

Town of Ramapo
Department of Public Works
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Tallman, New York 10982
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CHRISTOPHER P. ST. LAWRENCE
Supervisor

EDWARD P. DZURINKO
Director of Public Works

March 7, 2006

George Jacob, P.E. Project Manager
USEPA
Emergency & Remedial Response Division
New York Remediation Branch
290 Broadway, 20th Floor
New York, NY 10007-1866

Subject: Ramapo Landfill

Dear Mr. Jacob,

In a conference held with USEPA & NYSDEC on August 22, 2005 we reviewed the EPA recommendation to install additional monitoring wells to allow for a determination of a groundwater capture zone and to serve as an early warning regarding potential contamination of down-gradient drinking water supplies. I respectfully request that the EPA reconsider requiring the installation of the additional monitoring wells based on the findings and recommendations in the attached report by Sterling Environmental Engineering P.C., the Town's groundwater monitoring consultant.

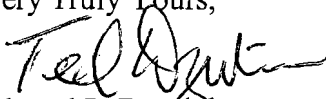
The March 6, 2006 STERLING report addresses the groundwater capture zone; the rate of groundwater movement in the shallow sand aquifer; the history of the Town's groundwater monitoring program; UWNYS's independent sampling of its production wells; the proximity of the existing monitoring wells to private wells PW-1 & PW-2 and UWNYS wells SVWC-93, SVWC-94, SVWC-95 & SVWC-96; and the Town's contingency plan to connect the private residences on Torne Brook Road to an alternate potable water supply. The conclusion of the report is that the installation of additional monitoring wells for determination of a groundwater capture zone and to give early warning regarding potential contaminant migration to down-gradient drinking water wells is not a necessary action.

It is important to note that the findings show that, due to the rapid groundwater movement in the shallow sand aquifer west of Torne Valley Road, additional monitoring wells would not likely provide adequate warning time for the closest down-gradient drinking water well (PW-1) in the event of a catastrophic release of contamination from the landfill.

The Town of Ramapo requests that groundwater monitoring at the Landfill monitoring wells, PW-1, PW-2 and the United Water Company wells for Part 360 Baseline Parameters continue on its current schedule and that water quality data collected by the RCHD and United Water Company for the off-site drinking water supply wells be reviewed by the regulating agencies on a monthly basis. In the event that regulating agencies determine that drinking water standards are being contravened, the Town of Ramapo is committed to the immediate implement its Contingency Plan to provide an alternative water supply to the residents located on Torne Brook Road. This will include providing residents with bottled water and/or an acceptable point-of-use treatment system until an extension of the water line from Torne Valley Road can be constructed.

Please call me at (845) 357-091 if you have any questions or comments.

Very Truly Yours,



Edward P. Dzurinko
Director of Public Works

Encl.

cc: Gerald J. Rider, P.E. – NYSDEC (Albany)
Saiban Mahamooth, P.E. – NYSDEC (New Paltz)
James Schreyer, P.E. – NYSDEC (New Paltz)
Supervisor St. Lawrence & Town Board
Michael Klein
Ed Moran
Elizabeth M. Davis – Sterling Environmental



March 6, 2006

Mr. Edward P. Dzurinko
Director
Department of Public Works
Town of Ramapo
18 Pioneer Avenue
Tallman, New York 10982-0446

Subject: Response Letter to USEPA Five-Year Review Report (December 2004)
Town of Ramapo Landfill
STERLING File #20010/Task 400

Dear Mr. Dzurinko,

This letter report is prepared for the Town of Ramapo by Sterling Environmental Engineering, P.C. (STERLING) and is a summary of STERLING's review of the United States Environmental Protection Agency (USEPA) Region 2 Five-Year Review Report (December 2004) for the Town of Ramapo Landfill.

Specifically, the USEPA Review summary indicates, "the current monitoring network does not allow for a determination of a groundwater capture zone nor give early warning regarding potential contaminant migration to downgradient drinking water wells". Part of the proposed USEPA Recommendation and Follow-Up Action for this issue is to install and sample additional monitoring wells.

The purpose of this review is to determine if the proposed USEPA recommendation to install additional monitoring wells is a necessary action considering the existing landfill monitoring well and extraction well network, local aquifer characteristics and the established contingency plan for an alternative water supply for two (2) downgradient residences.

A list of documents reviewed by STERLING is provided in Table 1.

I. Description of Off-Site Water Supply Wells Downgradient of Ramapo Landfill

Two (2) privately owned water supply wells are located to the southwest of the Landfill on Torne Brook Road. The closest well is located approximately 425 feet from the southwest corner of the Landfill waste boundary and is identified as PW-1. This well serves the Torne Brook Farm. The second well is approximately 1,020 feet from the southwest corner of the Landfill waste boundary and is identified as PW-2. This well serves a two-unit apartment residence. PW-1 is classified as a Community Water Supply (CSW) well because it serves more than twenty-five (25) people on a year-round basis. The Rockland County Health Department (RCHD) file for PW-1 indicates the well is shallow, however no well log was available for review. It is assumed that the groundwater source for PW-1 is an overburden aquifer. Groundwater quality data reviewed for PW-1 in the RCHD file is discussed in Section IV of this letter report and presented in Table 3. Information for PW-2 with regards to the water supply aquifer type and water quality data was not located by STERLING's review of the RCHD files.

Five (5) municipal water supply wells operated by United Water Company and identified as RVWF-1, SVWC-93, SVWC-94, SVWC-95 and SVWC-96 are located on the opposite side of the Ramapo River from the Landfill and are located at the following estimated distances from the southwest corner of the Landfill waste boundary:

RVWF-1	1,070 feet
SVWC-93	1,400 feet
SVWC-94	1,210 feet
SVWC-95	770 feet
SVWC-96	1,280 feet

The SVWC wells are 14-inch diameter wells continuously screened in sand and gravel deposits to an average depth of 93 feet below ground surface. Wells SVWC-94 and SVWC-95 are mostly gravel wells with cobble layers at varying depths. The well logs for the SVWC wells are provided in Appendix 1. Antimony water quality data for these four (4) municipal supply water wells is provided in Table 3.

II. Local Overburden Aquifer Characteristics and Potential Influences on Shallow Groundwater Flow Patterns

The aquifer of concern is an overburden sand and gravel aquifer that has an unconfined groundwater table that is part of the Ramapo River Basin Aquifer System. Groundwater level elevations measured in the shallow monitoring wells located at the Landfill during the October 2003 sampling event indicate groundwater flow in the shallow aquifer is to the southwest towards the Ramapo River. Torne Brook, a tributary to the Ramapo River, flows from north to south and lies between the Town Landfill and the two private water supply wells identified as PW-1 and PW-2 on Torne Brook Road. Based on results of aquifer pump tests conducted in December 1992 on monitoring wells located on the Landfill property, it was determined that Torne Brook is hydraulically connected to the shallow aquifer groundwater table. Stream elevation data was not located during STERLING's review, and it is unknown whether the stream acts as a discharge or recharge point for the shallow aquifer. Calculations from data recorded during the pump test in 1992 indicate the overburden sand aquifer west of Torne Valley Road show a hydraulic conductivity range value of 1.1×10^{-2} cm/s to 2.3×10^{-2} cm/s. This indicates that groundwater can flow through the overburden aquifer in this area at a rate equivalent to 31 to 65 feet per 24-hour day.

III. Ramapo Landfill Groundwater Capture Zone

According to a USEPA presentation titled "Capture Zone Analysis for Pump and Treat Systems", June 16, 2004, the term "Capture Zone" refers to the three-dimensional region that contributes the groundwater extracted by one or more wells or drains. For successful hydraulic containment, contaminants moving with groundwater in the containment zone must follow path lines that are captured by the Pump and Treat System (Methods for Monitoring Pump-and-Treat Performance, EPA/600/R-94/123, June 1994). For the Ramapo Landfill site, the Capture Zone is created by the pumping of extraction wells W-1 through W-7.

The extraction well collection system parallels a deeper leachate interception gravity system that starts on the northeast side of the Landfill and terminates along with the extraction well discharge line at Manhole A-5. Leachate is removed by a pump station located on the Landfill property to the Rockland County Sewer District (RCSD) #1 Facility in Orangeburg, New York where it is treated and discharged to the

Hudson River. The interception gravity system that parallels the leachate extraction well system is comprised of varying diameter, one-sided slotted PVC pipes that are located approximately 5-10 feet below ground surface, with some sections being part of the deep collector system at depths up to 20 feet below ground surface. The PVC pipes connect with lift pump stations that convey intercepted leachate to the RCSD #1 facility. The leachate interceptor system starts at the northeast corner of the landfill and runs along the northeast side of Torne Valley Road and terminates at the southern boundary of the landfill.

The extraction wells are located on the western side of the Landfill along Torne Valley Road between monitoring well clusters MW-3 and MW-8. The layout of the extraction well system is approximately 700 feet in length. Three (3) extraction wells, W-5, W-6, and W-7, are approximately 20 feet deep and are screened in dense sand and partially (~2.0 feet) into bedrock. The remaining extraction wells, W-1 through W-4, are deeper, ranging from 38 to 51 feet in depth and are screened in dense sand and partially (up to 10 feet) into bedrock. Drilling logs for the extraction wells are provided in Appendix 2.

According to the Town of Ramapo Department of Public Works, extraction wells W-5 and W-6 have not operated frequently due to lower groundwater levels and some others have at times been out of service due to clogging of the impellers and electrical power related issues. No records are available to show time periods when any of the extraction wells were operating or not. The Town noted it is currently preparing specifications for redeveloping some of the extraction wells in 2006.

There are no records of the volume of leachate pumped from individual extraction wells. Monthly totals for the volume of leachate pumped to the RCSD #1 are recorded, however, and a summary of the yearly volume of wastewater collected by extraction wells for the period from 1994 to September 2005 is presented in Table 2. The highest discharge volumes occurred between 1995 to 1998, with an estimated peak volume of 22,888,055 gallons of leachate discharged each year in 1997 and 1998. From 1999 to 2005, discharge volumes range from approximately 16 to 18 million gallons per year.

IV. Existing Town of Ramapo Landfill Monitoring Program

The current monitoring program for the Town landfill consists of sampling the landfill monitoring wells, private residence wells PW-1 and PW-2 and United Water New York municipal water supply wells SVWC-93, 94, 95 and 96 on an annual basis, every 5th quarter for NYCRR Part 360 Baseline parameters and site related Volatile Organic Compounds (VOCs). A variance was approved by the New York State Department of Environmental Conservation (NYSDEC) on October 27, 2003 to reduce the sampling frequency and number of monitoring wells based on the sampling results of thirty-six (36) rounds of sampling events conducted prior to 2003. Since October 2003, three (3) sampling events have occurred in October 2003, March 2004 and June 2005.

Analytical results for these three (3) events indicate consistent standard exceedances of iron and manganese and sporadic standard exceedances of chromium, antimony (one event), nickel, sodium, and thallium in samples from monitoring wells. One sample from 5-0S in March 2004 shows results with arsenic and beryllium standard exceedances.

Results for the private and municipal water supply wells sampled during these three (3) sampling events indicate a parameter exceedance of antimony in all wells in October 2003 (please see Section VI for a discussion on this event). PW-1 and PW-2 showed no parameter exceedances for the 2004 and 2005

events, while the four (4) municipal water supply wells reported only a sodium standard exceedance in 2004 and 2005.

V. United Water New York Monitoring Program

United Water New York (UWNY) wells SVWC-93, 94, 95 and 96 are sampled by UWNY on a quarterly basis for trace metals. UWNY sampling results for 2004 indicate no exceedances for the trace metals analyzed, including antimony.

VI. Groundwater Contamination Trends for Antimony

Antimony levels recorded from April 1996 to September 2005 for the Landfill monitoring wells, private water supply wells PW-1 and PW-2 and municipal water supply wells SVWC-93, -94, -95, and -96 are presented in Table 3. For Antimony, The Part 703.5 groundwater standard is 3 ug/l, the Primary Drinking water standard is 6 ug/l and the USEPA Region 9 Preliminary Remediation Goal (non-cancer) is 15 ug/l.

Antimony levels that consistently exceed the groundwater standard are evident in monitoring well 3-OS from May 2000 to October 2003. The only other well to show Antimony levels exceeding the groundwater standard during this time period is monitoring well 1-OS in May 2000. In October 2003, all of the monitoring wells, except 9-I, and all of the private and municipal water supply wells reported Antimony exceeding the groundwater standard. All of these levels were reported with a 'B' qualifier, meaning the concentration is less than the Contract Required Detection Limit (CRDL), but greater than the Instrument Detection Limit (IDL).

Since October 2003, results for two sampling events conducted in March 2004 and June 2005 indicate Antimony levels are below the groundwater standard for all the monitoring wells and off-site water supply wells, except for the sample collected at PW-2 in March 2004, where Antimony is reported at 5 ug/l. Water testing results for municipal water supply wells SVWC-93, -94, -95, and -96 in June-August 2004 report Antimony at non-detectable levels and PW-1 water test results obtained from the RCHD for December 2004 and September 2005 report Antimony at non-detectable levels.

VII. Contingency Plan for Alternative Water Supply

A Contingency Plan for an alternative water supply is outlined in general terms in the USEPA Superfund Record of Decision (ROD) for the Ramapo Landfill, 1992, and specifically in the Design Analysis Report, June 1994.

The Contingency Plan indicates that an alternate water supply may be deemed necessary if groundwater monitoring data indicates that drinking water standards are being contravened in residential wells or in other same-aquifer wells indicating that residential wells will be affected, and if detected concentrations are confirmed by subsequent sampling, then residents would immediately be provided with bottled water and/or an acceptable point-of-use treatment system until an alternate water supply can be constructed.

Three options are available for extending existing water lines to the PW-1 and PW-2 properties on Torne Brook Road:

1. Extend a municipal water line from the Village of Hillburn that terminates approximately 500 feet from Route 59 along Torne Valley Road. Supplying water to PW-1 and PW-2 will require this municipal water line to be extended by approximately two (2) miles.
2. The Pothat Water Company, currently owned by United Water of New York, provides water to individual properties on Lake Street. The distance from the easternmost extent of the Pothat water line to PW-1 and PW-2 is 1,500 feet.
3. Since 1994, a water line owned by the Rockland County Solid Waste Management Authority was installed on Torne Valley Road. When the water line was placed along Torne Valley Road, a connector "spur" was installed at the intersection of Torne Valley Road and Torne Brook Road, in anticipation that a water main extension to PW-1 and PW-2 may be deemed necessary based on future water quality data.

The Town of Ramapo Town Board has indicated its commitment to installing an alternate water supply source if required.

VIII. Findings and Recommendations

- Calculations based on a 1992 pump test indicate that groundwater movement in the shallow sand aquifer west of Torne Valley Road is fairly rapid, with estimated hydraulic conductivity values of 31 to 65 feet per day. Samples from additional monitoring wells screened in this aquifer would not likely provide adequate warning time for the closest downgradient drinking water well (PW-1) if contamination migration occurred in the shallow aquifer.
- Since October 2003, results for two monitoring events conducted in March 2004 and June 2005 indicate Antimony levels are below the groundwater standard of 3 ug/l for all the monitoring wells and off-site water supply wells (except for the sample collected at PW-2 in March 2004, where Antimony is reported at 5 ug/l.) Water testing results for municipal water supply wells SVWC-93, -94, -95, and -96 in June-August 2004 report Antimony at non-detectable levels and PW-1 water test results obtained from the RCHD for December 2004 and September 2005 report Antimony at non-detectable levels. The March 2004 and June 2005 monitoring events report no parameter standard exceedances for PW-1 and PW-2 and only a sodium parameter exceedance for the four (4) municipal water supply wells.
- The Landfill leachate extraction system reportedly is functioning at less than full capacity during the USEPA 5-year review period of 1999-2004 and leachate discharge volumes have declined since 1998. Plans are underway by the Town to redevelop some of the wells in 2006 in order to improve the extraction process. It is anticipated that improvements to the leachate extraction system will aid in improving groundwater quality in the overburden aquifer.
- A municipal supply water line is located on Torne Valley Road that is equipped with an extension spur at the intersection of Torne Valley Road and Torne Brook Road for the purpose of

extending the water line to the two properties on Torne Brook Road if deemed necessary by the regulating agencies.

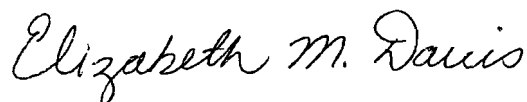
Based on the above listed findings, it is STERLING's opinion that the recommendation proposed in the USEPA Region 2 Five-Year Report (December 2004) to install additional monitoring wells for determination of a groundwater capture zone and to give early warning regarding potential contaminant migration to downgradient drinking water wells is not a necessary action.

STERLING recommends that monitoring of the Landfill monitoring wells, PW-1, PW-2 and the United Water Company wells for Part 360 Baseline Parameters continue on an annual basis and that water quality data collected by the RCHD and United Water Company for the off-site drinking water supply wells be reviewed by the regulating agencies on a monthly basis. If it is determined by the regulating agencies that drinking water standards are being contravened and subsequent sampling confirms a contamination trend, it is recommended the Town of Ramapo immediately implement its Contingency Plan to provide an alternative water supply to the residents located on Torne Brook Road. This will include providing residents with bottled water and/or an acceptable point-of-use treatment system until an extension of the water line from Torne Valley Road can be constructed.

STERLING appreciates this opportunity to provide this Review Report to the Town of Ramapo. Please call me at 518/456-4900 should you have any questions or comments.

Very truly yours,

STERLING ENVIRONMENTAL ENGINEERING, P.C.



Elizabeth M. Davis
Hydrogeologist
liz@sterlingenvironmental.com

EMD/bc
Facsimile/First Class Mail
Attachments

TABLES

TABLE 1
REVIEWED DOCUMENTS

TITLE	AGENCY	DATE(S)
Five-Year Review Report Ramapo Landfill Superfund Site Rockland County, New York	USEPA Region 2	December 2004
Town of Ramapo Leachate Pumping History	Town of Ramapo	1994 – 2005
(Portions of) Design Analysis Report for the Ramapo Landfill Vol. 1 of 3	URS Consultants, Inc.	June 1994
Operation and Maintenance Manual Ramapo Landfill Remediation NYSDEC Site No. 3-44-004	URS Greiner, Inc.	December 1998
Landfill Leachate Extraction Well Logs	James C. Anderson Assoc., Inc./ Town of Ramapo	1995
Spring Valley Water Company Well Logs for Wells SVWC-93,-94,-95,-96	Leggette Brashears & Graham/ United Water of New York	1978
Groundwater Quality Data for SVWC Municipal Water Supply Wells	United Water of New York	1996 – 2004
Construction Monitoring Report Ramapo Landfill Remediation	URS Greiner, Inc.	December 1998
Landfill Monitoring Well Data	Sterling Environmental Engineering, P.C.	1999 – 2005
Five-Year Review Report	USEPA	1999
Water Quality Data for PW-1	Rockland County Department of Health	1996 – 2005
Methods for Monitoring Pump-and-Treat Performance (EPA/600/R-94/123)	USEPA	June 1994
EPA Superfund Record of Decision: Ramapo Landfill EPA ID: NYD0005/1493 OU 01 Ramapo, NY 3/31/1992	USEPA	March 1992

TABLE 2

**TOWN OF RAMAPO LANDFILL/LEACHATE PUMPING HISTORY FOR
EXTRACTION WELLS AND GRAVITY INTERCEPTION SYSTEMS
(1994-2005)**

Year	Annual Total Gallons of Leachate Discharged
1994	3,690,500
1995	20,553,200
1996	21,851,062
1997 ⁽¹⁾	22,888,055
1998 ⁽¹⁾	22,888,055
1999	16,072,895
2000	17,234,622
2001	12,382,217
2002	13,576,560
2003	18,415,267
2004	13,827,647
2005 (up to 9/05)	18,285,355

⁽¹⁾ Several months in 1997 and 1998 have estimated leachate pumping volumes due to an inactive flow-meter.

TABLE 3
TOWN OF RAMAPO LANDFILL
POST-CLOSURE GROUNDWATER MONITORING DATA
COMPOUND: ANTIMONY

Sample ID	SAMPLE DATE (ug/l)																				
	Apr-96	Jun-99	Sep-99	Nov-99	May-00	Sep-00	Dec-00	Mar-01	Jul-01	Oct-01	Mar-02	Jul/Aug-02	Oct-02	Apr-03	Jul-03	Oct-03	Mar-04	Jun/Aug-04	Dec-04	Jun-05	Sep-05
1-OS	---	NA	ND	----	29.1 B	NA	<5.5N	<4.7	NA	<4.7	12.7B	NA	15 B,N	NA	NA	NA	NA	---	----	0.12 U	---
1-R	----	NA	ND	----	<3.4	NA	<5.5N	<4.7	NA	<4.7	10.5 B	NA	5.6 B, N	5 U	NA	25.1 B	NA	----	----	NA	----
2-OS	----	NA	ND	----	<3.4	NA	<5.5N	<4.7	NA	<4.7	14 B	NA	33 B,N	5 U	NA	24.6 B	7.1 U	----	---	0.12 U	----
2-R	----	NA	ND	---	<3.4	NA	<5.5N	<4.7	NA	<4.7	13.8 B	NA	5.3 U, N	5 U	NA	28.7 B	NA	----	---	NA	----
3-OS/I	----	NA	ND	---	4.8 B	NA	8.2 B,N	9.5 B,N	NA	9.4 B	15.1 B	NA	25.4 B, N	77.6	NA	155.0	5.8 U	---	----	0.12 U	----
3-R	---	NA	ND	----	<3.4	NA	<5.5N	<4.7	NA	<4.7	11.9 B	NA	5.5 B, N	5 U	NA	26.4 B	NA	---	----	NA	---
4-OS	----	NA	ND	----	<3.4	NA	<5.5N	<4.7	NA	<4.7	7.4 U	NA	5.3 U, N	5 U	NA	23.4 B	7.1 U	----	---	0.12 U	---
4-R	----	NA	ND	----	<3.4	NA	<5.5N	<4.7	NA	<4.7	9.7 B	NA	5.3 U, N	5 U	NA	23.7 B	NA	----	----	NA	----
5-OS	---	NA	NA	----	<3.4	NA	<5.5N	<4.7	NA	NA	NA	NA	NA	NA	NA	NA	7.1 U	---	----	NA	---
5-I	----	NA	ND	---	NA	NA	NA	NA	NA	<4.7	7.4 U	NA	5.3 U, N	5 U	NA	9.4 B	NA	----	----	0.12 U	---
5-R	----	NA	ND	----	<3.4	NA	<5.5N	<4.7	NA	<4.7	7.4 U	NA	5.3 U, N	5 U	NA	9.7 B	NA	----	---	NA	---
7-OS	----	NA	ND	---	<3.4	NA	<5.5N	<4.7	NA	<4.7	13.2 B	NA	5.3 U, N	5 U	NA	23.6 B	5.8 U	---	---	0.12 U	---
7-R	----	NA	ND	---	<3.4	NA	<5.5N	<4.7	NA	<4.7	13 B	NA	NA	NA	NA	NA	NA	----	---	NA	----
8-OS	---	ND	ND	----	<3.4	<11.0	<5.5N	<4.7	<4.7	<4.7	7.4 U	5.3 U	5.3 U, N	5 U	5.5 U	10.5 B	5.8 U	----	---	0.13 B	----
8-I	----	ND	ND	----	<3.4	<5.5	<5.5N	<4.7	<4.7	<4.7	10.9	5.3 U	5.3 U, N	5 U	7.5 B	20.7 B	5.8 U	---	----	0.12 U	---
8-R	----	ND	ND	----	<3.4	<5.5	<5.5N	<4.7	<4.7	<4.7	12 B	5.3 U	6.3 B,N	5 U	8 B	22.7 B	5.8 U	----	----	0.12 U	---
9-OS	----	ND	ND	---	<3.4	<5.5	<4.7	<4.7	<4.7	<4.7	7.4 U	5.3 U	5.3 U, N	5 U	5.5 U	7.5 B	5.8 U	----	---	0.15 B	---
9-I	----	ND	ND	---	<3.4	<5.5	<4.7	<4.7	<4.7	<4.7	7.4 U	5.3 U	5.3 U, N	5 U	5.5 U	5.5 U	5.8 U	----	----	0.12 U	----
9-R	----	ND	ND	----	<3.4	<5.5	<4.7	<4.7	<4.7	<4.7	7.4 U	5.3 U	5.3 U, N	5 U	9.7 B	10.2 B	5.8 U	----	----	0.12 U	----
PW-1	2.0	ND	ND	6.0	<3.4	<5.5	<4.7	<4.7	<4.7	<4.7	7.4 U	5.3 U	5.3 U, N	5 U	5.5 U	9.5 B	5.8 U	----	0.1	0.12 U	0.1
PW-2	----	ND	ND	----	<3.4	<5.5	<5.5N	<4.7	<4.7	<4.7	9.3 B	5.3 U	5.3 U, N	9.3 B	10.1 B	19.4 B	5.0	----	---	0.12 U	----
SVWC-93	----	ND	NA	----	<3.4	<5.5	<5.5N	<4.7	<4.7	NA	8 B	8.1 B	17.2 B,N	5 U	5.5 U	8.6 B	5.8 U	1U	----	0.14 B	----
SVWC-94	----	ND	NA	----	<3.4	<5.5	<5.5N	<4.7	<4.7	NA	11.4 B	5.3 U	5.5 B,N	5 U	5.5 U	7.1 B	5.8 U	1U	----	0.12 U	----
SVWC-95	----	ND	NA	----	<3.4	<5.5	<5.5N	<4.7	<4.7	NA	7.4 U	5.3 U	5.3 U, N	5 U	5.5 U	13.6 B	5.8 U	1U	----	0.12 U	----
SVWC-96	----	ND	NA	----	<3.4	<5.5	<5.5N	<4.7	<4.7	NA	7.4 U	5.3 U	5.3 U, N	5 U	7.1 B	11.1 B	5.8 U	1U	----	0.12 U	----

NOTES:

Concentrations reported in mg/L (ppb).
ND = Not Detected
NA = Not Analyzed
Values in **BOLD** indicate an exceedance of groundwater quality standard for Antimony, 3.0 mg/L.

B = The reported value is less than the Contract Required Detection Limit (CRDL), but greater than the instrument detection limit.
N = Spiked sample recovery not within control limits

APPENDIX 1
SVWC WELL LOGS

WELL LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

CONSULTING GROUND-WATER GEOLOGISTS
55 WEST STATE STREET
WESTPORT, CONNECTICUT

Page 1 of 3

Ramapo Valley Well Field

DESCRIPTION	THICK- NESS (FEET)	DEPTH (FEET)
Silt, grayish-brown; some gravel, fine		
and sand, coarse	9	9
Sand, medium to very coarse, greenish-		
brown; little gravel, fine	5	14
Sand, medium to very coarse, with little		
fine, greenish-brown; and gravel, fine		
with few medium, dark gray	5	19
Sand, medium with some coarse and few		
fine, greenish-brown with a little		
black; little gravel, fine to medium		
dark gray	5	24
Gravel, fine (angular) to medium, dark		
gray; much sand, coarse to very		
coarse with some medium, green to		
white	10	34
Sand, medium to coarse with some fine,		
light green; some gravel, fine dark		
gray	5	39
Sand, fine with much medium and some		
coarse, greenish-brown with a little		
multicolor; some gravel, fine to		
medium, subangular, dark gray	5	44
Sand, medium to fine with some coarse;		
some gravel, fine, dark gray; little		
silt, brown	5	49
(CONTINUED)		

OWNER: Spring Valley Water C

Ramapo Land Company
Parcel 1

LOCATION: Town of Ramapo, NY

WELL NO.: PW-A 93

DATE COMPLETED: July 28, 1978

DRILLING COMPANY: Rinbrand Well Drilling Co, Inc.

DRILLING METHOD: Cable-tool

SAMPLING METHOD: Bailer

SAMPLES EXAMINED BY: G. S. Sikora

REFERENCE POINT: Original Land Surface

ELEVATION OF R. P.: ±306 feet

58.3 feet of 20-inch

CASING: 58.3 feet of 14-inch

SCREEN TYPE: Continuous slot Stai
less steel

DIAM. 14-inch SLOT NO. 125

SETTING: 58½-89 feet^{b/}

PUMPING TEST DATE: September 5-8, 1978

DURATION: 72 hours

STATIC WATER LEVEL: 14.74 feet^{c/}

PUMPING WATER LEVEL: 53.6 feet^{c/}

YIELD: 1400 gpm

REMARKS:

Drilling started June 2 1978

a/ Including 1.8 and 2. feet above existing grade respectively

b/ Below present grade

c/ Below top of ½-inch stainless pipe

WELL LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

CONSULTING GROUND-WATER GEOLOGISTS

55 WEST STATE STREET

WESTPORT, CONNECTICUT

Page 2 of 3

DESCRIPTION	THICK- NESS (FEET)	DEPTH (FEET)	OWNER
Gravel, fine with some medium, dark gray; little sand, coarse; trace of silt, brown	5	54	Spring Valley Water Co. Ramapo Land Company Parcel 1 LOCATION: Town of Ramapo, NY
Sand, fine with some medium, greenish-brown; some gravel, fine dark gray	5	59	WELL NO.: PW-A (Contd.) 93 DATE COMPLETED: July 28, 1978 DRILLING COMPANY: Rinbrand Well Drilling Co., Inc. DRILLING METHOD: Cable-tool
Gravel, fine to medium, subangular, dark gray; some sand, very coarse to medium, greenish-brown; few small cobbles, rounded	5	64	SAMPLING METHOD: Bailer SAMPLES EXAMINED BY: REFERENCE POINT: ELEVATION OF R. P.:
Sand, medium to coarse with some fine, light green; some gravel, fine with some medium, dark gray	5	69	CASING: SCREEN TYPE: DIAM.: SLOT NO. SETTING:
Gravel, fine to medium with some coarse, subangular, dark gray; some sand, very coarse to medium, angular light green	5	74	PUMPING TEST DATE: DURATION: STATIC WATER LEVEL:
Gravel, fine, dark gray, some sand, very coarse to medium, light green	5	79	PUMPING WATER LEVEL: YIELD:
Sand, medium to fine with little coarse, greenish-brown; some gravel, fine, dark gray	5	84	REMARKS:
Sand, medium to fine with some coarse, some gravel, fine, subangular, dark gray; trace of silt, grayish-brown	6	90	
(Continued)			

LEGGETTE, BRASHEARS & GRAHAM, INC.

55 WEST STATE STREET

WESTPORT, CONNECTICUT

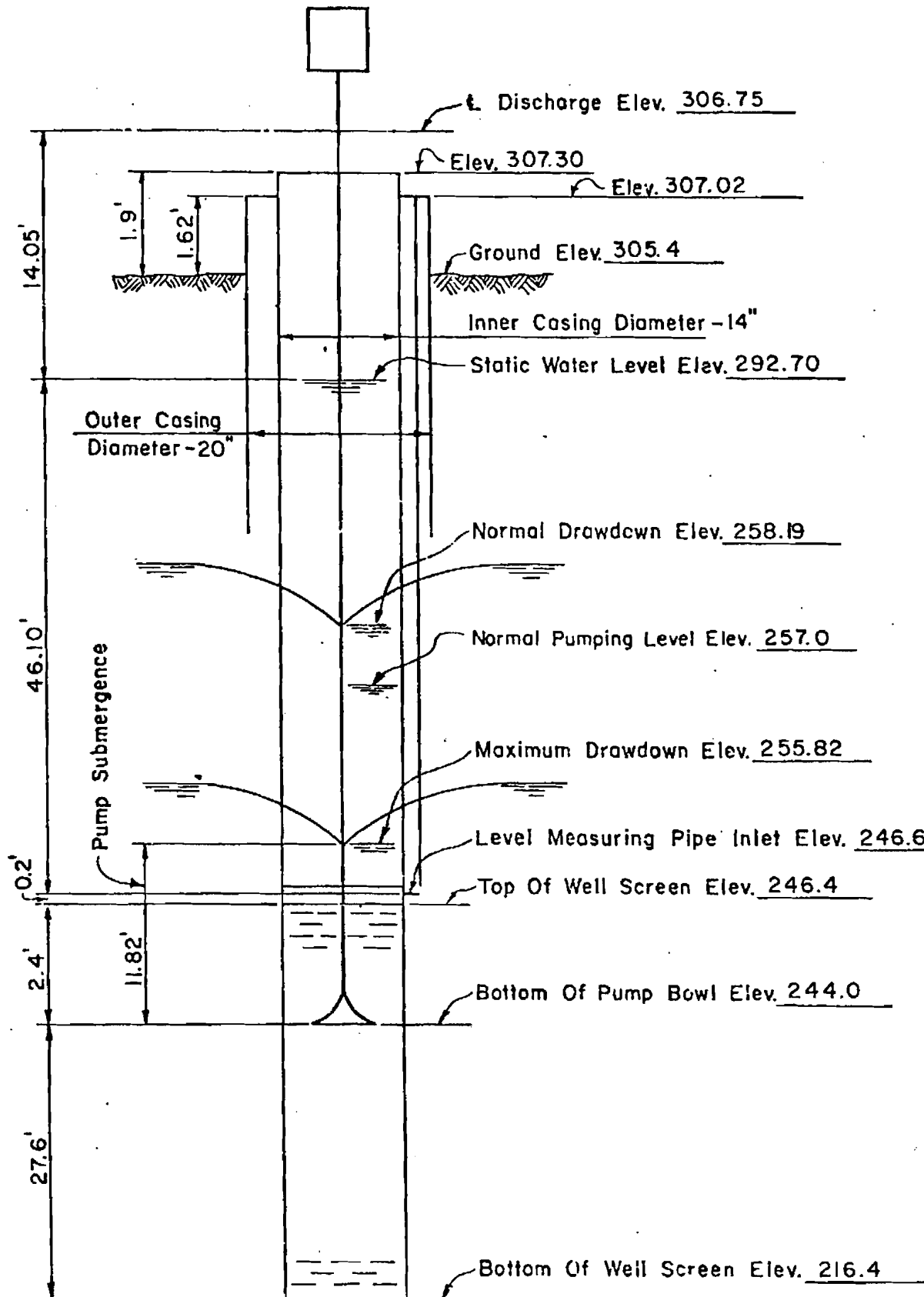
Page 3 of 3

Ramapo Valley Well Field

DESCRIPTION	THICK- NESS (FEET)	DEPTH (FEET)	OWNER: Spring Valley Water Co.
Sand, medium to fine with some coarse			Ramapo Land Company
subangular; some gravel, fine, sub-			Parcel 1
angular, dark gray; little silt,			LOCATION: Town of Ramapo, NY
greenish-brown	4½	94½	WELL NO.: PW-A (contd.) 93
			DATE COMPLETED:
			DRILLING COMPANY:
			DRILLING METHOD:
			SAMPLING METHOD:
			SAMPLES EXAMINED BY:
			REFERENCE POINT:
			ELEVATION OF R. P.:
			CASING:
			SCREEN TYPE:
			DIAM. SLOT NO.
			SETTING:
			PUMPING TEST DATE:
			DURATION:
			STATIC WATER LEVEL:
			PUMPING WATER LEVEL:
			YIELD:
			REMARKS:

WELL PUMP SETTING

WELL PW "A" 93



WELL LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

CONSULTING GROUND-WATER GEOLOGISTS

55 WEST STATE STREET

WESTPORT, CONNECTICUT

Ramapo Valley Well

Page 1 of 2 Field

DESCRIPTION	THICK- NESS (FEET)	DEPTH (FEET)	OWNER: Spring Valley Water Co.
Sand, coarse, brown; some sand and gravel, fine to coarse; little sand, fine and silt	9	9	Ramapo Land Company Parcel 1 LOCATION: Town of Ramapo, NY
Gravel, fine to medium, gray-brown; little gravel, coarse and sand, coarse	5	14	WELL No.: PW-AB 94 DATE COMPLETED: December 8, 1978 DRILLING COMPANY: Rinbrand Well Drilling Co, Inc. DRILLING METHOD: Cable-tool
Sand, coarse, brown; some sand, medium trace to little silt and sand, fine	5	19	SAMPLING METHOD: Bailer SAMPLES EXAMINED BY: Lee N. Grubman
Gravel, medium, gray-brown; some gravel, coarse; trace sand, coarse	5	24	REFERENCE POINT: Original Land Surface ELEVATION OF R. P.: +304 feet above MSL 61.3 feet of 20-inch casing 62.2 feet of 14-inch casing
Sand; coarse to medium, brown; little medium to fine gravel; and sand, fine and silt	5	29	SCREEN: Continuous Slot Stainless Steel DIAM.: 14-inch SLOT NO. 125 SETTING: 62½-99 feet ^{b/}
Gravel, fine to medium, gray-brown; little gravel, coarse and sand, coarse	5	34	PUMPING TEST DATE: January 15-18, 1979 DURATION: 72.5 hours STATIC WATER LEVEL: 9.84 feet ^{c/}
Gravel, medium, gray-brown; some gravel, coarse; little sand, coarse	5	39	PUMPING WATER LEVEL: 63.1 feet ^{c/} YIELD: 1600 gpm
Gravel, fine, brown; some sand, coarse and gravel, medium; trace gravel, coarse and sand, medium to fine and silt	5	44	REMARKS: a/ Including 1.2 and 2.0 feet above existing grade respectively b/ Below present grade c/ Below top of ½-inch stainless steel pipe
Gravel, coarse to medium, brown; little gravel, fine and sand, coarse; trace			
(Continued)			

WELL LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

CONSULTING GROUND-WATER GEOLOGISTS

Page 2 of 2

55 WEST STATE STREET

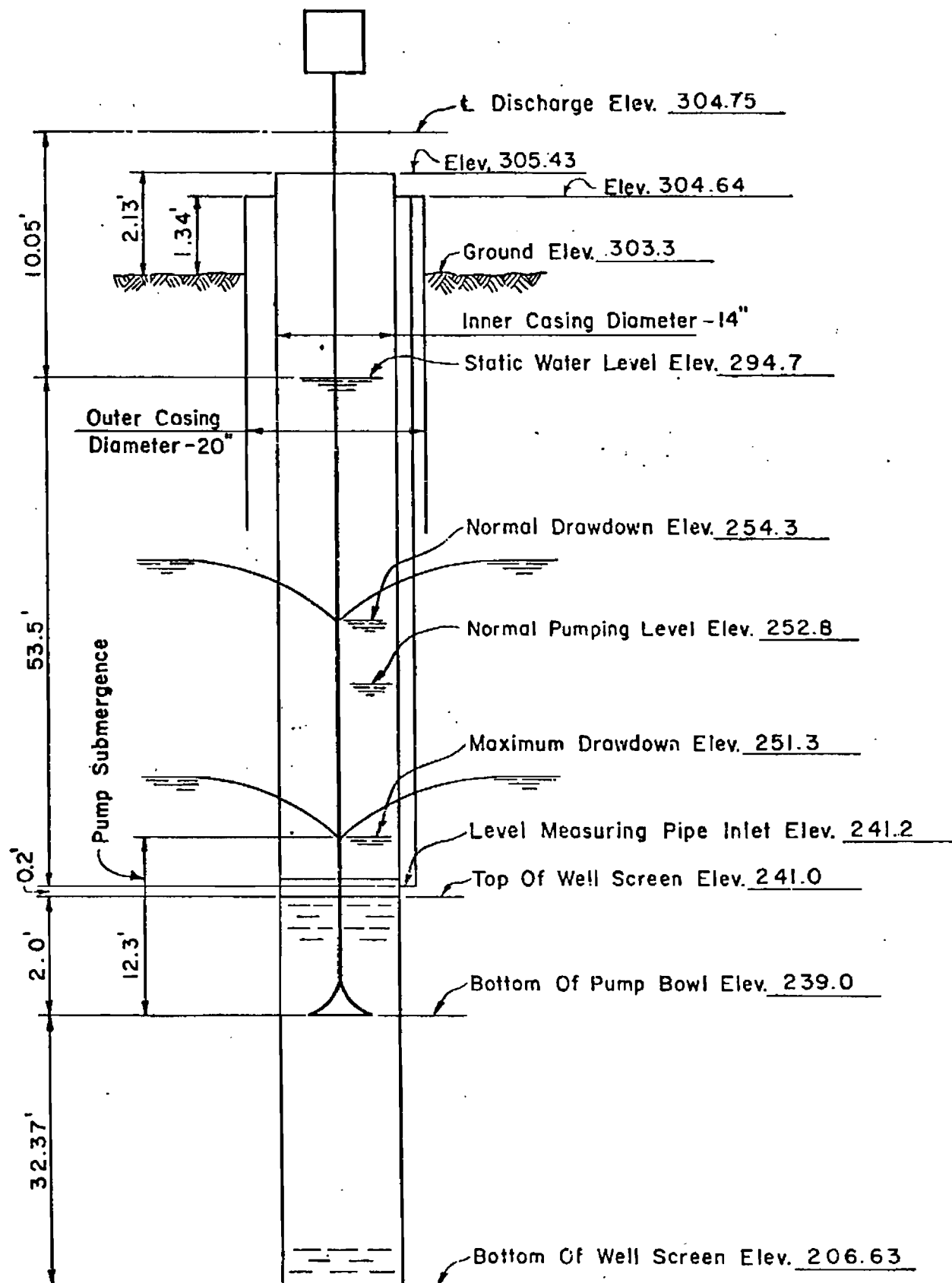
WESTPORT, CONNECTICUT

Ramapo Valley Well Field

DESCRIPTION	THICK- NESS (FEET)	DEPTH (FEET)	OWNER: Spring Valley Water Co
sand, medium to fine and silt	5	49	Ramapo Land Company Parcel 1 Town of Ramapo, NY
Gravel, medium to fine, gray-brown; little gravel; coarse and sand,			LOCATION: PW-AB (Continued) 94
coarse; with a few small cobbles	5	54	WELL NO.:
Gravel, medium, gray-brown; some			DATE COMPLETED:
gravel, coarse; trace sand, coarse	5	59	DRILLING COMPANY:
Gravel, coarse, gray; some small cobbles			DRILLING METHOD:
little gravel, medium to fine	5	64	SAMPLING METHOD:
Gravel, medium, gray-brown; some gra- vel, coarse; trace sand, coarse	5	69	SAMPLES EXAMINED BY:
Gravel, medium, mottled gray; some gravel, fine and coarse and sand,			REFERENCE POINT:
coarse	5	74	ELEVATION OF R. P.:
Gravel, fine, brown; some gravel, medi- um and sand, coarse; little sand,			CASING:
medium to fine and silt	15	89	SCREEN- TYPE:
Gravel, medium, mottled gray; some gravel, fine and coarse and sand,			DIAM.: SLOT No
coarse; little sand, medium to fine and silt	5	94	SETTING:
Sand, coarse; some rock fragments,			PUMPING TEST- DATE:
crystalline	5½	99½	DURATION:
			STATIC WATER LEVEL:
			PUMPING WATER LEVEL:
			YIELD:
			REMARKS:

WELL PUMP SETTING

WELL PW "AB" 94



WELL LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

CONSULTING GROUND-WATER GEOLOGISTS

55 WEST STATE STREET

WESTPORT, CONNECTICUT

Page 1 of 3

Ramapo Valley Well Field

DESCRIPTION	THICK- NESS (FEET)	DEPTH (FEET)	OWNER <u>Spring Valley Water Co</u>
Gravel, fine with some medium, subangular; some sand, medium to fine and silt, brown; few small cobbles	8½	8½	Ramapo Land Company Parcel 1 LOCATION: Town of Ramapo, NY
Gravel, fine, subangular; some sand very coarse to medium, little silt, brown.	10	18½	WELL NO: <u>PW-B 95</u> DATE COMPLETED: <u>April 10, 1978</u> DRILLING COMPANY: <u>Rinbrand Well Drilling Co, Inc.</u> DRILLING METHOD: <u>Cable-tool</u> SAMPLING METHOD: <u>Bailer</u> G. S. Sikora SAMPLES: <u>Robert Lamonica</u> EXAMINED BY:
Gravel, fine, angular. Many cobbles, small rounded; some sand, very coarse to medium; trace of silt, brown.	5	23½	REFERENCE POINT: <u>Original land surface</u> ELEVATION OF R. P.: <u>±302 feet above MSL</u> <u>58.0 feet of 20-inch casing</u> <u>59.3 feet of 14-inch casing</u> SCREEN TYPE: <u>Continuous slot, SS</u> DIAM.: <u>14-inch</u> SLOT NO. <u>125</u> SETTING: <u>59 - 89 feet b/</u> PUMPING TEST: <u>May 22-24, 1978</u> DATE: <u>50.25 hours</u> DURATION: <u>12.11 feet c/</u> STATIC WATER LEVEL: <u>56.2 feet c/</u> PUMPING WATER LEVEL: <u>880 gpm</u> YIELD:
Gravel, fine, subangular; sand, medium to very coarse; some silt	5	28½	
Gravel, fine to medium, subangular; sand, medium to very coarse; with silt and very fine sand	5	33½	
Sand, medium to coarse; some very coarse sand and fine gravel; some silt	5	38½	
Sand, medium to very coarse; with considerable gravel, medium to coarse, and some silt and stones	5	43½	REMARKS: <u>Drilling started</u> <u>March 22, 1978.</u> <u>a/ Including 1.7 and 2.</u> <u>feet above existing</u> <u>grade respectively.</u> <u>b/ Below present grade</u> <u>c/ Below top of ½-inch</u> <u>SS pipe</u>
Gravel, fine to medium, angular to subangular; cobbles, subrounded; sand, medium to very coarse; some silt and very fine sand	5	48½	

WELL LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

Page 2 of 3

CONSULTING GROUND-WATER GEOLOGISTS

55 WEST STATE STREET

WESTPORT, CONNECTICUT

Ramapo Valley Well Field

DESCRIPTION	THICK- NESS (FEET)	DEPTH (FEET)	OWNER: <u>Spring Valley Water (</u>
Gravel, fine to coarse; sand,			<u>Ramapo Land Company</u>
medium to very coarse; some silt			<u>Parcel 1</u>
and very fine sand	5	53½	LOCATION: <u>Town of Ramapo, NY</u>
Gravel, fine to very coarse; sand,			WELL NO.: <u>PW-B (Contd.) 95</u>
medium to very coarse; less silt	5	58½	DATE COMPLETED: <u>(continued)</u>
Sand, medium to very coarse; gravel			DRILLING COMPANY: _____
fine; silt and very fine sand	5	63½	DRILLING METHOD: _____
Sand, medium to very coarse;			SAMPLING METHOD: _____
gravel fine, some medium;			SAMPLES EXAMINED BY: _____
considerable silt and clay	5	68½	REFERENCE POINT: _____
Gravel, fine to coarse; sand,			ELEVATION OF R. P.: _____
medium to very coarse; silt and			CASING: _____
very fine sand; cobbles	5	73½	SCREEN TYPE: _____
Sand, medium to very coarse;			DIAM. _____ SLOT NO. _____
gravel, fine; some stones; less			SETTING: _____
silt.	5	78½	PUMPING TEST: _____
Sand, medium to very coarse; some			DATE: _____
gravel, fine; considerable silt			DURATION: _____
and clay	5	83½	STATIC WATER LEVEL: _____
Sand, medium to very coarse; gravel,			PUMPING WATER LEVEL: _____
fine; some silt and fine sand			YIELD: _____
(less than at 85')	5	88½	REMARKS: _____
Sand, fine to very coarse; some			
fine gravel; some silt	4½	93	
Washed sample: sand, medium to			

(continued)

LEGGETTE, BRASHEARS & GRAHAM, INC.

CONSULTING GROUND-WATER GEOLOGISTS

55 WEST STATE STREET

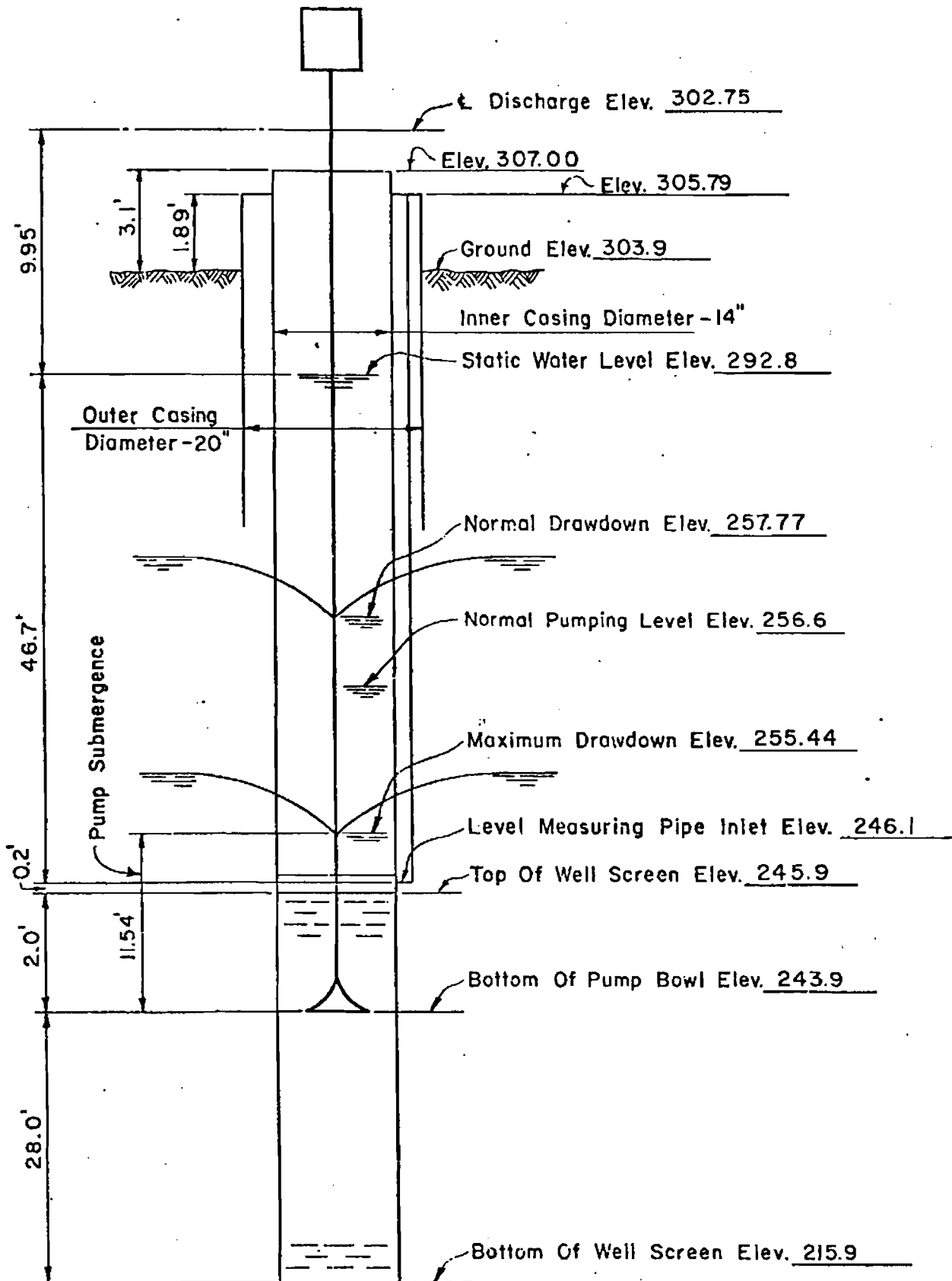
WESTPORT, CONNECTICUT

Ramapo Valley Well Field

DESCRIPTION	THICK- NESS (FEET)	DEPTH (FEET)	OWNER
very coarse, some fine gravel; pieces of granitic gneiss bedrock (fresh)	4½	93	Spring Valley Water Ramapo Land Company Parcel 1 LOCATION: Town of Ramapo, NY WELL NO.: PW-B 95 (continued)
Sand, fine to very coarse; some fine gravel; silt. Pieces of granitic gneiss; bedrock			DATE COMPLETED:
Washed sample: Sand, fine to very coarse; some fine gravel; small chips of bedrock	½	93½	DRILLING COMPANY:
Large chunk of granitic gneiss (gneissic granite)	½	93½	DRILLING METHOD:
			SAMPLING METHOD:
			SAMPLES: 1 EXAMINED BY:
			REFERENCE POINT:
			ELEVATION OF R. P.:
			CASING:
			SCREEN:- TYPE:
			DIAM.: SLOT NO.
			SETTING:
			PUMPING TEST:- DATE:
			DURATION:
			STATIC WATER LEVEL:
			PUMPING WATER LEVEL:
			YIELD:
			REMARKS:

WELL PUMP SETTING

WELL PW "B" 95



WELL LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

Page 1 of 2

CONSULTING GROUND-WATER GEOLOGISTS

55 WEST STATE STREET

WESTPORT, CONNECTICUT

Ramapo Valley Well Field

DESCRIPTION	THICK- NESS (FEET)	DEPTH (FEET)	OWNER: Spring Valley Water Co. Ramapo Land Company Parcel 1 LOCATION: Town of Ramapo, NY WELL NO.: PW-C 96 DATE COMPLETED: September 6, 1978 DRILLING COMPANY: Rinbrand Well Drill ing Co. DRILLING METHOD: Cable-Tool SAMPLING METHOD: Bailer SAMPLES EXAMINED BY: G. S. Sikora REFERENCE POINT: Original Land Sur face ELEVATION OF R. P.: ±299 feet above MS 59 feet of 20-inch a CASING: 59.3 feet of 14-inch SCREEN TYPE: Continuous slot- Stainless Steel DIAM.: 14-inch SLOT NO. 125 SETTING: 55½-84 feet b/ PUMPING TEST: October 11-14, DATE: 1978 DURATION: 72 hours STATIC WATER LEVEL: 12.40 feet c/ PUMPING WATER LEVEL: 44.9 feet c/ YIELD: 700 gpm REMARKS: Drilling started August 1978 a/Including 2.0 and 2.4 feet above existing grade respectively b/Below present grade c/Below top of 20-inch casing
Gravel, fine to medium, subangular, black; much sand, fine with some medium to coarse, brown; little silt brown	9	9	
Sand, medium to coarse with some fine, light green; some gravel, fine with little medium, subangular, black with some white	5	14	
Sand, fine, green; little gravel, fine with trace of medium, black	5	19	
Sand, fine, greenish-brown	5	24	
Sand, fine with few medium; greenish-brown; little gravel, fine with trace of medium, black	15	39	
Sand, fine with some medium, greenish-brown; few gravels, fine	10	49	
Gravel, fine to medium, black with little white, much sand, fine to coarse, green with some white	5	54	
Sand, fine with some medium and coarse greenish-brown; little gravel, fine, subangular, black	5	59	
Sand, fine with few medium, greenish-brown; little gravel, fine, black	5	64	
(Continued)			

WELL LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

CONSULTING GROUND-WATER GEOLOGISTS

55 WEST STATE STREET

WESTPORT, CONNECTICUT

Page 2 of 2

Ramapo Valley Well Field

DESCRIPTION

THICK-
NESS
(FEET)

DEPTH
(FEET)

OWNER: Spring Valley Water Co

Ramapo Land Company
Parcel 1

LOCATION: Town of Ramapo, NY

WELL NO. PW-C (continued) 96

DATE
COMPLETED:

DRILLING
COMPANY:

DRILLING
METHOD:

SAMPLING
METHOD:

SAMPLES
EXAMINED BY:

REFERENCE
POINT:

ELEVATION
OF R. P.:

CASING:

SCREEN-
TYPE:

DIAM. SLOT NO.

SETTING:

PUMPING TEST-
DATE:

DURATION:

STATIC WATER
LEVEL:

PUMPING WATER
LEVEL:

YIELD:

REMARKS:

Sand, fine with some medium and few
coarse, pale green; some gravel,
fine, subangular, black with little
white

5

69

Sand, medium to fine with some coarse
pale green with few white, some
gravel, fine with few medium, black
with little white

10

79

Sand, medium to fine with few coarse,
pale green with few white; some
gravel, fine to medium with few
coarse, black with little white

5

84

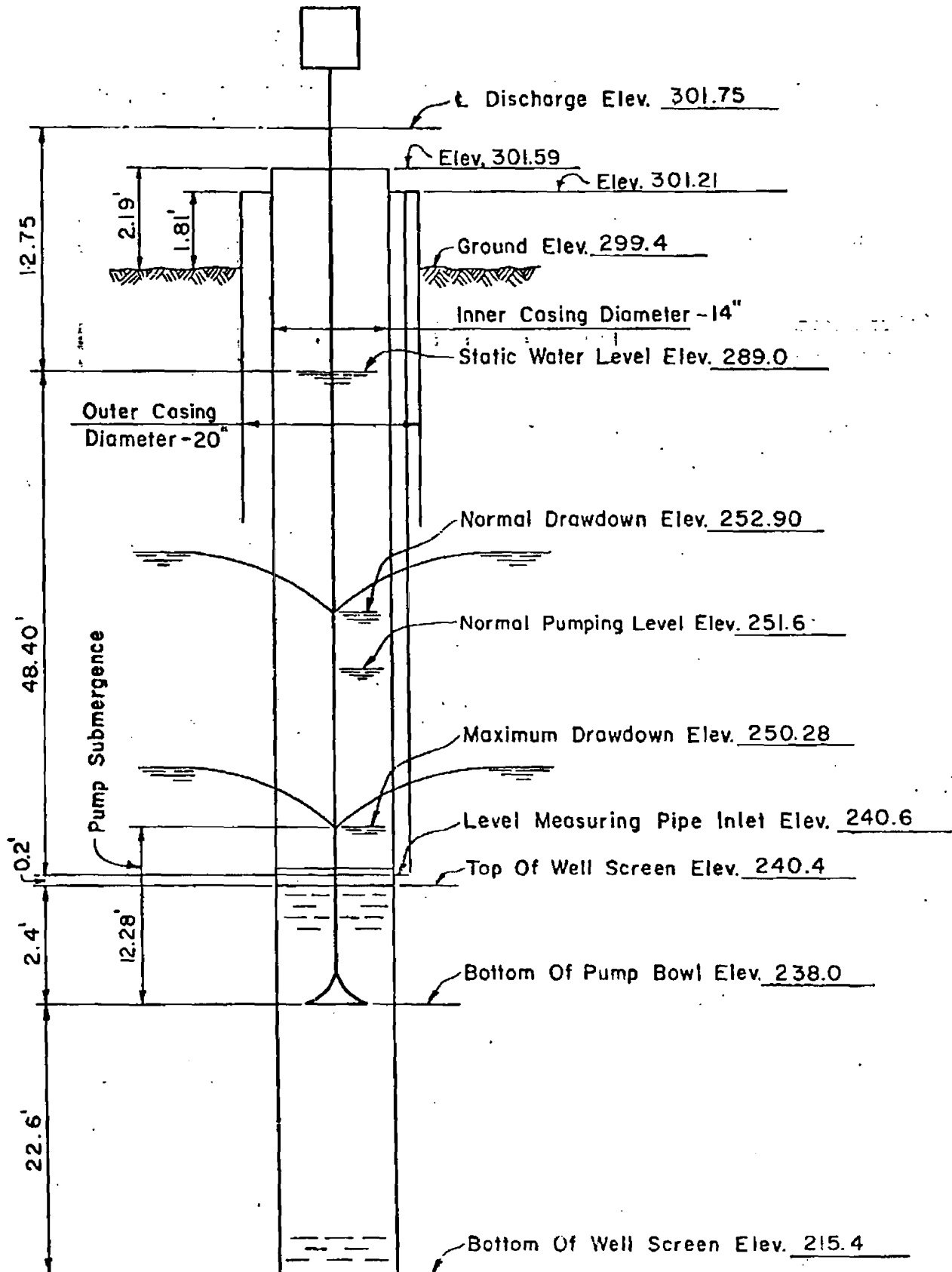
Sand, medium to fine with some coarse
pale green with some white; little
gravel, fine black with few white

2

86

WELL PUMP SETTING

WELL PW "C" 96



APPENDIX 2

DRILLING LOGS FOR EXTRACTION WELLS



JAMES C. ANDERSON ASSOCIATES, INC.
Drilling Contractor

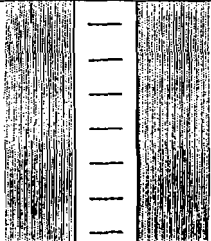
907 Pleasant Valley Avenue

Mount Laurel, New Jersey 08054

(609)-722-6700

PROJECT <i>Ramapo Landfill Remediation Site</i>				Sheet 1 of 2
CLIENT <i>GEO-CON Inc.</i>				Job No. D94DRE-463
GROUNDWATER		DRILLING METHOD	DEPTH	Borehole No. W-1
Date	Time	Depth	12" Air Rotary	0' To 44'
2/16/95		17.85 ft		
				Date Started : 2/14/95
				Date Finished : 2/16/95
				Driller : UNI-TECH
WELL CONSTRUCTION		COORDINATE NO.	STATE PERMIT NO.	Elevation TOC: 321.88
			SPOON SIZE	Inspector : URS
			2' X 3"	

grade	SAMPLE				CLASSIFICATION
	No.	Depth	Blows	N	
	1	0-2	12-18-18-23	36	brown fine to med SAND some Silt, trace fine Gravel
	2	3-5	10-12-14-17	26	S.A.A.
6	3	5-7	5-6-9-3	15	dark brown fine to med SAND trace Silt
	4	8-10	0-3-2-6	5	dark brown fine to med Clayey SAND trace fine Gravel
10.3	5	10-12	7-18-14-15	32	green, gray fine to coarse SAND some fine Gravel
12.3					
14.3	6	13-15	5-9-10-100/2	19	S.A.A. wet wet at 13 ft
	7	15-17			no sample
	8	18-20	13-15-18-20	33	green, gray fine to coarse SAND some fine Gravel, trace Clay wet
	9	20-22	9-11-15-18	26	S.A.A. wet
	10	23-25	12-12-14-14	26	S.A.A. wet
	11	25-27	11-10-15-16	25	S.A.A. wet
	12	28-30	8-9-8-15	17	S.A.A. wet
	13	30-32	4-10-11-9	21	green, gray fine to coarse Clayey SAND some med Gravel wet
	14	33-35	8-9-8-14	17	S.A.A. wet
	15	35-37	56-100/2		green fine to coarse Clayey SAND some fine to med Gravel wet

		SAMPLE			CLASSIFICATION
		No.	Depth	Blows	
		16	38-40	100/6	tan fine to coarse Clayey SAND some fine to med Gravel
		17	40-42	100/1	refusal at 40' 1" - gneiss fragments in tip of spoon
	44.3				

Well Depth
44ft 4inches

LEGEND

 Cement/Bentonite Grout

 Bentonite Pellet Seal

 Gravel Pack

 8" SCH 40 Type 304 Flush Joint Threaded Stainless Steel Casing

 8" 304 0.035 Slot Stainless Steel Screen

 Stainless Steel Centralizer

Notes:

1. Bore hole diameter was 12 inches.
2. Bore hole was flushed with air and water before casing and screen was set. Bore hole flushing was accomplished by introducing air and water through the drilling rods.
3. Filter pack was poured around the well casing from the bottom of the bore hole up.
4. Depth to top of filter pack was determined using a weighted measuring tape.
5. Bentonite pellets were slowly poured around the well casing and allowed to settle.
6. Bentonite seal hydrated for 14 hours.
7. Annular grout was placed via tremie method.
8. Cement/bentonite grout mix - 5lbs bentonite, 94lbs cement, and 8 gallons water.
9. Gravel pack - Ricci Bros. Sand Co., Inc., #1 Well Gravel, 20 100lb bags used.
10. Bentonite pellets - Rocktest, Inc., Peltonite (Wyoming Bentonite Sealing Agent), 1 50lb bucket used.
11. Bentonite - Baroid Drilling Fluids, Inc., 1/2 55lb bag used.
12. Cement - Allentown Cement Company, Inc., 5 94lb bags used.
13. Well Casing - Cook Screen Technology, Inc., 1x10ft and 1x5ft section used.
14. Well Screen - Cook Screen Technology, Inc., 3x10ft sections used.
15. Well was developed 26 hours after grouting.
16. Well was developed for 2 hours and 40 minutes at 2 gpm.
17. Well was developed using a submersible pump.
18. Development water was cloudy at first, then it cleared up after 2 hours of pumping.
19. Elevation of top-of-casing is 321.88.
20. The interval between annular grout and surface grade was left open.



JAMES C. ANDERSON ASSOCIATES, INC.
Drilling Contractor

907 Pleasant Valley Avenue

Mount Laurel, New Jersey 08054

(609)-722-6700

PROJECT <i>Ramapo Landfill Remediation Site</i>					Sheet 1 of 2	
CLIENT <i>GEO-CON Inc.</i>					Job No. <i>D94DRE-463</i>	
GROUNDWATER			DRILLING METHOD	DEPTH	Borehole No. <i>W-2</i>	
Date	Time	Depth	12" Air Rotary	0' To 43'	Date Started : <i>8/6/95</i>	
6/13/95		20.38 ft			Date Finished : <i>6/13/95</i>	
					Driller : <i>UNI-TECH</i>	
WELL CONSTRUCTION		COORDINATE NO.	STATE PERMIT NO.	SPOON SIZE 2' X 3"	Elevation TOC: <i>323.64</i>	
					Inspector : <i>URS</i>	

grade	SAMPLE				CLASSIFICATION
	No.	Depth	Blows	N	
	1	0-2	7-12-12-11	24	dark brown, brown fine to med SAND some med Gravel
6	2	5-7	7-6-3-2	9	brown fine to med SAND some small Gravel
8.5					
10.5					
12.5	3	10-12	5-2-2-2	4	brown fine SAND trace Silt moist
	4	15-17	11-14-16-16	30	brown fine SAND trace Silt wet
	5	18-20	36-52-40-21	92	black, gray fine to coarse SAND and med GRAVEL. wet
	6	23-25	7-18-50/4		gray, brown fine to coarse SAND with small Gravel wet
	7	27-29	27-29		gray, brown fine to coarse SAND with med Gravel wet
	8	33-35	5-5-25-30	30	light green, gray fine to coarse SAND with med Gravel wet

				SAMPLE					
				No.	Depth	Blows	N	CLASSIFICATION	
	—		42.5	9	37-39	15-22-25-25	47	black, gray fine to med SAND	wet
	10			39-40	150/2		gneiss fragment (quartz, feldspar, and serpentine visible)		

42.5

Well Depth
42ft 6inches

LEGEND



Cement/Bentonite Grout



Bentonite Permet Seal



Gravel Pack



8" SCH 40 Type 304 Flush Joint Threaded Stainless Steel Casing



8" Type 304 0.035 Slot Stainless Steel Screen



Stainless Steel Centralizer

Notes:

1. Bore hole diameter was 12 inches.
2. Bore hole was flushed with air and water before casing and screen was set. Bore hole flushing was accomplished by introducing air and water through the drilling rods.
3. Filter pack was poured around the well casing from the bottom of the bore hole up.
4. Depth to top of filter pack was determined using a weighted measuring tape.
5. Bentonite pellets were slowly poured around the well casing and allowed to settle.
6. Bentonite seal hydrated for 14 hours.
7. Annular grout was placed via tremie method.
8. Cement/bentonite grout mix - 5lbs bentonite, 94lbs cement, and 8 gallons water.
9. Gravel pack - Ricci Bros. Sand Co., Inc., #1 Well Gravel, 61 100lb bags used.
10. Bentonite pellets - Rocktest, Inc., Peltonite (Wyoming Bentonite Sealing Agent), 1 50lb bucket used.
11. Bentonite - Baroid Drilling Fluids, Inc., 1 55lb bag used.
12. Cement - Allentown Cement Company, Inc., 11 94lb bags used.
13. Well Casing - Cook Screen Technology, Inc., 1x10ft and 1x5ft section used.
14. Well Screen - Cook Screen Technology, Inc., 3x10ft sections used.
15. Well was developed 24 hours after grouting.
16. Well was developed for 1 hour at 10 gpm.
17. Well was developed using a submersible pump.
18. Development water was cloudy at first, then it cleared up after 30 minutes of pumping.
19. Elevation of top-of-casing is 323.64.
20. The interval between annular grout and surface grade was left open.
21. A void was encountered during the placement of well gravel. The void required additional bags of well gravel to fill.



JAMES C. ANDERSON ASSOCIATES, INC.
Drilling Contractor

907 Pleasant Valley Avenue

Mount Laurel, New Jersey 08054

(609)-722-6700

PROJECT Ramapo Landfill Remediation Site					Sheet 1 of 2	
CLIENT GEO-CON Inc.					Job No. D94DRE-463	
GROUNDWATER			DRILLING METHOD	DEPTH	Borehole No. W-3	
Date	Time	Depth	12' Air Rotary	0' To 30'	Date Started : 6/2/95	
6/5/95		22.98 ft			Date Finished : 6/5/95	
					Driller : UNI-TECH	
WELL CONSTRUCTION		COORDINATE NO.	STATE PERMIT NO.	SPOON SIZE	Elevation TOC: 328.26	
				2' X 3"	Inspector : URS	

grade	SAMPLE				CLASSIFICATION
	No.	Depth	Blows	N	
	1	0-2	4-5-5-6	10	brown, orange topsoil over light brown fine SAND, trace Silt
	2	3-5	9-10-9-8	19	light brown fine to med SAND trace Silt and fine Gravel
6	3	5-7	2-4-10-13	14	brown fine SAND some Clay
	4	8-10	2-2-3-4	5	brown Clayey fine to med SAND
10.3	5	10-12	0-1-1-2	2	green SILT some fine Sand and fine Gravel
12.3					
14.3	6	13-15	0-0-0-5	0	green, brown Silty CLAY some fine Gravel
	7	15-17	8-24-25-40	49	green fine to coarse SAND some med Gravel, wet at 17 ft
	8	18-20	17-24-30-24	54	S.A.A.
	9	20-22	16-13-16-26	29	S.A.A.
	10	23-25	50-42-34-21	76	green fine to coarse SAND some med Gravel, trace Silt
	11	25-27	25-38-100/5		green fine to coarse Clayey SAND some fine Gravel
		27.5	100/2		Auger Refusal at 27.5 ft - gneiss fragments in tip of spoon
29.3		27.5			Air Hammered through rock stopped at 31.5 ft
		31.5			

Well Depth
29ft 4inches

		SAMPLE			
No.	Depth	Blows	N	CLASSIFICATION	
LEGEND  Cement/Bentonite Grout  Bentonite Pellet Seal  Gravel Pack  8" SCH 40 Type 304 Flush Joint Threaded Stainless Steel Casing  8" Type 304 0.035 Slot Stainless Steel Screen  Stainless Steel Centralizer Notes: - Bore hole diameter was 12 inches. - Bore hole was flushed with air and water before casing and screen was set. Bore hole flushing was accomplished by introducing air and water through the drilling rods. - Filter pack was poured around the well casing from the bottom of the bore hole up. - Depth to top of filter pack was determined using a weighted measuring tape. - Bentonite pellets were slowly poured around the well casing and allowed to settle. - Bentonite seal hydrated for 14 hours. - Annular grout was placed via tremie method. - Cement/bentonite grout mix - 5lbs bentonite, 94lbs cement, and 8 gallons water. - Gravel pack - Ricci Bros. Sand Co., Inc., #1 Well Gravel, 19 100lb bags used. - Bentonite pellets - Rocktest, Inc., Peltonite (Wyoming Bentonite Sealing Agent), 1 50lb bucket used. - Bentonite - Baroid Drilling Fluids, Inc., 1/2 55lb bag used. - Cement - Allentown Cement Company, Inc., 5 94lb bags used. - Well Casing - Cook Screen Technology, Inc., 1x10ft and 1x5ft section used. - Well Screen - Cook Screen Technology, Inc., 1x10ft and 1x5ft section used. - Well was developed 24 hours after grouting. - Well was developed for 1 hour at 10 gpm. - Well was developed using a submersible pump. - Development water was cloudy at first, then cleared up after 25 minutes of pumping. - Elevation of top-of-casing is 328.25. - The interval between annular grout and surface grade was left open.					

JAMES C. ANDERSON ASSOCIATES, INC.
Drilling Contractor

907 Pleasant Valley Avenue

Mount Laurel, New Jersey 08054

(609)-722-6700

PROJECT		Ramapo Landfill Remediation Site			Sheet 1 of 2	
CLIENT		GEO-CON Inc.			Job No. D94DRE-463	
GROUNDWATER			DRILLING METHOD	DEPTH	Borehole No. W-4	
Date	Time	Depth	12" Air Rotary	0' To 34'	Date Started : 5/25/95	
6/1/95		22.71 ft			Date Finished : 6/1/95	
					Driller : UNI-TECH	
WELL CONSTRUCTION		COORDINATE NO.	STATE PERMIT NO.	SPOON SIZE	Elevation TOC: 330.09	
				2' X 3"	Inspector : URS	
grade		SAMPLE				CLASSIFICATION
No.	Depth	Blows	N			
1	0-2	4-6-6-8	12	light brown fine SAND trace Silt		
2	3-5	7-7-6-6	13	S.A.A. some fine to med Gravel		
3	5-7	3-3-4-4	7	brown fine to med SAND some Clay and fine Gravel		
4	8-10	2-2-3-2	5	brown med to coarse Clayey SAND		
5	10-12	4-2-2-2	4	S.A.A.		
6	13-15	2-1-2-2	3	brown SILT some fine Gravel and fine Sand		
7	15-17	2-2-1-16	3	green fine to coarse Clayey SAND trace fine Gravel, wet at 16.5 Ft		
8	18-20	24-10-10-9	20	S.A.A.		
9	20-22	7-10-14-20	24	S.A.A.		
10	23-25	15-20-18-20	38	S.A.A.		
11	25-27	8-20-18-46	38	S.A.A.		
27.5	100/1			Auger Refusal at 27.5 ft - gneiss fragments in tip of spoon		
27.5				Air Hammered through rock		
31.5				stopped at 31.5 ft		
34						
Well Depth 34ft						

		SAMPLE					
No.	Depth	Blows	N	CLASSIFICATION			
LEGEND  Cement/Bentonite Grout  Bentonite Pellet Seal  Gravel Pack  8" SCH 40 Type 304 Flush Joint Threaded Stainless Steel Casing  8" Type 304 0.035 Slot Stainless Steel Screen  Stainless Steel Centralizer Notes: 1. Bore hole diameter was 12 inches. 2. Bore hole was flushed with air and water before casing and screen was set. Bore hole flushing was accomplished by introducing air and water through the drilling rods. 3. Filter pack was poured around the well casing from the bottom of the bore hole up. 4. Depth to top of filter pack was determined using a weighted measuring tape. 5. Bentonite pellets were slowly poured around the well casing and allowed to settle. 6. Bentonite seal hydrated for 14 hours. 7. Annular grout was placed via tremie method. 8. Cement/bentonite grout mix - 5lbs bentonite, 94lbs cement, and 8 gallons water. 9. Gravel pack - Ricel Bros. Sand Co., Inc., #1 Well Gravel, 16 100lb bags used. 10. Bentonite pellets - Rocktest, Inc., Peltonite (Wyoming Bentonite Sealing Agent), 1 50lb bucket used. 11. Bentonite - Baroid Drilling Fluids, Inc., 1/2 55lb bag used. 12. Cement - Allentown Cement Company, Inc., 6 94lb bags used. 13. Well Casing - Cook Screen Technology, Inc., 2x10ft sections used. 14. Well Screen - Cook Screen Technology, Inc., 1x10ft and 1x5ft section used. 15. Well was developed 26 hours after grouting. 16. Well was developed for 1 hour at 10 gpm. 17. Well was developed using a submersible pump. 18. Development water was cloudy at first, then it cleared up after 35 minutes of pumping. 19. Elevation of top-of-casing is 330.09. 20. The interval between annular grout and surface grade was left open.							



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PROJECT <i>Ramapo Landfill Remediation Site</i>					Sheet 1 of 2	
CLIENT <i>GEO-CON Inc.</i>					Job No. <i>D94DRE-463</i>	
GROUNDWATER			DRILLING METHOD	DEPTH	Borehole No. <i>W-5</i>	
Date	Time	Depth	12" Air Rotary	0' To 20'	Date Started : <i>5/24/95</i>	
<i>5/24/95</i>		<i>dry</i>			Date Finished : <i>5/24/95</i>	
					Driller : <i>UNI-TECH</i>	
WELL CONSTRUCTION		COORDINATE NO.	STATE PERMIT NO.	SPOON SIZE	Elevation TOC: <i>345.82</i>	
				<i>2' X 3"</i>	Inspector : <i>URS</i>	

grade	SAMPLE				CLASSIFICATION
	No.	Depth	Blows	N	
	1	0-2	5-2-5-5	7	brown med to coarse SAND trace med Gravel
	2	3-5	5-100/1		S.A.A. to 3.5 ft boulder at 3.5 ft
6	3	5-7			boulder to 7.5 ft
8					
10	4	8-10	18-76-17-11	93	gray, green fine to coarse SAND with med Gravel
	5	10-12	10-8-5-6	13	S.A.A.
	6	13-15	16-18-100/2		gray, green Clayey SAND to 14.5 ft gneiss at 14.5 ft
		14.5 to 18.5			Air Hammered through rock stopped at 18.5
20					

Well Depth 20ft	
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		SAMPLE				CLASSIFICATION
No.	Depth	Blows	N			
LEGEND  Bentonite Pellet Seal  Gravel Pack  8" SCH 40 Type 304 Flush Joint Threaded Stainless Steel Casing  8" Type 304 0.035 Slot Stainless Steel Screen  Stainless Steel Centralizer Notes: 1. Bore hole diameter was 12 inches. 2. Bore hole was flushed with air and water before casing and screen was set. Bore hole flushing was accomplished by introducing air and water through the drilling rods. 3. Filter pack was poured around the well casing from the bottom of the bore hole up. 4. Depth to top of filter pack was determined using a weighted measuring tape. 5. Bentonite pellets were slowly poured around the well casing and allowed to settle. 6. Bentonite seal hydrated for 14 hours. 7. Gravel pack - Ricci Bros. Sand Co., Inc., #1 Well Gravel, 20 100lb bags used. 8. Bentonite pellets - Rocktest, Inc., Peltonite (Wyoming Bentonite Sealing Agent), 1 50lb bucket used. 9. Well Casing - Cook Screen Technology, Inc., 1x10ft section used. 10. Well Screen - Cook Screen Technology, Inc., 1x10ft section used. 11. Well was developed 26 hours after bentonite seal hydration. 12. Well was developed by bailing till dry at 15 minute intervals for 1 hour. 13. Well was developed using a hand bailer. 14. Development water cloudy at first, then cleared up after 30 minutes of bailing. 15. Elevation of top-of-casing is 345.82. 16. The annular space interval between the bentonite seal and surface grade was left open.						



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PROJECT <i>Ramapo Landfill Remediation Site</i>					Sheet 1 of 2
CLIENT <i>GEO-CON Inc.</i>					Job No. D94DRE-463
GROUNDWATER			DRILLING METHOD	DEPTH	Borehole No. W-6
Date	Time	Depth	12" Air Rotary	0' To 19'	Date Started : 7/24/95
7/24/95		dry			Date Finished : 7/24/95
					Driller : UNI-TECH
WELL CONSTRUCTION		COORDINATE NO.	STATE PERMIT NO.	SPOON SIZE	Elevation TOC: 350.40
				2' X 3"	Inspector : URS

grade	SAMPLE				CLASSIFICATION
	No.	Depth	.Blows	N	
	1	0-2	4-5-5-6	10	brown, orange topsoil over light brown fine SAND, trace Silt
4.5	2	3-5	9-10-9-8	19	light brown fine to med SAND trace Silt and fine Gravel
6.5	3	5-7	2-4-10-13	14	brown fine SAND some Clay
8.5	4	8-10	2-2-3-4	5	brown Clayey fine to med SAND
		10-13			Air Hammered through boulder 10.8 to 13 ft 13 to 13.2 - green, gray fine to coarse SAND moist
		13.2			auger refusal at 13.2 ft - gneiss in tip of spoon
		13.2 to 17.2			Air Hammered through rock stopped at 17.2 ft

Well Depth 18ft
Ginches

18.5

	SAMPLE				CLASSIFICATION
	No.	Depth	Blows	N	
LEGEND					
 Bentonite Pellet Seal					
 Gravel Pack					
 8" SCH 40 Type 304 Flush Joint Threaded Stainless Steel Casing					
 8" Type 304 0.035 Slot Stainless Steel Screen					
< > Stainless Steel Centralizer					
Notes:					
1. Bore hole diameter was 12 inches.					
2. Bore hole was flushed with air and water before casing and screen was set. Bore hole flushing was accomplished by introducing air and water through the drilling rods.					
4. Filter pack was poured around the well casing from the bottom of the bore hole up.					
5. Depth to top of filter pack was determined using a weighted measuring tape.					
6. Bentonite pellets were slowly poured around the well casing and allowed to settle.					
7. Bentonite seal hydrated for 14 hours.					
8. Gravel pack - Riccl Bros. Sand Co., Inc., #1 Well Gravel, 12 100lb bags used.					
9. Bentonite pellets - Rocktest, Inc., Peltonite (Wyoming Bentonite Sealing Agent), 1 50lb bucket used.					
10. Well Casing - Cook Screen Technology, Inc., 1x10ft section used.					
10. Well Screen - Cook Screen Technology, Inc., 1x10ft section used.					
11. Well was developed 26 hours after bentonite seal hydration.					
12. Well was developed by bailing till dry at 15 minute intervals for 1 hour.					
13. Well was developed using a hand bailer.					
14. Development water cloudy at first, then cleared up after 30 minutes of bailing.					
15. Elevation of top-of-casing is 350.40.					
16. The annular space interval between the bentonite seal and surface grade was left open.					



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PROJECT <i>Ramapo Landfill Remediation Site</i>					Sheet 1 of 1	
CLIENT <i>GEO-CON Inc.</i>					Job No. D94DRE-463	
GROUNDWATER			DRILLING METHOD	DEPTH	Borehole No. W-7	
Date	Time	Depth	12" Air Rotary	0' To 20'	Date Started : 6/19/95	
6/19/95		17.91 ft			Date Finished : 6/19/95	
					Driller : UNI-TECH	
WELL CONSTRUCTION		COORDINATE NO.	STATE PERMIT NO.	SPOON SIZE	Elevation TOC: 343.47	
				2' X 3"	Inspector : URS	

grade	SAMPLE				CLASSIFICATION
	No.	Depth	Blows	N	
	1	0-2	6-14-17-16	31	brown fine to coarse SAND some small Gravel
5	2	4-6	12-12-16-18	28	dark brown, brown fine to med SAND some small Gravel, trace Silt
7.2					
9.2					
	3	11-13	100/4.5		dark brown fine to med SAND some small to med Gravel
	4	14-16	9-15-100/5		weathered gneiss (brittle) moist
19.2					

Well Depth
19ft 2inches

		SAMPLE				CLASSIFICATION
No.	Depth	Blows	N			
LEGEND  Bentonite Pellet Seal  Gravel Pack  8" SCH 40 Type 304 Flush Joint Threaded Stainless Steel Casing  8" SCH 40 Type 304 0.035 Slot Stainless Steel Screen  Stainless Steel Centralizer Notes: 1. Bore hole was flushed before casing and screen was set. 2. Filter pack was poured around the well casing from the bottom of the bore hole up. 3. Depth to top of filter pack was determined using a weighted measuring tape. 4. Bentonite pellets were slowly poured around the well casing and allowed to settle. 5. Bentonite seal hydrated for 14 hours. 6. Gravel pack - Ricci Bros. Sand Co., Inc., #1 Well Gravel, 12 100lb bags used. 7. Bentonite pellets - Rocktest, Inc., Peltonite (Wyoming Bentonite Sealing Agent), 1 50lb bucket used. 8. Well Casing - Cook Screen Technology, Inc., 1x10ft section used. 9. Well Screen - Cook Screen Technology, Inc., 1x10ft section used. 10. Well was developed 26 hours after bentonite seal hydration. 11. Well was developed by pumping till dry at 15 minute intervals for 1 hour. 12. Well was developed using a submersible pump. 13. Development water cloudy at first, then cleared up after 30 minutes of pumping. 14. Elevation of top-of-casing is 343.47. 15. The annular space interval between the bentonite seal and surface grade was left open.						