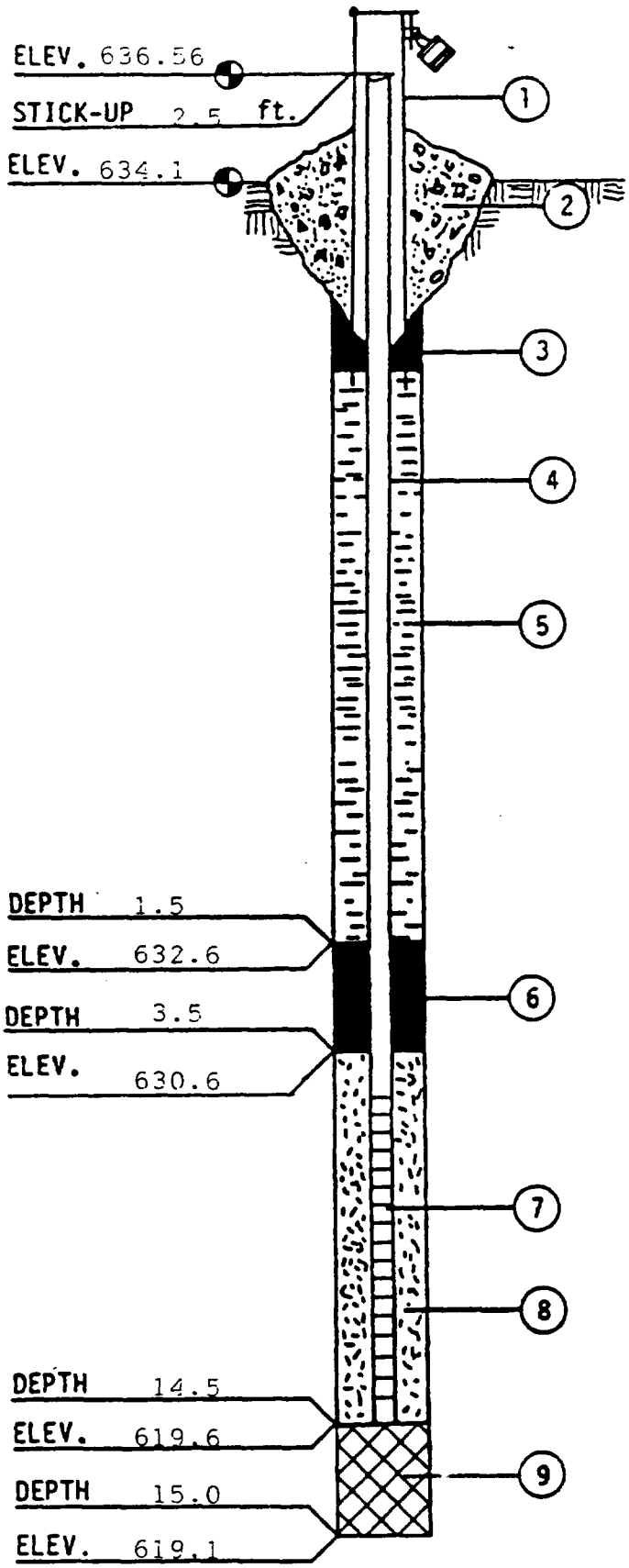
9. Type of Backfill Bentonite Pellets to 18 feet, Filler Sand to 16.5 feet

10. Drilling Method 4-1/4-in ID HSA

11. Additives Used (if any)

    None

All Depths Measured from Ground Surface



WARZYN

V251.00-1TJM

Monitoring Well Construction Information

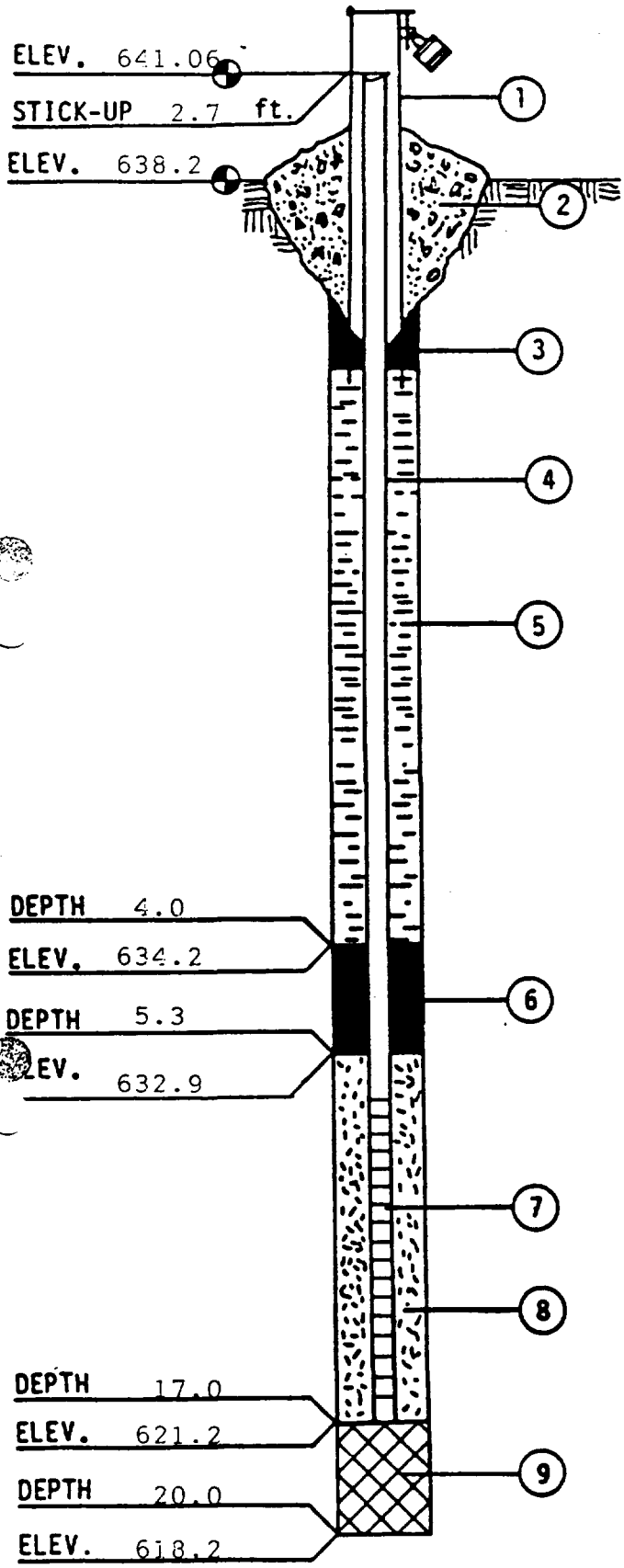
Project Number: 60251.00

Description: ACS

Boring/ Well No: MW03 Date: 7/21/89

1. Protective Casing: Yes
   Locking: Yes
2. Concrete Seal: Yes
3. Type of Surface Seal (if Installed): Cement
4. Solid Pipe Type: 304 Stainless Steel
   Solid Pipe Length: 7 feet
   Joint Type: Threaded
5. Type of Backfill: Cement to Surface
   Backfill Installed: From Surface
6. Type of Lower Seal (if installed): Bentonite Pellets
7. Screen Type: 304 Stainless Steel
   Screen Length: 10 feet
   Slot Size: 0.010 inches
   Slotted Interval Length: 10 feet
   Screen Diameter: 2 inches
8. Type of Backfill around Screen: Red Flint Filler Sand
9. Type of Backfill: Natural Cave-in
10. Drilling Method: 4-1/4-in ID HSA
11. Additives Used (if any): None

All Depths Measured from Ground Surface



WARZYN

V251.00-1TJM

Monitoring Well Construction Information

Project Number 60251.00

Description ACS

Boring/ Well No MW04 Date 7/29/89

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Cement

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 10 feet

   Joint Type Threaded

5. Type of Backfill Grout

   Backfill Installed From Surface

6. Type of Lower Seal (if Installed) Bentonite Pellets

7. Screen Type 304 Stainless Steel

   Screen Length 10 feet

   Slot Size 0.010 inches

   Slotted Interval Length 10 feet

   Screen Diameter 2 inches

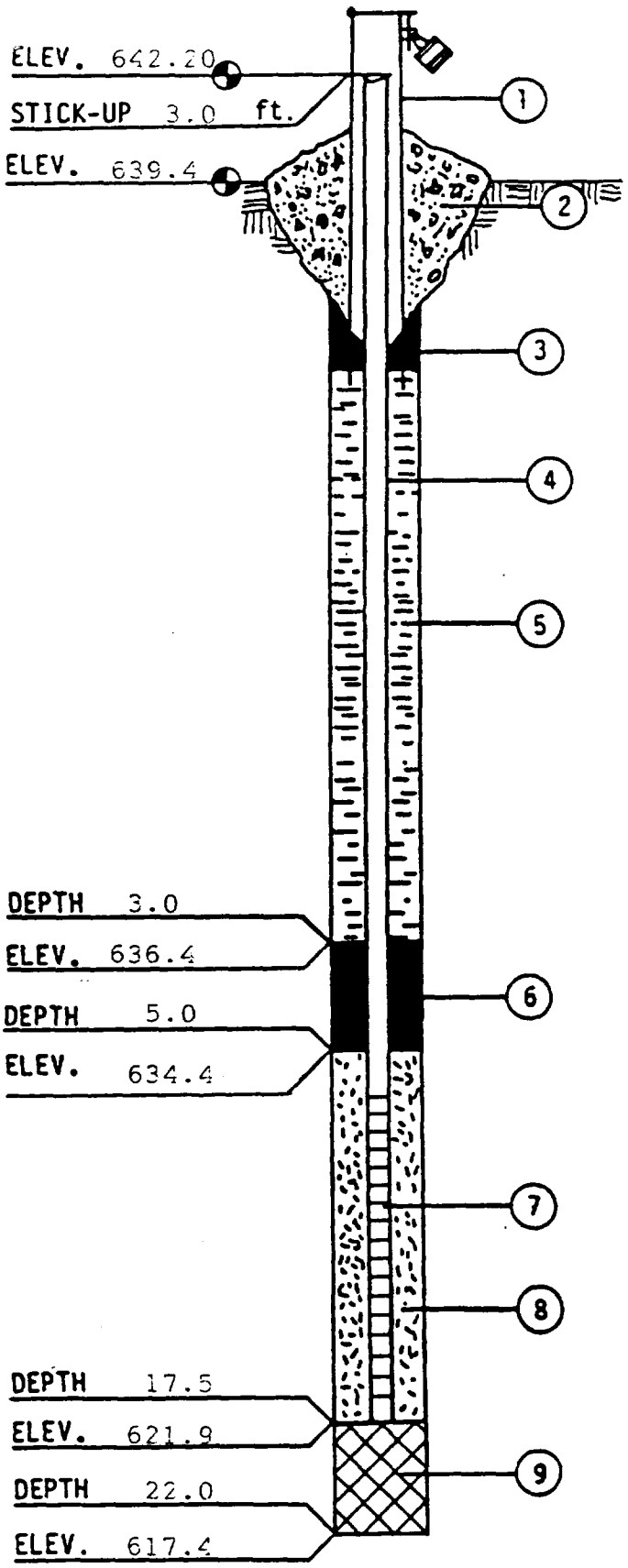
8. Type of Backfill around Screen Red Flint Filler Sand

9. Type of Backfill Bentonite Pellets to 19 feet, Filler Sand to 17 feet

10. Drilling Method 4-1/4-in ID HSA

11. Additives Used (if any) None

All Depths Measured from Ground Surface



WARZYN

V251.00-1TJM

Monitoring Well Construction Information

Project Number 60251.00

Description ACS

Boring/ Well No MW05 Date 7/19/89

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Grout

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 10 feet

   Joint Type Threaded

5. Type of Backfill Grout

   Backfill Installed From Surface

6. Type of Lower Seal (if installed) Bentonite Pellets

7. Screen Type 304 Stainless Steel

   Screen Length 10 feet

   Slot Size 0.010 inches

   Slotted Interval Length 10 feet

   Screen Diameter 2 inches

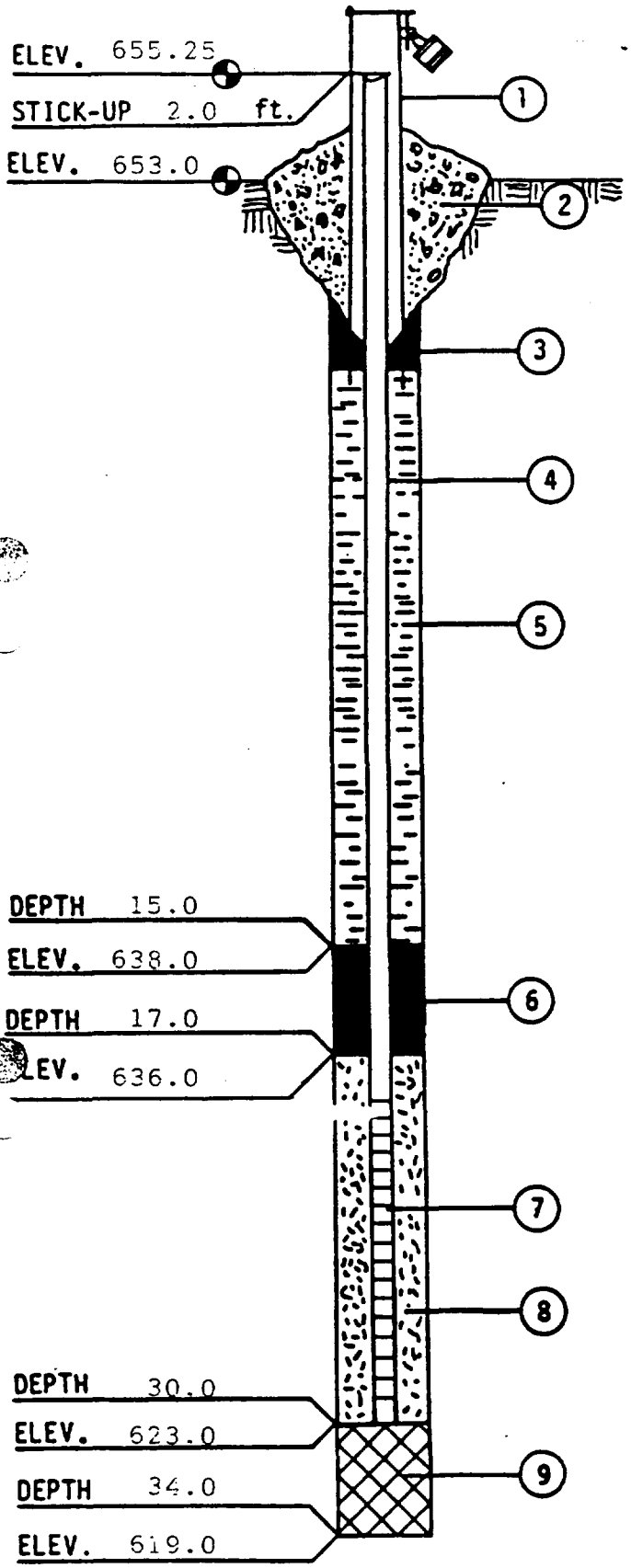
8. Type of Backfill around Screen Red Flint Filler Sand

9. Type of Backfill Bentonite Pellets to 18.5 feet Filler Sand to 17.5 feet

10. Drilling Method 4-1/4-in ID HSA

11. Additives Used (if any) None

All Depths Measured from Ground Surface



WARZYN

V251.00-1TJM

Monitoring Well Construction Information

Project Number 60251.00

Description ACS

Boring/ Well No MW06 Date 7/18/89

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if installed) Concrete Grout

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 22 feet

   Joint Type Threaded

5. Type of Backfill Cement Grout

   Backfill Installed Tremie

6. Type of Lower Seal (if installed) Bentonite Pellets

7. Screen Type 304 Stainless Steel

   Screen Length 10 feet

   Slot Size 0.010 inches

   Slotted Interval Length 10 feet

   Screen Diameter 2 inches

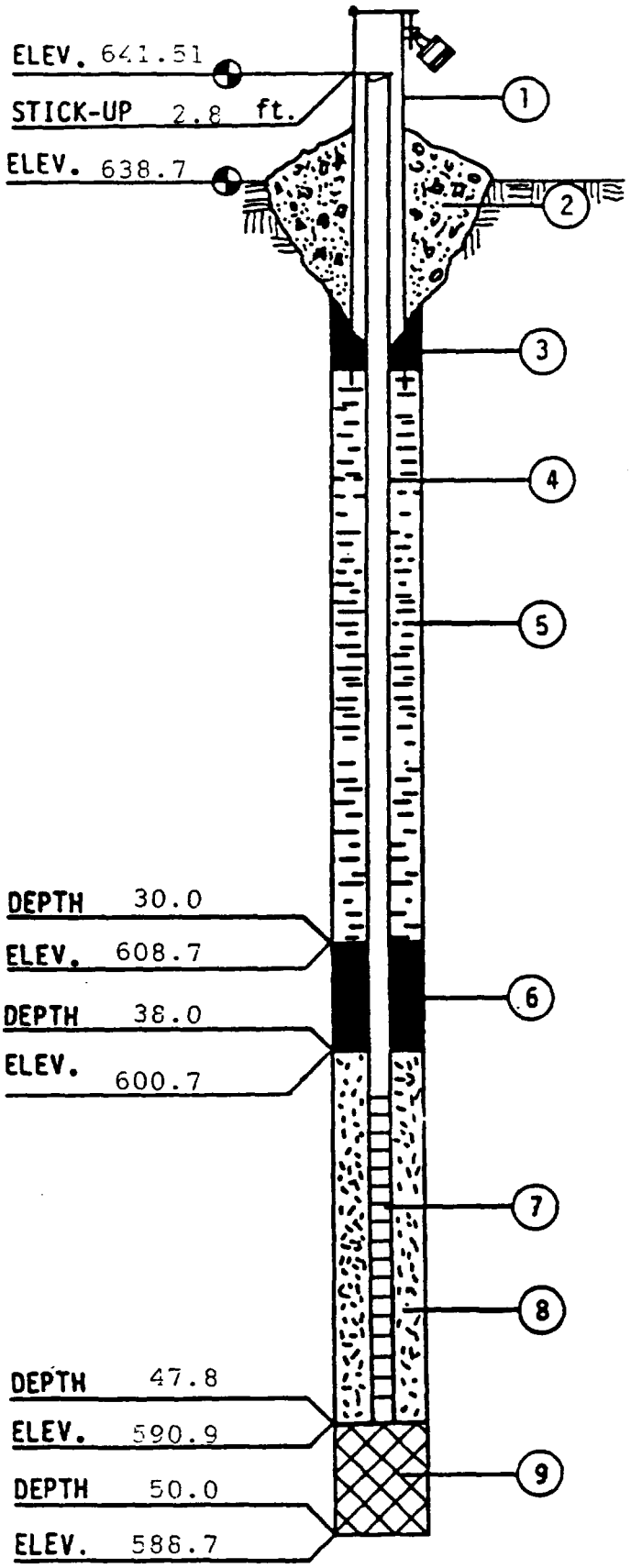
8. Type of Backfill around Screen Red Flint Filler Sand

9. Type of Backfill Bentonite Pellets to 31 feet, Sand to 30 feet

10. Drilling Method 4-1/4-in ID HSA

11. Additives Used (if any) None

All Depths Measured from Ground Surface



WARZYN

V251.00-1TJM

Monitoring Well Construction Information

Project Number 60251.00

Description ACS

Boring/ Well No MW07 Date 3/14/90

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Grout

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 45 feet

   Joint Type Threaded

5. Type of Backfill Grout

   Backfill Installed Tremie

6. Type of Lower Seal (if installed) Bentonite Pellets

7. Screen Type 304 Stainless Steel

   Screen Length 5 feet

   Slot Size 0.010 inches

   Slotted Interval Length 5 feet

   Screen Diameter 2 inches

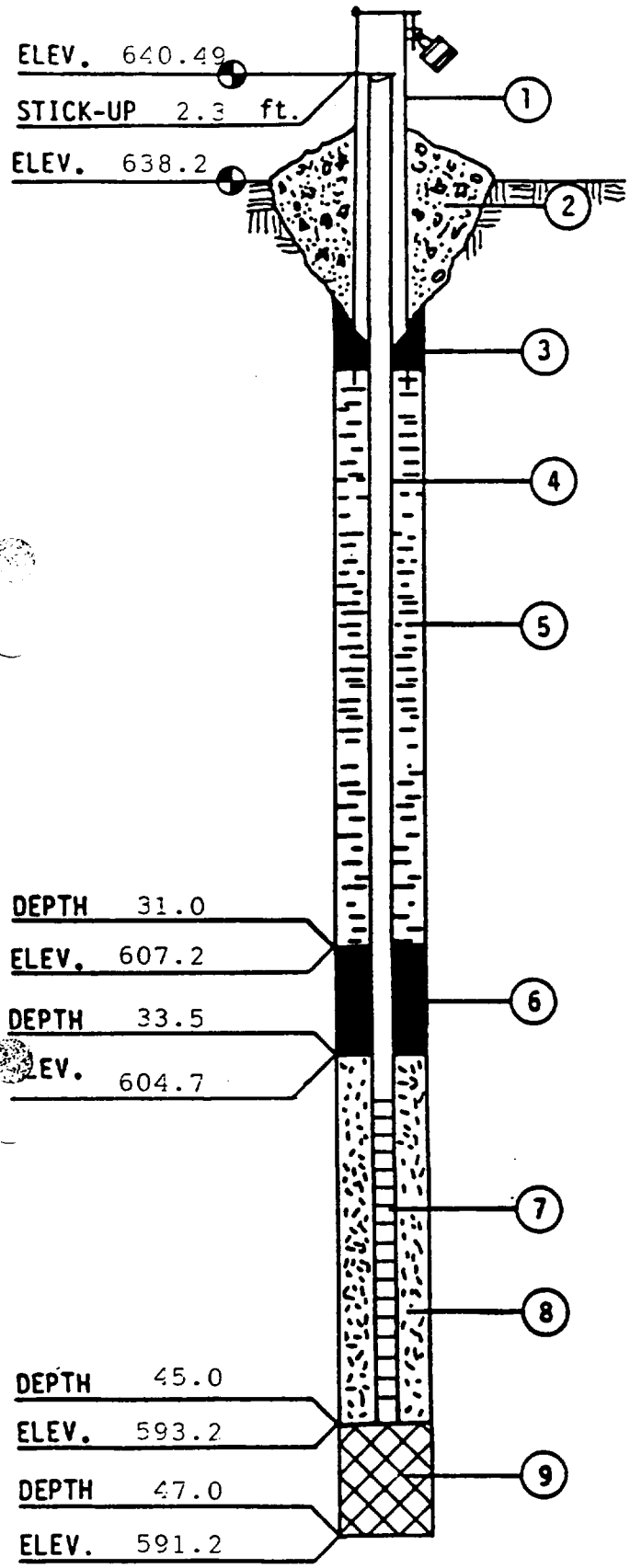
8. Type of Backfill around Screen Red Flint Filler Sand

9. Type of Backfill Natural Cave-in

10. Drilling Method 4-7/8 RWB

11. Additives Used (if any) Water

All Depths Measured from Ground Surface



WARZYN

V251.00-1TJM

Monitoring Well Construction Information

Project Number 60251.00

Description ACS

Boring/ Well No MW08 Date 3/16/90

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Grout

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 42 feet

   Joint Type Threaded

5. Type of Backfill Grout

   Backfill Installed Tremie

6. Type of Lower Seal (if installed) Bentonite Pellets

7. Screen Type 304 Stainless Steel

   Screen Length 5 feet

   Slot Size 0.010 inches

   Slotted Interval Length 5 feet

   Screen Diameter 2 inches

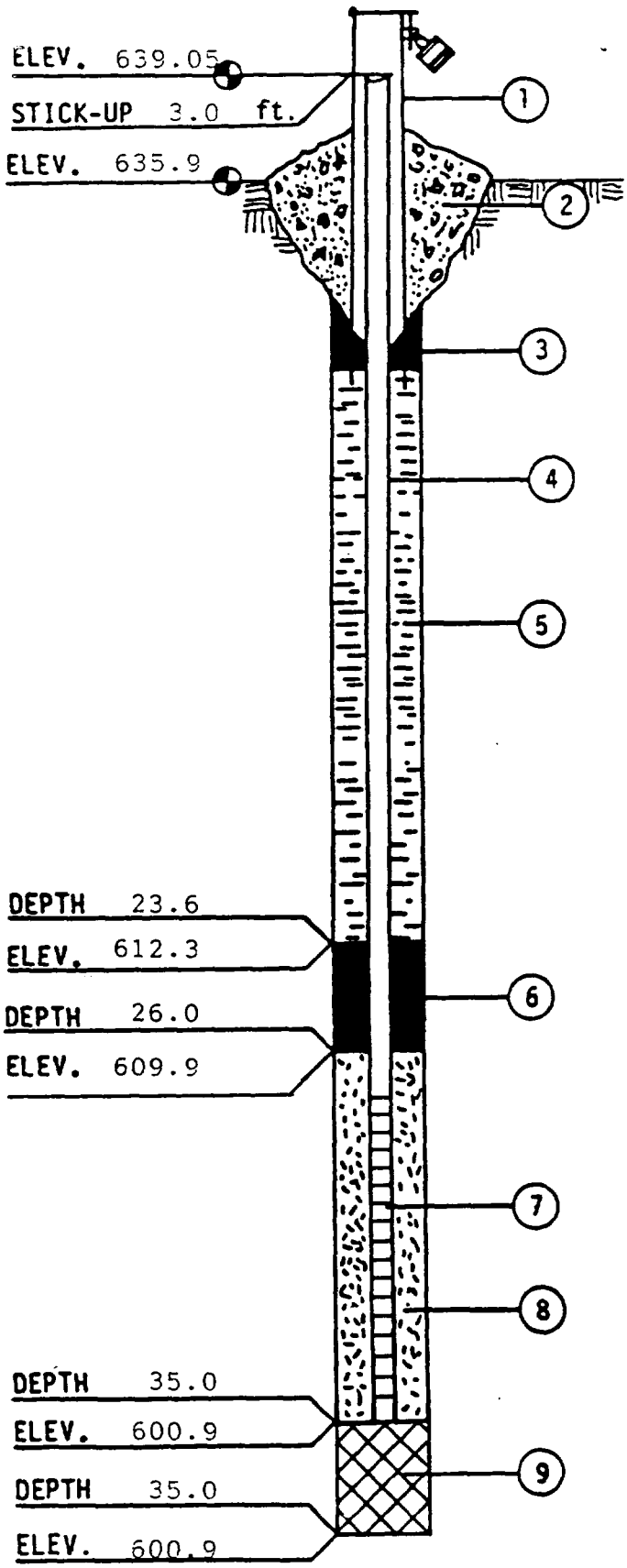
8. Type of Backfill around Screen Red Flint Filler Sand

9. Type of Backfill Natural Cave-in

10. Drilling Method 4-7/8 RWB

11. Additives Used (if any) Water

All Depths Measured from Ground Surface



WARZYN

V251.00-11JM

Monitoring Well Construction Information

Project Number 60251.00

Description ACS

Boring/ Well No MW09 Date 3/20/90

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Grout

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 32 feet

   Joint Type Threaded

5. Type of Backfill Grout

   Backfill Installed Tremie

6. Type of Lower Seal (if installed) Bentonite Pellets

7. Screen Type 304 Stainless Steel

   Screen Length 5 feet

   Slot Size 0.010 inches

   Slotted Interval Length 5 feet

   Screen Diameter 2 inches

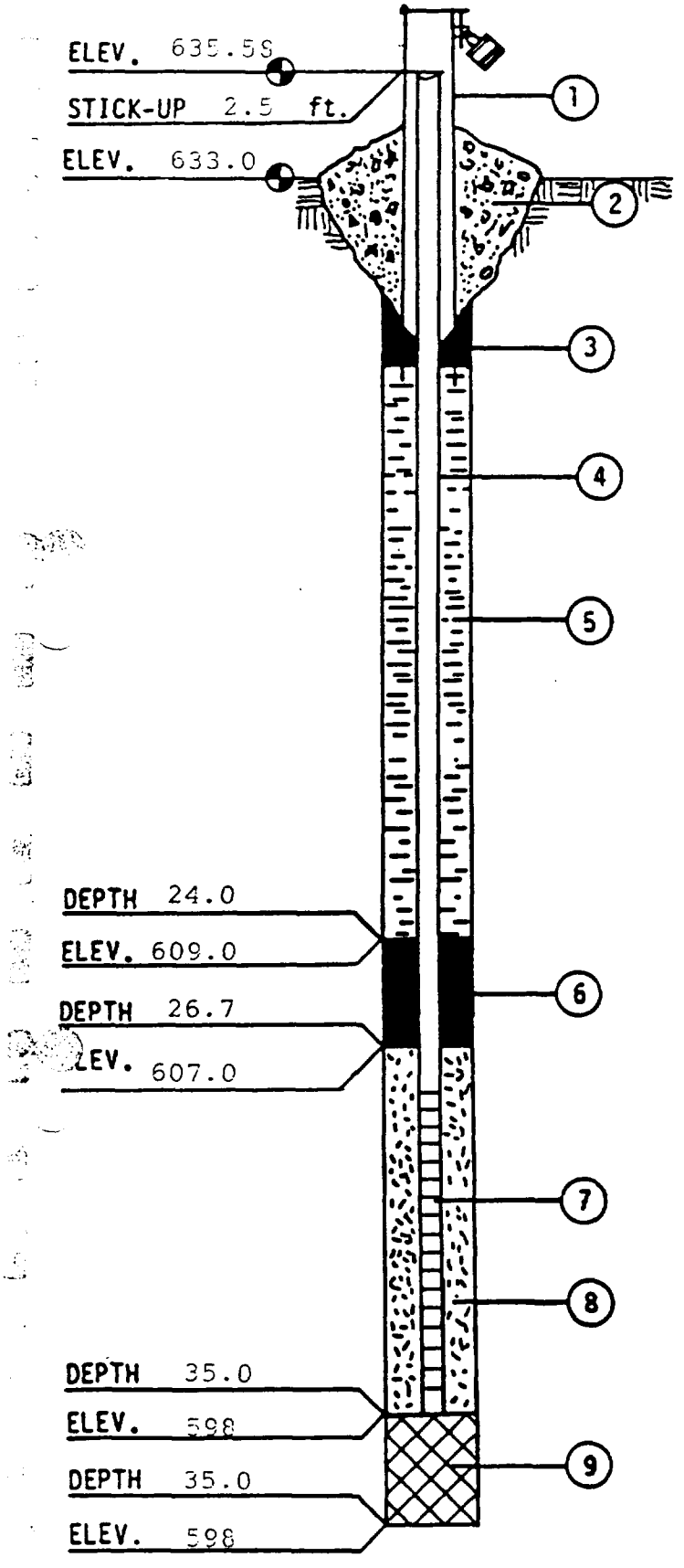
8. Type of Backfill around Screen Red Flint Filler Sand

9. Type of Backfill Natural Cave-in

10. Drilling Method 4-7/8 RWB

11. Additives Used (if any) Water

All Depths Measured from Ground Surface



WARZYN

V251.00-1TJM

Monitoring Well Construction Information

Project Number 60251.00

Description ACS

Boring/ Well No MW10 Date 5/1/90

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Grout

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 32 feet

   Joint Type Threaded

5. Type of Backfill Grout

   Backfill Installed Tremie

6. Type of Lower Seal (if installed) Bentonite Pellets

7. Screen Type 304 Stainless Steel

   Screen Length 5 feet

   Slot Size 0.010 inches

   Slotted Interval Length 5 feet

   Screen Diameter 2 inches

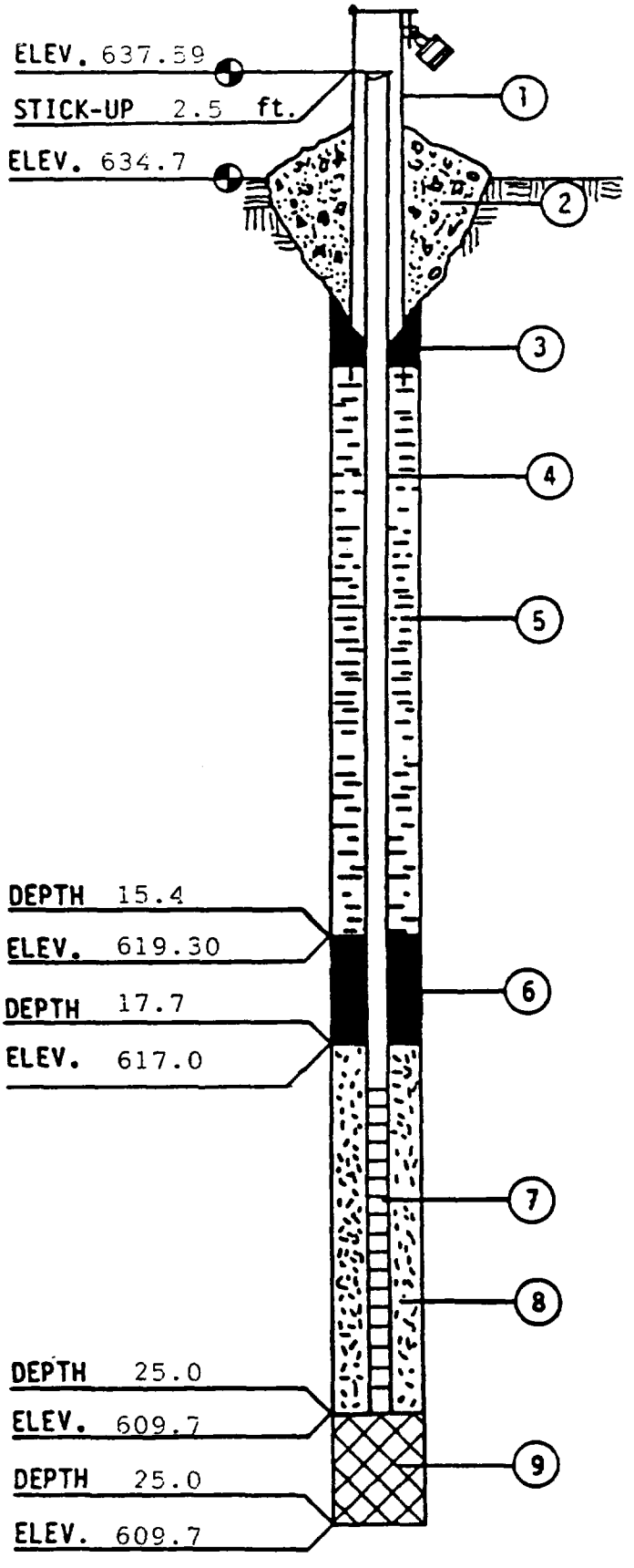
8. Type of Backfill around Screen Red Flint Filler Sand

9. Type of Backfill None

10. Drilling Method 4-7/8 RWB

11. Additives Used (if any) Water

All Depths Measured from Ground Surface



WARZYN

V251.00-1TJM

Monitoring Well Construction Information

Project Number 60251.00

Description ACS

Boring/ Well No MW10C Date 4/3/90

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Grout

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 22 feet

   Joint Type Threaded

5. Type of Backfill Grout

   Backfill Installed Tremie

6. Type of Lower Seal (if installed) Bentonite Pellets

7. Screen Type 304 Stainless Steel

   Screen Length 5 feet

   Slot Size 0.010 inches

   Slotted Interval Length 5 feet

   Screen Diameter 2 inches

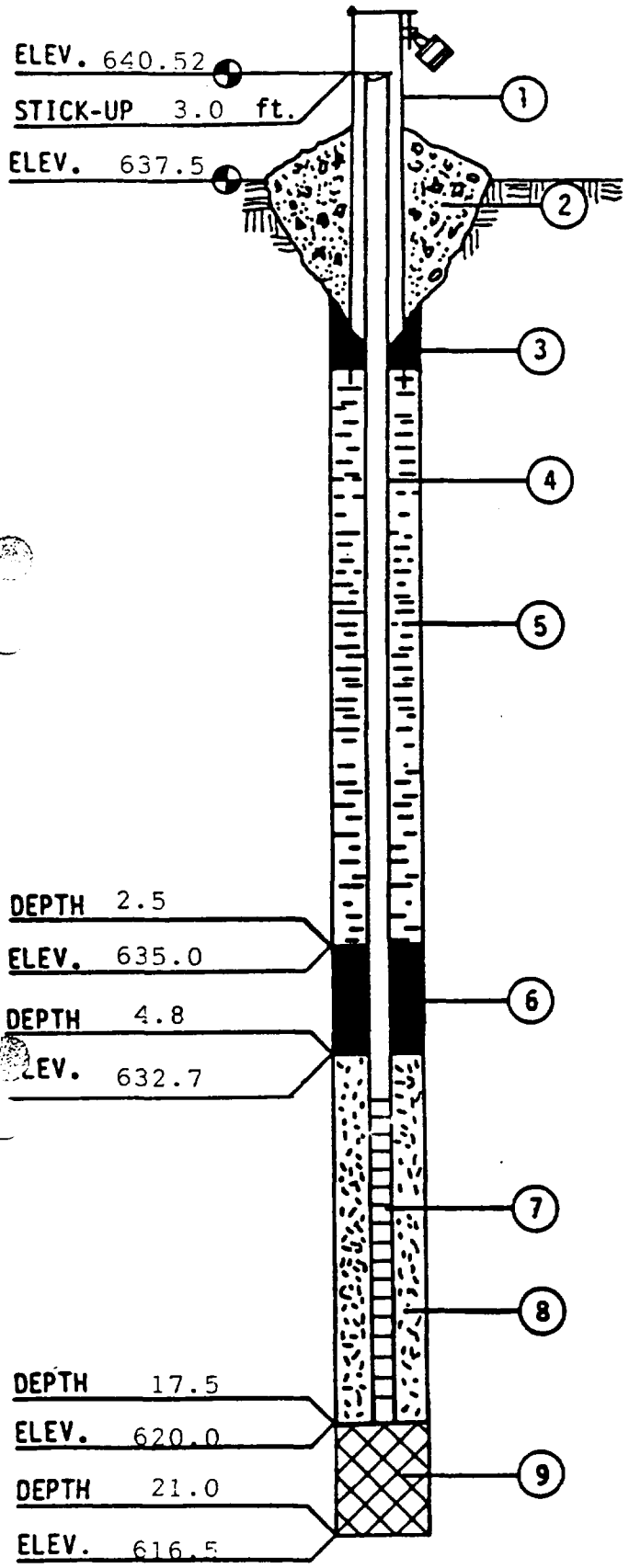
8. Type of Backfill around Screen Red Flint Filler Sand

9. Type of Backfill Natural Cave-in

10. Drilling Method 4-7/8 RWB

11. Additives Used (if any) Water

All Depths Measured from Ground Surface



WARZYN

V251.00-1TJM

Monitoring Well Construction Information

Project Number 60251.00

Description ACS

Boring/ Well No MW11 Date 3/29/90

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) None

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 10 feet

   Joint Type Threaded

5. Type of Backfill Grout

   Backfill Installed Tremie

6. Type of Lower Seal (if installed) Bentonite Pellets

7. Screen Type 304 Stainless Steel

   Screen Length 10 feet

   Slot Size 0.010 inches

   Slotted Interval Length 10 feet

   Screen Diameter 2 inches

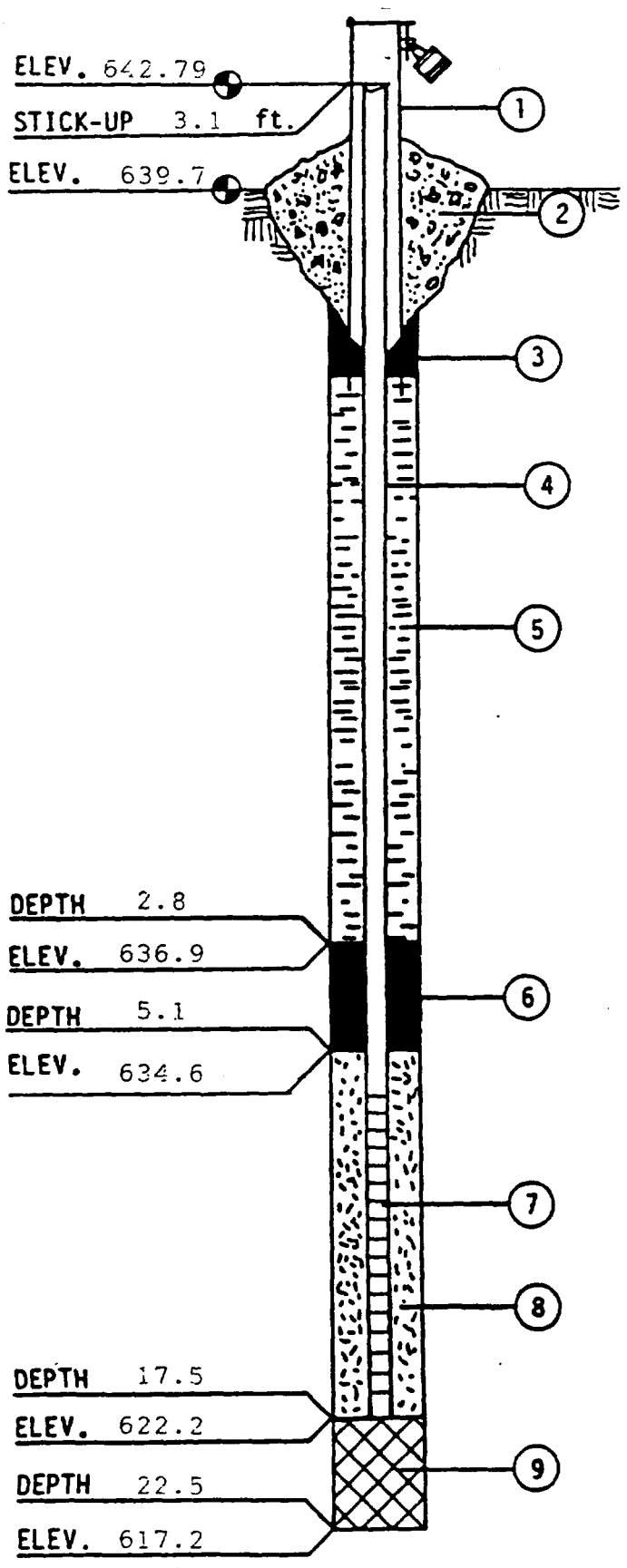
8. Type of Backfill around Screen Red Flint Filler Sand

9. Type of Backfill Red Flint Filler Sand

10. Drilling Method 4-1/4 ID HSA

11. Additives Used (if any) Water

All Depths Measured from Ground Surface



WARZYN

V251.00-1TJM

Monitoring Well Construction Information

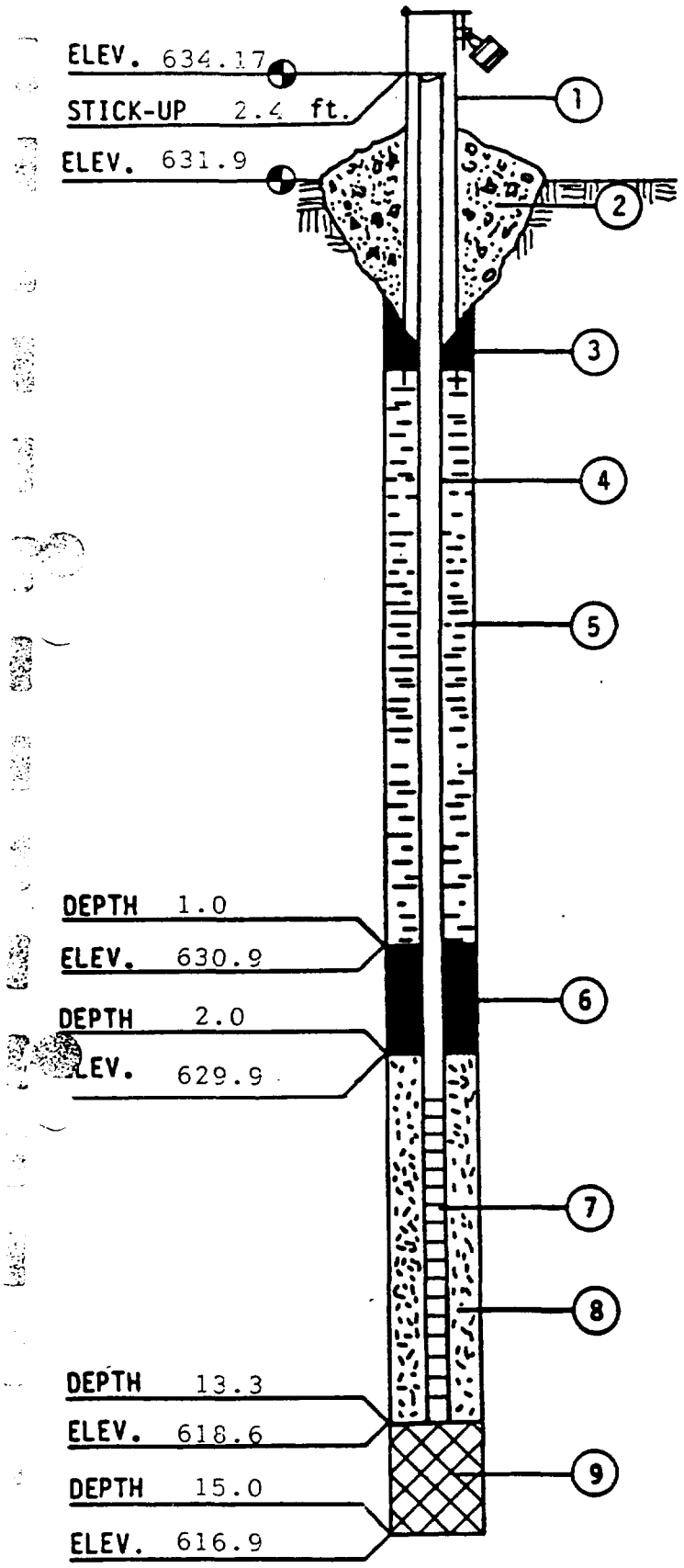
Project Number: 60251.00

Description: ACS

Boring/ Well No: MW12 Date: 3/30/90

1. Protective Casing: Yes
   Locking: Yes
2. Concrete Seal: Yes
3. Type of Surface Seal (if Installed): Grout
4. Solid Pipe Type: 304 Stainless Steel
   Solid Pipe Length: 10 feet
   Joint Type: Threaded
5. Type of Backfill: Grout
   Backfill Installed: From Surface
6. Type of Lower Seal (if installed): Bentonite Pellets
7. Screen Type: 304 Stainless Steel
   Screen Length: 10 feet
   Slot Size: 0.010 inches
   Slotted Interval Length: 10 feet
   Screen Diameter: 2 inches
8. Type of Backfill around Screen: Red Flint Filler Sand
9. Type of Backfill: Red Flint Filler Sand
10. Drilling Method: 4-1/4 ID HSA
11. Additives Used (if any): Water

All Depths Measured from Ground Surface



WARZYN

V251.00-11JM

Monitoring Well Construction Information

Project Number 60251.00

Description ACS

Boring/ Well No MW13 Date 4/3/90

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Grout

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 5 feet

   Joint Type Threaded

5. Type of Backfill Grout

   Backfill Installed From Surface

6. Type of Lower Seal (if installed) Bentonite Pellets

7. Screen Type 304 Stainless Steel

   Screen Length 10 feet

   Slot Size 0.010 inches

   Slotted Interval Length 10 feet

   Screen Diameter 2 inches

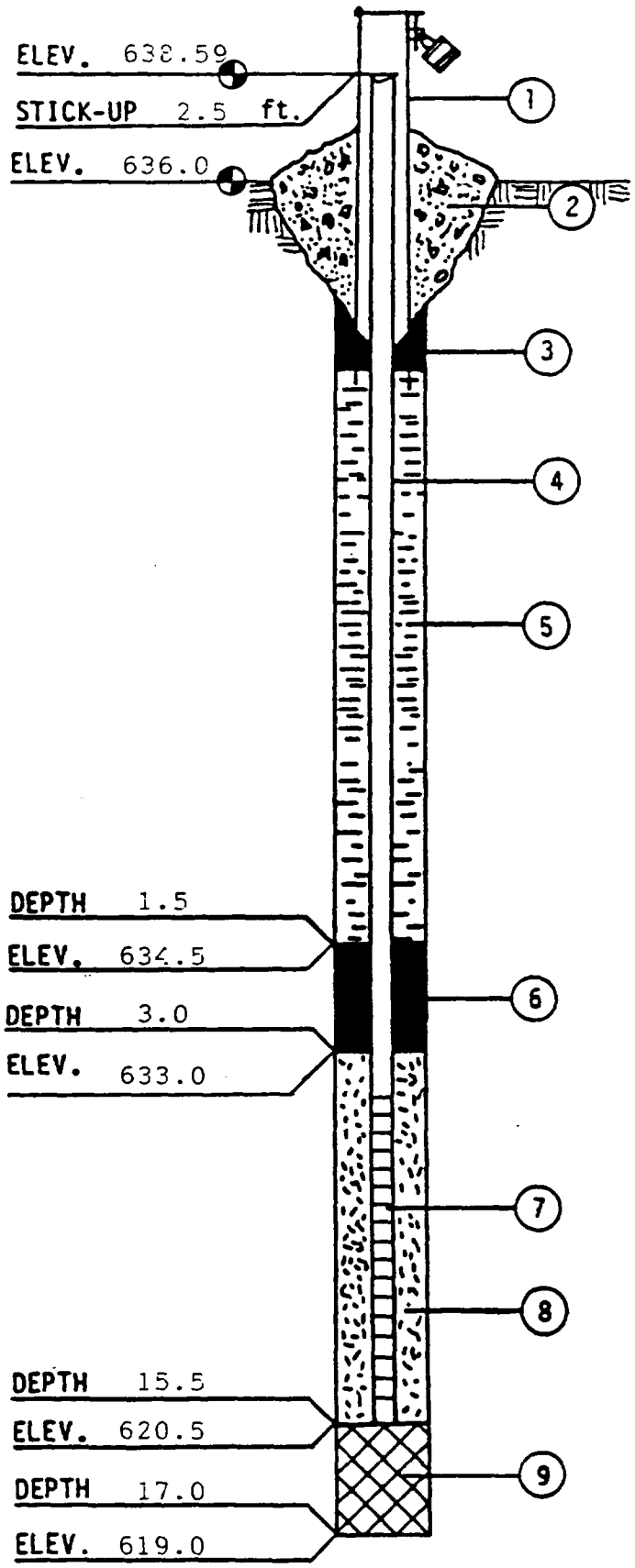
8. Type of Backfill around Screen Red Flint Filler Sand

9. Type of Backfill Natural Cave-in

10. Drilling Method 4-1/4 ID HSA

11. Additives Used (if any) None

All Depths Measured from Ground Surface



WARZYN

V251.00-1TJM

Monitoring Well Construction Information

Project Number 60251.00

Description ACS

Boring/ Well No MW14 Date 4/4/90

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Grout

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 7 feet

   Joint Type Threaded

5. Type of Backfill Grout

   Backfill Installed From Surface

6. Type of Lower Seal (if installed) Bentonite Pellets

7. Screen Type 304 Stainless Steel

   Screen Length 10 feet

   Slot Size 0.010 inches

   Slotted Interval Length 10 feet

   Screen Diameter 2 inches

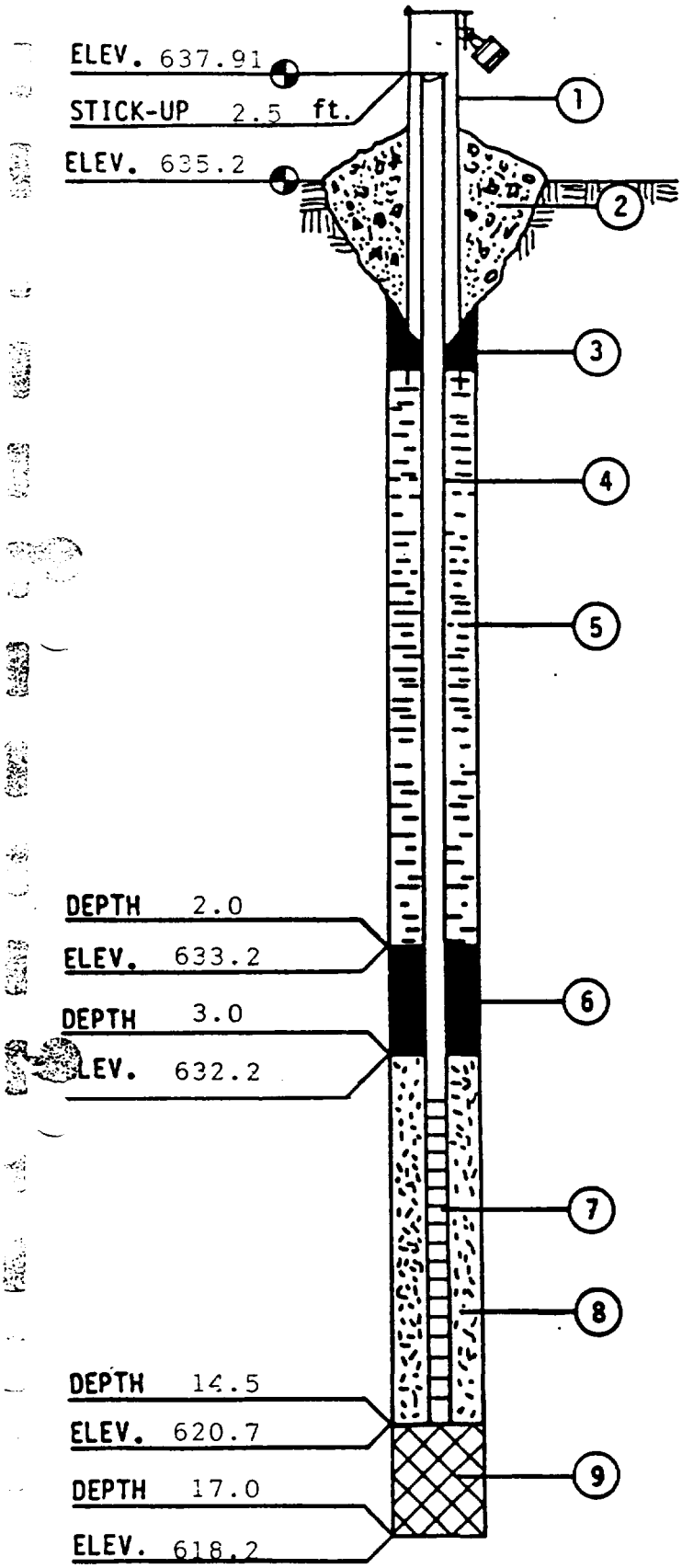
8. Type of Backfill around Screen Red Flint Filler Sand

9. Type of Backfill Natural Cave-in

10. Drilling Method 4-1/4 ID HSA

11. Additives Used (if any) None

All Depths Measured from Ground Surface



WARZYN

V251.00-1TJM

Monitoring Well Construction Information

Project Number 60251.00

Description ACS

Boring/ Well No MW15 Date 4/4/90

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Grout

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 7 feet

   Joint Type Threaded

5. Type of Backfill Grout

   Backfill Installed From Surface

6. Type of Lower Seal (if installed) Bentonite Pellets

7. Screen Type 304 Stainless Steel

   Screen Length 10 feet

   Slot Size 0.010 inches

   Slotted Interval Length 10 feet

   Screen Diameter 2 inches

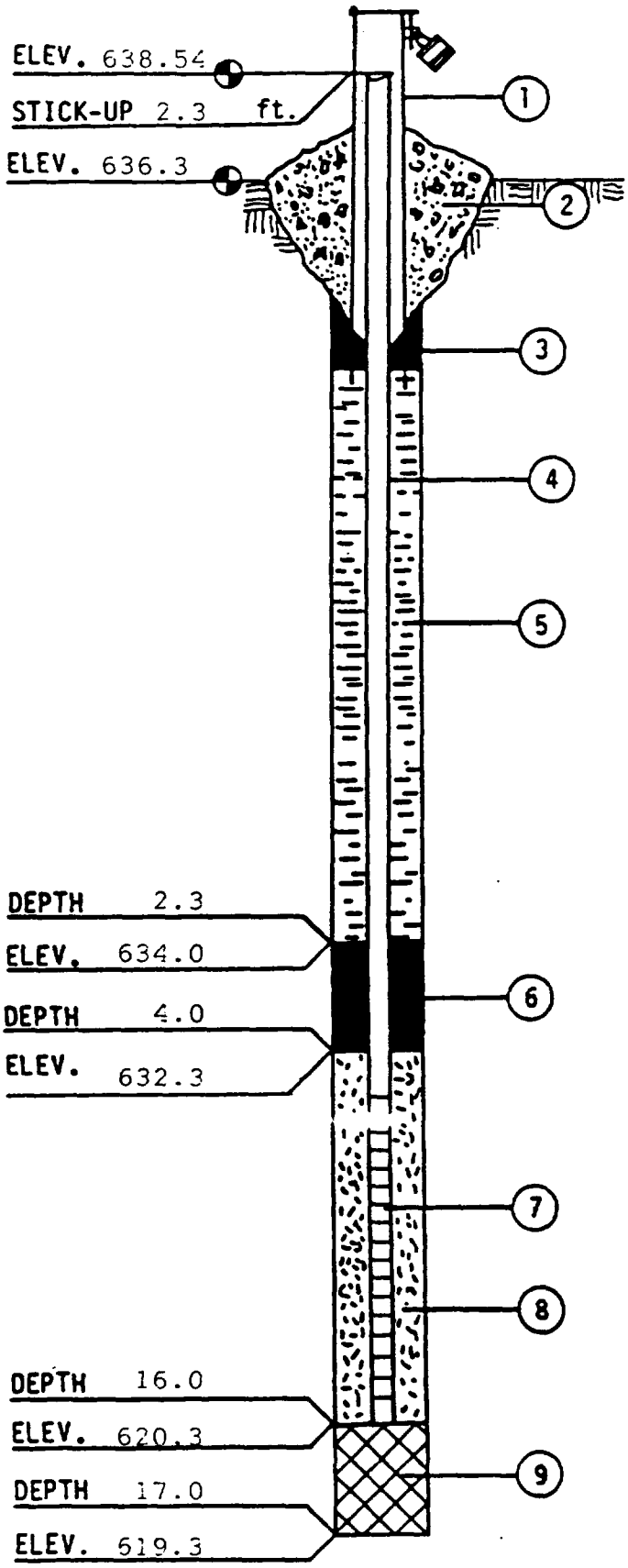
8. Type of Backfill around Screen Red Flint Filler Sand

9. Type of Backfill Natural Cave-in

10. Drilling Method 4-1/4 ID HSA

11. Additives Used (if any) None

All Depths Measured from Ground Surface



WARZYN

V251.00-1TJM

Monitoring Well Construction Information

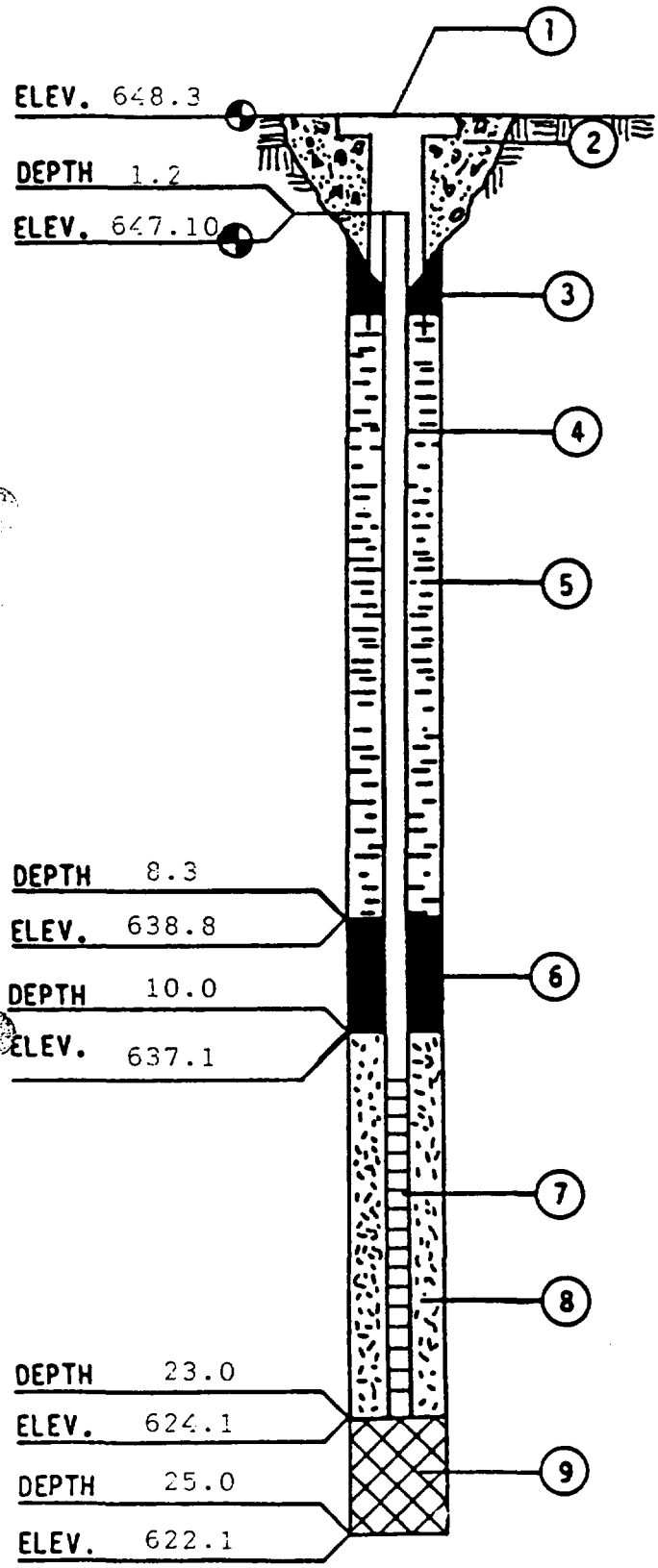
Project Number: 60251.00

Description: ACS

Boring/ Well No: MW16 Date: 4/5/90

1. Protective Casing: Yes
   Locking: Yes
2. Concrete Seal: Yes
3. Type of Surface Seal (if Installed): Grout
4. Solid Pipe Type: 304 Stainless Steel
   Solid Pipe Length: 8 feet
   Joint Type: Threaded
5. Type of Backfill: Grout
   Backfill Installed: From Surface
6. Type of Lower Seal (if installed): Bentonite Pellets
7. Screen Type: 304 Stainless Steel
   Screen Length: 10 feet
   Slot Size: 0.010 Inches
   Slotted Interval Length: 10 feet
   Screen Diameter: 2 inches
8. Type of Backfill around Screen: Red Flint Filler Sand
9. Type of Backfill: Natural Cave-in
10. Drilling Method: 4-1/4 ID HSA
11. Additives Used (if any): None

All Depths Measured from Ground Surface



WARZYN

V251.00-1TJM

Monitoring Well Construction Information

Project Number 60251.00

Description ACS

Boring/ Well No MW17 Date 4/5/90

1. Protective Casing Yes

   Locking No

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Granular Bentonite

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 12 feet

   Joint Type Threaded

5. Type of Backfill Grout

   Backfill Installed Threaded

6. Type of Lower Seal (if installed) Bentonite Pellets

7. Screen Type 304 Stainless Steel

   Screen Length 10 feet

   Slot Size 0.010 inches

   Slotted Interval Length 10 feet

   Screen Diameter 2 inches

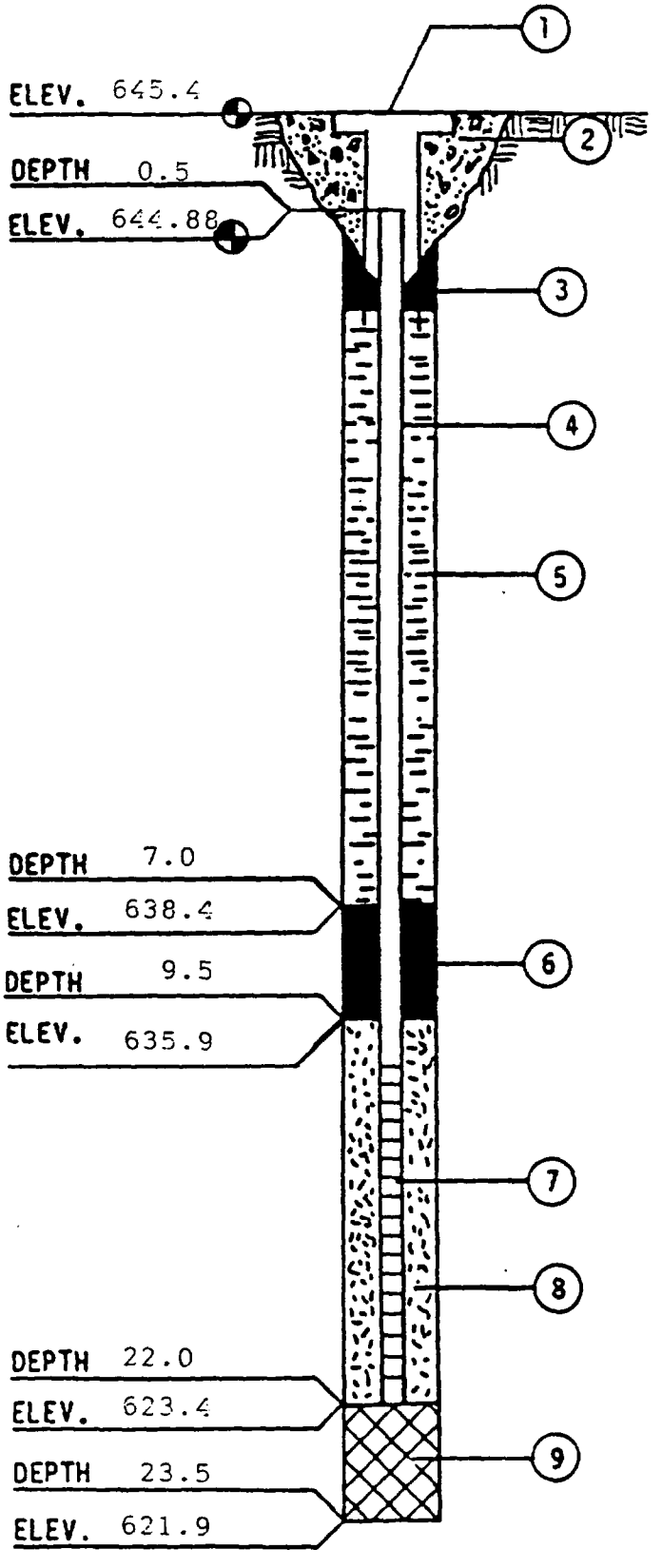
8. Type of Backfill around Screen Red Flint Filler Sand

9. Type of Backfill Natural Cave

10. Drilling Method 4-1/4-inch ID HSA

11. Additives Used (if any) Water

All Depths Measured from Ground Surface



WARZYN

V251.00-11JM

Monitoring Well Construction Information

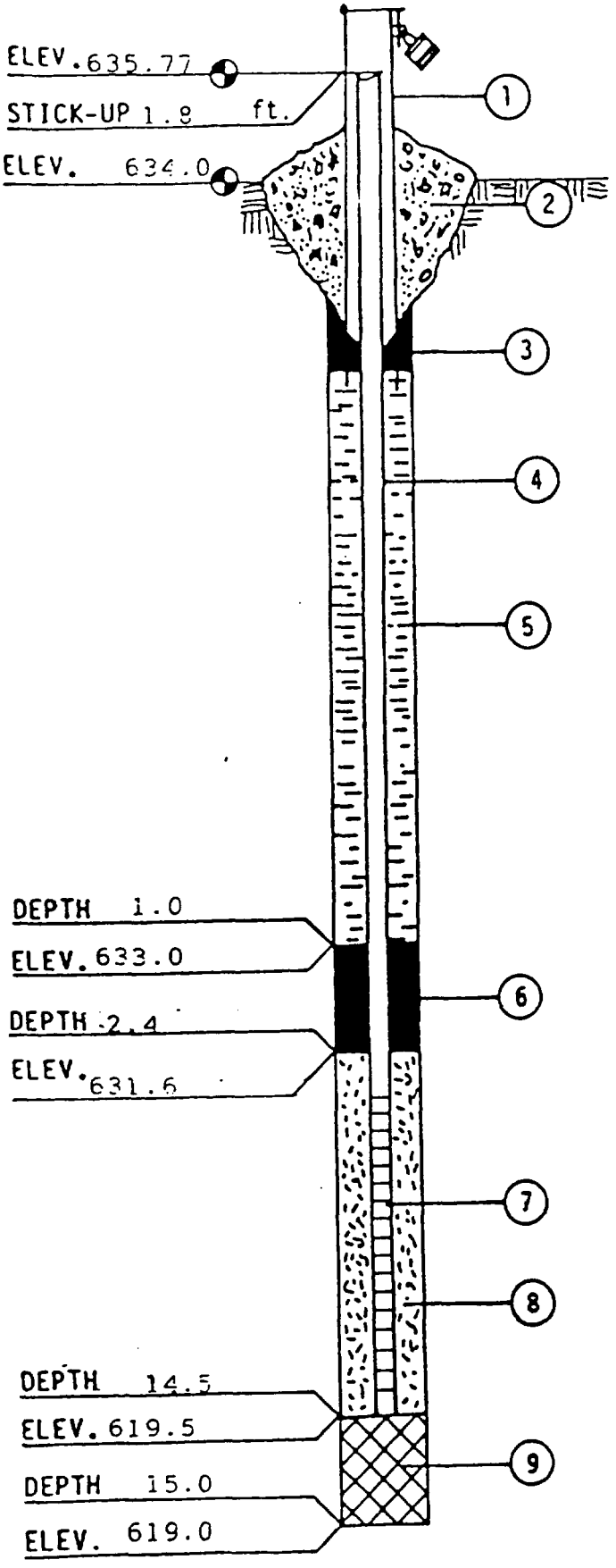
Project Number 60251.00

Description ACS

Boring/ Well No MW18 Date 6/29/90

1. Protective Casing Yes
   Locking No
2. Concrete Seal Yes
3. Type of Surface Seal (if Installed) Grout
4. Solid Pipe Type 304 Stainless Steel
   Solid Pipe Length 12 feet
   Joint Type Threaded
5. Type of Backfill Grout
   Backfill Installed Threaded
6. Type of Lower Seal (if installed) Bentonite Pellets
7. Screen Type 304 Stainless Steel
   Screen Length 10 feet
   Slot Size 0.010 inches
   Slotted Interval Length 10 feet
   Screen Diameter 2 inches
8. Type of Backfill around Screen Red Flint Filler Sand
9. Type of Backfill Filler Sand
10. Drilling Method 4-1/4-inch ID HSA
11. Additives Used (if any) None

All Depths Measured from Ground Surface



WARZYN

Monitoring Well Construction Information

Project Number 60251.22

Description ACS

Boring/ Well No MW19 Date 12/15/90

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Grout

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 10 feet

   Joint Type Threaded

5. Type of Backfill Cement/Bentonite Grout

   Backfill Installed From Surface

6. Type of Lower Seal (if Installed) Bentonite Pellets

7. Screen Type 304 Stainless Steel

   Screen Length 10.5

   Slot Size 0.01

   Slotted Interval Length 10 feet

   Screen Diameter 2 inches

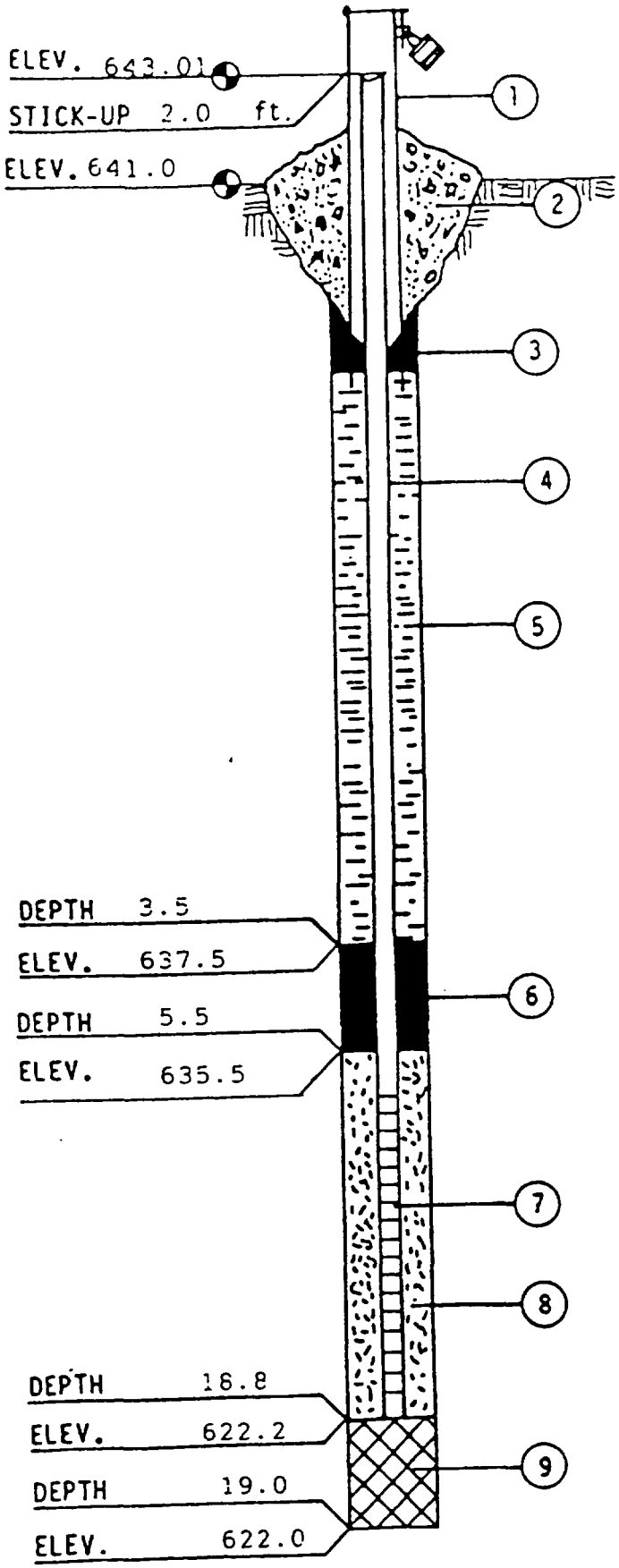
8. Type of Backfill around Screen 10-20 Silica Sand

9. Type of Backfill None

10. Drilling Method 4-1/4" HSA

11. Additives Used (if any)

    Clear Water



WARZYN

Monitoring Well Construction Information

Project Number 60251.22

Description ACS

Boring/ Well No MW20 Date 12/16/90

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Grout

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 10 feet

   Joint Type Threaded

5. Type of Backfill Cement/Bentonite Grout

   Backfill Installed From Surface

6. Type of Lower Seal (if Installed) Bentonite Pellets

7. Screen Type 304 Stainless Steel

   Screen Length 10.5

   Slot Size 0.01

   Slotted Interval Length 10 feet

   Screen Diameter 2 inches

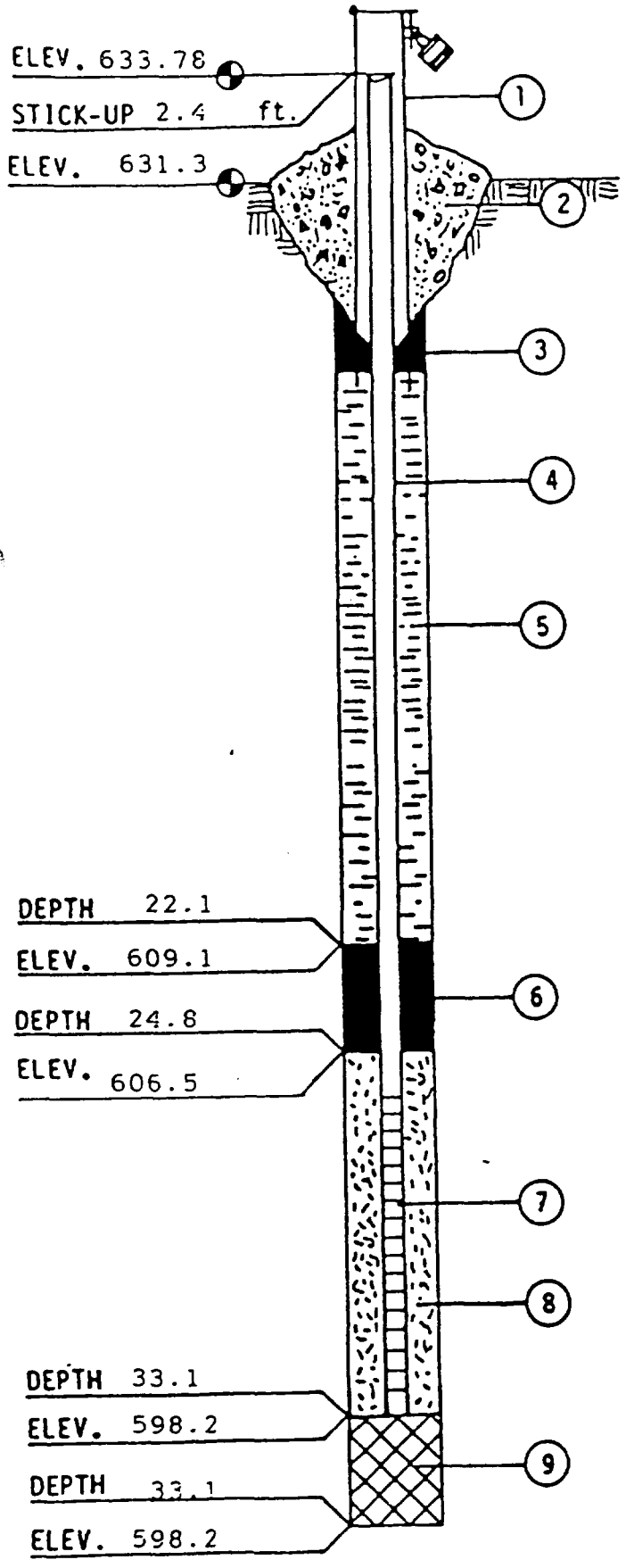
8. Type of Backfill around Screen 10-20 Silica Sand

9. Type of Backfill None

10. Drilling Method 4-1/4" HSA

11. Additives Used (if any)

    Clear Water



WARZYN

Monitoring Well Construction Information

Project Number 60251.22

Description ACS

Boring/ Well No MW21 Date 12/18/90

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Grout

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 30 feet

   Joint Type Threaded

5. Type of Backfill Cement/Bentonite Grout

   Backfill Installed Tremie

6. Type of Lower Seal (if Installed) Bentonite Pellets

7. Screen Type 304 Stainless Steel

   Screen Length 5 feet

   Slot Size 0.01 inch

   Slotted Interval Length 5 feet

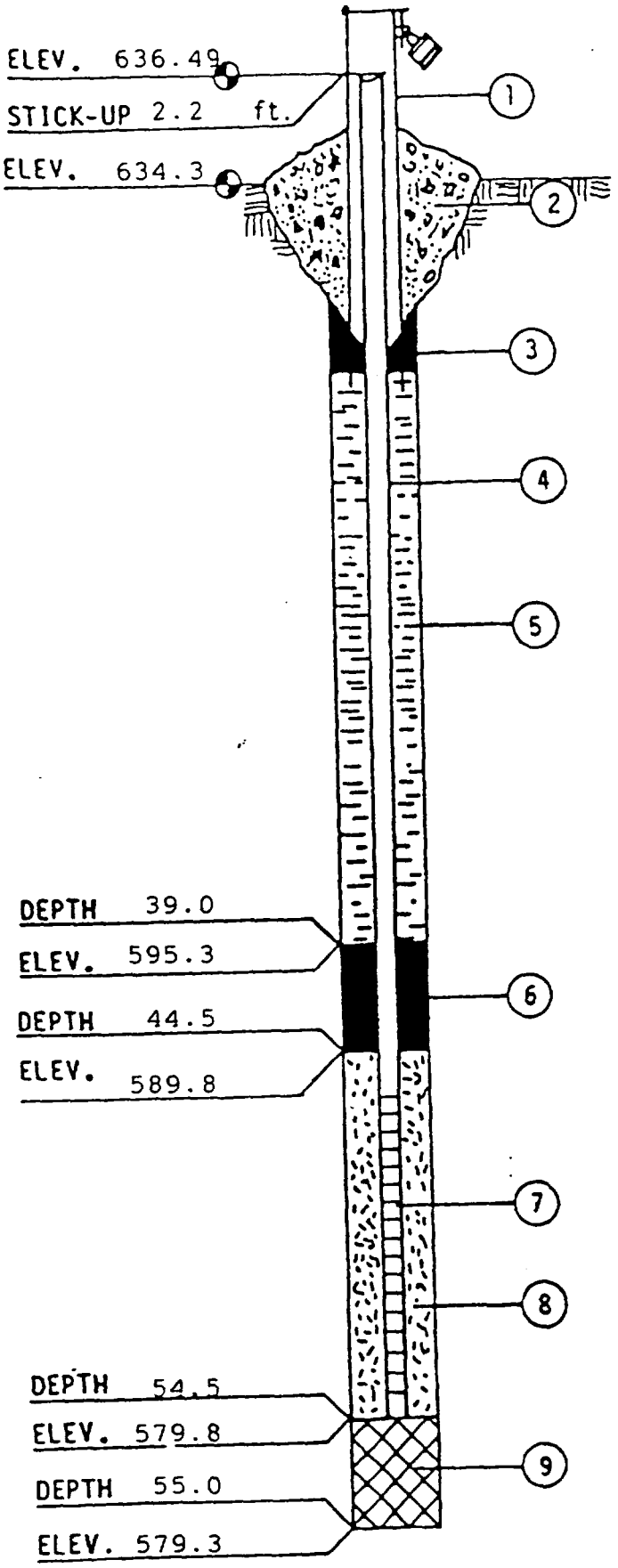
   Screen Diameter 2 inches

8. Type of Backfill around Screen 10-20 Silica Sand

9. Type of Backfill None

10. Drilling Method 3-7/8" RWB

11. Additives Used (if any) Clear Water



WARZYN

Monitoring Well Construction Information

Project Number 60251.22

Description ACS

Boring/ Well No MW22 Date 12/19/90

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Grout

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 50 feet

   Joint Type Threaded

5. Type of Backfill Cement/Bentonite Grout

   Backfill Installed Tremie

6. Type of Lower Seal (if Installed) Bentonite Slurry

7. Screen Type 304 Stainless Steel

   Screen Length 5.0 feet

   Slot Size 0.01 inch

   Slotted Interval Length 5.0 feet

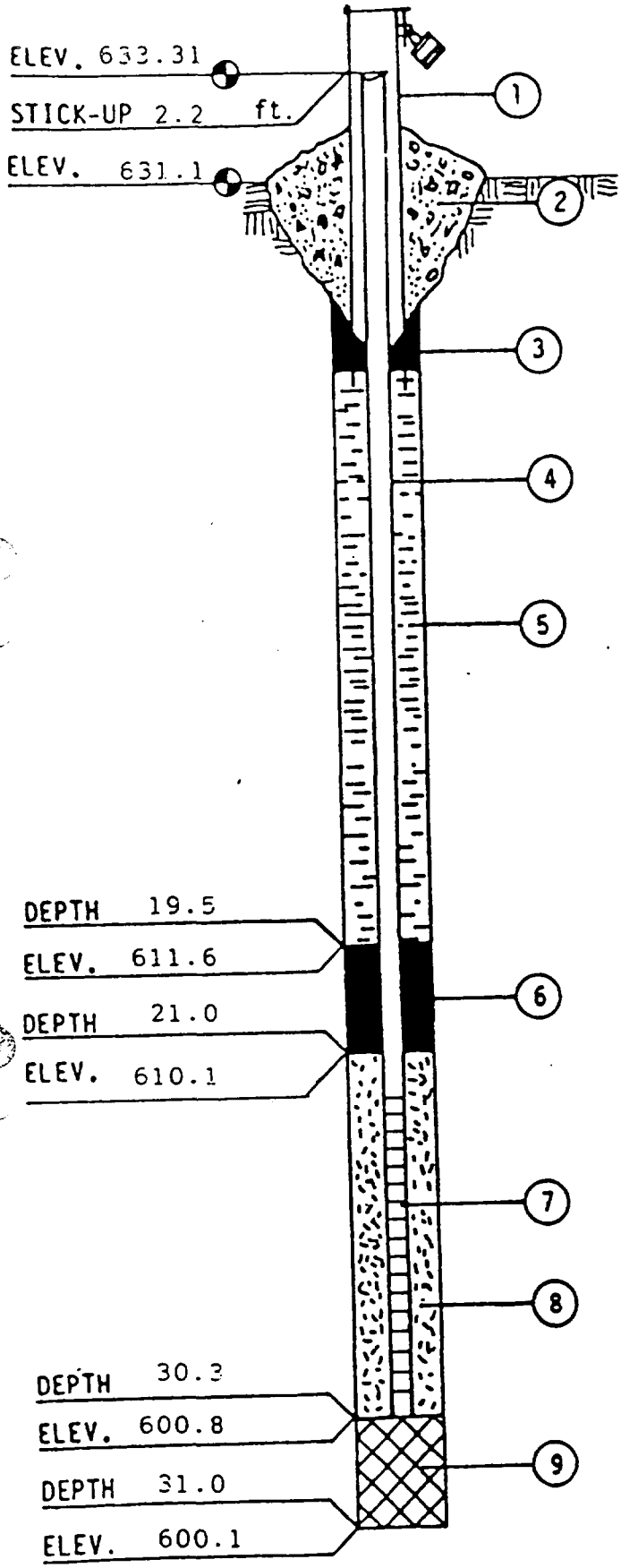
   Screen Diameter 2 inches

8. Type of Backfill around Screen 10-20 Silica Sand

9. Type of Backfill None

10. Drilling Method 3-7/8" RWB

11. Additives Used (if any) Clear Water and Light Bentonite Drilling Mud



WARZYN

Monitoring Well Construction Information

Project Number 60251.22

Description ACS

Boring/ Well No MW23 Date 1/15/91

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Grout

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 26 feet

   Joint Type Threaded

5. Type of Backfill Cement/Bentonite Grt.

   Backfill Installed Tremie

6. Type of Lower Seal (if Installed) Bentonite Pellets

7. Screen Type 304 Stainless Steel

   Screen Length 5.0 feet

   Slot Size 0.01 inch

   Slotted Interval Length 5.0 feet

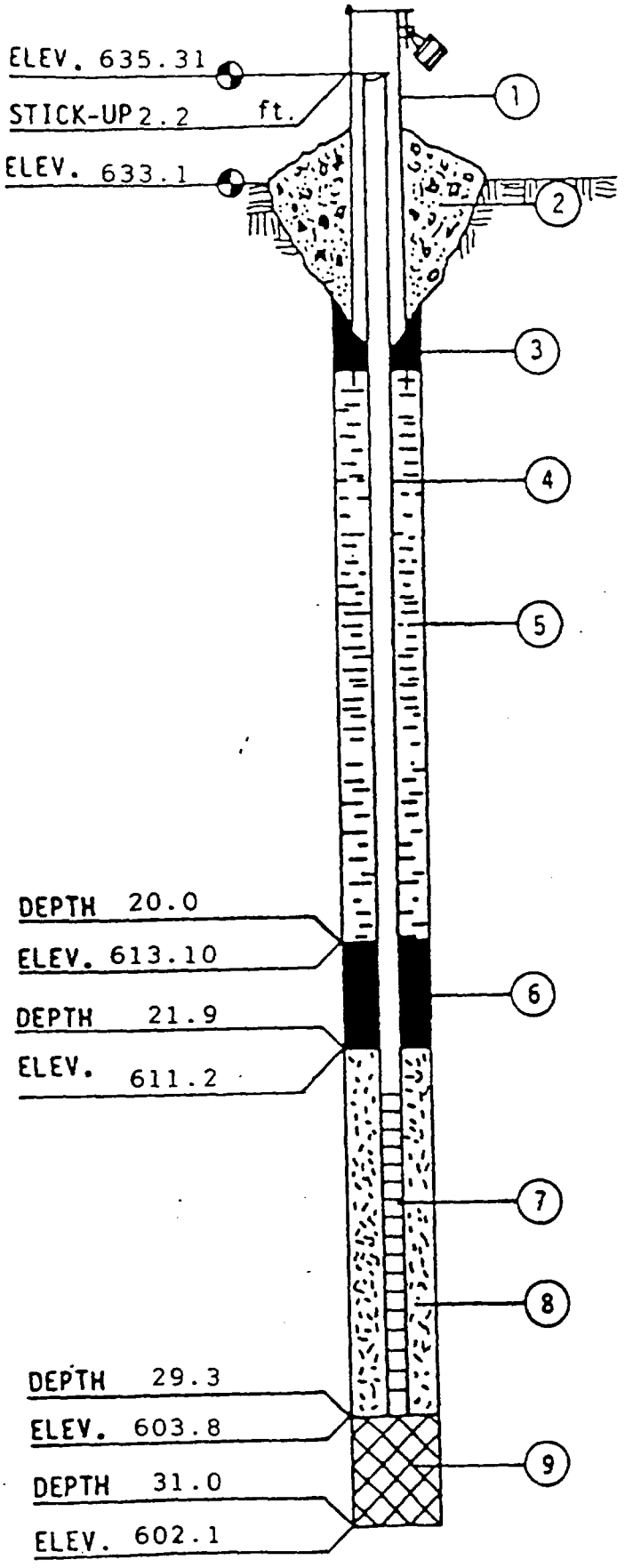
   Screen Diameter 2 inches

8. Type of Backfill around Screen Red Flint Filler Sand

9. Type of Backfill None

10. Drilling Method 4-7/8" RWB

11. Additives Used (if any)



WARZYN

Monitoring Well Construction Information

Project Number 60251.22

Description ACS

Boring/ Well No MW24 Date 1/11/91

1. Protective Casing Yes

   Locking Yes

2. Concrete Seal Yes

3. Type of Surface Seal (if Installed) Grout

4. Solid Pipe Type 304 Stainless Steel

   Solid Pipe Length 25 feet

   Joint Type Threaded

5. Type of Backfill Cement/Bentonite Grout

   Backfill Installed Tremie

6. Type of Lower Seal (if installed) Bentonite Pellets

7. Screen Type 304 Stainless Steel

   Screen Length 5.0 feet

   Slot Size 0.01 inch

   Slotted Interval Length 5.0 feet

   Screen Diameter 2 Inches

8. Type of Backfill around Screen Red Flint Filler Sand

9. Type of Backfill None

10. Drilling Method 4-7/8" RWB

11. Additives Used (if any)

    Clear Water

APPENDIX G

Auger Probe Tables

APPENDIX G
AUGER PROBE DESCRIPTIONS

Probe No.	Feet Below Ground Surface	Material Description	Maximum HNu (ppm)
NEAR KAPICA BUILDING			
AP-1	0 - 1.5	Gravel FILL	NR
	1.5 - 3.5	Dark Gray Sand (stained with odor)	20.0
	3.5 - 10	Brown Sand	15.0
AP-2	0 - 2	Gravel FILL	NR
	2 - 10	Dark Gray (stained) to Brown Sand	17.0
AP-3	0 - 2	Brown to Dark Gray silty Sand (stained with odor)	100.0
	2 - 4	Gray and Brown silty Clay (solvent odor)	50.0
	4 - 10	Dark Gray to Brown Sand	40.0
AP-4	0 - 7	Sandy FILL with Landfill Refuse	60.0
	7 - 10	Brown Sand	15.0
AP-5	0 - 6	Sandy FILL with Landfill Refuse (some drum lids)	70.0
	6 - 10	Brown Sand	NR
MOVING TOWARD OFF-SITE CONTAINMENT AREA			
AP-6	0 - 7	Sandy FILL with Landfill Refuse (oily sheen and paint-like odors detected)	3.0
	7 - 10	Dark Brown (stained) to Brown Sand	25
AP-7	0 - 3	Sandy FILL	10.0
	3 - 8.5	Black Sandy FILL with Landfill Refuse	2.0
	8.5 - 10	Brown Sand	4.0
AP-8	0 - 10	Brown to Gray Sand (with solvent odors)	70.0
AP-9	0 - 7	Sandy FILL with Landfill Refuse	40.0
	7 - 10	Brown and Gray Sand	12.0
OFF-SITE CONTAINMENT AREA			
AP-10	0 - 7	Sandy FILL with Landfill Refuse	4.0
	7 - 10	Dark Gray Sand (with solvent like odor)	80.0
AP-11	0 - 1	Sandy FILL	NR
	1 - 8	Sandy FILL with Trace of Landfill Refuse	50.0
	8 - 10	Brown Sand	70.0
AP-12	0 - 7	Sandy FILL	20.0
	7 - 10	Black tar-like waste (wire wound up on lead auger 9-10', stained)	70.0

Probe No.	Feet Below Ground Surface	Material Description	Maximum HNu (ppm)
AP-13	0 - 1	Sandy FILL	NR
	1 - 10	Black Sandy FILL with Landfill Refuse	1.0
AP-14	0 - 6	Sandy FILL with Trace of Landfill Refuse	15.0
	6 - 10	Dark Gray and Black Sand	90.0
AP-15	0 - 5	Sandy FILL	20.0
	5 - 6.5	Black Oily Waste	100.0
	6.5 - 10	Brown, Red and Black Sand (some staining)	65.0
AP-16	0 - 8	Brown to Dark Gray Sand FILL	60.0
	8 - 10	Sandy FILL with Landfill Refuse and a drum lid band	30.0
AP-17	0 - 7	Sandy FILL with Landfill Refuse	30.0
	7 - 10	Black to Gray Sand	3.0
AP-18	0 - 4	Sandy FILL with Landfill Refuse	5.0
	4 - 6	Dark Gray Sand	70.0
	6 - 10	Dark Gray Sand, (Trace of Landfill Refuse with oily staining)	80.0
AP-19	0 - 6	Sandy FILL	50.0
	6 - 8	Black Sand (stained with solvent odor)	80.0
	8 - 10	Brown Sand (with solvent odor)	120.0
AP-20	0 - 5	Sandy FILL with Trace of Landfill Refuse	50.0
	5 - 10	Drum lid at 5 ft then Brown Sand and Gravel (with solvent odors)	120.0
ON-SITE CONTAINMENT AREA			
AP-21	0 - 10	Brown to Dark Gray Sand	55
AP-22	0 - 0.5	Road Gravel	NR
	0.5 - 3.5	Brown Sand	5
	3.5 - 8	Dark Gray Sand (with petroleum-like odor)	200
	8 - 10	Gray Sand	200
AP-23	0 - 0.5	Road Gravel	NR
	0.5 - 3.0	Brown Sand	NR
	3.0 - 7.5	Gray Sand (black staining at 6-ft, with petroleum-like odor)	20
	7.5 - 10	Black to Gray Sand	5

APPENDIX G
AUGER PROBE DESCRIPTIONS

Probe No.	Feet Below Ground Surface	Material Description	Maximum HNu (ppm)
AP-24	0 - 0.5	Road Gravel	NR
	0.5 - 10	Brown to Gray Sand	230
AP-25	0 - 0.5	Road Gravel	NR
	0.5 - 3.5	Brown and Gray Sand	100
	3.5 - 10	Gray Sand	200
AP-26	0 - 0.5	Road Gravel	NR
	0.5 - 6.5	Brown Sand (napthalene-like odor)	190
	6.5 - 10	Gray Sand	130
AP-27	0 - 0.5	Road Gravel	NR
	0.5 - 3.5	Brown Sand (napthalene-like odor)	150
	3.5 - 5.5	Brown to Gray Sand	50
	5.5 - 10	Dark Gray and Black Sand	14
AP-28	0 - 5.0	Brown Sand	200
	5.0 - 10	Gray Sand (possible staining at 9 to 10 ft)	160
AP-29	0 - 5.0	Brown to Gray Sand	50
	5.0 - 10	Gray to Dark Gray Sand	80
AP-30	0 - 2.5	Brown Sand	7
	2.5 - 10	Brown to Gray and Black Sand	9
AP-31	0 - 10	Brown to Gray Sand	9
AP-32	0 - 5.5	Brown Sand	10
	5.5 - 10	Black to Gray Sand	20
AP-33	0 - 2 (est)	Brown Sandy FILL (with many drum carcasses and/or lids)	NR
	2 - 7	Brown to Gray Sand	250
	7 - 10	Black to Gray Sand	270
AP-34	0 - 4	Brown Sand	190
	4 - 8	Gray Sand	15
	8 - 10	Dark Gray Sand	150
AP-35	0 - 4	Brown Sand	18
	4 - 7.5	Black Sand	5
	7.5 - 10	Gray Sand	9
TREATMENT LAGOON AREA			
AP-36	0 - 7	Brown Sand and Gravel (with solvent odors)	40
	7 - 10	Black Sand	40

APPENDIX G
AUGER PROBE DESCRIPTIONS

Probe No.	Feet Below Ground Surface	Material Description	Maximum HNu (ppm)
AP-37	0 - 2.5	Brown Sand and Gravel	NR
	2.5 - 7.5	Black Silt (Traces of liquid waste)	35
	7.5 - 10	Brown Liquid Wastes (Trace of drum parts)	85
AP-38	0 - 4	Brown Sand and Gravel (some black waste at 2.5 ft)	NR
	4 - 8	Brown and Red Sand and Gravel (with oily staining and solvent odors)	90
	8 - 10	Black Sand	85
AP-39	0 - 10	Brown Sand and Gravel (with strong odor)	90
STILL BOTTOMS AREA			
AP-40	0 - 7	Brown Sand	NR
	7 - 10	Gray Sand (with oily sheen, solvent odors)	35
AP-41	0 - 4	Gray to Brown Sand	NR
	4 - 10	Gray Sand and Gravel	0
TREATMENT LAGOON AREA			
AP-42	0 - 4	Dark Gray Sand	50
	4 - 5	Red Sand	40
	5 - 10	Gray Sand	95
AP-43	0 - 3.5	Brown Sand	NR
	3.5 - 7.5	Brown and Gray Sand (with solvent odors)	95
	7.5 - 10	Reddish Sand and Gravel (some oily waste)	95
AP-44	0 - 2	Brown Sand	NR
	2 - 4	Black Sand	NR
	4 - 10	Gray Sand (with solvent odor)	65
AREA WEST OF FIRE POND			
AP-45	0 to 3	Sandy FILL with Rubble	NM
	3 to 6.5	Black Silty Fine SAND, Odorous	10
	6.5 to 10	Gray Silty Fine SAND, Odorous	10
AP-46	0 to 7	Black and Dark Gray Silty Fine Sand FILL, odorous	100
	7 to 8	Black Organic PEAT	NM
	8 to 10	Gray Silty Fine SAND, Trace Clay	25
AP-47	0 to 6.5	Black and Dark Gray Silty Fine Sand FILL, Trace Gravel, odorous	220
	6.5 to 7.5	Silty Fine SAND, Trace Peat, Trace oily substance	150
	7.5 to 10	Dark Gray to Gray Silty Fine SAND	80

Probe No.	Feet Below Ground Surface	Material Description	Maximum HNu (ppm)
AP-48	0 to 4	Black, Gray, and Brown Silty Fine Sand FILL	5
	4 to 6	Dark Gray Silty Fine SAND	15
	6 to 7	Black Peat-like Silty Fine SAND, Trace Clay	15
	7 to 8	Dark Gray Silty Fine SAND	5
	8 to 10	Gray Fine SAND	5
AP-49	0 to 5.5	Brown to Dark Brown Silty Fine SAND	15
	5.5 to 7	Gray to Dark Gray Silty Fine SAND	8
	7 to 7.5	Black PEAT, Trace Silty Fine Sand	NM
	7.5 to 10	Brown and Gray Fine SAND	10
AP-50	0 to 3.5	Brown Fine Sand FILL, Trace Gravel	10
	3.5 to 6.5	Brown and Gray Silty Fine SAND	100
	6.5 to 10	Brown Fine to Medium SAND, Trace Gravel, Black staining at 8 feet	50
AP-51	0 to 7	Black Silty Fine SAND, Odorous	230
	7 to 10	Gray Fine SAND	150
AP-52	0 to 2.5	Brown Fine to Medium Sand FILL	NM
	2.5 to 7	Black Silty Fine SAND, Trace Gravel	200
	7 to 10	Gray Fine to Medium SAND	20
AP-53	0 to 2	Brown Fine Sand FILL	NM
	2 to 4	Black Silty Fine SAND	200
	4 to 6	Dark Gray Fine SAND, Trace Gravel	200
	6 to 8	Black Silty Fine SAND, Trace organics	100
	8 to 10	Gray Fine SAND	20
OFF-SITE CONTAINMENT AREA			
AP-54	0 to 4	Coarse Limestone Gravel FILL	0
	4 to 10	Brown and Gray Fine SAND	8
AP-55	0 to 3.5	Coarse Gravel and Black Sand FILL	5
	3.5 to 6	Black to Dark Brown Fine Sand FILL, Trace Gravel	22
	6 to 10	Brown Fine SAND	8
AP-56	0 to 3.5	Black Fine Sand FILL, Trace debris and gravel	15
	3.5 to 6	Dark Gray Fine Sand FILL	5
	6 to 10	Gray and Black Fine to Medium Sand FILL, Trace debris and refuse	18
AP-57	0 to 10	FILL: Black Fine to Medium Sand, Trace debris and refuse	1
AP-58	0 to 7	Black and Brown Fine Sand FILL, Trace to some debris and refuse	NM
	7 to 10	FILL: Sand with paint-like staining (red, orange and purple pigments). Heavy solvent odors, Traces of debris and refuse	150

Probe No.	Feet Below Ground Surface	Material Description	Maximum HNu (ppm)
AP-59	0 to 5	Black and Dark Gray Sand FILL, Trace debris and refuse	20
	5 to 10	Waste consisting of a sludge-like/paint-like substance with various paint-like staining of white, orange, gray blue, and purple	150
AP-60	0 to 5	Black and Dark Gray Sand FILL, Trace gravel and debris	40
	5 to 6.5	Black and Dark Gray Sand FILL, Trace of solid paint-like pigments	NM
	6.5 to 10	Brown Fine SAND	180
AP-61	0 to 7	Black Sand FILL, Trace debris	40
	7 to 10	Brown Fine SAND	110
AP-62	0 to 3	Black and Brown Sand FILL	80
	3 to 6.5	Black Sand FILL, Trace gravel and debris	35
	6.5 to 10	Brown Fine SAND	80
AP-63	0 to 10	Dark Gray and Dark Brown Sand FILL, Trace rubble and debris	0
	10 to 13.5	Dark Brown and Dark Gray Fine SAND	0
AP-64	0 to 1	Brown Fine to Medium Sand FILL	NM
	1 to 11	Black Silty Sand FILL, Trace debris	1.0
	11 to 13.5	Black to Dark Gray Silty Fine SAND	0
AP-65	0 to 11.5	Brown to Black Silty Fine Sand FILL, Trace rubble and gravel Paint-like odors at 7 feet	5.0
	11.5 to 13.5	Brown to Gray Fine SAND	<1.0
AP-66	0 to 2	Brown to Black Silty Fine Sand FILL, Trace rubble	0.5
	2 to 12	Black Silty Fine Sand FILL, Trace debris	1.7
	12 to 13.5	Black and Brown Refuse FILL	0
AP-67	0 to 3	Brown to Black Silty Fine Sand FILL, Trace Gravel	40
	3 to 13.5	Black Refuse and Silty Fine Sand FILL	15
AP-68	0 to 13.5	Brown to Black Silty Fine Sand FILL, Trace debris, Oily sheen and staining at 10 feet	50
AP-69	0 to 3	Brown Silty Fine Sand FILL	40
	3 to 12	Dark Gray Silty Fine Sand FILL, Trace Clay, Sand, Gravel and Debris	170
	12 to 13.5	Brown Fine SAND, Trace staining	100
AP-70	0 to 13.5	Dark Brown and Black Silty Fine Sand FILL with Refuse and Debris	3.0

Probe No.	Feet Below Ground Surface	Material Description	Maximum HNu (ppm)
AP-71	0 to 1	Brown and Black Silty Fine Sand FILL	NM
	1 to 12	Black Silty Fine Sand FILL with debris	1.0
	12 to 13.5	Black to Dark Gray Fine SAND	0
OFF-SITE CONTAINMENT AREA, SURFICIAL OILY-WASTE AREA			
AP-72	0 to 1	Black Silty Fine Sand FILL	NM
	1 to 5	Encountered buried object covered or full of black oily liquid. Did not bring to surface.	70
AP-73	0 to 2.7	Dark Brown and Black Silty Fine Sand FILL, some debris and refuse	70
	2.7 to 5	Black Silty Fine Sand FILL saturated with black oily liquid	120
AP-74	0 to 4	Dark Brown to Black Silty Fine Sand FILL	60
	4 to 7	Black Silty Fine Sand FILL saturated with black oily liquid	100
	7 to 10	Dark Brown Silty Fine Sand FILL, Trace refuse	140
AP-75	0 to 10	Dark Brown to Black Silty Fine Sand FILL, Little black oil staining and Trace debris at 4.5 to 7.5 feet	120
AP-76	0 to 6.5	Brown Silty Fine Sand FILL, Trace debris	75
	6.5 to 10	Brown Silty Fine SAND, Trace black staining	100
AP-77	0 to 4	Dark Brown to Black Silty Fine Sand FILL, Trace debris	100
	4 to 7	Black Silty Fine Sand FILL saturated with black oily liquid	100
	7 to 9	Grayish purple (stained) and Dark Brown Silty Fine SAND, Trace Gravel	125
	9 to 10	Dark Brown and Black Silty Fine SAND	NM
KAPICA AREA			
AP-78	0 to 7	Dark Gray and Black Silty Fine Sand FILL, Trace staining and debris	50
	7 to 10	Black to Brown Silty Fine SAND	10
AP-79	0 to 6.5	Brown and Dark Gray Silty Fine Sand FILL	40
	6.5 to 10	Brown Fine SAND	5
AP-80	0 to 1	Brown Fine Sand FILL, Trace solid paint-like pigments	NM
	1 to 10	Brown Fine SAND, Trace black staining at 7 to 9.5 feet	110
AP-81	0 to 1.5	Coarse Limestone Gravel and Sand FILL	1.0
	1.5 to 5.0	Buried objects (possible drum lids). Did not bring to surface	2.0

APPENDIX G
AUGER PROBE DESCRIPTIONS

Probe No.	Feet Below Ground Surface	Maximum Material Description	HNu (ppm)
AP-82	0 to 5	Dark Brown Silty Fine Sand FILL, Trace debris	1.5
	5 to 10	Dark Brown and Black Silty Fine Sand FILL, Strong odors. Traces of black staining	55
AP-83	0 to 2	Brown Sand FILL with Coarse Gravel on surface	4.0
	2 to 3.5	Buried objects (possible drum lids)	
	3.5 to 10	Brown and Dark Gray Fine Sand FILL, Trace gravel and staining	25

Notes:
Material description and observations based on drill cuttings. Split-spoon soil sampling was not conducted during auger probes.
ppm = parts per million (of Benzene equivalent)
NM = Not Measured.

H

APPENDIX H

Test Pit Logs

LOG OF SOIL TEST PIT

WARZYN

Project: ACS
Kapica Area
Location: Griffith, Indiana

Pit No. TP-1
Surface Elevation 650
Job No. 60251.03
Date 8/15/89

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Sample No.	Ground Water Level ▽	Moisture	Depth	VISUAL CLASSIFICATION AND REMARKS
				1115 Begin excavation of Test Pit TP-1
				(0 to 2.0 ft.) Fill: Brown, dark gray, and black silty sand, trace to some drum lids and metallic debris. Trace of color paint-like pigments in silty sand.
			2.5	
1		M	3.5	
	4.0	W		(2.0 to 5.0 ft) Fill: Increased amount of drum carcasses and lids. Mostly corroded and mangled. Dark brown silty sand matrix with some paint-like pigments.
			5	
2		W	6.0	
			End of Pit 7.5	
			10	
				1125 Collect sample of waste material in and around drum carcasses approximately 3.5 feet below ground surface. Sample: ACS-TP-1-3.5' HNU headspace = 150 ppm Fill and drum carcasses to approximately 5.5 feet below ground surface. Native soils encountered at 5.5-6.0 feet. Brown fine sand, trace of black staining.
			12.5	
			15	
				1135 Collect sample of native soil beneath waste material. Sample: ACS-TP-1-6.0' HNU headspace = 11.0 Backfill pit with removed material.
			17.5	
			20	1200 End of excavation at 6.5 ft.

WATER LEVEL OBSERVATIONS

While Excavating: 4.0 ft.
Upon Completion of Excavating: 4.0 ft.
Time After Excavating:
Depth to Water:
Depth to Cave In:

GENERAL NOTES

Equipment Used: Dynahoe 190 rubber tire backhoe 1 yd^3 bucket
Geologist: Tim Maley
SSO: Leon Matejka

WARZYN

LOG OF SOIL TEST PIT

Project: ACS
On site containment area
Location: Griffith, Indiana

Pit No. TP-2
Surface Elevation 639
Job No. 60251.03
Date 8/15/89

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Sample No.	Ground Water Level ▽	Moisture	Depth
			2.5
1		M	
	4.0	W	
			5
2		W	
			End of Pit
			7.5
			10
			12.5
			15
			17.5
			20

VISUAL CLASSIFICATION AND REMARKS

1500 Begin excavation of test pit - TP-2

(0 to 1.0 ft.) Dark brown silty/sandy fill.

(1.0 to 5.0 ft.) Begin to encounter buried drums between 1.0 to 2.0 feet below ground surface. As drums are moved and/or carried out of pit, observe various liquids such as: brownish water/oil substance, thin medium bl liquid, and two drums containing a heavier blue paint-like liquid. Drums appear corroded, mangled, and mostly carcasses. Drums lying on their sides, packed closely together, directly next to one another. Estimate 3 to 4 drum thickness layer.

1510 Collect sample of waste material near drums at approximately 3 feet depth; material looks like blueish paint-like sludges, various colored staining, and sandy matrix.
Sample: ACS-TP-2-3' HNU headspace = 190 ppm
Native soil encountered at 5 ft.
Brown (unstained) fine to coarse sand.
Trace fine gravel.

1520 Collect sample of native soil.
Sample: ACS-TP-2-5' HNU headspace = 160 pp

End of excavation at 5½ ft. Backfill pit with removed material.

WATER LEVEL OBSERVATIONS

While Excavating 4.0
Upon Completion of Excavating 4.0
Time After Excavating
Depth to Water
Depth to Cave In

GENERAL NOTES

Equipment Used: Dynahoe 190 rubber tire backhoe
1 yd^3 bucket
Geologist: Tim Maley
SSO: Leon Matejka

LOG OF SOIL TEST PIT

WARZYN

Project: ACS
Treatment Pond No. 1 area
Location: Griffith, Indiana

Pit No. TP-3
Surface Elevation 642
Job No. 60251.03
Date 8/16/89

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Ground Water Level	Sample No.	Moisture	Depth	VISUAL CLASSIFICATION AND REMARKS
				Road Gravel Surface
				1000 Begin excavation of Test Pit TP-3
			2.5	(0 to 1.0 ft.) Fill: Brown silty sand and gravel. HNU = 0 ppm
				(1.0 to 7.0) Fill: Brown and black silty sand, traces of staining. Drum lid band recovered from 5 ft. Roots detected at 7 ft. Black staining at 7½ to 8 ft. HNU = 30 ppm at 8 ft.
			5	
			7.5	(7.0 to 9.0 ft.) Black stained silty sandy fill. Buried drum encountered at 9.0 ft. Brown and purplish viscous liquid accumulates in base of pit. HNU = 50 ppm in the pit at that time.
	1	M	9.0	
				1050 Collect waste sample of stained and oily saturated sandy fill; 9 feet depth. Sample: ACS-TP-3-9' (plus duplicate) HNU headspace = 60 ppm
			10	End of Pit
			12.5	Attempt to excavate deeper for a native soil sample but walls of pit continually slough into pit. Decide to abandon native soil sample attempt for a soil boring. (SB-14) Strong odors eminating from removed fill material. End of excavation at 10½ ft. Backfill pit with removed material.
			15	
			17.5	
			20	

WATER LEVEL OBSERVATIONS

While Excavating: None
Upon Completion of Excavating: None
Time After Excavating:
Depth to Water:
Depth to Cave In:

GENERAL NOTES

Equipment Used: Dynahoe 190 rubber tire backhoe with 1 yd³ bucket
Geologist: Tim Maley
SSO: Leon Matejka

WARZYN

LOG OF SOIL TEST PIT

Project: ACS
Treatment pond No. 1 Area
Location: Griffith, Indiana

Pit No.: TP-4
Surface Elevation: 641
Job No.: 60251.03
Date: 8/16/89

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Ground Water Level	Sample No.	Moisture	Depth	VISUAL CLASSIFICATION AND REMARKS
				Road Gravel Surface
				1400 Begin excavation of Test Pit TP-4
			2.5	(0 - 7 ft.) Fill: Brown fine sand; HNU =1.0 ppm Dark gray and black staining at 3 - 4 ft. HNU readings at 6 ft. = 10 ppm Drum lid encountered at 7.0 ft.
			5	(7.0 to 8.0) Brown and black (stained) sandy fill saturated with a thin oil-like brownish liquid. Liquid continually accumulates in base of pit.
				1440 Collect sample of waste material of stained and saturated sandy fill at 8 ft. depth.
	1	M	7.5	Sample: ACS-TP-4-8' HNU headspace = 200 ppm.
			End of Pit	End of test pit at 8 ft. Backfill pit with removed material. Location considered for at soil boring for native soil sample. (SB-15)
			10	
			12.5	
			15	
			17.5	
			20	

WATER LEVEL OBSERVATIONS

While Excavating: None
Upon Completion of Excavating: None
Time After Excavating:
Depth to Water:
Depth to Cave In:

GENERAL NOTES

Equipment Used: Dynahoe rubber tire backhoe 1 yd^2 bucket
Geologist: Tim Maley
SSO: Leon Matejka

LOG OF SOIL TEST PIT

WARZYN

Project: ACS
Treatment Pond No. 1 Area
Location: Griffith, Indiana

Pit No. TP-5
Surface Elevation 642
Job No. 60251.03
Date 8/17/89

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Ground Water Level ▽ Sample No.	↓	Moisture ↓	Depth	VISUAL CLASSIFICATION AND REMARKS
				Road Gravel Surface
				0910 Begin excavation of Test Pit TP-5
			2.5	(0 - 2.0 ft) Fill: Brown and black silty sand
1		M	3.0 *	(2.0 - 3½ ft.) Mangled drum encountered at 2.0 ft. Contains black oily liquid (appears mostly water) with some black sludge. Much of the liquid loose and situated in sandy fill around the drum(s). Another drum observed in pit at about 2½ - 3 ft. depth.
			End of Pit	
			5	
			7.5	0920 Collect waste sample of black liquid substance mixed with some sludge and sand. Sample: ACS-TP-5-3'. HNU headspace = 160 ppm.
				End of Test Pit at 3 ft. Backfill pit with removed material.
			10	Location considered for a soil boring to sample native under-soil. (SB-16)
			12.5	
			15	
			17.5	
			20	

WATER LEVEL OBSERVATIONS

While Excavating: None
Upon Completion of Excavating: None
Time After Excavating:
Depth to Water:
Depth to Cave In:

GENERAL NOTES

Equipment Used: Dynahoe rubber tire backhoe 1 yd^2 bucket
Geologist: Tim Maley
SSO: Leon Matejka

LOG OF SOIL TEST PIT

WARZYN

Project: ACS
Still Bottom Pond Area
Location: Griffith, Indiana

Pit No. TP-6
Surface Elevation 641
Job No. 60251.03
Date 8/17/89

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Ground Water Level	Sample No.	Moisture	Depth	VISUAL CLASSIFICATION AND REMARKS
				Road Gravel Surface
				1110 Begin excavating Test Pit TP-6.
			2.5	(0 - 3 ft.) Fill: Brown-gray silty sand. Grades into dark brown at 3 ft.
	1	D/M		(4 - 8 ft.) Fill: Dark gray silty sand (stained) at 4.0 ft. Grades back into dark brown silty sand. Trace of roots at 8 ft. Blue paint-like viscous substance runs out of apparent drum buried in wall of pit at 3½ ft. HNU readings = 130 ppm in pit.
			5	
			7.5	Stratigraphy in wall of pit shows various layering of discoloration between 2 - 5 ft. Traces of paint-like colors and oily staining. Native soil below encountered drum.
			End of Pit	(5 - 8 ft.) Brown fine sand.
			10	1140 Collect waste sample of blue paint-like substance along with stained sandy surrounding matrix. (ACS-TP-6-4')
				Attempt to clean out pit of sloughed waste. Unable to collect adequate native under-soil sample.
			12.5	Walls collapse.
				End of test pit at 8 ft.
				Backfill pit with removed material.
				Location considered for soil boring to sample native under-soil. (SB-17)
			15	
			17.5	
			20	

WATER LEVEL OBSERVATIONS

While Excavating: None
Upon Completion of Excavating: None
Time After Excavating:
Depth to Water:
Depth to Cave In:

GENERAL NOTES

Equipment Used: Dynahoe rubber tire backhoe
1 yd² bucket
Geologist: Tim Maley
SSO: Leon Matejka

WARZYN

LOG OF SOIL TEST PIT

Project: ACS
Still Bottom Pond Area
Location: Griffith, Indiana

Pit No. TP-7
Surface Elevation 641
Job No. 60251.03
Date 8/17/89

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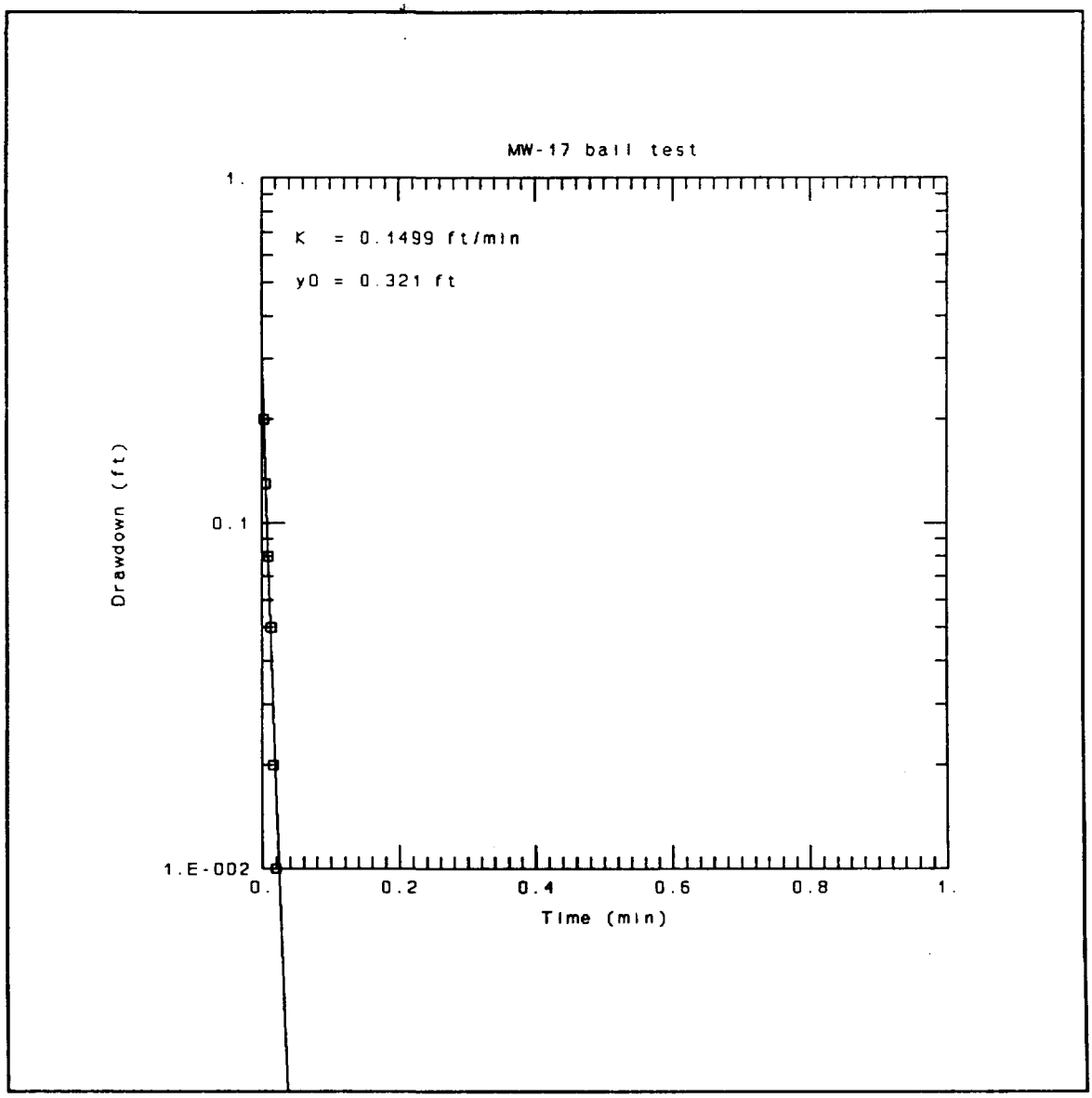
Ground Water Level	Sample No.	Moisture	Depth	VISUAL CLASSIFICATION AND REMARKS
				Road Gravel Surface
				1410 Begin excavating Test Pit TP-7. Brown gravel sand 0 - 1'. Fill.
			2.5	Brown-gray silty sand fill 90 ppm.
				Encounter drum at 3'. Bring to surface and discover it contains jelly-like brown opaque substance. Surrounding sandy fill saturated with black and rusty brown staining.
			5	Collect waste sample from surrounding sandy fill and substance in drum.
				Sample: ACS-TP-7-3' HNU == 90 ppm (Jelly-like substance difficult to dissect.)
			7.5	End of test pit at 3½ ft.
				Backfill test pit with removed material.
				Location considered for a soil boring with sampling for native under soil. (SB-18)
			10	
			12.5	
			15	
			17.5	
			20	

WATER LEVEL OBSERVATIONS

While Excavating: N/A
Upon Completion of Excavating: N/A
Time After Excavating:
Depth to Water:
Depth to Cave In:

GENERAL NOTES

Equipment Used: Dynahoe rubber tire backhoe
1 yd² bucket
Geologist: Tim Maley
SSO: Leon Matejka


MW-17 bail test
K = 0.1499 ft/min
y0 = 0.321 ft
Drawdown (ft)
1.
0.1
1.E-002
0.
0.2
0.4
0.6
0.8
1.
Time (min)

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PROBLEM DEFINITION

Problem title: MW-18 bail test

Knowns and Constants:
No. of data points............... 42
Radius of well casing............ 0.083
Radius of well................... 0.083
Aquifer saturated thickness...... 11.7
Well screen length............... 10
Static height of water in well... 11.7
Log(Re/Rw)....................... 3.797

ESTIMATION RESULTS

Analytical method: Bouwer and Rice (unconfined aquifer slug test)

PARAMETER ESTIMATES

	Estimate		Std. Error
K =	6.9116E-003	+/-	4.9989E-005
y0 =	2.0044E+000	+/-	6.2011E-003

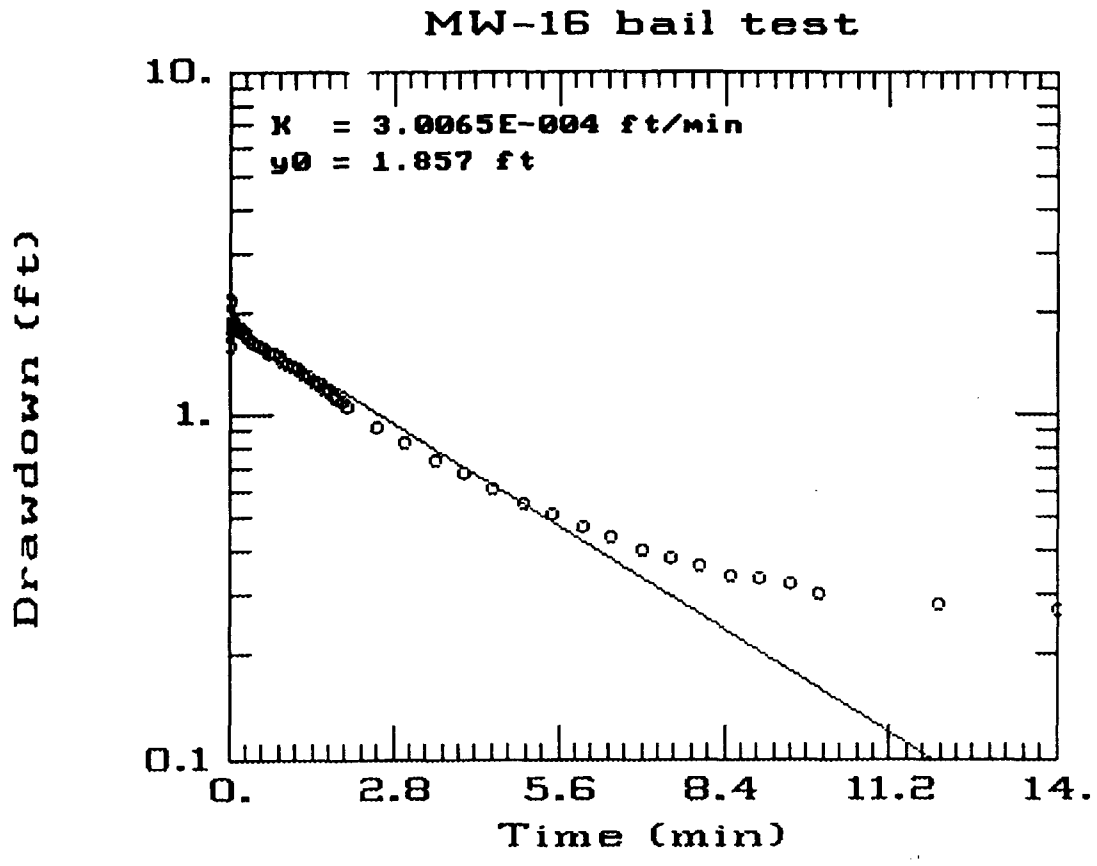
ANALYSIS OF MODEL RESIDUALS

residual = calculated - observed
weighted residual = residual * weight

Weighted Residual Statistics:
Number of residuals............... 42
Number of estimated parameters.... 2
Degrees of freedom................ 40
Residual mean..................... 0.005248
Residual standard deviation....... 0.01688
Residual variance................. 0.000285

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0033	2	1.9698	0.030205	1
0.0066	1.96	1.9357	0.024258	1
0.0099	1.9	1.9023	-0.0022783	1
0.0133	1.87	1.8684	0.001595	1
0.0166	1.84	1.8361	0.003895	1
0.02	1.8	1.8034	-0.0034101	1
0.0233	1.77	1.7722	-0.0022337	1
0.0266	1.74	1.7416	-0.0015962	1



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PROBLEM DEFINITION

Problem title: MW-17 bail test

Knowns and Constants:
- No. of data points............... 6
- Radius of well casing............ 0.083
- Radius of well................... 0.083
- Aquifer saturated thickness...... 12
- Well screen length............... 10.9
- Static height of water in well... 9
- Log(Re/Rw)....................... 3.369

ESTIMATION RESULTS

Analytical method: Bouwer and Rice (unconfined aquifer slug test)

PARAMETER ESTIMATES

	Estimate		Std. Error
K =	1.4989E-001	+/-	5.9847E-003
y0 =	3.2096E-001	+/-	1.0594E-002

ANALYSIS OF MODEL RESIDUALS

residual = calculated - observed
weighted residual = residual * weight

Weighted Residual Statistics:
- Number of residuals.............. 6
- Number of estimated parameters.... 2
- Degrees of freedom............... 4
- Residual mean.................... -0.001261
- Residual standard deviation....... 0.004048
- Residual variance................ 1.639E-005

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0033	0.2	0.2017	-0.0016963	1
0.0066	0.13	0.12675	0.0032513	1
0.0099	0.08	0.079651	0.00034943	1
0.0133	0.05	0.049354	0.00064619	1
0.0166	0.02	0.031015	-0.011015	0.5
0.02	0.01	0.019218	-0.0092175	0.5

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PROBLEM DEFINITION

Problem title: MW-16 bail test

Knowns and Constants:

- No. of data points............... 66
- Radius of well casing............ 0.083
- Radius of well................... 0.083
- Aquifer saturated thickness...... 11.99
- Well screen length............... 10
- Static height of water in well... 10.95
- Log(Re/Rw)....................... 3.538

ESTIMATION RESULTS

Analytical method: Bouwer and Rice (unconfined aquifer slug test)

PARAMETER ESTIMATES

	Estimate		Std. Error
K =	3.0065E-004	+/-	1.1545E-005
y0 =	1.8571E+000	+/-	1.8471E-002

ANALYSIS OF MODEL RESIDUALS

Residual = calculated - observed
Weighted residual = residual * weight

Weighted Residual Statistics:

- Number of residuals............... 66
- Number of estimated parameters.... 2
- Degrees of freedom................ 64
- Residual mean..................... 0.01227
- Residual standard deviation....... 0.09879
- Residual variance................. 0.00976

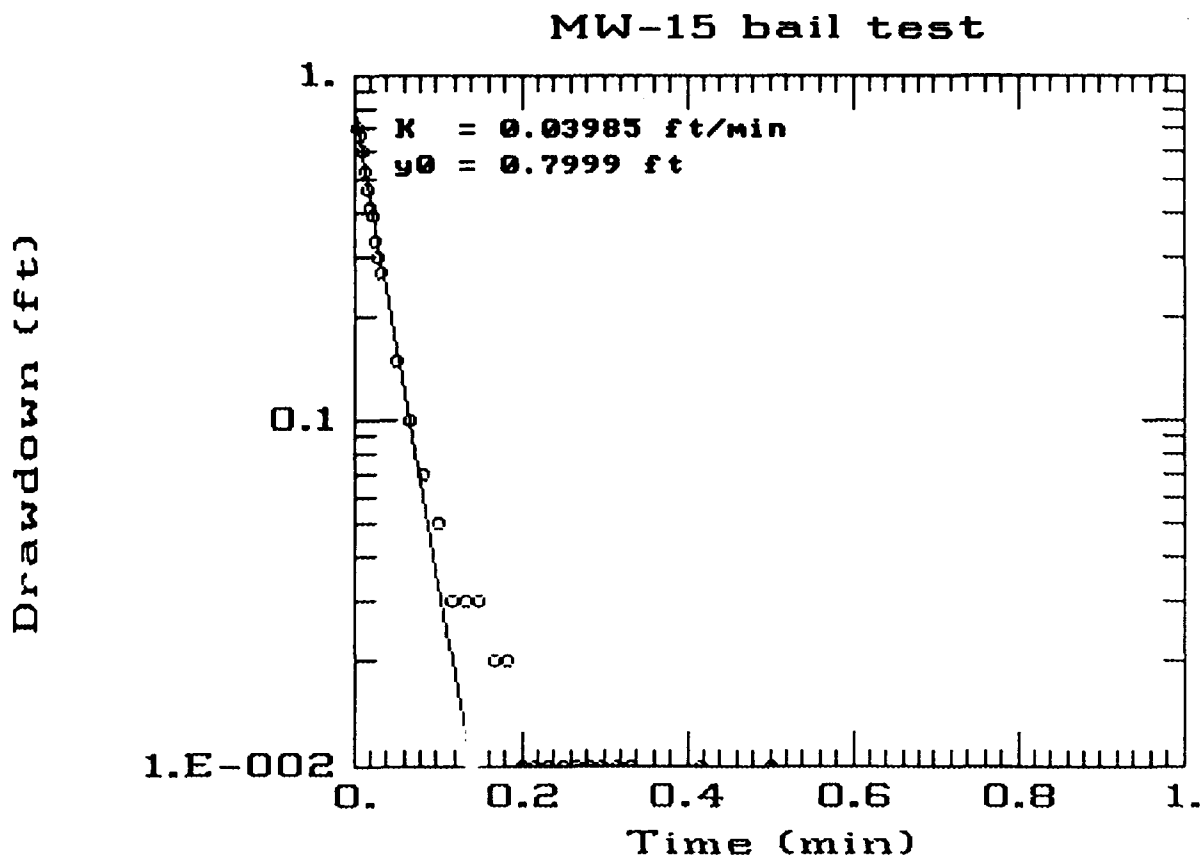
Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0033	2.19	1.8555	0.33446	1
0.0066	1.83	1.854	-0.024031	1
0.0099	1.6	1.8525	-0.25252	1
0.0133	1.79	1.851	-0.060969	1
0.0166	2.14	1.8495	0.29054	1
0.02	2.13	1.8479	0.28209	1
0.0233	1.87	1.8464	0.023591	1
0.0266	1.75	1.8449	-0.094906	1

0.03	1.84	1.8434	-0.0033591	1
0.0333	1.97	1.8419	0.12814	1
0.05	1.9	1.8343	0.065714	1
0.0666	1.85	1.8268	0.023211	1
0.0833	1.83	1.8193	0.010721	1
0.1	1.82	1.8118	0.0082014	1
0.1166	1.8	1.8044	-0.0043939	1
0.1333	1.8	1.797	0.0030249	1
0.15	1.8	1.7896	0.010413	1
0.1666	1.8	1.7823	0.017727	1
0.1833	1.79	1.7749	0.015055	1
0.2	1.78	1.7676	0.012353	1
0.2166	1.77	1.7604	0.0095769	1
0.2333	1.75	1.7532	-0.0031851	1
0.25	1.75	1.746	0.0040231	1
0.2666	1.73	1.7388	-0.0088412	1
0.2833	1.71	1.7317	-0.021692	1
0.3	1.71	1.7246	-0.014572	1
0.3166	1.69	1.7175	-0.027524	1
0.3333	1.68	1.7105	-0.030462	1
0.4167	1.63	1.6756	-0.045629	1
0.5	1.59	1.6415	-0.051545	1
0.5833	1.56	1.6082	-0.048154	1
0.6667	1.52	1.5754	-0.055404	1
0.75	1.51	1.5434	-0.033359	1
0.8333	1.48	1.512	-0.031966	1
0.9167	1.44	1.4812	-0.041175	1
1	1.42	1.451	-0.031046	1
1.0833	1.39	1.4215	-0.031531	1
1.1667	1.36	1.3926	-0.032581	1
1.25	1.32	1.3643	-0.044255	1
1.3333	1.29	1.3365	-0.046505	1
1.4166	1.26	1.3093	-0.049319	1
1.5	1.23	1.2827	-0.052655	1
1.5833	1.19	1.2566	-0.066565	1
1.6667	1.17	1.231	-0.060975	1
1.75	1.14	1.2059	-0.065935	1
1.8333	1.11	1.1814	-0.071406	1
1.9167	1.09	1.1573	-0.067346	1
2	1.05	1.1338	-0.083805	1
2.5	0.92	1.0022	-0.082229	1
3	0.83	0.88592	-0.055922	1
3.5	0.74	0.78311	-0.043112	1
4	0.67	0.69223	-0.022233	1
4.5	0.61	0.6119	-0.0019007	1
5	0.55	0.54089	0.0091094	1
5.5	0.51	0.47812	0.031879	1
6	0.47	0.42264	0.047364	1
6.5	0.44	0.37359	0.06641	1
7	0.4	0.33024	0.069765	1
7.5	0.38	0.29191	0.088088	1
8	0.36	0.25804	0.10196	1
8.5	0.34	0.22809	0.11191	1
9	0.33	0.20162	0.12838	1
9.5	0.32	0.17822	0.14178	1
10	0.3	0.15754	0.14246	1
12	0.28	0.096185	0.18381	1
14	0.27	0.058725	0.21128	1

MW-15 Last Run

0.03	0.3	0.30809	-0.0080947	1
0.0333	0.27	0.2774	-0.0074011	1
0.05	0.15	0.1631	-0.013104	1
0.0666	0.1	0.096207	0.0037934	1
0.0833	0.07	0.056567	0.013433	1
0.1	0.05	0.03326	0.01674	1
0.1166	0.03	0.019618	0.010382	1
0.1333	0.03	0.011535	0.018465	1
0.15	0.03	0.0067823	0.023218	1
0.1666	0.02	0.0040005	0.016	1
0.1833	0.02	0.0023522	0.017648	1
0.2	0.01	0.001383	0.008617	1
0.2166	0.01	0.00081577	0.0091842	1
0.2333	0.01	0.00047965	0.0095203	1
0.25	0.01	0.00028202	0.009718	1
0.2666	0.01	0.00016635	0.0098337	1
0.2833	0.01	9.7809E-005	0.0099022	1
0.3	0.01	5.7509E-005	0.0099425	1
0.3166	0.01	3.3922E-005	0.0099661	1
0.3333	0.01	1.9945E-005	0.0099801	1
0.4167	0.01	1.4061E-006	0.0099986	1
0.5	0.01	9.9438E-008	0.0099999	1



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piezometer method at the lower values of L/r_w. With the piezometer method a cavity is augered out in the soil below a piezometer tube. The water level in the tube is abruptly lowered, and K of the soil around the cavity is calculated from the rate of rise of the water level in the tube [*Bouwer and Jackson*, 1974]. The equation for K is

$$K = \frac{\pi r_w^2}{A_Y} \frac{1}{t} \ln \frac{y_0}{y_t} \qquad (12)$$

where A_Y is a geometry factor with dimension of length. Values of A_Y were evaluated with an electrolytic tank analog by *Youngs* [1968], whose results were expressed in tabular form as A_Y/r_w for different values of L/r_w (ranging between 0 and 8), $(H - L)/r_w$, and $(D - H)/r_w$.

Taking a hypothetical case where $L/r_w = 8$, $H/r_w = 12$, and $D/r_w = 16$, K calculated with (5) is 18% below K calculated with (12). This is more than the 10% error normally expected with (8) and (9) for the L/H value of 0.67 in this case. The larger discrepancy may be due to the difference in methodology, or to the fact that the L/r_w value is close to the lower limit of the range covered on the resistance network analog.

An approximate equation for calculating K with the piezometer method was presented by *Hvorslev* [1951]. The equation, which is based on the assumptions of an ellipsoidal cavity or well screen and infinite vertical extent (upward and downward) of the flow system, contains a term $[1 + (L/2r_w)^2]^{1/2}$. For most well-slug-test geometries, $L/2r_w$ will be sufficiently large to permit replacement of this term by $L/2r_w$. In that case, however, Hvorslev's equation for Q yields $R_e = L$, which is not true. In reality, R_e is considerably less than L. For example, if $L = 40$ m, $r_w = 0.4$ m, $H = 80$ m, and $D = \infty$, (8) shows that $R_e = 11.9$ m, which is much less than the value of 40 m indicated by Hvorslev's equation. However, since the calculation of K is based on $\ln (R_e/r_w)$ as shown by (5), the error in K is less than the error in R_e (i.e., 36 and 236%, respectively, in this case).

If, for the above example, the top of the well screen or cavity had been taken at the same level as the water table ($H = 40$ m), R_e would have been 8.6 m and Hvorslev's equation would have yielded a K value that is 50% higher than K given by (5). The larger error is probably due to Hvorslev's assumption of infinite vertical (upward) extent of the flow system, which is not met when the cavity is immediately below the water table. Using Hvorslev's equation for cavities immediately below a confining layer would increase the error to 73%, but this, of course, is due to the fact that a water table is not a solid boundary. Hvorslev's equation for the confining layer case can be shown to yield $R_e = 2L$.

Auger hole method. The analog analyses for (8) and (9) and Figure 3 were performed for $L < H$, because short circuiting between the water table and the well prevented simulation of the case where $L = H$. If the analog results are extrapolated to $L = H$, however, the geometry of the system in Figure 1 becomes similar to that of the auger hole technique, for which a number of equations and graphs have been developed to calculate K from the rise of the water level in the well [*Bouwer and Jackson*, 1974]. *Boast and Kirkham* [1971], for example, developed the equation

$$K = C_{BK} \frac{\Delta y}{\Delta t} \qquad (13)$$

where C_{BK} was determined mathematically and expressed in tabular form for various values of L/r_w, $(D - H)/r_w$, and y_0/H. Since the rate of rise of the water level in the hole after

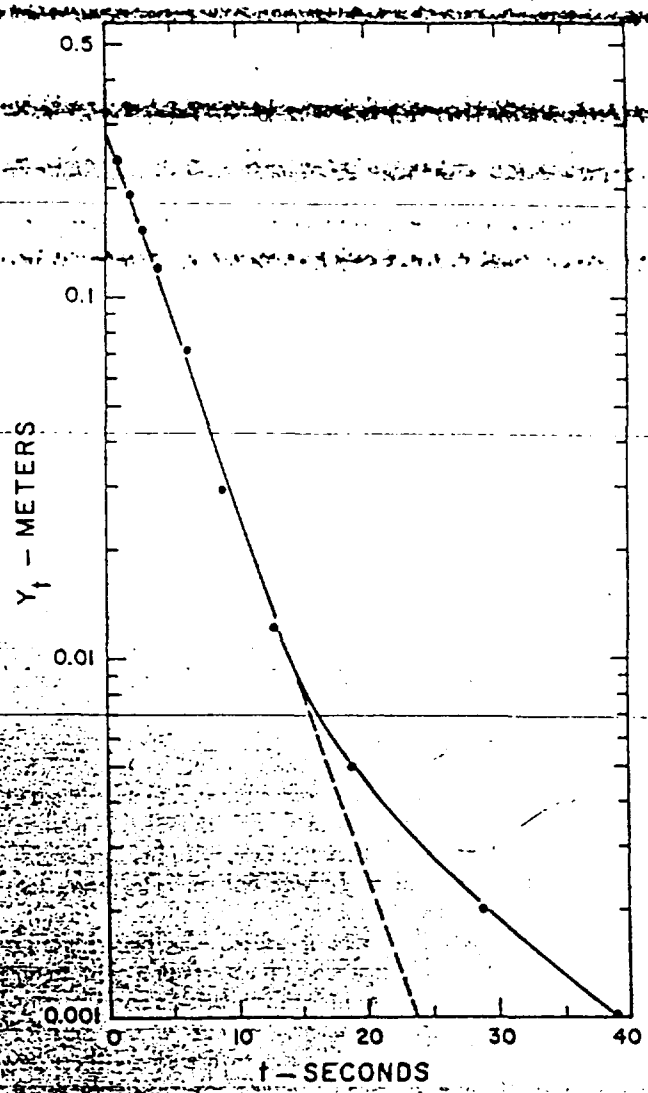

Fig. 4. Plot of y versus t for slug test on east well.

the removal of a slug of water decreases with decreasing y, $\Delta y/\Delta t$ is not a constant and the value of K obtained with this procedure depends on the magnitude of Δy used in the field measurements. The general rule is that Δy should be relatively small.

Taking a hypothetical case where $y_0 = 2.5$ m, $y_t = 2.4$ m, $\Delta t = 10$ s, $L = H = 5$ m, $D = 6$ m, and $r_w = 0.1$ m, (5) yields a K value that is 36% lower than K calculated with (13). However, if y_t is taken as 0.5 m, which should give $\Delta t = 394$ s according to the theory that $(1/t) \ln y_0/y_t$ is constant, the K value yielded by (5) is 26% higher than K obtained with (13). If y_t is taken as 0.9 m, (5) and (13) give identical results.

Slug test on wells in confined aquifers. The confined aquifer for which the slug test by *Cooper et al.* [1967] was developed is an aquifer with an internal water source, for example, recharge through aquitards or compression of confining layers or other material. This situation is similar to that of the unconfined aquifer presented in this paper because the water table is considered horizontal, like the upper boundary of a confined aquifer, and the water table is a plane source. Thus K or T calculated with (5) or (6) should be of the same order as K calculated with the procedure of *Cooper et al.* [1967], which involves plotting the rise of the water level in the well and finding the best fit on a family of type curves. *Cooper et al.* [1967] presented an example of the calculation of T for a well

with $r_c = r_w = 0.076$ m and $a = 98$ m. The resulting value of T was 45.8 m²/day. Values of D and H for this well were not given. However, since the well was 122 m deep and completely penetrating (at least theoretically), D and H must have been between 98 and 122 m. Assuming that both D and H were 100 m, (6) yields $T = 62.8$ m²/day, which is compatible with T obtained by Cooper et al.

CONCLUSIONS

The hydraulic conductivity of an aquifer near a well can be calculated from the rise of the water level in the well after a slug of water is suddenly removed. The calculation is based on the Thiem equation, using an effective radius R_e for the distance over which the head difference between the equilibrium water table in the aquifer and the water level in the well is dissipated. Values of R_e were evaluated by electrical resistance network analog. An empirical equation was then developed to relate R_e to the geometry of the system. This equation is accurate to within 10–25%, depending on how much of the well below the water table is perforated or otherwise open. The technique is applicable to partially or completely penetrating wells in unconfined aquifers. It can also be used to estimate the hydraulic conductivity of confined aquifers that receive water from the upper confining layer through recharge or compression.

The vertical distance between the rising water level in the well and the equilibrium water table in the aquifer must yield a straight line when it is plotted on a logarithmic scale against time. This can be used to check the validity of field measurements and to obtain the best-fitting line for calculating the hydraulic conductivity. Permeable aquifers produce rapidly rising water levels that can be measured with fast-response pressure transducers and strip chart recorders or x-y plotters. The portion of the aquifer sampled for hydraulic conductivity with the slug test is approximately a cylinder with radius R_e and a height somewhat larger than the perforated or otherwise open section of the well.

Hydraulic conductivity values obtained with the propo slug test are compatible with those yielded by the auger h and piezometer techniques, where the geometries of the system overlap, and by a slug test for completely penetrating wells i confined aquifers.

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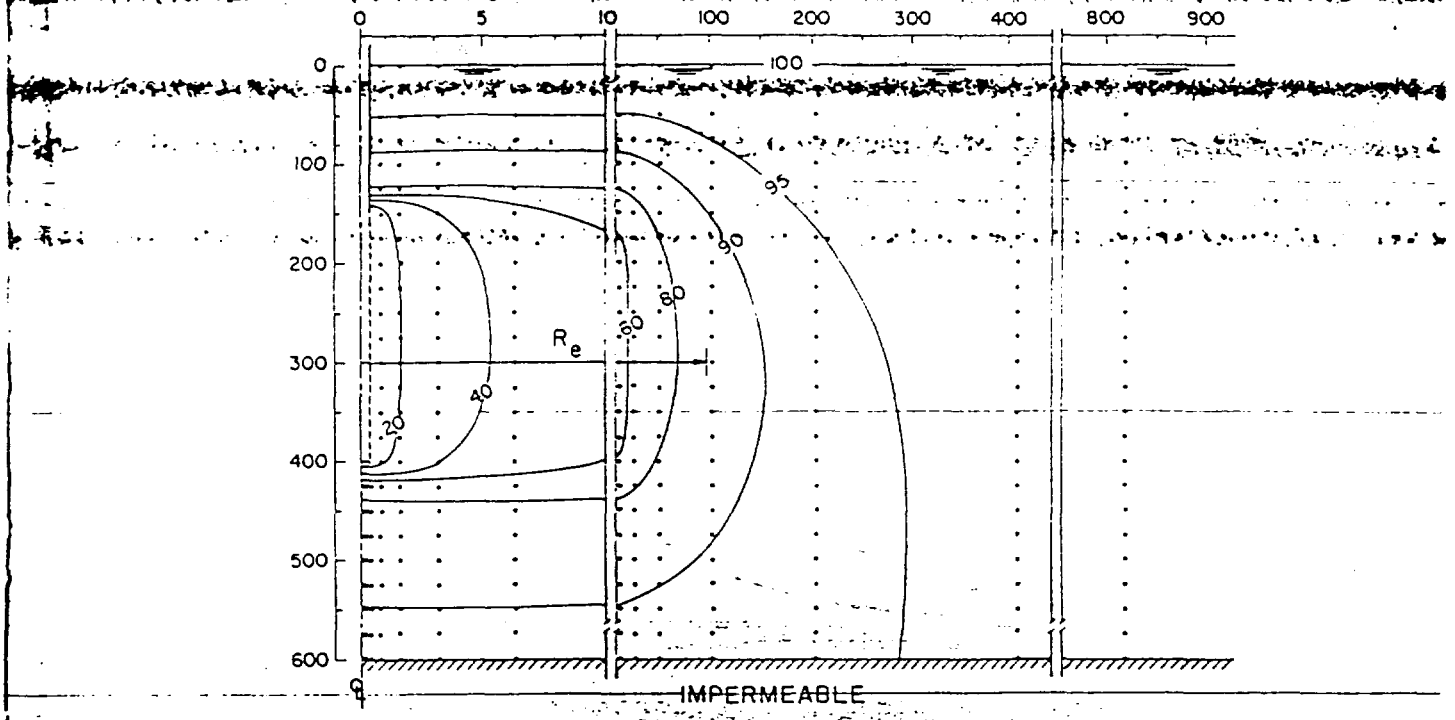

Fig. 2. Node arrangement (dots) for resistance network analog and potential distribution (indicated as percentages on equipotentials) for system with $L/r_w = 625$, $H/r_w = 1000$, and $D/r_w = 1500$. The numbers on the left and at the top of the figure are arbitrary length units (note breaks in horizontal scale).

less than the flow when the layer is taken as being infinitely permeable. The average of the two flows can then be taken as a good estimate of the flow that would occur if the aquifer were represented on the analog as being uniform to infinite depth [*Bouwer*, 1967]. This average flow was used to calculate R_e for $D = \infty$.

The analog analyses were performed by simulating a system with certain values of r_w, H, and D. The electrical current entering the 'well' was then measured for different values of L ranging from near H to near 0. This was repeated for other values of r_w, H, and D. The condition where $L = H$ could not be simulated on the analog because it would mean a short between the water table as the source and the well as the sink. The electrical current flow in the analog was converted to volume per day, and $\ln R_e/r_w$ was evaluated with (1) for each combination of r_w, H, L, and D used in the analog.

For a given geometry described by r_w, H, and D, the current flow Q_i into the simulated well varied essentially linearly with L and could be described by the equation

$$Q_i = mL + n \tag{7}$$

Because of the linearity between Q_i and L the results of the analyses could be extrapolated to the condition $L = H$. The values of m in (7) appeared to vary inversely with $\ln H/r_w$. The values of n varied approximately linearly with $\ln [(D - H)/r_w]$, the slope A and intercept B in these relations being a function of L/r_w. This enabled the derivation of the following empirical equation relating $\ln R_e/r_w$ to the geometry of the system:

$$\ln \frac{R_e}{r_w} = \left[\frac{1.1}{\ln (H/r_w)} + \frac{A + B \ln [(D - H)/r_w]}{L/r_w}\right]^{-1} \tag{8}$$

In this equation, A and B are dimensionless coefficients that are functions of L/r_w, as shown in Figure 3. If $D \gg H$, an increase in D has no measurable effect on $\ln R_e/r_w$. The analog results indicated that the effective upper limit of $\ln [(D - H)/r_w]$ is 6. Thus if D is considered infinity or $(D - H)/r_w$ is so large that $\ln [(D - H)/r_w]$ is greater than 6, a value of 6 should still be used for the term $\ln [(D - H)/r_w]$ in (8).

If $D = H$, the term $\ln [(D - H)/r_w]$ in (8) cannot be used. The analog results indicated that for this condition, which is the case of a fully penetrating well, (8) should be modified to

$$\ln \frac{R_e}{r_w} = \left(\frac{1.1}{\ln (H/r_w)} + \frac{C}{L/r_w}\right)^{-1} \tag{9}$$

where C is a dimensionless parameter that is a function of L/r_w as shown in Figure 3.

Equations (8) and (9) yield values of $\ln R_e/r_w$ that are within 10% of the actual value as evaluated by analog if $L > 0.4H$ and within 25% if $L \ll H$ (for example, $L = 0.1H$).

The analog analyses were performed for wells that were closed at the bottom. Occasionally, however, wells with open bottoms were also simulated. The flow through the bottom appeared to be negligible for all values of r_w and L used in the analyses. If L is not much greater than r_w (for example, $L/r_w \ll 4$), the system geometry approaches that of a piezometer cavity [*Bouwer and Jackson*, 1974], in which case the bottom flow can be significant. Equations (8) and (9) can also be used to evaluate $\ln R_e/r_w$ if a portion of the perforated or otherwise open part of the well is isolated with packers for the slug test.

Equipotentials for the flow system around a partially penetrating, partially perforated well in an unconfined aquifer after lowering the water level in the well are shown in Figure 2. The numbers along the symmetry axis and the water table represent arbitrary length units. The numbers on the equipotentials indicate the potential as a percentage of the total head difference between the water table (100%) and the open portion of the well (0%) shown as a dashed line.

The value of R_e for the case in Figure 2 is 96.7 length units. As shown in the figure, this corresponds approximately to the

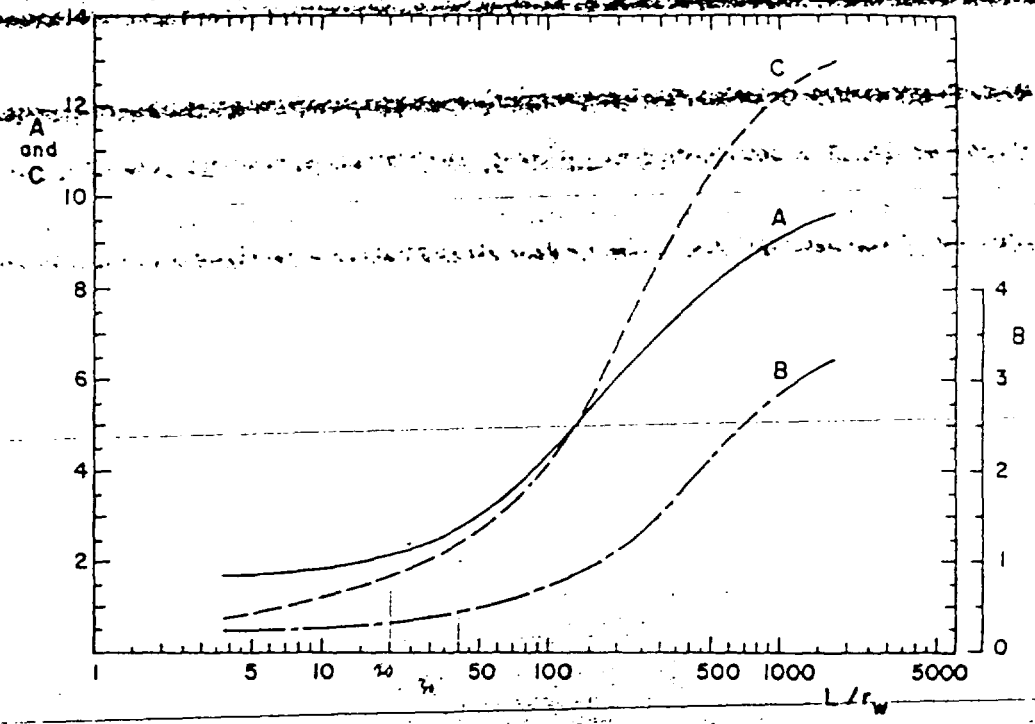

Fig. 3. Curves relating coefficients A, B, and C to L/r_w.

85% equipotential when R_e is laterally extended from the center of the open portion of the well. Thus most of the head loss in the flow system occurs in a cylinder with radius R_e, which is indicative of the horizontal extent of the portion of the aquifer sampled for K or T. The vertical extent is somewhat greater than L, as indicated by, for example, the 80% equipotential in Figure 2.

To estimate the rate of rise of the water level in a well after it is suddenly lowered, (5) can be written as

$$t = \frac{r_c^2}{2KL} \ln \frac{R_e}{r_w} \ln \frac{y_0}{y_t} \qquad (10)$$

By taking $y_t = 0.9y_0$, (10) reduces to

$$t_{90\%} = 0.0527 \frac{r_c^2}{KL} \ln \frac{R_e}{r_w} \qquad (11)$$

where $t_{90\%}$ is the time that it takes for the water level to rise 90% of the distance to the equilibrium level. By assuming a permeable aquifer with $K = 30$ m/day, a well with $r_c = 0.2$ m and $L = 10$ m, and $\ln (R_e/r_w) = 3$, (11) yields $t_{90\%} = 1.82$ s. Thus if y_0 is taken as 30 cm, it takes 1.8 s for the water level to rise 27 cm, another 1.8 s for the next 2.7 cm (90% of the remaining 3 cm), and another 1.8 s for the next 0.27 cm, or a total of 5.4 s for a rise of 29.97 cm. Measurement of this fast rise requires a sensitive and accurate transducer and a fast-response recorder. The rate of rise can be reduced by allowing groundwater to enter through only a portion of the open section of the well, as can be accomplished with packers.

For a moderately permeable aquifer with, for example, $K = 1$ m/day, a well with $r_c = 0.1$ m and $L = 20$ m, and $\ln (R_e/r_w) = 5$, (11) yields $t = 11.4$ s. In this case, it would take the water level 22.8 s to rise from 30 cm to 0.3 cm below static level.

EXAMPLE

A slug test was performed on a cased well in the alluvial deposits of the Salt River bed west of Phoenix, Arizona. The well, known as the east well, is located about 20 m east of six rapid infiltration basins for groundwater recharge with sewage effluent [*Bouwer*, 1970]. The static water table was at a depth of 3 m, $D = 80$ m, $H = 5.5$ m, $L = 4.56$ m, $r_c = 0.076$ m, and r_w was taken as 0.12 m to allow for development of the aquifer around the perforated portion of the casing. A Statham PM131TC pressure transducer was suspended about 1 m below the static water level in the well (when trade names and company names are included, they are for the convenience of the reader and do not imply preferential endorsement of a particular product or company over others by the U.S. Department of Agriculture). A solid cylinder with a vol equivalent to a 0.32-m change in water level in the well also placed below the water level. When the water level returned to equilibrium, the cylinder was quickly remov The transducer output, recorded on a Sargent millivolt corder, yielded the y-t relationship shown in Figure 4 with y plotted on a logarithmic scale. The straight-line portion is the valid part of the readings. The actual y_0 value of 0.29 m indicated by the straight line is close to the theoretical value of 0.32 m calculated from the displacement of the submerged cylinder.

Extending the straight line in Figure 4 shows that for the arbitrarily selected t value of 20 s, $y = 0.0025$ m. Thus $(1/t) \ln y_0/y_t = 0.238$ s^{-1}. The value of $L/r_w = 38$, for which Figure 3 yields $A = 2.6$ and $B = 0.42$. Substituting these values into (8) and using the maximum value of 6 for $\ln [(D - H)/r_w]$ (since $\ln [(D - H)/r_w]$ for the well exceeds 6) yield $\ln (R_e/r_w) = 2.37$. Equation (5) then gives $K = 0.00036$ m/s $= 31$ m/day. This value agrees with K values of 10 and 53 m/day obtained previously with the tube method on two nearby observation wells [*Bouwer*, 1970]. These K values were essentially point measurements on the aquifer immediately around the well bottoms, which were at depths of 9.1 and 6.1 m, respectively.

COMPARISONS

Piezometer method. The geometry to which (8) and (9) and the coefficients in Figure 3 apply overlaps the geometry of the

A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers With Completely or Partially Penetrating Wells

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A procedure is presented for calculating the hydraulic conductivity of an aquifer near a well from the rate of rise of the water level in the well after a certain volume of water is suddenly removed. The calculation is based on the Thiem equation of steady state flow to a well. The effective radius R_e over which the head difference between the equilibrium water table in the aquifer and the water level in the well is dissipated was evaluated with a resistance network analog for a wide range of system geometries. An empirical equation relating R_e to the geometry of the well and aquifer was derived. The technique is applicable to completely or partially penetrating wells in unconfined aquifers. It can also be used for confined aquifers that receive water from the upper confining layer. The method's results are compatible with those obtained by other techniques for overlapping geometries.

With the slug test the hydraulic conductivity or transmissibility of an aquifer is determined from the rate of rise of the water level in a well after a certain volume or 'slug' of water is suddenly removed from the well. The slug test is simpler and quicker than the Theis pumping test because observation wells and pumping the well are not needed. With the slug test the portion of the aquifer 'sampled' for hydraulic conductivity is smaller than that for the pumping test even though with the latter, most of the head loss also occurs within a relatively small distance of the pumped well and the resulting transmissibility primarily reflects the aquifer conditions near the pumped well.

Essentially instantaneous lowering of the water level in a well can be achieved by quickly removing water with a bailer or by partially or completely submerging an object in the water, letting the water level reach equilibrium, and then quickly removing the object. If the aquifer is very permeable, the water level in the well may rise very rapidly. Such rapid rises can be measured with sensitive pressure transducers and fast-response strip chart recorders or *x-y* plotters. Also it may be possible to isolate portions of the perforated or screened section of the well with special packers for the slug test. not only reduces the inflow and hence the rate of rise of the water level in the well, but it also makes it possible to determine the vertical distribution of the hydraulic conductivity. Special packer techniques may have to be developed to obtain a good seal, especially for rough casings or perforations. Effective sealing may be achieved with relatively long sections of inflatable stoppers or tubing. The use of long sections of these materials would also reduce leakage flow from the rest of the well to the isolated section between packers. This flow can occur through gravel envelopes or other permeable zones surrounding the casing. Sections of inflatable tubing may have to be long enough to block off the entire part of the well not used for the slug test. High inflation pressures should be used to minimize volume changes in the tubing due to changing water pressures in the isolated section when the head is lowered.

So far, solutions for the slug test have been developed only for completely penetrating wells in confined aquifers. *Cooper et al.* [1967] derived an equation for the rise or fall of the water level in a well after sudden lowering or raising, respectively. Their equation was based on nonsteady flow to a pumped, completely penetrating well, and the solution was expressed as a series of 'type curves' against which observed rates of water level rises were matched. Values for the transmissibility and storage coefficient were then evaluated from the curve parameter and horizontal-scale position of the type curve showing the best fit with the experimental data. *Skibitzke* [1958] developed an equation for calculating transmissibility from the recovery of the water level in a well that was repeatedly bailed. The technique is limited to wells in confined aquifers with sufficiently shallow water levels to permit short time intervals between bailing cycles [*Lohman*, 1972].

To use the slug test for partially penetrating or partially perforated wells in confined or unconfined aquifers, some solutions developed for the auger hole and piezometer techniques to measure soil hydraulic conductivity [*Bouwer and Jackson*, 1974] may be employed. However, the geometry of most groundwater wells is outside the range in geometry covered by the existing equations or tables for the auger hole or piezometer methods. For this reason, theory and equations are presented in this paper for slug tests on partially or completely penetrating wells in unconfined aquifers for a wide range of geometry conditions. The wells may be partially or completely perforated, screened, or otherwise open along their periphery. While the solutions are developed for unconfined aquifers, they may also be used for slug tests on wells in confined aquifers if water enters the aquifer from the upper confining layer through compression or leakage.

THEORY

Geometry and symbols of a well in an unconfined aquifer are shown in Figure 1. For the slug test the water level in the well is suddenly lowered, and the rate of rise of the water level is measured. The flow into the well at a particular value of y can be calculated by modifying the Thiem equation to

$$Q = 2\pi KL \frac{y}{\ln (R_e/r_w)} \tag{1}$$

where Q is the flow into the well (length³/time), K is the hydraulic conductivity of the aquifer (length/time), L is the height of the portion of well through which water enters (height of screen or perforated zone or of uncased portion of well), y is the vertical distance between water level in well and equilibrium water table in aquifer, R_e is the effective radius over which y is dissipated, and r_w is the horizontal distance

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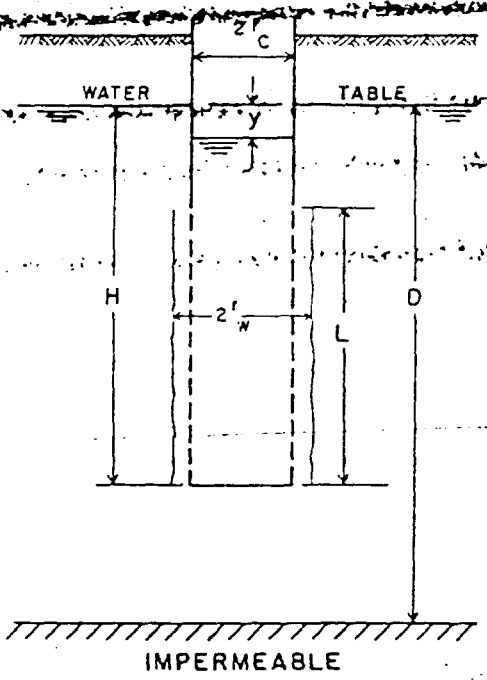


Fig. 1. Geometry and symbols of a partially penetrating, partially perforated well in unconfined aquifer with gravel pack or developed zone around perforated section.

from well center to original aquifer (well radius or radius of casing plus thickness of gravel envelope or developed zone).

The terms L, y, R_e, and r_w are all expressed in units of length. The effective radius R_e is the equivalent radial distance over which the head loss y is dissipated in the flow system. The value of R_e depends on the geometry of the flow system, and it was determined for different values of H, L, D, and r_w (Figure 1) with a resistance network analog, as will be discussed in the next section. Equation (1) is based on the assumptions that (1) drawdown of the water table around the well is negligible, (2) flow above the water table (in the capillary fringe) can be ignored, (3) head losses as water enters the well (well losses) are negligible, and (4) the aquifer is homogeneous and isotropic. These are the usual assumptions in the development of equations for pumped hole techniques [*Bouwer and Jackson*, 1974, and references therein].

The value of r_w in (1) represents the radial distance between the undisturbed aquifer and the well center. Thus r_w should include gravel envelopes or 'developed' zones if they are much more permeable than the aquifer itself (Figure 1).

The rate of rise, dy/dt, of the water level in the well after suddenly removing a slug of water can be related to the inflow Q by the equation

$$dy/dt = -Q/\pi r_c^2 \tag{2}$$

where πr_c^2 is the cross-sectional area of the well where the water level is rising. The minus sign in (2) is introduced because y decreases as t increases.

The term r_c is the inside radius of the casing if the water level is above the perforated or otherwise open portion of the well. If the water level is rising in the perforated section of the well, allowance should be made for the porosity outside the well casing if the hydraulic conductivity of the gravel envelope or developed zone is much higher than that of the aquifer. In that case the (open) porosity in the permeable zone must be included in the cross-sectional area of the well. For example, if the radius of the perforated casing is 20 cm and the casing is surrounded by a 10-cm permeable gravel envelope with a porosity of 30%, r_c should be taken as $[20^2 + 0.30(30^2 - 20^2)]^{1/2} = 23.5$ cm to obtain the cross-sectional area of the well that relates Q to dy/dt. The value of r_w for this well section is 30 cm.

Combining (1) and (2) yields

$$\frac{1}{y}\,dy = -\frac{2KL}{r_c^2 \ln (R_e/r_w)}\,dt \tag{3}$$

which can be integrated to

$$\ln y = -\frac{2KLt}{r_c^2 \ln (R_e/r_w)} + \text{constant} \tag{4}$$

Applying this equation between limits y_0 at $t = 0$ and y_t at t and solving for K yield

$$K = \frac{r_c^2 \ln (R_e/r_w)}{2L}\,\frac{1}{t}\,\ln \frac{y_0}{y_t} \tag{5}$$

This equation enables K to be calculated from the rise of water level in the well after suddenly removing a slug of water from the well. Since K, r_c, r_w, R_e, and L in (5) are constants, $(1/t) \ln y_0/y_t$ must also be constant. Thus field data should yield a straight line when they are plotted as $\ln y_t$ versus t. The term $(1/t) \ln y_0/y_t$ in (5) is then obtained from the best-fitting straight line in a plot of $\ln y$ versus t (see the example). The value of $\ln R_e/r_w$ is dependent on H, D, L, and r_w and can be evaluated from the analog results presented in the next section. The transmissibility T of the aquifer is calculated by multiplying (5) by the thickness D of the aquifer or

$$T = \frac{Dr_c^2 \ln (R_e/r_w)}{2L}\,\frac{1}{t}\,\ln \frac{y_0}{y_t} \tag{6}$$

This equation is based on the assumption that the aquifer is uniform with depth.

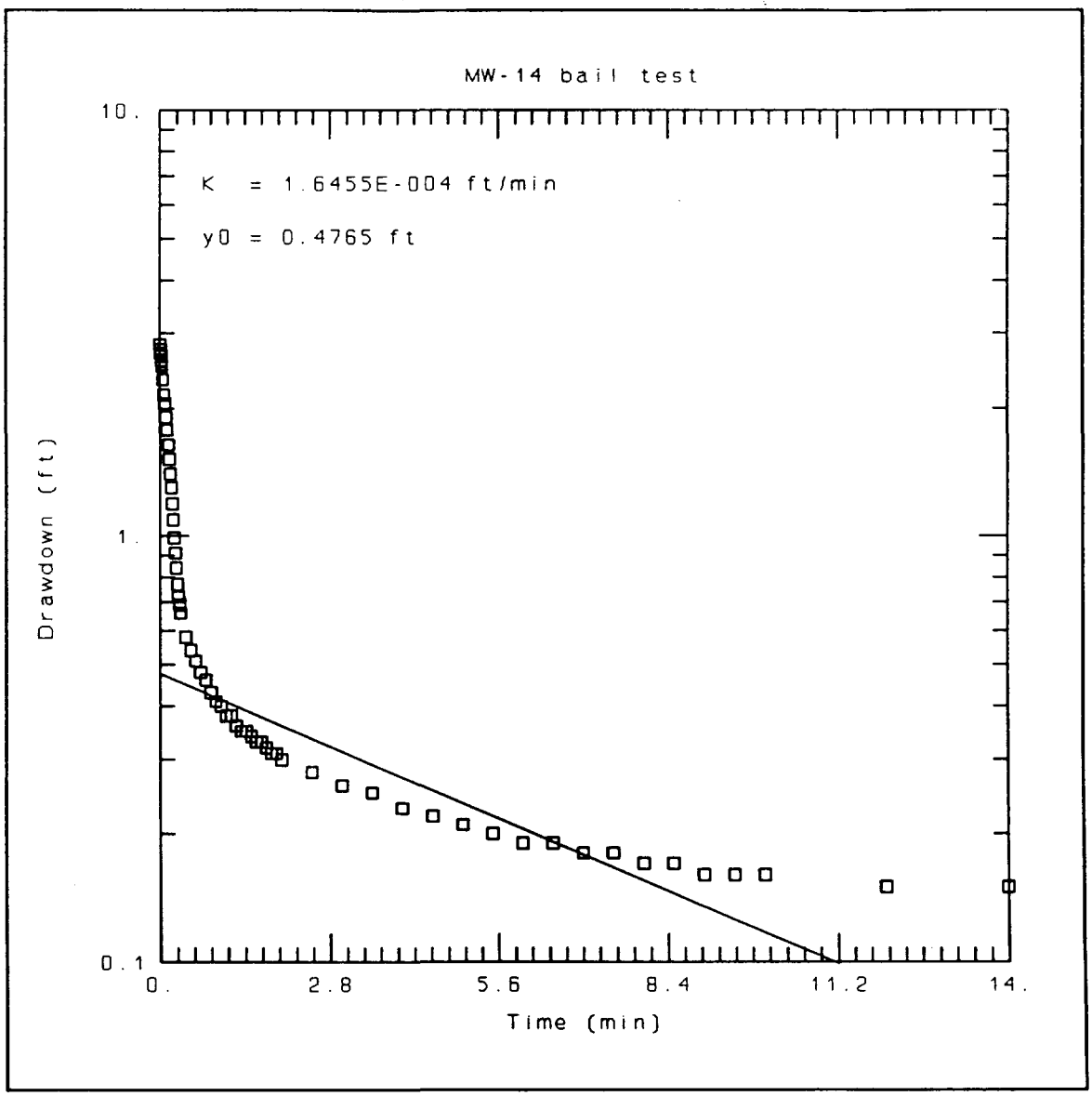
Equations (5) and (6) are dimensionally correct. Thus K and T are expressed in the same units as the length and time parameters in the equations.

EVALUATION OF R_e

Values of R_e, expressed as $\ln R_e/r_w$, were determined with an electrical resistance network analog for different values of r_w, L, H, and D (Figure 1), using the same assumptions as those for (1). An axisymmetric sector of 1 rad was simulated by a network of electrical resistors. The vertical distance between the nodes was constant, but the radial distance between nodes increased with increasing distance from the center line (Figure 2). This yielded a network with the highest node density near the well, where the head loss was greatest, and a decreasing node density toward the outer reaches of the system. For a more detailed discussion of graded networks for representing axisymmetric flow systems, see *Liebmann* [1950] and *Bouwer* [1960].

The radial extent of the medium represented on the analog was more than 60,000 times the largest r_w value used in the analyses. Thus the radial extent of the analog system was essentially infinite, as evidenced by the fact that a reduction in radial extent by several nodes did not have a measurable effect on the observed value of R_e.

The value of R_e for an infinitely deep aquifer ($D = \infty$) was determined by simulating an impermeable and then an infinitely permeable layer at a certain value of D. If this value of D is taken to be sufficiently large, the flow in the system when the layer at D is taken as being impermeable is only slightly


MW-14 bail test
K = 1.6455E-004 ft/min
y0 = 0.4765 ft
10.
1.
0.1
Drawdown (ft)
0.
2.8
5.6
8.4
11.2
14.
Time (min)

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A Q T E S O L V   R E S U L T S

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PROBLEM DEFINITION

Problem title: MW-15 bail test

Knowns and Constants:
- No. of data points............... 30
- Radius of well casing............ 0.083
- Radius of well................... 0.083
- Aquifer saturated thickness...... 12.61
- Well screen length............... 10
- Static height of water in well... 12
- Log(Re/Rw)....................... 3.638

ESTIMATION RESULTS

Analytical method: Bouwer and Rice (unconfined aquifer slug test)

PARAMETER ESTIMATES

	Estimate		Std. Error
K =	3.9845E-002	+/-	1.0212E-003
y0 =	7.9986E-001	+/-	1.1176E-002

ANALYSIS OF MODEL RESIDUALS

residual = calculated - observed
weighted residual = residual * weight

Weighted Residual Statistics:
- Number of residuals............... 30
- Number of estimated parameters.... 2
- Degrees of freedom................ 28
- Residual mean..................... 0.006719
- Residual standard deviation....... 0.01332
- Residual variance................. 0.0001773

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0033	0.7	0.72017	-0.020171	1
0.0066	0.67	0.64842	0.021575	1
0.0099	0.6	0.58383	0.016174	1
0.0133	0.53	0.52399	0.0060058	1
0.0166	0.47	0.47179	-0.0017919	1
0.02	0.41	0.42344	-0.013441	1
0.0233	0.39	0.38126	0.0087434	1
0.0266	0.33	0.34327	-0.013274	1

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A Q T E S O L V

A Program for

Automatic Estimation of Aquifer Coefficients

From Aquifer Test Data

By:

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and
James O. Rumbaugh, III

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1895 Preston White Drive, Suite 301
Reston, VA 22091

(703) 476 - 0335

A Q T E S O L V is a user-friendly program designed to analyze data from aquifer tests automatically. Aquifer coefficients for a variety of aquifer test conditions can be estimated by A Q T E S O L V , including the following:

- o confined aquifers, unconfined aquifers, and leaky aquifers
- o pumping tests, injection tests, recovery tests, and slug tests

Features:

- o Interactive, menu-driven program design
- o Nonlinear least-squares estimation of aquifer coefficients
- o Statistical analysis of results
- o Complete graphical display of results

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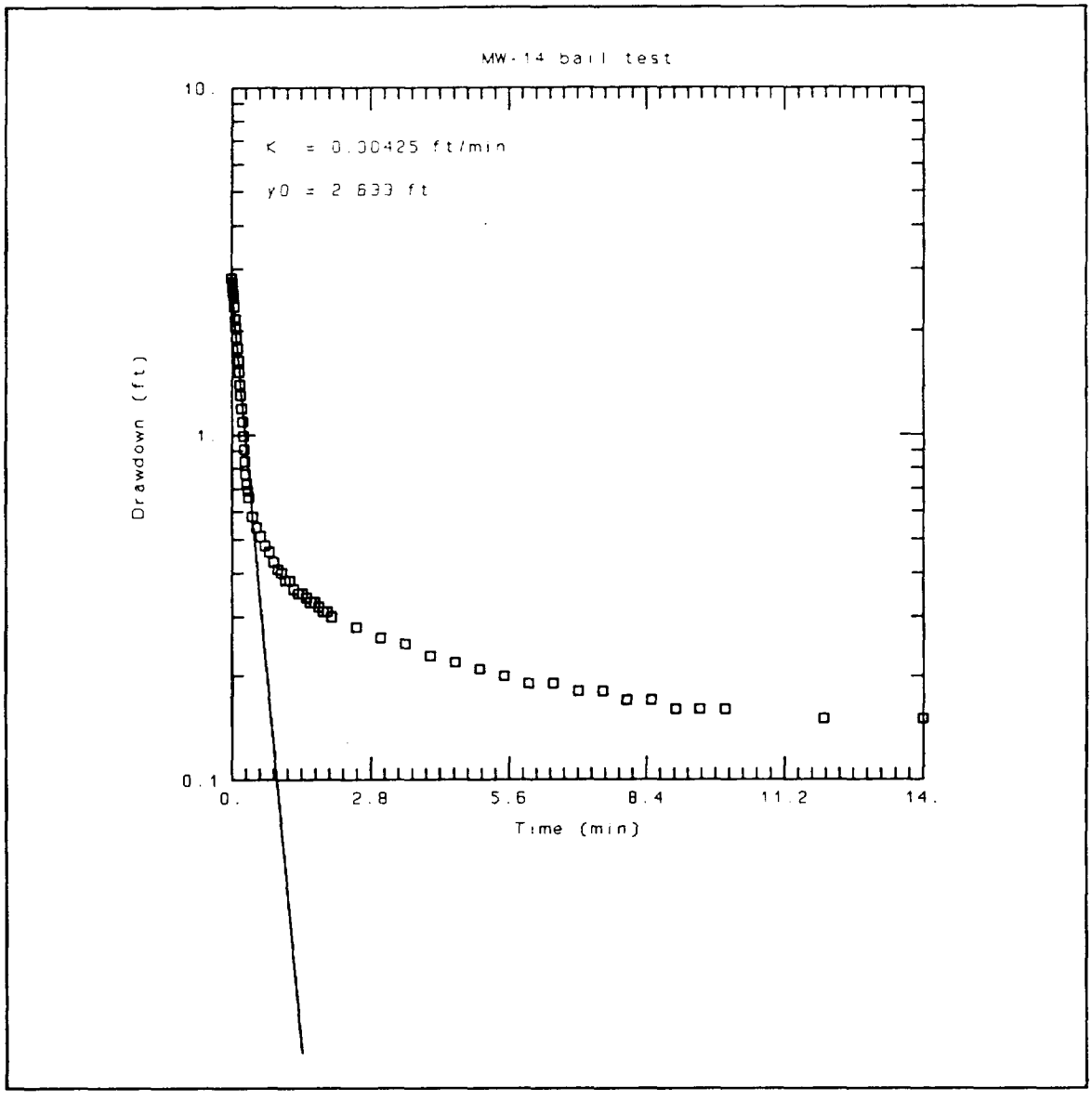
YPE CURVE DATA

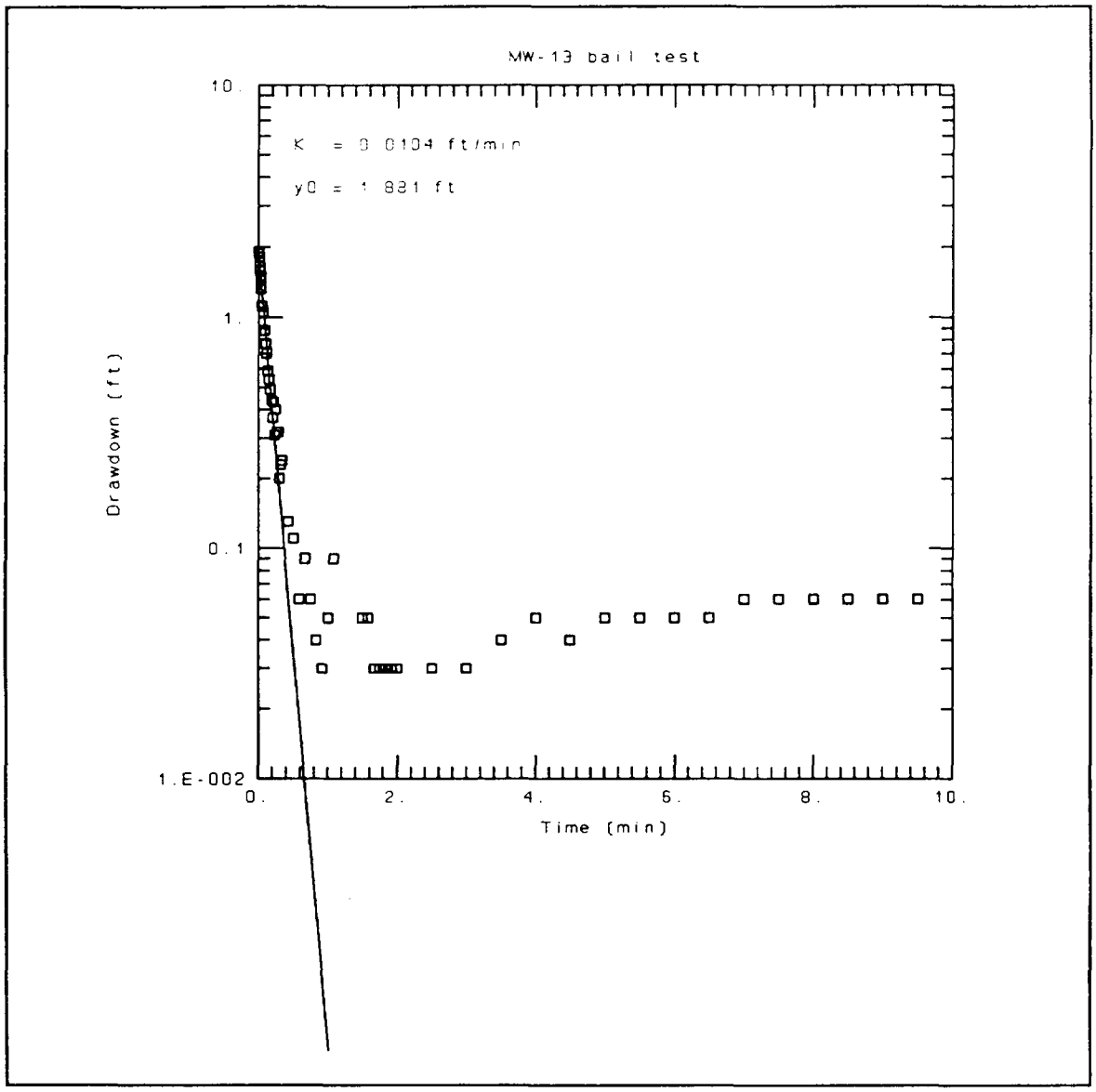
K = 4.24952E-003
y0 = 2.63330E+000

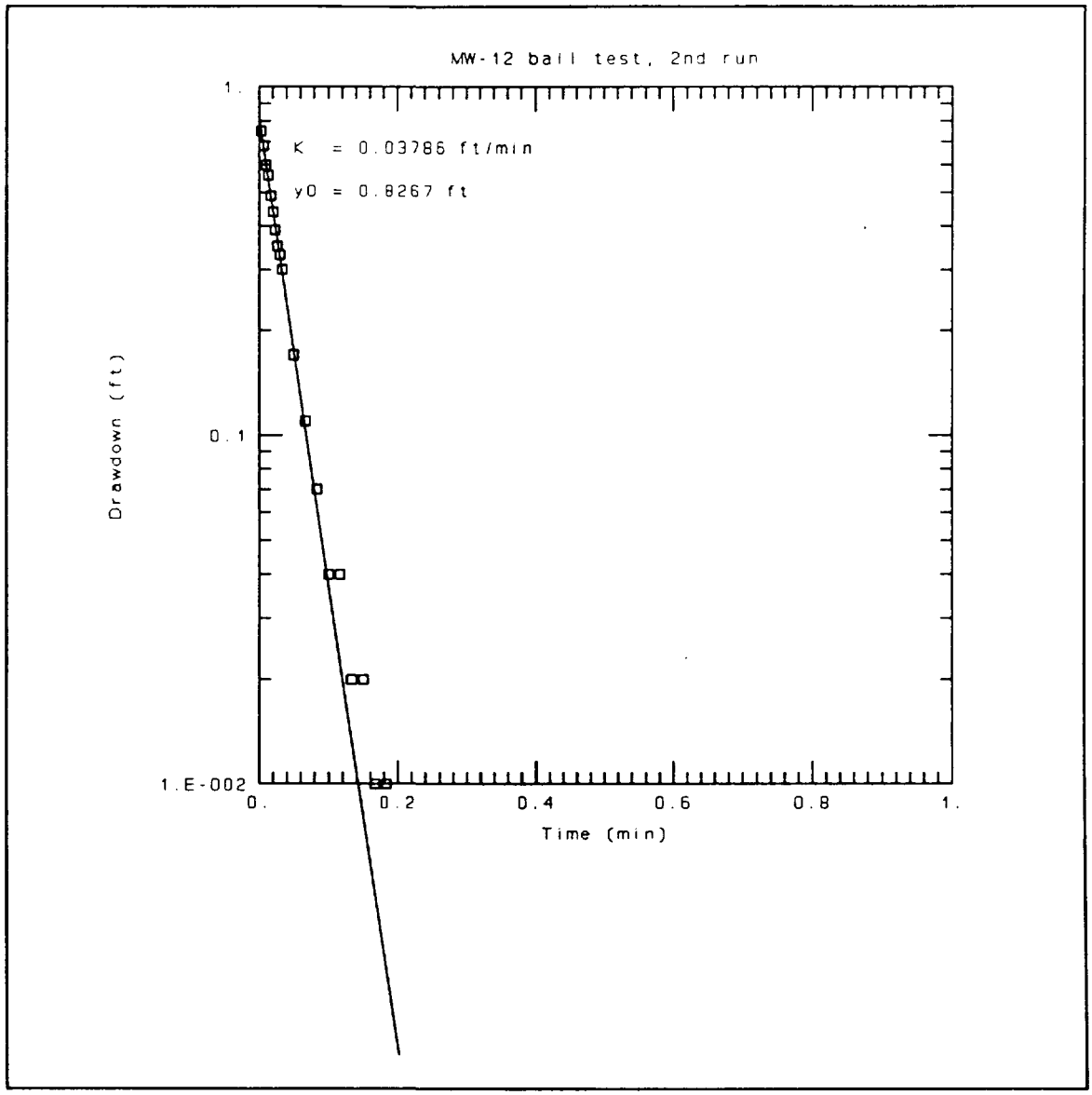
Time	Drawdown	Time	Drawdown	Time	Drawdown
).000E+000	2.633E+000	1.400E+001	2.319E-022		


MW-14 bail test
K = 0.00425 ft/min
y0 = 2.633 ft
10.
1.
0.1
Drawdown (ft)
0.
2.8
5.6
8.4
11.2
14.
Time (min)

MW 13 Dauer

0.03	1.46	1.4819	-0.021873	1
0.0333	1.33	1.4435	-0.1135	1
0.05	1.12	1.264	-0.14401	1
0.0666	1.05	1.1077	-0.057722	1
0.0833	0.88	0.96999	-0.089987	1
0.1	0.77	0.84938	-0.079377	1
0.1166	0.7	0.74436	-0.044356	1
0.1333	0.59	0.6518	-0.061802	1
0.15	0.54	0.57076	-0.030756	1
0.1666	0.49	0.50018	-0.010185	1
0.1833	0.44	0.43799	0.002009	1
0.2	0.37	0.38353	-0.013531	1
0.2166	0.43	0.33611	0.093891	1
0.2333	0.31	0.29432	0.015683	1
0.25	0.4	0.25772	0.14228	1
0.2666	0.32	0.22586	0.094145	1
0.2833	0.32	0.19777	0.12223	1
0.3	0.2	0.17318	0.026819	1
0.3166	0.23	0.15177	0.078232	1
0.3333	0.24	0.1329	0.1071	1
0.4167	0.13	0.068475	0.061525	1
0.5	0.11	0.03531	0.07469	1
0.5833	0.06	0.018208	0.041792	1
0.6667	0.09	0.0093817	0.080618	1
0.75	0.06	0.0048378	0.055162	1
0.8333	0.04	0.0024947	0.037505	1
0.9167	0.03	0.0012854	0.028715	1


MW-13 bail test
K = 0.0104 ft/min
y0 = 1.821 ft
10.
1.
0.1
1.E-002
Drawdown (ft)
0.
2.
4.
6.
8.
10.
Time (min)


MW-12 bail test, 2nd run
K = 0.03786 ft/min
y0 = 0.8267 ft
Drawdown (ft)
1.
0.1
1.E-002
0.
0.2
0.4
0.6
0.8
1.
Time (min)

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A Q T E S O L V   R E S U L T S

08/23/90 15:55:21

PROBLEM DEFINITION

Problem title: MW-13 bail test

Knowns and Constants:
- No. of data points............... 59
- Radius of well casing............ 0.083
- Radius of well................... 0.083
- Aquifer saturated thickness...... 11.59
- Well screen length............... 10
- Static height of water in well... 11.72
- Log(Re/Rw)....................... 3.798

ESTIMATION RESULTS

Analytical method: Bouwer and Rice (unconfined aquifer slug test)

PARAMETER ESTIMATES

	Estimate		Std. Error
K =	1.0402E-002	+/-	3.8235E-004
y0 =	1.8811E+000	+/-	3.0414E-002

ANALYSIS OF MODEL RESIDUALS

residual = calculated - observed
weighted residual = residual * weight

Weighted Residual Statistics:
- Number of residuals............... 35
- Number of estimated parameters.... 2
- Degrees of freedom................ 33
- Residual mean..................... 0.01996
- Residual standard deviation....... 0.07374
- Residual variance................. 0.005437

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0033	1.92	1.8323	0.08766	1
0.0066	1.88	1.7849	0.095111	1
0.0099	1.82	1.7387	0.081334	1
0.0133	1.74	1.6923	0.047705	1
0.0166	1.65	1.6485	0.0015297	1
0.02	1.59	1.6045	-0.014504	1
0.0233	1.58	1.563	0.017047	1
0.0266	1.51	1.5225	-0.012478	1

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A Q T E S O L V   R E S U L T S

08/22/90 18:04:00

PROBLEM DEFINITION

Problem title: MW-12 bail test, 2nd run

Knowns and Constants:
- No. of data points............... 19
- Radius of well casing............ 0.083
- Radius of well................... 0.083
- Aquifer saturated thickness...... 15.61
- Well screen length............... 10
- Static height of water in well... 12.82
- Log(Re/Rw)....................... 3.543

ESTIMATION RESULTS

Analytical method: Bouwer and Rice (unconfined aquifer slug test)

PARAMETER ESTIMATES

	Estimate		Std. Error
K =	3.7858E-002	+/-	6.2754E-004
y0 =	8.2669E-001	+/-	7.3954E-003

ANALYSIS OF MODEL RESIDUALS

Residual = calculated - observed
Weighted residual = residual * weight

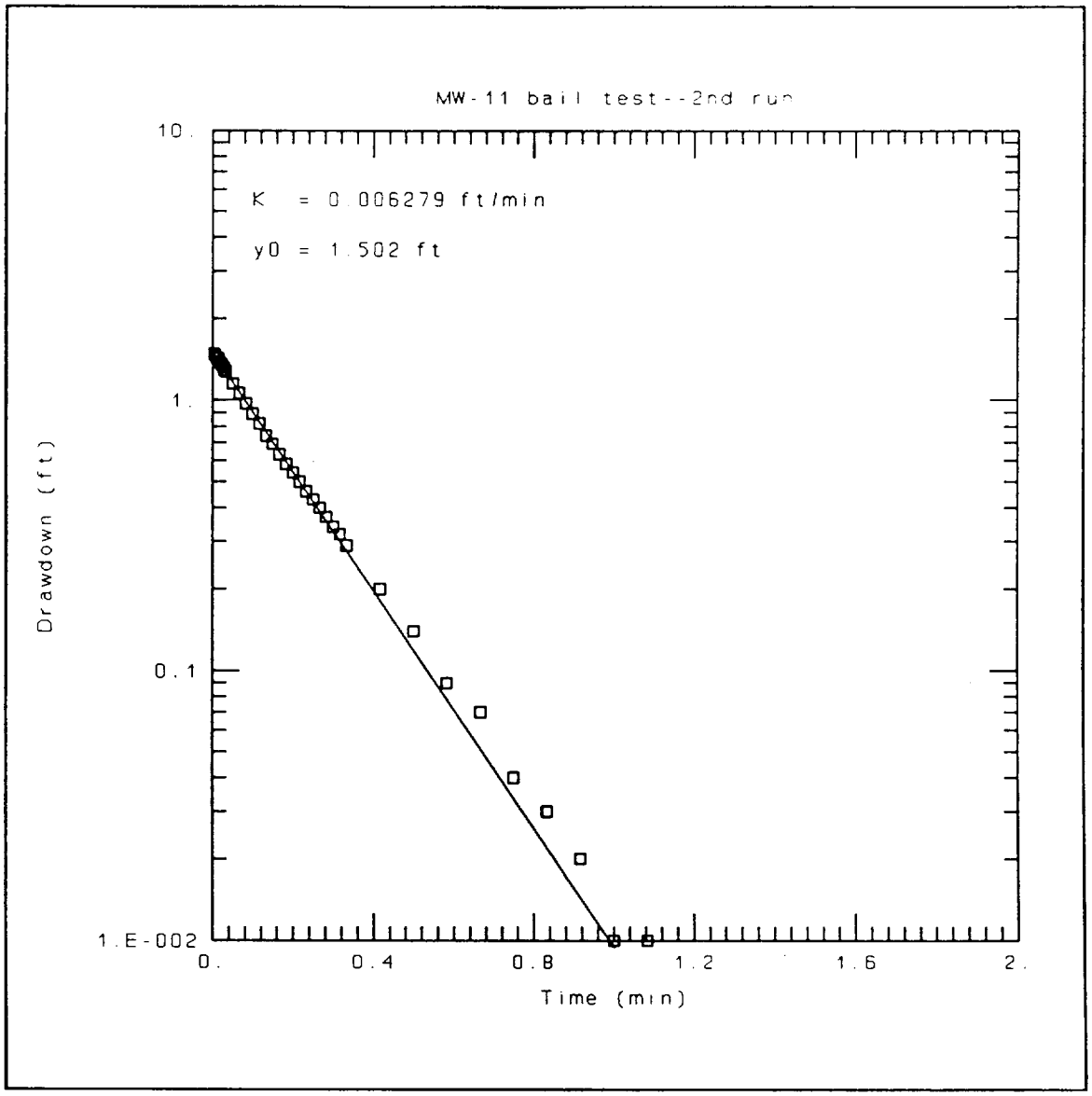
Weighted Residual Statistics:
- Number of residuals............... 19
- Number of estimated parameters.... 2
- Degrees of freedom................ 17
- Residual mean..................... 0.00274
- Residual standard deviation....... 0.008932
- Residual variance................. 7.978E-005

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0033	0.75	0.74625	0.0037481	1
0.0066	0.68	0.67364	0.0063585	1
0.0099	0.6	0.6081	-0.008096	1
0.0133	0.56	0.54723	0.012772	1
0.0166	0.49	0.49398	-0.0039827	1
0.02	0.44	0.44454	-0.004537	1
0.0233	0.39	0.40128	-0.011283	1
0.0266	0.35	0.36224	-0.012239	1

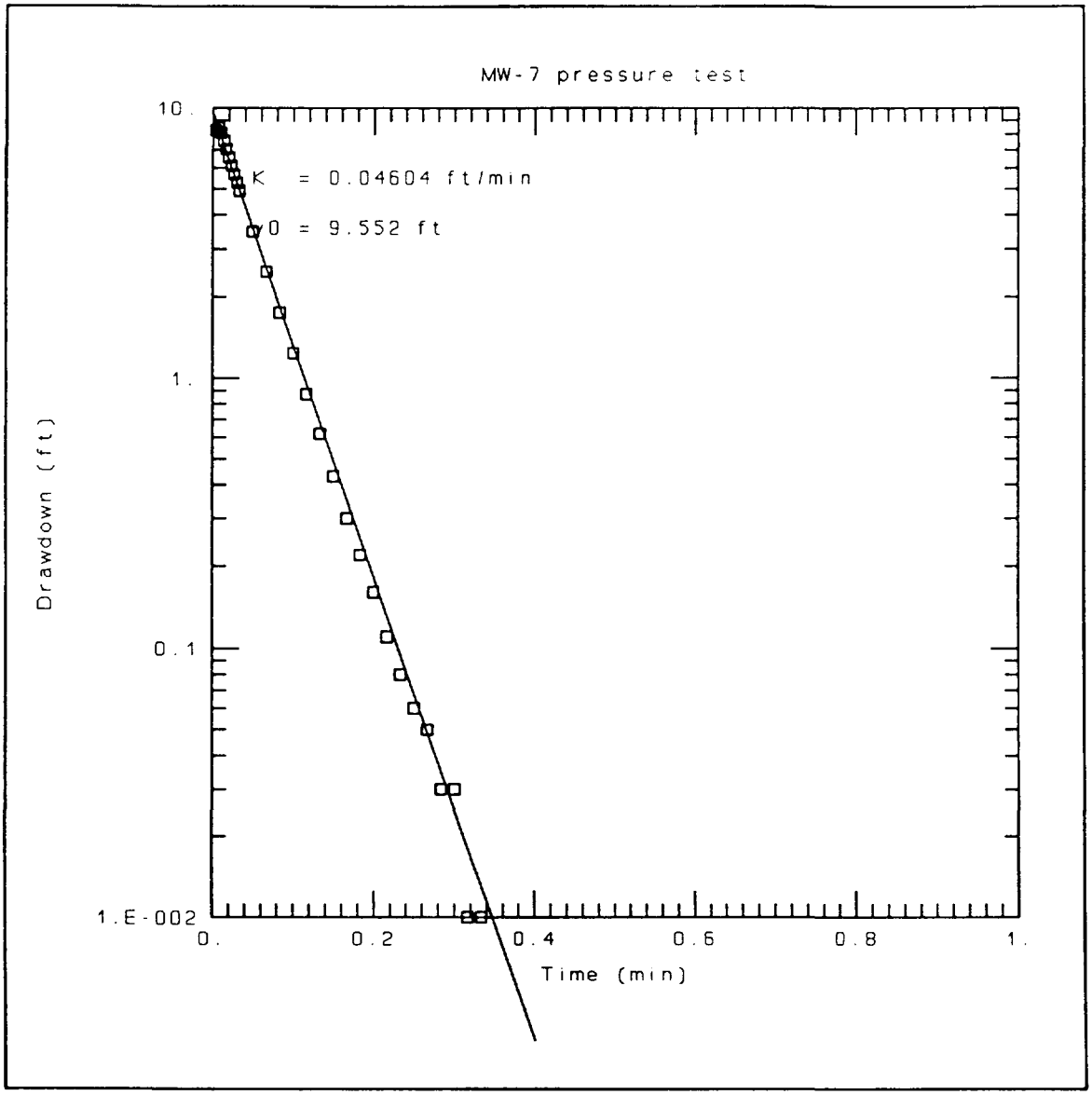
MW-12 Duller

0.03	0.33	0.32598	0.0040201	1
0.0333	0.3	0.29426	0.005738	1
0.05	0.17	0.17529	-0.0052898	1
0.0666	0.11	0.10474	0.0052567	1
0.0833	0.07	0.062395	0.0076051	1
0.1	0.04	0.037168	0.0028318	1
0.1166	0.04	0.02221	0.01779	1
0.1333	0.02	0.01323	0.0067699	1
0.15	0.02	0.0078811	0.012119	1
0.1666	0.01	0.0047093	0.0052907	1
0.1833	0.01	0.0028053	0.0071947	1


MW-11 bail test--2nd run
K = 0.006279 ft/min
y0 = 1.502 ft
10.
1.
0.1
1.E-002
Drawdown (ft)
0.
0.4
0.8
1.2
1.6
2.
Time (min)

MW-11 [illegible]

0.03	1.29	1.2904	-0.00036862	1
0.0333	1.27	1.269	0.0010459	1
0.05	1.15	1.1659	-0.015912	1
0.0666	1.06	1.0718	-0.011781	1
0.0833	0.97	0.98475	-0.014751	1
0.1	0.89	0.90479	-0.014787	1
0.1166	0.82	0.83174	-0.011738	1
0.1333	0.74	0.7642	-0.024199	1
0.15	0.69	0.70214	-0.012145	1
0.1666	0.63	0.64546	-0.015456	1
0.1833	0.58	0.59304	-0.013044	1
0.2	0.54	0.54489	-0.0048878	1
0.2166	0.5	0.5009	-0.00089575	1
0.2333	0.46	0.46022	-0.00022202	1
0.25	0.43	0.42285	0.0071489	1
0.2666	0.4	0.38871	0.011288	1
0.2833	0.37	0.35715	0.012852	1
0.3	0.34	0.32815	0.011853	1
0.3166	0.32	0.30165	0.018347	1
0.3333	0.29	0.27716	0.012842	1
0.4167	0.2	0.18157	0.018428	1
0.5	0.14	0.11901	0.020988	1
0.5833	0.09	0.078006	0.011994	1
0.6667	0.07	0.051103	0.018897	1
0.75	0.04	0.033496	0.0065041	1
0.8333	0.03	0.021955	0.0080451	1
0.9167	0.02	0.014383	0.0056169	1
1	0.01	0.0094274	0.00057258	1
1.0833	0.01	0.0061792	0.0038208	1


MW-7 pressure test
K = 0.04604 ft/min
D = 9.552 ft
10.
1.
0.1
1.E-002
Drawdown (ft)
0.
0.2
0.4
0.6
0.8
1.
Time (min)

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A Q T E S O L V   R E S U L T S

08/23/90 14:50:55

PROBLEM DEFINITION

Problem title: MW-8 pressure test

Knowns and Constants:
- No. of data points............... 28
- Radius of well casing............ 0.083
- Radius of well................... 0.083
- Aquifer saturated thickness...... 100
- Well screen length............... 5
- Static height of water in well... 28.07
- Log(Re/Rw)....................... 3.346

ESTIMATION RESULTS

Analytical method: Bouwer and Rice (unconfined aquifer slug test)

PARAMETER ESTIMATES

	Estimate		Std. Error
K =	4.3125E-002	+/-	2.2305E-004
y0 =	4.4403E+000	+/-	1.0547E-002

ANALYSIS OF MODEL RESIDUALS

residual = calculated - observed
weighted residual = residual * weight

Weighted Residual Statistics:
- Number of residuals............... 28
- Number of estimated parameters.... 2
- Degrees of freedom................ 26
- Residual mean..................... 0.005056
- Residual standard deviation....... 0.01708
- Residual variance................. 0.0002919

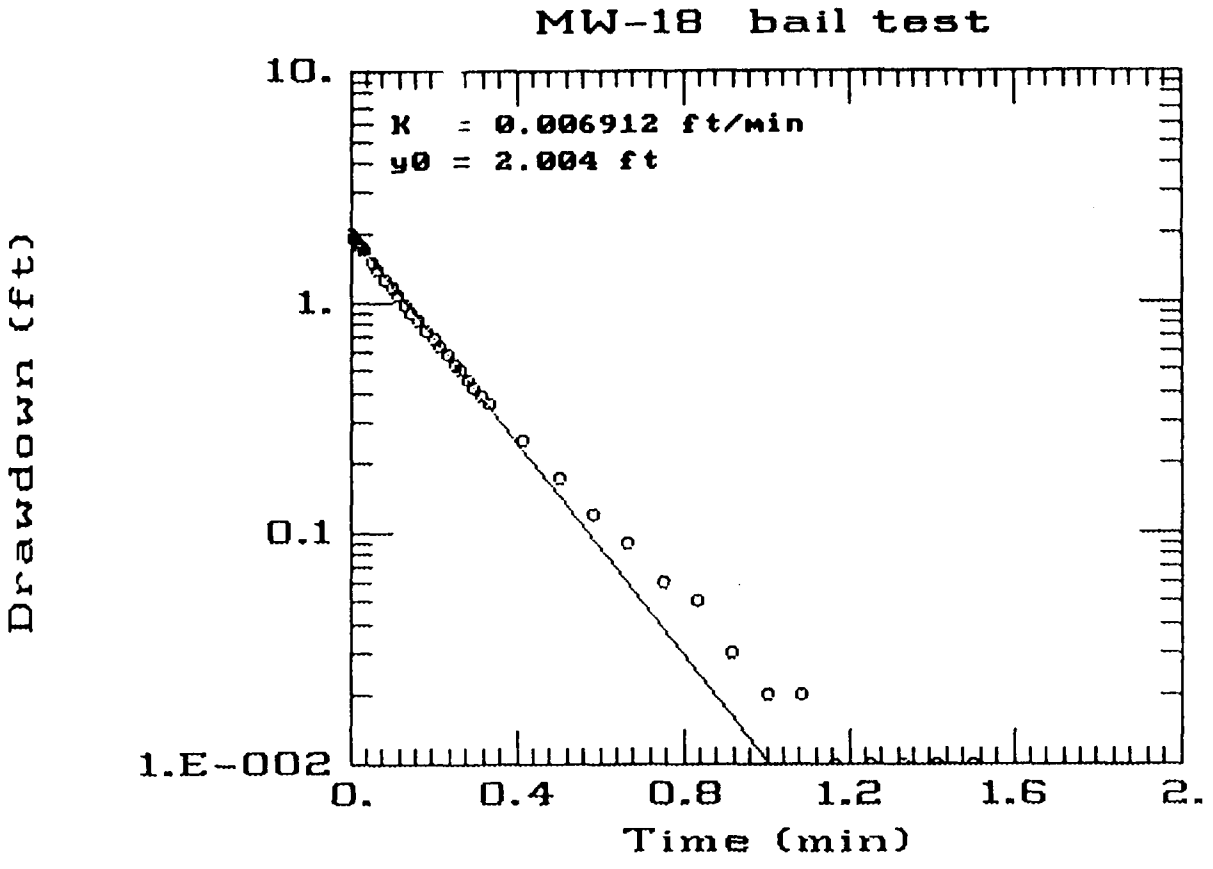
Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0033	4.18	4.1745	0.0055344	1
0.0066	3.92	3.9245	-0.0045152	1
0.0099	3.68	3.6895	-0.0095309	1
0.0133	3.48	3.4621	0.017867	1
0.0166	3.27	3.2548	0.015166	1
0.02	3.08	3.0542	0.025772	1
0.0233	2.89	2.8714	0.018647	1
0.0266	2.68	2.6994	-0.019428	1

APPENDIX I

Aquifer Test Results

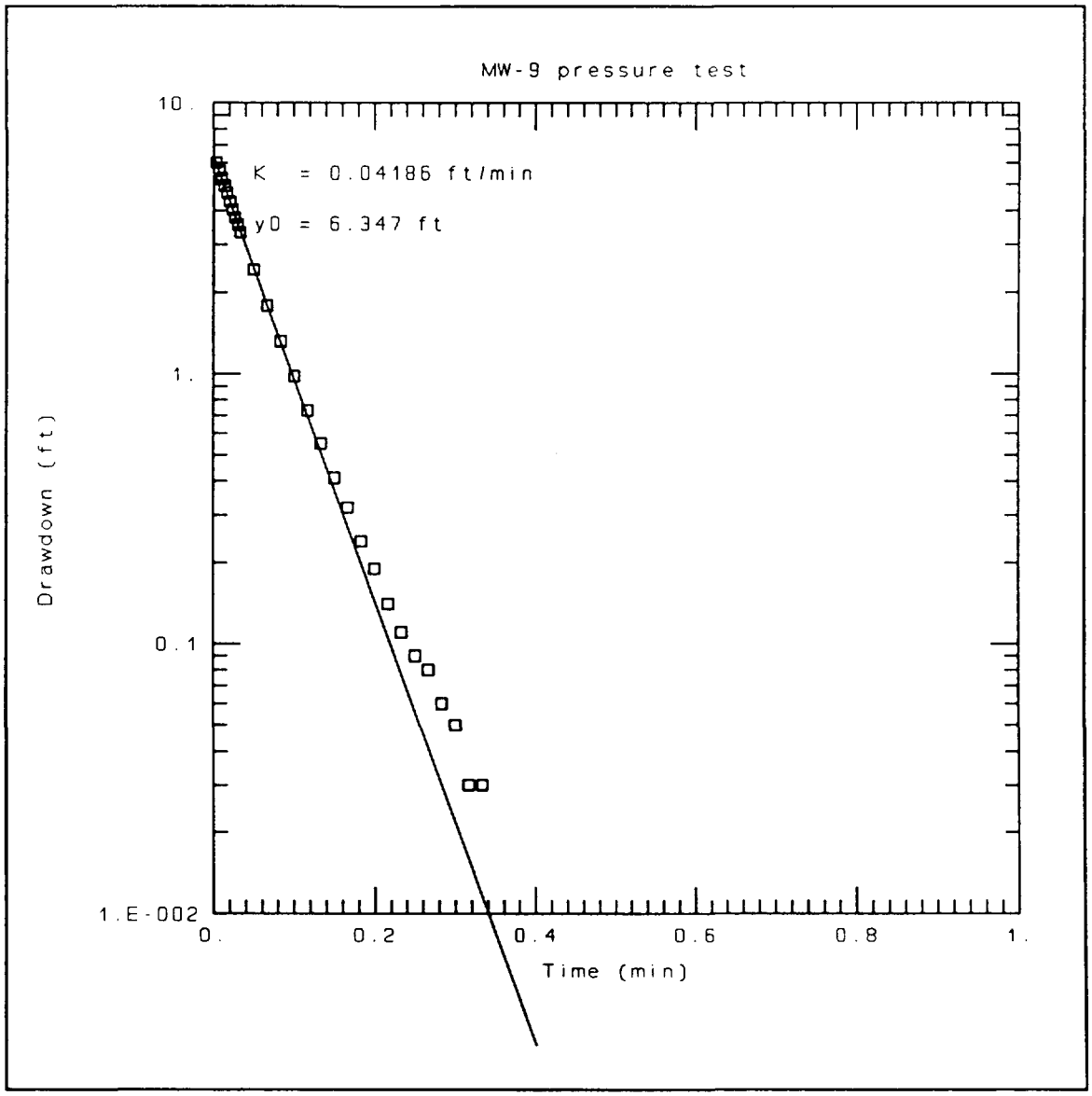
0.03	1.72	1.7106	0.0094158	1
0.0333	1.7	1.681	0.018988	1
0.05	1.52	1.539	-0.01902	1
0.0666	1.39	1.4098	-0.019767	1
0.0833	1.26	1.2907	-0.030686	1
0.1	1.16	1.1817	-0.021664	1
0.1166	1.06	1.0824	-0.022423	1
0.1333	0.98	0.99099	-0.010993	1
0.15	0.89	0.90729	-0.017285	1
0.1666	0.82	0.83109	-0.011088	1
0.1833	0.75	0.76089	-0.010887	1
0.2	0.69	0.69662	-0.0066163	1
0.2166	0.64	0.63811	0.0018885	1
0.2333	0.59	0.58421	0.0057887	1
0.25	0.54	0.53486	0.005136	1
0.2666	0.5	0.48994	0.010056	1
0.2833	0.46	0.44856	0.011441	1
0.3	0.42	0.41067	0.0093298	1
0.3166	0.39	0.37618	0.01382	1
0.3333	0.36	0.34441	0.015595	1
0.4167	0.25	0.22165	0.028351	1
0.5	0.17	0.14272	0.027278	1
0.5833	0.12	0.091901	0.028099	1
0.6667	0.09	0.059145	0.030855	1
0.75	0.06	0.038084	0.021916	1
0.8333	0.05	0.024523	0.025477	1
0.9167	0.03	0.015782	0.014218	1
1	0.02	0.010162	0.0098378	1
1.0833	0.02	0.0065436	0.013456	1
1.1667	0.01	0.0042113	0.0057887	1
1.25	0.01	0.0027117	0.0072883	1
1.3333	0.01	0.0017461	0.0082539	1
1.4166	0.01	0.0011243	0.0088757	1
1.5	0.01	0.00072358	0.0092764	1



AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group


MW-9 pressure test
K = 0.04186 ft/min
y0 = 6.347 ft
10.
1.
0.1
1.E-002
Drawdown (ft)
0.
0.2
0.4
0.6
0.8
1.
Time (min)

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A Q T E S O L V   R E S U L T S

08/22/90 18:18:30

PROBLEM DEFINITION

Problem title: MW-10 Pressure Test

Knowns and Constants:
- No. of data points............... 29
- Radius of well casing............ 0.083
- Radius of well................... 0.083
- Aquifer saturated thickness...... 100
- Well screen length............... 5
- Static height of water in well... 12.62
- Log(Re/Rw)....................... 3.04

ESTIMATION RESULTS

Analytical method: Bouwer and Rice (unconfined aquifer slug test)

PARAMETER ESTIMATES

	Estimate		Std. Error
K =	4.5807E-002	+/-	2.2526E-004
y0 =	5.6307E+000	+/-	1.3216E-002

ANALYSIS OF MODEL RESIDUALS

residual = calculated - observed
weighted residual = residual * weight

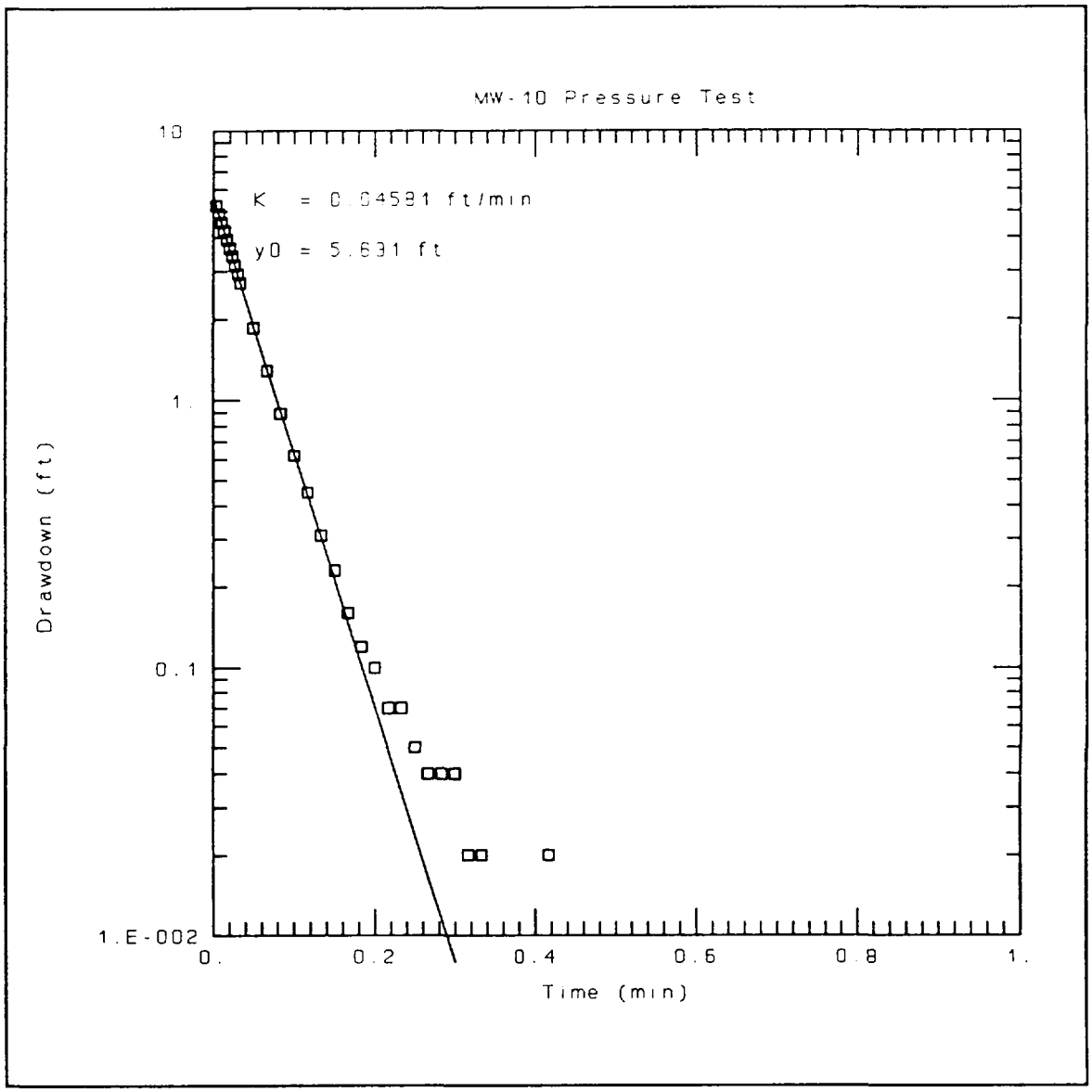
Weighted Residual Statistics:
- Number of residuals............... 29
- Number of estimated parameters.... 2
- Degrees of freedom................ 27
- Residual mean..................... 0.00904
- Residual standard deviation....... 0.01952
- Residual variance................. 0.0003811

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0033	5.23	5.2386	-0.0085832	1
0.0066	4.87	4.8738	-0.0037991	1
0.0099	4.53	4.5344	-0.0044163	1
0.0133	4.22	4.2094	0.010551	1
0.0166	3.91	3.9163	-0.006328	1
0.02	3.64	3.6357	0.0043426	1
0.0233	3.41	3.3825	0.027508	1
0.0266	3.15	3.147	0.0030453	1

Mu to product

0.03	2.93	2.9214	0.0085774	1
0.0333	2.72	2.718	0.0020081	1
0.05	1.86	1.8863	-0.026328	1
0.0666	1.29	1.312	-0.022007	1
0.0833	0.89	0.91055	-0.020553	1
0.1	0.62	0.63194	-0.011938	1
0.1166	0.45	0.43953	0.010465	1
0.1333	0.31	0.30504	0.004956	1
0.15	0.23	0.21171	0.018295	1
0.1666	0.16	0.14725	0.012752	1
0.1833	0.12	0.10219	0.017807	1
0.2	0.1	0.070923	0.029077	1
0.2166	0.07	0.04933	0.02067	1
0.2333	0.07	0.034236	0.035764	1
0.25	0.05	0.02376	0.02624	1
0.2666	0.04	0.016526	0.023474	1
0.2833	0.04	0.011469	0.028531	1
0.3	0.04	0.0079598	0.03204	1
0.3166	0.02	0.0055363	0.014464	1
0.3333	0.02	0.0038423	0.016158	1
0.4167	0.02	0.00061999	0.01938	1


MW-10 Pressure Test
K = 0.04581 ft/min
y0 = 5.631 ft
10
1.
0.1
1.E-002
Drawdown (ft)
0.
0.2
0.4
0.6
0.8
1.
Time (min)

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A Q T E S O L V   R E S U L T S

08/22/90 18:07:39

PROBLEM DEFINITION

Problem title: MW-11 bail test-first run

Knowns and Constants:
- No. of data points............... 35
- Radius of well casing............ 0.083
- Radius of well................... 0.83
- Aquifer saturated thickness...... 16.84
- Well screen length............... 10
- Static height of water in well... 14.02
- ln(Re/Rw)........................ 1.726

ESTIMATION RESULTS

Analytical method: Bouwer and Rice (unconfined aquifer slug test)

PARAMETER ESTIMATES

	Estimate		Std. Error
K =	2.6388E-003	+/-	1.5564E-005
y0 =	1.2042E+000	+/-	2.9491E-003

ANALYSIS OF MODEL RESIDUALS

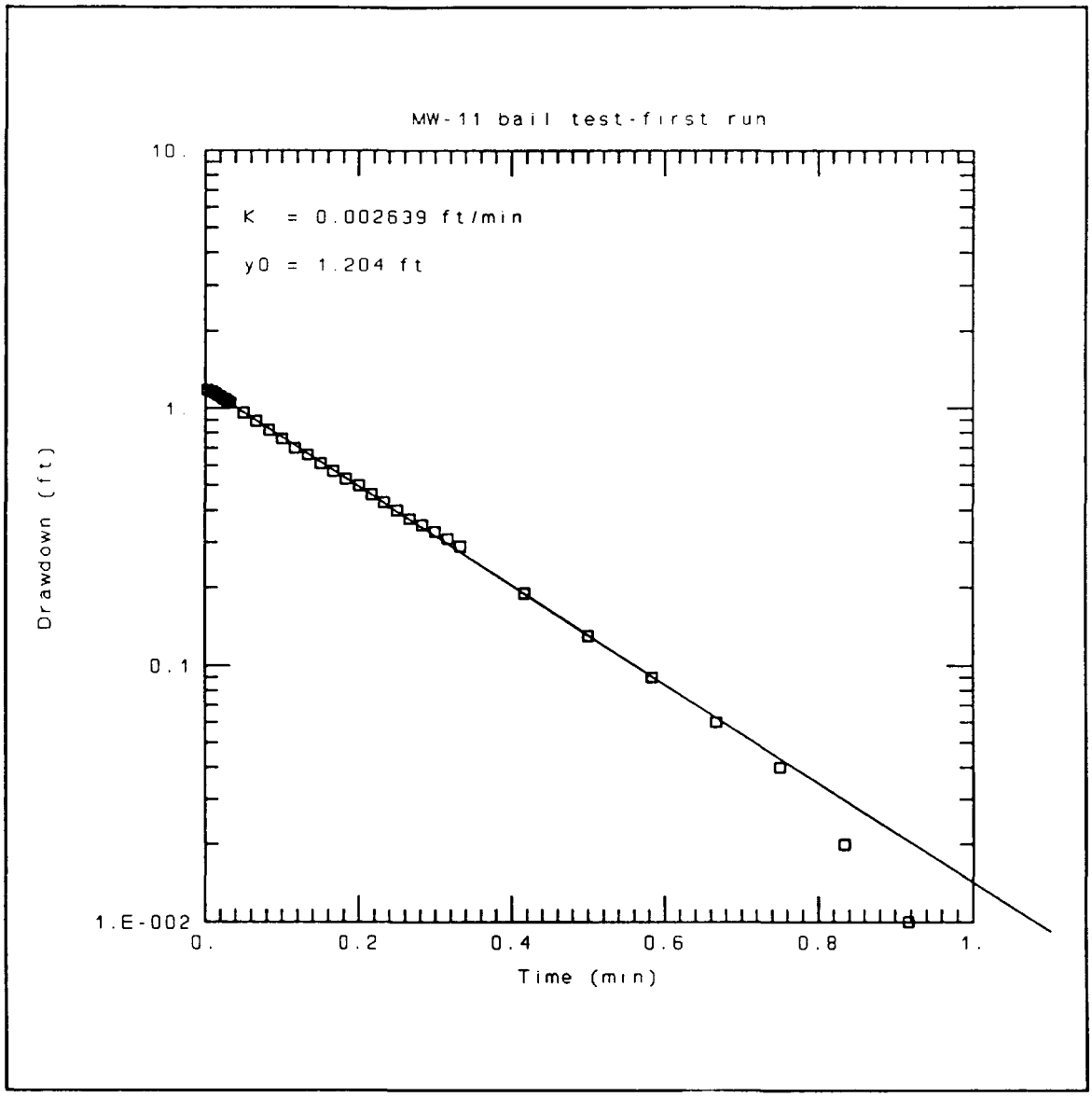
Residual = calculated - observed
Weighted residual = residual * weight

Weighted Residual Statistics.
- Number of residuals............... 35
- Number of estimated parameters.... 2
- Degrees of freedom................ 33
- Residual mean..................... -0.000231
- Residual standard deviation....... 0.008365
- Residual variance................. 6.997E-005

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0033	1.18	1.1867	-0.0066553	1
0.0066	1.16	1.1694	-0.0094058	1
0.0099	1.16	1.1524	0.0075929	1
0.0133	1.14	1.1352	0.0048483	1
0.0166	1.12	1.1187	0.0013491	1
0.02	1.11	1.1019	0.0080991	1
0.0233	1.09	1.0859	0.0041165	1
0.0266	1.08	1.0701	0.0099011	1

0.03	1.06	1.0541	0.0059241	1
0.0333	1.05	1.0388	0.011246	1
0.05	0.96	0.96456	-0.0045628	1
0.0666	0.89	0.89607	-0.0060685	1
0.0833	0.82	0.83207	-0.012069	1
0.1	0.76	0.77264	-0.01264	1
0.1166	0.7	0.71777	-0.017774	1
0.1333	0.66	0.66651	-0.0065087	1
0.15	0.61	0.6189	-0.0089047	1
0.1666	0.57	0.57496	-0.0049558	1
0.1833	0.53	0.53389	-0.0038908	1
0.2	0.5	0.49576	0.0042412	1
0.2166	0.46	0.46055	-0.00055454	1
0.2333	0.43	0.42766	0.0023396	1
0.25	0.4	0.39712	0.0028843	1
0.2666	0.37	0.36892	0.0010838	1
0.2833	0.35	0.34257	0.0074329	1
0.3	0.33	0.3181	0.0119	1
0.3166	0.31	0.29551	0.014489	1
0.3333	0.29	0.27441	0.015595	1
0.4167	0.19	0.18953	0.00047136	1
0.5	0.13	0.13096	-0.00096345	1
0.5833	0.09	0.090495	-0.00049517	1
0.6667	0.06	0.062504	-0.002504	1
0.75	0.04	0.04319	-0.00319	1
0.8333	0.02	0.029844	-0.0098441	1
0.9167	0.01	0.020613	-0.010613	1


MW-11 bail test-first run
K = 0.002639 ft/min
y0 = 1.204 ft
10.
1.
0.1
1.E-002
Drawdown (ft)
0.
0.2
0.4
0.6
0.8
1.
Time (min)

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A Q T E S O L V   R E S U L T S

08/23/90 11:16:36

PROBLEM DEFINITION

Problem title: MW-11 bail test--2nd run

Knowns and Constants:
- No. of data points............... 37
- Radius of well casing............ 0.083
- Radius of well................... 0.083
- Aquifer saturated thickness...... 16.94
- Well screen length............... 10
- Static height of water in well... 14.12
- Log(Re/Rw)....................... 3.594

ESTIMATION RESULTS

Analytical method: Bouwer and Rice (unconfined aquifer slug test)

PARAMETER ESTIMATES

	Estimate		Std. Error
K =	6.2788E-003	+/-	4.3647E-005
y0 =	1.5024E+000	+/-	4.4407E-003

ANALYSIS OF MODEL RESIDUALS

residual = calculated - observed
weighted residual = residual * weight

Weighted Residual Statistics:
- Number of residuals............... 37
- Number of estimated parameters.... 2
- Degrees of freedom................ 35
- Residual mean..................... 0.002433
- Residual standard deviation....... 0.01221
- Residual variance................. 0.0001491

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0033	1.48	1.4775	0.0025334	1
0.0066	1.46	1.4529	0.007053	1
0.0099	1.43	1.4288	0.0011656	1
0.0133	1.42	1.4044	0.015591	1
0.0166	1.39	1.3811	0.0088977	1
0.02	1.36	1.3575	0.0025066	1
0.0233	1.35	1.335	0.015035	1
0.0266	1.32	1.3128	0.0071898	1

$$\Delta B = (X^T X)^{-1} X^T \Delta Y \tag{B.5}$$

where:

ΔB = p x 1 vector of parameter corrections

X = n x p matrix of sensitivity coefficients

X^T = p x n transpose of X

$X^T X$ = p x p variance-covariance matrix

ΔY = n x 1 vector of residuals $(y_i - \hat{y}_i)$

To improve the conditioning of the variance-covariance matrix, the Marquardt correction factor is added:

$$\Delta B = (X^T X + \lambda \cdot I)^{-1} X^T \Delta Y \tag{B.6}$$

where:

λ = Marquardt correction factor

I = identity matrix

The Marquardt correction factor is added when parameter corrections computed by the Gauss-Newton method (equation B.5) fail to achieve a reduction in the residual sum of squares (equation B.4). Marquardt iterations start with a sufficiently small value of λ. Larger values of λ are added until equation B.4 is reduced. The algorithm terminates when equation B.4 is minimized.

Weighted least-squares estimation is accomplished by modifying equation B.5 as follows:

$$\Delta B = (X^T W X)^{-1} X^T W \Delta Y \tag{B.7}$$

where:

W = n x n nonsingular symmetric matrix obtained from $\omega^T \omega$

ω = n x n diagonal matrix of weights

Thus, assigning a larger weight to a measurement results in greater influence in the regression equation.

BAILDOWN TEST RESULTS FOR: MW-1
ACS RI/FS Site

WELL INFORMATION

Casing Diameter (in)	2
Effective Casing RADIUS (in)(rc)	1.0
Screen Diameter (in)	2.0
Effective RADIUS (in)(rw)	1.0
Screen Length (ft)(L)	10.0
Aquifer Thickness (ft)(D)	11.4
Well Penetration (ft)(H)	10.9

CALCULATED PARAMETERS

L / rw	120.0
A	4.90
B	0.80
C	4.8
ln ((D-h)/rw)	1.79
ln (Re / rw) Fully Penetrating	3.76
ln (Re / rw)Partially Penetrating	3.59
ln (Re / rw)Partially Penetrating(>6)	NA
1/t * ln (Yo /Yt)	2.82

RESULTS	FT/MIN	FT/DAY	GPD/SQ.FT	CM/SEC
Hydraulic Conductivity Fully-P	3.68E-03	5.30E+00	3.97E+01	1.87E-03
Hydraulic Conductivity Partial-P	3.51E-03	5.06E+00	3.78E+01	1.78E-03
Hydraulic Conductivity Partial-P (>6)	NA	NA	NA	NA

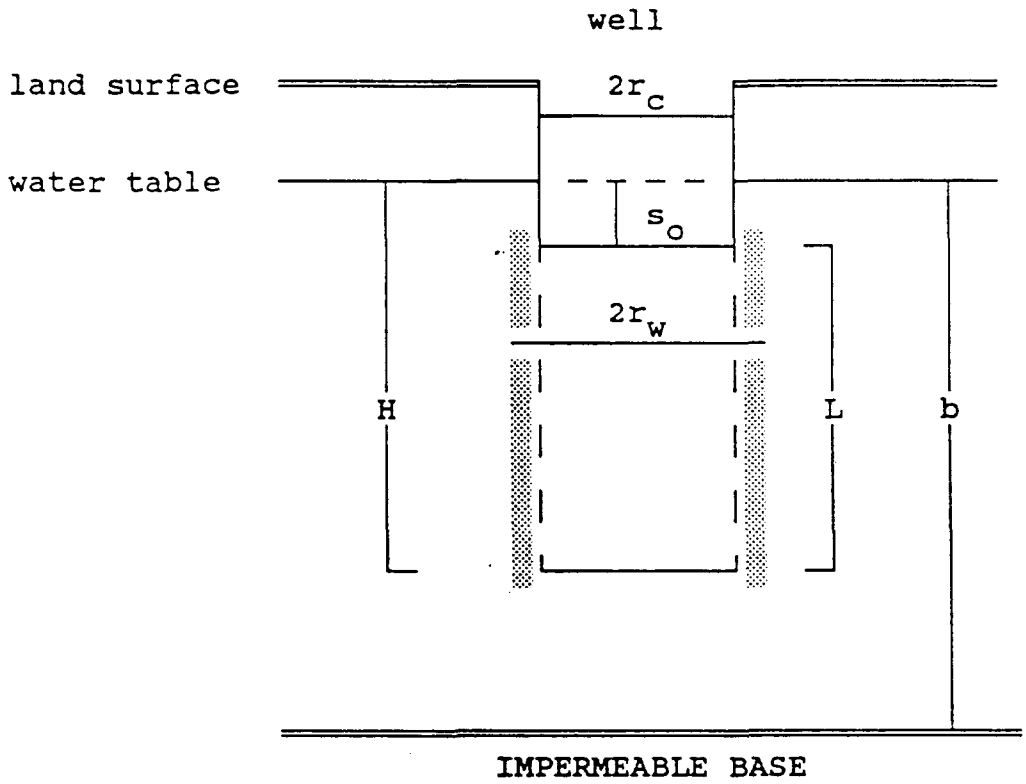
	SQ.M/MIN	SQ.FT/DAY	GPD/FT	SQ.M/SEC
Transmissivity Fully-P	4.20E-02	60.4	452.1	6.50E-05
Transmissivity Partial-P	4.01E-02	57.7	431.4	6.20E-05
Transmissivity Partial-P (>6)	NA	NA	NA	NA

		Time (min)	Depth to Water	Water level Change	Natural Log of Water Level Change		REGR LINE CALC.
Regression Output:		0	6.06	0.00			
Constant	0.378	0.0033	6.21	0.15	-1.90		0.37
Std Err of Y Est	0.005	0.0066	6.43	0.37	-0.99		0.36
R Squared	0.997	0.0099	10.52	4.46	1.50		0.35
No. of Observations	5	0.0133	8.70	2.64	0.97		0.34
Degrees of Freedom	3	0.0166	7.82	1.76	0.57		0.33
		0.02	8.14	2.08	0.73		0.32
X Coefficient(s)	-2.8178	0.0233	6.97	0.91	-0.09		0.31
Std Err of Coef.	0.0914	0.0266	7.70	1.64	0.49		0.30
		0.03	7.36	1.30	0.26		0.29
		0.033	7.42	1.36	0.31	0.31	0.28
		0.05	7.36	1.30	0.26	0.26	0.24
		0.067	7.29	1.23	0.21	0.21	0.19
		0.083	7.25	1.19	0.17	0.17	0.14
		0.1	7.19	1.13	0.12	0.12	0.10
		0.117	7.15	1.09	0.09		0.05
		0.133	7.11	1.05	0.05		0.00
		0.15	7.07	1.01	0.01		-0.04
		0.167	7.03	0.97	-0.03		-0.09
		0.183	7.01	0.95	-0.05		-0.14

Time (min)	Depth to Water	Water level Change	Natural Log of Water Level Change	REGR LINE CALC.
0.2	6.98	0.92	-0.08	-0.19
0.217	6.95	0.89	-0.12	-0.23
0.23	6.92	0.86	-0.15	-0.27
0.25	6.89	0.83	-0.19	-0.33
0.27	6.86	0.80	-0.22	-0.38
0.28	6.85	0.79	-0.24	-0.41
0.3	6.83	0.77	-0.26	-0.47
0.32	6.81	0.75	-0.29	-0.52
0.33	6.79	0.73	-0.31	-0.55
0.42	6.70	0.64	-0.45	-0.81
0.5	6.63	0.57	-0.56	-1.03
0.58	6.57	0.51	-0.67	-1.26
0.67	6.52	0.46	-0.78	-1.51
0.75	6.47	0.41	-0.89	-1.74
0.83	6.43	0.37	-0.99	-1.96
0.92	6.40	0.34	-1.08	-2.21
1	6.37	0.31	-1.17	-2.44
1.08	6.34	0.28	-1.27	-2.67
1.17	6.32	0.26	-1.35	-2.92
1.25	6.29	0.23	-1.47	-3.14
1.33	6.27	0.21	-1.56	-3.37
1.42	6.25	0.19	-1.66	-3.62
1.5	6.24	0.18	-1.71	-3.85
1.58	6.23	0.17	-1.77	-4.07
1.67	6.22	0.16	-1.83	-4.33
1.75	6.20	0.14	-1.97	-4.55
1.83	6.19	0.13	-2.04	-4.78
1.92	6.18	0.12	-2.12	-5.03
2	6.17	0.11	-2.21	-5.26
2.5	6.14	0.08	-2.53	
3	6.12	0.06	-2.81	
3.5	6.11	0.05	-3.00	
4	6.10	0.04	-3.22	
4.5	6.10	0.04	-3.22	
5	6.10	0.04	-3.22	
5.5	6.10	0.04	-3.22	
6	6.09	0.03		
	==========			
MIN:	6.06			
MAX:	10.52			

SLUG TEST METHOD FOR UNCONFINED AQUIFERS
(continued)

DEFINITION OF TERMS:



APPENDIX B: NONLINEAR PARAMETER ESTIMATION

AQTESOLV performs nonlinear weighted least-squares parameter estimation using the Gauss-Newton linearization method. To improve the convergence of the method from poor initial guesses for the unknown parameters, the Marquardt correction factor is included (Marquardt, 1963).

In the Gauss-Newton method of parameter estimation, the parameter corrections necessary to minimize the difference between observed and estimated values of the response variable can be expressed as a Taylor series expanded about the current estimated value as follows:

$$y_i = \hat{y}_i + \frac{\partial y}{\partial b}\Delta b + \frac{\partial^2 y}{2!\,\partial^2 b}(\Delta b)^2 + \frac{\partial^3 y}{3!\,\partial^3 b}(\Delta b)^3 \ldots \tag{B.1}$$

where:

y_i = ith observed value of response variable

$\hat{y}_i$ = estimate of ith value of response variable

Δb = parameter correction, $\hat{b}^1 - \hat{b}^0$

$\hat{b}^1$ = updated estimate of the unknown parameter

$\hat{b}^0$ = current estimate of the unknown parameter

Equation B.1 can be linearized by truncating the Taylor series after the first derivative:

$$y_i \approx \hat{y}_i + \frac{\partial y}{\partial b}\Delta b \tag{B.2}$$

Thus, for p unknown parameters, the general linearized equation for computing parameter corrections is written as follows:

$$y_i \approx \hat{y}_i + \sum_{k=1}^{p} \frac{\partial y_i}{\partial b_k}\Delta b_k \tag{B.3}$$

Equation B.3 is written for each observed value of the response variable. The partial derivatives of the response variable with respect to the unknown parameters are known as sensitivity coefficients. The resulting system of linearized equations is solved iteratively until convergence is achieved. The objective function for this minimization problem is the sum of squared residuals given by:

$$RSS = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2 \tag{B.4}$$

In matrix form, Gauss-Newton method computes parameter corrections as follows:

Geraghty & Miller's

A Q T E S O L V™

Aquifer Test Solver
Version 1.00
Documentation

by
Glenn M. Duffield
James O. Rumbaugh, III

Geraghty & Miller Modeling Group
1895 Preston White Drive, Suite 301
Reston, VA 22091
(703) 476-0333

October 17, 1989

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SLUG TEST METHOD FOR UNCONFINED AQUIFERS

REFERENCE: Bouwer, H. and R. C. Rice, 1976. A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resources Research, vol. 12, no. 3, pp. 423-428.

SOLUTION:

$$\ln s_o - \ln s_t = \frac{2 K L t}{r_c^2 \ln(r_e/r_w)}$$

where:

s_o = initial drawdown in well due to instantaneous removal of water from well [L]

s_t = drawdown in well at time t [L]

L = length of well screen [L]

r_c = radius of well casing [L]

$\ln(r_e/r_w)$ = empirical "shape factor" determined from tables provided in Bouwer and Rice (1976)

r_e = equivalent radius over which head loss occurs [L]

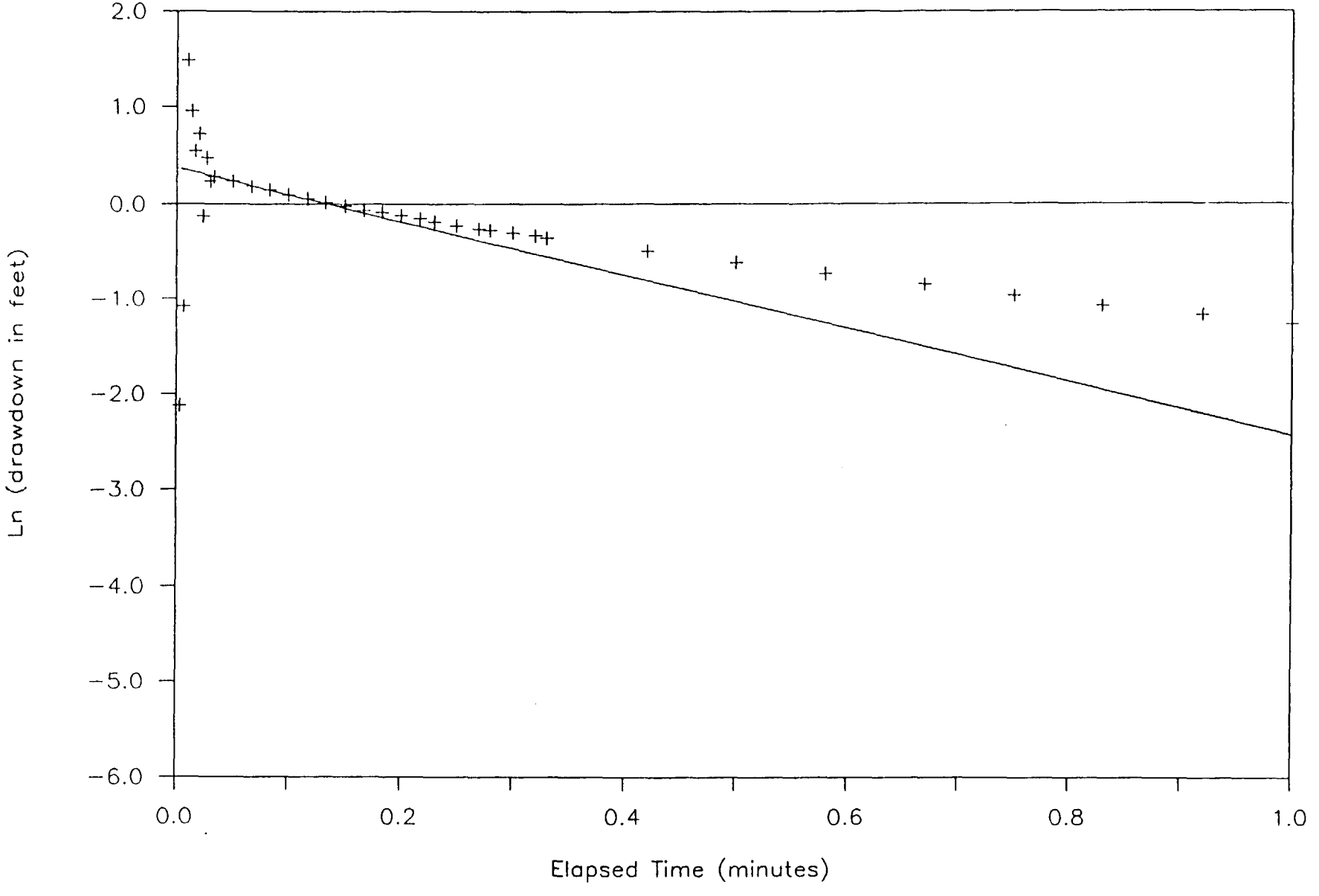
r_w = radius of well (including gravel pack) [L]

H = static height of water in well [L]

b = saturated thickness of aquifer

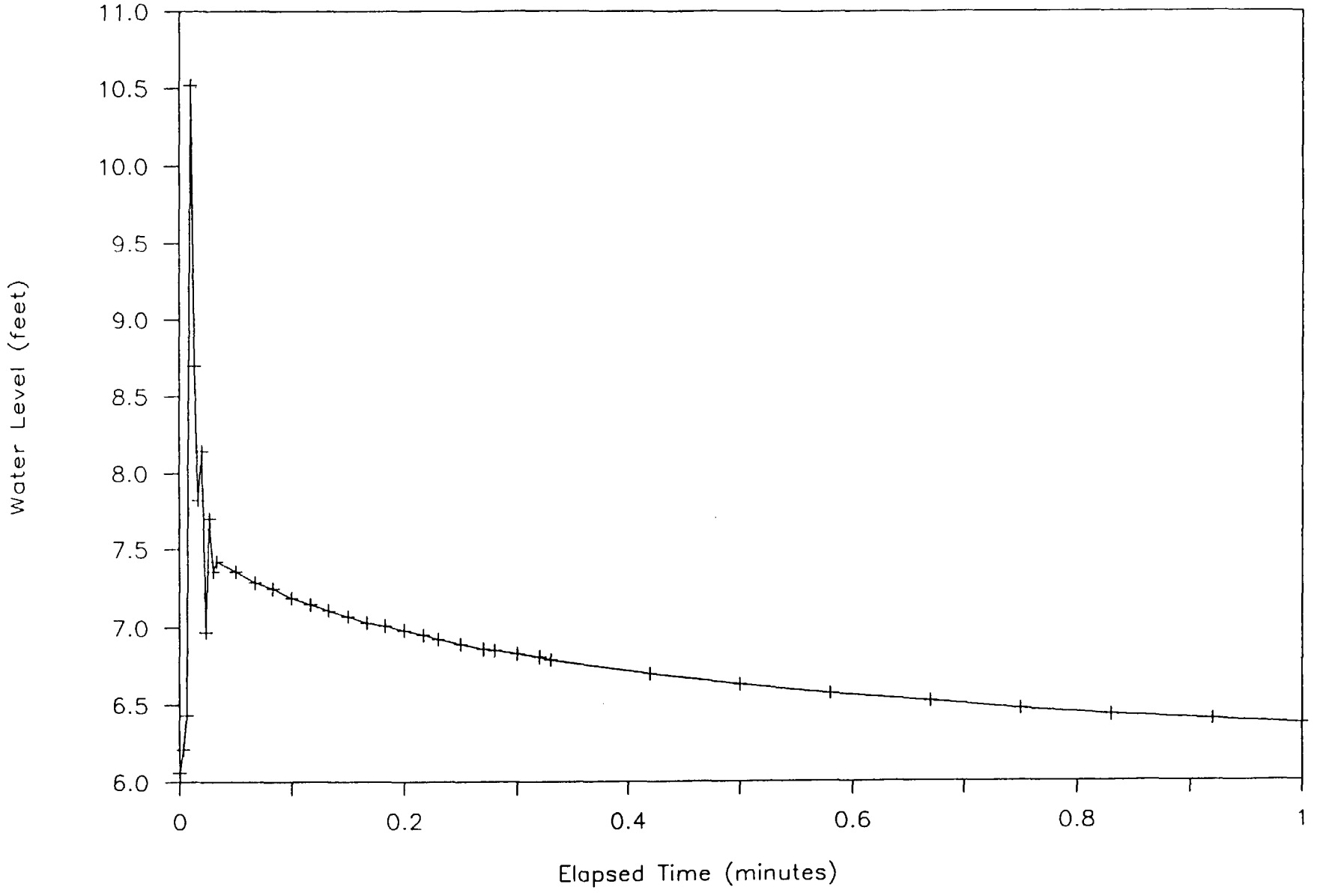
Slug Test at MW-1

Slope for Permeability Calculation



ACS RI/FS -- MW-1

Raw Slug Test Data



BAILDOWN TEST RESULTS FOR: MW-2
ACS RI/FS Site

WELL INFORMATION

Casing Diameter (in)	2
Effective Casing RADIUS (in)(rc)	1.0
Screen Diameter (in)	2.0
Effective RADIUS (in)(rw)	1.0
Screen Length (ft)(L)	10.0
Aquifer Thickness (ft)(D)	15.1
Well Penetration (ft)(H)	12.6

CALCULATED PARAMETERS

L / rw	120.0
A	4.90
B	0.80
C	4.8
ln ((D-h)/rw)	3.40
ln (Re / rw) Fully Penetrating	3.86
ln (Re / rw)Partially Penetrating	3.54
ln (Re / rw)Partially Penetrating(>6)	NA
1/t * ln (Yo /Yt)	2.39

RESULTS	FT/MIN	FT/DAY	GPD/SQ.FT	CM/SEC
Hydraulic Conductivity Fully-P	3.21E-03	4.62E+00	3.45E+01	1.63E-03
Hydraulic Conductivity Partial-P	2.94E-03	4.23E+00	3.17E+01	1.49E-03
Hydraulic Conductivity Partial-P (>6)	NA	NA	NA	NA

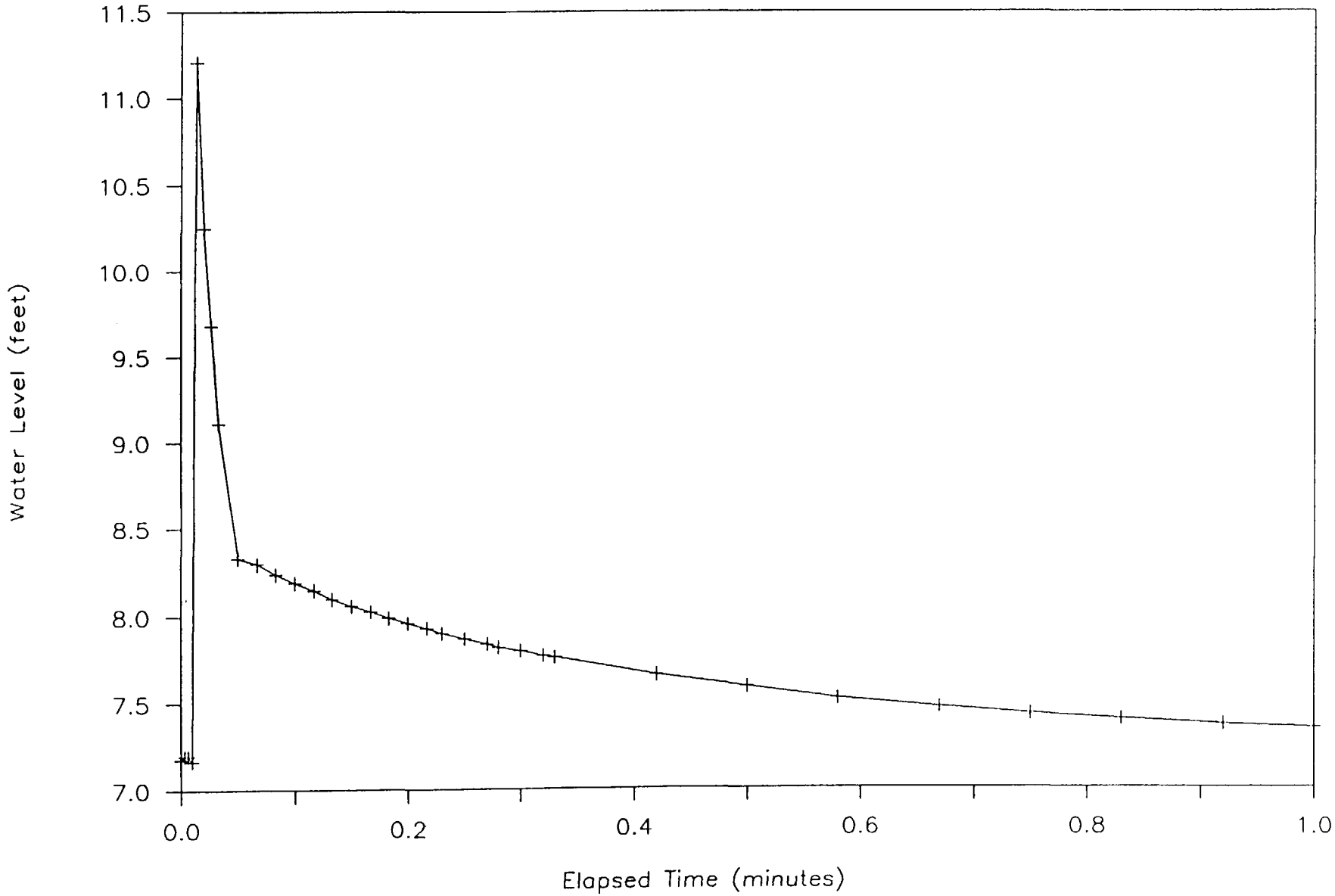
	SQ.M/MIN	SQ.FT/DAY	GPD/FT	SQ.M/SEC
Transmissivity Fully-P	4.84E-02	69.7	521.6	7.50E-05
Transmissivity Partial-P	4.44E-02	63.9	478.2	6.87E-05
Transmissivity Partial-P (>6)	NA	NA	NA	NA

Regression Output:		Time (min)	Depth to Water	Water level Change	Natural Log of Water Level Change		REGR LINE CALC.
		0	7.18	0.09	-2.41		0.34
Constant	0.337	0.0033	7.20	0.11	-2.21		0.33
Std Err of Y Est	0.007	0.0066	7.20	0.11	-2.21		0.32
R Squared	0.998	0.0099	7.17	0.08	-2.53		0.31
No. of Observations	12	0.0133	11.21	4.12	1.42		0.31
Degrees of Freedom	10	0.020	10.25	3.16	1.15		0.29
		0.027	9.68	2.59	0.95		0.27
X Coefficient(s)	-2.3940	0.033	9.11	2.02	0.70		0.26
Std Err of Coef.	0.0340	0.050	8.33	1.24	0.22	0.22	0.22
		0.067	8.30	1.21	0.19	0.19	0.18
		0.083	8.24	1.15	0.14	0.14	0.14
		0.100	8.19	1.10	0.10	0.10	0.10
		0.117	8.15	1.06	0.06	0.06	0.06
		0.133	8.10	1.01	0.01	0.01	0.02
		0.150	8.06	0.97	-0.03	-0.03	-0.02
		0.167	8.03	0.94	-0.06	-0.06	-0.06
		0.183	7.99	0.90	-0.11	-0.11	-0.10

Time (min)	Depth to Water	Water level Change	Natural Log of Water Level Change		REGR LINE CALC.
0.200	7.96	0.87	-0.14	-0.14	-0.14
0.217	7.93	0.84	-0.17	-0.17	-0.18
0.230	7.90	0.81	-0.21	-0.21	-0.21
0.250	7.87	0.78	-0.25		-0.26
0.270	7.84	0.75	-0.29		-0.31
0.280	7.82	0.73	-0.31		-0.33
0.300	7.80	0.71	-0.34		-0.38
0.320	7.77	0.68	-0.39		-0.43
0.330	7.76	0.67	-0.40		-0.45
0.420	7.66	0.57	-0.56		-0.67
0.50	7.59	0.50	-0.69		-0.86
0.58	7.52	0.43	-0.84		-1.05
0.67	7.47	0.38	-0.97		-1.27
0.75	7.43	0.34	-1.08		-1.46
0.83	7.40	0.31	-1.17		-1.65
0.92	7.37	0.28	-1.27		-1.86
1.00	7.35	0.26	-1.35		-2.06
1.08	7.33	0.24	-1.43		-2.25
1.17	7.31	0.22	-1.51		-2.46
1.25	7.30	0.21	-1.56		-2.65
1.33	7.29	0.20	-1.61		-2.85
1.42	7.28	0.19	-1.66		-3.06
1.50	7.27	0.18	-1.71		-3.25
1.58	7.26	0.17	-1.77		-3.44
1.67	7.26	0.17	-1.77		-3.66
1.75	7.25	0.16	-1.83		-3.85
1.83	7.25	0.16	-1.83		-4.04
1.92	7.25	0.16	-1.83		-4.26
2.0	7.24	0.15	-1.90		-4.45
2.5	7.22	0.13	-2.04		-5.65
	==========				
MIN:	7.17				
MAX:	11.21				

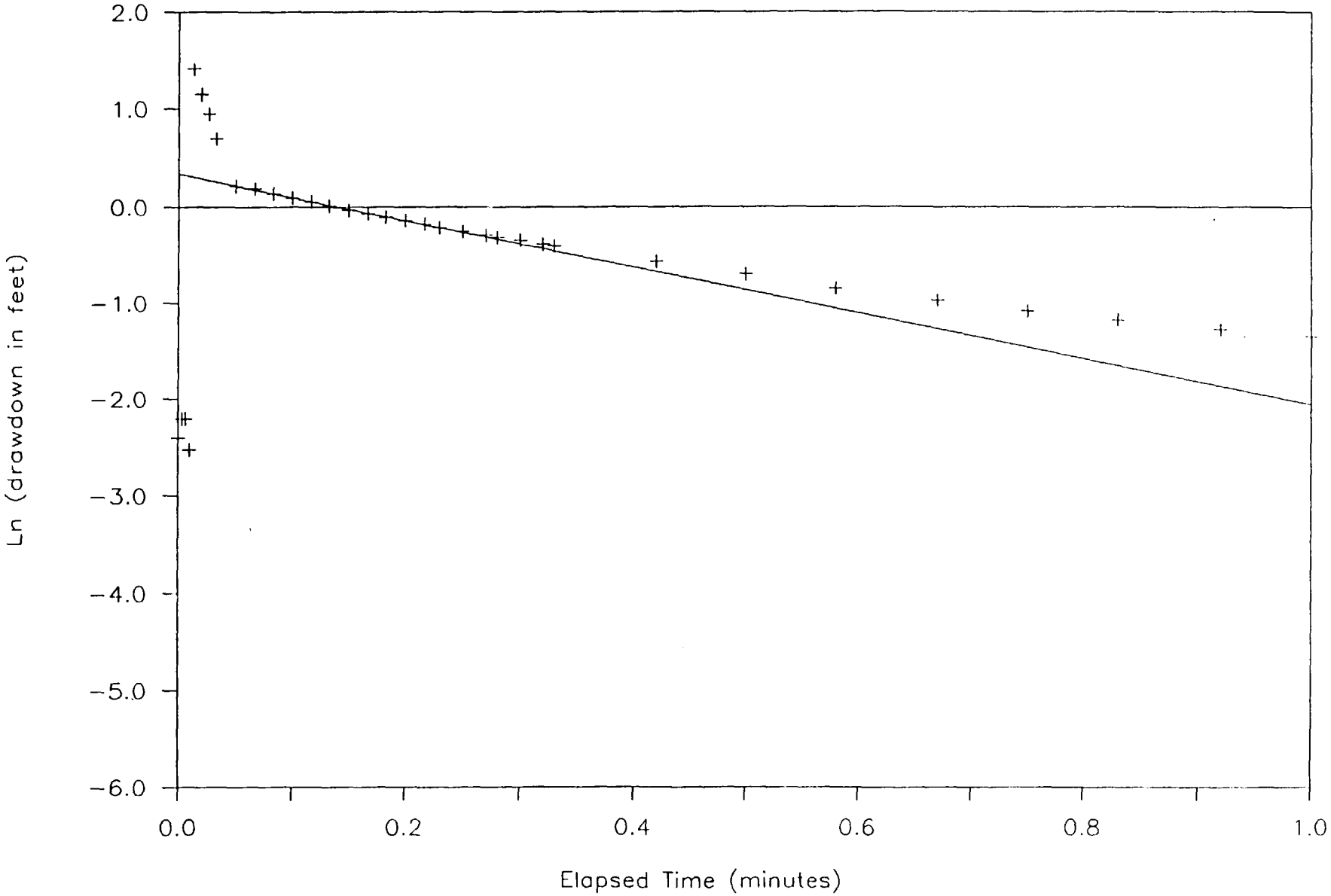
ACS RI/FS -- MW-2

Raw Slug Test Data



Slug Test at MW-2

Slope for Permeability Calculation



BAILDOWN TEST RESULTS FOR: MW-3
ACS RI/FS Site

WELL INFORMATION

Casing Diameter (in)	2
Effective Casing RADIUS (in)(rc)	1.0
Screen Diameter (in)	2.0
Effective RADIUS (in)(rw)	1.0
Screen Length (ft)(L)	9.5
Aquifer Thickness (ft)(D)	11.6
Well Penetration (ft)(H)	11.6

CALCULATED PARAMETERS

L / rw	114.0
A	NA
B	NA
C	4.7
ln ((D-h)/rw)	-13.63
ln (Re / rw) Fully Penetrating	3.79
ln (Re / rw)Partially Penetrating	NA
ln (Re / rw)Partially Penetrating(>6)	NA
1/t * ln (Yo /Yt)	3.03

RESULTS	FT/MIN	FT/DAY	GPD/SQ.FT	CM/SEC
Hydraulic Conductivity Fully-P	4.19E-03	6.03E+00	4.51E+01	2.13E-03
Hydraulic Conductivity Partial-P	NA	NA	NA	NA
Hydraulic Conductivity Partial-P (>6)	NA	NA	NA	NA

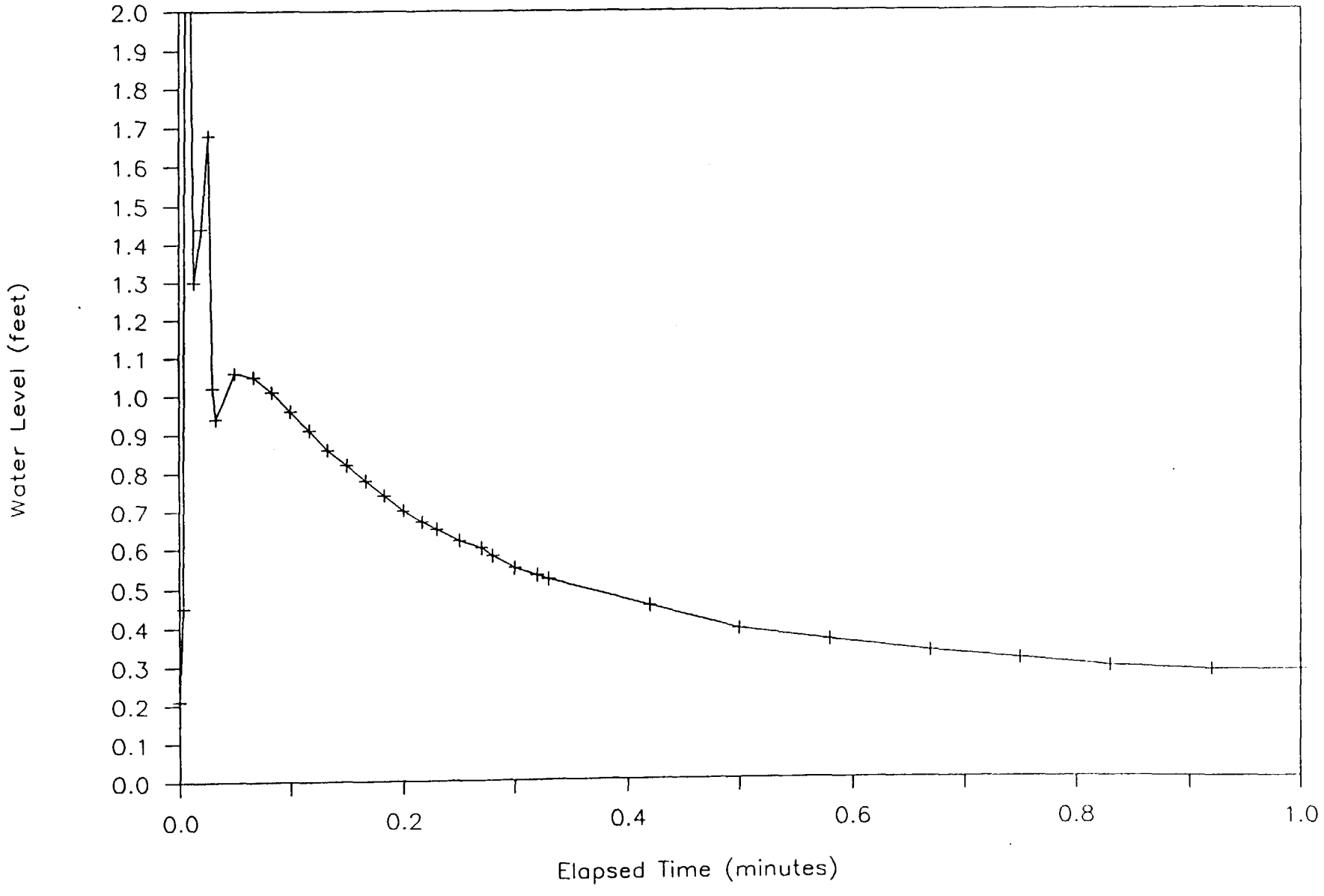
	SQ.M/MIN	SQ.FT/DAY	GPD/FT	SQ.M/SEC
Transmissivity Fully-P	4.86E-02	70.0	523.4	7.52E-05
Transmissivity Partial-P	NA	NA	NA	NA
Transmissivity Partial-P (>6)	NA	NA	NA	NA

Regression Output:		Time (min)	Depth to Water	Water level Change	Natural Log of Water Level Change		REGR LINE CALC.
		0	4.84	0.21	-1.56		0.26
Constant	0.257	0.0033	5.08	0.45	-0.80		0.25
Std Err of Y Est	0.005	0.0066	7.27	2.64	0.97		0.24
R Squared	0.999	0.0099	7.07	2.44	0.89		0.23
No. of Observations	11	0.0133	5.93	1.30	0.26		0.22
Degrees of Freedom	9	0.020	6.07	1.44	0.36		0.20
		0.027	6.31	1.68	0.52		0.18
X Coefficient(s)	-3.0270	0.030	5.65	1.02	0.02		0.17
Std Err of Coef.	0.0312	0.033	5.57	0.94	-0.06		0.16
		0.050	5.69	1.06	0.06		0.11
		0.067	5.68	1.05	0.05	0.05	0.05
		0.083	5.64	1.01	0.01	0.01	0.01
		0.100	5.59	0.96	-0.04	-0.04	-0.05
		0.117	5.54	0.91	-0.09	-0.09	-0.10
		0.133	5.49	0.86	-0.15	-0.15	-0.15
		0.150	5.45	0.82	-0.20	-0.20	-0.20
		0.167	5.41	0.78	-0.25	-0.25	-0.25
		0.183	5.37	0.74	-0.30	-0.30	-0.30

Time (min)	Depth to Water	Water level Change	Natural Log of Water Level Change		REGR LINE CALC.
0.200	5.33	0.70	-0.36	-0.36	-0.35
0.217	5.30	0.67	-0.40	-0.40	-0.40
0.230	5.28	0.65	-0.43	-0.43	-0.44
0.250	5.25	0.62	-0.48		-0.50
0.270	5.23	0.60	-0.51		-0.56
0.280	5.21	0.58	-0.54		-0.59
0.300	5.18	0.55	-0.60		-0.65
0.320	5.16	0.53	-0.63		-0.71
0.330	5.15	0.52	-0.65		-0.74
0.420	5.08	0.45	-0.80		-1.01
0.50	5.02	0.39	-0.94		-1.26
0.58	4.99	0.36	-1.02		-1.50
0.67	4.96	0.33	-1.11		-1.77
0.75	4.94	0.31	-1.17		-2.01
0.83	4.92	0.29	-1.24		-2.26
0.92	4.91	0.28	-1.27		-2.53
1.00	4.91	0.28	-1.27		-2.77
1.08	4.89	0.26	-1.35		-3.01
1.17	4.89	0.26	-1.35		-3.29
1.25	4.89	0.26	-1.35		-3.53
1.33	4.88	0.25	-1.39		-3.77
1.42	4.87	0.24	-1.43		-4.04
1.50	4.87	0.24	-1.43		-4.28
1.58	4.87	0.24	-1.43		-4.53
1.67	4.87	0.24	-1.43		-4.80
1.75	4.87	0.24	-1.43		-5.04
1.83	4.87	0.24	-1.43		-5.28
1.92	4.87	0.24	-1.43		-5.56
2.0	4.87	0.24	-1.43		-5.80
2.5	4.86	0.23	-1.47		-7.31
3.0	4.86	0.23	-1.47		-8.82
	==========				
MIN:	4.84				
MAX:	7.27				

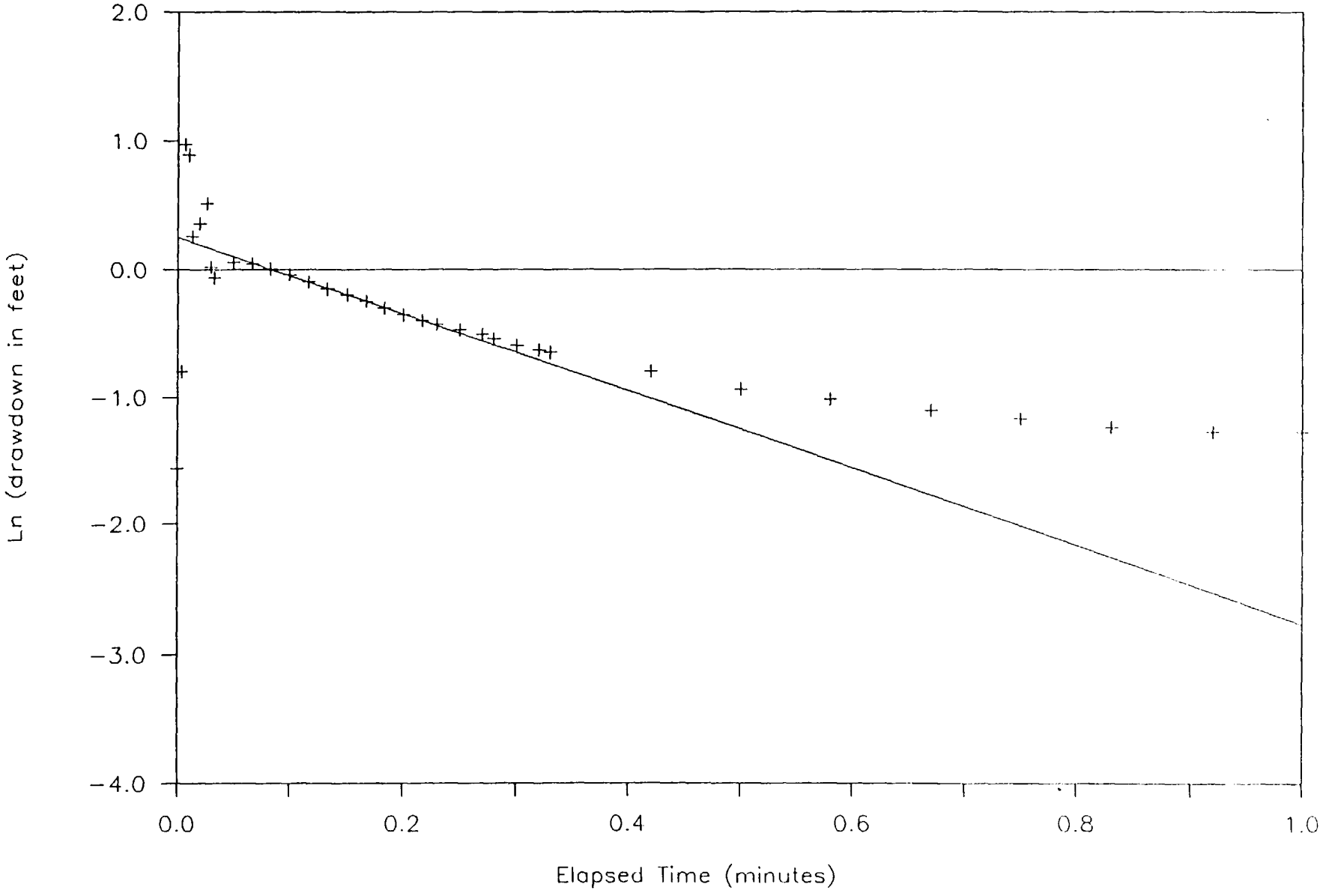
ACS RI/FS -- MW-3

Raw Slug Test Data



Slug Test at MW-3

Slope for Permeability Calculation



BAILDOWN TEST RESULTS FOR: MW-4
ACS RI/FS Site

WELL INFORMATION

Casing Diameter (in)	2
Effective Casing RADIUS (in)(rc)	1.0
Screen Diameter (in)	2.0
Effective RADIUS (in)(rw)	1.0
Screen Length (ft)(L)	10.0
Aquifer Thickness (ft)(D)	14.8
Well Penetration (ft)(H)	12.3

CALCULATED PARAMETERS

L / rw	120.0
A	4.90
B	0.80
C	4.8
ln ((D-h)/rw)	3.40
ln (Re / rw) Fully Penetrating	3.84
ln (Re / rw)Partially Penetrating	3.52
ln (Re / rw)Partially Penetrating(>6)	NA
1/t * ln (Yo /Yt)	2.28

RESULTS	FT/MIN	FT/DAY	GPD/SQ.FT	CM/SEC
Hydraulic Conductivity Fully-P	3.05E-03	4.39E+00	3.28E+01	1.55E-03
Hydraulic Conductivity Partial-P	2.79E-03	4.02E+00	3.01E+01	1.42E-03
Hydraulic Conductivity Partial-P (>6)	NA	NA	NA	NA

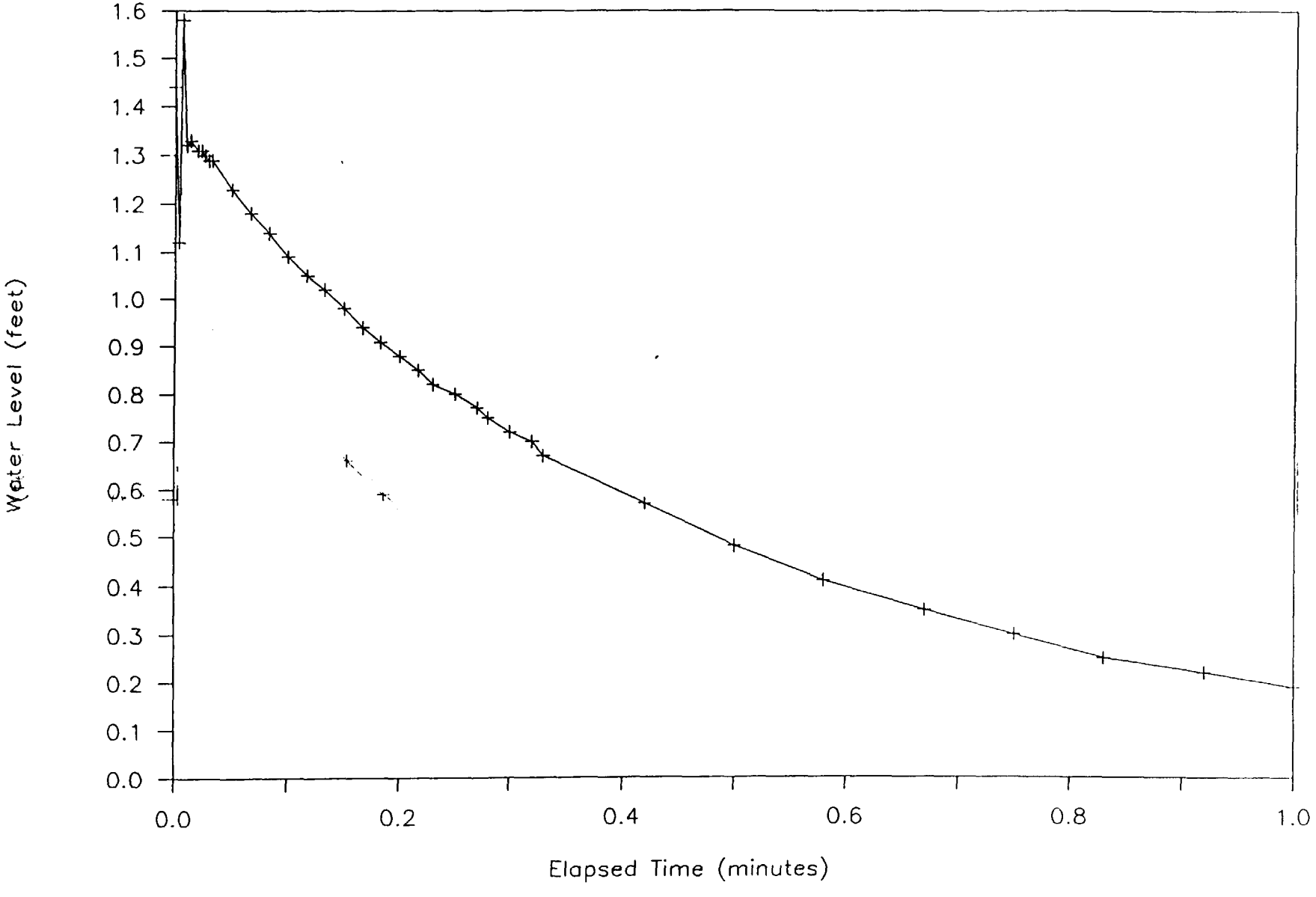
	SQ.M/MIN	SQ.FT/DAY	GPD/FT	SQ.M/SEC
Transmissivity Fully-P	4.51E-02	64.9	485.6	6.98E-05
Transmissivity Partial-P	4.14E-02	59.6	445.4	6.40E-05
Transmissivity Partial-P (>6)	NA	NA	NA	NA

Regression Output:		Time (min)	Depth to Water	Water level Change	Natural Log of Water Level Change		REGR LINE CALC.
		0	8.84	1.44	0.36		0.32
Constant	0.322	0.0033	8.52	1.12	0.11		0.31
Std Err of Y Est	0.004	0.0066	8.98	1.58	0.46		0.31
R Squared	0.999	0.0099	8.72	1.32	0.28		0.30
No. of Observations	14	0.0133	8.73	1.33	0.29		0.29
Degrees of Freedom	12	0.020	8.71	1.31	0.27		0.28
		0.023	8.71	1.31	0.27	0.27	0.27
X Coefficient(s)	-2.2835	0.027	8.70	1.30	0.26	0.26	0.26
Std Err of Coef.	0.0198	0.030	8.69	1.29	0.25	0.25	0.25
		0.033	8.69	1.29	0.25	0.25	0.25
		0.050	8.63	1.23	0.21	0.21	0.21
		0.067	8.58	1.18	0.17	0.17	0.17
		0.083	8.54	1.14	0 13	0.13	0.13
		0.100	8.49	1.09	0.09	0.09	0.09
		0.117	8.45	1.05	0.05	0.05	0.05
		0.133	8.42	1.02	0.02	0.02	0.02
		0.150	8.38	0.98	-0.02	-0.02	-0.02
		0.167	8.34	0.94	-0.06	-0.06	-0.06
		0.183	8.31	0.91	-0.09	-0.09	-0.10

Time (min)	Depth to Water	Water level Change	Natural Log of Water Level Change		REGR LINE CALC.
0.200	8.28	0.88	-0.13	-0.13	-0.13
0.217	8.25	0.85	-0.16		-0.17
0.230	8.22	0.82	-0.20		-0.20
0.250	8.20	0.80	-0.22		-0.25
0.270	8.17	0.77	-0.26		-0.29
0.280	8.15	0.75	-0.29		-0.32
0.300	8.12	0.72	-0.33		-0.36
0.320	8.10	0.70	-0.36		-0.41
0.330	8.07	0.67	-0.40		-0.43
0.420	7.97	0.57	-0.56		-0.64
0.50	7.88	0.48	-0.73		-0.82
0.58	7.81	0.41	-0.89		-1.00
0.67	7.75	0.35	-1.05		-1.21
0.75	7.70	0.30	-1.20		-1.39
0.83	7.65	0.25	-1.39		-1.57
0.92	7.62	0.22	-1.51		-1.78
1.00	7.59	0.19	-1.66		-1.96
1.08	7.55	0.15	-1.90		-2.14
1.17	7.53	0.13	-2.04		-2.35
1.25	7.52	0.12	-2.12		-2.53
1.33	7.50	0.10	-2.30		-2.72
1.42	7.48	0.08	-2.53		-2.92
1.50	7.47	0.07	-2.66		-3.10
1.58	7.46	0.06	-2.81		-3.29
1.67	7.45	0.05	-3.00		-3.49
1.75	7.45	0.05	-3.00		-3.67
1.83	7.44	0.04	-3.22		-3.86
1.92	7.43	0.03	-3.51		-4.06
2.0	7.43	0.03	-3.51		-4.25
2.5	7.41	0.01	-4.61		-5.39
3.0	7.40	0.00			-6.53
	==========				
MIN:	7.40				
MAX:	8.98				

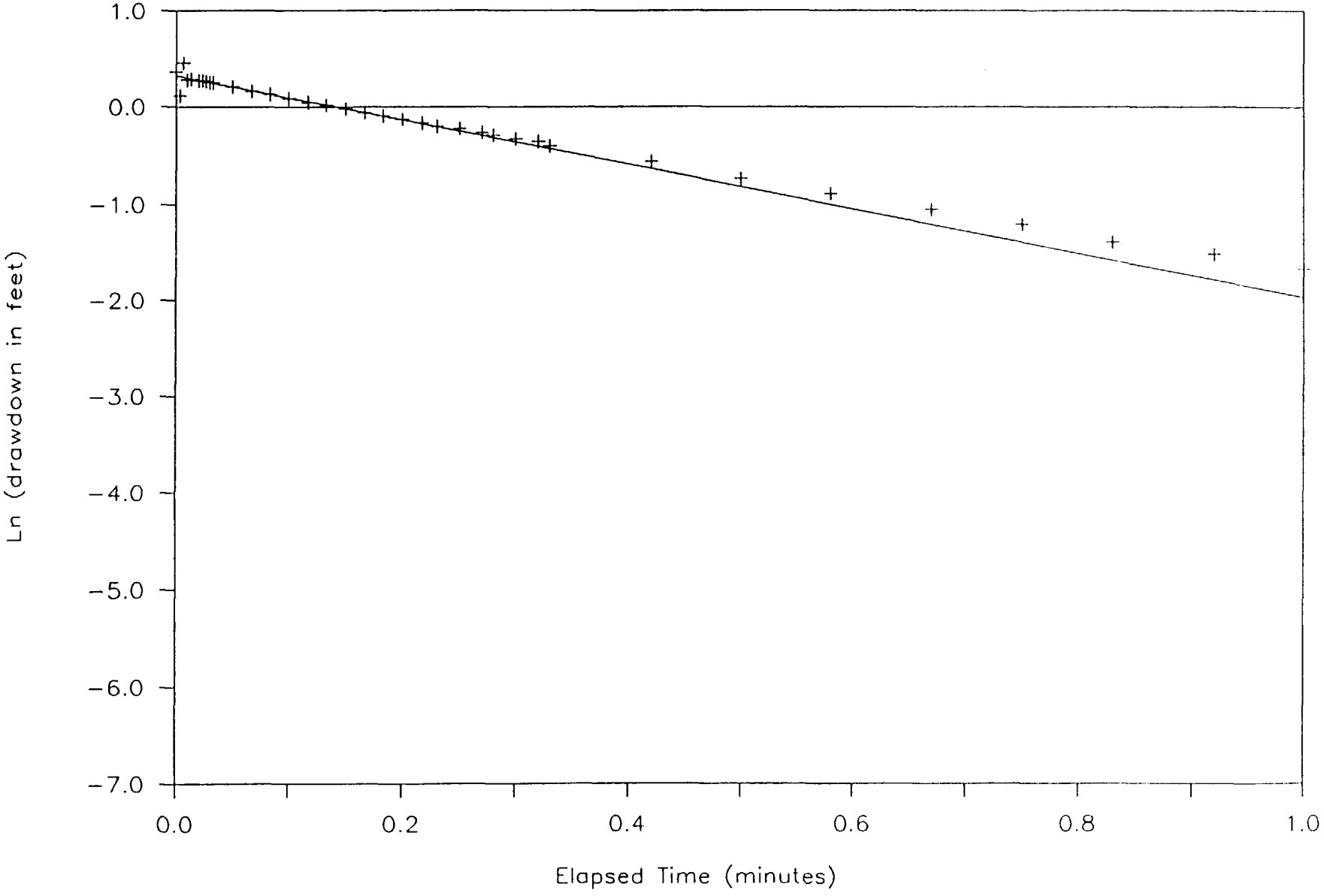
ACS RI/FS -- MW-4

Raw Slug Test Data



Slug Test at MW-4

Slope for Permeability Calculation



BAILDOWN TEST RESULTS FOR: MW-5
ACS RI/FS Site

WELL INFORMATION

Casing Diameter (in)	2
Effective Casing RADIUS (in)(rc)	1.0
Screen Diameter (in)	2.0
Effective RADIUS (in)(rw)	1.0
Screen Length (ft)(L)	10.0
Aquifer Thickness (ft)(D)	15.9
Well Penetration (ft)(H)	12.4

CALCULATED PARAMETERS

L / rw	120.0
A	4.90
B	0.80
C	4.8
ln ((D-h)/rw)	3.74
ln (Re / rw) Fully Penetrating	3.85
ln (Re / rw)Partially Penetrating	3.50
ln (Re / rw)Partially Penetrating(>6)	NA
1/t * ln (Yo /Yt)	18.81

RESULTS	FT/MIN	FT/DAY	GPD/SQ.FT	CM/SEC
Hydraulic Conductivity Fully-P	2.51E-02	3.62E+01	2.71E+02	1.28E-02
Hydraulic Conductivity Partial-P	2.29E-02	3.29E+01	2.46E+02	1.16E-02
Hydraulic Conductivity Partial-P (>6)	NA	NA	NA	NA

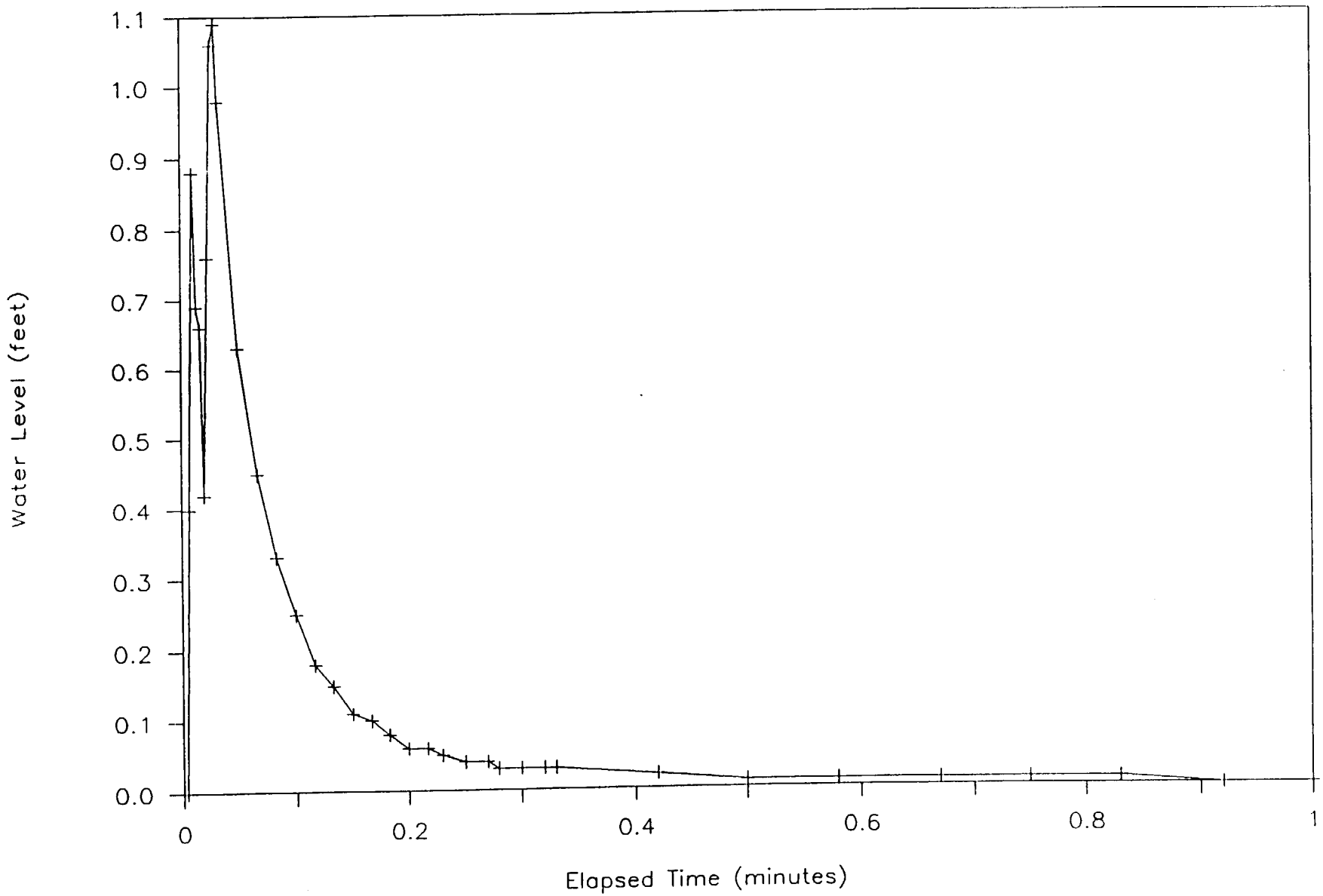
	SQ.M/MIN	SQ.FT/DAY	GPD/FT	SQ.M/SEC
Transmissivity Fully-P	4.00E-01	575.4	4303.1	6.19E-04
Transmissivity Partial-P	3.64E-01	523.5	3915.2	5.63E-04
Transmissivity Partial-P (>6)	NA	NA	NA	NA

Regression Output:		Time (min)	Depth to Water	Water level Change	Natural Log of Water Level Change		REGR LINE CALC.
		0	8.12	0.00	ERR		0.54
Constant	0.538	0.0033	8.12	0.00	ERR		0.48
Std Err of Y Est	0.083	0.0066	8.52	0.40	-0.92		0.41
R Squared	0.991	0.0099	9.00	0.88	-0.13		0.35
No. of Observations	9	0.0133	8.81	0.69	-0.37		0.29
Degrees of Freedom	7	0.0166	8.78	0.66	-0.42		0.23
		0.020	8.54	0.42	-0.87		0.16
X Coefficient(s)	-18.8082	0.023	8.88	0.76	-0.27		0.10
Std Err of Coef.	0.6751	0.027	9.18	1.06	0.06		0.04
		0.030	9.21	1.09	0.09	0.09	-0.03
		0.033	9.10	0.98	-0.02	-0.02	-0.08
		0.050	8.75	0.63	-0.46	-0.46	-0.40
		0.067	8.57	0.45	-0.80	-0.80	-0.72
		0.083	8.45	0.33	-1.11	-1.11	-1.02
		0.100	8.37	0.25	-1.39	-1.39	-1.34
		0.117	8.30	0.18	-1.71	-1.71	-1.66
		0.133	8.27	0.15	-1.90	-1.90	-1.96
		0.150	8.23	0.11	-2.21	-2.21	-2.28
		0.167	8.22	0.10	-2.30		-2.60
		0.183	8.20	0.08	-2.53		-2.90

Time (min)	Depth to Water	Water level Change	Natural Log of Water Level Change	REGR LINE CALC.
0.200	8.18	0.06	-2.81	-3.22
0.217	8.18	0.06	-2.81	-3.54
0.230	8.17	0.05	-3.00	-3.79
0.250	8.16	0.04	-3.22	-4.16
0.270	8.16	0.04	-3.22	-4.54
0.280	8.15	0.03	-3.51	-4.73
0.300	8.15	0.03	-3.51	-5.10
0.320	8.15	0.03	-3.51	-5.48
0.330	8.15	0.03	-3.51	-5.67
0.420	8.14	0.02	-3.91	-7.36
0.50	8.13	0.01	-4.61	-8.87
0.58	8.13	0.01	-4.61	-10.37
0.67	8.13	0.01	-4.61	-12.06
0.75	8.13	0.01	-4.61	-13.57
0.83	8.13	0.01	-4.61	-15.07
0.92	8.12	0.00		-16.77
1.00	8.12	0.00		-18.27
1.08	8.12	0.00		-19.77
1.17	8.12	0.00		-21.47
1.25	8.12	0.00		-22.97
1.33	8.12	0.00		-24.48
1.42	8.12	0.00		-26.17
1.50	8.12	0.00		-27.67
1.58	8.12	0.00		-29.18
1.67	8.12	0.00		-30.87
1.75	8.12	0.00		-32.38
1.83	8.12	0.00		-33.88
1.92	8.12	0.00		-35.57
2.0	8.12	0.00		-37.08
	==========			
MIN:	8.12			
MAX:	9.21			

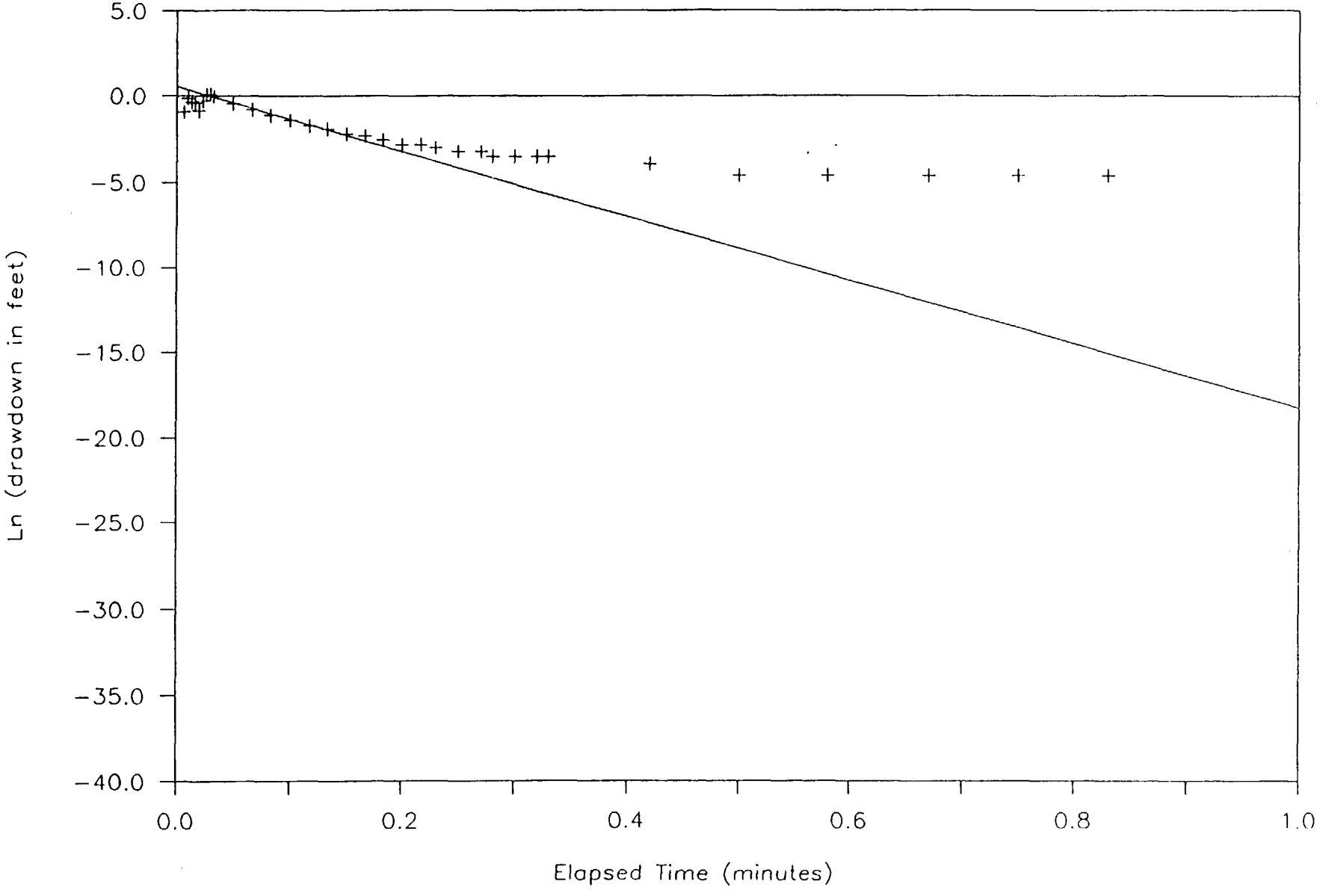
ACS RI/FS -- MW-5

Raw Slug Test Data



Slug Test at MW-5

Slope for Permeability Calculation



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A Q T E S O L V   R E S U L T S

08/23/90 12:42:36

PROBLEM DEFINITION

Problem title: MW-9 pressure test

Knowns and Constants:
- No. of data points............... 28
- Radius of well casing............ 0.083
- Radius of well................... 0.083
- Aquifer saturated thickness...... 100
- Well screen length............... 5
- Static height of water in well... 19.39
- Log(Re/Rw)....................... 3.208

ESTIMATION RESULTS

Analytical method: Bouwer and Rice (unconfined aquifer slug test)

PARAMETER ESTIMATES

	Estimate		Std. Error
K =	4.1860E-002	+/-	3.1451E-004
y0 =	6.3475E+000	+/-	2.1959E-002

ANALYSIS OF MODEL RESIDUALS

Residual = calculated - observed
Weighted residual = residual * weight

Weighted Residual Statistics:
- Number of residuals.............. 28
- Number of estimated parameters.... 2
- Degrees of freedom................ 26
- Residual mean..................... 0.01483
- Residual standard deviation....... 0.03532
- Residual variance................. 0.001247

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0033	6.01	5.9629	0.047094	1
0.0066	5.62	5.6016	0.018373	1
0.0099	5.28	5.2622	0.017764	1
0.0133	4.96	4.9341	0.025945	1
0.0166	4.66	4.6351	0.024888	1
0.02	4.32	4.346	-0.026041	1
0.0233	4.04	4.0827	-0.042724	1
0.0266	3.78	3.8354	-0.055361	1

0.03	3.56	3.5962	-0.036167	1
0.0333	3.34	3.3783	-0.038283	1
0.05	2.43	2.4622	-0.032249	1
0.0666	1.79	1.798	-0.0080028	1
0.0833	1.32	1.3105	0.0095325	1
0.1	0.98	0.95513	0.024871	1
0.1166	0.73	0.69746	0.032538	1
0.1333	0.55	0.50834	0.041657	1
0.15	0.41	0.3705	0.039497	1
0.1666	0.32	0.27055	0.049448	1
0.1833	0.24	0.19719	0.042809	1
0.2	0.19	0.14372	0.046278	1
0.2166	0.14	0.10495	0.03505	1
0.2333	0.11	0.076492	0.033508	1
0.25	0.09	0.055751	0.034249	1
0.2666	0.08	0.040711	0.039289	1
0.2833	0.06	0.029672	0.030328	1
0.3	0.05	0.021626	0.028374	1
0.3166	0.03	0.015792	0.014208	1
0.3333	0.03	0.01151	0.01849	1

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A Q T E S O L V   R E S U L T S

09/11/90 13:54:14

PROBLEM DEFINITION

oblem title: MW-7 pressure test

Knowns and Constants:
- No. of data points............... 28
- Radius of well casing............ 0.083
- Radius of well................... 0.083
- Aquifer saturated thickness...... 100
- Well screen length............... 5
- Static height of water in well... 30.75
- g(Re/Rw)...................... 3.379

ESTIMATION RESULTS

Analytical method: Bouwer and Rice (unconfined aquifer slug test)

ARAMETER ESTIMATES

	Estimate		Std. Error
K =	4.6044E-002	+/-	1.0817E-003
y0 =	9.5518E+000	+/-	1.0434E-001

ANALYSIS OF MODEL RESIDUALS

lual = calculated - observed
nted residual = residual * weight

Weighted Residual Statistics:
- Number of residuals............... 28
- Number of estimated parameters.... 2
- Degrees of freedom................ 26
- Residual mean..................... -0.01447
- Residual standard deviation....... 0.1636
- Residual variance................. 0.02675

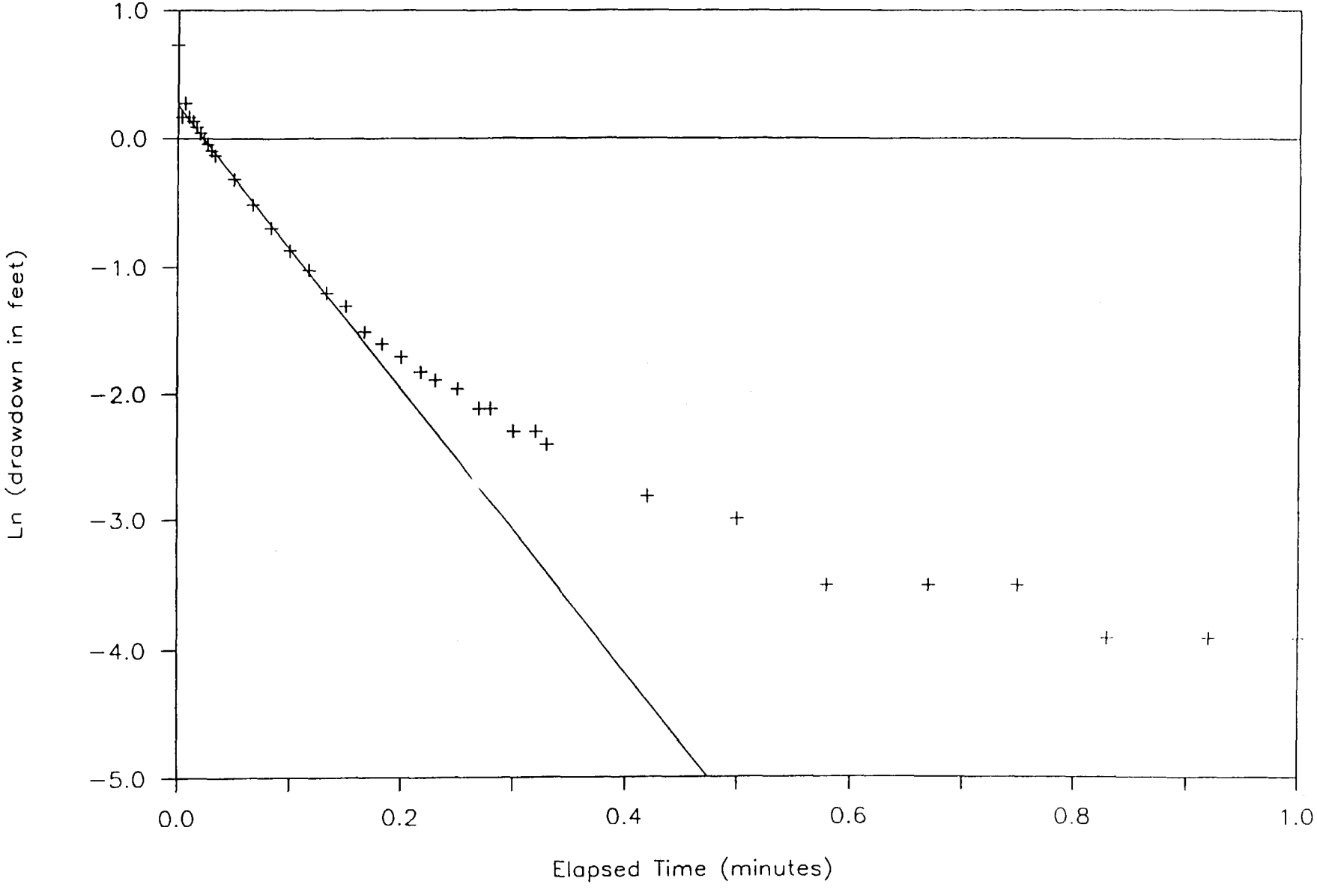
Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0033	8.26	8.9482	-0.6882	1
0.0066	8.49	8.3827	0.10728	1
0.0099	8.1	7.853	0.24703	1
0.0133	7.58	7.3422	0.23783	1
0.0166	7.04	6.8782	0.16182	1
0.02	6.55	6.4308	0.11922	1
0.0233	6.1	6.0244	0.075607	1
0.0266	5.67	5.6437	0.026316	1

0.03	5.29	5.2766	0.013415	1
0.0333	4.93	4.9431	-0.013133	1
0.05	3.48	3.5525	-0.072473	1
0.0666	2.48	2.5581	-0.078105	1
0.0833	1.75	1.8384	-0.088429	1
0.1	1.24	1.3212	-0.081221	1
0.1166	0.87	0.9514	-0.0814	1
0.1333	0.62	0.68374	-0.063741	1
0.15	0.43	0.49138	-0.061383	1
0.1666	0.3	0.35384	-0.053841	1
0.1833	0.22	0.25429	-0.034294	1
0.2	0.16	0.18275	-0.022753	1
0.2166	0.11	0.1316	-0.021599	1
0.2333	0.08	0.094576	-0.014576	1
0.25	0.06	0.067969	-0.0079688	1
0.2666	0.05	0.048944	0.0010563	1
0.2833	0.03	0.035174	-0.0051743	1
0.3	0.03	0.025279	0.0047213	1
0.3166	0.01	0.018203	-0.008203	1
0.3333	0.01	0.013082	-0.0030819	1

Slug Test at MW-6

Slope for Permeability Calculation



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A Q T E S O L V

A Program for

Automatic Estimation of Aquifer Coefficients

From Aquifer Test Data

By:

Glenn M. Duffield
and
James O. Rumbaugh, III

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Reston, VA 22091

(703) 476 - 0335

A Q T E S O L V is a user-friendly program designed to analyze data from aquifer tests automatically. Aquifer coefficients for a variety of aquifer test conditions can be estimated by A Q T E S O L V , including the following:

- o confined aquifers, unconfined aquifers, and leaky aquifers
- o pumping tests, injection tests, recovery tests, and slug tests

Features:

- o Interactive, menu-driven program design
- o Nonlinear least-squares estimation of aquifer coefficients
- o Statistical analysis of results
- o Complete graphical display of results

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BAILDOWN TEST RESULTS FOR: MW-6
ACS RI/FS Site

WELL INFORMATION

Casing Diameter (in)	2
Effective Casing RADIUS (in)(rc)	1.4
Screen Diameter (in)	2.0
Effective RADIUS (in)(rw)	1.0
Screen Length (ft)(L)	10.0
Aquifer Thickness (ft)(D)	11.2
Well Penetration (ft)(H)	9.7

CALCULATED PARAMETERS

L / rw	120.0
A	1.75
B	0.25
C	0.9
ln ((D-h)/rw)	2.89
ln (Re / rw) Fully Penetrating	4.19
ln (Re / rw)Partially Penetrating	3.97
ln (Re / rw)Partially Penetrating(>6)	NA
1/t * ln (Yo /Yt)	11.10

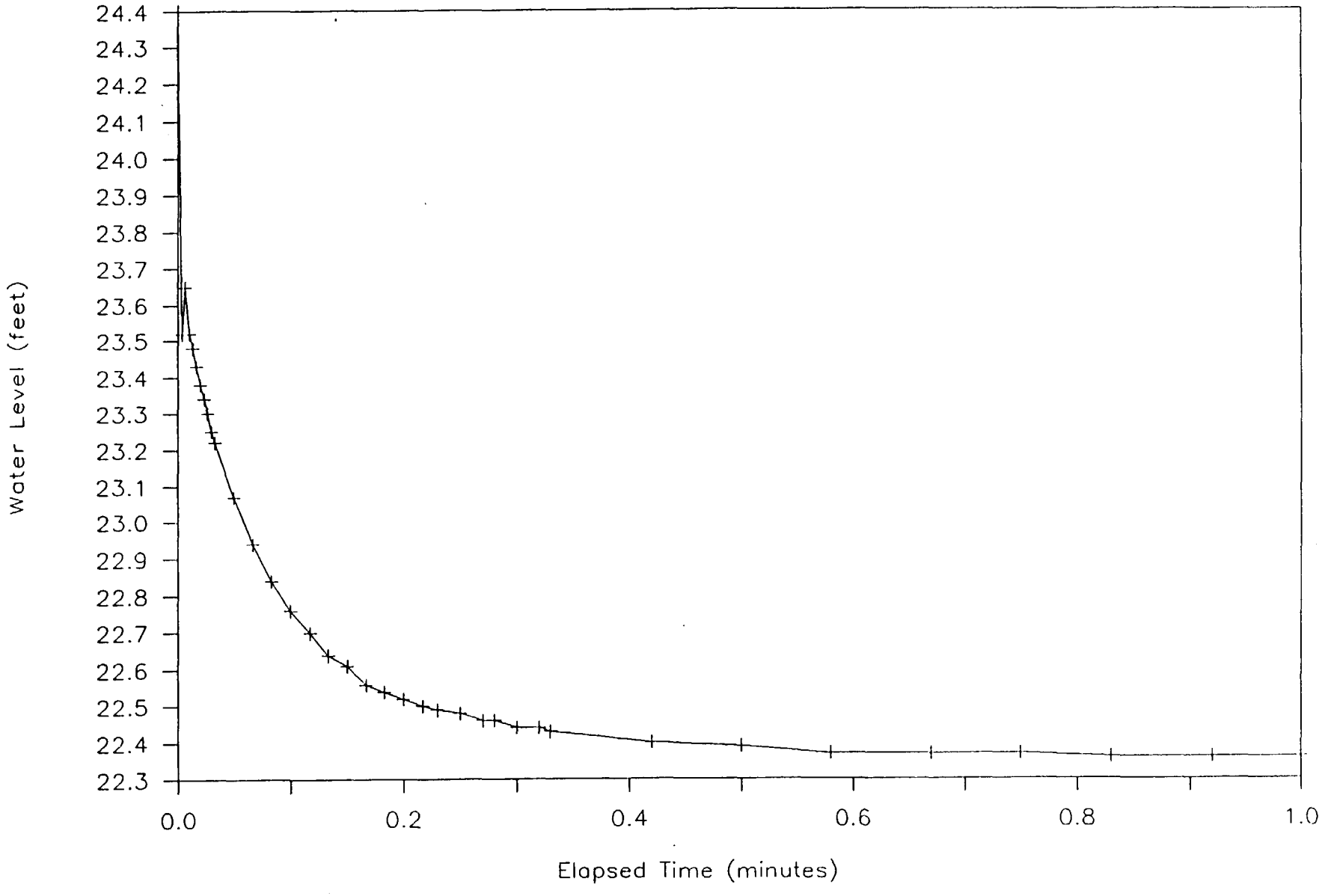
RESULTS	FT/MIN	FT/DAY	GPD/SQ.FT	CM/SEC
Hydraulic Conductivity Fully-P	3.03E-02	4.36E+01	3.26E+02	1.54E-02
Hydraulic Conductivity Partial-P	2.87E-02	4.13E+01	3.09E+02	1.46E-02
Hydraulic Conductivity Partial-P (>6)	NA	NA	NA	NA

	SQ.M/MIN	SQ.FT/DAY	GPD/FT	SQ.M/SEC
Transmissivity Fully-P	3.39E-01	488.5	3653.6	5.25E-04
Transmissivity Partial-P	3.22E-01	463.1	3463.5	4.98E-04
Transmissivity Partial-P (>6)	NA	NA	NA	NA

Regression Output:							
		Time (min)	Depth to Water	Water level Change	Natural Log of Water Level Change		REGR LINE CALC.
		0	24.40	2.06	0.72		0.25
Constant	0.253	0.0033	23.52	1.18	0.17		0.22
Std Err of Y Est	0.018	0.0066	23.65	1.31	0.27		0.18
R Squared	0.999	0.0099	23.52	1.18	0.17		0.14
No. of Observations	13	0.0133	23.48	1.14	0.13	0.13	0.11
Degrees of Freedom	11	0.0166	23.43	1.09	0.09	0.09	0.07
		0.020	23.38	1.04	0.04	0.04	0.03
X Coefficient(s)	-11.0959	0.023	23.34	1.00	0.00	0.00	-0.01
Std Err of Coef.	0.1293	0.027	23.30	0.96	-0.04	-0.04	-0.04
		0.030	23.25	0.91	-0.09	-0.09	-0.08
		0.033	23.22	0.88	-0.13	-0.13	-0.11
		0.050	23.07	0.73	-0.31	-0.31	-0.30
		0.067	22.94	0.60	-0.51	-0.51	-0.49
		0.083	22.84	0.50	-0.69	-0.69	-0.67
		0.100	22.76	0.42	-0.87	-0.87	-0.86
		0.117	22.70	0.36	-1.02	-1.02	-1.05
		0.133	22.64	0.30	-1.20	-1.20	-1.22
		0.150	22.61	0.27	-1.31		-1.41
		0.167	22.56	0.22	-1.51		-1.60
		0.183	22.54	0.20	-1.61		-1.78

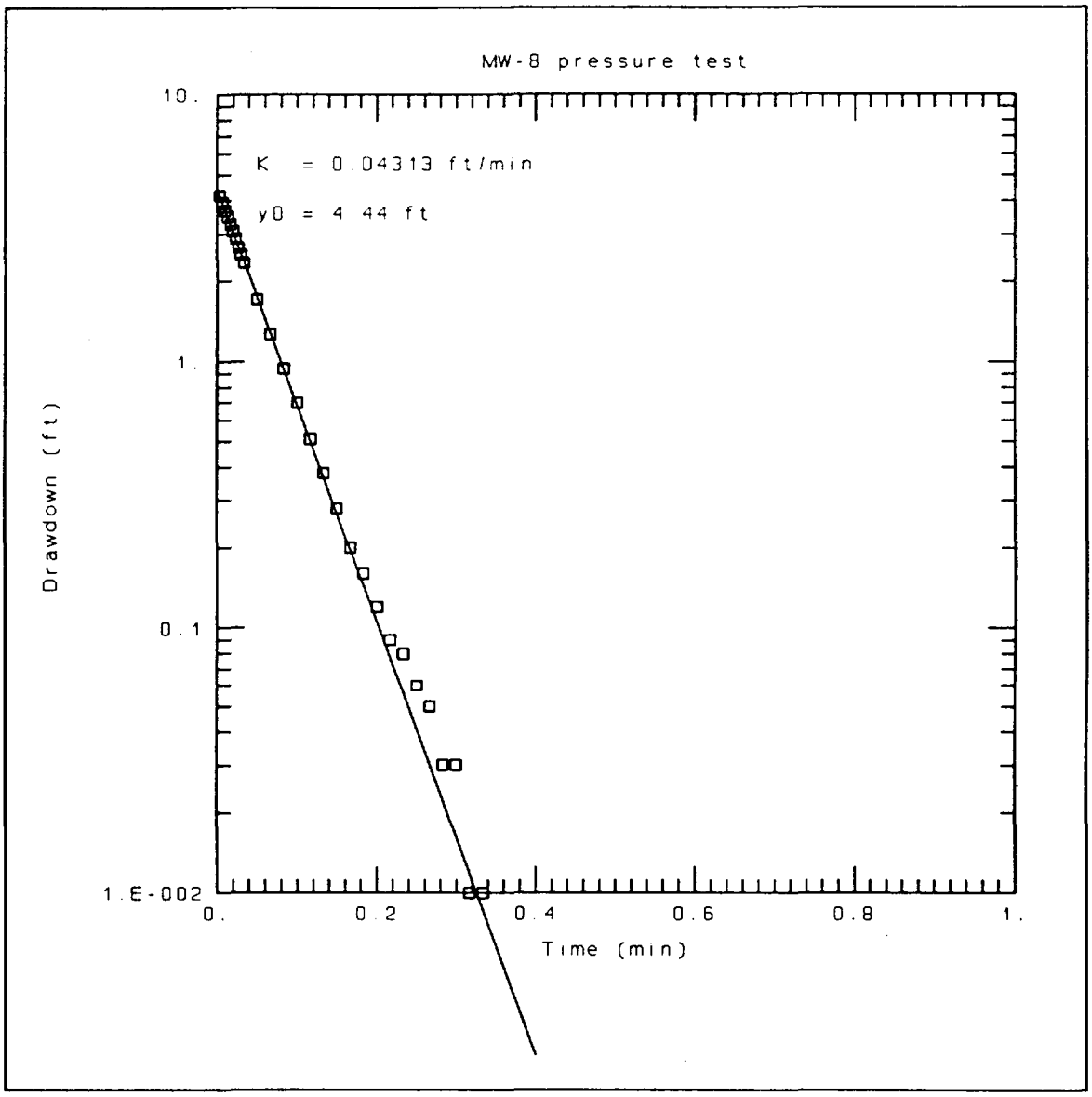
ACS RI/FS -- MW-6

Raw Slug Test Data



MW-8 Pressure

0.03	2.51	2.5331	-0.023053	1
0.0333	2.35	2.3814	-0.031384	1
0.05	1.71	1.7423	-0.032328	1
0.0666	1.27	1.2772	-0.0071532	1
0.0833	0.94	0.93442	0.005577	1
0.1	0.7	0.68367	0.016334	1
0.1166	0.51	0.50114	0.0088622	1
0.1333	0.38	0.36666	0.013345	1
0.15	0.28	0.26826	0.011739	1
0.1666	0.2	0.19664	0.0033603	1
0.1833	0.16	0.14387	0.016129	1
0.2	0.12	0.10526	0.014738	1
0.2166	0.09	0.077159	0.012841	1
0.2333	0.08	0.056453	0.023547	1
0.25	0.06	0.041303	0.018697	1
0.2666	0.05	0.030276	0.019724	1
0.2833	0.03	0.022151	0.0078487	1
0.3	0.03	0.016207	0.013793	1
0.3166	0.01	0.01188	-0.0018799	1
0.3333	0.01	0.0086919	0.0013081	1


MW-8 pressure test
K = 0.04313 ft/min
y0 = 4 44 ft
10.
1.
0.1
1.E-002
Drawdown (ft)
0.
0.2
0.4
0.6
0.8
1.
Time (min)

TABLES