WELL REDEVELOPMENT
AND
GROUND AND SURFACE WATER SAMPLING REPORT

FLINTKOTE PROPERTY
ORANGEBURG, NEW YORK

MARCH 11, 1988

Dames & Moore
1 BLUE HILL PLAZA, PEARL RIVER, NEW YORK 10965

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SECTION 1.0

1.0 Introduction

On August 21, 1987, the Flintkote Company contracted with Dames & Moore to provide services for the development and implementation of a Sampling and Analysis Plan for Flintkote's property located in Orangeburg, New York (Reference 1). The Sampling and Analysis Plan was developed on August 31, 1987. Final approval for the Plan was received from the New York State Department of Environmental Conservation (NYSDEC) on October 5, 1987 (Reference 2). Plan field activities were implemented between October 22, 1987 and November 20, 1987.

The Flintkote property (Figure 1) has been designated as a Class 2a site on New York State's Registry of Inactive Hazardous Waste Sites. A Class 2a designation indicates that additional studies are necessary before a final remediation priority can be assigned to the site. The designation of Flintkote's property as a Class 2a site was based in part on the results of a prior study (Reference 3) by Lawler, Matusky, & Skelley Engineers (LMS) of Pearl River, NY, which indicated high concentrations of asbestos as well as base/neutral extractable compounds and some metals in the ground water beneath the property.

This Report describes the field activities performed by Dames & Moore in connection with the redevelopment and resampling of fifteen ground water monitoring wells located on the property and the collection of surface water samples from five locations on the property. In addition, this Report provides the laboratory analytical results for the samples collected along with an interpretation of the significance of those findings.

1.1 Site History

The Flintkote Orangeburg property was used for the pre-shipment storage of "Orangeburg pipe" and the disposal of pipe which did not meet specifications from approximately 1893 to 1972, according to a report prepared by EWK Consultants, Inc. (Reference 1) in 1981. This pipe was widely used in industrial and agricultural applications for purposes such as drainage conduits. The pipes were made of paper fiber saturated with a hard coal tar pitch. From 1946 until 1970, asbestos was used as an additive in the fiber. Some plastic pipes and fittings were also reported as being manufactured in later years, although no polymerization was done at the site.

In 1986, LMS performed onsite investigations including installation and sampling of wells, sampling of surface water and sampling of test pits. The locations of existing monitoring wells on the Flintkote property are shown on Figure 2. A summary description of the construction specifications, screen setting, etc. for these wells is included as Table 1-1.

1.2 Site Location and Physiography

The site is located in the southeastern portion of Rockland County, New York, adjacent to Interchange 5 of the Palisades Interstate Parkway. The site consists of two parcels of land. The northern parcel, occupying about six acres, is bounded to the west by the Conrail Railroad right-of-way, to the north by Highview Avenue, and to the south and east by Greenbush Road.

The southern parcel, about seventeen acres, is bounded to the west by the Conrail Railroad right-of-way and a private home, to the north by property owned by Parkway Land Resources, to the east by State Route 303, and to the south by Palisades Interstate Parkway Commission land. Both parcels of land are referred to collectively in this Report as the Flintkote Site.

The land is flat-lying with some gentle slopes, generally to the east. The northern portion of the property is paved, with some grasses and small to medium size trees. The southern portion of the site is mostly unpaved. Much of this part of the property is covered by grasses and weeds. Trees are also located throughout this part of the property, particularly along the eastern and southern boundaries of the site.

SECTION 2.0

2.0 Scope of Work

Dames & Moore activities in connection with the present project can be broken down into the following 5 tasks. Each of these tasks is described below.

2.1 Development of Sampling and Analysis Plan

Prior to initiation of field activities, a Sampling and Analysis Plan was prepared (Reference 4). This plan was reviewed by the New York State Department of Environmental Conservation (NYSDEC). NYSDEC approval of the Plan was obtained on October 5, 1987 (Reference 2).

2.2 Well Redevelopment

Upon review of the previous consulting reports prepared for this site, Dames & Moore concluded that the monitoring wells were probably not as fully developed as necessary. This conclusion was based on the following:

- High levels of asbestos, base neutral compounds, iron, manganese, chromium and lead were reported present in the ground water from the wells, including the upgradient wells; and

- Many of the samples were described in the LMS Report as being turbid.

Based on this conclusion, and with NYSDEC approval, a well redevelopment program was planned and initiated. The objective of this well redevelopment program was to reduce the effects of suspended particulate matter and obtain samples which more closely reflected the quality of groundwater present beneath the Flintkote property.

Redevelopment of fifteen (15) existing monitoring wells located on the Flintkote property was performed during the period of October 22 to November 13, 1987. The procedure utilized for the redevelopment of the wells was overpumping. Overpumping consists of the pumped withdrawal of large volumes of water from a well. The purpose of overpumping is to draw water through the well screen and surrounding sand pack. This results in the flushing from the well of the finer grained (sand size and smaller)

materials which were loosened and disturbed during the well drilling and installation process and which either adhered to the well screen or were too small to be trapped by the surrounding sand pack.

The wells were pumped using a compressed air driven positive displacement pump, following the procedures described in the Sampling and Analysis Plan approved for this site (Reference 4). This pump was selected for use at this site because it does not require the introduction of water or air into the water column within the well. The compressed air which drives the pump is provided by an oilless compressor designed for use with groundwater sampling pumps. In addition, this air is isolated from the interior of the well by a pair of check valves.

During the pumping of each well, periodic measurements of the turbidity of the purge water were made. A development goal of 50 nephelometric turbidity units (NTU) was chosen by NYSDEC for these wells. Table 2-1 lists the total volume of water removed from each well and the lowest recorded turbidity value. As the table shows, all but two of the fifteen wells reached their development goals. Of the two which did not, one well, MW-9D, achieved a low turbidity value of 52 NTU with a total volume of water removed of 470 gallons, or approximately 83 well volumes.

The other well which did not reach the development goal of 50 NTU was MW-9S, with a lowest recorded turbidity of 118 NTU, despite the purging of 211 gallons of water, approximately 195 well volumes. The high turbidity associated with this well may be the result of fine organic matter naturally present in the groundwater. As the boring log for this well shows, it is screened within an organic silty sand layer for the lower portion of the screened interval. This is consistent with the well's location in a marshy area along the southern part of the fill area. Copies of boring logs for each of the wells installed by LMS are provided as Appendix 1. The Well Development Records for these wells are included as Appendix 2.

The water removed from each well during development was discharged to nearby natural surface drainage pathways and not immediately adjacent to the well. Approval for this procedure was obtained from NYSDEC prior to commencement of field work. Effects of redevelopment on site ground water quality are discussed in Section 3.0.

2.3 Ground Water Sampling and Analysis

Ground water samples from each of the monitoring wells were collected in order to evaluate the effectiveness of the redevelopment program. Ground water sampling was completed between November 17 and November 20, 1987. The laboratory analytical results are discussed in Section 3.0.

Groundwater sampling procedures are described in the Sampling and Analysis Plan approved by NYSDEC for this work (Reference 4).

Groundwater sampling was not performed immediately after well redevelopment and additional water was removed from each well prior to the collection of the sample. In each case, a minimum of three times the static volume of water within the well was removed prior to collection of the sample. This well volume exchange helps to ensure that the sample collected is representative of formation pore water at the location and depth of the screened interval and has not been influenced by stagnation within the well. The well volume exchange was performed using a stainless steel bailer fitted with a teflon bottom check valve. Each bailer was raised and lowered using a dedicated length of polyethylene rope. Prior to use in the field, each bailer was cleaned and wrapped as described in the Sampling and Analysis Plan. A sufficient number of bailers was used such that cleaning of the bailers in the field was not necessary.

Immediately following the well volume exchanges the ground water was sampled. Sample bottles provided by the laboratory were labeled with the well number, date and time of sampling, and the analytical parameters to be tested. A Field Sampling Record was completed for each well sampled. This form provides a record of the well volume exchange, sampling method, sample designation, field tests, and other pertinent data regarding the sampling. Copies of the Field Sampling Records for each well are provided as Appendix 3.

Following collection of ground water, the sample bottles were packed in coolers for shipment to the laboratory. Shipment of samples collected each day was by an overnight delivery service such that the bottles were received at the laboratory within 24 hours of shipment.

As an independent check of the laboratory, three duplicate sets of samples were collected:

- Sample MW-6T duplicates sample MW-6R
- Sample MW-7T duplicates sample MW-7S
- Sample MW-9T duplicates sample MW-9D

The results of this duplicate sampling and a discussion of site ground water quality are presented and discussed in section 3.0.

2.4 Surface Water Sampling

In order to confirm the prior surface water sampling results and better characterize the quality of surface water, five surface water samples were collected for laboratory analysis. The surface water sampling was conducted on November 20, 1987. An interpretation of the laboratory analytical data is provided in Section 3.0.

Three surface water samples were taken from the stream on the Flintkote property. This stream flows south to southeastward along eastern side of the site. It receives surface runoff from most of the site, including the unpaved pipe fill area in the southern half of the property. The stream is about five to ten feet wide and about 0.5 to three feet in depth. Flow rates are variable, but are generally slow, except during periods of increased flow due to rainfall runoff from the site.

Two samples were taken of leachate seeps which were flowing from the fill material along the eastern side of the property. Analytical results from these samples were used to help characterize seepage inputs to surface water quality. Figure 3 shows the approximate location of these sampling points.

SW-1 was collected from the outfall of the cement culvert through which the stream passes as it turns eastward and enters the wooded portion of the site along the eastern boundary.

SW-2 was collected from a small tributary emanating from a leachate seep located on the eastward facing hillside approximately midway between well locations 6

and 7. The sampling point was approximately five feet downstream of the point where the leachate was seeping.

SW-3 was collected from the eastern portion of the site where the stream flows below Route 303 as it leaves the site.

SW-4 was collected from a marshy area located east-southeast of well 7. A small but constant flow of water eastward from this area was observed, indicating that this wet spot is the result of ground water seepage in this area.

SW-5 was collected from the outfall of the metal culvert located at the far northern limit of the stream on the property. A duplicate sample was also collected at this location. That duplicate sample was designated as SW-6.

Surface water was collected by placing the laboratory-supplied sample jars directly into the water, as described in the Sampling and Analysis Plan (Reference 3). In cases where the larger lab bottles could not be completely submerged, a smaller bottle (which did not contain lab preservatives) from the same set was used to collect the water, which was then transferred to the larger bottles. After the larger bottles were full and capped, the small bottles were filled, capped and the set of bottles was complete. This approach eliminated the need for separate sampling vessels which would need to be decontaminated between sampling points.

The surface sampling records for these samples are attached as Appendix 4.

2.5 Laboratory Analysis

Laboratory analytical services in connection with this project were provided by Huntingdon Analytical Services, Inc. (HAS) of Middleport, New York. HAS is a NYSDEC certified analytical laboratory for the analysis of environmental ground and surface water samples. The laboratory data report sheets for these samples are included as Appendix 5 of this Report. The data is discussed in Section 3.0 of this Report.

SECTION 3.0

3.0 Interpretation of Data

This section presents data collected during the ground and surface water sampling efforts and interprets laboratory analytical results.

3.1 Ground Water Flow

Three principal water bearing zones have been identified beneath Flintkote's property. In order of increasing depth these are:

- The fill material. - This zone ranges from 0 to approximately 15 feet in thickness across the Flintkote property. The wells given an "S" designation are screened within this unit;

- The glacial till material. - The thickness of this zone from approximately 15 to 30 feet on the Flintkote property. Wells screened within this unit are designated by a "D" in the well number. Well EMW is also screened in this unit; and

- The bedrock. - This consists predominantly of red sandstone and conglomerate. Wells having an "R" designation are screened within this unit.

Each of these units have different hydrologic and water transmitting characteristics. Therefore, ground water flow directions and water quality have been evaluated independently.

The direction of ground water flow can be estimated by evaluation of the piezometric surface associated with the aquifer. The piezometric surface represents the "head" distribution in the aquifer. It is defined as the elevation at any given point to which water will rise in tightly cased wells screened within the aquifer. Ground water flow within the aquifer will be from higher heads to lower heads. Figures 4 through 6 illustrate the piezometric surface for each of the three principal water-bearing zones present on the Flintkote property.

Figure 4 illustrates groundwater flow within the shallow fill material. These flows are from the west and northwest to the east and southeast. No lateral flow has been

observed or should be expected given the current distribution of the piezometric surface at the site. Therefore, ground water flows within this material cannot impact properties to the north (i.e, Parkway Land Resources or Hanover Trails).

Figure 5 shows groundwater flows in the glacial till material. Flows in the till are also from the west and northwest to the east and southeast. In this case, water from the Flintkote site, is flowing onto adjacent northern properties.

Figure 6-3 depicts groundwater flows in the underlying bedrock zone. Bedrock groundwater flows are also from the west and northwest to the east and southeast, consistent with the flow direction in the overlying water bearing zones.

3.2 Analytical Results

Table 3-1 provides a summary of the laboratory analytical data developed as part of the present study. Copies of the laboratory data sheets are included as Appendix 5.

3.2.1 Asbestos

Each sample of ground and surface water collected as part of the present study was tested for the presence of asbestos using transmission electron microscopy techniques. This technique allows for the identification of the mineral form of asbestos as well as the amount present in the samples. A summary of the asbestos data generated by this study as well as the results provided in the prior LMS report is provided as Table 3-2. From these data, several important conclusions can be drawn.

- Asbestos is present in most of the ground water samples. However, the levels reported are significantly less (up to five orders of magnitude) than those obtained by LMS. This is believed to be a result of the well redevelopment performed prior to sampling. The asbestos is relatively immobile within the ground water and does not appear to be migrating offsite. This conclusion is supported by the fact that no asbestos was detected in EMW, the farthest downgradient well.

- Asbestos was found in only one of the surface water samples. Low levels of asbestos were detected in sample SW-5, collected from the outfall of the metal culvert. The

duplicate sample collected at this same location, SW-6, was not found to contain asbestos. Two additional samples collected further downstream, SW-1 and SW-3, also contained no asbestos. Further, asbestos was not detected in either of the two leachate seeps that were sampled, SW-2 and SW-4.

Based upon these results for both ground and surface water samples, asbestos does not appear to be migrating off the Flintkote property.

3.2.2 Volatile Organic Compounds

Table 3-3 summarizes the results of Volatile Organic Compound (VOC) analyses. As the table shows, methylene chloride was detected in all but two of the samples analyzed. Acetone was also detected in samples SW-5 and SW-6. Both methylene chloride and acetone are common laboratory reagents and solvents. These compounds, despite adherence to proper protocols, are often introduced and detected in samples during the lab analysis.

To guard against falsely identifying these compounds in samples where they do not genuinely exist (false positives), a laboratory trip blank was used. This blank consists of two vials of laboratory grade distilled water which are prepared and sealed by the lab prior to sampling. These vials accompany the other bottles to the sampling location and are later returned and analyzed. Sample Number TB-1 is the trip blank for this study. As the table shows, methylene chloride and acetone were also detected in the trip blank. This indicates that these compounds were introduced during the preparation or analysis of the samples and that they are not present within the ground or surface water at the Flintkote property.

3.2.3 Metals

All of the ground and surface water samples collected were tested for iron and manganese concentrations. In addition, selected samples were tested for USEPA Priority Pollutant Metals, in accordance with the Sampling and Analysis Plan. The results of these analyses are included in Table 3-1.

Iron concentrations in all but one of the samples, MW-2R, exceeded state drinking water standards of 0.3 ppm. The highest reported concentration of iron was 107 ppm at

seep sample SW-4. Iron was reported at 35.3 ppm from SW-2, the other seep sample. The highest iron contents reported for the ground water samples were from the shallow (fill material) wells. The bedrock wells, as a group, contained the least iron. Iron was found to exceed standards in upgradient, as well as downgradient wells.

Manganese concentrations were in excess of state drinking water standards in nineteen of the samples tested. Generally, manganese concentrations are greater in the shallow wells and surface leachate seep samples. Both upgradient and downgradient samples also were found to exceed manganese standards.

Priority pollutant metals analysis for selected samples reveals several parameters which exceeded State drinking water standards. Sample SW-2 contained arsenic at 0.140 ppm, in excess of the standard of 0.025 ppm. This location was not sampled in the previous study.

Beryllium was found to exceed State standards of 0.003 ppm in three samples, SW-2, SW-5, and the duplicate sample for that location, SW-6. Although the LMS report states that samples were analyzed for Priority Pollutant Metals, Beryllium, as well as Selenium, Antimony, and Thallium results were not included in that report.

Chromium was found to exceed State drinking water standards in samples MW-2D, MW-2R, MW-7S, its duplicate sample MW-7T, and MW-8D. The highest reported concentration of chromium was 0.068 ppm in MW-7S. This is slightly above the drinking water standard of 0.050 ppm. The fact that above-standard chromium levels were found in MW-2R, an upgradient bedrock well and in only one of the shallow fill wells (MW-7S) suggests that the source of the chromium is not related to materials present on the Flintkote property.

Antimony was detected at levels above drinking water standards in two sampling locations. SW-2 contained antimony at a concentration of 0.32 ppm. SW-5 contained antimony at 0.10 ppm. The duplicate sample for SW-5, SW-6 contained 0.09 ppm of antimony. These results are in excess of the 0.003 ppm standard for this parameter. Results for antimony were not provided in the prior LMS report. Above standard antimony concentrations at the site are limited to these two locations.

Thallium was detected in all of the ground and surface water samples tested, including upgradient samples. Concentrations of thallium ranged from a low of 0.02 ppm in sample MW-6T to a high of 0.20 ppm in sample SW-3. These values are in excess of the standard of 0.004 ppm for this parameter. As with antimony, no results were provided for thallium in the prior LMS study. The presence of thallium in the upgradient samples suggests that the source of thallium found on Flintkote's property may be unrelated to materials present on the property.

3.2.4 Base/Neutral Extractables

Base/neutral extractable compounds were detected in three ground water and two surface water samples taken from the Flintkote property.

Base/neutrals were detected in three of the four shallow (fill) wells: MW-6S, MW-7S, and MW-8S. No base/neutrals were detected in MW-9S. Additionally, base/neutrals were not detected in any of the deep (glacial) or bedrock wells. This result indicates that base/neutral contamination in the groundwater is confined to the northeast portion of the exposed (unpaved) fill areas on the property. The specific compounds detected, with their concentrations, are shown in Table 3-1.

Base/neutrals were also detected in two of the five surface water sampling locations. SW-4, a leachate seep originating east of MW-7S contained five base/neutral compounds at relatively low concentrations, all below 90 ppb. SW-3, the stream sample at the point where the stream crosses Route 303, contained nine base/neutrals ranging in concentration from 57 ppb to 240 ppb. The fact that base/neutrals were not detected at the two stream sampling locations upstream of this location suggests that these compounds are originating as local recharge to the stream from the immediately adjacent unpaved fill area. Table 3-1 lists the base/neutral compounds detected in these samples along with their concentrations.

3.2.5 Acid Extractables

A single acid extractable compound, 4-nitrophenol was detected in two samples. MW-6S contained 260 ppb of 4-nitrophenol and MW-7S contained 90 ppb. No acid extractable compounds were detected in any of the other surface or ground water samples at the property. Although 4-nitrophenol was not reported to be detected in the prior

LMS study, several related phenolic acid extractable compounds were detected. These were erroneously reported with the base/neutral compounds in that study. As with the base/neutrals, the presence of 4-nitrophenol may be related to leaching of the fill material.

3.2.6 Pesticides and PCBs

Analytical results of the samples collected as part of this program did not report the presence of PCBs. This result confirms the negative finding with respect to PCBs which was stated in the LMS report.

Above standard pesticide concentrations were reported in two samples. MW-7S reported 4-4' DDT at 0.19 ppb, Beta-BHC at 0.56 ppb, and endosulphan at 0.61 ppb. MW-8d reported heptachlor at 0.16 ppb. These values are within 0.51 ppb of the method detection limit of 0.10 ppb. In MW-2D and MW-9S, which were previously reported by LMS to contain pesticides, no pesticides were detected. The variation in both type and location of reported pesticides between the two sampling events, combined with the very small quantities (less than 1 ppb in only two wells) reported, is a strong indication that these may be false positives.

3.2.7 Petroleum Hydrocarbons

Sixteen samples were tested for petroleum hydrocarbons and no petroleum hydrocarbons were detected. This finding suggests that the low levels previously reported (Reference 3) may not have been representative of ground water conditions on the Flintkote property.

3.2.8 TOC, COD, TDS

Seven ground water and four surface water samples were each analyzed for Total Organic Carbon (TOC), Chemical Oxygen Demand (COD), and Total Dissolved Solids (TDS). The results of these analyses are included in Table 3-1. These parameters provide a general indication of ground water quality and do not identify specific chemical compounds. Because only five samples were tested for these parameters in the prior LMS study, different samples were selected for these tests in the current round of

sampling. This helps provide a clearer understanding of how these parameters vary across the Flintkote property.

Comparison of TOC values between the two sample sets shows that the values obtained for the deep and bedrock wells in this sampling are generally consistent with those reported by LMS. Typical TOC concentrations in the bedrock and till aquifer are low and range between <5 ppm to <20 ppm.

However, a difference is seen between the results reported for the shallow wells. In the previous sampling, MW-6S reported 663 ppm of TOC and MW-8S reported 37.3 ppm. In this sampling round, two shallow water samples, MW-7S and its duplicate sample, MW-7T were analyzed. Results of 20 ppm and 10 ppm respectively were obtained. Well MW-7S is located near (within 150 feet) MW-6S and is screened within the same interval, the fill material. This suggests that redevelopment of the wells has resulted in reduced TOC concentrations within the samples.

The results for COD and TDS are consistent with previous sampling results for each water bearing zone. TDS concentrations ranged from a low of 328 ppm in MW-2R to a high of 752 ppm in MW-7S. TDS valves were generally below or close to the standard of 500 ppm. These results are consistent with those reported in the LMS study. They are probably related to dissolved metals, particularly iron and manganese, present in the samples. COD concentrations ranged from below the detection limit of 5 ppm in several samples to a high of 1722 ppm in MW-7S. This is to be expected as MW-7S also contained one of the highest reported concentrations of base neutral and acid extractable compounds, which would raise COD concentrations.

SECTION 4.0

4.0 Summary and Conclusions

Based upon the results of the well redevelopment program and the interpretation of ground water and surface water quality data the following conclusions can be made:

- Although asbestos is known to be present onsite, the concentrations in the groundwater are low. The asbestos does not appear to be mobile in the groundwater and our work did not indicate that it was migrating. Additionally, our tests did not indicate that asbestos is migrating offsite via the surface stream or leachate seeps.

- Most Priority Pollutant metals are present at levels below or close to drinking water standards. Thallium concentrations are above the standard in both upgradient and downgradient samples. This indicates that the source of thallium may not be related to materials present on the Flintkote property.

- Iron and Manganese concentrations in the onsite ground water do exceed state standards. However, these parameters are generally considered relatively innocuous and are often found to occur naturally in above-standard concentrations in ground and surface water.

- Base/neutrals and acid extractable compounds were reported above detection limits in ground water samples from wells MW-6S, MW-7S, and MW-8S and nearby surface water samples SW-3 and SW-4. These sample locations are clustered together in a 100,000 sq. ft. area in the northeast portion of the unpaved fill area. (Figure 7)

- PCBs and petroleum hydrocarbons were not detected in any of the samples. VOC and pesticides were detected but in concentrations strongly indicative of false positive values.

Analytical data from this site demonstrate that infiltration and percolation through the unpaved fill areas of the property is the mechanism by which base/neutral and acid extractable compounds become dissolved in the ground water. Base/neutral and acid extractable compounds were not detected in the three wells located within the paved area nor were they detected in surface water samples (SW-5 and SW-6) taken from the

discharge of the culvert where the stream emerges from beneath the paved portion of the site.

Base/neutral or acid extractable compounds were not detected in the surface water until the stream flowed into the fill area shown on Figure 7. This area, which also contains ground water with elevated levels of base/neutral and acid extractable compounds, is one of the lowest points (topographically) on the site and contains the thickest layer of fill material. It is within this approximate two acre area that the need for remedial activities should be evaluated. The remaining portions of the Flintkote site, exclusive of this area, do not require remediation.

Remedial activities, in this limited area can be accomplished consistent with a range of property development goals. Such activities should have as their primary objective the reduction or elimination of infiltration of surface water into the unpaved portion of the fill area. This could include such activities as:

- Regrading and covering with low permeability soil or similar materials;
- Regrading and paving; or
- Excavation of portions of the fill material and redeposition onsite above the water table.

A final remedial action can be evaluated and selected relatively quickly (i.e. several weeks).

REFERENCES

REFERENCES

1. EWK Consultants, Inc., Assessment of the Environmental Impact of On-Site Waste Disposal, Orangeburg Manufacturing Co., Orangeburg, Rockland County, New York, 1893 - 1972, dated 20 January, 1980.

2. NYSDEC, Letter from Lawrence J. Alden providing approval of Sampling and Analysis Plan, dated October 5, 1987.

3. Lawler, Matusky & Skelly Engineers, Progress Report, Remedial Investigation Study at Flintkote Site, Orangeburg, New York, dated October, 1986.

4. Dames & Moore, Sampling and Analysis Plan, Flintkote Company Site, Orangeburg, New York, dated 30 September, 1987.

TABLES

Table 1-1

Summary of Well Specifications
Flintkote Property
Orangeburg, New York

Well Number	Well Depth	Unit Screened In	Diameter	Screened Interval (ft)	Casing Elevation
MW-1D	22	Glacial	2 in.	5-22	105.13
MW-2D	35	Glacial	2 in.	5-35	105.03
MW-2R	51	Bedrock	2 in.	41-51	105.23
MW-6S	13	Fill	2 in.	3-13	92.89
MW-6D	42	Glacial	2 in.	16-41.5	92.54
MW-6R	69	Bedrock	2 in.	54-69	92.52
MW-7S	10	Fill	2 in.	3-7	88.95
MW-7D	34	Glacial	2 in.	13-31.5	90.23
MW-8S	10	Fill	2 in.	3-10	100.39
MW-8D	37	Glacial	2 in.	15-35	99.99
MW-9S	8	Fill	2 in.	4-8	96.47
MW-9D	39	Glacial	2 in.	9-39	93.01
MW-9R	64	Bedrock	2 in.	54-64	97.67
MW-10R	67	Bedrock	2 in.	57-67	108.42
EMW	18	Glacial	4 in.	N/A	N/A

N/A - Information Not Available

Table 2-1
Well Redevelopment Data
Flintkote Site

Well Number	Total Gallons Removed	Lowest Recorded Turbidity (NTU)
MW-1D	110	50
MW-2D	156	48
MW-2R	480	48
MW-6S	285	43
MW-6D	326	18
MW-6R	66	16
MW-7S	168	6
MW-7D	155	10
MW-8S	108	6
MW-8D	113	16
MW-9S	211	118
MW-9D	470	52
MW-9R	80	7
MW-10R	50	32
EMW	40	4

Table 3-1
Laboratory Analytical Results
Flintkote Property, Orangeburg, N.Y.

PARAMETER	MW-1D	MW-2D	MR-2R	MW-6S	MW-6D	MW-6R	MW-6T	MW-7S	MW-7T
Asbestos (f/l * 10^6)	4.5	3.75	0.25/ND	75	33	0.625	0.1875	0.3	10.5
Volatile Organics (ppb) (1)									
Acetone	NA	ND	ND	NA	NA	ND	ND	ND	ND
Methylene Chloride	NA	ND	6.8	NA	NA	6.4	6.3	5.8	7.3
Metals (ppm)									
Arsenic	NA	<0.01	0.012	NA	NA	<0.01	<0.01	<0.01	0.01
Beryllium	NA	<0.005	<0.005	NA	NA	<0.005	<0.005	<0.005	<0.005
Selenium	NA	<0.01	<0.01	NA	NA	<0.10	<0.10	<0.10	<0.10
Cadmium	NA	<0.02	<0.02	NA	NA	<0.02	<0.02	<0.02	<0.02
Chromium	NA	0.061	0.051	NA	NA	0.041	0.044	0.068	0.066
Copper	NA	0.017	0.011	NA	NA	0.021	0.026	0.016	0.013
Nickel	NA	<0.05	<0.05	NA	NA	<0.05	<0.05	<0.05	<0.05
Lead	NA	<0.05	<0.05	NA	NA	<0.05	<0.05	<0.05	<0.05
Zinc	NA	0.41	0.22	NA	NA	0.19	0.61	0.5	0.56
Silver	NA	<0.015	<0.015	NA	NA	<0.015	<0.015	<0.015	<0.015
Antimony	NA	<0.01	<0.01	NA	NA	<0.01	<0.01	<0.01	<0.01
Thallium	NA	0.07	0.031	NA	NA	0.028	0.02	0.15	0.15
Mercury	NA	<0.0002	<0.0002	NA	NA	<0.0002	<0.0002	<0.0004	<0.0004
Iron	2.63	1.12	0.16	39.4	5	0.83	1.08	20.9	19.5
Manganese	0.61	4.77	<0.08	1.23	0.94	<0.08	<0.08	1.95	1.97
Base / Neutral Extr. (ppb) (2)									
Acenaphthene	ND	ND	ND	820	ND	ND	ND	220	NA
Anthracene	ND	ND	ND	280	ND	ND	ND	210	NA
Benzo(a)anthracene	ND	ND	ND	540	ND	ND	ND	630	NA
Benzo(b)fluoranthene	ND	ND	ND	830	ND	ND	ND	ND	NA
Benzo(k)fluoranthene	ND	ND	ND	810	ND	ND	ND	390	NA
Benzo(a)pyrene	ND	ND	ND	500	ND	ND	ND	460	NA
Benzo(ghi)perlyne	ND	ND	ND	410	ND	ND	ND	ND	NA
Chrysene	ND	ND	ND	550	ND	ND	ND	670	NA
Dibenzo(a,b)anthracene	ND	ND	ND	ND	ND	ND	ND	75	NA
2,6-Dinitrotoluene	ND	ND	ND	360	ND	ND	ND	73	NA
Fluoranthene	ND	ND	ND	1000	ND	ND	ND	140	NA
Fluorene	ND	ND	ND	360	ND	ND	ND	100	NA
Indeno(1,2,3-cd)pyrene	ND	ND	ND	300	ND	ND	ND	230	NA
Naphthalene	ND	ND	ND	970	ND	ND	ND	110	NA
Phenanthrene	ND	ND	ND	960	ND	ND	ND	870	NA
Pyrene	ND	ND	ND	960	ND	ND	ND	1300	NA
Acid extractable (ppb) (3)									
4-Nitrophenol	ND	ND	ND	260	ND	ND	ND	90	NA
Pesticides (ppb) (4)									
Beta-BHC	NA	ND	ND	NA	NA	ND	NA	0.56	NA
4,4'-DDT	NA	ND	ND	NA	NA	ND	NA	0.19	NA
Endosulphan I	NA	ND	ND	NA	NA	ND	NA	0.61	NA
Heptachlor Epoxide	NA	ND	ND	NA	NA	ND	NA	ND	NA
PCBs (ppb)	NA	ND	ND	NA	NA	ND	NA	ND	NA
Petrol Hydrocarbon (ppm)	NA	ND	ND	NA	NA	ND	NA	ND	NA
Others (ppm)									
TOC	NA	<5	<5	NA	NA	2.5	<5	20	10
COD	NA	95.2	187	NA	NA	133	72.3	878	1722
TDS	NA	516	328	NA	NA	555	522	752	708

Notes:

ND - Parameter Not Detected or Below Detection Limits
NA - Parameter Not Analyzed
(1) All other volatile organics were Not Detected
(2) All other base/neutrals were Not Detected
(3) All other acid extractables were Not Detected or Below Detection Limits
(4) All pesticides were Not Detected or Below Detection Limits

Table 3-1 (continued)
Laboratory Analytical Results
Flintkote Property, Orangeburg, N.Y.

PARAMETER	MW-7D	MW-8S	MW-8D	MW-9S	MW-9D	MW-9T	MW-9R	MW-10R	EMW
Asbestos (f/l * 10^6)	6	41.25	210/28.25	157.5	30	30	ND	0.05	ND
Volatile Organics (ppb) (1)									
Acetone	NA	NA	ND	NA	NA	NA	NA	NA	NA
Methylene Chloride	NA	NA	6.9	NA	NA	NA	NA	NA	NA
Metals (ppm)									
Arsenic	NA	NA	<0.01	NA	NA	NA	NA	NA	NA
Beryllium	NA	NA	<0.005	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	<0.10	NA	NA	NA	NA	NA	NA
Cadmium	NA	NA	<0.02	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	0.059	NA	NA	NA	NA	NA	NA
Copper	NA	NA	0.015	NA	NA	NA	NA	NA	NA
Nickel	NA	NA	<0.05	NA	NA	NA	NA	NA	NA
Lead	NA	NA	<0.05	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	0.26	NA	NA	NA	NA	NA	NA
Silver	NA	NA	<0.015	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	<0.01	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	0.047	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	<0.0004	NA	NA	NA	NA	NA	NA
Iron	2.75	1.09	17.8	19.3	2.13	11.2	2.06	1.06	4.53
Manganese	2.16	<0.4	1.19	1.39	5.2	4.93	1.16	0.24	<0.08
Base / Neutral Extr. (ppb) (2)									
Acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	ND	200	ND	ND	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	110	ND	ND	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene	ND	130	ND	ND	ND	ND	ND	ND	ND
Benzo(ghi)perlyne	ND	69	ND	ND	ND	ND	ND	ND	ND
Chrysene	ND	190	ND	ND	ND	ND	ND	ND	ND
Dibenzo(a,b)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	ND	350	ND	ND	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	61	ND	ND	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	ND	140	ND	ND	ND	ND	ND	ND	ND
Pyrene	ND	350	ND	ND	ND	ND	ND	ND	ND
Acid extractable (ppb) (3)									
4-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pesticides (ppb) (4)									
Beta-BHC	NA	NA	ND	NA	NA	NA	NA	NA	NA
4,4'-DDT	NA	NA	ND	NA	NA	NA	NA	NA	NA
Endosulphan I	NA	NA	ND	NA	NA	NA	NA	NA	NA
Heptachlor Epoxide	NA	NA	0.16	NA	NA	NA	NA	NA	NA
PCBs (ppb)	NA	NA	ND	NA	NA	NA	NA	NA	NA
Petrol Hydrocarbon (ppm)	NA	NA	ND	NA	NA	NA	NA	NA	NA
Others (ppm)									
TOC	NA	NA	17	NA	NA	NA	NA	NA	NA
COD	NA	NA	78.1	NA	NA	NA	NA	NA	NA
TDS	NA	NA	746	NA	NA	NA	NA	NA	NA

- - - - - - - -

Notes:

ND - Parameter Not Detected or Below Detection Limits
NA - Parameter Not Analyzed
(1) All other volatile organics were Not Detected
(2) All other base/neutrals were Not Detected
(3) All other acid extractables were Not Detected or Below Detection Limits
(4) All pesticides were Not Detected or Below Detection Limits

Table 3-1 (continued)
Laboratory Analytical Results
Flintkote Property, Orangeburg, N.Y.

PARAMETER	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	CB-1	TB-1
Asbestos (f/l * 10^6)	ND	ND	ND	ND	0.125	ND	ND	NA
Volatile Organics (ppb) (1)								
Acetone	NA	ND	ND	NA	82	91	ND	39.3
Methylene Chloride	NA	6.8	6.5	NA	46	42	ND	22.6
Metals (ppm)								
Arsenic	NA	0.14	<0.05	NA	<0.05	<0.05	<0.05	NA
Beryllium	NA	0.006	<0.005	NA	0.01	0.01	<0.005	NA
Selenium	NA	<0.005	NA	NA	<0.005	<0.005	<0.005	NA
Cadmium	NA	<0.02	<0.02	NA	<0.02	<0.02	<0.02	NA
Chromium	NA	<0.02	<0.02	NA	<0.02	<0.02	<0.02	NA
Copper	NA	<0.01	<0.01	NA	<0.01	<0.01	<0.01	NA
Nickel	NA	<0.05	<0.05	NA	<0.05	<0.05	<0.05	NA
Lead	NA	<0.05	<0.05	NA	<0.05	<0.05	<0.05	NA
Zinc	NA	0.31	0.08	NA	0.54	0.51	<0.02	NA
Silver	NA	<0.015	<0.015	NA	<0.015	<0.015	<0.015	NA
Antimony	NA	0.32	<0.05	NA	0.1	0.09	<0.05	NA
Thallium	NA	0.18	0.2	NA	0.14	0.14	<0.04	NA
Mercury	NA	0.0003	<0.0002	NA	<0.0002	<0.0002	<0.0004	NA
Iron	7.69	35.3	5.97	107	5.54	5.09	0.71	NA
Manganese	2.05	2.52	2	5.19	0.58	0.58	<0.08	NA
Base / Neutral Extr. (ppb) (2)								
Acenaphthene	ND	ND	ND	ND	ND	ND	ND	NA
Anthracene	ND	ND	ND	ND	ND	ND	ND	NA
Benzo(a)anthracene	ND	ND	130	ND	ND	ND	ND	NA
Benzo(b)fluoranthene	ND	ND	240	86	ND	ND	ND	NA
Benzo(k)fluoranthene	ND	ND	230	83	ND	ND	ND	NA
Benzo(a)pyrene	ND	ND	120	ND	ND	ND	ND	NA
Benzo(ghi)perlyne	ND	ND	76	ND	ND	ND	ND	NA
Chrysene	ND	ND	140	51	ND	ND	ND	NA
Dibenzo(a,b)anthracene	ND	ND	ND	ND	ND	ND	ND	NA
2,6-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	NA
Fluoranthene	ND	ND	220	61	ND	ND	ND	NA
Fluorene	ND	ND	ND	ND	ND	ND	ND	NA
Indeno(1,2,3-cd)pyrene	ND	ND	57	ND	ND	ND	ND	NA
Naphthalene	ND	ND	ND	ND	ND	ND	ND	NA
Phenanthrene	ND	ND	ND	ND	ND	ND	ND	NA
Pyrene	ND	ND	180	52	ND	ND	ND	NA
Acid extractable (ppb) (3)								
4-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	NA
Pesticides (ppb) (4)								
Beta-BHC	NA	ND	ND	ND	ND	ND	ND	NA
4,4'-DDT	NA	ND	ND	ND	ND	ND	ND	NA
Endosulphan I	NA	ND	ND	ND	ND	ND	ND	NA
Heptachlor Epoxide	NA	ND	ND	ND	ND	ND	ND	NA
PCBs (ppb)	NA	ND	ND	ND	ND	ND	ND	NA
Petrol Hydrocarbon (ppm)	NA	ND	ND	ND	ND	ND	ND	NA
Others (ppm)								
TOC	NA	13	13	NA	9	15	<5	NA
COD	NA	81.9	101	NA	85.7	53.3	13.8	NA
TDS	NA	632	464	NA	376	356	<1	NA

Notes:

ND - Parameter Not Detected or Below Detection Limits
NA - Parameter Not Analyzed
(1) All other volatile organics were Not Detected
(2) All other base/neutrals were Not Detected
(3) All other acid extractables were Not Detected or Below Detection Limits
(4) All pesticides were Not Detected or Below Detection Limits

TABLE 3-2

Summary of Asbestos Results
Flintkote Property

	Present Study Results		Previous Study Results
Sample Number	Mineral Type	Asbestos Concentration (fibers/liter x 10^6)	Asbestos Concentration (fibers/liter x 10^6)
MW-1d	Actinolite	4.50	4,600
MW-2d	Actinolite	3.75	1,600
MW-2r	Chrysotile	0.25	--
MW-2r (QA)	Chrysotile	ND	--
MW-6s	Chrysotile	75.0	340,000
MW-6d	Chrysotile	33.00	9,500
MW-6r	Chrysotile	0.625	--
MW-6t=6r	Chrysotile	0.1875	--
MW-7s	Chrysotile	0.30	11,000
MW-7t=7s	Chrysotile	10.5	11,000
MW-7d	Chrysotile	6.0	24,000
MW-8s	Chrysotile	41.25	4,100,000
MW-8d	Chrysotile	210.0	240,000
MW-8d (QA)	Chrysotile & Amosite	28.25	240,000
MW-9s	Chrysotile	157.5	3,600
MW-9d	Chrysotile	30.00	660
MW-9t=9d	Chrysotile	30.00	660
MW-9r		ND	--
MW-10r	Chrysotile	0.05	--
EMW		ND	--
SW-1		ND	--
SW-2		ND	--
SW-3 (LMS #2)		ND	680
SW-4		ND	--
SW-5 (LMS #1)	Chrysotile	0.125	880
SW-6 (LMS #1)		ND	880
CB-1		ND	

-- = not tested

TABLE 3-3

Volatile Organic Compounds

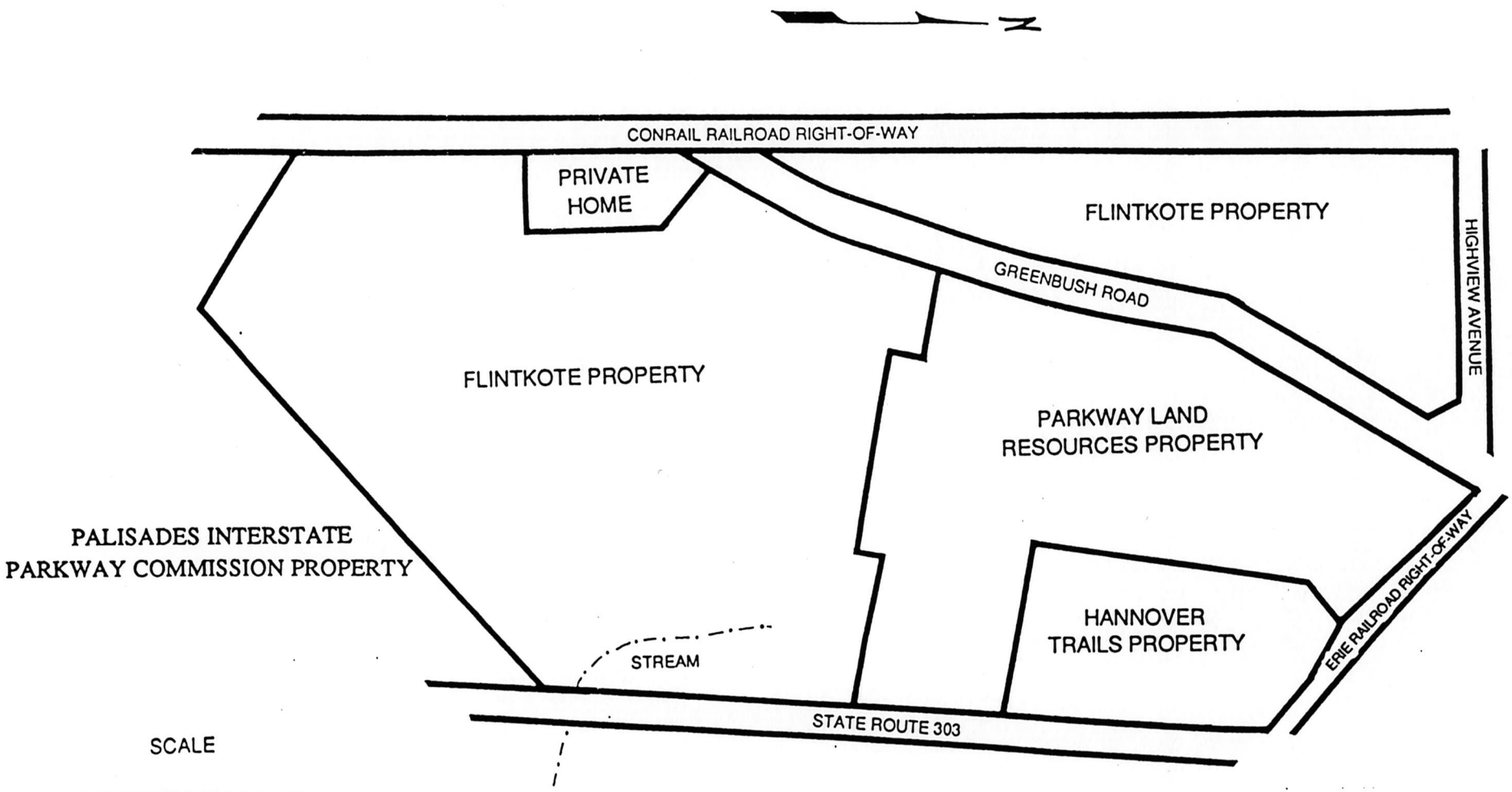
Summary of Results
Flintkote Property

	Compound *	
Sample Number	Methylene Chloride (ppb)	Acetone (ppb)
MW-2d	ND	ND
MW-2r	6.8	ND
MW-6r	6.4	ND
MW-6t	6.3	ND
MW-7s	5.8	ND
MW-7t	7.3	ND
MW-8d	6.9	ND
SW-2	6.8	ND
SW-3	6.5	ND
SW-5	46.0	82.0
SW-6	42.0	91.0
CB-1	ND	ND
TB-1	22.6	39.3

ND Not Detected

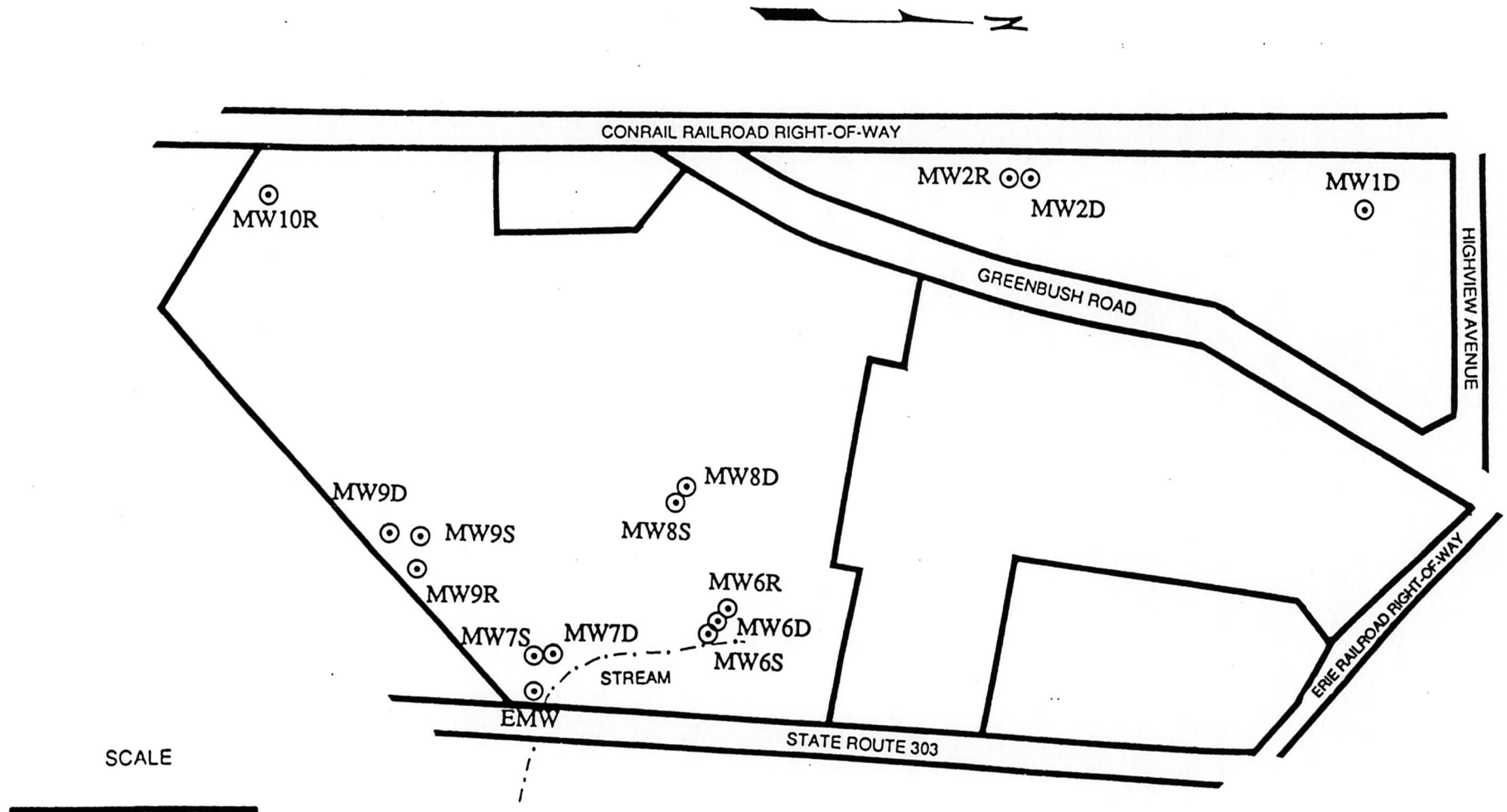
* All other volatile organic compounds were Not Detected or Below Minimum Detection Limits.

FIGURES



FLINTKOTE SITE MAP
ORANGEBURG, NY

Dames & Moore
FIGURE 1

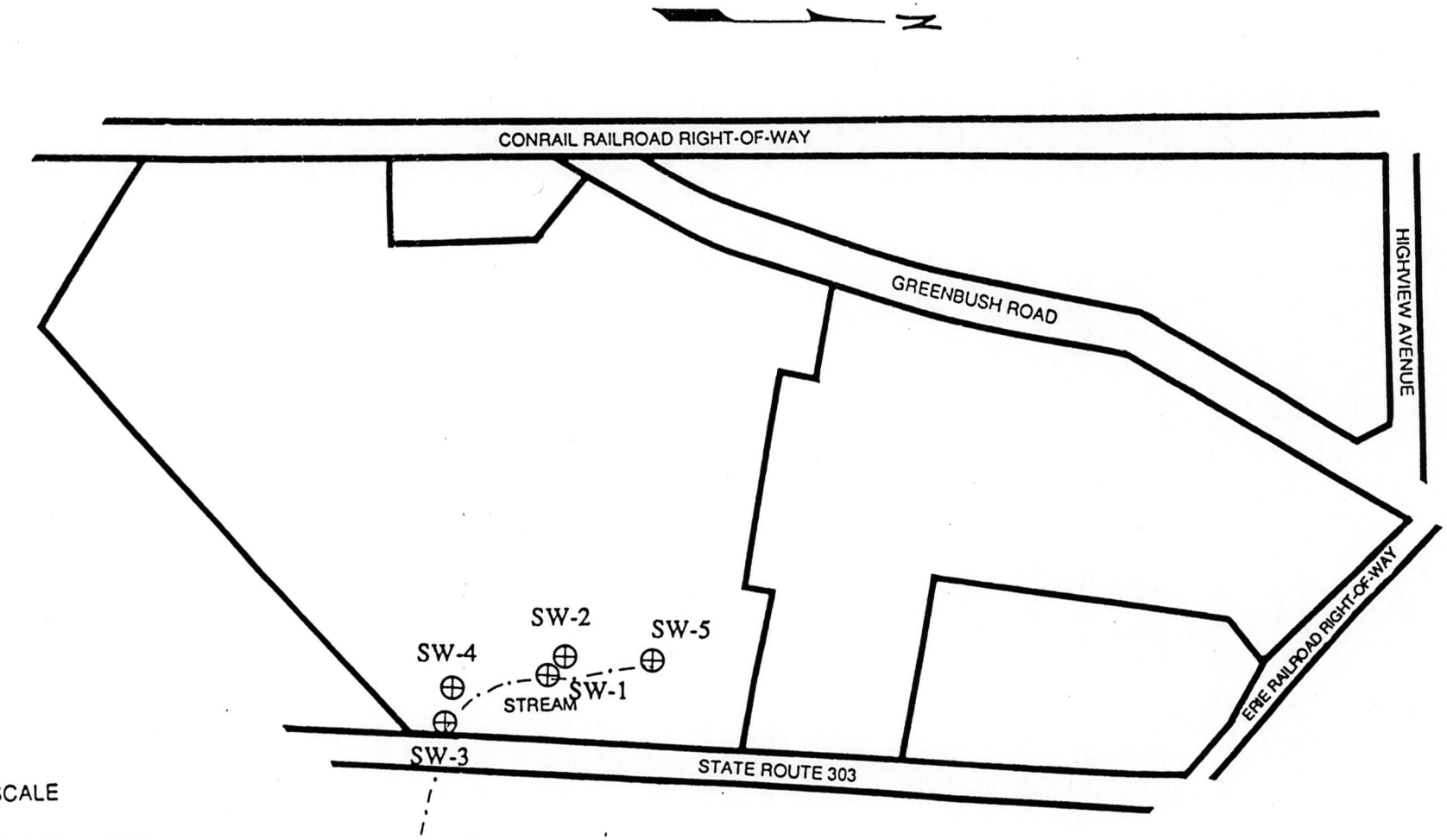


LOCATION OF EXISTING MONITORING WELLS, FLINTKOTE SITE, ORANGEBURG, NY

NOTE: WELL LOCATIONS ARE APPROXIMATE

Dames & Moore

FIGURE 2



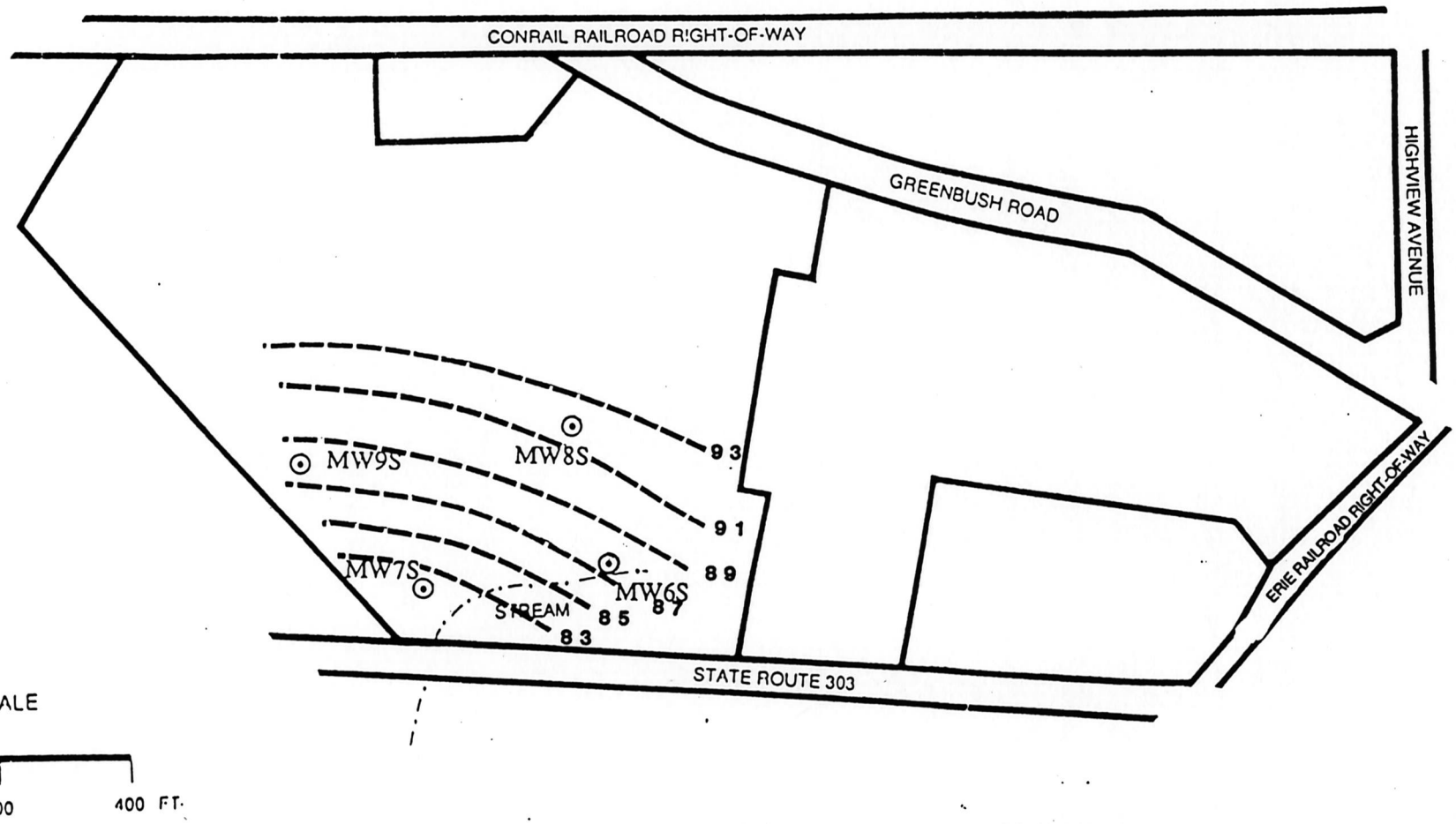
SURFACE WATER SAMPLE LOCATIONS
FLINTKOTE SITE, ORANGEBURG, NY

⊕ SURFACE WATER SAMPLE LOCATIONS

Dames & Moore

FIGURE 3

THE CONTOURS SHOWN REPRESENT AN EVALUATION OF THE MOST PROBABLE CONDITIONS BASED UPON INTERPRETATION OF PRESENTLY AVAILABLE DATA, SOME OF WHICH WAS SUPPLIED BY OTHERS. VARIATIONS FROM THESE CONDITIONS MAY OCCUR.



SCALE

0 200 400 FT.

⊙ SHALLOW MONITORING WELL

PIEZOMETRIC SURFACE CONTOURS

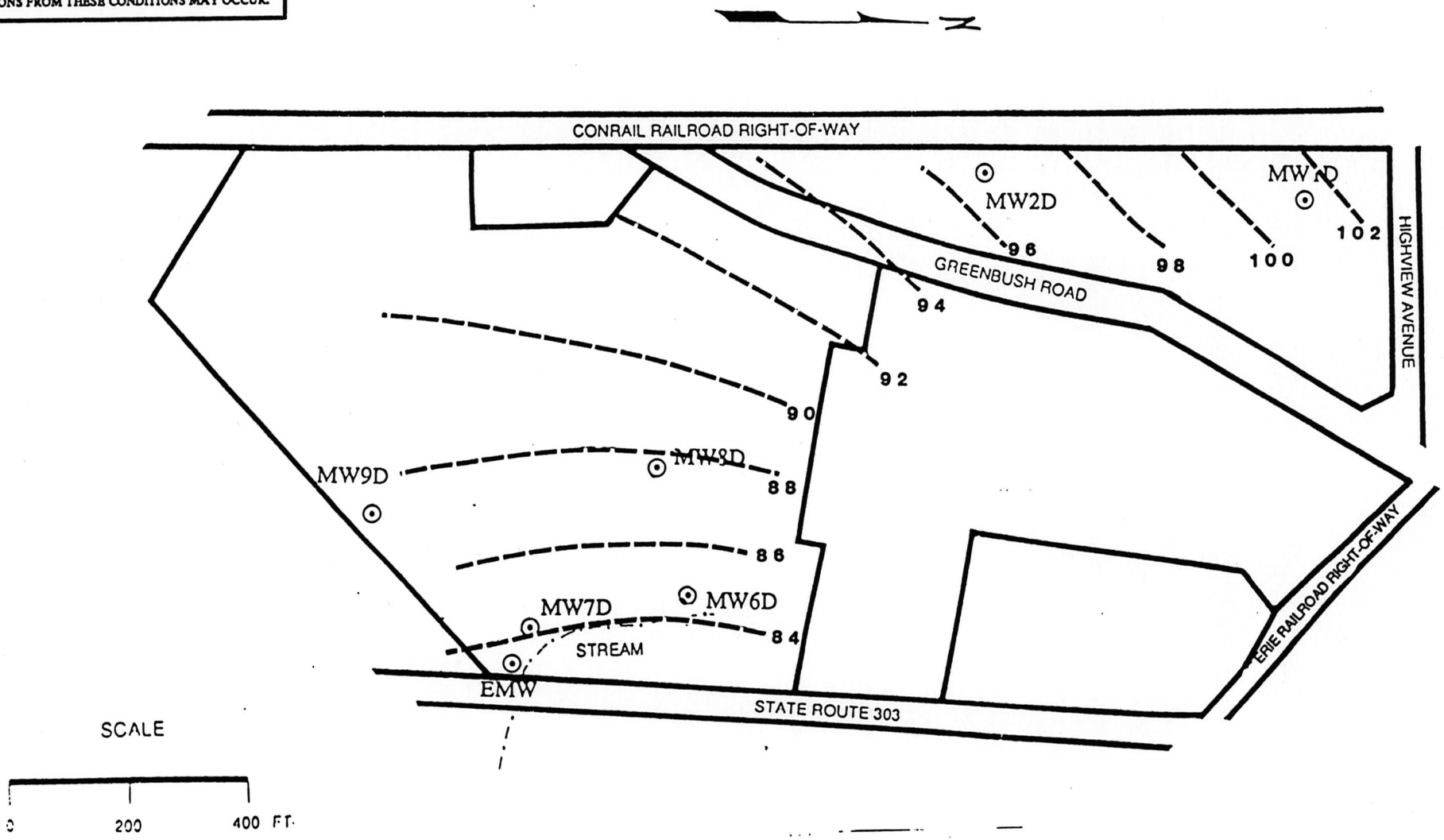
NOTE: WELL LOCATIONS ARE APPROXIMATE

SHALLOW (FILL) PIEZOMETRIC SURFACE FLINTKOTE SITE, ORANGEBURG, NY

Dames & Moore

FIGURE 4

THE CONTOURS SHOWN REPRESENT AN EVALUATION OF THE MOST PROBABLE CONDITIONS BASED UPON INTERPRETATION OF PRESENTLY AVAILABLE DATA, SOME OF WHICH WAS SUPPLIED BY OTHERS. VARIATIONS FROM THESE CONDITIONS MAY OCCUR.



⊙ DEEP MONITORING WELL
PIEZOMETRIC SURFACE CONTOURS

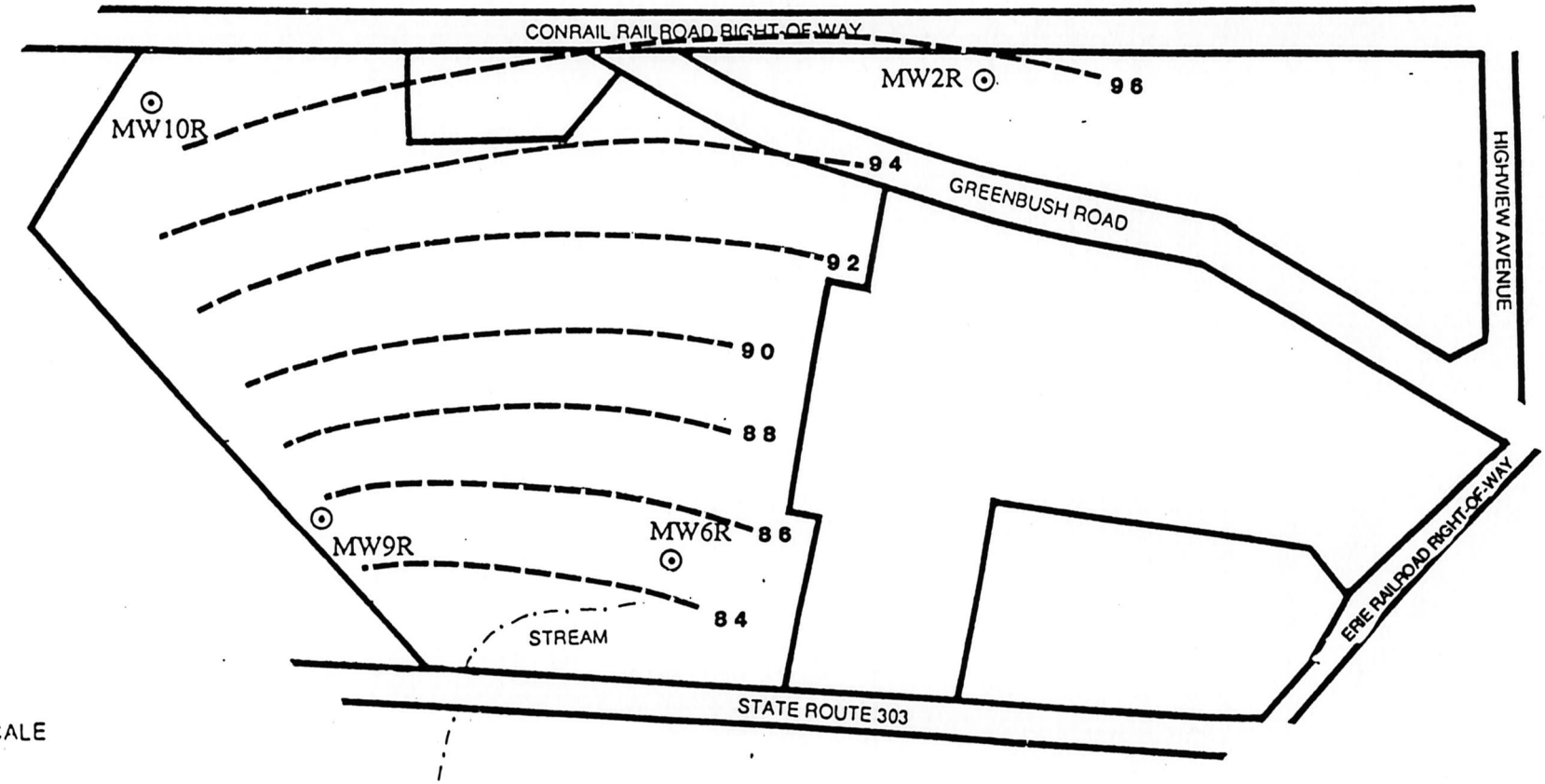
NOTE: WELL LOCATIONS ARE APPROXIMATE

DEEP (GLACIAL) PIEZOMETRIC SURFACE FLINTKOTE SITE, ORANGEBURG, NY

Dames & Moore

FIGURE 5

THE CONTOURS SHOWN REPRESENT AN EVALUATION OF THE MOST PROBABLE CONDITIONS BASED UPON INTERPRETATION OF PRESENTLY AVAILABLE DATA, SOME OF WHICH WAS SUPPLIED BY OTHERS. VARIATIONS FROM THESE CONDITIONS MAY OCCUR.



SCALE

0 200 400 FT.

⊙ BEDROCK MONITORING WELL

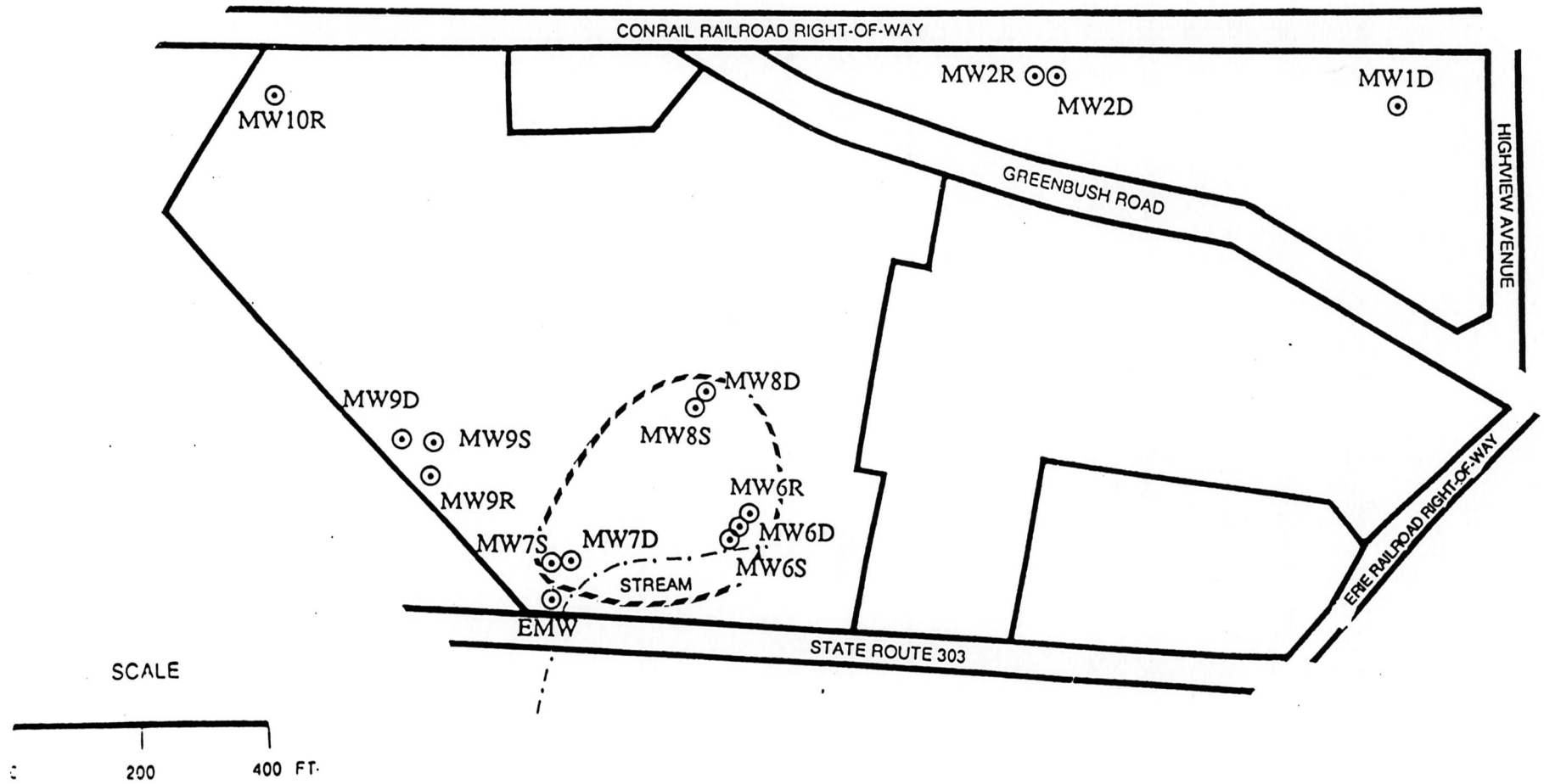
PIEZOMETRIC SURFACE CONTOURS

NOTE: WELL LOCATIONS ARE APPROXIMATE

BEDROCK PIEZOMETRIC SURFACE FLINTKOTE SITE, ORANGEBURG, NY

Dames & Moore

FIGURE 6



⊙ EXISTING MONITORING WELL

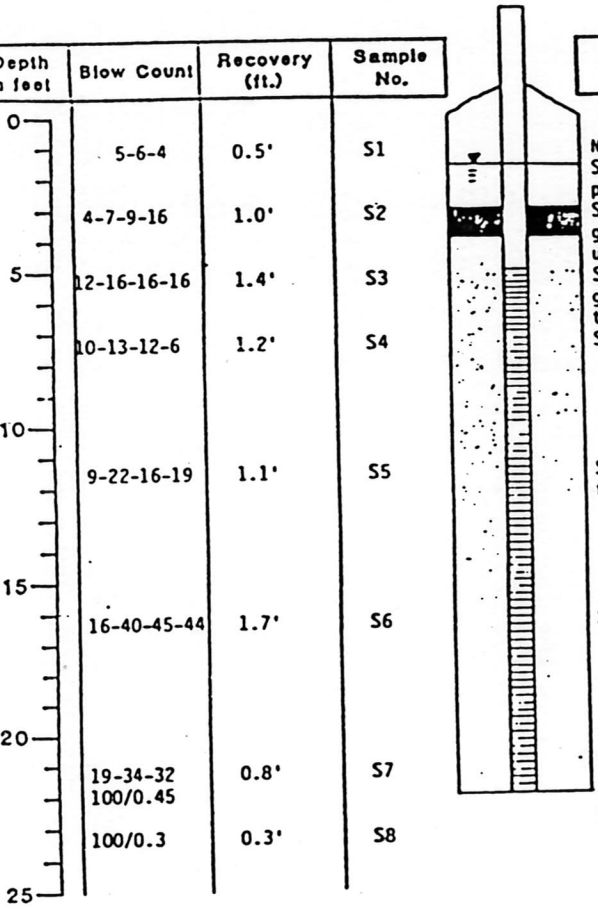
NOTE: WELL LOCATIONS ARE APPROXIMATE

REMEDIAL AREA - FILL MATERIAL
FLINTKOTE SITE, ORANGEBURG, NY

Dames & Moor

FIGURE 7

APPENDIX 1

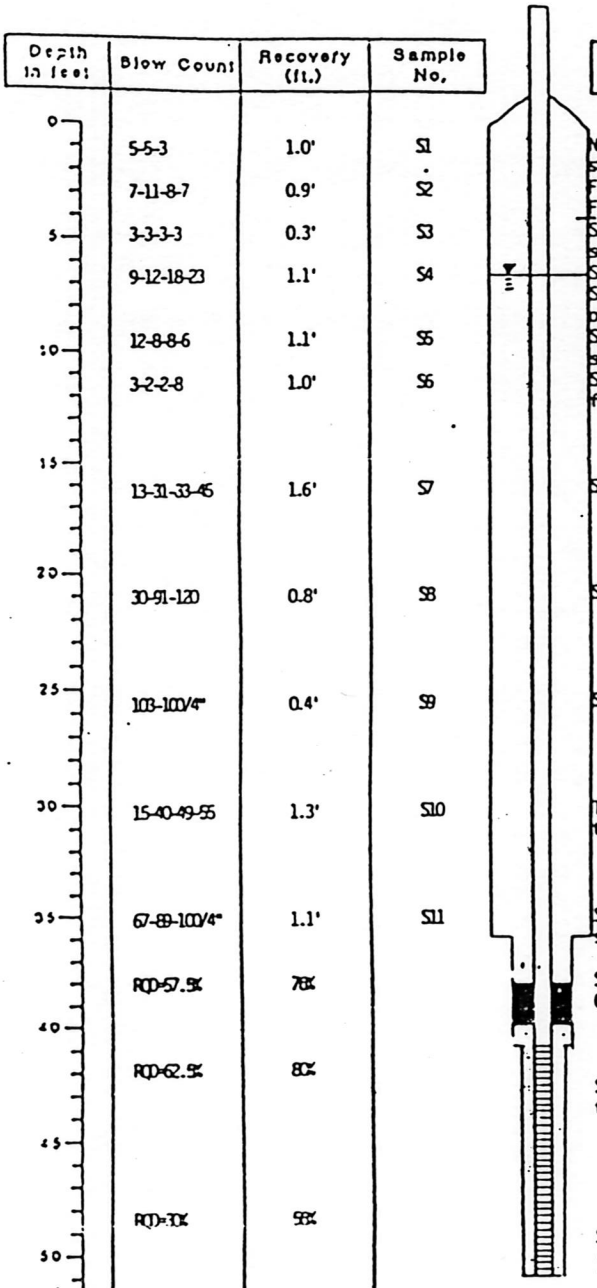


Depth in feet	Blow Count	Recovery (ft.)	Sample No.	Description
0	5-6-4	0.5'	S1	Note: Concrete-cored with spin-bit 0 to 0.5' depth. Silty sand and fill-reddish brown, fine grained, few pieces of coal, trace ash, some medium sand.
	4-7-9-16	1.0'	S2	Silty sand and fill?- Reddish brown, fine to medium grained, layered with darker,(stained?) zones of materi up to 0.15' thick, trace pebble.
5	12-16-16-16	1.4'	S3	Silty sand-reddish brown, fine to medium grained at top, grading to fine sand at bottom, some pebbles, cohesive, trace clay.
	10-13-12-6	1.2'	S4	Silty sand-reddish brown, same as above.
10	9-22-16-19	1.1'	S5	Silty sand-tan to brown, fine grained some coarse grain few pebbles, trace clay, compact. (Till).
15	16-40-45-44	1.7'	S6	Silty sand-same as above except very compact (Till).
20	19-34-32 100/0.45	0.8'	S7	Silty sand-same as above. Rock fragment-yellow to tan, weathered. Weathered bedrock-red, medium to coarse grained sandstone, mostly quartz, hematite cement.
	100/0.3	0.3'	S8	Weathered bedrock-red, same as above.
25				

Project No.: 514-001
Client: Kurdistan
Drilling Began: 8/19/86
Drilling Completed: 8/19/86
Well Construction Completed: 8/19/86
Development Method/Completed: Bailer/8/25/86
Yield:
Total Depth: 22.8'
Depth to Refusal: 22.0'
Screened Interval: 5'-22'
Aquifer: Glacial

Boring No.: MW 1D
Permit No.: NA

SWL (date): 100.68' (9/15/86)
Elevation, Ground Surface: 102.35
Elevation, Top of Casing: 105.13
Latitude:
Longitude:
Hole Dia.: 8" O.D./4-1/4" I.D.
Monitoring Tube: 2" SCH 40 PVC

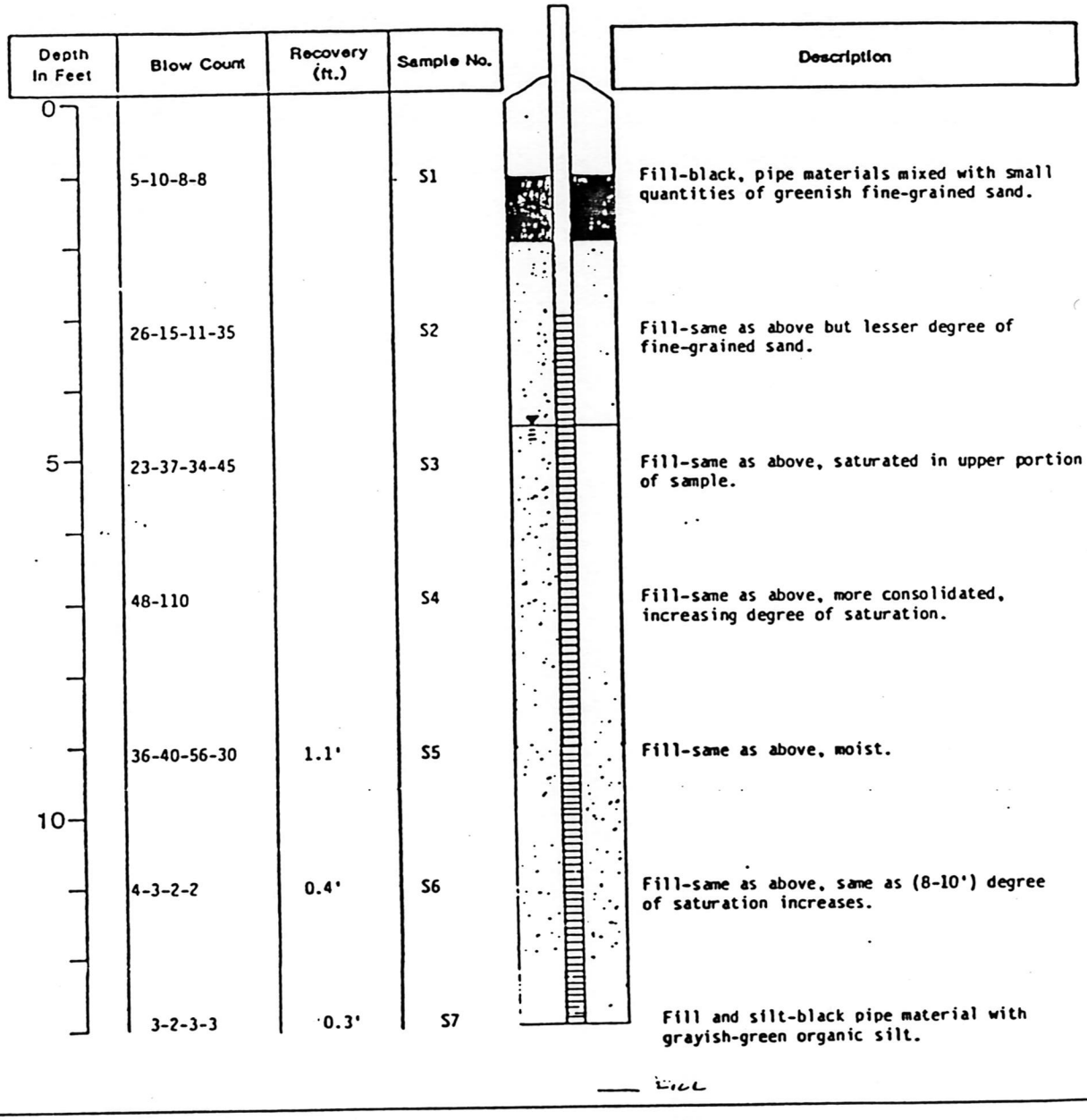


Depth in feet	Blow Count	Recovery (ft.)	Sample No.	Description
0	5-5-3	1.0'	S1	Note: 0.5' of asphalt and gravel augered before sampling. Fill-brown with some red streaks, silty sand fine grained, cinders, few pebbles.
	7-11-8-7	0.9'	S2	Fill-silty sand-same as above.
				Fill-black, coal particles and fragements, concoidal fracture, glossy texture.
5	3-3-3-3	0.3'	S3	Sandy clay-gray to brown, cohesive, some fine grained sand, trace pebbles. Some thi seams (0.01') of medium to coarse white and red sand. (Fill).
	9-12-18-23	1.1'	S4	Sandy clay-brown, same as above.
				Sand and gravel-varying in color (red, gray) trace clay, sand is fine grained, frag of trap-rock, sandstone fragement in tip.
10	12-8-8-6	1.1'	S5	Silty sand-red, very fine to fine grained, some zones of cemented material, trace cl some dark particles present in dark clayey mottling.
	3-2-2-8	1.0'	S6	Silty sand-red, same as above, except zone black sand (fine to medium grained) and r fragements near spoons tip last 0.3' of sample.
15	13-31-33-45	1.6'	S7	Silty sand brown-to red, very compact, trace pebble, rock fragement in spoon's tip.
20	30-91-120	0.8'	S8	Silty sand-brownish, fine grained with some pebbles of granite materials, compact.
25	103-100/4"	0.4'	S9	Silty sand-brown to reddish brown, medium grained sand with some pebbles.
30	15-40-49-55	1.3'	S10	Till-reddish brown, lower portion (0.3') shows some rock materials embedded in soil traces of clay in upper portion (0.3'), sugary white particles appears throughout s
35	67-89-100/4"	1.1'	S11	Silty sand-reddish brown, fine grained. Lower portion (0.1') white fine grained sandstone.
	RQD=57.5%	78%		Sandstone, brown to reddish brown, coarse grained sugary white zones ranging from 0.125' to 0.21' in top to lower portion respectively.
40	RQD=62.5%	80%		Sandstone-brown to reddish brown, fine to medium grained. Powdery white grains throughout sample.
45	RQD=70%	98%		Sandstone-reddish brown, very fine to fine grained, mostly quartz, upper portion (0.75') well cemented with sugary white coarse grained sandstone Note: NX core lifter broken, sample hammered out of barrel.
50				
55				

Project No.: 514-001
Client: Kurdistan
Drilling Began: 8/14/86
Drilling Completed: 8/14/86
Well Construction Completed: 8/14/86
Development Method/Completed: Bailer/8/22/86
Yield:
Total Depth: 51.3'
Depth to Refusal: NA
Screened Interval: 41'-51'
Aquifer: Bedrock

Boring No.: MW 2R
Permit No.: NA

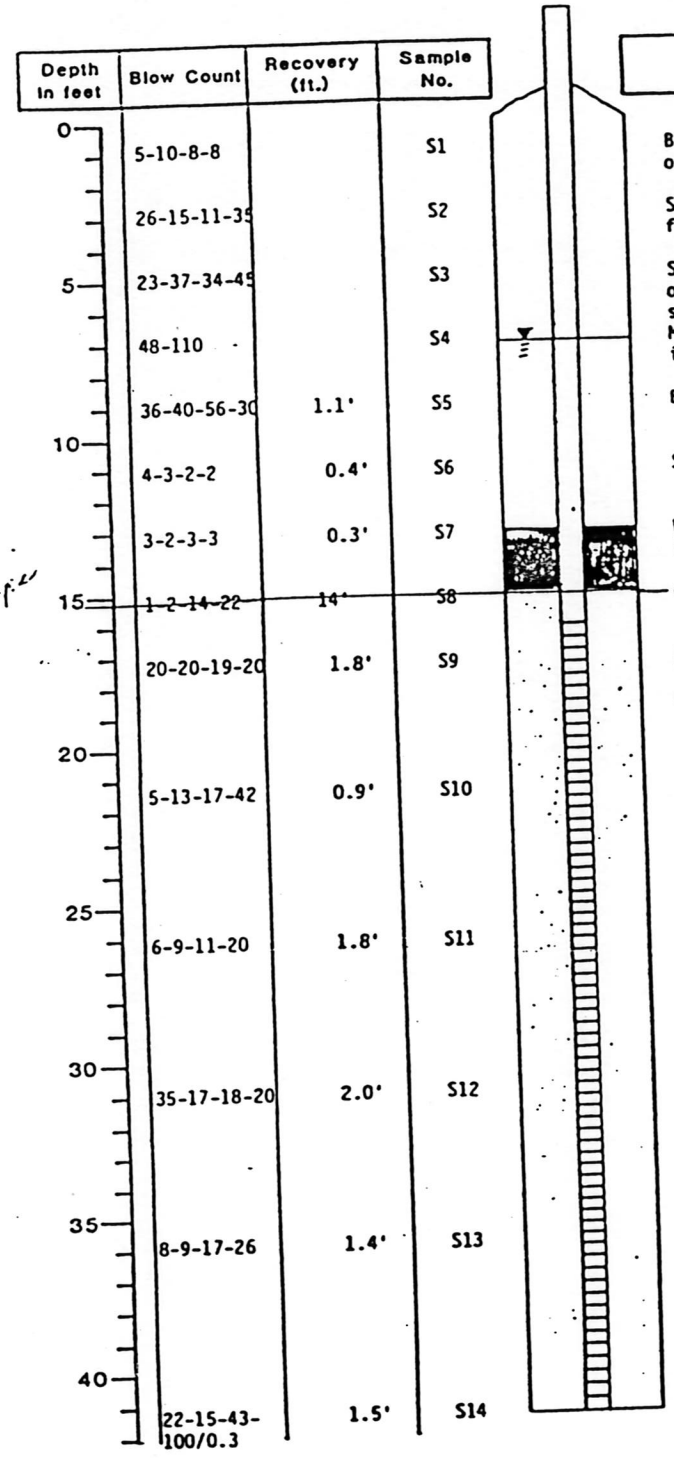
SWL (date): 96.03' (9/15/86)
Elevation, Ground Surface: 102.82
Elevation, Top of Casing: 105.23
Latitude:
Longitude:
Hole Dia.: 4" x 3-1/2" x 3"
Monitoring Tube: 2" SCH 40 PVC



Project No.: 514-001
Client: Kurdistan
Drilling Began: 8/13/86
Drilling Completed: 8/13/86
Well Construction Completed: 8/13/86
Development Method/Completed: Pump/8/22/86
Yield:
Total Depth: 13.0'
Depth to Refusal: NA
Screened Interval: 3'-13'
Aquifer: Fill

Boring No.: MW 6S
Permit No.: NA

SWL (date): 85.59 (9/15/86)
Elevation, Ground Surface: 90.16
Elevation, Top of Casing: 92.89
Latitude:
Longitude:
Hole Dia.: 8" O.D./4-1/4" I.D.
Monitoring Tube: 2" SCH 40 PVC

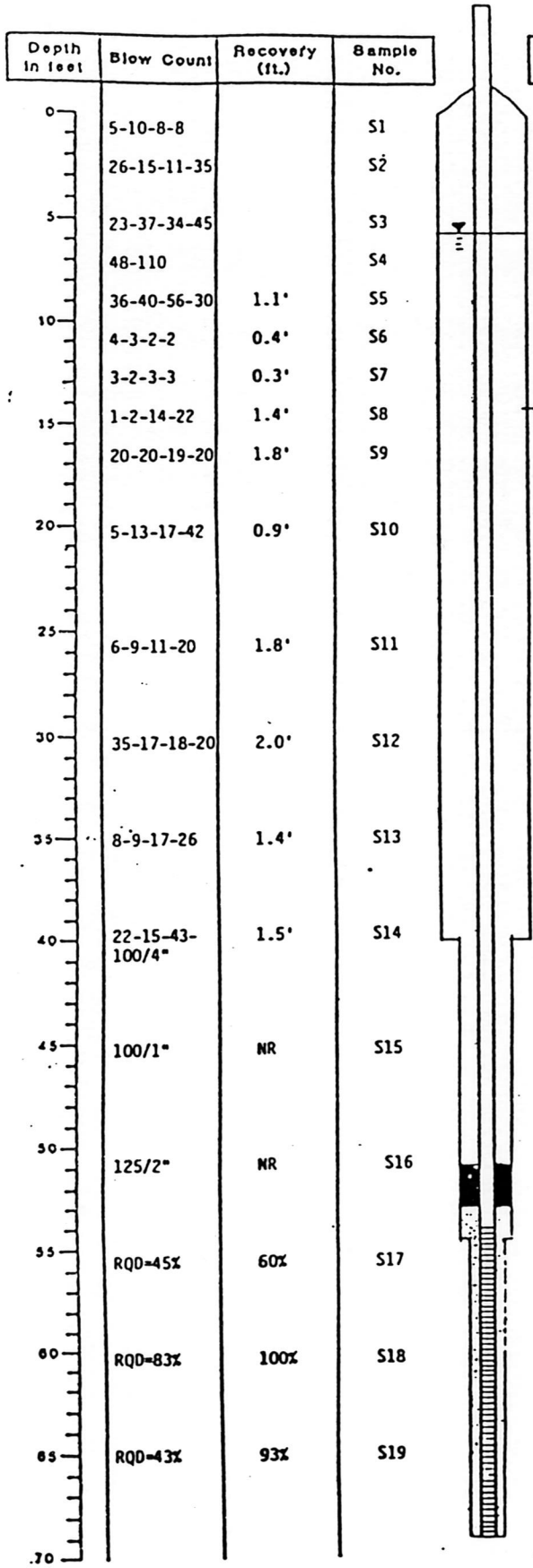


Depth in feet	Blow Count	Recovery (ft.)	Sample No.	Description
0	5-10-8-8		S1	Black pipe materials mixed with small quantities of greenish fine-grained sand.
	26-15-11-35		S2	Sample similar to 0-2' but lesser degree of fine-grained sand.
5	23-37-34-45		S3	Same as above (black pipe materials) but traces of water saturation in the upper portion of sample.
	48-110		S4	More consolidated black pipe materials with increasing degree of saturation.
	36-40-56-30	1.1'	S5	Black pipe materials, moist.
10	4-3-2-2	0.4'	S6	Same as (8-10'). but degree of wetness increases.
	3-2-3-3	0.3'	S7	Wet black pipe materials with some organic silt included.
15	1-2-14-22	14'	S8	Gray, fine to very fine sand with clay, wet.
	20-20-19-20	1.8'	S9	Brown to reddish brown of natural soil with little traces of greyish fine sand small pebbles observed.
20	5-13-17-42	0.9'	S10	Brownish red natural soil on the upper layer, fine grained sand, greenish black in the lower part, small pebbles, wet.
25	6-9-11-20	1.8'	S11	Brown to reddish brown, not natural soil with very fine sand and some pebbles pieces of black shiny zones (coal/tar?) observed.
30	35-17-18-20	2.0'	S12	Brown to reddish brown natural soil mixed with fine to medium sand, pebbles.
35	8-9-17-26	1.4'	S13	Reddish brown to red natural soil with some traces of clay material, very fine grained whi particles observed. (possibly representative bedrock material.
40	22-15-43-100/0.3	1.5'	S14	Upper portion - moist, brown-brownish red medi grained sand. Lower portion - dry, reddish, medium grained sandstone (bedrock?).

Project No.: 514-001
Client: Kurdistan
Drilling Began: 8/11/86
Drilling Completed: 8/11/86
Well Construction Completed: 8/11/86
Development Method/Completed: Bailer/8/22/86
Yield:
Total Depth: 41.8'
Depth to Refusal: 41.5'
Screened Interval: 16'-41.5'

Boring No.: MW 60
Permit No.: NA

SWL (date): 83.42 (9/15/86)
Elevation, Ground Surface: 90.45
Elevation, Top of Casing: 92.54
Latitude:
Longitude:
Hole Dia.: 8" O.D./4-1/4" I.D.
Monitoring Tube: 2" SCH 40 PVC

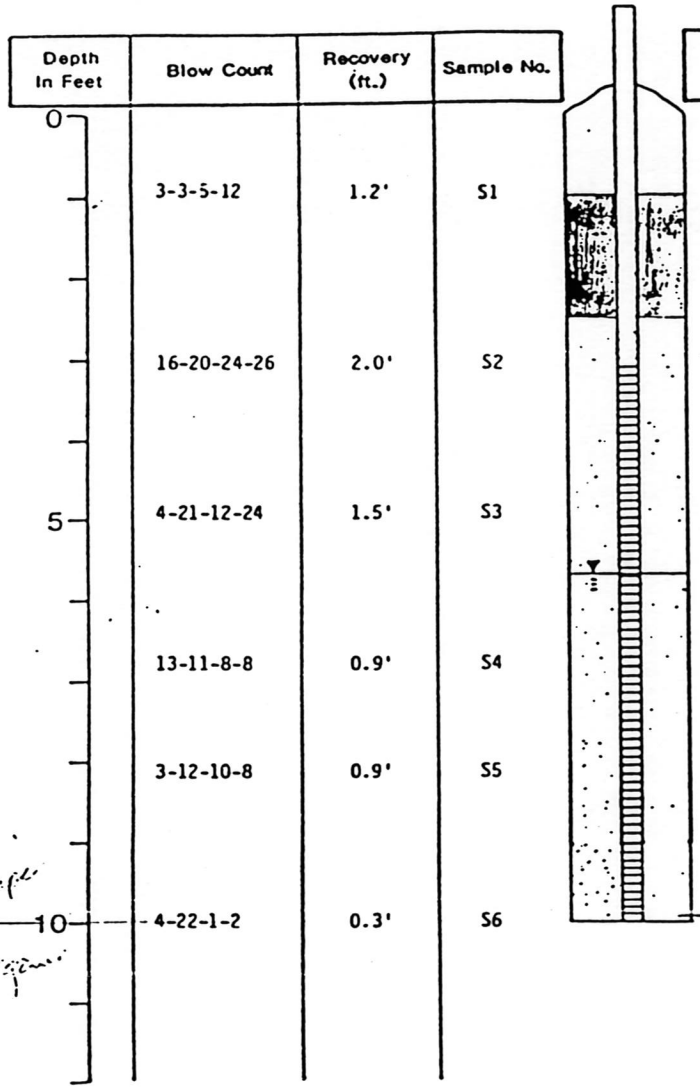


Depth in feet	Blow Count	Recovery (ft.)	Sample No.	Description
0	5-10-8-8		S1	Black pipe materials mixed with small quantities of greenis fine-grained sand.
	26-15-11-35		S2	Sample similar to 0-2 ft but lesser degree of fine-grained sand.
5	23-37-34-45		S3	Same as above (black pipe materials) but traces of water saturation in the upper portion of sample.
	48-110		S4	More consolidated black pipe materials with increasing degree of saturation.
	36-40-56-30	1.1'	S5	Black pipe materials, moist.
10	4-3-2-2	0.4'	S6	Same as (8-10') but degree of wetness increases.
	3-2-3-3	0.3'	S7	Wet black pipe materials with some organic silt included.
15	1-2-14-22	1.4'	S8	Gray, fine to very fine sand with clay, wet.
	20-20-19-20	1.8'	S9	Brown to reddish brown of natural soil with little traces of greyish fine sand, small pebbles observed.
20	5-13-17-42	0.9'	S10	Brownish red natural soil on the upper layer, fine grained sand, greenish black in the lower part, small pebbles wet.
25	6-9-11-20	1.8'	S11	Brown to reddish brown, wet natural soil with very fine san and some pebbles pieces of black, shiny zones (coal/tar?) observed.
30	35-17-18-20	2.0'	S12	Brown to reddish brown natural soil mixed with fine to medium sand, pebbles.
35	8-9-17-26	1.4'	S13	Reddish brown to red natural soil with some traces of clay material, very fine grained white particles observed. (possibly representative of bedrock material.
40	22-15-43-100/4"	1.5'	S14	Sand-brown-brownish red, medium grained 0.3'. Lower portion - dry reddish, medium grained sandstone (bedrock?).
45	100/1"	NR	S15	Note: Wash-out includes coarse-grained reddish brown sandstone fragments with traces of coarse quartz.
50	125/2"	NR	S16	Note: Wash-out contains coarse-grained reddish brown sandstone fragments with some red quartz sand.
55	RQD=45%	60%	S17	NX Core (54.6'-69.6') Sandstone-reddish brown with traces of clay at the upper portion (0.25' clay), brownish sugary quartz zones ranging from 0.25' to 0.83', fine to medium grained.
60	RQD=83%	100%	S18	NX Core (59.6'-64.6') Sandstone-reddish brown, medium grained with sugary white quartz from 0.15'-0.60'. Sugary quartz zone ranging from 0.15' to 0.60'.
65	RQD=43%	93%	S19	NX Core (64.6'-69.0') Note: Full at 69.0' barrel had to be hammered to get samp out. Reddish sandstone, medium to fine grained. Sugary quartz zone decreased.
70				

Project No.: 514-001
Client: Kurdistan
Drilling Began: 8/12/86
Drilling Completed: 8/13/86
Well Construction Completed: 8/13/86
Development Method/Completed: Bailer
Yield:
Total Depth: 69.0'
Depth to Refusal: NA
Screened Interval: 54'-69'
Aquifer: Bedrock

Boring No.: MW 6R
Permit No.: NA

SWL (date): 5.95' (9/15/86)
Elevation, Ground Surface: 90.25
Elevation, Top of Casing: 92.52
Latitude:
Longitude:
Hole Dia.: 4" x 3-1/2" x 3
Monitoring Tube: 2" SCH 40 PVC

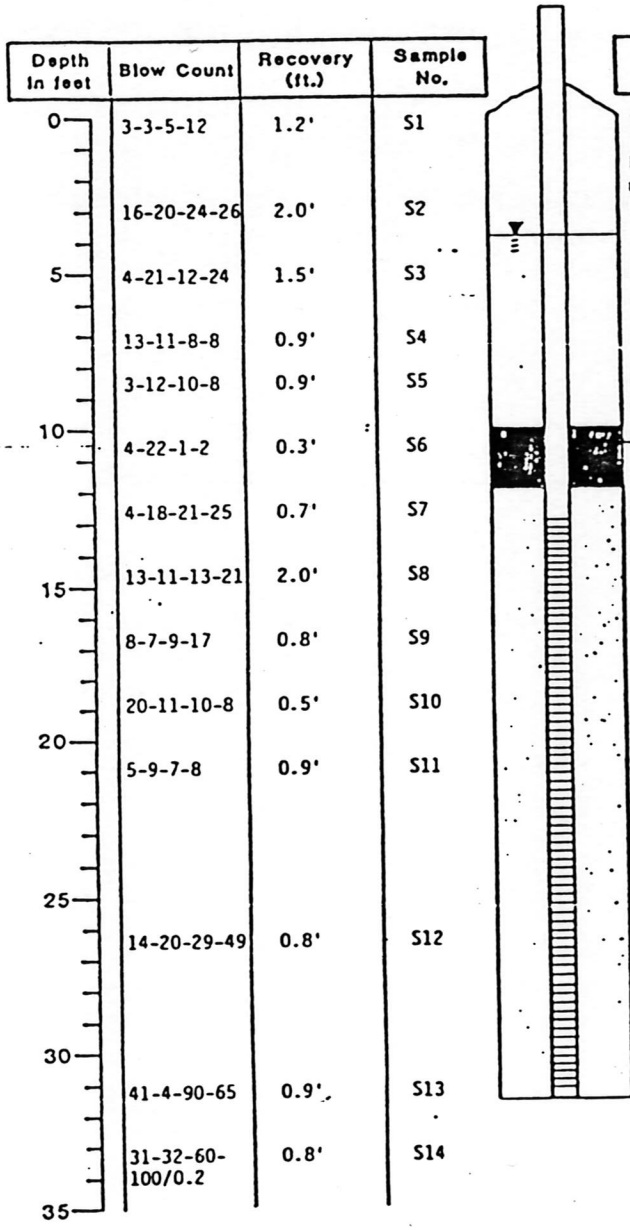


Depth In Feet	Blow Count	Recovery (ft.)	Sample No.	Description
0				Silty sand-brown, fine-medium grained, some red clay presence (moist).
	3-3-5-12	1.2'	S1	Fill-black, bituminous pipe particles and fragments, some medium sand (moist).
	16-20-24-26	2.0'	S2	Fill-black, same as above, trace sand (moist).
5	4-21-12-24	1.5'	S3	Fill-black, some zones of grey (0.25' thick) fine grained, same as above, wood fragements. (moist-lower 0.4' wet).
	13-11-8-8	0.9'	S4	Fill-black bituminous material, some medium to coarse grained sand, (brown) some red brick particles (sat.).
	3-12-10-8	0.9'	S5	Fill-grey to black, bituminous particles with some medium grained sand and brick fragments. Lower 0.4' is harder and fused together. (sat.).
10	4-22-1-2	0.3'	S6	Peat and silt-dark brown, plant fibers, cohesive (moist).

Project No.: 514-001
Client: Kurdistan
Drilling Began: 8/11/86
Drilling Completed: 8/12/86
Well Construction Completed: 8/12/86
Development Method/Completed: Pump/8/22/86
Yield:
Total Depth: 10.0'
Depth to Refusal: NA
Screened Interval: 3'-7'
Aquifer: Fill

Boring No.: MW 7S
Permit No.: NA

SWL (date): 81.84' (9/15/86)
Elevation, Ground Surface: 87.56
Elevation, Top of Casing: 88.95
Latitude:
Longitude:
Hole Dia.: 8" O.D./4-1/4" I.D.
Monitoring Tube: 2" SCH 40 PVC

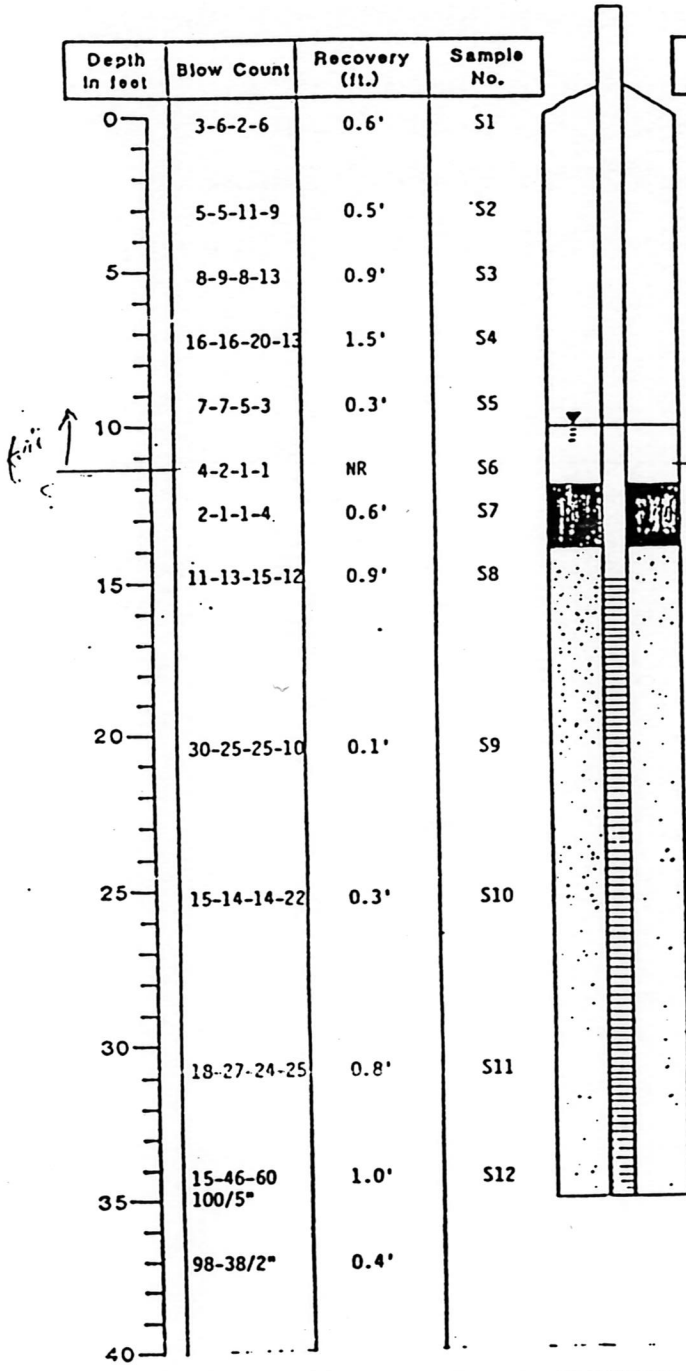


Depth in feet	Blow Count	Recovery (ft.)	Sample No.	Description
0	3-3-5-12	1.2'	S1	Silty sand-brown, fine-medium grained, some red clay presence (moist).
				Fill-black, bituminous pipe particles and fragments, some medium sand (moist).
	16-20-24-26	2.0'	S2	Fill-black, same as above, trace sand (moist).
5	4-21-12-24	1.5'	S3	Fill-black, some zones of grey (0.25' thick) fine grained, same as above, wood fragements. (moist-lower 0.4 wet).
	13-11-8-8	0.9'	S4	Fill-black bituminous material, some medium to coarse grained sand, (brown) some red brick particles (sat.).
	3-12-10-8	0.9'	S5	Fill-grey to black, bituminous particles with some medium grained sand and brick fragments. Lower 0.4' is harder and fused together. (sat.).
10	4-22-1-2	0.3'	S6	Peat and silt-dark brown, plant fibers, cohesive (moist).
	4-18-21-25	0.7'	S7	Clayey sand-pink to red with some grey mottling color, fine to medium grained. few pebbles (sat.).
15	13-11-13-21	2.0'	S8	Sand-red to pink, medium to coarse grained, some clay, some pebbles, (sat.).
	8-7-9-17	0.8'	S9	Silty sand-red to brown, very fine to fine grained, some coarse gravel, (sat.).
	20-11-10-8	0.5'	S10	Silty sand-red to brown, very fine to fine grained, same as above. Some zones (0.15') of liquified sand.
20	5-9-7-8	0.9'	S11	Silty sand-brownish red, fine grained sand with some coarse grains and some pebbles.
25	14-20-29-49	0.8'	S12	Silty sand-brown, very fine to fine grained. Upper portion contains more silt while the reverse can be founc on the bottom, some pebbles. Trace clay.
30	41-4-90-65	0.9'	S13	Till-reddish brown, mostly silt, trace coarse sand, few pebbles trace clay, very hard dark red quartz sandstone zone (12"-18") with hematite cement. (moist).
35	31-32-60-100/0.2	0.8'	S14	Till-same as above. Slightly more coarse grained sand. Sandstone-red, mostly quartz, fine to medium grained, hematite cement.

Project No.: 514-001
Client: Kurdistan
Drilling Began: 8/8/86
Drilling Completed: 8/11/86
Well Construction Completed: 8/11/86
Development Method/Completed: Bailer/8/22/86
Yield:
Total Depth: 33.7'
Depth to Refusal: 31.5'
Screened Interval: 13'-31.5'
Aquifer: Glacial

Boring No.: MW 7D
Permit No.: NA

SWL (date): 83.65' (9/15/86)
Elevation, Ground Surface: 87.51
Elevation, Top of Casing: 90.23
Latitude:
Longitude:
Hole Dia.: 8" O.D./4-1/4" I.D.
Monitoring Tube: 2" SCH 40 PVC

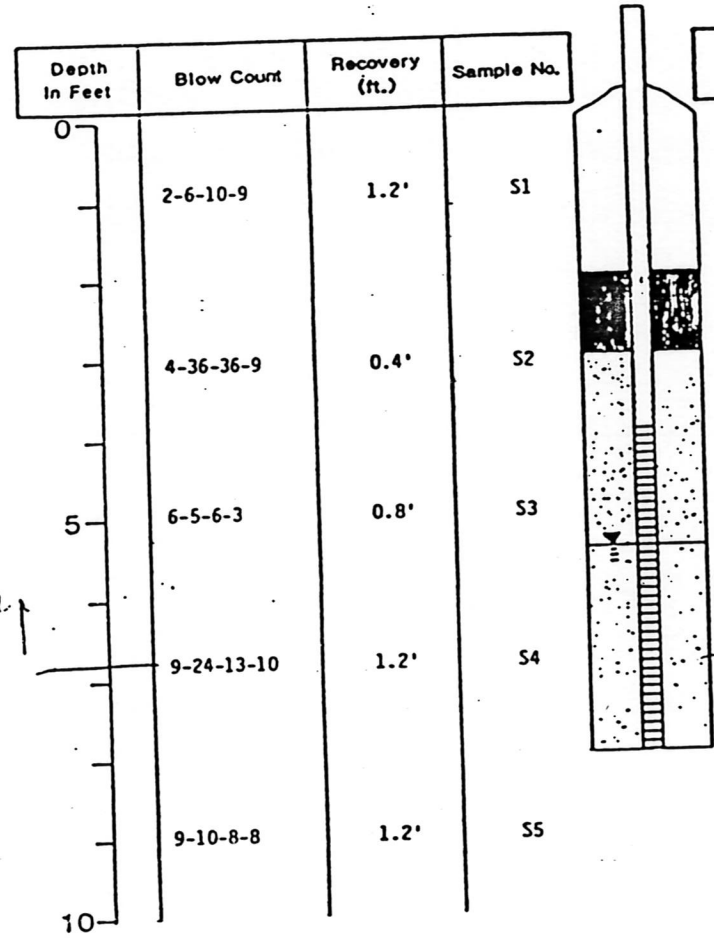


Depth In feet	Blow Count	Recovery (ft.)	Sample No.	Description
0	3-6-2-6	0.6'	S1	Silty Sand-brown, fine grained, some plant fibers and tube Fill-black and brown, concrete fragments, brick fragements some brown silt, bituminous grains, wood.
	5-5-11-9	0.5'	S2	Fill-black and brown, same as above except some clay prese and more cohesive. Decayed wood in tip.
5	8-9-8-13	0.9'	S3	Fill-brown to black, decayed wood, some staining, brick fragements, some silt. Lower 0.3' is exclusively bitumino pipe fragement, compacted.
	16-16-20-13	1.5'	S4	Fill-brown, decayed wood, some brick fragement, some silt.
	7-7-5-3	0.3'	S5	Fill-black, bituminous pipe fragements, some ground pipe particles, compact. (coal tar odor). Fill-black, same as above, very compact, slight coal tar odor.
10	4-2-1-1	NR	S6	Inferred marsh deposit, muck, organic silt.
	2-1-1-4	0.6'	S7	Silt grayish green, plant fibers, soft to touch, cohesive organic. (Marsh deposit) slight organic odor.
15	11-13-15-12	0.9'	S8	Silty sand-brown to red, fine grained, some pebbles, trace gravel, trace clay.
				Note: Used core bit to core 18-20' interval.
20	30-25-25-10	0.1'	S9	Assorted gravel-red sandstone, trap rock, etc. From wash cuttings from core?
25	15-14-14-22	0.3'	S10	Silty sand-brown, fine grained, some gravel, rock in spoon tip. Note: Extremely hard obstruction at 27.8'. Used core bit to core 27.8-29.8' interval.
30	18-27-24-25	0.8'	S11	Silty sand-brown, fine grained, some pebbles, few gravel, trace clay (Till).
35	15-46-60 100/5"	1.0'	S12	Silty sand-brown, same as above (Till). Note: Tip of spoon empty.
	98-38/2"	0.4'		Silty sand-brown, same as above (Till).
40				Auger refusal at 36.5'

Project No.: 514-001
Client: Kurdistan
Drilling Began: 8/14/86
Drilling Completed: 8/14/86
Well Construction Completed: 8/14/86
Development Method/Completed: Bailer/8/22/86
Yield:
Total Depth: 36.7'
Depth to Refusal: 36.5'
Screened Interval: 15'-35'
Aquifer: Glacial

Boring No.: MW 8D
Permit No.: NA

SWL (date): 86.61' (9/15/86)
Elevation, Ground Surface: 96.71
Elevation, Top of Casing: 99.99
Latitude:
Longitude:
Hole Dia.: 8" O.D./4-1/4" I.D.
Monitoring Tube: 2" SCH 40 PVC

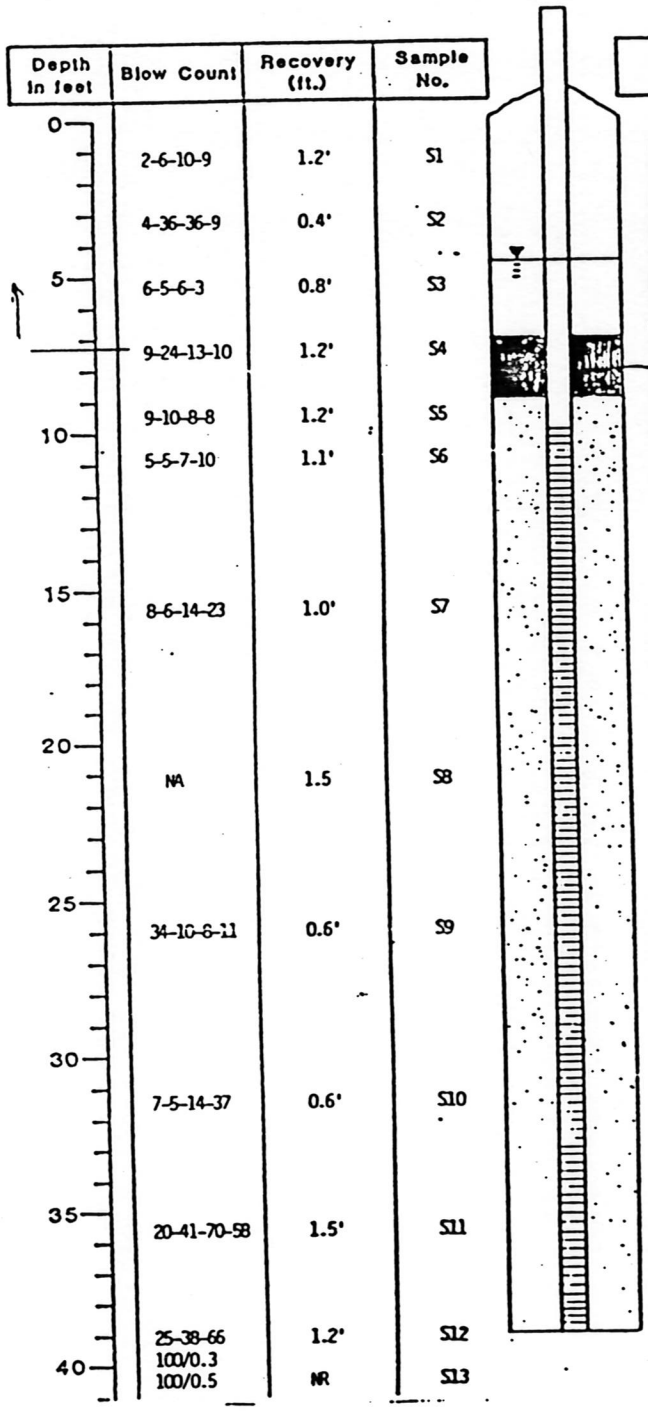


Depth In Feet	Blow Count	Recovery (ft.)	Sample No.	Description
0	2-6-10-9	1.2'	S1	Silty sand-red to brown with some gray, very fine t fine grained, trace clay. (damp). Fill-black, bituminous pipe material, layered, (mo
	4-36-36-9	0.4'	S2	Silty sand-reddish brown, some pebbles, some clay. Fill-black, same as above except harder. Layering noted (0.01' thick).
5	6-5-6-3	0.8'	S3	Decayed wood and silt-brown and yellow, oily sheen. Fill-black, hard, same as above, oily sheen. Sandy silt-brown to red, some dark brown mottling, some bituminous fragements. Wire (coat-hanger dia.) in
	9-24-13-10	1.2'	S4	Decayed wood and silt-dark gray with black, organic odor. Silty sand-fine to dark gray, fine grained, some re grains trace clay (in streaks).
10	9-10-8-8	1.2'	S5	Silt-reddish brown with dark grey mottling, trace fine sand, trace clay, cohesive, dense.

Project No.: 514-001
Client: Kurdistan
Drilling Began: 8/18/86
Drilling Completed: 8/18/86
Well Construction Completed: 8/18/86
Development Method/Completed: Pump/8/25/86
Yield:
Total Depth: 8.0'
Depth to Refusal: NA
Screened Interval: 4'-8'
Aquifer: Fill

Boring No.: MW 9S
Permit No.: NA

SWL (date): 87.03' (9/15/86)
Elevation, Ground Surface: 92.51
Elevation, Top of Casing: 96.47
Latitude:
Longitude:
Hole Dia.: 8" O.D./4-1/4" I.D.
Monitoring Tube: 2" SCH 40 PVC

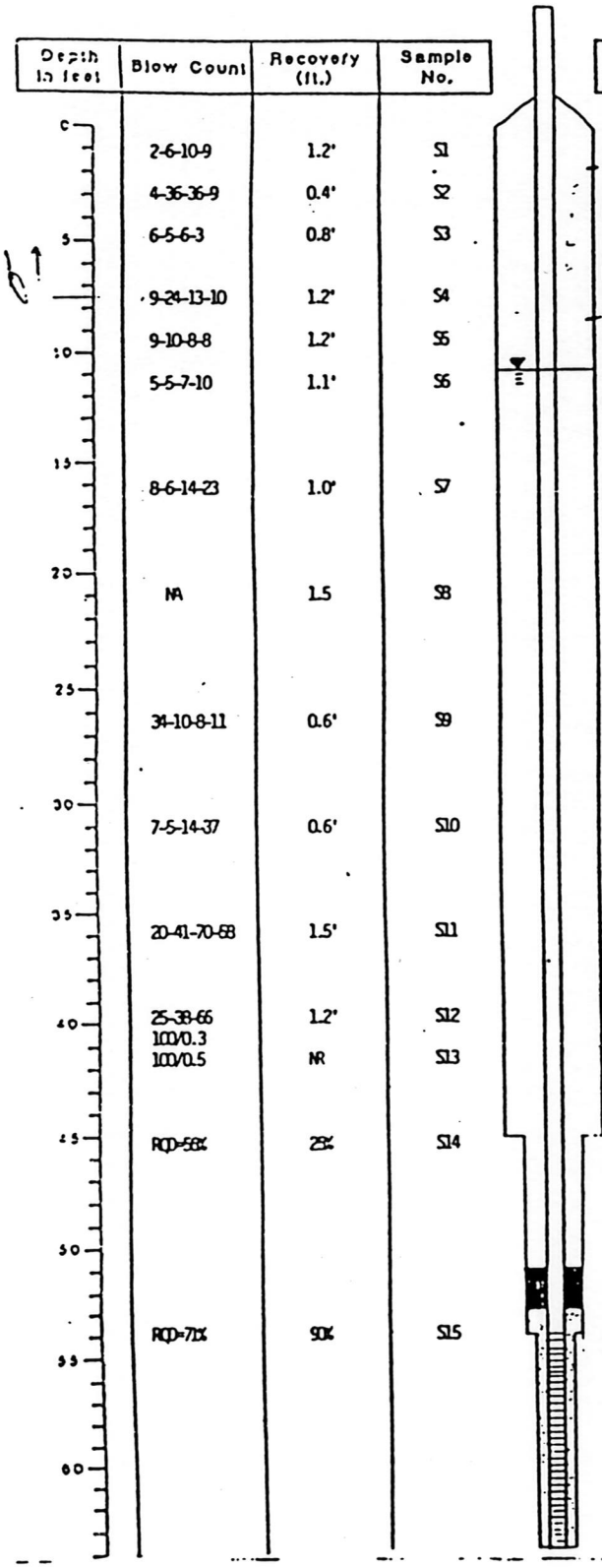


Depth in feet	Blow Count	Recovery (ft.)	Sample No.	Description
0	2-6-10-9	1.2'	S1	Silty sand-red to brown with some gray, very fine to fine grained, trace clay. (damp).
				Fill-black, bituminous pipe material, layered, (moist).
	4-36-36-9	0.4'	S2	Silty sand-reddish brown, some pebbles, some clay.
				Fill-black, same as above except harder. Layering noted (0.01' thick).
5	6-5-6-3	0.8'	S3	Decayed wood and silt-brown and yellow, oily sheen. Fill-black, hard, same as above, oily sheen. Sandy silt-brown to red, some dark brown mottling, some bituminous fragements. Wire (coat-hanger dia.) in tip.
	9-24-13-10	1.2'	S4	Decayed wood and silt-dark gray with black, organic odor.
				Silty sand-fine to dark gray, fine grained, some red grains trace clay (in streaks).
	9-10-8-8	1.2'	S5	Silt-reddish brown with dark grey mottling, trace fine sand, trace clay, cohesive, dense.
10	5-5-7-10	1.1'	S6	Sandy silt-red to dark grey with zones (0.05' 0.10' thick) of fine grained water bearing sand.
15	8-6-14-23	1.0'	S7	Sandy silt-red, same as above.
				Sand-red with varying colors, fine to coarse grained, some pebbles, subrounded.
				Sandy silt-red, same as above.
20	NA	1.5	S8	Silty sand-red, fine grained, trace clay, grading to medium sand wit depth.
25	34-10-8-11	0.6'	S9	Cobble dark gray, very fine grained, some quartz, thin streaks of black.
				Silty sand-red, very fine to fine grained, some pebbles, trace clay.
30	7-5-14-37	0.6'	S10	Silty sand-red, dry fine to fine sand, trace clay, some pebbles.
35	20-41-70-58	1.5'	S11	Clay-reddish brown, some gravel, trace fine sand, trace silt. (damp).
				Sand gravel-brown, fine to medium grained, trace red silt (wet).
				Clay-reddish brown/same as 0.5' above.
				Sandstone rock fragements in tip of spoon red, some clay as alteration (weathering).
	25-38-66	1.2'	S12	Till and sandstone fragments-red, very fine to fine grained sand, some silt, very dense, few limestone clasts, (damp).
40	100/0.3 100/0.5	NR	S13	Inferred rock surface.

Project No.: 514-001
Client: Kurdistan
Drilling Began: 8/12/86
Drilling Completed: 8/13/86
Well Construction Completed: 8/13/86
Development Method/Completed:
Yield:
Total Depth: 39.0'
Depth to Refusal: 39.0'
Screened Interval: 9'-39'
Aquifer: Glacial

Boring No.: MW 9D
Permit No.: NA

SWL (date): 85.70' (9/15/86)
Elevation, Ground Surface: 90.31
Elevation, Top of Casing: 93.01
Latitude:
Longitude:
Hole Dia.: 8" O.D./4-1/4" I.D.
Monitoring Tube: 2" SCH 40 PVC

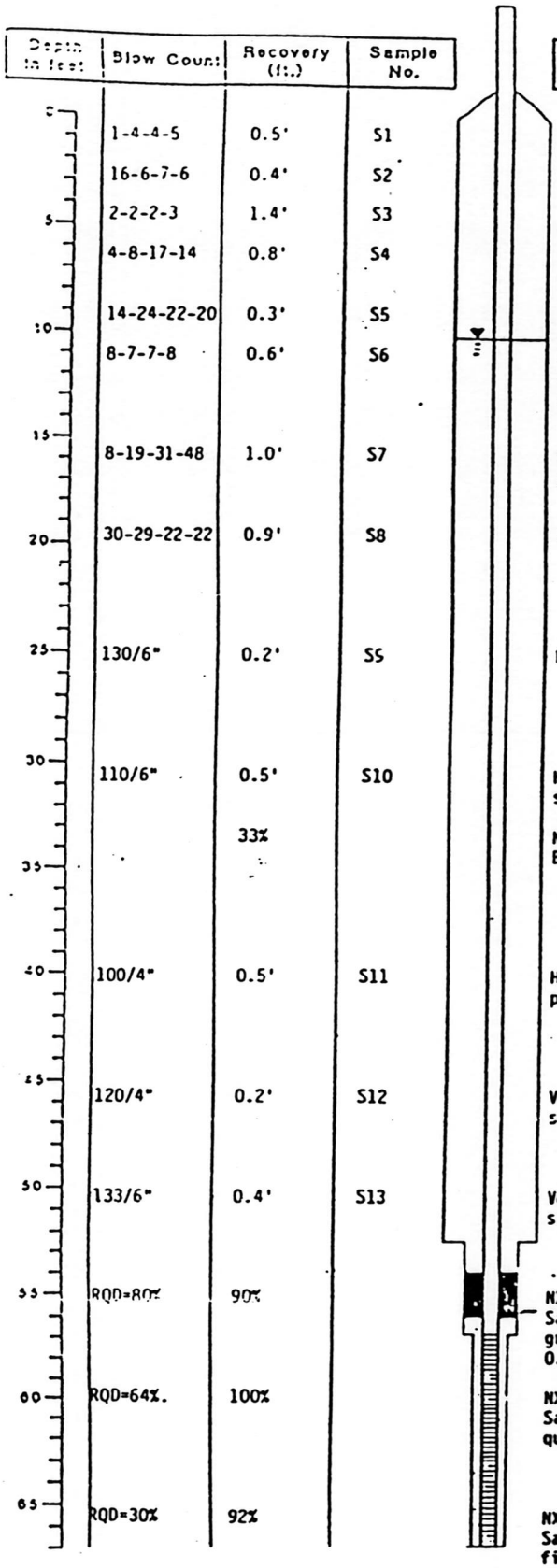


Depth in feet	Blow Count	Recovery (ft.)	Sample No.	Description
0	2-6-10-9	1.2'	S1	Silty sand-red to brown with some gray, very fine to fine grained, trace clay. (dam
				Fill-black, bituminous pipe material, layered, (moist).
	4-36-36-9	0.4'	S2	Silty sand-reddish brown, some pebbles, some clay.
				Fill-black, same as above except harder. Layering noted (0.01' thick).
5	6-5-6-3	0.8'	S3	Decayed wood and silt-brown and yellow, oily sheen. Fill-black, hard, same as above sheen. Sandy silt-brown to red, some dark brown mottling, some bituminous fragment
				Wire (coat-hanger dia.) in tip.
	9-24-13-10	1.2'	S4	Decayed wood and silt-dark gray with black, organic odor.
				Silty sand-fine to dark gray, fine grained, some red grains trace clay (in streaks).
	9-10-8-8	1.2'	S5	Silt-reddish brown with dark grey mottling, trace fine sand, trace clay, cohesive, d
10	5-5-7-10	1.1'	S6	Sandy silt-red to dark grey with zones (0.05' 0.10' thick) of fine grained water be sand.
15	8-6-14-23	1.0'	S7	Sandy silt-red, same as above.
				Sand-red with varying colors, fine to coarse grained, some pebbles, subrounded.
				Sandy silt-red, same as above.
20	NA	1.5	S8	Silty sand-red, fine grained, trace clay, grading to medium sand wit depth.
25	34-10-8-11	0.6'	S9	Cobble dark gray, very fine grained, some quartz, thin streaks of black.
				Silty sand-red, very fine to fine grained, some pebbles, trace clay.
30	7-5-14-37	0.6'	S10	Silty sand-red, dry fine to fine sand, trace clay, some pebbles.
35	20-41-70-68	1.5'	S11	Clay-reddish brown, some gravel, trace fine sand, trace silt. (damp). Sand gravel-brown, fine to medium grained, trace red silt (wet). Clay-reddish brown/same as 0.5' above. Sandstone rock fragements in tip of spoon red, some clay as alteration (weathering).
40	25-38-66	1.2'	S12	Till and sandstone fragments-red, very fine to fine grained sand, some silt,
	100/0.3			very dense, few limestone clasts, (damp).
	100/0.5	NR	S13	Inferred rock surface.
45	RQD=58%	25%	S14	NX Core (45'-49.8')
				Note: Core barrel blocked after 4.8'. Sandstone-reddish brown, medium to coarse grained, some clay as alteration, some white, sugary zones within.
50				
55	RQD=71%	90%	S15	NX Core (54-56.1)
				Note: Core barrel blocked after 2.1'. Sandstone-reddish brown, same as above.
				Note: Hole advanced t 64' depth using 3.5" Tri-core roller bit. Clay content of rock prevents further use of NX core.
60				

Project No.: 514-001
Client: Kurdistan
Drilling Began: 8/20/86
Drilling Completed: 8/20/86
Well Construction Completed: 8/20/86
Development Method/Completed: Bailer/8/25/86
Yield:
Total Depth: 64.0'
Depth to Refusal: NA
Screened Interval: 54'-64'
Aquifer: Bedrock

Boring No.: MW 9R
Permit No.: NA

SWL (date): 85.15 (9/15/86)
Elevation, Ground Surface: 96.15
Elevation, Top of Casing: 97.67
Latitude:
Longitude:
Hole Dia.: 4" x 3-1/2" x 3"
Monitoring Tube: 2" SCH 40 PVC



Depth in feet	Blow Count	Recovery (ft.)	Sample No.	Description
0	1-4-4-5	0.5'	S1	Top soil-brown to black, very silty sand, plant roots.
	16-6-7-6	0.4'	S2	Topsoil-brown to brownish black silty sand, very fine grain stones present. Light brown quartz particles.
5	2-2-2-3	1.4'	S3	Organic silt-brown to black, some brown plant fibers moist.
	4-8-17-14	0.8'	S4	Silty sand-brownish to reddish brown, fine grained, some p (moist).
10	14-24-22-20	0.3'	S5	Silty sand-brownish, very fine to fine grained, wet, some p and traces of plant roots (saturated).
	8-7-7-8	0.6'	S6	Silty sand-brown to reddish brown with some zones (mostly a center of sample) of green and black fine particles of brok pebbles, very fine to fine grained.
15	8-19-31-48	1.0'	S7	Silty sand-brownish fine to coarse grained, to greenish blac gravel, (wet).
20	30-29-22-22	0.9'	S8	Silty sand-brownish, very fine to fine grained, some pebbles
25	130/6"	0.2'	S9	Hard till-brown to greyish coarse grained sand, many pebbles
30	110/6"	0.5'	S10	Hard till-brown to greyish, very fine grained, several grave stones (silt dominant in the sample).
		33%		NX Core (32.3'-36.3')
35				Boulders-(hard), mostly grey to brown, with quartz banding.
40	100/4"	0.5'	S11	Hard till-reddish brown to brown, very fine grained sand, bl pea gravel.
45	120/4"	0.2'	S12	Very hard till-brownish very fine grained with several gravel stones (mostly black).
50	133/6"	0.4'	S13	Very hard till-brown to reddish brown, same as (45-45.3') sample 12 less gravel.
55	RQD=80%	90%		NX Core (52.5'-57.5')
				Sandstone-brown to reddish brown very fine grained with some grey sandstone spots, coarse grained quartz in lower 0.6'.
60	RQD=64%.	100%		NX Core (57.5'-62.5')
				Sandstone-reddish brown, coarse grained, some gravel mostly quartz.
65	RQD=30%	92%		NX core (62.5'-67.5')
				Sandstone-reddish brown, coarse grained in upper portion to fine grained to the bottom, some gravel, mostly quartz in the upper portion.

Project No.: 514-001
Client: Kurdistan
Drilling Began: 8/20/86
Drilling Completed: 8/20/86
Well Construction Completed: 8/20/86
Development Method/Completed: Pump/8/22/86
Yield:
Total Depth: 67.5'
Depth to Refusal: NA
Screened Interval: 57'-67'
Aquifer: Bedrock

Boring No.: MW 10R
Permit No.: NA

SWL (date): 96.11' (9/15/86)
Elevation, Ground Surface: 106.51
Elevation, Top of Casing: 108.42
Latitude:
Longitude:
Hole Dia.: 4" x 3-1/2" x 3"
Monitoring Tube: 2" SCH 40 PVC

APPENDIX 2

WELL DEVELOPMENT RECORD
DAMES & MOORE

CLIENT FLINTKOTE

JOB # 5351A-012-505

WELL # 1D

FIELD PERSONNEL CFennell

DATE	TIME STARTED	TIME STOPPED	GALS.REMOVED	TURBIDITY (NU)	DEPTH TO WATER	pH	COND.
11/8	9:15	10:15	30	>200 Brown	3.7'		
11/9	10:15	11	7	7200	#		
11/9	10:40	12:00	28	—	4.0'		
11/10	10:30	11:30	20	Not a good result 200 ?<50	4.0'		
11/13	10:00	11:00	20	140	4.0'		
11/13	11:00	11:40	15	50			

WELL DEVELOPMENT RECORD
DAMES & MOORE

CLIENT Flintkote

JOB # 03510-012-505

WELL # 2D

FIELD PERSONNEL R Pennfield

DATE	TIME STARTED	TIME STOPPED	GALS.REMOVED	TURBIDITY (NU)	DEPTH TO WATER	pH	COND.
10/6	3:15	3:30	20	>200			
10/6	3:30	3:45	20	>200 (BROWN)			
10/6	3:45	4:00	20				
11/9	2:40	4:20	40		8'6"		
11/10	12:00	13:15	12:40 – 20 12:50 – 20 13:15 – 16 — 56	48	8.51		

WELL DEVELOPMENT RECORD
DAMES & MOORE

CLIENT Flintkote

JOB # 03510-012-5051

WELL # ~~25~~ 3R

FIELD PERSONNEL R Pennypacker

DATE	TIME STARTED	TIME STOPPED	GALS.REMOVED	TURBIDITY (NU)	DEPTH TO WATER	pH	COND.
10/6	11:10	11:25	30	>200 MUDDY			
10/6	11:25	11:55	30	7200			
10/6	11:55	12:15	20	—			
10/6	12:15	12:45	30	—			
10/6	12:45	1:10	30				
10/6	1:10	1:25	20				
10/6	1:25	1:50	20	200			
10/6	1:50	2:00	20				
10/6	2:00	2:10	20				
10/6	2:10	2:20	20	60			
10/6	2:20	2:30	20				
10/6	2:30	2:45	50	70			
10/6	2:45	3:05	60	15.58			
10/6	3:05	3:15	20	45			
11/9	12:45	2:35	80		10' 2"		
11/10	13:30	3:30	13:45 20 14:35 20	48	10'.2		

WELL DEVELOPMENT RECORD
DAMES & MOORE

CLIENT Flintkote

JOB # 03510-012-5051

WELL # MW-65

FIELD PERSONNEL W. Fuller

DATE	TIME STARTED	TIME STOPPED	GALS.REMOVED	TURBIDITY (NU)	DEPTH TO WATER	pH	COND.
10/20/87	~~1:30~~	3:25	58	160			
10/23	10:35	12:30	80	>200	6.8'		
10/26	9:10	—	—		6.8'		
10/26	12:05	12:40	20	59			
10/26	12:40	1:20	25				
10/26	1:20	1:50	20	43			
10/26	1:50	3:15	12	95			
10/26	3:15	4:10	20	46 ✓			
10/26	4:10	4:43	10				
10/27	10:30	—	—		6.5		
11/13	8:15	9:00	20	130	6.5		
11/13	9:00	9:45	20	54			

WELL DEVELOPMENT RECORD
DAMES & MOORE

CLIENT Flintkote

JOB # 03510-012-5051

WELL # MW-6D

FIELD PERSONNEL

W. Fuller

DATE	TIME STARTED	TIME STOPPED	GALS.REMOVED	TURBIDITY (NU)	DEPTH TO WATER	pH	COND.
10/22/87	12:35	1:15	21				
10/22	3:28	4:55	35	97			
10/23	9:45	9:55	5		7.9'		
10/23	12:35	1:30	40	>200	9.8'		
10/23	1:30	2:35	40	108	[illegible]		
10/26	9:10	—	—		8.9'		
10/26	9:20	9:45	20	>200			
10/26	9:45	10:13	20				
10/26	10:15	11:05	20				
10/26	11:05	11:40	15	29			
10/26	11:40	12:00	10				
10/27	10:30	←	—		9.0		
10/27	10:55	10:55	20				
10/27	10:55	11:50	20	190			
10/27	11:50	12:05	20	(73)			
11/12/87	14:15	12:45	20	77			
11/12/87	12:45	13:35	20	NV			

WELL DEVELOPMENT RECORD
DAMES & MOORE

CLIENT Flintkote

JOB # 03510-012-5051

WELL # MW-6R

FIELD PERSONNEL W. Fuller

DATE	TIME STARTED	TIME STOPPED	GALS.REMOVED	TURBIDITY (NU)	DEPTH TO WATER	pH	COND.
10/22/87	12:00	12:15	6	18	7.8'		
10/23	10:30	10:35	15				
10/23	12:55				29.4'		
10/23	2:40	3:15	12	16	[illegible]		
10/26	9:10	—	—		8.0'		
10/26	3:15	←	—		8.0'		
10/26	4:15	5:00	15.0	19			
10/27	10:30	—	—		8.0'		
10/27	12:05	1350	18	25 V			

WELL DEVELOPMENT RECORD
DAMES & MOORE

CLIENT Flintkote

JOB # 03510-012-5057

WELL # 1MW-7S

FIELD PERSONNEL W. Fuller

DATE	TIME STARTED	TIME STOPPED	GALS.REMOVED	TURBIDITY (NU)	DEPTH TO WATER	pH	COND.
10/27	1:45	—	—	~~37~~	6.7'		
~~10/27~~	~~[illegible]~~	—	—	~~[illegible]~~	—		
10/28	3:30	4:25	20	>200			
10/25	9:55	—	—		6.3'		
10/25	1:15	2:05	20	>200			
10/28	2:05	2:50	20	17			
10/25	2:50	3:35	20	6			
10/25	3:35	4:40	30				
10/27	1:25	2:20	20				
10/27	2:20	3:15	20	18			
10/27	3:15	4:15	18	13 ✓			

WELL DEVELOPMENT RECORD
DAMES & MOORE

CLIENT Flintkote

JOB # 03510-012-5057

WELL # MW-7D

FIELD PERSONNEL W. Fulk

DATE	TIME STARTED	TIME STOPPED	GALS.REMOVED	TURBIDITY (NU)	DEPTH TO WATER	pH	COND.
10/24	1:45	2:40	20	37	6.2'		
10/27	2:40	3:50	15				
10/25	9:55	10:40	20		5.8'		
10/28	10:40	11:45	20	100			
10/28	11:45	1:05	20				
10/29	10:05	10:55	20		6.1		
10/29	10:55	12:10	20				
10/29	12:10	1:20	20	15			
10/27	1:20	—	—	10 V			

WELL DEVELOPMENT RECORD
DAMES & MOORE

CLIENT Tintkote

JOB # 03510-012-5057

WELL # 85

FIELD PERSONNEL W. Fuller

DATE	TIME STARTED	TIME STOPPED	GALS.REMOVED	TURBIDITY (NU)	DEPTH TO WATER	pH	COND.
11/4/87	9:30	—	—	[illegible]	8.7		
11/4/87	12:55	1:45	15	>200			
11/4/87	1:45	2:50	20	28			
11/4	2:50	3:55	20	14			
11/4	3:55	4:45	78				
11/5	9:20	—	—		8.7		
11/5	11:20	1:40	20	>200			
11/5	1:40	2:22	[illegible] 15	[illegible] 6 ✓			

WELL DEVELOPMENT RECORD
DAMES & MOORE

CLIENT Flintkote

JOB # 03510-012-5051

WELL # 8D

FIELD PERSONNEL W. Fuller

DATE	TIME STARTED	TIME STOPPED	GALS.REMOVED	TURBIDITY (NU)	DEPTH TO WATER	pH	COND.
11/4/87	9:30	—	—		12.0		
11/4	9:40	10:30	20	>200			
11/4	10:30	11:55	20	18			
11/4	11:55	12:50	20	108			
11/4	12:50	12:55	3	16			
~~11/5~~ 11/5	9:20	10:05	20	122	12.8		
11/5	10:05	11:20	30	22 ✓			

PAGE 1 OF 1

TD = 15.6
DTW = 8.8
WH = 6.8 x 0.16
WV = 1.08

WELL DEVELOPMENT RECORD
DAMES & MOORE

CLIENT Flintkote

JOB # 03510-012-5057

WELL # 95

FIELD PERSONNEL W. Fella

DATE	TIME STARTED	TIME STOPPED	GALS.REMOVED	TURBIDITY (NU)	DEPTH TO WATER	pH	COND.
10/10/87	2:00	—	—		8.5		
11/2	9:10	9:35	5	>200	8.6		
11/2	9:35	10:55	20				
11/2	10:55	12:00	20	>200			
11/2	12:00	1:18	20	190			
11/2	1:18	1:54	10	192			
11/2	1:54	2:55	20	186			
11/2	2:55	4:05	20	170			
11/3	9:10	—	—		8.8		
11/3	11:10	12:20	20	>200			
11/3	12:20	1:35	20	188			
11/3	1:35	2:25	15	154			
11/3	2:25	3:40	20	152			
11/3	3:40	4:30	15	118			
11/4	9:30	9:45	2	/	8.8		
11/11	12:00	12:37	2	Dirty			
11/12	11:30	11:45	2	"			

WELL DEVELOPMENT RECORD
DAMES & MOORE

T.D = 47.2
DTW = 7.0
Wt = 35.2 x 0.16
WV = 5.63

CLIENT Flintkote

JOB # 03510-012-5051

WELL # 9D

FIELD PERSONNEL W. Fuller

DATE	TIME STARTED	TIME STOPPED	GALS.REMOVED	TURBIDITY (NU)	DEPTH TO WATER	pH	COND.
10/30/87	2:00	2:20	20	>200	6.5		
10/30	2:20	2:40	20	>200			
10/30	2:42	3:55	15	>200			
10/30	2:55	3:25	30	>200			
10/30	3:25	3:50	30				
10/30	~~3:50~~	4:15	20	166			
11/2	9:10	—	—		6.8		
11/3	9:10	9:35	20	7200	6.6		
11/3	9:35	10:05	25				
11/3	10:05	10:40	25				
11/3	10:40	11:10	25	(58)			
11/11/87	9:45	11:00	60	52	7.0		
11/11/87	11:00	12:00	60	52			
11/11/87	12:34	15:00	60	dirty			
11/11/87	9:45	12:00	20, 40/60	(120)			

WELL DEVELOPMENT RECORD
DAMES & MOORE

CLIENT Flintkote

JOB # 03510-012-5051

WELL # 9R

FIELD PERSONNEL W. Fuller

DATE	TIME STARTED	TIME STOPPED	GALS.REMOVED	TURBIDITY (NU)	DEPTH TO WATER	pH	COND.
10/30/87	9:20	9:55	20	14	11.9		
10/30	9:55	10:30	20				
10/30	~~10:30~~	11:05	20	7 V			
10/30	11:05	11:35	20				

TD = 69.25
DTW = 10.70
WH = 58.55 x 0.16
WV = (9.36) gallons in the well

WELL DEVELOPMENT RECORD
DAMES & MOORE

CLIENT FLINT KOTE

JOB # 03510-012-5051

WELL # 10R

FIELD PERSONNEL A. Hanain

DATE	TIME STARTED	TIME STOPPED	GALS.REMOVED	TURBIDITY (NU)	DEPTH TO WATER	pH	COND.
11/11/87	8:15	9:00 / DTW 55'	10 gall	32	10.7 V. Slow recovery		
11/12/87	8:30	9:35	10 gall	34	Pump do not reach the bottom		
11/13/87	11:00	1:05	30	32			

PAGE 1 OF 1

TD 17.5
DTW 6.7

WELL DEVELOPMENT RECORD
DAMES & MOORE

CLIENT Fintlicte

JOB # 03510-012-5051

WELL # EMW

FIELD PERSONNEL A. Jensen

4" ϕ galvanize pipe —

DATE	TIME STARTED	TIME STOPPED	GALS.REMOVED	TURBIDITY (NU)	DEPTH TO WATER	pH	COND.
11/12/87	12:20	13:15	20	18	6.7		
11/12/87	13:15	13:45	20	4 ✓			

APPENDIX 3

DAMES & MOORE
FIELD SAMPLING RECORD

Job Flintkote
Job # 03510-012

Date 11/13/87

Well # MW-1d
Location

Well Diameter 2"

I Water Level Measurements (From Top of Casing) in Feet.
Total Well Depth: 21.7
Depth to Water: 3.3
Height of Water Column: 21.4
Volume Conversion Factor: 0.16
Gallons in Well: 3.4

Conversion Factor
(0.16) = 2" ID
0.65 = 4" ID
1.47 = 6" ID

II Well Evacuation
Pumping: Submersible
Nitrogen
Centrifugal

Bailing: Kemmerer
: (Stainless Steel)
Bucket Bailer
: Other (Describe)

Pump On:
Pump Off:
Pumping Time:
Pumping Rate:
Gallons Removed:

Bailing Started: 9:15
Bailing Stopped: 9:40
Gallons Removed: 10.5

III Sampling
Withdrawal: Pumped (describe)
(Bailed) (describe) Stainless w/ Teflon valve

Time: 9:45
Date:
Sample I.D. #: MW-1d
Trip Blank #: TB-1
No. of containers filled (primary lab): 3
No. of containers filled (replicate samples): —
Physical appearance and odor: silty tan - no odor

Refrigerated: Date:
Time:

Field Tests (Before (After) Evacuation)
Temperature ((°C)/°F): 14
pH: —
Spec Cond (umhos/cm): 680
~~Dissolved oxygen (mg/l)~~: Turbidity >200 ntu

Weather: cloudy - cool

Comments:

DAMES & MOORE
FIELD SAMPLING RECORD

Job Flintkote
Job # 03510-012

Date 11/17/87

Well # MW-2d
Location

Well Diameter 2"

I Water Level Measurements (From Top of Casing) in Feet.
Total Well Depth: 37.1
Depth to Water: 3.0
Height of Water Column: 28.1
Volume Conversion Factor: 0.16
Gallons in Well: 4.7

Conversion Factor
0.16 = 2" ID
0.65 = 4" ID
1.47 = 6" ID

II Well Evacuation
Pumping: Submersible
Nitrogen
Centrifugal

Bailing: Kemmerer
(Stainless Steel)
Bucket Bailer
Other (Describe)

Pump On:
Pump Off:
Pumping Time:
Pumping Rate:
Gallons Removed:

Bailing Started 10:20
Bailing Stopped:
Gallons Removed: 14

III Sampling
Withdrawal: Pumped (describe)
(Bailed) (describe) Stainless w/ teflon valve

Date:

Time:
Sample I.D. #: MW-2d
Trip Blank #: TB-1
No. of containers filled (primary lab): 9
No. of containers filled (replicate samples): —
Physical appearance and odor:

Refrigerated: Date:
Time:

Field Tests (Before (After) Evacuation)
Temperature (°C °F): 17
pH: —
Spec Cond (umhos/cm): 600
~~Dissolved oxygen (mg/l):~~ Turbidity >200 NTU

Weather: cloudy - cool

Comments:

DAMES & MOORE
FIELD SAMPLING RECORD

Job Flintkote
Job # 03510-012

Date 11/17/87

Well # MW-2r
Location

Well Diameter 2"

I Water Level Measurements (From Top of Casing) in Feet.
Total Well Depth: 53.0
Depth to Water: 9.5
Height of Water Column: 43.5
Volume Conversion Factor: 0.16
Gallons in Well: 7

Conversion Factor
0.16 = 2" ID
0.65 = 4" ID
1.47 = 6" ID

II Well Evacuation
Pumping: Submersible
Nitrogen
Centrifugal

Bailing: Kemmerer
(Stainless Steel)
Bucket Bailer
Other (Describe)

Pump On:
Pump Off:
Pumping Time:
Pumping Rate:
Gallons Removed:

Bailing Started: 11:15
Bailing Stopped: 11:15
Gallons Removed: 21

III Sampling
Withdrawal: Pumped (describe)
(Bailed) (describe) stainless w/ teflon valve

Date: 11/17

Time: 12:20
Sample I.D. #: MW-2r
Trip Blank #: TB-1
No. of containers filled (primary lab): 22
No. of containers filled (replicate samples): —
Physical appearance and odor: clear

Refrigerated: Date:
Time:

Field Tests (Before (After) Evacuation)
Temperature (°C/°F): 11
pH: —
Spec Cond (umhos/cm): 520
~~Dissolved oxygen (mg/l)~~: Turbidity 17 NTU

Weather: cloudy - cool

Comments: